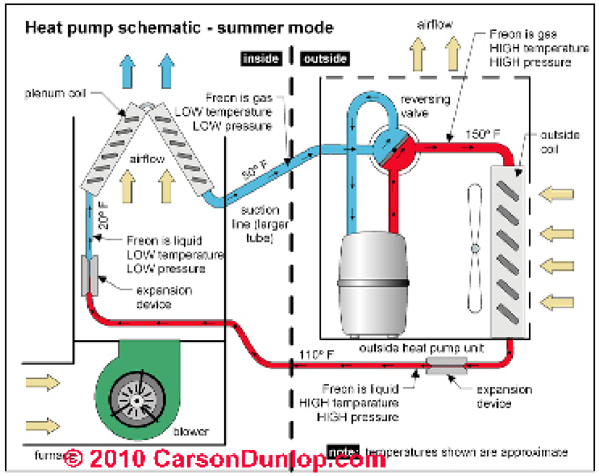
InspectAPedia®

Free Encyclopedia of Building & Environmental Inspection, Testing, Diagnosis, Repair

Search
Google™ InspectAPedia

Ask a Question or Search InspectAPedia



Air Conditioning Diagnosis, & Repair Guide

InspectAPedia® - ShareThis +1

- How to inspect, diagnose, & repair central air conditioning systems and heat pumps: A/C repair, lost cooling, insufficient cooling.
- What are the basic air conditioning components?
- Determining air conditioning cooling capacity & energy efficiency
- Troubleshooting air conditioning compressor problems
- Diagnosing air conditioning air handler problems
- Air conditioning condensate problems
- Duct system inspections, defects, repairs
- Cleaning air conditioning equipment & fixing leaking A/C refrigerants
- Questions & answers about how to diagnose and repair air conditioning and heat pump systems.

This website explains in detail the inspection, troubleshooting diagnosis, and repair of all types of residential and light commercial central air conditioning and heat pump systems. This article describes how to inspect and repair all types of residential air conditioning systems (A/C systems). Information for home buyers, owners, and home inspectors about A/C or heat pump system problems. If you don't see information you want, ask us for it using the comments box at the end of this article. Page top image provided courtesy Carson Dunlop Associates.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

Mobile View

AIR CONDITIONING & HEAT PUMP SYSTEMS

A/C - HEAT PUMP CONTROLS & SWITCHES
- Outside Switches, Fuses, Breakers
- Inside Switches,Components
- Air Handler / Blower Switches
- Blower Door Switches
- Backup Heat Controls
- CAPILLARY TUBES
- CIRCUIT BREAKER SIZE for A/C or HEAT PUMP
- Compressor Condenser Switches, Controls
- Condensate Overflow Switch
- CONTACTOR RELAY DIAGNOSIS & REPAIR
- CONTROL CIRCUIT BOARD, A/C
- CRANKCASE HEATERS

FAN, COMPRESSOR/CONDENSER UNIT
Duct System Switches
Duct System Filters
OPERATING CONTROLS, A/C & HEAT PUMP
Starter Capacitors
Thermostats & Controls
Thermostatic Expansion Valves
Motor Overload / Overheat Reset Switch
Pressure Controls & Safety Switches
Zone Damper Controls

A/C DATA TAGS
A/C - HEAT PUMP CRITICAL DEFECTS
A/C DIAGNOSTIC FAQs
A/C REFRIGERANTS
A/C TYPES, ENERGY SOURCES

AGE of CHIMNEYS & FIREPLACES
AGE of AIR CONDITIONERS & HEAT PUMPS
AIR CLEANER PURIFIER TYPES
AIR CONDITIONER BTU CHART
AIR CONDITIONER COMPONENT PARTS
Indoor A/C Components
Outdoor A/C Components
AIR CONDITIONER TYPES, ENERGY SOURCES
AIR CONDITIONER NOT WORKING
AIR FILTER EFFICIENCY
AIR FILTERS, FIBERGLASS PARTICLES
AIR FILTERS for HVAC SYSTEMS
Air Filter Accessibility
Air Filter Bypass Leakage
Air Filter Installation Procedure
Build Large Air Filters
AIR FILTER EFFECTIVENESS
AIR FILTER EFFICIENCY
MERV, HEPA Definitions
MERV Air Filter Ratings
AIR FILTER LOCATION
AIR FILTERING STRATEGIES
CONTINUOUS BLOWER FAN OPERATION
DIRTY AIR FILTER PROBLEMS
ENERGY SAVINGS by AIR FILTERS
FIBERGLASS & AIR FILTERS
Air Filters Shed Fibers?
Fiberglass & Test Lab Accuracy
Variations in Fiber Size
GASKETED AIR FILTERS
Debris in Return Air Plenum
Washable air filters
HOW AIR FILTERS WORK
MISSING / LEAKY AIR FILTERS
OPTIMUM INDOOR AIR FILTERS
Air Filter Efficiency
Optimum Air Filter Design / Location
How to Cascade Air Filters
PARTICLE SIZES & IAQ
SOURCES FOR AIR FILTERS
OTHER AIR CLEANERS
AIR FILTERS, OPTIMUM INDOOR

Page top illustration of a heat pump schematic is provided courtesy of Carson Dunlop Associates and is found in their Home Reference Book. A somewhat simpler schematic of an air conditioning-only system is provided just below.

Srpski prevod nad današji stranica [Serbian translation of this air conditioning information]




This article series describes the basic components of an air conditioning system and then we discuss how to estimate the rated cooling capacity of an air conditioning system by examining various data tags and components. The limitations of visual inspection of A/C systems are described. We continue to add to and update this text as new details are provided. Contact us to suggest text changes and additions and, if you wish, to receive online listing and credit for that contribution.

If your air conditioner or heat pump system is not working, start at LOST COOLING CAPACITY for help in diagnosing and repairing the trouble.

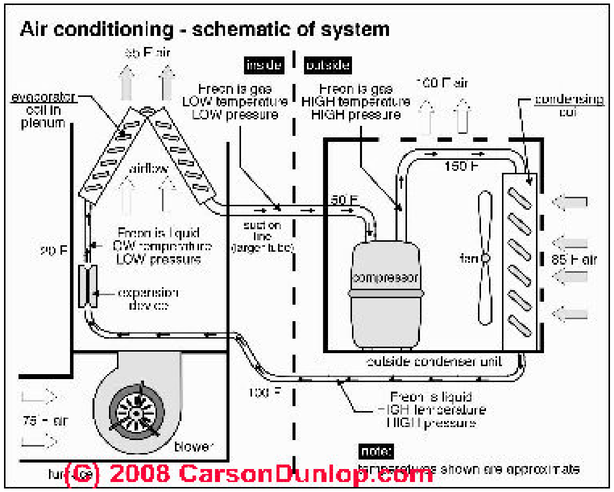
 Use page top links to major topics or use links at the left of each page to navigate ***within*** topics and documents at this website. Green links show where you are in a document series or at this website.

All the detail about air conditioning you want is provided here - CONTACT us if you can't find something. Let's introduce the most basic concepts of air conditioning first:

What are the Parts of an Air Conditioning or Heat Pump System and How do Air Conditioners Work?

Here is a simple explanation of how an air conditioning system works, with enough detail so that it isn't simply magic (the schematic of an air conditioner shown at left is compliments of Carson Dunlop) A detailed list and photos of air conditioner components can be seen at AIR CONDITIONER COMPONENT PARTS.

1. A air conditioning or heat pump compressor which compresses low pressure refrigerant gas into a high pressure, high temperature gas. Usually the compressor is in the outdoor portion of an air conditioning or heat pump system.



AIR FILTERS, SOURCES FOR
AIR FILTERING STRATEGIES
AIR FILTERING CONTINUOUS FAN OPERATION
AIR FLOW MEASUREMENT CFM
AIR HANDLER / BLOWER UNITS
ADDING A/C: RETROFIT SIZING
BLOWER FAN CONTINUOUS OPERATION
BLOWER FAN OPERATION & TESTING
BLOWER LEAKS, RUST & MOLD
COOLING COIL or EVAPORATOR COIL
DIRTY A/C BLOWERS
Leaks, Rodents In Air Handlers
Mold Growth in Air Handlers

ANIMAL ALLERGENS / PET DANDER
ANIMAL ENTRY POINTS in buildings
ANIMAL ODORS IN buildings
APPLIANCE EFFICIENCY RATINGS
ASBESTOS IDENTIFICATION IN buildings

BACKUP HEAT for HEAT PUMPS
BLOWER DOORS & AIR INFILTRATION
BLOWER FAN CONTINUOUS OPERATION
BLOWER FAN OPERATION & TESTING
BOOKSTORE - Air Conditioning "How To" Books

CAPACITORS for HARD STARTING MOTORS
CAPILLARY TUBES
CHINESE DRYWALL HAZARDS
CIRCUIT BREAKER SIZE for A/C or HEAT PUMP
CLEANING & *Legionella* BACTERIA
COMBUSTION GASES & PARTICLE HAZARDS

COMPRESSOR & CONDENSING COIL, A/C
BURNED-OUT COMPRESSOR
CAPACITORS for HARD STARTING MOTORS
CONDENSING COIL REPAIR REPLACE
CONTACTOR RELAY DIAGNOSIS & REPAIR
CONTROL CIRCUIT BOARD, A/C
CRANKCASE HEATERS
FAN, COMPRESSOR/CONDENSER UNIT
HARD STARTING COMPRESSOR MOTORS
INSPECTION CHECKLIST - OUTDOOR UNIT
INSTALLATION ERRORS, COMPRESSORS

The air conditioner or heat pump compressor unit is basically a high pressure pump driven by an electric motor. The air conditioning compressor is usually packaged in the outdoor compressor/condenser unit illustrated by our page top drawing. See COMPRESSOR CONDENSER, and see REFRIGERANTS & PIPING

2. A condenser or condensing unit: typically a *condensing coil* inside which high temperature high pressure refrigerant gas flows, and over which a fan blows air to cool the refrigerant gas back to a liquid state (thus transferring heat from the refrigerant gas to the air being blown by the fan). The condenser unit is basically a coil of finned tubing and a fan to blow air across the coil. Usually the condenser unit is in the outdoor portion of an air conditioning system, often packaged along with the compressor motor discussed above. See COMPRESSOR CONDENSER and see our page top sketch too. The *change of state* of the refrigerant, from hot high pressure gas to a liquid releases heat, including heat collected inside the building) to the outdoors.

3. A metering device which dispenses liquid refrigerant into an evaporator coil. The metering device may be simply a thin section of tubing (a capillary or "cap" tube) or it may be a bit more sophisticated thermostatic expansion valve (TEV) which includes a temperature sensing control that can open and shut the device against refrigerant flow. See THERMOSTATIC EXPANSION VALVES or see CAPILLARY TUBES.

4. An evaporator coil or cooling coil: typically the cooling coil is a section of finned tubing (it looks a lot like a car radiator) into which liquid refrigerant is metered and permitted to *evaporate* from liquid to gas state inside the coil. This *state change* of the refrigerant, from liquid to gas, absorbs heat, cooling the evaporator coil surface and thus cooling indoor air blown across the cooling coil. Usually the cooling coil is located inside the air handler. See AIR HANDLER / BLOWER UNITS and articles like DIRTY COOLING COIL. Evaporative cooling systems, or swamp coolers are discussed separately at EVAPORATIVE COOLING SYSTEMS.

5. An air handler and blower unit which provides a fan to blow building air across or through the evaporator coil. The air handler blower fan unit moves building air across the evaporator coil surface in order to condition building air by cooling it (and thus also by removing moisture from the cooled air). See AIR HANDLER / BLOWER UNITS and BLOWER FAN OPERATION & TESTING.

6. A duct system which distributes conditioned air from the air handler in to the occupied space (supply ducts), and which takes air from the occupied space and returns it to the cooling system air handler. See DUCT SYSTEM

7. Heat Pump Systems use the same components we have described just above, with the addition of a *reversing valve* that in essence permits the system to run "backwards" in cold weather. So in air conditioning mode the heat pump is moving heat from inside the building to outdoors while in heating mode the heat pump is moving heat from outdoor air (or water in some designs) to the building interior. Because the ability of a heat pump to extract heat from outdoor air diminishes at low outdoor temperatures, heat pump systems in northern climates also include a backup or auxiliary heating system. Details of how heat pumps work, are inspected, diagnosed, and repaired begin at HEAT PUMPS.

8. Air conditioner controls and features, which include a room thermostat, electrical switches, fuses or circuit breakers, condensate handling system, and air filters. See OPERATING CONTROLS and AIR FILTERS for HVAC SYSTEMS

For photographs of these various air conditioning and heat pump parts, and for an explanation of where these air conditioning components are physically located, see A/C COMPONENTS which discusses Indoor A/C Components and Outdoor A/C Components

How to diagnose and fix an air conditioning system that is not working: list of diagnostic articles

Since the failure of an air conditioner to turn on, loss of air conditioner cooling capacity, reduced air conditioning output temperatures, loss of cool air supply, or even loss of air flow entirely can be due to a variety of problems with one or more components of an air conditioner or air conditioning system, *after reviewing the lost air conditioner cooling diagnosis procedures described in this article,* be sure to also review the diagnostic procedures at each of the individual air conditioning diagnosis and repair major topics listed just below. To return to our air conditioning and refrigeration home page go to AIR CONDITIONING & HEAT PUMP SYSTEMS.

Electrical problems on HVAC systems: Keep in mind that despite the depth of technical detail you will find here about all components of air conditioners and heat pumps, most service calls for non-working air conditioners or heat pumps turn up an electrical problem. So if your A/C system is just not working at all be sure to check all of our electrical and control setting suggestions first.

Mechanical problems on HVAC systems: tend to fall into these groups: refrigerant leaks, dirty condenser coil or unit, dirty evaporator or cooling coil, or burned out (or hard-starting) compressor motors. We have also seen a number of problems with fans and fan motors in both the compressor/condenser unit and in the air handler/blower fan unit. *Some* of those fan problems are mechanical - like a loose fan belt or blade.

If your air conditioning or heat pump system has completely lost cooling capacity or if it plain won't start you can jump right to AIR CONDITIONER NOT WORKING or select one or more of the diagnostic articles listed below.

- A/C REFRIGERANT LEAK DETECTION: how to use a TIF5000 to detect air conditioning refrigerant gas leak. Also see REFRIGERANT LEAK DETECTION and REFRIGERANT LEAK REPAIR and REFRIGERANT PIPING & DISTANCES
- A/C DIAGNOSTIC FAQs: air conditioning system diagnostic FAQs: Q&A about air conditioner repair - a detailed air conditioning system diagnostic checklist
- AIR HANDLER UNIT: problems with the air handler, air filters, and the cooling coil itself
- BACKUP HEAT: on heat pumps, types of backup heat; problems with backup heat; begin here if your heat pump is not providing enough heat or if your air conditioning

DEHUMIDIFICATION PROBLEMS
CONDENSATION or SWEATING PIPES, TANKS

DEW POINT CALCULATION for WALLS
DEW POINT TABLE - CONDENSATION POINT GUIDE
DIAGNOSE & FIX AIR CONDITIONER / HEAT PUMP

DUCT SYSTEM & DUCT DEFECTS
AIR FILTERS for HVAC SYSTEMS
AIR FLOW IMPROVEMENT, HVAC
AIR FLOW MEASUREMENT CFM
ALLOY SYSTEMS FLEXDUCT
ASBESTOS HVAC DUCTS
ASBESTOS PAPER on DUCTWORK
ASBESTOS TRANSITE DUCTWORK
BALANCING AIR DUCT FLOW
DUCT & AIR HANDLER ODORS
DUCT in CONCRETE FLOOR
DUCT DAMAGE, MECHANICAL
DUCT INSULATION - Asbestos Paper
DUCT ROUTING & SUPPORT
DUST CONTAMINATION FROM HVAC?
FIBERGLASS DUCT, RIGID CONSTRUCTION
FIBERGLASS HVAC DUCTS
FIRE DAMPERS in DUCTWORK
FLOOD DAMAGE in DUCT WORK
GOODMAN GRAY FLEXDUCT
INCREASING RETURN AIR
LEAKY DUCT CONNECTIONS
Leaky or Missing Air Ducts
Hidden Missing Air Conditioner Duct
Duct Retrofit Leaks
Rooftop Duct Leaks
RETURN DUCT AIR LEAKS
SUPPLY DUCT AIR LEAKS
LOCATION OF REGISTERS & DUCTS
MOLD in AIR HANDLERS & DUCT WORK
NOISES in DUCT SYSTEM
ODORS in AIR HANDLERS & DUCT WORK
OWENS CORNING FLEXDUCT
OWL FLEXDUCT
RETURN AIR REGISTERS & DUCTS
SOUNDPROOFING for DUCTWORK
SUPPLY DUCTS & REGISTERS
TRANSITE PIPE AIR DUCTS
UNDERSIZED RETURN DUCTS
UNSAFE DUCT OPENINGS
VIBRATION DAMPENERS
WATER & ICE IN DUCT WORK
WET CORRODED DUCT WORK
ZONE DAMPER CONTROLS
DUCTLESS AIR CONDITIONERS & HEAT PUMPS
DUST CONTAMINATION FROM HVAC?

EDUCATION, HVAC SCHOOLS
ELECTRIC MOTOR DIAGNOSTIC GUIDE
ELECTRIC MOTOR OVERLOAD RESET SWITCH
ELECTRICAL POWER SWITCH FOR HEAT
ENERGY SAVINGS in buildings

system provides heat when it should be providing cooling.

- Blower Fan AUTO ON controls for air conditioning or heating blower fan units
- BLOWER FAN OPERATION & TESTING: problems with the blower fan on furnaces, heat pumps, and air conditioners
- COMPRESSOR CONDENSER: problems with air conditioner compressor/condenser units
  - COMPRESSOR & CONDENSING COIL, A/C
    BURNED-OUT COMPRESSOR - how do we diagnose a burned out compressor motor?
    CAPACITORS for HARD STARTING MOTORS - diagnose, install, replace an air conditioner motor starter capacitor
    CONDENSING COIL REPAIR REPLACE
    CONTACTOR RELAY DIAGNOSIS & REPAIR
    CONTROL CIRCUIT BOARD, A/C
    CRANKCASE HEATERS
    FAN, COMPRESSOR/CONDENSER UNIT
    HARD STARTING COMPRESSOR MOTORS - cause and cure of hard starting air conditioner compressors
    INSPECTION CHECKLIST - OUTDOOR UNIT
    INSTALLATION ERRORS, COMPRESSORS
    LEVELING REQUIREMENTS, COMPRESSOR
    LONG-ON CYCLING AC COMPRESSOR
    MOTOR OVERLOAD RESET SWITCH - where to find some "hidden" reset switches to get your A/C going again
    NOISES, COMPRESSOR CONDENSER
    Pressure Controls & Safety Switches
    PRESSURE READINGS, COMPRESSOR
    REPLACING A COMPRESSOR
    SHORT CYCLING AC COMPRESSOR - diagnose and cure A/C compressor that turns on and off too frequently
    TIGHT or SEIZED AC COMPRESSORS
- A/C - HEAT PUMP CONTROLS & SWITCHES: air conditioner controls and switches - begin here if your A/C won't start. Here's an important tip: *most refrigeration problems, in air conditioners, refrigerators, or freezers, are electrical, not mechanical.* In air conditioning school, we used to drive out and collect abandoned refrigerators that people were tossing out during our community's spring cleanup week.

  Taking these appliances back into the shop we found that almost always the problem that had caused the owner to dispose of their air conditioner or freezer was in an electrical connection or electrical control and some refrigeration class instructions opine that 80% of problems on these systems are electrical in nature. So it's worth checking out switches and controls on an air conditioner before replacing more costly components.

  Controls and switches on air conditioners and heat pumps also include THERMOSTATS, circuit breakers, service switches, CONTACTOR RELAY, refrigerant metering devices such as CAPILLARY TUBES or THERMOSTATIC EXPANSION VALVES, air conditioning or heat pump pressure switches that detect improper high or low pressures and for safety shut off the system, motor overload or motor overheat reset buttons and switches, fan control switches and FAN LIMIT SWITCH, and in some systems automatic duct dampers and ZONE DAMPER CONTROLS.
- Dehumidification Problems - Air conditioner cools but does not dehumidify
- DUCT SYSTEM DEFECTS: problems with the air duct system, air filters, supply registers, return air registers
- ELECTRIC MOTOR DIAGNOSTIC GUIDE - troubleshooting an electric motor

- ENERGY SAVINGS in buildings - complete list of options to make buildings energy efficient
- EVAPORATIVE COOLING SYSTEMS - how can a "swamp cooler" or evaporative cooling system best deliver cool air in a building?
- FAN, AIR HANDLER BLOWER UNIT - diagnose and fix problems with the indoor furnace or air conditioner blower unit fan and fan motor
- FAN, COMPRESSOR/CONDENSER UNIT - diagnose and fix problems with the outdoor compressor/condenser fan and fan motor
- Fire dampers, and Heating and Cooling Air Duct Controls such as manual and automatic duct dampers, zone dampers, and fire dampers are discussed and distinguished at DRAFT REGULATORS - barometric damper
- HEAT PUMPS - diagnosis & repair articles specifically for heat pumps
- LOST COOLING CAPACITY: what to do when not enough cool air comes out of the system
    - What to check first if there is no cool air or not enough cool air
    - Compressor failure diagnosis: checks of the air conditioner compressor
    - Ducts & Air Handler diagnosis: basic checks of the indoor air handler (blower), air ducts, and filter system
    - A/C Flow Too Weak - weak cool air flow can be caused by several problems, filters, icing, duct leaks, etc.
    - A/C Filter Problems - dirty or missing filters cause other operating problems
    - A/C Compressor Problems - quick check
    - A/C Off - Condensate Pan Switch - some overflow pans have a switch that will shut down the system
    - A/C Cooling Coil Icing - slow air flow, improper charge, etc. - eventually we get no cooling
    - A/C Not Dehumidifying - improperly-sized unit, other causes, and cures for lack of dehumidification
    - A/C Air Duct Problems - leaks, sizing, inadequate return capacity
    - Air Conditioner Won't Start - various causes including some simple switches to check
    - Air Conditioner Refrigerant Problems - too much is as bad as too little; leaks, cures.
    - Blower Fan No Start / No Stop - weird blower behavior can be diagnosed and fixed. See BLOWER FAN OPERATION & TESTING.
    - Compressor Diagnosis: Diagnose & Repair - serious look into the compressor unit
    - Cooling Capacity of the Duct System
- MANUALS & PARTS GUIDES - HVAC - where to find air conditioner, heat pump, and heating repair manuals, owners guides, installation guides, and parts lists
- OPERATING DEFECTS: major air conditioning problem symptoms and how to get the air conditioning system working again,e.g. compressor or fan noises, failure to start, and inadequate cool air volumes
- REFRIGERANT LEAK DETECTION: how to find and fix air conditioning refrigerant gas leaks. Also see REFRIGERANT LEAK DETECTION and REFRIGERANT LEAK REPAIR and REFRIGERANT PIPING & DISTANCES
- SHORT CYCLING AC COMPRESSOR - what causes the air conditioner compressor to keep turning on and off

Air Conditioner Won't Start
Air Conditioner Refrigerant Problems
Blower Fan No Start / No Stop
Compressor Diagnosis: Diagnose & Repair
Cooling Capacity of the Duct System
Repair Guide Master List
LOW VOLTAGE TRANSFORMER TEST

MANUALS & PARTS GUIDES - HVAC
MINI SPLIT AIR CONDITIONERS & HEAT PUMPS
MOTOR OVERLOAD RESET SWITCH
MOLD in AIR HANDLERS & DUCT WORK
MOLD INFORMATION CENTER

NOISE AIR CONDITIONER / HEAT PUMP
NOISE / SOUND DIAGNOSIS & CURE
Air Leak Noises
AIR CONDITIONING & HEAT PUMP NOISES
AIR HANDLER / BLOWER NOISES
COMPRESSOR CONDENSER NOISES
DUCT SYSTEM NOISES
FAN NOISES

ODORS in AIR HANDLERS & DUCT WORK
OPERATING COST
OPERATING DEFECTS
OPERATING TEMPERATURES
Air Conditioning System Temperatures
Instruments Used to Measure A/C Temperatures
Procedures for Making Temperature Measurements

PORTABLE ROOM AIR CONDITIONERS
PRESSURE READINGS, REFRIGERANT

REPAIR GUIDE, AIR CONDITIONERS / HEAT PUMPS
REPAIR & DIAGNOSTIC FAQs for A/C
REFRIGERANTS & PIPING
GAUGE, REFRIGERATION PRESSURE TEST
REFRIGERANT CHARGING PROCEDURE
REFRIGERANT DRIERS & FILTERS
REFRIGERANT LEAK DETECTION
REFRIGERANT LEAK REPAIR
REFRIGERANT METERING DEVICES TEVs
REFRIGERANT METERING CAPILLARY TUBES
REFRIGERANT PIPING & DISTANCES
REFRIGERANT PIPING INSULATION
REFRIGERANT PRESSURE READINGS
REFRIGERANT SIGHT GLASS
RETROFIT SIZING for A/C or HEAT PUMPS

SEER RATINGS & OTHER DEFINITIONS
SEER RATING HISTORY

SOLAR ENERGY SYSTEMS
Solar Cooling Subtopics
SOLAR GAIN CALCULATION
SOLAR SHADES & SUNSCREENS
SOLAR SHADES, LOW-E EFFECTIVENESS
SUNGAIN, FILMS, LOW-E GLASS

too quickly?

- ZONE DAMPER CONTROLS . discusses manual and automatic air duct zone controls

HVA/C COMPONENT LIST - Air Conditioning & Heat Pump Components Inspection List - the basics

Conventional Residential Air Conditioners: Outside Condenser/Compressor unit, Inside Evaporator Air Handler unit

Conventional cooling systems include the following components:

1. Indoor Components of an air conditioning system (Details can be read and seen at AIR CONDITIONER COMPONENT PARTS)
    1. Air Handler Unit (AHU) which typically includes the following [AIR HANDLER / BLOWER UNITS]
        - Air filters - located at return registers or possibly at or in the air handler [AIR FILTERS for HVAC SYSTEMS]
        - Return Plenum
        - Blower fan in a blower compartment [BLOWER FAN OPERATION & TESTING]
        - Evaporator Coil = Cooling Coil [COOLING COIL or EVAPORATOR COIL]
        - Supply plenum
        - Condensate collection & drainage system - CONDENSATE HANDLING, A/C
    2. Supply air ducts and registers [DUCT SYSTEM & DUCT DEFECTS]
    3. Return air ducts and registers
    4. Air filter(s) and possibly other air cleaning/IAQ equipment [AIR FILTERS for HVAC SYSTEMS]
    5. Electrical shut off switches, circuit breakers/fuses [CONTROLS & SWITCHES, A/C - HEAT PUMP]
2. Outdoor Air Conditioning System Components (Details can be read and seen at AIR CONDITIONER COMPONENT PARTS)
    1. Compressor motor - on residential units this is normally a hermetic motor-compressor combined in a single sealed unit - COMPRESSOR & CONDENSING COIL, A/C
    2. Condensing coil - CONDENSING COIL REPAIR REPLACE
    3. Outdoor cooling fan or condenser unit fan - FAN, COMPRESSOR/CONDENSER UNIT

4. Electrical shut-off switch(es) for service & circuit protection - CONTROLS & SWITCHES, A/C - HEAT PUMP

All of the components, controls, switches of air conditioning systems and how to diagnose and debug cooling system problems are discussed in detail at this website.

Rooftop Air Conditioning Systems

Rooftop combined units: While the list above describes the common components of a typical residential air conditioning system, other configurations and packaged units are also in increased use in both residential and commercial installations.

Alternative air conditioning system designs may combine all components except for the duct work in a rooftop mounted unit such as the one shown above where it was mounted on a flat roof over offices at a commercial building.

More details: see Rooftop-mounted Air Conditioners / Heat Pumps

Wall Convector Heating and Air Conditioning Units

Wall convector heating and cooling units (at left) are often used for both heating and cooling in commercial installations and high-rise apartment buildings. The unit shown has its own compressor mounted right in the cabinet, visible at lower center in the photo.

Wall-mounted heating and cooling convector installations may be designed with one central heater or cooling system which feeds multiple units with chilled or heated water or possibly refrigerant from a single remote heating and cooling heat pump.

More details: see Wall Convector Units, Heating / Air Conditioning

Split System Air Conditioners or Ductless Air Conditioners & Heat Pumps

Another common residential alternative dispenses with duct work entirely, using a wall-mounted indoor evaporator/blower unit and a separate outside compressor/condenser (below left and right). In this split system air conditioning design, one compressor/condenser may serve multiple wall-mount indoor units.

The Sanyo® compressor/condenser unit shown (above left) can support two indoor evaporator/fan cooling units. In this installation the indoor units were mounted in two different areas of the home. The thermostat and controls for split system air conditioners and heat pumps may be wall mounted but often are a portable hand-held remote controller.

Details about ductless air conditionres, split systems, mini split systems and ceiling-mount A/C systems are at SPLIT SYSTEM AIR CONDITIONERS & HEAT PUMPS.

Goofy Home Made or Do-it-yourself Air Conditioning Systems

Do-It-Yourself Home made air conditioning systems such as this goofy example may actually work but not without problems. This system used a window air conditioner placed in a home's attic.

Manhole ventilation duct (liberated from New York City) was used along with a home made hood attached to the air conditioner to blow cool air into the home through a ceiling register. The air conditioning condensate was collected in the blue plastic kiddie pool seen in the photo, and drained by gravity to a plumbing vent stack.

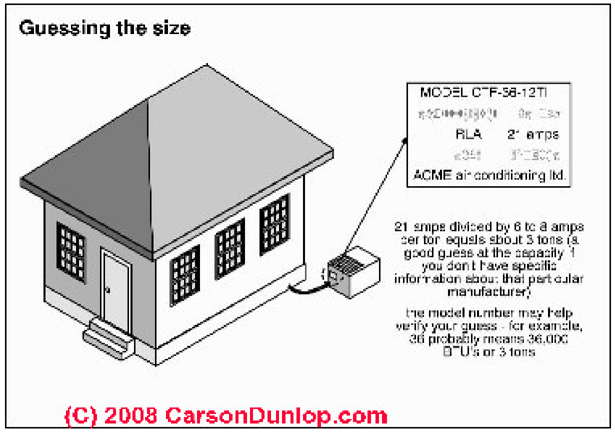
Nothing about the system was proper, safe, nor very effective, and in addition, the attic moisture conditions were terrible as you can see from the blackened plywood roof sheathing.

Also see: Home Made Air Conditioning Systems

RATED A/C or Heat Pump COOLING CAPACITY - How to Determine Air Conditioning Equipment Rated Cooling Capacity - the basics

The cooling capacity of an air conditioning system is expressed in BTU's or tons. One ton of cooling capacity equals 12,000 BTU's/hour of cooling capacity.

Air conditioner size guessing sketch (left) is provided



courtesy of Carson Dunlop Associates. Thanks to reader Joe Panimondo for technical editing.

One ton" of cooling capacity, historically, referred to the cooling capacity of a ton of ice. Tons of ice does not explain a key ingredient in the comfort produced by air conditioning systems, dehumidification of indoor air - that is, taking water out of the air. Cool air can hold less water (in the form of water molecules or gaseous form of H2O) than warm air.

Think of the warmer air as having more space between the gas molecules for the water molecules to remain suspended.

When we cool the air, we in effect are squeezing the water molecules out of the air. When an air conditioner blows warm humid building air across an evaporator coil in the air handler unit, it is not only cooling the air, it's squeezing out some of the water in that air. Both of these effects, cooler air and drier air, increase the comfort for building occupants.

There are several ways to determine the rated cooling capacity of an air conditioning system's equipment. We discuss these in detail at COOLING CAPACITY, RATED.

Questions & Answers regarding this article

Questions & answers about how to diagnose and repair air conditioning and heat pump systems. If your air conditioner or heat pump system is not working, start at LOST COOLING CAPACITY for help in diagnosing and repairing the trouble.

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(1 days ago) DanJoeFriedman (mod) said:

Sabine,

Your A/C technician should check the unit for an electrical short or damage - meanwhile it would be smart to leave it off.

(1 days ago) Sabine said:

We had roofing done last week and when it rained last night there was a leak in our roof right over the indoor ac unit in the attic. That night the ac started up a couple of times but would not stay on long until it eventually stopped starting all together. Can the rain water which fell onto the indoor unit have cause our ac to stop working?

(1 days ago) Jim said:

Three ton Goodman freezes up. Low presure not constant, and slowly moves from about 60 psi to 68-70 psi and repeats this change.

(4 days ago) DanJoeFriedman (mod) said:

Brent, from just your question alone, we can't say. A check of the air temperatures across the cooling coil can tell you if the system is not cooling air adequately - look for about 14 deg F

(4 days ago) DanJoeFriedman (mod) said:

Cherie,

Electrical wires that have been accidentally cut can certainly be repaired, - though the splice needs to be inside an electrical box - so a box may need to be added; But if the cut also shorted the wires it's possible that a fan motor, control circuit board, or other component was damaged and needs replacement too.

(Aug 1, 2012) Cherie said:

If wires from a heat pump fan motor to the control panel get cut accidently-can the wires be repaired or will I need a new fan motor?

(July 31, 2012) Brent said:

At night the house is cool and holds temp good. During the day the AC unit runs all day because it can't hold the temp down in the house. Do you think I need to have the freon charged? Or what could be the problem?

(July 30, 2012) DanJoeFriedman (mod) said:

Jim:

see the article BLOWER FAN OPERATION & TESTING (links at page left) and look for bad fan mount, bearings, drive belt, motor.

(July 29, 2012) Anonymous said:

all 3 fan terminals on rheem circuit board have voltage in ac mode black 120 blue 180 red 150 fan not staying on all time board bad?

(July 29, 2012) Jim said:

indoor unit vibrating like an gas engine

(showing 1 to 10)

Recommend / Share this Article

+1 ShareThis EMAIL Print

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also include a list of recommended books for the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

AIR CONDITIONING & HEAT PUMP SYSTEMS

- CARSONDUNLOP Carson, Dunlop & Associates Ltd., 120 Carlton Street Suite 407, Toronto ON M5A 4K2. (416) 964-9415 1-800-268-7070 info@carsondunlop.com. The firm provides professional home inspection services & home inspection education & publications. Alan Carson is a past president of ASHI, the American Society of Home Inspectors. Thanks to Alan Carson and Bob Dunlop, for permission for InspectAPedia to use text excerpts from *The Home Reference Book* & illustrations from *The Illustrated Home*. Carson Dunlop Associates' home inspection education products include
    - The ASHI-adopted Home Inspection Training Program, and Commercial Building Inspection Courses

  - The Home Inspection Home Study Course, and publications such as
  - The Home Reference Book, a reference & inspection report product for building owners & inspectors
  - The Home Reference *eBook*, an electronic version for PCs, the iPad, iPhone, & Android smart phones
  - Home Inspection Report writing materials, including the Horizon Software System that manages business operations, scheduling, & inspection report writing using Carson Dunlop's knowledge base & color images. The *Horizon* system runs on always-available cloud-based software for office computers, laptops, tablets, iPad, Android, & other smartphones.
  - The Illustrated Home illustrates construction details and building components, a reference for owners & inspectors
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).

- [1] "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- [2] Thanks to Mark Cramer, Tampa Florida, for assistance in technical review of the "Critical Defects" section and for the photograph of the deteriorating gray Owens Corning flex duct in a hot attic. Mr. Cramer is a Florida home inspector and home inspection educator.
- [3] Thanks to Jon Bolton, an ASHI, FABI, and otherwise certified Florida home inspector who provided photos of failing Goodman gray flex duct in a hot attic.
- [4] Thanks to Scott at SJM Inspect for suggesting this EPA document and for technical editing remarks regarding our air conditioning website, SJM Inspection Service LLC, serves the entire state of CT, sjminspect.com 203-543-0447 or 203-877-4774 5/16/07
- [5] Thanks to Joe Panimondo for technical editing, April 2011
- [6] This website discusses these air conditioning and heat pump terms and problems: Air Conditioners: Central Air Conditioning Troubleshooting & Repair Guide: How to Inspect, Diagnose, & Repair Central Air Conditioning: Defects in A/C compressors, air handlers, duct work, and controls. We explain how to inspect & repair central air conditioning systems and for homeowners we also answer basic HVAC questions such as what are the basic air conditioning components? We provide guidance in determining air conditioning cooling capacity & energy efficiency, Troubleshooting air conditioning compressor problems, Diagnosing air conditioning air handler problems, Air conditioning condensate problems, Duct system inspections, defects, repairs, Cleaning air conditioning equipment & A/C refrigerants.
- [7] HVAC brands discussed include but are not limited to: Lennox, American Standard, Amana, Everrest, Goodman, Frigidaire, Coleman and Gibson. Brands of related air handling equipment include Honeywell, Aprilaire, White-Rogers, Broan. Nutone, Fantech, Venmar, Arzel, Hi-Velocity, Vanguard, Wirsbo, Weil McLain, Unico, Heat Link, A.O. Smith, Water Furnace, ClimateMaster, Geo-Excel, Command Aire, Friedrich, LG, Mitsubishi, Sanyo, Hart &
Cooley, Munchkin, Superstor Ultra, Lochinvar and Knight HVAC equipment.
- [8] HVAC Employment: U.S. Department of Labor website describes HVAC jobs and the employment outlook for HVAC technicians.
- [9] HVAC Education, Training Accreditation agencies: Quoting the U.S. DOL HVAC website above::
After completing the programs below, new technicians generally need between 6 months to 2 years of field experience before they are considered proficient. Three accrediting agencies have set academic standards for HVACR programs:

  - [10] *HVAC Excellence. 1701 Pennsylvania Ave NW, Washington, DC 20006* Tel: (800) 394-5268. Quoting:
HVAC Excellence is a not for profit organization that has been serving the HVACR industry since

1994. It is our goal to improve competency through validation of the technical education process. By setting standards and verifying that they have been met, we inspire the industry to excel. We know that all of the challenges that face our industry are achievable by continuous improvement in the way that we prepare technicians.

- [11] *National Center for Construction Education and Research, 3600 NW 43rd Street, Bldg. G, Gainesville, FL 32606, Tel: 888.622.3720, Quoting:*
  NCCER is a not-for-profit education foundation created to develop industry-driven standardized craft training programs with portable credentials and help address the critical workforce shortage facing the construction industry.
- [12] *The Partnership for Air-Conditioning, Heating, and Refrigeration Accreditation, (PAHRA) 2111 Wilson Blvd., Suite 500 Arlington, VA 22201-3001 (703) 524-8800, Quoting: The Partnership for Air-Conditioning, Heating, Refrigeration Accreditation (PAHRA) is an independent, third party organization that is a partnership between heating, ventilation, air-conditioning and refrigeration (HVACR) educators and the HVACR industry that will award accreditation to programs that have met and/or exceeded industry validated standards. This programmatic accreditation program is the only one that is supported by the major industry associations.*

Licensure. Heating, air-conditioning, and refrigeration mechanics and installers are required to be licensed by some States and localities. Requirements for licensure vary greatly, but all States or localities that require a license have a test that must be passed. The contents of these tests vary by State or locality, with some requiring extensive knowledge of electrical codes and others focusing more on HVACR-specific knowledge. Completion of an apprenticeship program or 2 to 5 years of experience are also common requirements.

In addition, all technicians who purchase or work with refrigerants must be certified in their proper handling. To become certified to purchase and handle refrigerants, technicians must pass a written examination specific to the type of work in which they specialize. The three possible areas of certification are: Type I—servicing small appliances; Type II—high-pressure refrigerants; and Type III—low-pressure refrigerants. Exams are administered by organizations approved by the U.S. Environmental Protection Agency, such as trade schools, unions, contractor associations, or building groups.

- [13] HVAC Training Courses, Schools: HVAC Technician Training Schools [http://technicianschool.net/hvac-technician-training-schools/], lists thefollowing schools offering technical courses may offer specific training programs for potential careers, including HVAC technicians. Among HVAC schools that website lists are
  - Everest Colleges [http://www.everest.edu],
  - Florida Career College 7891 Pines Blvd Hollywood, FL 33024 http:// www.careercollege.edu/,
  - Lincoln Institute 2299 Vauxhall Road Union, NJ 07083 http:// www.lincolnedu.com/
  - NOTE: when considering an HVAC training course or school, check the HVAC education accrediting associations listed above.
- [14] Ratib Bakera is member of Refrigeration Service Engineers Society (RSES), an International training organization for the HVACR industry provides educational and certification programs to HVACR professionals of all experience levels. www.rses.org provides information on the organization and its training materials. Independent testing and certification of HVAC technicians is provided by North American Technician Excellence - NATE - see www.natex.org. NATE is supported by ASHRAE, the US EPA, and a host of other trade and professional associations.
- [15] Singer brand HVAC equipment brand history: Singer was bought by & became the climate control unit of Dallas-based Snyder General Corp. (founded by a former Singer HVAC manager) in 1982. The name

Singer was dropped in 1984. In 1984 Snyder General operations included Arcoaire, Comfortmaker, and McQuay. In 1991 Snyder General sold Arcoaire & Comfortmaker to Inter-City Products. In 1994 Snyder General was acquired by Hong Leong Group Malaysia. Snyder General is at 2001 Ross Avenue Dallas, TX 75201.

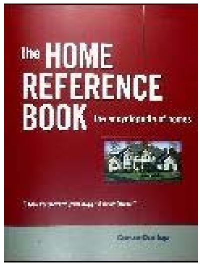
- [16] Lennox air conditioning and heat pump owners manuals for air conditioners, air handlers, furnaces, heat pumps, indoor air quality systems, packaged units, water heaters, zone controls and other controls such as thermostats, are provided by Lennox at http://www.lennox.com/support/manuals.asp
- [23] Air Diffusion Council, 1901 N. Roselle Road, Suite 800, Schaumburg, Illinois 60195, Tel: (847) 706-6750, Fax: (847) 706-6751 - info@flexibleduct.org - www.flexibleduct.org/ -
*"The ADC has produced the 4th Edition of the **Flexible Duct Performance & Installation Standards** (a 28-page manual) for use and reference by designers, architects, engineers, contractors, installers and users for evaluating, selecting, specifying and properly installing flexible duct in heating and air conditioning systems.*
Features covered in depth include: descriptions of typical styles, characteristics and requirements, testing, listing, reporting, certifying, packaging and product marking.
Guidelines for proper installation are treated and illustrated in depth, featuring connections, splices and proper support methods for flexible duct. A single and uniform method of making end connections and splices is graphically presented for both non-metallic and metallic with plain ends."
The printed manual is available in English only. Downloadable PDF is available in English and Spanish.
- [24] Engineering toolbox properties of water - http://www.engineeringtoolbox.com/water-thermal-properties-d_162.html and email: editor.engineeringtoolbox@gmail.com web search 09/16/2010
- [25] Owens Corning Duct Solutions - www.owenscorning.com/ductsolutions/ - provides current HVAC ductwork and duct insulating product descriptions and a dealer locator. Owens Corning Insulating Systems, LLC, One Owens Corning Parkway, Toledo, OH 43659 1-800-GET-PINK™
- [26] "Flexible Duct Media Fiberglas™ Insulation, Product Data Sheet", Owens Corning - see owenscorning.com/quietzone/pdfs/QZFlexible_DataSheet.pdf
"Owens Corning Flexible Duct Media Insulation is a lightweight, flexible, resilient thermal and acoustical insulation made of inorganic glass fibers bonded with a thermosetting resin."
- [27] Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982
- [28] Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- [29] Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages
- [30] Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- [31] IMG HSPACE="3" VSPACE="0" BORDER="0" WIDTH="28" HEIGHT="11" SRC="/graphics/new.gif" ALT="New" />Air Conditioning SEER - New DOE Air Conditioner and Heat Pump Efficiency Standard
- [32] FlowKinetics LLC, 528 Helena Street Bryan, Texas 77801 USA, Tel: (979) 680-0659, Email: inform@flowkinetics.com, Website: www.flowkinetics.com, "FKS 1DP-PBM Multi-Function Meter Pressure, Velocity & Flow User's Manual", web search 07/16/2012, original source: http://www.flowkinetics.com/FKS_1DP_PBM_Manual.pdf [copy on file] and "FKT Series Flow Measurement And Pressure Acquisition System User's Manual" http://www.flowkinetics.com/FKTSeriesManual.pdf [copy on file]
- [33] *Histoire de l'Académie royale des sciences avec les mémoires de mathématique et de physique tirés des registres de cette Académie*: 363–376. Retrieved 2009-06-19.- Pitot Tubes, Henri Pitot (1732)
- [34] Wikipedia provided background information about some topics discussed at this website provided this citation is also found in the same article along with a " retrieved on" date. NOTE: because Wikipedia entries are fluid and can be amended in real time, we cite the retrieval date of Wikipedia citations and we

do not assert that the information found there is necessarily authoritative.
"Pressure sensor", retrieved 7/16/2012

- [35] "GE Zoneline® Owners Manual and Installation Instructions, Heat/Cool Model 2900, Heat Pump Model 3900", General Electric Corporation, [copy on file].
- [36] "GE Zoneline® Owners Manual and Installation Instructions, Heat Pump Model 5800", General Electric Corporation, [copy on file].
- [37] "Whirlpool WGPH45 Packaged Heat Pump, Product Specifications", Whirlpool Corporation, [copy on file]. Website: www.whirlpoolcomfort.com
- [38] N Lu, YL Xie, Z Huang, "Air Conditioner Compressor Performance Model", U.S. Department of Energy, August 2008, [copy on file as PNNL-17796.pdf] Available to the public from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161 ph: (800) 553-6847, fax: (703) 605-6900 email: orders@ntis.fedworld.gov online ordering: http://www.ntis.gov/ordering.htm.
- [39] Yinger R, R Bravo, and D Martinez. 2006 Air Conditioner Stalling Effects Study/Air Conditioner Testing Procedures. Southern California Edison, Rosemead, California
- [40] Bravo, R, R Yinger, and L Gaillac. 2006. Conditioner Stalling Unit Level Solutions Test Report. Southern California Edison, Rosemead, California.
- [41] Lu N, B Yang and Z Huang. 2008a. Evaluation of Southern California Edison Air-Conditioner Stalling Solutions. PNNL-17686, Pacific Northwest National Laboratory, Richland, Washington.
- [42] Danny S. Parker, John R. Sherwin, Bart Hibbs, "Development of High Efficiency Air Conditioner Condenser Fans", ASHRAE Transactions June 2005, [copy on file as FSEC-CR-1674-05.pdf]

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia Bookstore.



- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

  Or choose the The Home Reference eBook for using this reference on PCs, Macs, Kindle, iPad, iPhone, or Android Smart Phones

Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

- Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982
- Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]

Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages

- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- NEW! Air Conditioning SEER - New DOE Air Conditioner and Heat Pump Efficiency Standard
- Asbestos HVAC Ducts and Flues field identification photos and guide
- Fiberglass: Indoor Air Quality Investigations: Fiberglass in Indoor Air, HVAC ducts, and Building Insulation
- ...

Mobile View
AIR CONDITIONING & HEAT PUMP SYSTEMS

A/C - HEAT PUMP CONTROLS & SWITCHES
A/C DATA TAGS
A/C - HEAT PUMP CRITICAL DEFECTS
A/C DIAGNOSTIC FAQs
A/C REFRIGERANTS
A/C TYPES, ENERGY SOURCES

AGE of AIR CONDITIONERS & HEAT PUMPS
AGE of HEATERS, BOILERS, FURNACES
AGE of WATER HEATERS

AIR CONDITIONER BTU CHART
AIR CONDITIONER COMPONENT PARTS
Indoor A/C Components
Outdoor A/C Components
AIR CONDITIONER TYPES, ENERGY SOURCES
AIR CONDITIONER NOT WORKING

Air Conditioning Compressor Condenser Unit Inspection Checklist for Owners & Inspectors

InspectAPedia® - ShareThis +1

- A quick visual inspection checklist for the outdoor air conditioning system compressor/condenser unit
- How to inspect the outdoor components of an air conditioning system - simple tips for home owners and home inspectors
- Questions & answers about how to inspect the outdoor compressor/condenser unit for signs of trouble

Air Conditioner Inspection Checklist: This air conditioning inspection article discusses the how to perform a simple visual inspection of an air conditioning compressor-condenser unit, including links to more detailed air conditioning inspection,diagnosis and repair articles useful in the evaluation of air conditioner compressor noises, hard starting, lost cooling capacity, and detection of a burned out compressor or A/C compressors at or near end of their life.

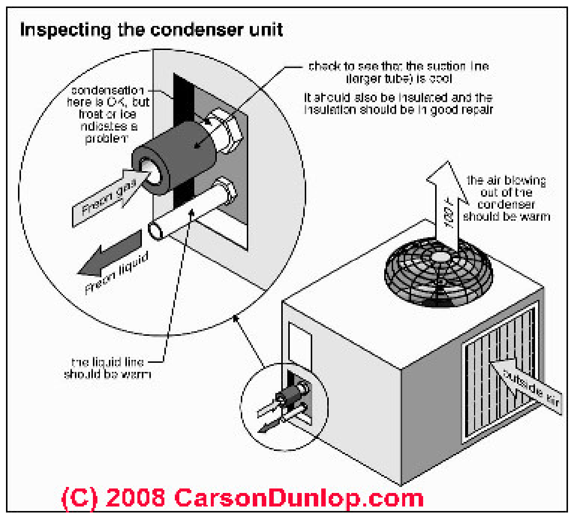
InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

Maintenance tips including attention to compressor support pads and avoiding air conditioning refrigerant leaks are addressed. Initial, simple *diagnostic checks* of the air conditioning compressor are also described at Compressor failure diagnosis.

AIR CONDITIONING & HEAT PUMP SYSTEMS describes the major components of an air conditioning system. Sketches and photographs are provided, and common defects for each A/C component are listed along with visual or other clues that may suggest a problem or probable failure of each components. We explain how an air conditioning service technician will diagnose certain common air conditioning system failures or defects. We include photographs to assist readers in recognizing cooling system defects.

If your air conditioning or heat pump system has lost its cooling capacity or won't start see REPAIR GUIDE for AIR CONDITIONERS. See How to determine the cooling capacity of air conditioning equipment if the system seems to be working but is inadequate to cool your building. Contact us to suggest text changes and additions and, if you wish, to receive online listing and credit for that contribution.

How do We Inspect an Air Conditioning Compressor - Visual Inspection Procedure



The (usually) outdoor half of a typical air conditioning system is a unit containing the refrigerant compressor and condensing coil. The air conditioning compressor motor is a pump which draws heat laden refrigerant gas from the building's indoor components (evaporator coil and air handler), and compresses the low pressure refrigerant gas to high pressure and higher temperature.

The diagnosis and repair of various defects in the air conditioning compressor/condenser unit are discussed in detail using the links provided at the left of this page.

Here is a little visual inspection checklist that any homeowner or home inspector can perform.

Sketch courtesy of Carson Dunlop Associates.

Air Conditioner Compressor Unit Inspection Checklist for an Air Conditioner Report - Outdoor Unit Observations

- Location of the Compressor/Condenser: Locate the outdoor unit or units and look at the characteristics of just where the unit(s) have been placed:
  - Is there good air circulation around the compressor/condenser unit or is it too close to a wall, to close to an overhead deck, porch, shrubs - Details are at INSTALLATION ERRORS, COMPRESSORS
  - Is the unit too close to the property line - a possible noise issue for neighbors or a local building code violation? Most municipalities require that the compressor be at least 10' from the property line.
  - Is the compressor/condenser too close to a gas appliance vent or to a clothes dryer vent? - Details are at INSTALLATION ERRORS, COMPRESSORS
  - Are all of the cabinet parts and cabinet base above ground - the unit should not be partially buried

ODORS in AIR HANDLERS & DUCT WORK

- Condition of the compressor/condenser cabinet: look for rust damage or dents from having been struck by a garden tractor or dropped during installation
- Levelness of the condenser/compressor unit: the unit should be level or within 10 deg. of level. See CONDENSING COIL REPAIR REPLACE
- Condition of the compressor/condenser condensing coil: look for evidence of damage to the cooling fins or dirt, debris, grass clippings blocking the air flow of the unit. See CONDENSING COIL REPAIR REPLACE
- Condition of the compressor/condenser fan: look for evidence of damage to the fan itself (rare). See FAN, COMPRESSOR/CONDENSER UNIT for details.
- Presence of an electrical service disconnect switch at the air conditioner compressor/condenser: a service disconnect switch, fuse, or circuit breaker should be installed, usually on the building wall close to the unit. Check the size of the fuse or circuit breakers and compare with the overcurrent protection specified on the data plate on the compressor/condenser unit body. See A/C - HEAT PUMP CONTROLS & SWITCHES.
- Condition of the wiring to the air conditioner compressor/condenser unit: look for signs of damage or overheating, broken conduit that should be protecting the wiring. A home inspector or electrical inspector will compare the size (current carrying capacity) of the wiring with the fuse or circuit breaker size and the size specified by the data tag. She should also check that the wiring to the compressor/condenser is rated for outdoor use or is suitably installed in conduit. See ELECTRICAL INSPECTION, DIAGNOSIS, REPAIR.
- Condition of the air conditioner refrigerant lines: look for lost insulation on the suction line; look for absence of any bend or slack in the refrigerant line; if the compressor/condenser is connected to copper piping that is rigid between the unit and the building wall, vibration, settlement, slight movement can produce a refrigerant leak. See REFRIGERANT LEAK DETECTION.
- Air Conditioner Data Plate Information: is there a data plate at all? If you can find it, record the model, serial number, and other data from this tag - it can help locate service manuals, system specifications such as RLA, maximum fuse size, and it will permit you to find the age and cooling capacity of the unit. See DATA TAGS on AIR CONDITIONERS. A home inspector can be asked to make a rough comparison between the cooling capacity of the compressor and the square footage of the building it serves. See COOLING CAPACITY, RATED for how to do this, and see AIR CONDITIONER BTU CHART.
- If the compressor can be run, listen to the motor and fan motor when the unit starts and after it gets running; Noisy or hard starting compressors may be at or near the end of life or may need service and repair. See NOISES, COMPRESSOR CONDENSER, and see OPERATING DEFECTS.
- Operating temperatures: a home inspector or service technician may use other instruments, including measuring simple air temperatures at the compressor/condenser to get an idea how well the system is functioning. See OPERATING TEMPERATURES.

Air Conditioning System Diagnostic Articles

- At LOST COOLING CAPACITY, our focus is on the case in which the air conditioning system seems to be "running" but not enough cool air, or no cool air at all is being delivered to the occupied space. Sketch from Carson Dunlop Associates.
- At OPERATING DEFECTS we take you through the major air conditioning problem symptoms and how to get the air conditioning system working again.
- At A/C - HEAT PUMP CONTROLS & SWITCHES we explain the many electrical switches and controls that control an air conditioner or heat pump system. You'll need to check these if your air conditioner won't start.

Questions & Answers regarding this article

Questions & answers about how to inspect the outdoor compressor/condenser unit for signs of trouble

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(June 19, 2012) DanJoeFriedman (mod) said:

Evilu if the outdoor fan is not turning but the outdoor compressor motor is trying to run it sounds like a fan relay or fan start run capacitor problem. TURN OFF the system to avoid damaging it while you wait for repair.

(June 19, 2012) Evilu Pridgeon said:

The outdoor compressor fan is not turning even though the a/c is running. Air does not seem as strong or as cool as it usually is. Should I turn it off in order not to burn up the motor, or what are my other options? Can it be fixed?

(May 17, 2012) DanJoeFriedman (mod) said:

Slam Jeme I haven't seen cutoff valves on refrigeration lines, but if that's what youv'e got it may be that a swap-out ability was what was intended. Just ask your tech how they are going to get all of the air out of the new system and lines during the reconnection process.

(May 15, 2012) slam jeme said:

please , my condensing unit is carrier but the hot gas by bass has cut off can i install a new compressor whithout unloding capilitily

(Apr 26, 2012) kristopheruu said:

that was very helpful

(Mar 16, 2012) Jeff said:

I turned our A/C unit on and it is blowing hot air. I checked the outside unit and the fan is on. I was standing by it when it came on, the fan came on first, then a few seconds later I heard the compressor come on, it was humming pretty loud. The pressure line going into the unit was very warm. I checked the coils inside the house, (air handler?) and they were pretty warm also. Could this be the start up capacitor? Thanks.

(June 16, 2011) DanJoeFriedman (mod) said:

Shade and A/C condenser units: good question Estelle. The outdoor condenser indeed has a slightly easier time of it if located in shade, though the units are designed to be capable of functioning in full sunlight. I have not found a source that gives us actual data on the change of system efficiency when shaded. So I'm reluctant to give a "made-up" number guess.

You can do several things to restore shade to your compressor unit such as:

- temporarily install a beach umbrella to shade the unit

- build a pergola or lattice-work cover above the unit

But WATCH OUT - don't put any shade over the compressor/condenser that is so close or closed as to block airflow over the unit.

Most A/C compressor installation manuals will give the required clearances around all sides and above the unit in order that its airflow is not obstructed. If you can't find that information, and if your shade source is at least six feet above the unit you should be OK.

(June 12, 2011) estelle j. said:

A question which just came up: A large tree was recently cut back which had provided shade for my outdoor condenser which faces southwest. Will the efficiency of the unit be adversely affected by this exposure to the hot uninterrupted summer sun? Your comments will be of great help for someone who obviously is not very knowledgeable. Thanks.

(May 12, 2011) DanJoeFriedman (mod) said:

Click on the COMPRESSOR & CONDENSING COIL A/C article linked-to at page left and you can see what is inside of that sealed A/C compressor motor. There we include illustrations and text.

(May 10, 2011) Anonymous said:

what is inside if the air compressor units if you cut them open

Recommend / Share this Article

ShareThis

EMAIL

Print

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also include a list of recommended books for the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

INSPECTION CHECKLIST - OUTDOOR UNIT

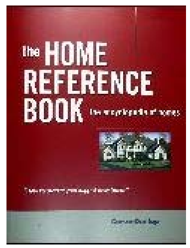
- Thanks to Mark Cramer, Tampa Florida, for assistance in technical review of the "Critical Defects" section and for the photograph of the deteriorating gray Owens Corning flex duct in a hot attic. Mr. Cramer is a Florida home inspector and home inspection educator.
- CARSONDUNLOP Carson, Dunlop & Associates Ltd., 120 Carlton Street Suite 407, Toronto ON M5A 4K2. (416) 964-9415 1-800-268-7070 info@carsondunlop.com. The firm provides professional home inspection services & home inspection education & publications. Alan Carson is a past president of ASHI, the American Society of Home Inspectors. Thanks to Alan Carson and Bob Dunlop, for permission for InspectAPedia to use text excerpts from *The Home Reference Book* & illustrations from *The Illustrated Home*. Carson Dunlop Associates' home inspection education products include
  - The ASHI-adopted Home Inspection Training Program, and Commercial Building Inspection Courses
  - The Home Inspection Home Study Course, and publications such as
  - The Home Reference Book, a reference & inspection report product for building owners & inspectors
  - The Home Reference *eBook*, an electronic version for PCs, the iPad, iPhone, & Android smart phones
  - Home Inspection Report writing materials, including the Horizon Software System that manages business operations, scheduling, & inspection report writing using Carson Dunlop's knowledge base & color images. The *Horizon* system runs on always-available cloud-based software for office computers, laptops, tablets, iPad, Android, & other smartphones.
  - The Illustrated Home illustrates construction details and building components, a reference for owners &

inspectors

- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- Thanks to Scott at SJM Inspect for suggesting this EPA document and for technical editing remarks regarding our air conditioning website, SJM Inspection Service LLC, serves the entire state of CT, sjminspect.com 203-543-0447 or 203-877-4774 5/16/07

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia Bookstore.



- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

  Or choose the The Home Reference eBook for using this reference on PCs, Macs, Kindle, iPad, iPhone, or Android Smart Phones

Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

- Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982
- Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- NEW!
  Air Conditioning SEER - New DOE Air Conditioner and Heat Pump Efficiency Standard
- Asbestos HVAC Ducts and Flues field identification photos and guide
- Fiberglass: Indoor Air Quality Investigations: Fiberglass in Indoor Air, HVAC ducts, and Building Insulation

- ...

]

InspectAPedia®

Free Encyclopedia of Building & Environmental Inspection, Testing, Diagnosis, Repair

Search

InspectAPedia

Ask a Question or Search InspectAPedia

Mobile View
AIR CONDITIONING & HEAT PUMP SYSTEMS

CAR MOLD CONTAMINATION
CARBON MONOXIDE - CO
CARBON DIOXIDE - CO_2
DIAGNOSE AIR CONDITIONER PROBLEMS

FURNACES WARM AIR HEATING SYSTEMS

GAS EXPOSURE EFFECTS, TOXIC
GAS DETECTION & MEASUREMENT
Use of a Drager pump
GAUGE, REFRIGERATION PRESSURE TEST
How Colorimetric gas detection tubes work
Using the TIF 5000 Gas Detector
Warnings re instruments for detection of gases
Warning: choose the right tube for gas detection
HEAT EXCHANGER LEAKS

Guide to Refrigeration Gas Test Gauge Use

InspectAPedia® - ShareThis +1

- Recommendations for refrigeration gas pressure measurement using a test gauge set
- Proper Use of the Refrigeration Charging / Testing Gauge Set to Keep Moisture & Dirt out of an Air Conditioner, Heat Pump, Refrigerator, Freezer, etc.
- How to hook up a refrigerant test / charging gauge set to the test ports - Attaching the Refrigeration Gauge Set to the Air Conditioner, Heat Pump, or other refrigeration equipment
- Reading the Gauges on a Refrigeration Gauge Set
- Procedure for Charging the HVAC System or Appliance with Refrigerant Using a Gauge Set
- Questions & Answers about how to hook up and use an air conditioner, heat pump, or other refrigeration equipment refrigerant gas pressure test gauge

Air conditioner & heat pump refrigerant test gauges: this article describes the connections, use, and reading of a refrigerant gas pressure test gauge set. We describe the procedure for using test gauges when adding or replacing refrigerant: charging an air conditioner, heat pump, refrigerator with refrigerant gas. We explain how a refrigeration gauge set should be connected to HVAC equipment to avoid contamination damage and we review the refrigeration system evacuation and cleaning procedure. Also see REFRIGERANT PRESSURE READINGS. Readers whose air conditioners or heat pumps are not working properly should see LOST COOLING CAPACITY, also see REFRIGERANT LEAK REPAIR at our discussion of REFRIGERANTS & PIPING under AIR CONDITIONING & HEAT PUMP SYSTEMS.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

Details on Proper Use of the Refrigeration Charging / Testing Gauge Set to Keep Moisture & Dirt out of an Air Conditioner, Heat Pump, Refrigerator, Freezer, etc.

To keep moisture out of a refrigeration system, in addition to finding and fixing leaks, we need to know how to properly use a refrigerant gauge set with charging lines, and how to use cap off plugs on the charging fittings.

To be clear, when connecting an HVAC refrigeration gauge set to test fittings on an air conditioner or heat pump we must:

1. Connect the gauge set center supply tube to a canister of the proper refrigerant gas matching the refrigerant in the system being tested
2. Leave some positive pressure of refrigerant gases in each of the two gauge test connection hoses - the high pressure side and the low pressure side, so that when the gauge hose fitting is connected to the service port on the HVAC equipment no outside air or moisture are pushed into the system piping.

Refrigeration Servicing Gauge Set Installation & Use

Reading the Gauges on a Refrigeration Gauge Set

We use (and illustrate) a traditional Imperial System Analyzer gauge set that provides three charging lines (refrigerant canister, high side, low side). This is a diaphragm type gauge but other methods of measuring and charging systems are available.

How to Read the Low Pressure Side Refrigerant Gauge

The compound gauge at left is used on the low pressure side of the system and shows pressure readings in black, from 0 to 300 psi gauge pressure. *[Click any image to see an enlarged, detailed version.]*

Temperature corresponding to pressure is shown in red on this gauge for R12 and R22, or for newer refrigerants on newer gauges.

Vacuum is also shown on this gauge on a scale from 0-30 in. Hg. in green..

Reminder: as we discuss at REFRIGERANT PRESSURE READINGS if you use pressure test gauges (GAUGE, REFRIGERATION PRESSURE TEST) to measure the refrigerant pressure in the static or equalized air conditioning or heat pump system, the gauges only tell you the refrigerant pressure, not the quantity of refrigerant that is present in the system.

DIAGNOSE & FIX HEATING PROBLEMS-BOILER
DIAGNOSE & FIX HEATING PROBLEMS-FURNACE
DUCT SYSTEM & DUCT DEFECTS
DUCTS - Asbestos
DUCT INSULATION, Asbestos Paper
DUCT INSULATION for SOUNDPROOFING
DUCT SYSTEM NOISES
DUCTS, Asbestos Transite Pipe
DUST CONTAMINATION FROM HVAC?

EDUCATION, HVAC SCHOOLS
ELECTRIC MOTOR DIAGNOSTIC GUIDE
ELECTRIC MOTOR OVERLOAD RESET SWITCH
ELECTRICAL POWER SWITCH FOR HEAT
ENERGY SAVINGS in buildings
EVAPORATOR COIL or COOLING COIL
EVAPORATIVE COOLING SYSTEMS
EXPANSION VALVES, REFRIGERANT

FAN, AIR HANDLER BLOWER UNIT
FAN AUTO ON Thermostat Switch
FAN, COMPRESSOR/CONDENSER UNIT
FAN CONVECTOR HEATERS - HYDRONIC COILS
FAN LIMIT SWITCH
FAN NOISES
FURNACES WARM AIR HEATING SYSTEMS

GAS EXPOSURE EFFECTS, TOXIC
GAS DETECTION & MEASUREMENT
GAUGE, REFRIGERATION PRESSURE TEST

HEAT LOSS (or GAIN) in buildings
HEAT LOSS (or GAIN) INDICATORS
HEAT LOSS R U & K VALUE CALCULATION
HEAT PUMPS
HEATING SMALL LOADS
HOUSEWRAP AIR & VAPOR BARRIERS
HUMIDITY LEVEL TARGET

INDOOR AIR QUALITY IMPROVEMENT GUIDE
INSPECTION CHECKLIST - OUTDOOR UNIT
INSPECTION LIMITATIONS, A/C SYSTEMS

LIGHT, GUIDE to FORENSIC USE
LOST COOLING CAPACITY
LOW VOLTAGE TRANSFORMER TEST

MANUALS & PARTS GUIDES - HVAC
MOTOR OVERLOAD RESET SWITCH
MOLD in AIR HANDLERS & DUCT WORK
MOLD INFORMATION CENTER

NOISE AIR CONDITIONER / HEAT PUMP
NOISE / SOUND DIAGNOSIS & CURE

ODORS in AIR HANDLERS & DUCT WORK
OPERATING COST, AIR CONDITIONER
OPERATING DEFECTS, AIR CONDITIONING
OPERATING TEMPERATURES, AIR CONDITIONER

PORTABLE ROOM AIR CONDITIONERS
PRESSURE READINGS, REFRIGERANT

REPAIR GUIDE, AIR CONDITIONERS / HEAT PUMPS

For example at 70F ambient temperature and with R12 refrigerant, the static system pressure would be at 70 psi as long as there is enough refrigerant in the system to have at least some in liquid state.

Reading the High Pressure Side Refrigerant / HVAC Test Gauge

The compound gauge on the right of this gauge set is used on the high pressure side of the refrigeration system and shows refrigerant pressures, typically from 0 - 500 psi on the black scale or 0 - 35 KG/CM^3 on the outermost red scale.

In the center of the refrigerant gauge the red scales give temperature readings for three older refrigerants (this is an old gauge): R502, R12, and R22.

Attaching the Refrigeration Gauge Set to the Air Conditioner, Heat Pump, or other refrigeration equipment

Find the service ports

Central air conditioning systems, heat pumps, and split systems typically have service ports installed specifically for the attachment of test gauges for system inspection, evacuation, and charging.

Residential refrigerators, freezers, and window or portable air conditioners typically will not have these service ports. To service one of those latter devices you'll need to cut the refrigerant line and install (solder in place) a tee and a service port.

Our photo (left) shows four covered service ports on this split system compressor/condenser unit. That's because this unit supports two indoor wall-mounted cooling units.

If its not obvious to you that the larger diameter line is the low pressure or suction side and the smaller diameter refrigerant line is the high pressure side, then really you should not be messing with this equipment before taking a refresher class in HVAC servicing and repair.

Using Temporary Access Valves for HVAC or Refrigeration Testing & Diagnosis

Tapaline and other piercing valves are available in various sizes to allow the HVAC technician to tap into the refrigerant lines on a system in order to perform diagnosis where there are not already service valves installed. Smaller bullet-type valves are installed using an allen wrench.

Use these valves as a temporary service tool, preferably attached on the process tube. [See Types of air conditioner or heat pump compressors & compressor designs if you don't know what a process tube is.]

Watch out: do not leave these temporary test valves on the refrigerant piping - you're asking for a future leak. These valves are suitable to aid diagnosis of a refrigeration system by avoiding disturbing the troubled state of the system (as you'd do if you had to cut lines and solder in service valves just to do a test).

After using a temporary tap-in valve on the process tube at a compressor unit, you should solder off the line puncture and add a permanent service valve fitting - the type that uses a schrader valve and cap - also referred to as an access valve or line valve.

Connect the Test Gauges to the Air Conditioner, Heat Pump, etc

In the shop we connect both high and low pressure gauges to the equipment being tested. In the field we usually use only the low pressure side, since high side problems also show up on the low side.

On test gauge sets such as ours shown here, the service lines always open or close to the gauges. You'll notice in our photo that both ends of the refrigerant hoses are attached to the gauge set. On the front of this gauge are three blind connector plugs to which we connect the hoses when the gauge is not in use - this step is to help keep the gauge hoses clean of debris.

The gauge set has stop valve handles that you see on either side of the gauge. These controls open or close the high or low side service lines once they have been properly connected to the high or low side service port.

As we've mentioned before, we would not normally connect our gauge set to the service ports without first attaching a can of the proper refrigerant to the gauge set service port and then using that refrigerant to purge any air that may be in the refrigerant hoses. That's to avoid blowing air and contaminants into the HVAC system.

The low pressure gauge is connected to the low side of the system at that service port.

On our gauges we used a blue flexible hose on the low-side gauge, a red hose on the high side gauge, and a yellow hose on the center gauge service port just to help avoid any confusion in the field.

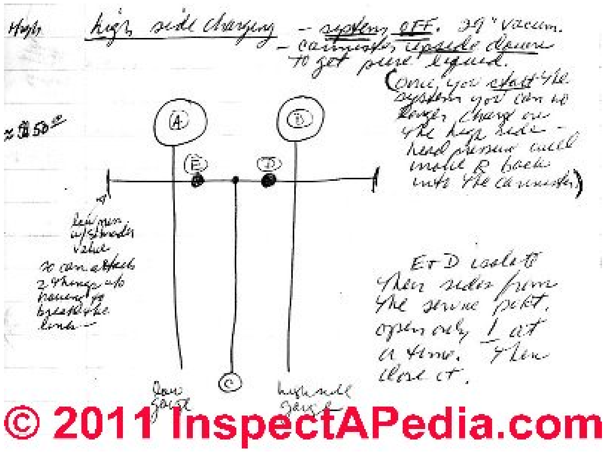
The high pressure gauge (red hose) is connected to the high side of the system at that service port.

The center service port on the gauge set is connected to a refrigerant canister, charging device, or to an evacuator pump, depending on what the HVAC technician needs to do.

Depending on which valves you open or close, this gauge set permits charging the refrigerant system on either the high side or the low side.

Refrigerant Test Gauge Hose Hookup Details

In our sketch below (A) is the low side pressure gauge, (B) the high side pressure gauge, (C) is the service line at the gauge center, connected to a refrigerant gas source or perhaps to an evacuator pump. (D) is the location of the high side gauge control valve and (E) is the functioning location of the low side control valve.



Watch out: Valves (D) and (E) are used to isolate their sides from the service port. Open only one at a time, then close it before opening the other.

1. Attach the refrigerant canister to the gauge set
2. Loosely attach the low side gauge (A) line to the low side service port. Assure that the service valve is turned all the way OUT
3. Open the refrigerant canister (C) and by opening the gauge valve (E - low side) purge the lines (do not use the system's refrigerant to purge the gauge lines)
4. Tighten the service line to the service port
5. Turn off the refrigerant gas canister supply
6. Turn the equipment service valve in slightly and run the system. The gauge(s) will indicate what the system is doing.

Watch out: as we warn at many places in this article series, do not send liquid refrigerant into the low side of a refrigeration system. Liquid refrigerant will enter the bottom of the compressor motor and can damage the compressor, or even if the compressor tolerates and passes the refrigerant through its pumping system, the refrigerant can carry away the lubricating oil from the compressor, and/or cause an air trap in the system.

We use the same procedure for attaching the gauges to the high side of the system.

Restating a bit:

For the gauge set shown above, turn the valves all the way out to attach the gauges, since service ports are stopped OFF.

Turn the gauge control valve all the way in (closed) to stop off the line to the evaporator/condenser (depending on which valve you are using).

Attach the gauge hose test line loosely to the test port;

Feed a small amount of refrigerant through the gauge test line and the charging line to purge any air. [NOTE that newer test equipment may provide other solutions for this step to avoid releasing *any* refrigerant to the atmosphere.]

Then tighten the connection of the test hose to the equipment service port.

To Remove the Service Test Gauges on Refrigeration Equipment

Back-seat (all the way out) the equipment service valve to close off the service port, then remove the gauge and cap both the service port and the test gauge hose ends.

Frequently Asked Questions (FAQs) About Refrigeration & Air Conditioning or Heat Pump Refrigerant Gas Pressure Test

Gauge Use

Question: what is a good R14 refrigeration pressure ? What should the refrigerant pressure be in my unit?

model cxa6 keeprite unit r14 refrigeration what psi pressure it should be good. - Litt 7/26/2011

what are the low and high readings for a 7.5 ton, 220 three phase compressor with two cooling coils and serves two inside units, mod BTA090C300H0, SER W01 195521 - rcannon49@att.net 8/2/11

Reply:

Litt

The pressure of any refrigerant will measure very differently depending on system operating status. At equalization pressure the LOW and HIGH sides will read the same, and as long as there is at least some liquid refrigerant in the system the pressure will be given by a temperature/pressure chart for that specific refrigerant.

If you scroll down to the list of article references below you'll see a link to a refrigeration pressure and temperature chart provided by Reece, an Australian company. That chart is missing R-14 refrigerant but at encyclopedia [dot]airliquide[dot]com[slash]Encyclopedia[dot]asp?GasID=61#VaporPressureGraph you can find that information.

You'll see that at 10 bars of pressure R14 will be at 185K or about -88 C - in other words readily boiling to a vapor at ambient pressures. At 40 bars the temperature will be 230K or -43C. For a working pressure/temperature chart for refrigerants at ambient and typical HVAC pressures I'd go to the unit manufacturer.
[dot]airliquide[dot]com[slash]Encyclopedia[dot]asp?GasID=61#VaporPressureGraph you can find that information.

I add that for R14, its Latent heat of vaporization (1.013 bar at boiling point) is 135.7 kJ/kg

One Bar is 0.06895 psi
One kJ/kg = 2.326 British BTUs/Lb

But I THINK that the question you are asking is what pressures will be seen on the HIGH and LOW sides of a refrigeration system using R14 refrigerant.
For any refrigerant, you have to consult the individual refrigerant pressure/temperature chart, note the temperature of your system and the measured HVAC-system running stable state suction pressure (LOW SIDE) evaporative data, and of course the running HIGH side for the compressor/condenser condensation pressure data.

Mr. Cannon

You need to consul the manufacturer's technical literature for the refrigerant gas in use and the compressor model in use, and then you'll need to use a table of gases that provides temperature and pressure data in one place, as ambient temperature affects the answer. In sum there is no single precise right number. There are typical operating ranges of refrigerant pressures, as you can see a REFRIGERANT PRESSURE READINGS. Also take a look at our answer to Mr. Litt, just above.

Question: what causes excessive refrigerant pressure?

what cause to much high pressure - Anonymouse

Reply:

Anon: among the reasons for excessively high pressure on the HIGH Side or output side of the compressor/condenser section of an air conditioner or heat pump are a plugged or debris blocked condensing coil, plugged refrigerant line, plugged dryer/filter on the line, or a stuck refrigerant metering device such as a capillary tube or thermostatic expansion valve. There may be other causes of high refrigerant pressure that other readers can add.

Question: High pressure readings on the low side of my heat pump

I am getting very high pressure readings on the low side of my heat pump. The discharge and return line to the air handler are cool and equal in temp.(showing no refrigerant movement), But my suction line and discharge line leading in to and out of my compressor are very hot. Have open the lines and checked the orifices and they are clear as is the lines to the air handler. Is it possible that the condensing alone can be clogged? I did have a compressor burn out last year. - D. Nix 8/7/11

Reply:

High pressure on the low side sounds to me as if a metering device is stuck wide open; perhaps when your compressor burned up last year it left some debris in the refrigerant lines that has found its way to the TEV and has jammed it. Ask your HVAC tech to check the system again, check the TEV adjustment, and also consider installing a (new) filter/drier on both ends of the refrigerant piping system.

Question: can a refrigerant gas leak be fixed or does the whole compressor need replacement?

I need to know whether a leak form one of the compressor tubes is fixable or not. My technician said that the whole compressor would need to be replaced. - Ehab 8/176/11

Reply:

Ehab refrigerant leaks can be repaired by various patch methods. But if the leak is discovered to be a symptom of more extensive corrosion, such as at a cooling coil, it's a much bigger repair than just a patch. I'm not sure why, if the compressor was working normally, you'd need to replace all the equipment- perhaps the tech is referring to the issue that s/he cannot any longer recharge with R12 or R22 - used in older compressors, but there are alternative refrigerants that can often work with some adjustments.

Question: Comment on hose color coding; How do I know if the HVAC Tech Put In Enough Refrigerant?

Blue line goes to bigger line in compressor and red on little line
For high side - Anon 10/6/11

Hello, For a typical home split air conditioner, how to make sure that the technician has filled in enough gas in the out door compressor unit? - Sanjay 7/21/2012

Reply:

Sanjay, without evacuating the air conditioner completely and putting in a precisely measured charge using gauges and metering equipment, you cannot know yourself exactly how much refrigerant is in the system. But there are indications of the refrigerant charge being too much or too little that can show up without sophisticated instruments. For example:

- if you hear a bubbling sound in the liquid line the charge may be low

- if you see bubbles in the sight glass (usually only found on commercial refrigeration equipment and on some residential air conditioner or heat pump systems) the charge may be low

- if the cooling coil is frosting over one of the causes is low refrigerant charge

- if the compressor makes a horrible clanking sound and then stops dead, one of the possible causes is overcharging or another problem (such as a failed TEV or other refrigerant metering control) that has caused liquid slugging of the compressor on the suction side.

Beyond these observations, you need to be able to trust your HVAC technician. While mistakes are of course possible, no service tech any credible motive for placing an improper refrigerant charge into the system. Doing so just makes more work and trouble for everyone.

Questions & Answers regarding this article

Comments

name

enter your comment here

comment

(July 28, 2012) DanJoeFriedman (mod) said:

Sanjay I've added our reply at the end of the FAQs above.

(July 23, 2012) Sanjay said:

Hello, For a typical home split air conditioner, how to make sure that the technician has filled in enough gas in the out door compressor unit?

Pl help

Recommend / Share this Article

+1 ShareThis

EMAIL

Print

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also include a list of recommended books for the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

- CARSONDUNLOP Carson, Dunlop & Associates Ltd., 120 Carlton Street Suite 407, Toronto ON M5A 4K2. (416) 964-9415 1-800-268-7070 info@carsondunlop.com. The firm provides professional home inspection services & home inspection education & publications. Alan Carson is a past president of ASHI, the American Society of Home Inspectors. Thanks to Alan Carson and Bob Dunlop, for permission for InspectAPedia to use text excerpts from *The Home Reference Book* & illustrations from *The Illustrated Home*. Carson Dunlop Associates' home inspection education products include
  - The ASHI-adopted Home Inspection Training Program, and Commercial Building Inspection Courses
  - The Home Inspection Home Study Course, and publications such as
  - The Home Reference Book, a reference & inspection report product for building owners & inspectors
  - The Home Reference *eBook*, an electronic version for PCs, the iPad, iPhone, & Android smart phones
  - Home Inspection Report writing materials, including the Horizon Software System that manages business operations, scheduling, & inspection report writing using Carson Dunlop's knowledge base & color images. The *Horizon* system runs on always-available cloud-based software for office computers, laptops, tablets, iPad, Android, & other smartphones.
  - The Illustrated Home illustrates construction details and building components, a reference for owners & inspectors
- TIF Instruments, Inc., 9101 NW 7th Avenue, Miami, Florida 33150 (This is where we've sent our TIF 8800 and TIF 5000 for repairs).
- Jennifer Moore, Sales Administrator, Nextteq, LLC, Tampa FL, www.nextteq.com 813-249-5888. Nextteq is the master Distributor for Gastec in the United States. According to the company's website, Gastec Gas Sampling Pumps are the industry's first and only pumps to provide on-the-spot measurement of ambient temperature.

[Private email, JM to DF 5/23/08]

- "Choosing and Using a Carbon Monoxide CO Monitor," Dan Friedman, *The ASHI Technical Journal*, Vol. 2 No. 1, July1991
- "Heat Exchanger Testing, Who's Right?" Dan Friedman, *The ASHI Technical Journal*, Vol. 2 No. 1, July1991
- "Case History: LP Gas Leak - Using the TIF 8800," Dan Friedman, *The ASHI Technical Journal*, Vol. 2 No. 1, July1991
- Refrigeration Temperature & Pressure Chart, web search 07/27/2011, Reece National Support Centre 118 Burwood Highway Burwood Victoria 3125 Australia. The company also has offices in New Zealand. Phone: +613 9274 0000 Fax: +613 9274 0198, original source: http://www.reece.com.au/plumbing/techtools/refrigerant - quoting from Reece:

  Reece is Australia's leading supplier of bathroom and plumbing products with over 400 stores across the country including our market leading Bathroom Life™ showrooms. We also cater for more specialised industries through our Irrigation, hvac-r and Civil businesses as well Onsite which services commercial plumbers and volume home builders.
- Refrigeration temperature & pressure chart for R-14, R14, tetrafluoromethane, also referred to as CF4, web search 07/27/11, original source http://encyclopedia.airliquide.com/Encyclopedia.asp?GasID=61#VaporPressureGraph
- Carbon fluoride; Freon 14; Perfluoromethane; Carbon tetrafluoride; Halocarbon 14; R 14; PFC 14 are synonyms for R14 refrigerant.

How to diagnose and fix an air conditioning system that is not working

Since the failure of an air conditioner to turn on, loss of air conditioner cooling capacity, reduced air conditioning output temperatures, loss of cool air supply, or even loss of air flow entirely can be due to a variety of problems with one or more components of an air conditioner or air conditioning system, *after reviewing the lost air conditioner cooling diagnosis procedures described in this article,* be sure to also review the diagnostic procedures at each of the individual air conditioning diagnosis and repair major topics listed just below. To return to our air conditioning and refrigeration home page go to AIR CONDITIONING & HEAT PUMP SYSTEMS.

If your air conditioning or heat pump system has lost its cooling capacity or won't start select one or more of the diagnostic articles listed below.

- A/C - HEAT PUMP CONTROLS & SWITCHES: air conditioner controls and switches - begin here if your A/C won't start. Here's an important tip: *most refrigeration problems, in air conditioners, refrigerators, or freezers, are electrical, not mechanical.* In air conditioning school, we used to drive out and collect abandoned refrigerators that people were tossing out during our community's spring cleanup week. Taking these appliances back into the shop we found that almost always the problem that had caused the owner to dispose of their air conditioner or freezer was in an electrical connection or electrical control. So it's worth checking out switches and controls on an air conditioner before replacing more costly components.
- OPERATING DEFECTS: major air conditioning problem symptoms and how to get the air conditioning system working again,e.g. compressor or fan noises, failure to start, and inadequate cool air volume
- LOST COOLING CAPACITY: what to do when not enough cool air comes out of the system
  - What to check first if there is no cool air or not enough cool air
  - Compressor failure diagnosis: basic checks of the air conditioner compressor
  - Ducts & Air Handler diagnosis: basic checks of the indoor air handler (blower), air ducts, and filter systems
- COMPRESSOR CONDENSER: problems with air conditioner compressor/condenser units
- AIR HANDLER UNIT: problems with the air handler, air filters, and the cooling coil itself

- DUCT SYSTEM DEFECTS: problems with the air duct system, air filters, supply registers, return air registers
- A/C REFRIGERANT LEAK DETECTION: how to use a TIF5000 to detect air conditioning refrigerant gas leak
- REFRIGERANT LEAK REPAIR - how to repair refrigerant leaks in piping, evaporator coils, condenser coils
- A/C DIAGNOSTIC FAQs: air conditioning system diagnostic FAQs: Q&A about air conditioner repair - a detailed air conditioning system diagnostic checklist

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- GAS EXPOSURE EFFECTS, TOXIC Toxic Gas Exposure effects, including links to toxic gas exposure screening and gas testing protocols.
- Gases: Toxic gases, indoor exposure levels, testing, identification
  - A Toxic Gas Testing Plan: A Gas Sampling Plan for Residential and Commercial buildings lists some of the toxic indoor gases for which we test, depending on the building complaint and building conditions
  - Gas Exposure Hazard Levels: for Toxic Gas Exposure to Ammonia, Arsine, Arsenic, Bromine, Carbon Dioxide, Carbon Monoxide, Hydride, Ozone - allowable exposure levels and hazard levels
  - Carbon Dioxide Gas Toxicity hazard level, poisoning symptoms, & testing
  - Carbon Monoxide Gas Toxicity hazard levels, poisoning symptoms, & testing
  - Formaldehyde: US EPA. UFFI (Urea Formaldehyde Foam Insulation) was previously considered a hazard (formaldehyde outgassing). Subsequent research virtually closed concern regarding this material; however formaldehyde appears to remain a health concern for sensitive individuals.
  - Ozone Warnings -
    NEW!
    Use of Ozone as a "mold" remedy is ineffective and may be dangerous.
  - Sampling for gases in air such as VOC's, MVOC's, toxic chemicals, and combustion products. Unfortunately no single test or tool can detect all possible building contaminants. We use methods and equipment which can test for common contaminants. If the identity of a specific contaminant is known in advance we can also test for a very large number of specific contaminant gases in buildings.
    We use gas sampling equipment provided by the two most reliable companies in the world, Draeger-Safety's detector-tubes and Drager accuro bellows pump, the Gastec cylinder pump and detector-tube system produced by Gastec. We also have used gas detection tubes by Gastec previously marketed for use with Sensidyne pumps but Sensidyne pumps now use Kitagawa gas detection tubes. We also use Sensidyne's Gilian air pump. For broad screening for combustibles and a number of other toxic gases and for leak tracing we also use Amprobe's Tif8850 and 8800, and the TIF 5000 automatic halogen leak detector (for air conditioning and cooling system refrigerant leak detection). All of these instruments, their applications, and sensitivities (minimum detectable limits) for specific gases are described in our Gas Sampling Plan online document.
  - Radon Gas U.S. EPA Radon level maps
- ...

Mobile View
AIR CONDITIONING & HEAT PUMP SYSTEMS

A/C - HEAT PUMP CONTROLS & SWITCHES
A/C DATA TAGS
A/C - HEAT PUMP CRITICAL DEFECTS
A/C DIAGNOSTIC FAQs
A/C REFRIGERANTS
A/C TYPES, ENERGY SOURCE
AGE of AIR CONDITIONERS & HEAT PUMPS
AIR CLEANER PURIFIER TYPES
AIR CONDITIONER BTU CHART
AIR CONDITIONER COMPONENT PARTS
AIR CONDITIONER TYPES, ENERGY SOURCES
AIR CONDITIONER NOT WORKING
AIR FILTER EFFICIENCY
AIR FILTERS, FIBERGLASS PARTICLES
AIR FILTERS for HVAC SYSTEMS
AIR FLOW MEASUREMENT CFM
AIR HANDLER / BLOWER UNITS

Air Conditioning & Heat Pump Compressor/Condenser Unit: inspection, diagnosis, repair or replacement guide

InspectAPedia® - ShareThis +1

- Guide to troubleshooting an air conditioner or heat pump compressor/condenser unit
- How does an air conditioner compressor and condensing coil work?
- What is the "Compressor" unit in an air conditioner or heat pump system?
- What are the components of the outdoor compressor/fan-coil unit on an air conditioner?

- Air conditioner or heat pump compressor motor crankcase heaters
- Air conditioner compressor problem diagnosis & repair guide
- Air conditioner condenser compressor fan diagnosis & repair
- Loss of air conditioner or refrigerator cooling capacity
- Types of air conditioner or heat pump compressors & compressor designs
- When is an air conditioner or heat pump compressor or fan/coil unit at or near end of its life?
- Questions & Answers about HVAC compressors & condensers: the condensing unit

Air conditioner compressor unit diagnosis & repair guide: this article discusses the *outdoor* components of air conditioners and heat pumps: how the air conditioning compressor-condenser unit works; the detection of defects in air conditioning compressor and condensing units, including evaluation of air conditioner compressor noises, hard starting, lost cooling capacity, and detection of a burned out compressor or A/C compressors at or near end of their life. Maintenance tips including attention to compressor support pads and avoiding air conditioning refrigerant leaks are also addressed.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

 Use page top links to major topics or use links at the left of each page to navigate ***within*** topics and documents at this website. Green links show where you are in a document series or at this website.

How do Air Conditioning Compressor / Condenser Units Work?

What is the "Compressor" unit in an air conditioner or heat pump system?

In a nutshell, the air conditioner compressor, condenser, fan unit is the "outdoor" half of an air conditioning or heat pump installation that uses a compressor motor (below right) to compress refrigerant gas to high pressure, sending the pressurized gas through cooling coils (condensing coils) where aided by air movement drawn by the condenser unit fan, the gas is returned to a liquid refrigerant state. The process of compressing and then condensing the refrigerant back from a gas to a liquid also moves heat out of the refrigerant and into outdoor air. We explain this process in detail below.

The outdoor half of a typical air conditioning system (shown at below left) is a unit containing the refrigerant compressor and condensing coil and a cooling fan. In our photo the gray screened area covering one side of the condensing coil of the first compressor in this row is easily visible. The compressor motor itself (below-right) is not visible unless the covers of this unit are removed.

Do I Need a New A/C or Heat Pump Compressor Unit?

Watch out: before assuming that the compressor motor or the entire HVAC compressor/condenser unit needs replacement, be sure you (or more likely your trained, qualified HVAC repair technician) has checked for simple and lower-cost problems such as a bad start/run capacitor, contactor relay switch, control board, or even just a loose wire or similar component.

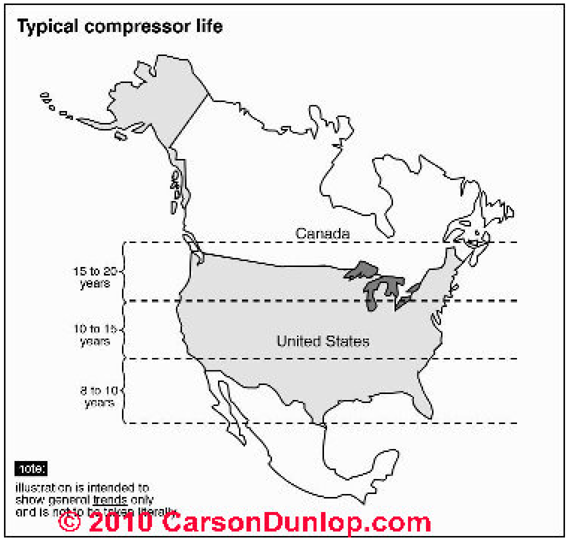
What is the Average Life of an Air Conditioning or Heat Pump Compressor ?

Just how long should an air conditioning or heat pump compressor unit or motor last?

There is not a single right answer. The typical life of an A/C compressor ranges from 10-20 years, as you can see in Carson Dunlop Associates' sketch at left.

But besides the climate (how hard and how many days a year the compressor unit has to work), other factors can be very important including

- Compressor/condenser location: putting the unit where air flow is blocked causes the system to work harder, increases operating costs, and reduces compressor motor life
- Failure to install inspect, maintain, and repair the equipment



can include factors that reduce compressor life such as

- Liquid slugging of the compressor by an improper refrigerant charge or by a misadjusted thermostatic expansion valve
- Improperly routed or sloped refrigerant tubing, loss of lubricating oil
- Dirt in the system, for example following replacement of a burned-out compressor motor
- Frequent low voltage conditions at the electrical power supply
- A bad start-run capacitor leaving the compressor spending lots of time trying to start its motor
- Other A/C or heat pump compressor/condenser unit problems listed in our detailed repair guide (page left links under COMPRESSOR & CONDENSING COIL, A/C)

See INSPECTION CHECKLIST - OUTDOOR UNIT for a simple checklist for the outdoor compressor/condenser unit. Also see DIAGNOSE & FIX AIR CONDITIONER / HEAT PUMP where we include some suggestions for diagnosing compressor or condenser fan and coil problems that can mean intermittent or totally lost cooling capacity of your system. Initial, simple diagnostic checks of the air conditioning compressor are also described at Compressor failure diagnosis. For a discussion of the *indoor* components of an air conditioning or heat pump system see AIR HANDLER / BLOWER UNITS.

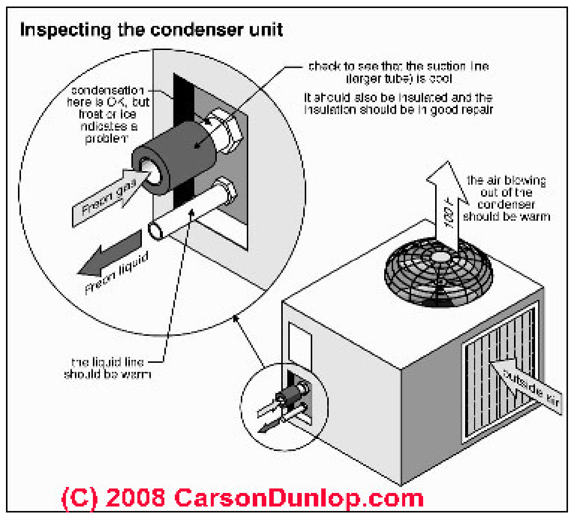
If your air conditioning or heat pump system has lost its cooling capacity or won't start see REPAIR GUIDE for AIR CONDITIONERS. See How to determine the cooling capacity of air conditioning equipment if the system seems to be working but is inadequate to cool your building. Contact us to suggest text changes and additions and, if you wish, to receive online listing and credit for that contribution.

Even with the covers off you wont' see much of the actual air conditioner compressor motor: A/C compressor motors in residential and most commercial systems are hermetically sealed motors - that is, the motor is encased in a sealed steel can - all you'll see is a black metal container with metal (usually copper) tubing and some wires running to it.

That's the compressor motor. In our illustration of a hermetically-sealed residential compressor motor (above right), the smaller cylinder to the right of the compressor is a filter/dryer built onto this replacement unit.

Below we will sketch the internal parts of this air conditioner compressor motor.

How the Air Conditioning Compressor/Condenser Unit Works to Move Heat from Indoors to Outside



The A/C Compressor: The air conditioning compressor motor is a pump which draws *sensible heat laden refrigerant gas* from the building's indoor components (evaporator or "cooling coil" in the indoor air handler) through the larger diameter refrigerant suction line into the compressor where that pump compresses the low pressure refrigerant gas to high pressure and higher temperature.

Raising the coolant (refrigerant) temperature above outdoor ambient temperature causes heat to flow from the coolant (flowing out of the compressor and through the outdoor A/C condenser coil) into outdoor air. (Heat always flows from warmer to cooler substances).

Sketch courtesy of Carson Dunlop Associates.

As we explain at THERMOSTATIC EXPANSION VALVES, it is the *flow restriction* provided by a cap tube or by a TEV in the refrigerant piping system that allows the A/C compressor pump to raise the system pressure and thus increase the temperature at which the coolant changes state. In other words, the TEV or cap tube allows the compressor to reduce refrigerant pressure on the LOW side of the metering device and raise refrigerant pressure on the HIGH side of the metering device.

Incidentally, A/C compressors can only accept and compress refrigerant in *gas* form. In fact the refrigerant vapor is *superheated* to be sure that there is no liquid at the pump - lest the pump be damaged. If liquid refrigerant were to flow into the compressor motor it would most likely cause catastrophic damage.

The A/C Condenser: The high pressure high temperature refrigerant gas leaves the outdoor compressor and enters the outdoor condensing coil where it is cooled to a liquid state by the condensing unit fan that blows outside air across the condensing coil or by immersion of the condensing coil in cooling water in some designs.The heat produced in these steps is transferred to the outside by a fan which blows outside air across the condensing coil. The liquid refrigerant is then able to return to the indoor components for cooling and dehumidifying the building interior.

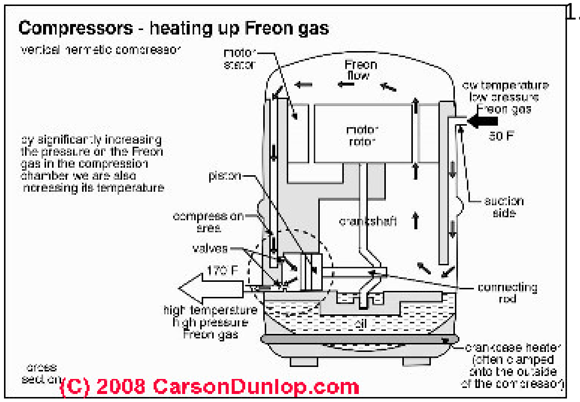
Definition of an Air Conditioner or Heat Pump

An air conditioner or heat pump compressor is a basically a motorized pump which moves refrigerant *gas* from the indoor cooling coil (where it has evaporated to cool indoor air blowing over that coil) to the outdoor compressor/condenser where the gas is compressed and cooled back to a liquid form. Refrigerant gas moves from the indoor air handler cooling coil to the outdoor compressor via the larger refrigerant "suction line". Liquid refrigerant returns from the outdoor compressor/condenser to the in-building air handler and evaporator coil. Evaporating liquid refrigerant inside the indoor cooling coil cools and dehumidifies indoor air. Condensing refrigerant gas outdoors at the compressor/condenser effectively is moving heat from indoors to the outdoor air. [During heat pump "heating" cycles the process is reversed, moving "heat" from outdoor air to the indoor coil.]

The diagnosis and repair of various defects in the air conditioning compressor/condenser unit are discussed in detail using the links provided at the left of this page. Here is more detail about the components of the air conditioner or heat pump compressor/condenser unit:

Heat pumps are described separately and in more detail at HEAT PUMPS.

What are the Components of the Outdoor Portion of a Central Air Conditioning System - the Air Conditioning Compressor Unit?



1. The Air Conditioning Compressor Itself - on residential units the A/C compressor motor is most often a hermetic motor-compressor combined in a single sealed unit like the Carrier™ unit shown at left.

   You cannot actually see the individual A/C compressor parts because at least on residential air conditioners or heat pumps, the entire assembly is enclosed. Sketch from Carson Dunlop Associates.

   If a ductless split-system air conditioner is installed an outside compressor unit is still required, typically looking like the Sanyo™ unit shown at the top of this page.

If a "portable" indoor air conditioner is in use, all of these parts may be inside of a single portable cooling unit, usually mounted on wheels. Portable air conditioner units use a duct and fan system to blow to outdoors the heat that has been extracted from indoor air.

Window air conditioners also contain all of these parts in a single unit, but by hanging the window unit in a window or in a wall opening, the device has ready access to outdoor air into which it ultimately is transferring heat from indoors.

How does an air conditioning compressor motor work?

The job of the compressor/condenser unit is to recompress warm refrigerant gas (pulled from the indoor air handler cooling coil) back to a liquid refrigerant that can be returned to the indoor cooling coil once again. When the room thermostat calls for cooling, both the indoor blower or air handler and the outdoor compressor/condenser begin to work. Control circuits and a contactor relay turn on the outside compressor/condenser motor and its outdoor cooling fan as well.

The air conditioning or heat pump compressor compresses the incoming refrigerant to a high pressure gas and moves that gas into the condensing coil described just below. Typically a piston moves up and down inside of a cylinder inside the compressor motor, drawing in refrigerant gas on the down stroke of the piston, and compressing the refrigerant gas on the up stroke of the piston. (Some refrigeration compressors such as those made by Frigidaire™ used a rotary compressor design that we found durable and powerful enough to lead us to salvage and re-use these motors for other purposes.

The refrigerant gas leaves the compressor at high pressure and at high temperature (since compressing a gas will raise its temperature). In most air conditioning or heat pump compressors, a piston moves up and down to draw in and then compress refrigerant gas, moving refrigerant vapor from the incoming *low side* to the outgoing *high side* of the compressor.

The refrigerant gas leaving the compressor (and entering the condensing coil) will contain both heat that the refrigerant absorbed at the evaporator coil (heat from air in living space of the building), and additional heat produced at the compressor by the process of compressing the gas. The refrigerant gas is thus *heat laden* with *sensible heat* (heat that we can measure) from the living area and compressor heat from the compressor motor.

Low side and *high side* refer to the low-pressure and high-pressure areas of the air conditioning equipment and are defined in more detail at SEER RATINGS & OTHER DEFINITIONS where we also explain *sensible heat* and other air conditioning terms.

Refrigeration and Air Conditioning Theory: In an air conditioning system, *pressure* is used to change (increase) the vaporization point (state change from liquid to gas) or condensation point (state change from gas to liquid) of the refrigerant. On the A/C system's *high side* (high refrigerant gas pressure side of the system), the condensation point must be some temperature above ambient outdoor air temperature (if air is being used to cool the condensing coil) or condensation of the refrigerant gas back to a liquid will not occur.

Creation of high side & low side in a refrigeration system: The restriction in refrigerant flow created by the *thermostatic expansion valve* (TEV, discussed below) [or on many systems simpler CAPILLARY TUBES] located close to the evaporator coil (cooling coil) allows the compressor to raise the pressure and increase the temperature at which the refrigerant (coolant) will change state (from liquid to gas in the cooling coil, and from gas back to liquid in the condensing coil).

This restriction in refrigerant flow at the TEV is what allows the compressor a pressure difference between the high side and low sides of the system. Evaporator coil is defined at A/C COMPONENTS and discussed further at AIR HANDLER / BLOWER UNITS. TEVs, AEVs, manual and adjustable expansion valves, and float valves are discussed at THERMOSTATIC EXPANSION VALVES. Capillary tubes for metering refrigerant are discussed separately at CAPILLARY TUBES.

Room air conditioners such as window or through wall mounted units, and some other refrigeration equipment such as a home refrigerator, use a capillary tube (cap tube) instead of a thermostatic expansion valve. A cap tube is simply a small diameter tube used to meter liquid refrigerant from the "high" side of the system into the cooling coil (the start of the low side of the system). Unlike a TEV, a cap tube is fixed in output and cannot be adjusted.

State changes of refrigerant are what remove heat: Refrigeration systems rely on two state changes of the refrigerant: gas to liquid, and liquid back to a gas. It is these state changes of the refrigerant that move sensible heat from one side of the air conditioning system to the other: by absorbing BTUs of heat during evaporation (in the evaporator coil) and by releasing BTUs of heat during condensation (in the condenser coil).

R12 refrigerant has a boiling point of -21 degF (change of state from liquid to gas vapor) and R22 has a boiling point of -41 degF.

State change of refrigerant gas to liquid: The state change of the air conditioning refrigerant from a high pressure high temperature gas back to a liquid occurs inside the outdoor condensing coil. This state change (gas to liquid) releases energy in the form of heat which is blown into outdoor air (or transferred into water). Note: the compressor has to produce high enough output pressure that the gas moving through the condensing coil moves at a good velocity in order to scrub the entire condensing coil tubing surface and thus transfer its heat out through the condensing coil tubing into ambient air (or water).

State change of refrigerant liquid to gas: the state change from a liquid refrigerant to a low pressure gas occurs in the indoor evaporator or cooling coil, absorbing energy in the form of heat (the heat in indoor air being blow across the evaporator coil), thus moving heat from the indoor air into the refrigerant gas in the system. For example, R12 changes state at -21 degF; R22 changes state at -41 degF.
Watch out: use safety glasses when handling refrigerant gases. Getting a liquid refrigerant in your eye can cause serious permanent eye damage.

So summing up this theory and practice of air conditioning, the job of the air conditioning compressor is to reduce pressure on the low side (cooling side) of the system and to increase pressure on the high side (warming side) of the system. These pressure differences move refrigerant through the system and enable it to change states from liquid to gas (at the TEV and in the evaporator coil) and from gas to liquid (in the condensing coil). This process moves heat (absorbed by the evaporator coil inside the cooling or refrigerated area) through the condenser coil and into outside air (or water).

Special oil used in air conditioning & refrigeration compressor motors

Air conditioning and refrigeration compressors use a special oil which does not react with the refrigerant liquid or gas in the system. The oil may mix and travel with the refrigerant however, and some cooling systems are designed for deliberate movement of the compressor oil in order to lubricate some parts such as refrigerant metering valves or compressor valves.

2. Refrigerant lines:

   The larger diameter refrigerant suction line connects the indoor evaporator coil outlet to the compressor inlet. The larger refrigerant line (located on the *low side* of the system) reduces system pressure and causes vaporization of the refrigerant (so that sensible heat is absorbed and the suction line feels cool to the touch). Refrigerant returning to the compressor from the evaporator coil and through the refrigerant low pressure suction line, is in the form of a low pressure, low temperature gas.

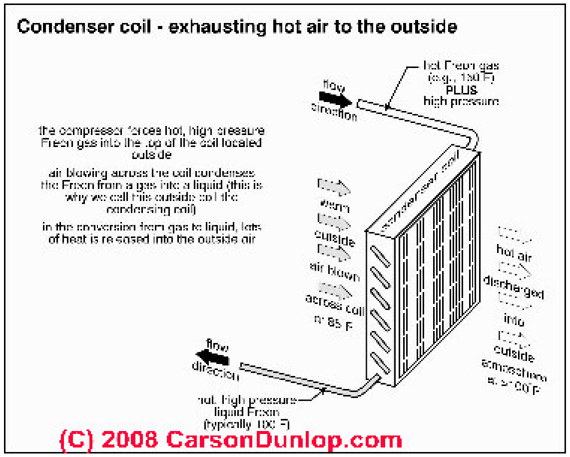
   Most air conditioning compressors are designed only to pump gas vapors, not liquid refrigerant (which could damage compressor internal parts).

   The refrigerant gas entering the compressor at its inlet port is said to be *heat laden*, that is, it was at a low-enough temperature to have absorbed heat from the evaporator coil in the living area.

   The smaller-diameter high pressure refrigerant lines connect the compressor outlet and the condensing coil inlet and also move refrigerant liquid in it's cooled, condensed and now liquid state from the outlet of the condensing coil to the thermal expansion valve (basically a refrigerant metering device) and the evaporator coil inlet in the air handler unit in the building. This smaller (in diameter) refrigerant piping or tubing (located on the *high side* of the air conditioning system) reduces volume and thus increases pressure and temperature in the lines (so that sensible heat can be transferred to ambient outdoor air or water if a water-cooled air conditioner system is in use).

   Service valves or ports are usually present on the refrigeration lines near the compressor. to permit testing the condition of the air conditioning system and permit removal, replacement, or additions to the refrigerant in the system.

3. Condensing coil (shown at left) receives high pressure refrigerant gas from the compressor and cools this refrigerant gas back to a liquid state. Sketch from



Carson Dunlop Associates.

Typically refrigerant leaves the compressor and enters the outdoor condensing coil at about 100 psi and about 95 degF. These pressures vary of course by type of refrigerant, ambient temperatures, compressor details, etc.

4. Outdoor cooling fan moves outdoor air across the condensing coil to cool it and assist in condensing the high pressure, high temperature refrigerant gas back into a liquid.

   It is this process which completes the transfer of heat through the refrigerant from indoor air to outdoor air as the compressor/condenser unit compresses and then cools the refrigerant back to a liquid.

   See FAN, COMPRESSOR/CONDENSER UNIT for help in diagnosing and fixing problems with the outdoor compressor/condenser *fan and fan motor.*

   Watch out: as we explain at BURNED-OUT COMPRESSOR, if the condensing unit fan is not working the compressor itself may shut down or even be ruined by overpressure or over temperature. Also see NOISES, COMPRESSOR CONDENSER where some noise problems are traced to the cooling fan .

5. Electrical shut-off switch(es) for service at the unit are provided to permit maintenance and repair of the equipment. Below we describe the basic electrical switches and controls on air conditioners and heat pumps. See A/C - HEAT PUMP CONTROLS & SWITCHES for details.

   Circuit breaker(s) at the electrical panel protect the circuit supplying power to the air conditioning system. Typically separate circuit breakers (or fuses) power the compressor/condenser unit and the indoor air handler/blower assembly.

Air conditioner / heat pump control circuit board (typically a "control board" shown in our photo at left) and a contactor relay (shown in our photo below) are used in the compressor/condenser to turn it off and on in response to the indoor thermostat's call for cooling.

While diagnosing a circuit or component problem *within* an air conditioner or heat pump control board is beyond the skill of most homeowners, a simple visual inspection might show you that the control board has been visibly burned, broken, or damaged. Of course the board may *look* OK and still be damaged.

See CONTROL CIRCUIT BOARD, A/C for details.

A/C heat pump Contactor Relay: A/C and heat pump systems use a *contactor relay* (circled at left) because the little

12-24V wall thermostat circuit and switches are not capable of handling the higher voltage used by the compressor/condenser motors.

The contactor relay is basically a low-voltage-operated switch [typically 12-14 volts] controlled by the low-voltage room thermostat) that switches a heavier-duty electrical relay to give 120V or 240V electrical power to the compressor/condenser unit.

Most A/C and heat pump contactor relays use an electromagnetic 24-volt two-pole contactor relay that is rated for 30 amps. The "two poles" simply means that the relay switches two electrical wires simultaneously - which is what you'd expect if your heat pump motor is running on 240 Volts.

See details at CONTACTOR RELAY DIAGNOSIS & REPAIR

Also see A/C - HEAT PUMP CONTROLS & SWITCHES

Watch out: Some of our readers report successfully replacing minor electrical components such as switches, relays, and contactors. But unless you are qualified to do so we do not recommend trying to do work on electrical systems and components in your home as there are potentially fatal electrical shock hazards. Because air conditioner compressor/condenser units include start/run capacitors (see CAPACITORS for HARD STARTING MOTORS), even when you have turned off power you can get a nasty shock if you're not careful.

Also see SAFETY for ELECTRICAL INSPECTORS and Using DMMs & VOMs Safely.

HVACR Compressor Motor Crankcase Heater Warnings

6. Air conditioner or heat pump compressor motor crankcase heaters:

   A crankcase heater is used to warm an air conditioner or heat pump compressor motor to help protect against liquid slugging damage to the compressor and to assure that lubrication oil residing in the compressor motor base will be distributed properly when the compressor motor first starts operation. Not all compressor models use a crankcase heater. For models that do use a crankcase heater to permit system operation without damage at lower temperatures, manufacturers give power-on requirement warnings such as the following:

   Furnish power to crankcase heater a minimum of 24 hr before starting unit. To furnish power to heater only, set thermostat to OFF and close electrical disconnect to outdoor unit. NOTE: On 24ANA7 models, starting the compressor without a minimum of 12 hours of crankcase heat prior to initial start--up may result in a compressor chattering noise and possible damage to the compressor. [2]

All of the above-listed air conditioner or heat pump components are discussed in detail throughout this website using the links at the left of these pages.

Air Conditioner or Heat Pump Compressor Unit Safety, Damage, & Environmental Warnings

Using Carrier installation instructions for the Carrier 24ANA unit as an example [2] and quoting:

[Compressor/Condenser] Unit Operation & Safety Hazard

Failure to follow this caution may result in minor personal injury, equipment damage or improper operation. To prevent compressor damage or personal injury, observe the following

- *Do not overcharge system with refrigerant.*
- *Do not operate unit in a vacuum or at negative pressure.*
- *Do not disable low pressure switch*
- *Dome temperatures may be hot in scroll and bottom temperatures may be hot in recip.*

  Environmental Hazard Warnings - Failure to follow this caution may result in environmental damage.

  Federal regulations require that you do not vent refrigerant to the atmosphere. Recover during system repair or final unit disposal.

Minimum Air Conditioner Compressor Unit Observations for an Air Conditioner Home Inspection Report

Example home inspection report language for an air conditioning compressor:

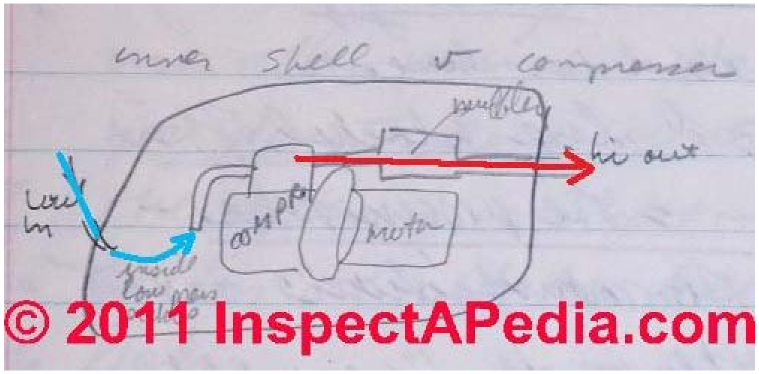
- The compressor and fan operated normally.
- The rated cooling capacity, estimated age and general condition of the unit are reported below.

  OR

- We did not operate this equipment because ... Therefore you should ...
  [... explanatory text inserted by inspector]

Types of air conditioner or heat pump compressors & compressor designs

Sealed Compressors



Sealed air conditioning or heat pump compressors enclose both the driving electric motor and the mechanical compressor engine itself within a hermetically sealed "can".

Sealed compressors cannot be opened for repair in the field and are normally replaced entirely when needed.

The diagnosis of a sealed compressor relies on external observations and measurements such as current draws (amps) of the compressor motor and the operating pressures the equipment can achieve.

While a sealed hvac compressor unit can't be field-repaired, the unit can be replaced as an entire system, and in some cases the damaged unit can be traded in for an allowance on the replacement compressor.

What are those three tubes seen welded or soldered to the hermetically sealed HVAC compressor can? There are three tubes you'll find on a typical sealed compressor unit:

1. A suction line (generally larger in diameter - low side line) - receives low pressure refrigerant gas from the cooling coil
2. A condenser line (generally smaller in diameter - high side line) - sends high pressure refrigerant gas as compressor output to the condensing coil
3. A third line, blocked off, not used in the field - the process tube. This tube is used by the manufacturer of the compressor unit to test and charge the system.
4. 5-port HVAC or refrigeration compressors: include a low side, high side, and process tube and two more tubes that send oil through an oil cooler or oil cooler condenser. The oil cooler condenser lines will always be close together and close to the bottom of the unit (to pick up oil to be cooled) - that's how you can identify which of those tubes coming in and out of the sealed compressor are doing which jobs.

Watch out: if you are carrying a refrigerator or freezer in other than upright position, that is if you have to place the unit on its side, place it so that the low side (suction side) refrigerant lines are facing "up" so as not to drain oil or liquid refrigerant into a line where it does not belong and where it may block a cap tube.

If you make a mistake and carry the appliance in the wrong position, you would be smart to leave it in the upright or operating position for a few hours before turning it on to avoid forcing a slug of oil into (and blocking) the CAPILLARY TUBES often used on home refrigerators or freezers. Leaving the system upright allows oil that may have leaked into the refrigerant line to drain back into the compressor motor. If you turn on the system too soon the risk is that you push this oil into the cap tube where it may remain or be hard to get out or worse, you may leak oil into the reed valves where they will be damaged when the compressor motor is turned on.

Open type refrigeration compressors

Open type refrigeration compressors are commonly found on automotive air conditioning systems. The motor that drives the actual compressor (the mechanical engine that compresses refrigerant gas) is physically separate from the compressor and is located outside of it. Typically a motor drives the compressor via a belt and pulley system (cars and some commercial refrigeration systems).

This is why you should run your automobile air conditioner from time to time even out of the cooling season - to lubricate the shaft seal around the compressor motor/pulley - that's a spot where refrigerant may leak out at a dried seal.

Semi-sealed HVAC compressors

Semi-sealed compressors can be disassembled and repaired, as can the open type above.

Air Conditioner / Heat Pump Compressor Valves - two common designs

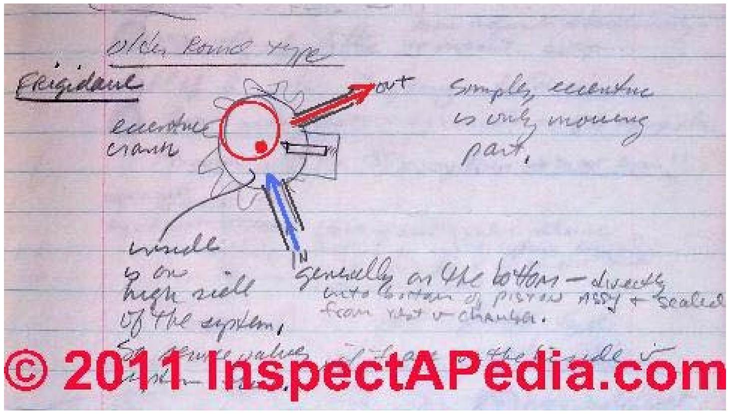
All compressors have a suction and a discharge valve to control refrigerant flow through the unit.

Reed Valve refrigeration compressor motors

Often the valve is a reed design - in which case the bottom reed is the intake valve and a top mounted reed is the discharge reed or valve that discharges out through a noise muffler into the condenser piping and coil.

It is these valves that can be destroyed if liquid refrigerant is sent through the compressor.

Rotary valve refrigeration compressor motors - Frigidaire rotary compressor motors



Some other refrigeration compressor valve designs are quite different from these simple reeds, including an old and very successful eccentric crank system: the rotary compressor motor design patented by Frigidaire™ and used in refrigerators for several decades.

This compressor motor design was used in a range of Frigidaire equipment and appliances including refrigerators and some air conditioners. The durability of the design stems at least in part from its simplicity: a simple eccentric crank (see our sketch at left) is the only moving part in the motor.

On this compressor motor the inlet or suction line is generally found on the bottom of the unit, feeding directly into the bottom of the piston assembly and sealed from the rest of the chamber. The interior of the compressor chamber (sketch note and arrow at left) is on the HIGH side of the system. So service valves, if they are installed at all, are placed on the high side of the system there.

Frigidaire eccentric crank rotary refrigeration compressor motors were remarkably durable and reliable - we used a salvaged Frigidaire refrigerator compressor as our HVAC service vacuum pump for many years.

Air Conditioner / Heat Pump Compressor Motor Refrigerant Oils

Refrigeration compressor motors use 300 viscosity oils when working with refrigerants in the Freon family and 150 viscosity oils when working with other refrigerants. These are special oils that use a non-wax base such as Texaco Capella oil or oils by Virginia Chemical.

The refrigeration oil lubricates the moving parts of the compressor motor as it receives and compresses refrigerant gases. At Types of air conditioner or heat pump compressors & compressor designs when we warned that carrying a refrigerator or freezer on its side could drain oil out of the compressor motor into the refrigerant lines where it might later become a problem by blocking the capillary tube or might enter reed valves causing valve damage, this is the oil we were talking about.

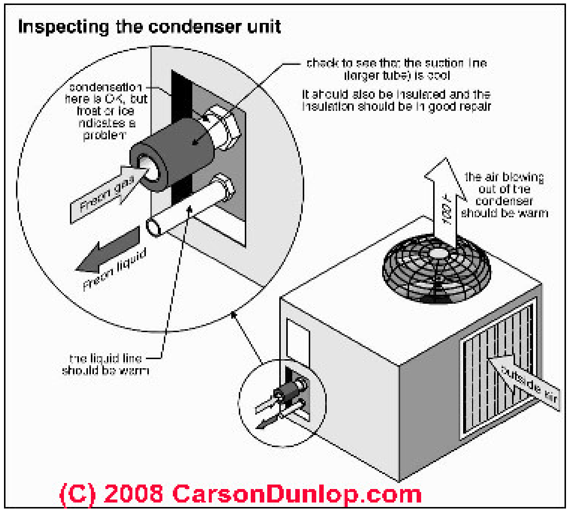
How to diagnose and fix an air conditioning system that is not working

If your air conditioning system won't work, follow these easy A/C-heat pump diagnostic guides

- At LOST COOLING CAPACITY, our focus is on the case in which the air conditioning system seems to be "running" but not enough cool air, or no cool air at all is being delivered to the occupied space. Sketch from Carson Dunlop Associates.

  At OPERATING DEFECTS we take you through the major air conditioning problem symptoms and how to get the air conditioning system working again.

- At A/C - HEAT PUMP CONTROLS & SWITCHES we explain the many electrical switches and controls that control an air conditioner



or heat pump system. You'll need to check these if your air conditioner won't start.

List of air conditioning system diagnostic articles: See our complete list of air conditioning system diagnostic and repair guide articles just below.

Since the failure of an air conditioner to turn on, loss of air conditioner cooling capacity, reduced air conditioning output temperatures, loss of cool air supply, or even loss of air flow entirely can be due to a variety of problems with one or more components of an air conditioner or air conditioning system, *after reviewing the lost air conditioner cooling diagnosis procedures described in this article,* be sure to also review the diagnostic procedures at each of the individual air conditioning diagnosis and repair major topics listed just below. To return to our air conditioning and refrigeration home page go to AIR CONDITIONING & HEAT PUMP SYSTEMS.

If your air conditioning or heat pump system has lost its cooling capacity or won't start, or if your air conditioning electrical bill has increased even though the system "on" time has not changed, select one or more of the diagnostic articles listed below.

- A/C - HEAT PUMP CONTROLS & SWITCHES: air conditioner controls and switches - begin here if your A/C won't start. Here's an important tip: *most refrigeration problems, in air conditioners, refrigerators, or freezers, are electrical, not mechanical.* In air conditioning school, we used to drive out and collect abandoned refrigerators that people were tossing out during our community's spring cleanup week. Taking these appliances back into the shop we found that almost always the problem that had caused the owner to dispose of their air conditioner or freezer was in an electrical connection or electrical control. So it's worth checking out switches and controls on an air conditioner before replacing more costly components.
- OPERATING DEFECTS: major air conditioning problem symptoms and how to get the air conditioning system working again,e.g. compressor or fan noises, failure to start, and inadequate cool air volume
- LOST COOLING CAPACITY: what to do when not enough cool air comes out of the system
  - What to check first if there is no cool air or not enough cool air Compressor failure diagnosis: basic checks of the air conditioner compressor
  - Ducts & Air Handler diagnosis: basic checks of the indoor air handler (blower), air ducts, and filter systems
- COMPRESSOR CONDENSER: problems with air conditioner compressor/condenser units. Examples of signs of a failing air conditioner compressor include hard starting or increased electrical bills when the A/C system is running. See the links at page left, including BURNED-OUT COMPRESSOR and HARD STARTING COMPRESSOR MOTORS, and also MOTOR OVERLOAD RESET SWITCH.. AIR HANDLER UNIT: problems with the air handler, air filters, and the cooling coil itself.

  If the fan in the air handler unit is not running, also see MOTOR OVERLOAD RESET SWITCH.DUCT SYSTEM DEFECTS: problems with the air duct system, air filters, supply registers, return air registers A/C REFRIGERANT LEAK DETECTION: how to use a TIF5000 to detect air conditioning refrigerant gas leak

- A/C DIAGNOSTIC FAQs: air conditioning system diagnostic FAQs: Q&A about air conditioner repair - a detailed air conditioning system diagnostic checklist

Frequently Asked Questions (FAQs) about Air Conditioner or Heat Pump or other refrigeration system Compressor/Condenser Units

Beginning at COMPRESSOR & CONDENSING COIL, A/C see the articles at page left for detailed HVAC compressor/condenser troubleshooting and repair procedures. We include more general compressor/condenser questions just below.

Question: compressor just runs for a few seconds, then cuts off; short cycling A/C compressor problems

My condenser starts for a few seconds then cuts off cycle continues - Anon.

my compressor fun has started to short cycle, it run for 2-3 min then shuts off for one second then restarts runs again then stops etc. with no funny sounds or noises - Don

Reply:

It's not clear from your question where in the entire cooling system your unit's troubles begin, so I'd look at diagnostic tips that may explain your compressor/condenser short cycling are found at LOST COOLING CAPACITY. Certainly a compressor that is having trouble starting can be diagnosed at HARD STARTING COMPRESSOR MOTORS, if you're sure the trouble is outside.

Question: ice on the refrigerant line, no cooling in the house

My line set going to outdoor unit has ice on it. Lost cooling in house. What is the problem and is there anything I can do to fix the issue - Pat

Reply: check the indoor air handler for an ice-blocked coil

A problem with a refrigerant metering device (thermostatic expansion valve, capillary tube, etc), or even a dirty air filter can lead to improper metering of refrigerant into the indoor cooling coil, leading to icing; but other causes of ice formation include an improper refrigerant charge or even something as simple as missing refrigerant line insulation. But when you also lose cooling inside, I suspect an ice blocked coil. See FROST BUILD-UP on AIR CONDITIONER COILS

Question: ice build up inside the ductwork

I have ice build up on the inside of the furnace duct work. This will plug up the lines and the fans will not circulate thus stop blowing cold air

Reply:

If you find ice build-up inside the ductwork itself that's pretty unusual except in winter in freezing climates when moist air is rising into the duct system. Usually ice forms at the cooling coil in an air conditioner air handler or blower unit.

But I agree that ice can block air flow and more, when it melts, can cause water damage or even a mold problem in the building.

For more detailed advice please see WATER & ICE IN DUCT WORK.

To diagnose and fix ice formation on the cooling coil itself, see FROST BUILD-UP on AIR CONDITIONER COILS

Question: My A/C unit kept blowing a fuse, now nothing runs

My Center A/C unit had a tuned up. I clean the evaporator, I put the blower down and put the new motor and clean the blades deeply, I have a clean filter, I clean the condenser deeply, and I bought a new thermostat. OK. The unit star running normally and you fill the normal warm air in the fan (outside) But 3 to 5 minutes later the heat in the condenser air increased suddenly the condenser stop with noise, and I need to turn it off. what is this? Please give me a clue? - Anon 6/28/22

I have a pretty old Tappan unit, and when the power goes out, if the A/C is running it will blow the fuse, usually we just replace the fuse, and now nothing will run on the A/C unit. any ideas? - Shantel 6/20/11

Reply:

Shantel:

Often when an A/C unit keeps blowing the fuse it's a sign that the compressor is drawing high amps which means it's jamming which, I'm sorry to say, means it's at end of its life. I'd have a service tech look at the unit; it might limp along for a while longer if s/he installs a hard-start capacitor kit. When "nothing runs" you may have meant that the fuse or breaker tripped enough times that you've lost power on that circuit.

Anonymous - from what you describe you need a service call from a trained HVAC tech.

Question: My hi line is cold, low line is warm and the condenser blows hot air

In my situation the high pressure line is colder than the low pressure line. The condensor coil blows mainly hot air, but the end closest to the compressor blows hotter air than the end furthest from the compressor line. Any suggestions? - Jim T. 7/13/11

Reply:

Mundo suggested: hey jim t check for restriction at the evaporator

Jim T:
Also, is your unit a heat pump or only an air conditioning system? - Editor. Let's be sure your system is in cooling mode.

Question: water comes out of my system when I turn on the A/C

When i turn on the (AC Outside unit Lennox) there is an overflow of water in my basement at the furnace which is a gas furnace- Don 7/24/11

Reply:

Don if you see water in your basement at the A/C unit when it's on, your condensate drain or pump is not working.

Question: No water is coming out of the condensate drain

water is not going through the drain hose - Anon 7/20/12

Reply:

Anon:

If you don't see condensate coming out of the condensate drain there are several likely explanations:

- the drain system for condensate has become clogged - you need to clear the drain line - check this first

- the system is off or not in cooling mode so not producing condensate

- the air is dry enough in your environment that not much condensate is being produced

- your system uses a condensate pump that has lost power or failed

Question: Is the problem with the fan motor or the compressor motor in my condenser unit?

I've a Lennox outside a/c unit. The fan/motor and compressor are part of the unit. The fan was not spinning and the A/c is not running. I've isolated the problem down to the fan/motor or the compressor, but don't know how to check or find out which it is. Any idea on how to check if the fan/motor is 'bad' or the compressor is 'bad'? - Fan or ... 7/23/11

Reply:

Fan or compressor: you could also have a bad control board, or relay switch in the compressor/condenser unit. If the fan is bad and the compressor is OK you'll hear the compressor turn on at the start of a cooling cycle, though a bad fan and system overheating could later cause some compressors to turn themselves back off. Similarly, if the compressor is bad your fan motor would still run. So I'm suspecting a control or switch problem./

Question: Our new AC won't keep running

uhm my A/C compressor broke about two weeks ago, we got a new one but when the fan starts the compressor works for a while and then it shuts down, and its turning on and off and i dont know whats wrong - Help. 7/25/11

Reply:

Help: if your new A/c won't keep running after it has just been installed, surely you should call the installer and expect it to be repaired under warranty - it's just been two weeks.

Even if all of the new equipment is in good condition, an example of a problem that could occur during compressor replacement is that contamination, moisture, dirt in the refrigeration system (which is made worse if a compressor burns up) can interfere with proper system operation.

Question: My AC won't work if I set the temperature down below 25C

my a/c is working properly when it is adjusted at 25 degree temprature, but if it is lower than 25, the compressor is disconnected by the overload protection. what is the problem with my a/c. - Mohamed 8/5/11

Reply:

Mohamed an A/C compressor may cut off on thermal overload due to overheating from local conditions around the compressor/condenser unit (no shade, very hot weather), an older motor that is failing, a start capacitor problem, or even a refrigerant metering device problem. If there's nothing obvious to you, I'd get a service tech to take a look. Keep us posted.

Question: Icing at the compressor; compressor not turning on?

the outside unit of the heat pump is icing up on the compressor - Steve 8/7/11

Hi my fan in my house goes on but my compressor unit does not all the electric seems to be fine . could it be my thermostat? - Sam 8/7/11

the accu very heat,although it is new gen. clean,2Tr LS-60psi & HS-100psi, - Anon 8/6/11

Reply:

Steve: icing at the compressor/condenser sounds like a refrigerant charger or refrigerant metering problem.

Sam: if your thermostat turns on the air handler but the compressor/condenser does not run, the problem is not the thermostat. Check out the diagnostic suggestiosn beginning at LOST COOLING CAPACITY (link at page left)

Anon: those pressures look kind of low, no? What does your HVAC tech say about normal for that system?

Question: My A/C compressor just won't stop running

I recently noticed my AC condenser unit still running when the system inside shutoff by itself. and also, does the condenser unit have to be leveled. I notice the slap which holding the unit is slopping. Any suggestions? Thank you. - Rick 8/16/11

Reply:

A/C compressor/condenser won't stop running:

Rick usually when an A/C condenser unit won't stop running even though the inside equipment has shut off by itself my thinking divides into two investigations:

- is there a problem with the INDOOR unit such as a blower fan that won't start, an access door switch open, a condensate drain switch turning off the blower unit - these can leave the system calling for heat and the compressor running (though that's not good for the compressor)

- is there a problem with the outdoor equipment such as a bad control relay or control board

Question: can the condenser get oil logged

can a condenser become oil logged, how and why? - Dominic 8/22/11

Reply:

Dom, it is normal for some refrigerant oil to circulate through the HVAC refrigeration system; Oil logging can occur in some installations if the refrigerant piping is not properly routed or due to an improper charge. The more usual problem is not at the condenser coil but at smaller orifices such as a cap tube or the TEV.

Dominic:

A condenser, if you mean the condensing coil, set level, would not be expected itself to become oil clogged, though condensers do sometimes clog from a combination of debris and moisture or oil.

But refrigerant oil moving through the system can clog a refrigerant metering device such as a capillary tube.

Question: our A/C compressor tries to start but then shuts right back off

I turned my AC on and noticed it wasn't getting cooler inside, I went out to the condensing unit and the compressor tries to kick on but then shuts right back off. Can not having enough refrigerant cause this? If not what's the deal? - Derek 8/22/11

Reply:

Derek, as another reader commented, your compressor/condenser may be having trouble starting. A start capacitor can sometimes fix this problem and give some added life to the unit.

Not having enough refrigerant would not itself prevent the compressor from starting, though there are some more technical connections one could draw (low refrigerant, sticking thermostatic expansion valve, high head pressure can mean hard starting - but that's not where I'd start).

Question: compressor starts, fan doesn't start, I hear a hissing

My compressor turns on but the fan does not turn(Ican turn the blades by hand) within 10 t0 15 seconds I get a long a loud hisssssssssssssssssssss.
Thanks foir you help
Henry - 9/8/11

I HAVE SOME MORE INFO ON MY A/C WHEN THE A/C IS TURNED ON BY DROPPING THE TEMP IN THE HOUSE THE COMPRESSOR TURNS ON BUT THE FAN DOES NOT TURN, IF YOU START TO TURN THE FAN BY HAND IT STARTS SPINNING. WHEN I TURN IT OFF BY PICKING UP THE TEMP IT STOPS. WHEN I DROP THE TEMP AGAIN NOTHING GOES ON. IF I WAIT A FEW MINUITES AND TRY IT AGAIN THE COMPRESSOR STARTS BUT THE FAN STILL HAS TO BE STARTED BY HAND. THANKS FOR ANY HELP YOU CAN GIVE...

Reply:

Henry I suspect a bad fan start-run capacitor.

Question: no air is coming out of our supply registers

I have a coleman unit. Had heating probs 2 years ago leading to complete computer panel replaced, evaporator coils cleaner, gas regulator replaced. Two days ago, my A/C decided to stop working. I hear the freon flowing into the coil region, the fan outside is turning, but no air is coming out of registers. What can it be? - Cheryl 9/9/11

Reply:

Cheryl if you have no air coming out of supply registers the blower fan is not working or the duct system has become disconnected or blocked. Coil ice-over in the air handler can also block airflow. Start by determining that the blower is running and that the air filter is clean.

Question: water at the air return vent

what makes the water from an airconditioner build up in the return vent? - Connie Woyan 9/15/11

Reply:

Connie: if you see water at the return vent it may be condensation on a cool surface, or it could be condensate leaking down into the return vent from your air handler. You'll need to make a closer inspection of the air handler (blower unit) itself.

Question: what type of copper is used in HVAC refrigeration piping or tubing?

What is the content of copper tubes used in AC? (i.e I would like to know the contents of pipe which is being connected between the Fan and compressor of split AC) - Pratik Shah 10/1/11

Reply:

Pratik

Copper tubing used in A/C systems for refrigerant piping is just that. Soft flexible copper piping. While the differences between K, L, M and DWV copper piping are primarily in wall thickness, the the copper tubing alloy class may also vary for flexible copper tubing used in HVAC applications such as refrigerant piping and oil line piping.

1/2" K copper tubing has a wall thickness of about 0.049"
1/2" L copper tubing has a wall thickness of about 0.040"
1/2" M copper tubing has a wall thickness of about 0.028"

1 1/4" copper DWV piping has a wall thickness about the same as L copper or about 0.040"

The flexibility of copper tubing also depends on how it was produced: annealed vs drawn. Annealed copper is softer, suitable for flared and compression fittings, though it can also be soldered with proper edge smoothing/rounding.

Drawn copper is generally used for soldered fittings though drawn copper types A and B tubing can be joined with some types of compression fittings as well.

Details about the alloy mix of various copper piping materials is given by standard ASTM B88 and are providedin exhausting detail by copper dot org.

Question: no sweat on the suction line

what could be the problem when the sunction line of an air conditioner is not sweating? - Diana 2/3/12

Reply:

x

Question: hard starting compressor

jon- ac system is less than a year old, when I turned on ac to check, condensor comes on then shuts back off, then 30-45 seconds after comes on again for 2-5 seconds. Whats wrong? - Jon Anon 8/18/12

Compressor on Lennox centeal air not turning even if the thermostat is activated.. It is blowing warm air.
Possible problem - Roger 7/8/12

Reply:

Anon: regarding your hard-starting compressor/condenser unit: we can't with confidence say what's wrong with so little information - your service tech can diagnose the problem, probably fairly quickly. But a common cause of the symptoms you describe is a bad start/run capacitor or worse, a failing compressor motor.

Todd said to Roger:

Rpger...not a professional myself but I had the same issue. The motor on my outside unit had worn out to the point that it needed to be replaced. Forturantely for me it was under warranty from a unit that I purchase 4-5 years ago. This might be strange for most units but we've had some above average summers here in Texas the last couple of years. Another thing my HVAC tech does is check and replace the capacitor if necessary...I've been told that if the capacitor is shot, it will expand, almost resembling a coke can that is about to explode. Good luck.

Thanks Todd.

Roger, presuming you checked tonassure the unit has power and the thermostat is calling for cooling, if the suggestions in this article didn't get your system diagnosed check the LOST COOLING article linked above at page left - Editor

Question: does it help to spray the compressor/condenser coils when it's hot outside?

Does it help to spray water on the compressor coils when the outside air temp. is 100+? The inside air is going up in the afternoon to 82. - Greg Warner 7/7/12

Reply:

Some readers have reported that their compressor was overheating and ran ok when water cooled - this is perhaps a diagnostic step but not a reasonable repair. And don't soak electrical components.

Question: oil in the capillary tube? - recurrent cap tube clogging

i have replaced my compressor from company and when i started it was giving cool air but the copper pipe out side (large) was not cool enough and after 40 mints its timer light flashes and after 10 more mints its down automatically. it happens again and again i sent back it to company technician is looking into it. He said oil was in capillary and it needs flushing so he will replace its capilary since after cleaning its not fixed. do u think there is no fault in compressor? or what possibly is the problem.. - Wagar 7/11/12

Reply:

You'll want to check the installation manual to find the control light decoding for your brand and model of cooling equipment. Could be a control or control board problem too. It's just about impossible to flush a cap tube so replacement is normal. But if there is debris in the system, or excessive oil, the new cap can clog as well; good practice would be to empty the system, pull a vacuum, flush the whole system, install a filter dryer, replace the cap tube, and recharge.

Question: A/C not cooling, condenser fan not running

Several days ago I noticed that even though my air handeler was rinning the AC was not cooling, I foudn that the condensor was not turning, I flipped the breaker (that apprered to be in the on position) and it worked for awhile. 15 minutes later I noticed that the condenser was not operating again so I flipped the breaker again it corrected the problem. I then went on the replace the breaker which seemed to correct the problem, the AC worked normally for several days. Now I find the condenser is not working again and flipping the breaker fails the correct the problem. When the condenser was working it was providing good normal cool air. The system is 2 years old. I assume I have an electrical problem in the condenser. What is likely to cause this problem and how can I test for it (I have a test meter) but I want to be careful because I know that a coil can retain a dangerous electrical charge even when all power is off and disconnected. - Rick 7/13/12

Reply:

typically we see if the fan spins, if it has power, and if the controls and fan contactor are bringing power to the fan when the condenser unit starts up.

Reader Followup

My problem turned out to be a bad contacter (damaged by ants) - Rick 7/13/12

Question: loud cricket chirping sounds at the compressor/condenser unit, and slow starting

outside unit making loud cricket sounding noise when running. Takes long time to come on when temp set low. - JT 7/276/12

Reply:

JT our link at page left NOISE AIR CONDITIONER / HEAT PUMP provides noise diagnostics.

About taking a long time for the A/C to "come on" when the temperature is set low: the thermostat is operating like an "on-off" switch that turns the air conditioner system on and off in response to room temperature. It's not an accelerator. So if there is an operating problem related to the system controls, the number of degrees below the room temperature to which the thermostat is set should make no difference in how long it takes the A/C system to start. As long as the SET temperature is lower than the room temperature the cooling system will turn on.

Questions & Answers regarding this article

Questions & Answers about HVAC compressors & condensers: the condensing unit.

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(3 days ago) Pete Moreno said:

condensor will come on, but fan motor will make a hissing noise and will not turn.

(July 3, 2012) good said:

it's very useful to me,thank you.

(June 21, 2012) sibte, shah said:

Thanks so much for bringing this excellent , comprehensive and easy to understand article. God bless you

(Feb 23, 2012) rick said:

2

Need an narrow 13 or better seer outside unit Where to buy? Thanks Rick

(July 11, 2011) matt said:

Seems like it is a dead technology, can anyone share any new air conditioning technologies?

Recommend / Share this Article

+1 ShareThis

EMAIL

Print

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also list books on the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.
- Additional technical contributors & reference sources for this article are listed below.

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.AIR CONDITIONING & HEAT PUMP SYSTEMS

COMPRESSOR CONDENSER
- BURNED-OUT COMPRESSOR
- CAPACITORS for HARD STARTING MOTORS
- CONDENSING COIL REPAIR REPLACE
- CONTACTOR RELAY DIAGNOSIS & REPAIR
- CONTROL CIRCUIT BOARD, A/C
- CRANKCASE HEATERS
- FAN, COMPRESSOR/CONDENSER UNIT
- HARD STARTING COMPRESSOR MOTORS
- INSPECTION CHECKLIST - OUTDOOR UNIT
- INSTALLATION ERRORS, COMPRESSORS
- LEVELING REQUIREMENTS, COMPRESSOR
- LONG-ON CYCLING AC COMPRESSOR
- MOTOR OVERLOAD RESET SWITCH
- NOISES, COMPRESSOR CONDENSER
- Pressure Controls & Safety Switches
- PRESSURE READINGS, COMPRESSOR
- REPLACING A COMPRESSOR
- SHORT CYCLING AC COMPRESSOR
- TIGHT or SEIZED AC COMPRESSORS

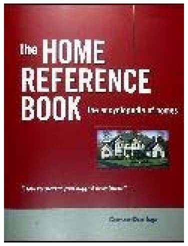
LOST COOLING CAPACITY
LOW VOLTAGE TRANSFORMER TEST

- Carson, Dunlop & Associates Ltd., 120 Carlton Street Suite 407, Toronto ON M5A 4K2. (416) 964-9415 1-800-268-7070 info@carsondunlop.com. The firm provides professional home inspection services & home inspection education & publications. Alan Carson is a past president of ASHI, the American Society of Home Inspectors. Thanks to Alan Carson and Bob Dunlop, for permission for InspectAPedia to use text excerpts from *The Home Reference Book* & illustrations from *The Illustrated Home*. Carson Dunlop Associates' home inspection education products include
  - The ASHI-adopted Home Inspection Training Program, and Commercial Building Inspection Courses
  - The Home Inspection Home Study Course, and publications such as
  - The Home Reference Book, a reference & inspection report product for building owners & inspectors
  - The Home Reference *eBook*, an electronic version for PCs, the iPad, iPhone, & Android smart phones
  - Home Inspection Report writing materials, including the Horizon Software System that manages business operations, scheduling, & inspection report writing using Carson Dunlop's knowledge base & color images. The *Horizon* system runs on always-available cloud-based software for office computers, laptops, tablets, iPad, Android, & other smartphones.
  - The Illustrated Home illustrates construction details and building components, a reference for owners & inspectors
- [2] Carrier 24ANA Infinity™ Series Air Conditioners with Puron® Refrigerant, 2 to 5 Nominal Tons (Sizes 24-60) Installation Instructions, Carrier Corporation, [copy on file as 24ana-6si.pdf]
- Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- NEW!

Air Conditioning SEER - New DOE Air Conditioner and Heat Pump Efficiency Standard

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia Bookstore.



- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

  Or choose the The Home Reference eBook for using this reference on PCs, Macs, Kindle, iPad, iPhone, or Android Smart Phones

Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

Asbestos HVAC Ducts and Flues field identification photos and guide

- Fiberglass: Indoor Air Quality Investigations: Fiberglass in Indoor Air, HVAC ducts, and Building Insulation

- ...

Home About Us Accuracy Contact Us Content Use Policy Printing Tips Privacy Website Description

Mobile View
AIR CONDITIONING & HEAT PUMP SYSTEMS

A/C - HEAT PUMP CONTROLS & SWITCHES
A/C DATA TAGS
A/C - HEAT PUMP CRITICAL DEFECTS
A/C DIAGNOSTIC FAQs
A/C REFRIGERANTS
A/C TYPES, ENERGY SOURCE
AGE of AIR CONDITIONERS & HEAT PUMPS
AIR CLEANER PURIFIER TYPES
AIR CONDITIONER BTU CHART
AIR CONDITIONER COMPONENT PARTS
AIR CONDITIONER TYPES, ENERGY SOURCES
AIR CONDITIONER NOT WORKING
AIR FILTER EFFICIENCY
AIR FILTERS, FIBERGLASS PARTICLES
AIR FILTERS for HVAC SYSTEMS
AIR FLOW MEASUREMENT CFM
AIR HANDLER / BLOWER UNITS

Installation Guide to Air Conditioning Compressor Motor & Other Electric Motor Start-Boost or Run Capacitors

InspectAPedia® - ShareThis +1

- Use of air conditioner compressor motor starting capacitors
- Use of starting capacitors on electric motors for air conditioning, pumps, etc.
- Start or Run Capacitor Diagnostic Checks: How to Use a VOM or Multimeter to Test a Motor Starting Capacitor
- How to fix or replace a hard-starting air conditioner compressor or other hard starting electric motor
- How to inspect, test, or install an air conditioner motor starting capacitor
- Warnings about remaining life of hard-starting air conditioner or heat pump compressor motors
- Questions & answers about installing a hard-start capacitor to get an air conditioner motor, fan motor, or other electric motor running.

Electric motor start/run capacitor installation: this air conditioning, heat pump, or other electric motor repair article discusses the selection, installation, testing, & use of electric motor starter start and run capacitors designed to get a hard-starting air conditioner compressor motor, fan motor, refrigerator, or freezer compressor or other electric motor (such as a well pump) going.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

at the left of each page to navigate ***within*** topics and documents at this website. Green links show where you are in a document series or at this website.

Air Conditioning Compressor or Other Electric Motor Starting Capacitors

Capacitors are electric devices that get an electric motor running at start-up or that help keep a motor running once it has started. If the capacitor has failed the symptom is that the motor won't start. You may hear it humming or observe that it's getting hot. If you observe this we suggest that to avoid damage you turn off the system while waiting for repairs.

Single phase electric motors such as those used in air conditioner compressors and fan motors contain two different stator windings: an auxiliary starter winding fed by an electric capacitor and a main run winding fed by the principal electrical circuit. The auxiliary starter winding is used to provide an extra boost (and proper direction) to get the motor spinning at start-up, by creating a high-torque, rotating, electrical field in the motor. In many of these motors there are actually two capacitors, one boosting the start winding (the start capacitor) and a second that remains in the circuit while the motor continues running (the run capacitor). These two capacitors may, however, be hidden within a single physical device, as we'll illustrate below.

Normal start/run capacitors on compressors, fan motors, other electric motors

Air conditioner compressor motors (and lots of other electrical motors) that run on two-phase (220V) or single phase (120V) electrical power usually6 include a capacitor in the start circuit to help get the motor spinning; a capacitor can be put into the "run" circuit of the motor as well to increase motor efficiency.

The starter capacitor gives extra torque or boost to get a motor spinning in the right direction by providing about double that nominal system voltage.

Once the motor has started, in some designs a run capacitor may be used to help the motor retain full power, providing 1.5 x the nominal system voltage and varying as needed depending on the load on the motor.

In some old-school class views adding a run capacitor is similar to making two-phase out of one-phase electricity and is a common practice on air conditioners. What these folks really are saying is that "With capacitive reactive power of about 75% of the nominal power of the motor, the comparison of power is slightly lower than that of a three-phase motor of equal size." [2]

Where are Starter Capacitors ***Not Found*** on Air Conditioners, Heat Pumps, Other Motors?

A three-phase electric motor typically won't have a starter capacitor, but you won't find many residential cooling systems wired for 3-phase current. You also won't see a starter capacitor on scroll-type refrigeration compressor motors.

What are ***Hard-start*** start/run capacitors or "booster" capacitors?

If your air conditioner has stopped running (see LOST COOLING CAPACITY) , a possible problem is the failure of the starting capacitor found on the outside compressor/condenser unit. If that unit has electrical power but the compressor and/or its cooling fan are not running, one of the components to check (and that is easy to replace) is the starter.

When an electrical motor is having trouble starting, such as an air conditioning compressor motor (see HARD STARTING COMPRESSOR MOTORS), blower motor, a refrigerator motor or a freezer motor, or even a fan motor, the repair technician may install a simple and inexpensive starting capacitor.

DUCT INSULATION, Asbestos Paper
DUCT INSULATION for SOUNDPROOFING
DUCT SYSTEM NOISES
DUCTS, Asbestos Transite Pipe
DUST CONTAMINATION FROM HVAC?

EDUCATION, HVAC SCHOOLS
ELECTRIC MOTOR DIAGNOSTIC GUIDE
ELECTRIC MOTOR OVERLOAD RESET SWITCH
ELECTRICAL POWER SWITCH FOR HEAT
ENERGY SAVINGS in buildings
EVAPORATOR COIL or COOLING COIL
EVAPORATIVE COOLING SYSTEMS
EXPANSION VALVES, REFRIGERANT

FAN, AIR HANDLER BLOWER UNIT
FAN AUTO ON Thermostat Switch
FAN, COMPRESSOR/CONDENSER UNIT
FAN CONVECTOR HEATERS - HYDRONIC COILS
FAN LIMIT SWITCH
FAN NOISES
FURNACES WARM AIR HEATING SYSTEMS

GAS EXPOSURE EFFECTS, TOXIC
GAS DETECTION & MEASUREMENT
GAUGE, REFRIGERATION PRESSURE TEST

HEAT LOSS (or GAIN) in buildings
HEAT LOSS (or GAIN) INDICATORS
HEAT LOSS R U & K VALUE CALCULATION
HEAT PUMPS
HEATING SMALL LOADS
HOUSEWRAP AIR & VAPOR BARRIERS
HUMIDITY LEVEL TARGET

INDOOR AIR QUALITY IMPROVEMENT GUIDE
INSPECTION CHECKLIST - OUTDOOR UNIT
INSPECTION LIMITATIONS, A/C SYSTEMS

LEED GREEN BUILDING CERTIFICATION
LOST COOLING CAPACITY
LOW VOLTAGE TRANSFORMER TEST

MANUALS & PARTS GUIDES - HVAC
MOTOR OVERLOAD RESET SWITCH
MOLD in AIR HANDLERS & DUCT WORK
MOLD INFORMATION CENTER

NOISE AIR CONDITIONER / HEAT PUMP

OPERATING COST
OPERATING DEFECTS
OPERATING TEMPERATURES
Air Conditioning System Temperatures
Instruments Used to Measure A/C Temperatures
Procedures for Making Temperature Measurements

The starting capacitor is a simple electrical device which can give an extra voltage jolt or "boost" to get the hard-starting motor spinning.

The starting capacitor in our page top photo is oval in cross section, but most replacement and many newer air conditioner motor starting capacitors are simply cylindrical in shape (photo at left).

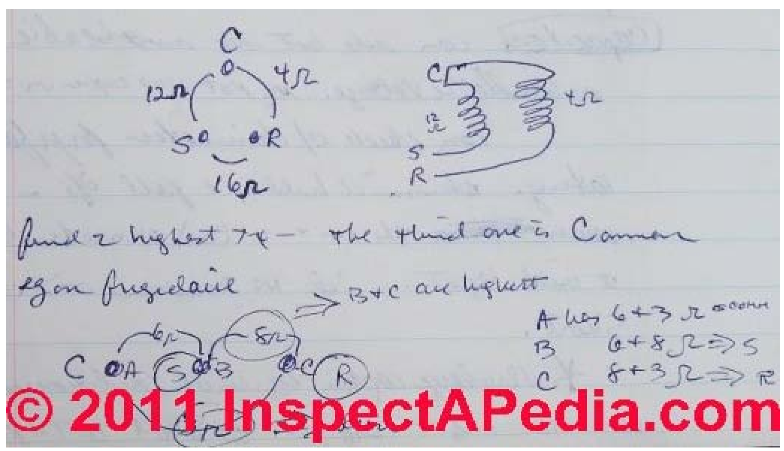
How to tell what type of capacitor is installed on your motor: start capacitor vs. start/run capacitor

To spot a Start/Run capacitor that combines both functions, look for *three* terminals on the capacitor: one will be marked "common" or may be marked with a red dot to indicate that role. Note that especially among replacement starting capacitors, the replacement unit may be designed to provide either just the "start" function or both start and run function, depending on whether or not all of the wires on the capacitor are connected.

How & Where to Find or Locate the Starter Capacitor in or on Electrical Equipment

Look for starter capacitors in your air conditioning equipment in the outside air handler where a starter capacitor may be used to aid compressor motor start-up, and look for a smaller motor starting capacitor on fan motors, both in the outside compressor/condenser and indoors in the air handler unit's blower compartment.

Make These Simple A/C Compressor Checks Before Adding a Hard-Start Capacitor



Most electrical problems in air conditioning systems are in th compressors and their relays or motor overload switches.

In a single phase (common residential A/C) compressor you can verify with an ohmeter whether or not the A/C compressor is bad.

A fractional horsepower electrical motor should show different electrical resistance beween the three terminals (Start, Run, and Common) as we illustrate just below.

Find the two highest resistance terminals. The third one will be the common terminal. Our example is for a Frigidaire compressor motor.

In our capacitor testing and wiring sketch at left, you note we use the letters S, C, and R to identify the usual terminals to which a start/run capacitor is wired. On many systems these terminals may be labelled so that the three leads on a start/run capacitor can be wired correctly:

- S = start wire connector
- R = Run wire connector
- C = common connector

See How to Install and Wire Up an Air Conditioner Compressor, Blower Motor, or Fan Motor Hard Starting Capacitor.

Electric Motor run speed side note: Incidentally while most electric motors are marked with a data tag indicating the motor run speed (in RPMs) it's worth noting that the number of run coils is what determines the run speed of the motor. Two-coils marks a motor that runs at 3450 rpm (3600 rpm "nominal"), while 4 coils marks a 1725 rpm motor. (120V, 60 cycle/sec x 60 sec/min = 3600 rpm).

Causes of Hard-Starting Air Conditioners, Refrigerators, Freezers, and other Electric Motors

A compressor or other motor may have trouble starting for any of a variety of reasons such as:

- Low line voltage supplied to the equipment or excessive power drop on a long circuit wire
- Un-balanced cooling or refrigeration systems - such as a compressor motor that is having trouble starting when the refrigerant pressures are high on one side and low on the other side of the cooling system. This hard starting condition happens when a compressor is turned off in the middle of an "on" run cycle.

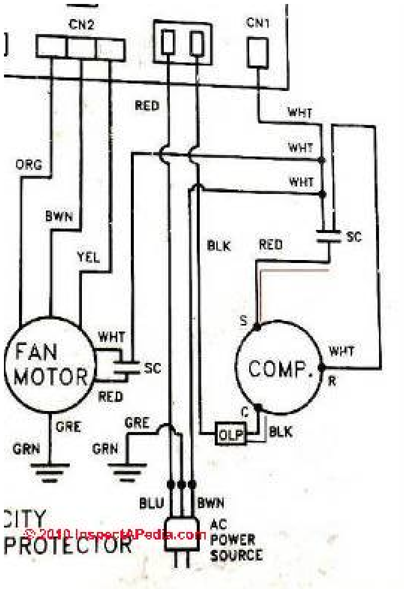
  You can guess that you have this condition on an air conditioner if the system starts just fine when it's been shut down for a half hour or more (refrigerant pressures are equalized on both sides of the compressor) but starts with difficulty (the compressor motor "hums" and does not start quickly or may even trip the circuit breaker) when trying to restart a few minutes after having been shut off.
- Old, aging compressor motors or other electrical motors that are at or near the end of their life may have trouble starting and may be able to function for some additional time given the "help" provided by a starting capacitor. See HARD STARTING COMPRESSOR MOTORS and also TIGHT or SEIZED AC COMPRESSORS for more details about old or failed compressor motors.
- Troubles with an electric motor such as used on an air conditioner air handler, condensing coil fan, or a well water pump: see ELECTRIC MOTOR OVERLOAD RESET SWITCH
- Bad or failed starting capacitor: the air conditioner compressor (and some other electric motors) may already have a starting capacitor installed, but the starting capacitor might have failed, causing the air conditioner compressor to start with difficulty or not at all. A bad starter capacitor can also disable the fan in the outdoor compressor/condenser, or the blower fan in the indoor air handler unit.

  We give more detail about *failed electric motor starting capacitors*, and we explain possible visual diagnosis of a failed starter capacitor (bulged ends) without having to perform electrical testing, at HARD STARTING COMPRESSOR MOTORS. Thanks to reader George Fazio for this air conditioner start-up diagnosis suggestion and for the photo (above left).

Starting capacitors or electric motor starting capacitors (or motor start boosters) are often present on large single phase air conditioning compressors, as found on home air conditioning units, or on occasion on blower motors or even fan motors. Electric motor starting capacitors are only very rarely present on small refrigeration compressors, such as those in refrigerators, and as far as we know, never present on 3-phase power systems.

Start or Run Capacitor Diagnostic Checks: How to Use a VOM

or Multimeter to Test a Motor Starting Capacitor



There are two quick indicators of a bad electric motor start capacitor:

1. The motor will draw higher than normal current when it is trying to start, having trouble starting, refusing to start at all, perhaps humming and overheating, and perhaps tripping an internal thermal overload switch or tripping the circuit breaker or blowing a fuse. These symptoms may come and go depending on the operating state of the A/C or heat pump system: when the system is operating under load (high refrigerant pressures are present) the compressor motor will have a harder time starting than when the system has been turned off for some period and refrigerant pressures (REFRIGERANT PRESSURE READINGS) are equalized.

   Intermittent compressor hard-starting: A bad starter capacitor can cause the compressor to fail to start sometimes while other times it seems to start and run OK.

   Compressor hard starting, fan runs OK: If the compressor is having trouble starting or won't start at all but the condenser fan runs just fine, we figure it's a bad start capacitor or possibly a bad run capacitor.

   Compressor and condenser fan both won't start: we suspect a bad capacitor that is designated as a combination start/run capacitor unit wired to both devices.

   A service technician can test for a failing motor by measuring the current draw in amps during start and run, and by comparing the result to information on the motor's data tag.

2. A quick test of the starter capacitor itself can indicate that it is faulty as we detail here.

Use a VOM in ohms setting to check resistance across the capacitor. If the meter does not move (no current flows) the capacitor is "open". If there is zero resistance the capacitor is shorted.

In the partial wiring diagram at left, the compressor (COMP) is at lower right, and the component labeled SC shows the position of the starting capacitor in the air conditioning equipment's wiring schematic.

- Here is the full wiring diagram for this portable air conditioner.
- Here is a simple electrical wiring diagram for a typical room or window air conditioner [Sears Roebuck]

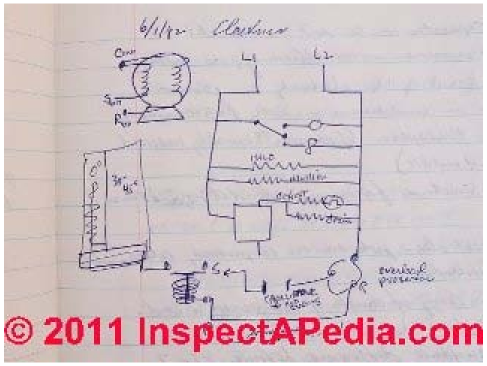
Watch out: while you might get lucky by finding that just replacing the starter capacitor fixes an air conditioner compressor, a fan motor, or another electrical motor, a hard-starting motor can be an indication that the more expensive A/C compressor or electrical motor is itself beginning to fail.

General advice: Electrical Tests to Check HVAC Blower Fan Motor or Outdoor Compressor Fan Motor Winding on Heating or Cooling Equipment or on Other Electrical Motors

See USING DMMs VOMs SAFELY. Example: testing a blower fan motor winding: referring to the electrical diagram for your equipment, unplug electrical connectors at the fan motor. Measure the resistance between each lead wire with a multimeter or VOM. The multimeter should be set in the X1 range. For accuracy, don't measure when the fan motor is hot, allow it to cool off.

When the resistance between each lead wire are those listed in the specifications for your equipment the fan motor should be normal. Zero resistance or infinite resistance are indicators of a problem. More examples of checking wiring: see BURNED-OUT COMPRESSOR. See HARD STARTING COMPRESSOR MOTORS also TIGHT or SEIZED AC COMPRESSORS for more details about old or failed compressor motors. Also see Test a Motor Starting Capacitor

Details of How a Starting Capacitor or Booster for Hard Starting Air Conditioners Works



Our little sketch of a basic refrigeration circuit shown at left illustrates where and how a starting capacitor fits into a refrigeration or air conditioning electrical circuit.

The starting capacitor works by "accumulating" a large electrical charge inside the capacitor. During compressor or other motor startup, the start capacitor releases its charge to give a voltage "boost" to get the electric motor spinning.

During an electric motor start-up (such as an air conditioner compressor motor and some fan motors) where a starting capacitor is included in the circuit, with the added charge stored in the capacitor, run-start and start-common voltages increase to a maximum value to start the motor spinning. The total supply subsequently current drops back to normal run conditions when the start device is dropped from the circuit - the motor continues to run.

This "electrical starting booster charge" can be particularly needed if an air conditioner is suddenly switched off and back on when it has been operating. Suddenly switching off an air conditioning compressor leaves a high "head pressure" inside the compressor which can provide extra mechanical resistance when the motor is attempting to re-start.

Traditionally electrical capacitors were also called "accumulators" for this reason. The capacitor's electrical charge is released at motor start-up time, gives the compressor motor or other electrical motor a boost for starting.

What makes the Start Capacitor Drop from the Circuit when the Motor has Started

As we explain next at How to Find, Choose, & Buy a Replacement Electric Motor Starting Capacitor, once a starting capacitor has provided the necessary boost to get the electric motor spinning, to avoid possible motor damage the capacitor has to drop from the electrical circuit, leaving the motor to run on normal operating current.

Centrifugal switches: a mechanical centrifigual switch may be used to disconnect the starting capacitor when the motor speed has reached a critical rpm, typically about half of the motor's run speed.[2]

PTC-devices: Positive Temperature Coefficient devices are the traditional means of dropping the capacitor from the motor circuit once the motor has successfully started. PTC devices are basically a tiny electric heater that use the change in electrical resistance of the heating element to open an electrical switch that removes the start winding in the motor from the run circuit. The switch opens in less than a second after the motor has started.

PTC devices have the advantage of being simple and avoiding the need for more complex electrical wiring of a motor starting system. Supco explains that this device is unable to sense whether or not the motor has successfully started, and if the motor does not start, several minutes are needed to let the heater cool down before the motor restart can be attempted again. This cool-down time provides a safety margin that helps protect against burning out the windings of a hard-starting motor.

PRD-devices: Potential Relay Devices use voltage sensing (The Supco method) or current sensing devices (two different approaches) to determine when to release the starting capacitor from the motor run circuit. Supco points out that "The electronic potential relay is inherently more reliable and precise than the older type mechanical potential relay." [1]

Both of these start capacitor control approaches work fine, and typical HVAC or residential appliance motor repairs the technician won't need to consider which method is being used to control the capacitor as long as she/he follows the manufacturer's recommendations on the product for its selection and use.

How to Find, Choose, & Buy a Replacement Electric Motor Starting Capacitor

Table 1. Low voltage
110/125 V a.c. supply voltage 150 V r.m.s. max capacitor voltage.

Motor size	Typical capacitor value
kW	µ F
0,093	100/130
0,124	120/150
0,186	160/200
0,249	240/230
0,373	320/400
0,560	400/500
0,746	500/580

Table 2. Medium voltage
200/250 V a.c. supply voltage 275 V max capacitor voltage

Motor size	Typical capacitor value
kW	µ F
0,093	20/30
0,124	30/40
0,185	40/70
0,249	60/80
0,373	80/110
0,560	108/140
0,746	138/182

Table 3. High voltage 280 V a.c. supply voltage 350 V r.m.s. max capacitor voltage

Motor size	Typical capacitor value
kW	µF
0,093	26/37
0,124	37/51
0,186	51/68
0,249	68/90
0,373	90/115
0,560	105/130
0,746	130/165

The best option if you are replacing a starting capacitor or a start/run capacitor is to match the existing device on your system.

You can substitute capacitors on a cooling system but the substitute capacitor must be able to handle the voltage. For example you can't sub a 110V-rated capacitor into a 220V system. Depending on the application, the micro-farad range of starting capacitors varies according to the motor size. Run capacitors typically range in micro-farads from 1.5 to 50uf. Start capacitors typically range from 20-30 uf up to 250-300 uf. The example capactor charts (left) are adapted from AFCAP. [2]

You can also check a capacitor to compare its peformance with its microfarad rating by using an ohmeter. In a working capacitor ohms will build-up and then fall off (when the capacitor discharges). If you reverse the + and - leads of the DC ohmeter leads it will repeat. If you do not see any resistance in the capacitor then it has an internal short and it's shot - you need a new one.

HVAC suppliers sell general-use starting capacitors that are intended for use across a range of electrical motors and motor sizes.

But at least some industry sources (the Sealed Unit Parts Company or Supco) make a more careful argument explaining that it's best not to install a significantly oversized starting capacitor on an electric motor. According to Supco, [quoting]

If the start capacitor is too large for the application, the capacitor can actually mask the developed voltage in the start windings and keep the start capacitor in the circuit continuously. .... The ... run-start voltage is suppressed below the trigger voltage of the start device. As a result, the start capacitor remains in the circuit as the motor runs.

A secondary, fail-safe method is necessary to ensure that the start device is ultimately removed from the circuit. ... *A start device that fails to remove the start capacitor from the circuit has the potential to cause premature failure of the start windings in the compressor. ... If the capacitor is never removed from the start windings, premature winding failure could occur. As such, care should be taken when selecting capacitor sizes for an application.*

Care should also be taken regarding products that tout a "bigger capacitor is better" approach to compressor starting. SUPCO E-Class devices provide a secondary timing safety device to ensure that the start capacitor is dropped from the circuit in a fail-safe mode.
[Italics are ours-Ed.].

Field report: describes diagnosing & replacing a bad starter capacitor on a heat pump that had stopped working

Our Heat Pump was new in 2002. It is a 3 ton unit ProSeries brand by Service Masters. We just had a big birthday party at our house for my 1 year old daughter. 95 degrees outside. House full of Aunts, Uncles, friends, Great Grandparents. We got through that before the failure. Next morning it is just real gooey in our house. I can feel the blower fan is on. No cool air at all. I had to go to work so I left the house. Come back home in the mid afternoon to find house is hotter than before and my wife reports that the air hasn't been cooling at all. It's around 86-88 degrees in the house.

I check the little screw in fuse on the side of the blower unit. Hoping to find a $2 fuse blown. Nope. Fuse looks fine. Getting a little sense of panic because I remember how expensive our last service call cost for this heat pump. Plus it takes two days to get a technician to come out.

The key that I found on your web pages was the fact that the fan on the top of the condenser unit wasn't running and the Compressor wasn't running either. This pointed [possibly] to the start capacitor. In my system it is actually a pair of them, a dual capacitor unit. Aha! Finding the start capacitor took about twenty minutes. I work really slowly when I'm trying to not drop a handful of sheet metal screws in the grass [or worse into an electrical component where left in place a dangerous short circuit could occur].

I could see a little bit of bulging on the capacitor and some rust and grunge on the top.

I found a local HVAC Supply house in the phone book and read them the nomenclature from the side of the old Start Capacitor. The order clerk I spoke to was amazingly patient with me. About an hour and a half later I was plugging the new Start Capacitor in and flipping the circuit breaker back on. I put my hand on the coolant line and felt the copper getting cool fast. - James Oiler

Watch out: remember to turn off electrical power to any equipment before opening or working on it. Otherwise you could be electrocuted. Also, remember that an electrical capacitor can retain a large electrical charge even after electrical power has been turned off. You could still be shocked!

How to Install and Wire Up an Air Conditioner Compressor, Blower Motor, or Fan Motor Hard Starting Capacitor

The instructions that come with a starting capacitor are simple enough that they are often printed right on the capacitor itself.

Watch out: But be careful, failing to turn off electrical power, and failing to discharge a capacitor when working on electrical equipment can result in a nasty or even a fatal shock. See our motor starting capacitor safety warnings just below.

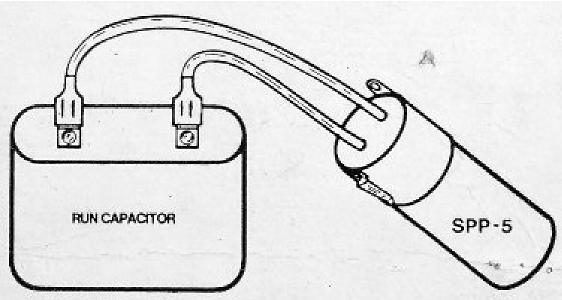
The particular starting capacitor to be purchased is matched to the horsepower range and voltage of the compressor or motor being repaired. Many motor starter capacitors to support a pretty wide range of motors. For example our sample capacitor was rated for use on 115V electric motors rated from 1/12 horsepower to 1/2 horsepower.

Prices for typical air conditioner compressor starter capacitors range from around $10. to $50. U.S.

Simple Relay and Hard Start Capacitor Instructions - Example 1

Relay and hard start capacitors such as the Starter Pow-R-Pak sold by Sealed Unit Parts Co., can be installed with no wiring changes to the original system whatsoever. Quoting from Part No. SPP-5, a relay and hard start capacitor sold by that company:

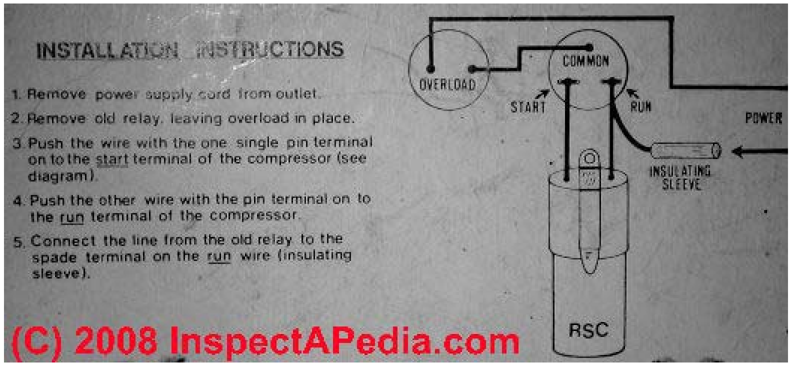
Connect the two wires from the SPP-5 in parallel with the [existing, already installed] run capacitor (one wire each side) without removing any original wires.



Use special "piggy back" terminal of the SPP-5 if all the run capacitor terminals are being used. [Install only on PSC units equipped with run capacitor.]

Simple Relay and Hard Start Capacitor Instructions - Example 2

Here are some sample capacitor installation instructions for adding a motor starter capacitor to an air conditioning compressor motor - taken from the product package for a relay and start capacitor intended for use on a refrigerator or freezer. Similar starter capacitors are available for air conditioning compressors.



1. Remove the power supply cord from the electrical outlet - in other words, be absolutely certain that electrical power has been turned off to the equipment being serviced.
2. Remove the old starting relay, leaving the old overload protection in place.
3. Push the wire with the one single pin terminal onto the "start" terminal of the air conditioning compressor. (See the wiring diagram above).
4. Push the other wire with the pin terminal onto the "run" terminal of the air conditioning compressor.
5. Connect the line from the old starting relay to the spade terminal on the "run" wire (insulating sleeve).
6. Restore electrical power

Start / Run Capacitor Mounting Positions

Start/run electric motor capacitors can be mounted in any direction or position. However there are some other capacitor mounting considerations that can affect capacitor life: basically you want to minimize the capacitor's exposure to vibration and heat.

As Afacp points out, ..."the temperature on the surface of the capacitor cannot exceed, even under the worst conditions, the maximum permitted temperature. It is advisable to make an experimental measurement of the temperature reached by the capacitor under the working conditions in the final application and after the thermal equilibrium has been achieved."[2]

Air Conditioner Motor Starting Capacitor Safety warnings:

When testing a compressor, one must discharge the capacitor first! It'll otherwise have enough power stored on it to be at least very painful. (Author and others have been zapped!) Some systems will automatically discharge the capacitor, but shorting its leads [to grounbd] with a screwdriver (after verifying that the power's off) is a safe way to ensure that you won't get shocked. Motor starting capacitors can hold a charge for days!

If oil has leaked out of a capacitor: Don't touch any oil that leaked out: old capacitors may contain PCB oils, an extremely carcinogenic (cancer causing) material which require special disposal.

Once the capacitor has been discharged (as described just above), then it can be tested with a multi meter. Either use the meter's built in capacitor test function, or use this trick: Charge the capacitor by using the sense current the meter puts out when set to ohms. You should observe a rapidly rising resistance before the meter indicates over range/infinity. Disconnect the test leads, and switch over to volts. Then, reconnect the test leads. A voltage reading should be observed, approaching zero.

If the capacitor doesn't hold a charge, or the resistance reading never approaches infinity, it probably needs replacement.

Also, the capacitor may be defective if the compressor hums but does not start. Visual inspection may reveal it to be bulged, or have a blown out safety plug.

Questions & Answers regarding this article

Questions & answers about installing a hard-start capacitor to get an air conditioner motor, fan motor, or other electric motor running.

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(July 20, 2012) DanJoeFriedman (mod) said:

Jeane wild guesses include that a power surge can kill a control circuit board or on occasion blow a start run capacitor.

(July 20, 2012) jeanne said:

My ac was running fine until we had a few power blinks.. Now the inside blower is working but, the fan outside will not come back on.. I've checked all breakers and turned the breaker off and on just to be sure... Any idea why the fan outside will not come back on??

(July 20, 2012) DanJoeFriedman (mod) said:

Jeremy, probably not. If your thermostat SET temperature is higher than the actual room temperature then the thermostat is NOT callling for cooling and the A/C system should not run.

(July 16, 2012) frank casupang said:

thank you this is very helpful and imformative subject.

(July 16, 2012) Jeremy said:

If it is normal that the outside central ac unit keep running all the time as soon as we turn the electrical box switch on. In order to stop it I have to turn the electrical box switch off.

(July 15, 2012) Anonymous said:

the motor just has a light buzzing noise when turned on. i kicked started the fan blades manually and the motor ran, but a little shaky. everything seemed to be running inside and out but the air was not cold after three to five minutes so i shut it down?

(July 15, 2012) DanJoeFriedman (mod) said:

Jana, you could wire caps in parallel, but if the one you installed is working properly and is the right size for the unit and the motor is still not starting I suspect there may be another problem. Try leaving the equipment off completely for two hours, then turning it back on. If the compressor starts easily then the problem could be difficulty starting against high head pressure.

(July 15, 2012) DanJoeFriedman (mod) said:

Thanks for the nice note Jessica, we work hard to make InspectApedia information accurate and useful, so we are really happy when we hear from a reader that an article is a success. We also welcome questions or content suggestions as it is of benefit to everyone. - Daniel

(July 15, 2012) Jana said:

Mine is just 3 years old it has hard start problem i changed the capacitor still same issue can i series tow capacitor?

(July 7, 2012) Jessica said:

Thank you for these awesome pages! We were able to replace our capacitor ourselves on our AC unit, saving a bundle! Thanks so much!

(showing 1 to 10)

Recommend / Share this Article

+1 ShareThis

EMAIL

Print

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also include a list of recommended books for the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

Starting Capacitor Safety

TIGHT or SEIZED AC COMPRESSORS

- Supco, Sealed Unit Parts Company, PO Box 21, 2230 Landmark Place, Allenwood, New Jersey, 08720, Tel: 732-223-6644, 201-449-3300, email: info@supco.com, provided the compressor starting capacitor and packaging information (purchased by the author from an air conditioning parts supplier in New York) - our example uses a Sealed Unit Parts Company Solid State part No. RSC 10 115V starting capacitor which was designed for installation on refrigerators and freezers. See www.supco.com/
- [1] "The E Class Advantage", Supco (op cit), describes the company's advanced start/run capacitor products. Web search 08/04/2011, original source: http://www.supco.com/eclassadvantage.htm. Quoting from that article:

  The SUPCO E-Class Series comprise the most advanced developments in start device technology:

  1. Voltage sensing technology that monitors for motor start (current sensing devices require internal fuse protection).
  2. A 2-wire connection that simplifies installation
  3. A secondary timing circuit that ensures that the capacitor is not permanently left in the start winding circuit
  4. A fully electronic device - minimizing the limitations of mechanical devices and secondary fusing associated with triac devices
  5. A start device matched with an appropriately sized capacitor to cover the range of compressors for the intended application (one size does not fit all)

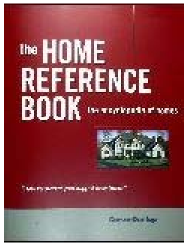
  The use of compressor start devices results from a need to ensure that a compressor (usually air conditioning) will start under voltage conditions that are less than ideal. As discussed, several options exist in the market to address compressor start concerns. Start devices exist in many forms for specific applications. SUPCO provides a full range of products in all relevant technologies to effectively match the proper start device to the application. Care should be taken to utilize a device that meets the requirements of the job. Extra caution should be observed when employing the "one-size-fits-all" and "a bigger capacitor is better" approach to applying a start device. Consult SUPCO, a manufacturer with a complete product range, to ensure the greatest success in the start device application.

- [2] "Motor Start and Run Capacitors", AFCAP (African Capacitors Limited), web search 08/05/2011, original source: http://www.afcap.co.za/manual/Part2.pdf
- [3] "Kenmore model 580. 75121 room unit air conditioner wiring diagram", Sears Roebuck window air conditioner wiring diagram for a typical room or window air conditioner
- George Fazio, reader, contributed comments on failed starter capacitor diagnosis by noting the bulged capacitor ends. 09/25/2009
- Troubleshooting Compressor Problems," Henry Puzio, ***Fuel Oil & Oil Heat with Air Conditioning*** Magazine, June 1993, p. 39
  Tom Morris, Engineer, capacitor discussion and correction to the original data. Email to D Friedman 5/29/2006 - Thanks Tom for critical editing. The text above explaining about capacitors was suggested by Mr. Morris. The original text of the 1993 compressor diagnosis article had the resistance explanation backwards.
- Thanks to reader Diane McGivney for asking about air conditioner compressor motor starting capacitor costs and typical air conditioner service call fees - (May 2010)
- Thanks to reader James Oiler for reporting on the replacement of a heat pump starter capacitor, August 2010.

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia Bookstore.

  - The Home Reference Book - the Encyclopedia of Homes, Carson Dunlop & Associates,



Toronto, Ontario, 2010, $69.00 U.S., is available from Carson Dunlop, and from the InspectAPedia bookstore. The 2010 edition of the Home Reference Book is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. InspectAPedia.com ® author/editor Daniel Friedman is a contributing author. Field inspection worksheets are included at the back of the volume.

- Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982
- Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- NEW!
  Air Conditioning SEER - New DOE Air Conditioner and Heat Pump Efficiency Standard
- Asbestos HVAC Ducts and Flues field identification photos and guide
- Fiberglass: Indoor Air Quality Investigations: Fiberglass in Indoor Air, HVAC ducts, and Building Insulation
- ...

InspectAPedia®

Free Encyclopedia of Building & Environmental Inspection, Testing, Diagnosis, Repair

Search
InspectAPedia

Ask a Question or Search InspectAPedia

HOME | AIR CONDITIONING | ELECTRICAL | EXTERIORS | HEATING | HOME INSPECTION | INTERIORS | PLUMBING | ROOFING | SEPTIC SYSTEMS | STRUCTURE | WATER SUPPLY

ENERGY SAVINGS | ENVIRONMENT | INDOOR AIR IAQ | INSULATION | MOLD INSPECT TEST REMOVE | NOISE | ODORS | SOLAR ENERGY | VENTILATION | EXPERTS DIRECTORY | CONTACT US

Mobile View
AIR CONDITIONING & HEAT PUMP SYSTEMS

A/C - HEAT PUMP CONTROLS & SWITCHES
Outside Switches, Fuses, Breakers
Inside Switches,Components
Air Handler / Blower Switches
Blower Door Switches
Backup Heat Controls
CAPILLARY TUBES
CIRCUIT BREAKER SIZE for A/C or HEAT PUMP
Compressor Condenser Switches, Controls
Condensate Overflow Switch
CONTACTOR RELAY DIAGNOSIS & REPAIR
CONTROL CIRCUIT BOARD, A/C
CRANKCASE HEATERS
FAN, COMPRESSOR/CONDENSER UNIT
Duct System Switches
Duct System Filters
OPERATING CONTROLS, A/C & HEAT PUMP

How to Diagnose & Repair Loss of Air Conditioner / Heat Pump Cooling Capacity or an Air Conditioner that is Not Working

InspectAPedia® - ShareThis +1

- How to diagnose & repair loss of air conditioning cooling capacity or has *stopped working* - Air conditioner repair checklist: before calling an air conditioning service technician check these items
- How to diagnose & repair *loss of heating or cooling capacity* from an A/C or heat pump system - weak air flow or air flow not at the right temperature
- Air conditioner repair checklist: before calling an air conditioning service technician check these items
- Air conditioner compressor defect diagnosis, How to diagnose and fix an air conditioning system that is not working
- Causes & cures of air conditioner or heat pump compressor hard starting or short cycling on and off
- Questions & Answers about air conditioner or heat pump system cooling diagnosis & repair

How to diagnose an air conditioner or heat pump that is not cooling: this article explains how to diagnose and correct air conditioning problems like lost or reduced air conditioner cooling capacity, reduced or no cool air flow, reduced or no actual lowering of the air temperaturer, or an air conditioner that won't start. If not enough cool air is provided by your air conditioner, or if the air temperature is not cool enough, or if you just can't get your A/C unit running, this article helps diagnose and correct the problem with step by step things to check and links to more detailed explanation when you need it.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

What to Check First if the Air Conditioner Output is Inadequate or A/C Won't Run

These Simple Checks May Enable Inexpensive Repair of Lost Cooling Output from an Air Conditioner

If you don't see information you want, ask us for it using the comments box on this page.

Is there no cool air at all coming out of the supply registers?

Or is there air blowing out of the supply registers but it's not cool enough?

Here we explain how to diagnose loss of air conditioning cool air flow or cool air temperature.

Before ordering an expensive air conditioner service call to restore lost cooling capacity, here are a few simple steps to perform. Some of these can be done by any homeowner, others may require a bit more expertise.

Below we provide first a very basic Air Conditioning or Heat Pump Diagnostic Checklist, followed by more detailed descriptions of common problem cooling system topics.

First try our air conditioner checklist just below - try these steps before calling your HVAC service company.

Following the checklist we provide more detailed descriptions, photos, and links to in-depth air conditioning inspection, diagnosis, and repair or improvement advice.

Where to start: check that the air conditioning equipment is turned on, the thermostat is calling for cooling, and that the blower unit or air handler is actually blowing air through the ductwork. Details of how to proceed in figuring out what's wrong with your air conditioner begin just below.

Air Conditioning Checklist for Lost Cooling: What to Do First in Air Conditioner / Heat Pump Tests

If the air conditioning system is not running at all:

1. Check the Room Thermostat Temperature Setting: Set the thermostat to at least 5 degrees below room temperature. Our elderly mom has no patience with switches and controls. She regularly calls her air conditioning service company with a service request, sometimes late at night, because she has simply failed to set the temperature on the thermostat lower

LONG-ON CYCLING AC COMPRESSOR
MOTOR OVERLOAD RESET SWITCH
NOISES, COMPRESSOR CONDENSER
Pressure Controls & Safety Switches
PRESSURE READINGS, COMPRESSOR
REPLACING A COMPRESSOR
SHORT CYCLING AC COMPRESSOR
TIGHT or SEIZED AC COMPRESSORS

CONDENSATE HANDLING, A/C
CONDENSATION or SWEATING PIPES, TANKS
CONDENSING COIL
COOL OFF HEAT Thermostat Switch
COOLING CAPACITY, RATED
COOLING COIL or EVAPORATOR COIL
DAMAGED COOLING COIL
DIRTY COOLING COIL
DIRTY COIL CLEANING PROCEDURES
FROST BUILD-UP on AIR CONDITIONER COILS
INCREASING RETURN AIR

DATA TAGS on AIR CONDITIONERS
DEFINITION of Heating & Cooling Terms
DEHUMIDIFICATION PROBLEMS
DEW POINT CALCULATION for WALLS
DEW POINT TABLE - CONDENSATION POINT GUIDE
DIAGNOSE & FIX AIR CONDITIONER / HEAT PUMP
DIAGNOSE & FIX HEATING PROBLEMS-BOILER
DIAGNOSE & FIX HEATING PROBLEMS-FURNACE
DUCT SYSTEM & DUCT DEFECTS
DUCTS - Asbestos
DUCT INSULATION, Asbestos Paper
DUCT INSULATION for SOUNDPROOFING
DUCT SYSTEM NOISES
DUCTS, Asbestos Transite Pipe
DUST CONTAMINATION FROM HVAC?

EDUCATION, HVAC SCHOOLS
ELECTRIC MOTOR DIAGNOSTIC GUIDE
ELECTRIC MOTOR OVERLOAD RESET SWITCH
ELECTRICAL POWER SWITCH FOR HEAT
ENERGY SAVINGS in buildings
EVAPORATOR COIL or COOLING COIL
EVAPORATIVE COOLING SYSTEMS
EXPANSION VALVES, REFRIGERANT

FAN, AIR HANDLER BLOWER UNIT
FAN AUTO ON Thermostat Switch
FAN, COMPRESSOR/CONDENSER UNIT
FAN CONVECTOR HEATERS - HYDRONIC COILS
FAN LIMIT SWITCH
FAN NOISES
FURNACES WARM AIR HEATING SYSTEMS

GAS EXPOSURE EFFECTS, TOXIC
GAS DETECTION & MEASUREMENT
GAUGE, REFRIGERATION PRESSURE TEST

than the room temperature. Don't drive your A/C like *our* mother.

2. Check that the Room Thermostat is set to "Cool" *not* "Off" or "Heat". If the thermostat is not set to "cool" it is simply turning off your A/C.
3. Check that electricity is on for the equipment. Check all switches and controls, including service switches, including outside by the compressor, inside at the air handler, and fuses or circuit breakers in the electrical panel.

   For example, condensate spilling into an overflow pan that uses a sensor switch can be enough to shut down your air conditioner. There are several switches and controls, both manual and automatic that can leave an air conditioner or heat pump turned "off" such as a blower compartment door interlock safety switch, an electric motor overload or overheat switches, and a condensate tray spillage detector switch.

   Watch out: See A/C - HEAT PUMP CONTROLS & SWITCHES to be sure you have found and checked *every* manual or automatic electrical switch on the system. A bad or failed starter capacitor could also be leaving your system shut down, failing to start a blower, fan, or compressor motor. Some hard-to-find switches could be keeping your air conditioner from starting, such as a Float Switch on Condensate Tray or a blower MOTOR OVERLOAD RESET SWITCH

If the air conditioning system is still not working, or if the A/C system is running but cool air is not coming out of the supply registers you probably need to call a service technician, but below are some things to check further yourself.

If At Least Some of the Air Conditioner or Heat Pump Equipment is Running but Cool Air is Not Being Delivered - 5 Quick Diagnostic Air Conditioning / Heat Pump System Checks to Get the Air Conditioner Running Again

The basic air conditioning diagnostic checks just below are followed by more detailed investigation of why the air conditioner is not working. But unless you already have a good idea of what's not working, start with these five steps.

If the air conditioning system is still not working, or if the A/C system is running but cool air is not coming out of the supply registers you probably need to call a service technician, but here are some things to check further yourself. Just *after* these checks we discuss what to do if the air conditioner is running but air flow is too weak (A/C Flow Too Weak) or too warm.

Step 1: Check the Outside Air Conditioning /Heat Pump Compressor-Condenser unit

Is the outdoor compressor-fan unit (COMPRESSOR & CONDENSING COIL) running?

If not, be sure that the outdoor compressor/condenser unit service switch and the air conditioner indoor power switch, fuse, or circuit breaker are all in the "on" position.

Check the outside compressor condensing coil for damage or blockage.

A blocked condensing coil can cause the compressor to overheat, stop running, or become noisy and work poorly. A/C Compressor Problems

If you cannot find your air conditioner controls and switches see A/C - HEAT PUMP CONTROLS & SWITCHES - list of controls and switches found on air conditioners and heat pumps

Also check the compressor/condenser outdoor fan and fan motor

Condensing unit fan diagnostics: at FAN, COMPRESSOR/CONDENSER UNIT we explain the diagnosis of problems with the compressor/condenser fan and fan motor.

At BURNED-OUT COMPRESSOR we explain that if the condensing unit fan is not working the compressor itself may shut down or even be ruined by overpressure or over temperature. Also see NOISES, COMPRESSOR CONDENSER where some noise problems are traced to the cooling fan .

Step 2: Check the Air Conditioning /Heat Pump Indoor Air Handler

Is the indoor blower unit running? If not be sure that the electrical power switch at your furnace or air conditioner air-handler is in the "on" position. Typically the air handler or blower unit is indoors inside the basement, crawl area, or attic.

Sometimes there is more than one switch, such as one right at the unit and another at the entry to the room where the equipment is located, or even upstairs on a higher floor if your air handler is in a basement or crawl space.

Make sure that the blower compartment cover or door is properly closed or an interlock switch may be keeping the system "off".

Also remember to check for a dirty, blocked COOLING COIL or EVAPORATOR COIL. A coil blocked by ice or dirt will not produce cool air. A/C Cooling Coil Icing.

Step 3: Check the Air Conditioning /Heat Pump Air Filter(s)

If your air conditioning equipment is running but little or no cool air is coming out of the supply registers, check that your air filter(s) have not become blocked with dirt and debris.

Usually the air filter is right at the air handler or blower unit, or your air filter may be installed behind a grille covering a central warm-air return that sends air back to the air handler. See A/C Filter Problems

Step 4: Check the Air Conditioning /Heat Pump system duct work & air supply registers

In ceilings, walls, or floors, where cool air is supposed to be delivered to various rooms in the building, be sure that the register is in the "open" position (you will be able to see through it into the ductwork) and be sure you haven't blocked the supply registers with a carpet or furniture.

Look for a duct damper or register that has been closed; look for a flex-duct section that has become disconnected, bent, or crimped or squashed. Remember that a duct may have become disconnected in an attic or crawl space.

Look for an air filter that has come loose and blown into the ductwork, clogging it.

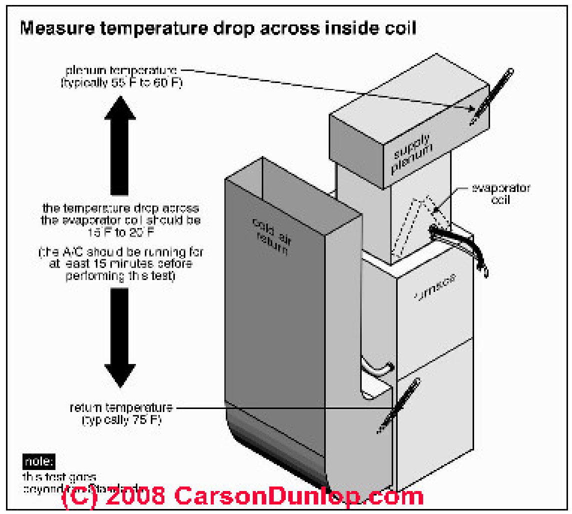
At left you can see a ceiling air supply register that has leak stains around its opening - further investigation for a condensate leak or roof leak is needed.

Step 5: Check the Air Conditioning /Heat Pump indoor air handler blower fan assembly

If the indoor air handler blower fan itself won't start, see BLOWER FAN OPERATION & TESTING. Check for lost power, a fan motor that wont' start or has tripped a motor reset button or needs a start / run capacitor. Check for a blower fan that is loose on the motor drive shaft or for a broken or lost blower fan drive belt on pulley-driven blower systems.

Also see ELECTRIC MOTOR DIAGNOSTIC GUIDE.

How to Diagnose Air Conditioner Output Cool Air Flow Too Weak, Too Cold, or Too Warm



Air Conditioner Blower fan unit not moving enough air: too little air coming out of your air conditioning ducts?

Check the condition of the blower unit: if it's dirty the blower may be spinning but not moving much air. See DIRTY A/C BLOWERS for details.

Dirty filters or iced coils or crimped or disconnected air ducts can also cause loss of cool air or too little cool air coming out of supply registers.

These items are addressed below in this air conditioner diagnostic guide. Also see DIRTY COOLING COIL and FROST BUILD-UP on AIR CONDITIONER COILS.

Sketch courtesy of Carson Dunlop Associates.

Air flow that is too slow for any reason (such as a dirty filter or dirty blower fan assembly blades) can cause first, air temperatures that are abnormally low coming out of the air conditioner, and eventually a reduction in air flow as coil ices over. See A/C Cooling Coil Icing.

Air flow that is too fast for any reason (improper fan motor, speed, fan belt or pulley size, duct design, duct registers removed, etc) can produce air that is not cool enough and can prevent proper air dehumidification (oversized A/C system). A/C Not Dehumidifying.

Check and Fix Existing Air Conditioning Problems Before Trying to ***Improve*** its Cooling Capacity

Watch out: It could be a mistake to spend on any costly air conditioning improvement if the original system actually already had the needed capacity, but simply needed maintenance (like replacing a filter - A/C Filter Problems) or repair (like repairing a leaky duct - A/C Air Duct Problems).

FIRST: review all of the air conditioning performance diagnosis suggestions here at - LOST COOLING CAPACITY to be sure there is not something that needs to be repaired or corrected with the system. For example we have seen cool air output significantly improved by finding and fixing a disconnected cool air duct that no one had noticed in a hard-to-access crawl area.

Certainly some central air conditioning systems, especially retrofit designs, have less than optimum duct design, such as inadequate central return air registers, room doors that are so tight that it is difficult to blow cool air into the room when the door is closed, inadequate supply ducts or less than optimum supply register placement such as only in floors. But redesigning and installing for an optimum air conditioning duct system can be costly, so it might be worth taking some other steps.

SECOND: make sure that other energy-savings steps have been taken in the building, such as proper insulation, sealing un-wanted drafts, etc. See ENERGY SAVINGS in buildings - those suggestions apply to both heating and cooling costs.

If your HVAC service technician is sure that the present cooling system is working as intended, then if you are not considering supply or return air duct improvements, or a replacement air conditioner system of higher capacity, you *might* consider a stronger blower fan (discuss what you could do with your HVAC tech), or booster fans individual registers.

Watch out - just boosting air conditioner air flow by installing a higher capacity blower fan is not that simple - if the blower moves air through the duct system faster than the design speed for the system ,the cooling coil may be insufficient in capacity, the air will not be dehumidified (and the building will be *less* comfortable - A/C Not Dehumidifying), or you might get annoying duct or equipment noises. Discuss these possibilities with your HVAC service company.

Air Conditioner Filter Clogging Problems Cause Weak Cool Air Flow

Clogged Air Conditioner filters can lead to lost cooling capacity first, because the clogged filter reduces the air flow through the system, meaning that you'll feel less air flow at the supply registers than was previously present.

See AIR FILTERS for HVAC SYSTEMS for details.

Air Filter problems: not enough air coming out of air conditioning ducts? Check for a very dirty, blocked air filter or blower fan. See AIR FILTERS for HVAC SYSTEMS and AIR HANDLER / BLOWER UNITS

Air Conditioner Compressor Problems - noisy or hard starting air conditioner compressors

Compressor problems - Air Conditioner Compressor: problems such as an aging air conditioner compressor motor that is at or near the end of its life may be unable to properly compress the returning refrigerant gas to a sufficiently high pressure. A service technician will need to evaluate and test the system and if needed, replace the compressor.

Since this is a costly repair, be sure to ask why the compressor failed and to correct any underlying cause (such as low voltage). Variations

in line voltage can lead to improper compressor operation and loss of cooling output.

If you have a hard-starting air conditioner compressor that "hums" but doesn't start, it may be possible to get more life out of the compressor motor with a simple starting capacitor (rather than a costly whole new compressor motor.) See and HARD STARTING COMPRESSOR MOTORS and CAPACITORS for HARD STARTING MOTORS.

We first mentioned at NOISES, COMPRESSOR CONDENSER that we had a field report from a reader who explained that a noisy outdoor compressor unit was, according to his HVAC service technician, traced to a blocked, clogged outdoor condensing coil. We speculate that perhaps the compressor was running hot and that correcting air flow across the condensing coil corrected that condition.

Air conditioner compressor problems, including compressor noises, hard starting, and burned-out compressors, are explained in detail beginning at COMPRESSOR & CONDENSING COIL and includes topics such as BURNED-OUT COMPRESSOR and MOTOR OVERLOAD RESET SWITCH.

COMPRESSOR/CONDENSER COOLING - Can Cooling Down the Air Conditioner Compressor Motor to Keep the A/C Working?

Several readers have described a step of cooling down an overheated air conditioning or heat pump compressor motor to get it running again producing cool air indoors. One reader used a garden hose to spray the outdoor unit (after all it's intended to tolerate being rained-on). Another used a watering can. A third, buckets of water.

All three reported that this step got their cooling system cooling again when before either the compressor had stopped running entirely or it was running but the system was not producing cool air. But for several reasons this is not an effective durable repair:

- The "repair" achieved by pouring water over a hot compressor is not lasting and if you wet electrical components it could cause damage or be dangerous
- It's hot standing outside dumping water on your A/C unit and you're not supposed to have to do that
- The loss of cooling means there is some problem to be found and fixed

While we wait for more comments from air conditioning service technicians and experts (CONTACT us), here are some interpretations of what may be going on:

1. The A/C compressor motor may be at or near end of life, running hot. An air conditioner motor that is overheating may turn itself off on thermal reset. In this case when the motor cools down it may automatically reset itself and start up again - for a while. Sometimes you can get a compressor motor starting again on its own by adding or replacing a starting capacitor - see CAPACITORS for HARD STARTING MOTORS. Also see MOTOR OVERLOAD RESET SWITCH. Also see HARD STARTING COMPRESSOR MOTORS.
2. The A/C compressor motor may be overheating due to its location: for example in hot sun. Most equipment will tolerate this condition but an older unit or very hot sunny conditions may lead to thermal

overheating and an overload circuit trip-off.

3. The A/C system compressor/condenser fan may not be running or may be damaged, failing to adequately cool the refrigerant gas in the condensing coils. Watch the fan to see that it is running while the compressor motor is on, and perhaps even before and after the compressor motor starts or stops. [But not indefinitely.]
4. The A/C condenser unit coils may be blocked, bent, dirty, damaged. It may be possible to clean the coils of leaves, dirt, grass kicked up by nearby mowing, etc. and thus improve the condenser operation and start making cool air again. COMPRESSOR & CONDENSING COIL
5. The air conditioning or heat pump system may be very low on refrigerant. You'll need a service technician to check and repair this condition. REFRIGERANT LEAK DETECTION

Air Conditioner Cooling Coil Icing Problems & Coil Leaks

Cooling Coil Ice-Up on the air conditioner air handler or evaporator coil: A second result of the reduced air flow due to a dirty air conditioning filter can cause the evaporator coil (the cooling coil) in the air handler to become blocked by ice, stopping or significantly reducing cool air output from the system.

A visual inspection of the cooling coil in the air handler can quickly show whether or not it's ice-covered. If the coil is iced-up and blocked, turn off the cooling system entirely until the ice has all evaporated and cleared. Be sure that your condensate drain is not blocked and that the water from melting ice will be properly disposed-of.

If you replace all dirty filters on the system and remove ice from an iced coil and the coil ices up again when the system is turned back on, you may have the next condition in this list.

For a detailed discussion of air conditioner or other refrigeration (or dehumidifier) cooling coil ice-up diagnosis and cure, see Air Conditioning Cooling Coil or Evaporator Coil Ice-up at FROST BUILD-UP on AIR CONDITIONER COILS

Cooling Coil (Evaporator Coil) Leaks, Condensing Coil Leaks: if your A/C system used to work fine but now is blowing only warm air, it is possible that you have lost refrigerant in the system. A refrigerant leak can occur anywhere in the refrigerant piping system, in the cooling coil, or in the condensing coil.

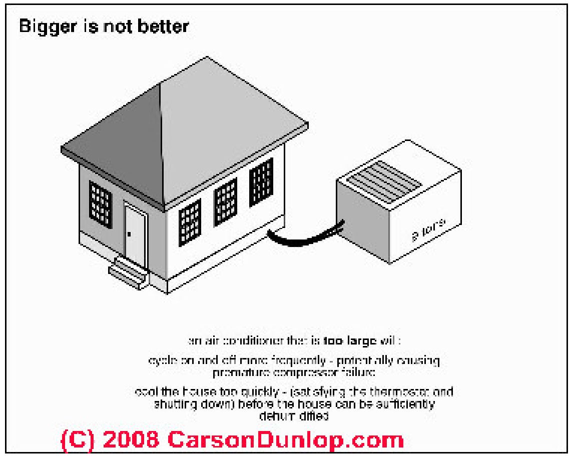
You'll need an HVAC technician to find and repair the leak problem. If the leak is in a refrigerant line it can usually be soldered and sealed and the system re-charged. If the leak is in a cooling coil or condensing coil, the coil probably needs to be replaced. We explain this topic in more detail below at Air Conditioner Refrigerant Problems - Refrigerant Leaks, Low Refrigerant, Wrong Temperatures.

Also see REFRIGERANT LEAK DETECTION and REFRIGERANT LEAK REPAIR.

Air Conditioning System Dehumidification Problem Diagnosis & Cures

Details about inadequate dehumidification by central air conditioning and heat pump systems are found at DEHUMIDIFICATION PROBLEMS. Excerpts are below.

Air Conditioning Dehumidification Problems: air conditioning system cools but does not dehumidify the room. The most common cause of inadequate dehumidification by an



air conditioning system is the installation of a cooling unit which has too much capacity, or is "over-sized" for the space it is being used to cool. What happens is simple:

If an air conditioning compressor unit is oversized (too many BTUH of cooling capacity) what happens is it cools the room so quickly that the system does not move enough total volume of air across the cooling coil to remove much moisture before the room temperature has dropped to the A/C cut-off point.

In other words, an air conditioner needs to run longer, and move more total volume of air through itself to drop room humidity than it does to just cool the air.

"Bigger" cooling capacity or higher BTU capacity for an air conditioning system is not necessarily better, and it can actually prevent the air conditioner from adequately dehumidifying indoor air.

Sketch courtesy of Carson Dunlop Associates.

See details about indoor dehumidification problem diagnosis and repair at DEHUMIDIFICATION PROBLEMS

We discuss the air conditioning system sizing problem at AIR CONDITIONER BTU CHART and while details are found at DEHUMIDIFICATION PROBLEMS, we also introduce the oversized air conditioner problem at LOST COOLING CAPACITY.

Also see COOLING RULES OF THUMB to guesstimate how many tons or BTUs of cooling a building needs and see RATED COOLING CAPACITY to determine the cooling capacity of existing air conditioning equipment.

Air Conditioning Air Duct Problems and Cool Air Flow Defects - Poor Air Flow

- Duct problems: Damaged Air Conditioning Ducts such as ducts which have been improperly routed

and are crimped, crushed, or have excessive bends can reduce cool air flow in an otherwise properly functioning system.

One client had us drive a considerable distance to repair her apartment's central air conditioning system after having had several unsuccessful service calls.

Apparently no one had managed to get into a rather tight and hard-to-enter attic crawl space where the cooling ducts were routed. We found that the main cooling duct had become disconnected.

The attic was nice and cool but no cool air was being blown into the living area. Check the condition of the duct system for blocked ducts, loose leaky connections, closed dampers, crimps and bends, before calling your service technician.

See DUCT SYSTEM DEFECTS for details of various A/C supply and return air duct and register problems and how to detect and correct them.

Air Conditioner Won't Start - electrical problems

As we stated earlier, check that electricity is on for the equipment, everywhere. Check all switches and controls, including service switches, including outside by the compressor, inside at the air handler, and fuses or circuit breakers in the electrical panel.

For example, condensate spilling into an overflow pan that uses a sensor switch can be enough to shut down your air conditioner. There are several switches and controls, both manual and automatic that can leave an air conditioner or heat pump turned "off" such as a blower compartment door interlock safety switch, an electric motor overload or overheat switches, and a condensate tray spillage detector switch

See A/C - HEAT PUMP CONTROLS & SWITCHES to be sure you have found and checked every manual or automatic electrical switch on the system. A bad or failed starter capacitor could also be leaving your system shut down, failing to start a blower, fan, or compressor motor.

Electrical problems: air conditioning system won't start: it may sound silly, but is the air conditioner turned on?

Has the cooling thermostat been set to "cool" and the temperature set below ambient room temperature?

Do both the outdoor compressor/condenser unit and the indoor blower fan/evaporator coil unit have electrical power?

Has the air conditioning electrical wiring been physically damaged or cut? Photo courtesy of Tim Hemm.

Are the power switches on at these units, are the fuses good, are the circuit breakers in the "on" position, and is the thermostat set correctly? See A/C - HEAT PUMP CONTROLS & SWITCHES and THERMOSTATS for some diagnostic tips.

Air conditioner compressor problems, including compressor noises, hard starting, and burned-out compressors, are explained in detail beginning at COMPRESSOR & CONDENSING COIL and including topics such as BURNED-OUT COMPRESSOR and HARD STARTING COMPRESSOR MOTORS and MOTOR OVERLOAD RESET SWITCH and ELECTRIC MOTOR DIAGNOSTIC GUIDE.

Air Conditioner Won't Start or Stays Off Due to Condensate Pan Switch

Condensate pan switch lockout: an attic or other air conditioner air handler condensate drip tray or drip pan located under an air handler is installed to catch air handler condensate leaks if the normal condensate drain system fails. Some condensate pans have their own separate overflow drain (a proper installation) or share their drain with the normal condensate drain (an improper installation).

But on some air conditioning air handlers the installer may provide a condensate overflow pan switch rather than a separate pan drain line. In this installation the switch is designed to turn off the air conditioning system if it finds condensate water in the overflow pan. The idea is to shut down the air conditioner before there is a more costly leak into the building insulation or ceiling.

Condensate leaks into the condensate pan can shut down the air conditioner.

In tracking down an air conditioner condensate leak, I found that the the condensate pump drain line, a small-diameter PVC pipe, was clogged with water mold. That was why my air conditioner wasn't kicking on. It would of ended up costing at least a hundred dollars just for a service tech to fix something as simple as that. I had to take the pump apart and clean it. I took off the PVC drain line coming out of inside air conditioner and blow and clean it all out too. - Jacob Behrends, FL

So if your air conditioning system seems to be normal in all other respects but it simply won't turn on, check for a flooded condensate pan or a defective condensate switch. See DRIP TRAY DEFECTS and also Use of float switches on air conditioning condensate overflow pans. Also see CONDENSATE DRAIN CLEAN & DE-CLOG and CONDENSATE TRAY CLEANING.

Air Conditioner Refrigerant Problems - Refrigerant Leaks, Low Refrigerant, Wrong Temperatures

Refrigerant problems: Improper air conditioner refrigerant charge - too little, too much, too leaky: an air conditioner system which has lost some (but not most) of its refrigerant will sometimes run too cold at the evaporator coil, leading to coil icing and loss of cool air delivery in the home.

If the filters are clean and the coil ices-up this condition may be present. A service technician will need to evaluate and test the system and if needed, adjust the refrigerant charge.

See REFRIGERANTS & PIPING, see REFRIGERANT LEAK REPAIR see PRESSURE READINGS, COMPRESSOR, and A/C REFRIGERANT LEAK DETECTION for more details.

- Low refrigerant level in the air conditioning system: Watch out for refrigerant leaks that lead to a repeat of this problem. An air conditioner or refrigerator is a sealed system that should not normally "use up" refrigerant. If the cooling system is low on refrigerant because it has a leak, it is much smarter to find and fix the leak than to simply keep adding refrigerant. If you keep adding refrigerant to a cooling system you're leaking possible contaminants into the environment as well as wasting money.

  Abnormally low output air temperature: A refrigerant leak in an air conditioning system may show up first as abnormally low system output air temperature, followed by rising air temperatures, followed by just plain old warm air coming out of the system, as the amount of refrigerant that has been lost increases.

- Loss of most refrigerant from an air conditioning system means that the cooling coil will not get cool at all.

  Abnormally high output air temperature: A service technician will need to evaluate and test the system and if needed, find and fix the refrigerant leak, evacuate the system, and install the proper refrigerant charge. See A/C REFRIGERANT LEAK DETECTION for diagnostic details.

  Don't keep adding refrigerant. Refrigerant leaks should be found and repaired. It may be easier to keep adding refrigerant, and sometimes a refrigerant leak can be hard to find, but a proper repair is to find an fix the refrigerant leak, not just to keep adding refrigerant. See REFRIGERANT LEAK DETECTION. See A/C REFRIGERANT LEAK DETECTION for details.

- Improper refrigerant charge - too much can also lead to improper air conditioning system operation and in some cases can damage the compressor (called liquid-slugging the air conditioner compressor). A service technician will need to evaluate and test the system and if needed, adjust the refrigerant charge. In this case the cooling coil is probably not going to ice-over, it just won't get cool.

Air Conditioner Won't Start - Blower Fan Will Not Turn on or Will Not Turn Off

Thermostat problems: Air Conditioner Thermostats:

Air conditioner won't turn on, or fan won't turn on or won't turn off.

See THERMOSTATS for a discussion of how air conditioner thermostats work and how the air conditioner blower fan controls work.

Air Conditioner Air Handler Blower motor Won't Start?

See MOTOR OVERLOAD RESET SWITCH just to be sure that the air handler blower fan motor has not shut off on thermal overload. And if your blower fan is driven by a fan belt and an electric motor, of course check to see that the drive belt is in place and un-damaged. If the blower fan belt is broken the electric motor will run just fine (you may be able to hear it) but the blower fan assembly itself won't be turning.

Air Conditioner Compressor Diagnosis: How to Diagnose & Repair an Air Conditioner Compressor Which has Lost Cooling Capacity

A compressor which appears to have lost cooling capacity can be diagnosed by a service technician who can connect the appropriate test gauges to the system. Lower than normal discharge pressure and higher than normal suction vacuum will indicate this problem.

But before assuming that something is wrong with the air conditioning compressor, some basic investigation is in order. Unless there is an obvious indication of a compressor problem (noise, hard starting, compressor won't start), the service technician, to be thorough and economical, will inspect the system in an order, checking the easy and least-costly problems first, such as presence of electrical power, proper setting and operation of system controls, condition of filters, condition of duct work, operation of blower fans, before moving on to check the compressor itself by looking at the air conditioner operating temperatures, pressures, and current draw in Amps.

Cooling Capacity of the Air Conditioning Equipment

The cooling capacity of an air conditioning *equipment* refers to the ability of the compressor/condenser (usually outside) and the air handler/evaporator (usually inside) to deliver cool air to the occupied space.

Briefly, the compressor/condenser draws refrigerant gas from the building air handler, compresses it and cools it back to a liquid refrigerant, and the air handler/evaporator coil permits liquid refrigerant to evaporate inside a cooling coil, across which the fan blows building air to cool and dehumidify it.

The particular combination of this equipment has a cooling capacity, usually rated in BTUh or thousands of BTU's of cooling capacity per hour, documented on equipment data tags discussed at RATED COOLING CAPACITY.

Also see COOLING RULES OF THUMB to guesstimate how many tons or BTUs of cooling a building needs and see RATED COOLING CAPACITY to determine the cooling capacity of existing air conditioning equipment.

Air Conditioner Long on cycle and Insufficient Cooling - Loose or Worn Compressors

A longer than normal on cycle combined with little or no cool air conditioner output could be due to an inefficient air conditioning compressor or one which has lost its ability to "compress" the refrigerant due to internal wear. This condition can be diagnosed by an air conditioning service technician who will install air conditioning manifold gauges onto the system to check the compressor suction vacuum and discharge or "high side" output pressure. If gauge ports are not installed on the air conditioner compressor unit the technician cannot make this test without cutting the refrigerant lines to install gauge ports (adding to the cost of this diagnosis).

Low air conditioner motor amperage draw

Low amperage draw: unlike a high-amp current draw which indicates that the compressor is danged internally in a way that its piston(s) is(are) tight in the cylinder, a low-amp current draw, if below normal, may confirm internal wear on the compressor parts, and would support the diagnosis that the compressor is worn and inefficient. Where there are no gauge ports to actually measure compressor low side and high side vacuum and pressure, this simple electrical test is a useful first step.

If you have the opposite concern, that is the A/C compressor is turning on and off too frequently, see SHORT CYCLING AC COMPRESSOR.

Abnormal air conditioner compressor pressure readings

Refrigerant line pressure readings which are abnormal (probably too low) on the high pressure side (compressor output) or on the low pressure side (compressor input or suction line) can indicate a problem with the compressor's ability to develop normal operating pressure ranges and thus will affect the cooling capacity of the air conditioning system. For more details on air conditioner refrigerant line pressures and how they are examined see COMPRESSOR PRESSURE READINGS

Details about air conditioning compressor functions, how air conditioner compressors work, what goes wrong with air conditioner compressors, and how to measure and diagnose air conditioner compressors are provided at COMPRESSOR CONDENSER.

Cooling Capacity of the Air Conditioning Duct System

Even if a very high BTUH capacity cooling system is installed, if the duct system is defective the ability of the system to deliver cool air to the occupied space can be severely or even totally lost.

Duct System Efficiency (in percent) describes the percent of cooled air produced by the A/C equipment which is actually delivered to the occupied space. This number is less than 100% because of air flow restrictions and losses in the duct work.

Duct Delivery Effectiveness is the percent of cooling capacity which is delivered through the registers into the occupied space. Registers themselves restrict air flow. See DUCT SYSTEM & DUCT DEFECTS - see links at left.

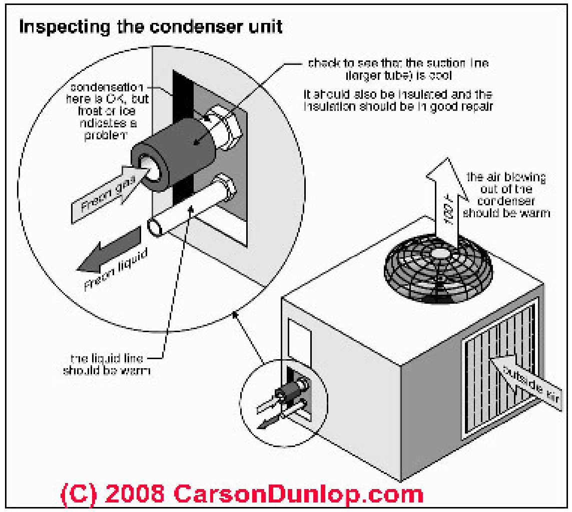
Cooling Capacity of the Whole Air Conditioning System

So the ability of the entire A/C system to cool a building or rooms in it requires that both the cooling equipment and the duct system be in proper working order.

Details about duct system and air handler diagnosis, including duct defects, air filter defects, and air handler problems are provided at AIR HANDLER UNIT: problems with the air handler, air filters, and the cooling coil itself.

How to diagnose and fix an air conditioning system that is not working

If your air conditioning system won't work, follow our diagnostic guides



- At LOST COOLING CAPACITY, our focus is on the case in which the air conditioning system seems to be "running" but not enough cool air, or no cool air at all is being delivered to the occupied space. Sketch from Carson Dunlop Associates.
- At OPERATING DEFECTS we take you through the major air conditioning problem symptoms and how to get the air conditioning system working again.
- At A/C - HEAT PUMP CONTROLS & SWITCHES we explain the many electrical switches and controls that control an air conditioner or heat pump system. You'll need to check these if your air conditioner won't start.

  See our complete list of air conditioning system diagnostic and repair guide articles just below.

  Sketch courtesy of Carson Dunlop Associates.

Since the failure of an air conditioner to turn on, loss of air conditioner cooling capacity, reduced air conditioning output temperatures, loss of cool air supply, or even loss of air flow entirely can be due to a variety of problems with one or more components of an air conditioner or air conditioning system, *after reviewing the lost air conditioner cooling diagnosis procedures described in this article,* be sure to also review the diagnostic procedures at each of the individual air conditioning diagnosis and repair major topics listed just below. To return to our air conditioning and refrigeration home page go to AIR CONDITIONING & HEAT PUMP SYSTEMS.

If your air conditioning or heat pump system has lost its cooling capacity or won't start select one or more of the diagnostic articles listed below.

Frequently Asked Questions (FAQs) on How to Diagnose & Fix A Cooling System Air Conditioner or Heat Pump that is Not Working or has Lost Cooling Capacity

Question: My Air Conditioner won't turn off - what to do?

Carla said: My outside air unit will not turn off on its own. I have to manually turn the breaker off to turn it off. Does anyone know why or how I can fix it?

Reply:

Carla if your A/C won't turn off it could be that the thermostat is set to a temperature that the system cannot reach - due to lost cooling or due to a setting below the capability of the system. If your A/C won't turn off even if you set the thermostat to a temperature that is above the current room temp, then the thermostat or an A/C control board or switch is bad and needs replacement - in that case you need a service call from a trained HVAC Technician. See OPERATING TEMPERATURES and also CONTROLS & SWITCHES, A/C - HEAT PUMP

Question: My Air Conditioner (or heat pump) keeps cycling on and off too rapidly - what might be wrong? short A/C on-cycle problems

Joe said: short cycling air conditioner compressor diagnosis: I have the same problem as Mathew: my A/C compressor cycles on and of every ~10 seconds. I is about 5yr old. What can we do to fix this system. Please help. Thanks!

Matthew said: short cycling air conditioner problems: Our air conditioning compressor cycles on and of every few seconds or minutes. What can we do to fix this systems not even a year old

Five causes of a home air conditioner compressor short cycling on and off too rapidly - Short Cycling Air Conditioner Diagnosis & Repair

DanJoeFriedman (mod) said to Joe and Matthew (re questions just above):

1. Loss of air conditioner refrigerant - a refrigerant leak in the system. You may be able to repair the short cycling problem temporarily by recharging the air conditioning system but the proper repair is to find and fix the leak. Otherwise you will have to keep repeating the costly service call to just add refrigerant. See REFRIGERANT LEAK DETECTION.
2. A/C Coil Icing - the evaporator coil (cooling coil) is iced over (such as due to improper refrigerant charge or dirt or a reduced air flow due to a dirty filter) - take a look in the air handler to see if the coil is blocked by ice or dirt.See FROST BUILD-UP on AIR CONDITIONER COILS
3. Oversized air conditioner - if the short cycling has always been a problem since the day the system was installed, there is a good chance that the unit is too big (too many BTUS) for the space being cooled. A more subtle version of this same problem is that you've done something like closing doors or adding a partition that had the effect of reducing the size of the space being cooled. Sometimes we can mitigate this problem by running the blower fan at a lower speed or by opening interior doors to increase the size of the space being cooled or even by moving the thermostat. See AIR CONDITIONER BTU CHART and OPERATING TEMPERATURES
4. A/C control problem - it's less likely, but a damaged control board or switch could also be causing rapid equipment on-[off cycling.
5. Compressor damage or compressor start-troubles: - I've seen these other causes of air conditioner short cycling: if someone manually turns the air conditioner thermostat up and down or on and off too frequently, a hard-starting compressor may find that it has been shut down with high internal head pressure inside the compressor. Normally that head pressure bleeds off over time, making it easier for the compressor to re-start (against low head pressure) the next time it turns on. See HARD STARTING COMPRESSOR MOTORS

   But if someone is turning the system on and off quickly, the compressor may have a hard time re-starting against the pressure on its outlet side. A starter capacitor addition or replacement might fix the problem. If your A/C compressor is showing this symptom but works OK if you leave it shut off for 30 minutes or longer, that may be the trouble.

   We have also see or a damaged compressor internal refrigerant valve causing high head pressures;

In sum, you need a service call from a professional to correctly diagnose and repair the problem. Ask the service tech what she/he found and let us know - what you find will help other readers.

If your air conditioner or heat pump has the opposite problem, staying on too long, see LONG-ON CYCLING AC COMPRESSOR.

Question: Why is my A/C not producing enough cool air?

A/C not producing enough cool air - I had my air conditioning system gassed up last week - $210. ! The unit is not producing enough cold air. The unit is set on 72 and does great at nights but during the day where the temp. outside is reaching mid 90"s it's getting up to 80 in the house. Is my duct work screwed up? How do you repair trailer metal ducting? - Amanda

90 degrees outside and 83 inside with thermometer at 76. Cools off to 76 when sun starts to go down and house then gets cold. New capacitor and condensor just put in. Help. - Ginny 5/17/12

Reply:

Amanda: if your system is not cooling there could be any of a number of problems - see the article above as a place to start. If your basic complaint is that the A/C temperature at the supply registers is cool enough but the volume of air flow is too weak, we'd start by:

- Install a new clean air filter
- Check that the air supply registers are open
- Check that ductwork has not become disconnected or crimped or crushed
- See DUCT SYSTEM & DUCT DEFECTS where we list quite a few steps in diagnosing poor air flow out of an HVAC duct system

Weak air conditioner air flow - is there a relationship between refrigerant charge level and weak cool air flow rate?

Les said: Weak air conditioner air flow: Our A/C was serviced two months ago and the repairman said it had a leak. $400 later it was recharged with coolant and now the ac is doing the same thing. Very little pressure coming out of vents and no cold air coming out. Does anyone know what I can do for the weekend? It is stifling!!!! See A/C Air Duct Problems

DanJoeFriedman (mod) said:

Les: A leak that was fixed by a re-charge is not as good a repair as a leak that was fixed by finding and fixing the leak - you'll just have to keep adding refrigerant.

But weak air flow out of the vents would not be due to a refrigerant leak; more likely a clogged filter or crushed or disconnected ductwork, or a blower fan problem.

Weak air Flow traced to Clogged Air Filters: Can Clogged Air Filters Affect the Room Thermostat?

(May 13, 2011) Jim said: If air conditioner filters are clogged will it cause the thermostat to shut off?

Jim: clogged A/C filters won't cause a room thermostat to shut off. The thermostat responds to room temperature. However clogged A/C filters that reduce air flow, cause coil frosting, or otherwise reduce or stop the flow of cool air into the room where the thermostat is located would mean that the thermostat would remain "un-satisfied" and should mean that the thermostat says "on" - continuing to call for cooling. See AIR FILTERS for HVAC SYSTEMS

Air Filters & Cooling System Amperage Draw: Could Removing the Air Filters Cause the Electric Motor in the Air Handler to Draw Higher Amps?

Question: got one for you. i put an ammeter on my air handler and it read 8.25 amps, I removed the filters and it went up to 9.75 lmao at the situation the amperage should have gone down. what gives here

Reply: causes of variations in electric motor efficiency and current draw measured in amps

Lost: this amps variation is beyond my expertise, but in general reducing the load on an electric motor will show up as *lower* amps or current draw, not higher amps. Here are two interesting explanations of amps or current variations on an electric motor that I found when researching the question:

1. Voltage variations and current draw at electric motors: If your supply voltage is varying from your power company that can show up as higher amps draw on the motor (though it's a suspicious coincidence to see it exactly when you removed the filters and supposedly reduced the load on the motor). Quoting from motorsanddrives [dot] com: "*The effect of low voltage on electric motors is pretty widely known and ... The amount of power the motor draws is roughly related to the voltage times current (amps). Thus, when voltage gets low, the current must get higher to provide the same ... To summarize the situation, low voltage can cause high currents"*

2. Load variations and electric motor efficiency: A second possible source of seeing higher amps or current draw on your blower motor when you pulled out the air filters and thus reduced the load on the blower motor might be illuminated by this U.S. DOE pamphlet "Determining Electric Motor Load and Efficiency" - Quoting: "*Most electric motors are designed to run at 50% to 100% of rated load. Maximum efficiency is usually near 75% of rated load. Thus, a 10-horsepower (hp) motor has an acceptable load range of 5 to 10 hp; peak efficiency is at 7.5 hp. A motor's efficiency tends to decrease dramatically below about 50% load.*"

Question: what causes warm suction lines in an air conditioner or heat pump system? Warm A/C suction line (should be cold) and zone control dampers that stopped working

JMONTE said: warm A/C suction line question: After my condenser is turned on for about 4 minutes the suction line starts to get warm to the touch. can you tell me what the problem may be

Reply:

JMONTE: If the HVAC suction line gets warm, you may be out of refrigerant, or the system may be running in heating mode if it's a heat pump. See OPERATING TEMPERATURES.

Becky, If a motorized HVAC zone control damper is not opening or closing, most likely the motor has failed, or the thermostat that operates that zone control is off or set in an incorrect position. See ZONE DAMPER CONTROLS

Becky said: motorized air conditioning zone dampers not working

My house has "zone" control with dampeners to close off the upstairs over the garage room unless that thermostat is on - the room is not cooling. I have located the damper under the house. What are some causes for the damper not opening and how to repair them? condensation, motor to damper? silicon glued properly?

x

Questions & Answers regarding this article

Questions & Answers about air conditioner system diagnosis & repair

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(July 30, 2012) DanJoeFriedman (mod) said:

Don, did you call the HVAC tech who installed your Goodman A/C compressor just a month ago? Surely the tech will want to return to check and fix the trouble.

(July 29, 2012) Don said:

I just had a 900.00 compressor replacement on a goodman ac... about a month later, it quit cooling. Reading this i checked for ice and found the inside unit is about 20% iced over(iced on bottom part). Before I found the ice, and before i turned the unit off I found that the outside lines seem to be backwards (the larger pipe is hot and the smaller pipe is cold)the smaller pipe inside is cold too. Is this normal for an iced up unit? Is it posible they x-crossed the lines while installing the compressor? I turned the unit off and just have the fan alone blowing to let it defrost faster. Would like to see if I can get an answer to this before turning it back on and messing it up worse.

(July 28, 2012) DanJoeFriedman (mod) said:

Viv,

Yes indeed an animal shorting out electrical wiring terminals at a start/run capacitor can destroy the capacitor or other components.

(July 27, 2012) DanJoeFriedman (mod) said:

K Shipman

If air is coming out of your vents but is not cool and the outside compressor/condenser is not running then at least we know the problem is probably there - or in a control or control board. If your compressor has been replaced and failed repeatedly something's wrong, perhaps an incomplete diagnosis, dirt in the system, or a diagnosis problem. Have a polite conversation with your HVAC service company's service manager and review the history and ask for a senior technician to help figure out what's wrong.

PEdwards:

We don't know if the problem is in the outdoor condenser unit's compressor motor itself or something nicer like a bad start/run capacitor or relay or wire or control. It's worth asking for help from someone with experience and training.

(July 25, 2012) KShipman said:

about half way through the day yesterday my house temp started climbing and when i look at my thermostat it said 81! i had it set at 73. I go to look outside to see if my unit was working or the fan was turning, nothing! the air coming out of my vents is lukewarm at best. someone suggested it could be my contactor, but i looked at it, no burned or rusty spots. we just had our compressor replaced in march. it had broken two times before that! so over this unit constantly breaking down, HELP!

(July 24, 2012) PEdwards said:

My central air conditioner has been working fine...albeit often but now it's only blowing warm air. When I turn on the A/C and go to the outside unit, I hear a distinct difference about 10-15 seconds after the fan kicks on. The fan will continue to run but I don't hear what I believe to be the condenser. Your article suggests one of the root causes could be malfunctioning parts internal to the compressor. Could this be a DIY (testing and/or repair) considering I have very little experience in HVAC.
Regards.

(July 21, 2012) Viv said:

I found a fried lizard laying across what appears to be the terminals to a large capacitor. The AC will not kick on. Could this have shorted it? It is a RUUD unit.

(July 21, 2012) qazi said:

my split is not showing any sign after voltage suddenly increases . is there any fuse problum or compressor damage ?

(July 20, 2012) DanJoeFriedman (mod) said:

I add to anon's suggestions that cleaning even a small amount of dirt off of a squirrel cage blower fan makes a huge improvement in air flow. Try that first, working meticulously.

Second, going to a pleated filter can give good filtration while, thanks to the larger surface area, much less restricts air flow.

(July 20, 2012) Anonymous said:

@ Mike

I would look into replacing the filter with a more flow-efficient type that would increase the airflow and still provide proper air filtration ... It could be that you are using HEPA rated filters rather than standard filters, and if you dont need the HEPA rated filtration you could quite nicely do without it...

Aside from that option, replacing your fan or blower unit may prove feasible. It may be that your current fan or blower is dying on you or you just need a more powerful unit to blow air through thick air filters (especially if you are using HEPA filters and you need to keep them for health concerns...)

(showing 1 to 10)

Recommend / Share this Article

+1 ShareThis
EMAIL
Print

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Carson, Dunlop & Associates Ltd., 120 Carlton Street Suite 407, Toronto ON M5A 4K2. (416) 964-9415 1-800-268-7070 info@carsondunlop.com. The firm provides professional home inspection services & home inspection education & publications. Alan Carson is a past president of ASHI, the American Society of Home Inspectors. Thanks to Alan Carson and Bob Dunlop, for permission for InspectAPedia to use text excerpts from *The Home Reference Book* & illustrations from *The Illustrated Home*. Carson Dunlop Associates' home inspection education products include
  - The ASHI-adopted Home Inspection Training Program, and Commercial Building Inspection Courses
  - The Home Inspection Home Study Course, and publications such as
  - The Home Reference Book, a reference & inspection report product for building owners & inspectors
  - The Home Reference *eBook*, an electronic version for PCs, the iPad, iPhone, & Android smart phones
  - Home Inspection Report writing materials, including the Horizon Software System that manages business operations, scheduling, & inspection report writing using Carson Dunlop's knowledge base & color images. The *Horizon* system runs on always-available cloud-based software for office computers, laptops, tablets, iPad, Android, & other smartphones.
  - The Illustrated Home illustrates construction details and building components, a reference for owners & inspectors
- Timothy Hemm, Yucala, CA, contributed photographs of electrical wiring and equipment installed in California buildings. Mr. Hemm can be contacted at TimHemm@yahoo.com

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

LOST COOLING CAPACITY
- What to Check First
- A/C Flow Too Weak
- A/C Filter Problems
- A/C Compressor Problems
- A/C Off - Condensate Pan Switch
- A/C Cooling Coil Icing
- A/C Not Dehumidifying
- A/C Air Duct Problems
- Air Conditioner Won't Start
- Air Conditioner Refrigerant Problems
- Blower Fan No Start / No Stop
- Compressor Diagnosis: Diagnose & Repair
- Cooling Capacity of the Duct System
- Repair Guide Master List

- See our detailed list of links to HVACR diagnostic articles at page left
- A/C - HEAT PUMP CONTROLS & SWITCHES: air conditioner controls and switches - begin here if your A/C won't start. Here's an important tip: *most refrigeration problems, in air conditioners, refrigerators, or freezers, are electrical, not mechanical.* In air conditioning school, we used to drive out and collect abandoned refrigerators that people were tossing out during our community's spring cleanup week. Taking these appliances back into the shop we found that almost always the problem that had caused the owner to dispose of their air conditioner or freezer was in an electrical connection or electrical control. So it's worth checking out switches and controls on an air conditioner before replacing more costly components.
- OPERATING DEFECTS: major air conditioning problem symptoms and how to get the air conditioning system working again,e.g. compressor or fan noises, failure to start, and inadequate cool air volume
- LOST COOLING CAPACITY: what to do when not enough cool air comes out of the system
    - What to check first if there is no cool air or not enough cool air
    - Compressor failure diagnosis: basic checks of the air conditioner compressor
    - Ducts & Air Handler diagnosis: basic checks of the indoor air handler (blower), air ducts, and filter systems
- COMPRESSOR CONDENSER: problems with air conditioner compressor/condenser units
- AIR HANDLER UNIT: problems with the air handler, air filters, and the cooling coil itself
- DUCT SYSTEM DEFECTS: problems with the air duct system, air filters, supply registers, return air registers
- A/C REFRIGERANT LEAK DETECTION: how to use a TIF5000 to detect air conditioning refrigerant gas leak
- A/C DIAGNOSTIC FAQs: air conditioning system diagnostic FAQs: Q&A about air conditioner repair - a detailed air conditioning system diagnostic checklist

- Thanks to reader and research scientist Cyril Roberts, Barbados, for technical discussion and investigation of air conditioning system dehumidification problems (April 2009).
- Thanks to readers Beth & Dennis for asking about how to improve an inadequate air conditioning system supplying cool air through crawl space ducts and floor registers. (May 2010).
- Thanks to reader William Smith for discussing cooling coil leaks and lost cooling capacity diagnosis - June 2010
- Thanks to reader Jacob Behrends, FL for discussing how a clogged condensate drain line can overflow condensate into a condensate pan that in turn may contain a safety switch that shuts down the whole air conditioning system. August 2010.

- CARSONDUNLOP Carson, Dunlop & Associates Ltd., 120 Carlton Street Suite 407, Toronto ON M5A 4K2. (416) 964-9415 1-800-268-7070 info@carsondunlop.com. The firm provides professional home inspection services & home inspection education & publications. Alan Carson is a past president of ASHI, the American Society of

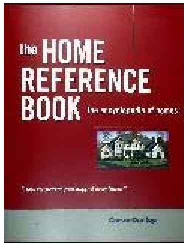
Home Inspectors. Thanks to Alan Carson and Bob Dunlop, for permission for InspectAPedia to use text excerpts from *The Home Reference Book* & illustrations from *The Illustrated Home*. Carson Dunlop Associates' home inspection education products include

- The ASHI-adopted Home Inspection Training Program, and Commercial Building Inspection Courses
- The Home Inspection Home Study Course, and publications such as
- The Home Reference Book, a reference & inspection report product for building owners & inspectors
- The Home Reference *eBook*, an electronic version for PCs, the iPad, iPhone, & Android smart phones
- Home Inspection Report writing materials, including the Horizon Software System that manages business operations, scheduling, & inspection report writing using Carson Dunlop's knowledge base & color images. The *Horizon* system runs on always-available cloud-based software for office computers, laptops, tablets, iPad, Android, & other smartphones.
- The Illustrated Home illustrates construction details and building components, a reference for owners & inspectors

- Determining Electric Motor Load and Efficiency, U.S. Department of Energy, web search 08/01/2011, original source: http://www.p2pays.org/ref/40/39569.pdf [copy on file at InspectAPedia.com]

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia Bookstore.



- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

  Or choose the The Home Reference eBook for using this reference on PCs, Macs, Kindle, iPad, iPhone, or Android Smart Phones

Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

- Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982
- Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- NEW! Air Conditioning SEER - New DOE Air Conditioner and Heat Pump Efficiency Standard
- Asbestos HVAC Ducts and Flues field identification photos and guide
- Fiberglass: Indoor Air Quality Investigations: Fiberglass in Indoor Air, HVAC ducts, and Building Insulation

- ...

Mobile View
AIR CONDITIONING & HEAT PUMP SYSTEMS

A/C - HEAT PUMP CONTROLS & SWITCHES
A/C DATA TAGS
A/C - HEAT PUMP CRITICAL DEFECTS
A/C DIAGNOSTIC FAQs
A/C REFRIGERANTS
A/C TYPES, ENERGY SOURCES
AGE of AIR CONDITIONERS & HEAT PUMPS
AIR CLEANER PURIFIER TYPES
AIR CONDITIONER BTU CHART
AIR CONDITIONER COMPONENT PARTS
AIR CONDITIONER TYPES, ENERGY SOURCES
AIR CONDITIONER NOT WORKING
AIR FILTER EFFICIENCY
AIR FILTERS, FIBERGLASS PARTICLES
AIR FILTERS for HVAC SYSTEMS
AIR FLOW MEASUREMENT CFM
AIR HANDLER / BLOWER UNITS

Air Conditioner Compressor & Refrigerant Pressure Readings

InspectAPedia® - ShareThis +1

- What are the Typical Air Conditioner Compressor & Refrigerant Pressure Readings ? A/C Refrigerant Pressure
- How Much Refrigerant is in the Proper Charge?
- Diagnostics that indicate overcharging or undercharging refrigerant levels
- Definition of Air Conditioner High Side and Low Side Pressures
- Explanation of Air Conditioner or Heat Pump Refrigerant Equalization Pressure
- What are the effects of overcharging or undercharging the refrigerant level in an air conditioner or refrigerator?
- Effects of Overcharging the Refrigerant Level in an Air Conditioner, Heat Pump, or other refrigeration equipment
- Causes of liquid slugging in an A/C or heat pump or refrigeration compressor motor
- Effects of Undercharging the Refrigerant Level in an Air Conditioner, Heat Pump, or other refrigeration equipment
- Questions & Answers about refrigerant pressure readings in air conditioners, heat pumps, & other refrigeration equipment

This air conditioning repair article discusses the the diagnosis and correction of abnormal air conditioner refrigerant line pressures as a means for evaluating the condition of the air conditioner compressor motor, which in turn, is a step in how we evaluate and correct lost or reduced air conditioner cooling capacity. We explain how overcharging or undercharging of refrigerant in an air conditioner or heat pump is detected and we list the effects of overcharged or undercharged refrigerant. We also explain the various causes of liquid slugging a compressor motor.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

What are the Typical Air Conditioner or Heat Pump System Pressures During Normal Operation

See OPERATING TEMPERATURES for a discussion of what temperatures to expect at different points in the air conditioning system, and see COOLING CAPACITY, RATED of air conditioning equipment if the system seems to be working but is inadequate to cool your building.

See GAUGE, REFRIGERATION PRESSURE TEST to review how test gauges are connected and used on refrigeration systems. Also see REFRIGERANTS & PIPING, see REFRIGERANT LEAK REPAIR see PRESSURE READINGS, COMPRESSOR, and A/C REFRIGERANT LEAK DETECTION for more details. Contact us to suggest text changes and additions and, if you wish, to receive online listing and credit for that contribution.

Refrigerant pressure readings measured at the air conditioning compressor/condenser unit and which are found to be too low on the high pressure side (compressor output) or on the low pressure side (compressor input or suction line) can indicate a problem with the compressor's ability to develop normal operating pressure ranges and thus will affect the cooling capacity of the air conditioning system.

Abnormally high compressor output pressures are possible but less likely. (See Two Basic A/C Refrigerant Pressure Diagnostics below).

Definition of Air Conditioner High Side and Low Side Pressures

First let's explain "low-side" and "high-side" air conditioner compressor motor pressures and what they mean.

Air conditioning service manuals and training refer to:

- Low-side air conditioner compressor motor pressure: this is the pressure in the air conditioner's refrigerant suction line (low side pressure during compressor operation) and this will be a relatively low number, often less than 100 psi.

  During operation refrigerant is returning to the compressor from the cooling (evaporator) coil in this line. If we connected the suction line directly to a sealed vacuum test gauge we'd actually find that the compressor could pull an actual vacuum on the line. (We used to use an old Frigidaire™ rotary-design compressor motor as our vacuum pump when we needed to get the air out of a refrigeration system prior to charging it with new refrigerant.)

  The low-side of an air conditioning system is always located inside of the space to be cooled, or inside of an air handler which moves air through the space to be cooled.

  By lowering the pressure in the cooling coil located on the "low side" of the air conditioning system, the compressor permits liquid refrigerant to be discharged into the cooling coil where the change of refrigerant state from a liquid to a gas absorbs heat and brings the cooling coil to the proper operating temperature.

  The LOW SIDE of a refrigeration system is the low-pressure and low temperature half of the system. Normally this is the indoor air handler - located inside the space that is to be cooled by bringing indoor air to operating temperature. (For a refrigerator this is typically 38 to 45 degF.)

- High-side air conditioner compressor pressure: output (high side pressure during operation) is the pressure of the compressed refrigerant gas as it leaves the compressor motor. In other words, refrigerant gas returns to the compressor through the suction line from the cooling coil (which is cooling building air).

DUST CONTAMINATION FROM HVAC?

EDUCATION, HVAC SCHOOLS
ELECTRIC MOTOR DIAGNOSTIC GUIDE
ELECTRIC MOTOR OVERLOAD RESET SWITCH
ELECTRICAL POWER SWITCH FOR HEAT
EVAPORATOR COIL or COOLING COIL
EVAPORATIVE COOLING SYSTEMS
EVAPORATOR COIL or COOLING COIL
EXPANSION VALVES, REFRIGERANT

FAN, AIR HANDLER BLOWER UNIT
FAN AUTO ON Thermostat Switch
FAN, COMPRESSOR/CONDENSER UNIT
FAN CONVECTOR HEATERS - HYDRONIC COILS
FAN LIMIT SWITCH
FAN NOISES
FURNACES WARM AIR HEATING SYSTEMS

GAS EXPOSURE EFFECTS, TOXIC
GAS DETECTION & MEASUREMENT
GAUGE, REFRIGERATION PRESSURE TEST

HEAT LOSS (or GAIN) in buildings
HEAT LOSS (or GAIN) INDICATORS
HEAT LOSS R U & K VALUE CALCULATION
HEAT PUMPS
HEATING SMALL LOADS
HOUSEWRAP AIR & VAPOR BARRIERS
HUMIDITY LEVEL TARGET

INDOOR AIR QUALITY IMPROVEMENT GUIDE
INSPECTION CHECKLIST - OUTDOOR UNIT
INSPECTION LIMITATIONS, A/C SYSTEMS

LEED GREEN BUILDING CERTIFICATION
LOST COOLING CAPACITY
LOW VOLTAGE TRANSFORMER TEST

MANUALS & PARTS GUIDES - HVAC
MOTOR OVERLOAD RESET SWITCH
MOLD in AIR HANDLERS & DUCT WORK

ODORS in AIR HANDLERS & DUCT WORK
OPERATING COST
OPERATING DEFECTS
OPERATING TEMPERATURES
Air Conditioning System Temperatures
Instruments Used to Measure A/C Temperatures
Procedures for Making Temperature Measurements

PORTABLE ROOM AIR CONDITIONERS
PRESSURE READINGS, REFRIGERANT

REPAIR GUIDE, AIR CONDITIONERS / HEAT PUMPS
REPAIR & DIAGNOSTIC FAQs for A/C
REFRIGERANTS & PIPING
GAUGE, REFRIGERATION PRESSURE TEST
REFRIGERANT CHARGING PROCEDURE
REFRIGERANT DRIERS & FILTERS
REFRIGERANT LEAK DETECTION
REFRIGERANT LEAK REPAIR
REFRIGERANT METERING DEVICES TEVs
REFRIGERANT METERING CAPILLARY TUBES

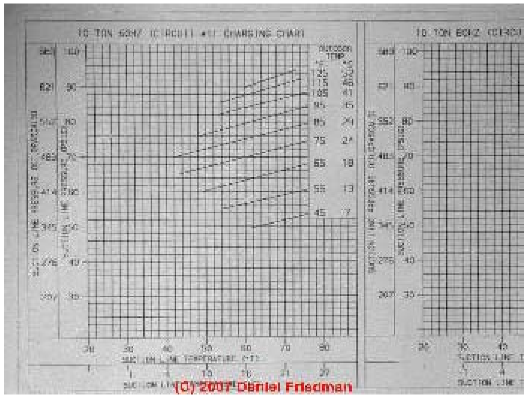
The low-pressure refrigerant gas is compressed to a high-pressure refrigerant gas inside the compressor motor. This high temperature refrigerant gas is then cooled down to condense into a refrigerant liquid before it is returned indoors to the air handler and evaporator coil to be used to cool building air. (Thus we get the name the name "condensing coil" and "condensing unit" or "condenser" for the outside half of an air conditioning system.)

The high side components of an air conditioning system, such as the compressor, condensing coil, and fan unit used to cool the condensing coil are located outside of the conditioned or refrigerated space, and will be immersed in air at ambient outdoor temperature, say 72 degF.

Here is where the *magic* of air conditioning occurs. As long as the compressor can produce a temperature in the outdoor condensing coil which is above ambient outdoor air temperature, heat will flow from the condensing coil into outdoor air (for example outdoor air blown across the condensing coil by a fan).

If you studied thermodynamics in high school you learned that *heat always flows from the warmer to the cooler material*. The effect is to transfer heat gathered in the indoor or conditioned space into outdoor air.

The HIGH SIDE of a refrigeration system is at high temperature and higher (refrigerant) pressure and will always be above ambient temperature. So in a cooling system it will be located outside in order to transfer heat to the outdoor air. A heat pump designed to pump heat into a building will, of course, reverse these roles when in heating mode.



Typical residential air conditioning refrigerant pressures vary depending on the model, compressor motor size and design, and the refrigerant used. The design pressures may be provided on labels attached to the equipment but the actual air conditioner operating pressure will vary in part as a function of the incoming air temperatures.

"Charging Charts" (such as the commercial unit charging chart shown here) are provided in service manuals to determine the target suction vacuum (negative) pressure and output pressure for a given compressor motor.

Use of the charging chart for the specific compressor is the correct way to service it. The following example pressures are based on "rules of thumb" that get you in the right "ballpark" if no charging chart is at hand.

Example actual air conditioner compressor high side output pressure: using R-22 refrigerant and assuming an outside air temperature of 85 degF called for 120 degF. inside the compressor (add 35 degF. to incoming air temperature) and an output high-side compressor pressure of about 260 psi.

Example of actual air conditioner low side input or suction line pressure during operation (low-side pressure) during normal operation of the same compressor model and refrigerant and the same outdoor air temperature of 85 degF called for 45 degF. temperature entering the compressor (subtract 40 degF. from incoming air temperature) which on the service chart indicates that the incoming or suction line pressure would be about 75 psi.

Example of a more theoretical air conditioner or heat pump pressure and temperature at the compressor and at the cap tube or thermostatic expansion valve during normal operation: at an outdoor temperature of 72 degF, liquid refrigerant (R12 for example) leaving the outdoor condensing coil and entering the cap tube or TEV might be at 100 psi and 95 degF.

These numbers vary by changes in ambient temperature, compressor model, and refrigerant gas used. On the low side of the TEV or cap tube (in the cooling coil in the air handler) where the liquid refrigerant is changing state to a gas, it

REFRIGERANT PIPING & DISTANCES
REFRIGERANT PIPING INSULATION
REFRIGERANT PRESSURE READINGS
REFRIGERANT SIGHT GLASS
RETROFIT SIZING for A/C or HEAT PUMPS

SEER RATINGS & OTHER DEFINITIONS
SOLAR ENERGY SYSTEMS
SPLIT SYSTEM AIR CONDITIONERS & HEAT PUMPS
SWAMP COOLERS
SYSTEM OPERATION

THERMOSTATS, HEATING / COOLING
THERMOSTATIC EXPANSION VALVES

WATER COOLED AIR CONDITIONERS
WINDOW / WALL AIR CONDITIONERS
WINDOW / WALL A/C SUPPORTS

More Information

may be cooled down to 10 degF. and by the time the refrigerant leaves the cooing coil (evaporator coil) and gets back to the compressor motor it will be all vapor and may be at just 15 psi. [R12 refrigerant changes from liquid to vapor at 14.6 psi at 10 degF.

Air Conditioner or Heat Pump Refrigerant Equalization Pressure - System-OFF refrigerant pressures

When you measure heat pump or cooling system pressures makes as much difference as *where* you measure it. When an air conditioning or heat pump system has turned off and been off for some time (30 minutes or more) pressures equalize throughout the system between the high and low sides.

At that point the refrigerant pressure in both the high side and low side of the air conditioner or heat pump system will be in accordance with the ambient air temperature and the properties of the particular refrigerant gas present.

The static or equalized system refrigerant pressure will be defined by the refrigerant gas type (which defines its boiling point and pressure at various temperatures).

For example with that cute old R12 refrigerant, as long as there is just about any refrigerant in the system - enough so that there is some liquid refrigerant, i.e. it's not all just gas) then in equalized condition at 70 psi ambient temperature the refrigerant pressure will be 70 psi.

With a temperature correction chart you can read the static or equalized refrigerant pressure for any refrigerant gas and the actual ambient temperature.

Reminder: this refrigerant gas behavior means that if you use pressure test gauges (GAUGE, REFRIGERATION PRESSURE TEST) to measure the refrigerant pressure in the static or equalized air conditioning or heat pump system, the gauges only tell you the refrigerant pressure, not the quantity of refrigerant that is present in the system.

Some Basic A/C Refrigerant Pressure Diagnostics

Refrigerant Leak, short charge: Low head pressure: If the head pressure at the compressor is low we figure that there is a short charge - that is, the system has lost refrigerant.

Condenser coil plugged: High head pressure: if the head pressure at the compressor is abnormally high we figure that the condenser coil is plugged and needs replacement.

Short refrigerant charge: Low pressure on both the High and Low sides of the system typically means that there has been a loss of refrigerant or a short charge.

Frozen TEV: Low side pressure or zero pressure on the low side of the air conditioner or heat pump system may mean that the metering device such as a TEV is frozen or jammed and is not releasing any refrigerant into the cooling coil. In this condition the high side pressure may go up, then down. You can test and temporarily cure this condition by warming the TEV or cap tube.

Plugged or saturated drier: by comparison with the above conditions, a partially clogged drier will form a restriction in the refrigerant line so that the low side pressure drops and the high side pressure increases. You may also notice that the refrigerant line temperature is significantly different on the inlet and outlet sides of the drier.

High side pressures in the air conditioner or heat pump system that are too low

High side pressures in the air conditioner or heat pump system that are too low (100 psi for example) can indicate that the compressor is failing (cannot pump up to pressure) or that the refrigerant metering device is stuck wide open and the system is not developing enough pressure difference between the high and low sides.

High side pressures in the air conditioner or heat pump system that are too high

High side pressures in the air conditioner or heat pump system that are too high can also mean serious trouble: a blocked condensing coil, blocked filter/dryer on the high side, or a refrigerant metering device (TEV) that is stuck closed.

A small refrigerant pressure change on the high pressure side of a refrigeration system will make a big change on the low side. A common field diagnostic step is to quickly look at the system low-side pressure since if that reading is bad you know that there is a problem on the high side.

Low side pressures in the air conditioner or heat pump system at 90 psi or up mean trouble

Low side pressures in the air conditioner or heat pump system reflect the compressor's ability to draw refrigerant through the system and the rate of metering and evaporation of refrigerant in the cooling coil. While newer higher efficiency air conditioners and heat pumps run at higher suction pressures than older units, a rule of thumb used by many HVAC techs is that the low side pressure should be well under 90 psi. If you are seeing 90-100 psi (or higher) on the low side of the system then either the compressor is damaged (not able to pump down to a low enough pressure) or the refrigerant metering device is stuck wide open and flowing too much refrigerant through the system.

How Much Refrigerant is in the Proper Charge?

The manufacturer specifies the quantity of refrigerant that should be placed into any system: air conditioner, heat pump, refrigerator, freezer. Especially on residential systems installing the proper total refrigerant charge, which has to take into account not just refrigerant liquid volume but also ambient temperatures, is critical. [On many commercial refrigerant systems there is a receiver that holds a larger buffer quantity of refrigerant, so you'll notice the effects of refrigerant loss only after quite a bit has leaked out.]

Changes in air conditioner or heat pump operating pressure can be effected by adding or removing refrigerant from the system. Changing the amount of refrigerant will cause a pressure change at the point where the refrigerant changes state. Normally an HVAC technician will charge the system to its recommended pressure and we won't vary the total refrigerant charge away from what the system manufacturer recommends.

Effects of Overcharging the Refrigerant Level in an Air Conditioner, Heat Pump, or other refrigeration equipment

Effect of too much refrigerant in the system - overcharging, over-metering, or other high refrigerantpressure situations: normally we want the low side pressure to be as low as possible for refrigeration systems. Excessive refrigerant in the system raises the system operating pressure and temperature and actually reduces the cooling ability of the system.

Overcharging of the refrigerant in a closed refrigerant system such as a typical residential air conditioner, heat pump, or refrigerator, where no liquid refrigerant receiver is included, has the following effects:

- Improper operating pressures - too hight: Refrigerant pressure will be increased on both the high side and low side of the system
- More expensive operation: The system may still be able to change state, but at a higher temperature than intended, thus in an air conditioner, it won't cool as effectively nor as efficiently as with the proper charge
- Causes of Liquid Slugging the compressor motor:if liquid refrigerant enters moving parts of the compressor motor, the motor is likely to be destroyed. The compressor motor's moving parts (piston & cylinder, scroll spirals, or rotary vane pump) expect to be compressing a gas and can't handle liquids. HVAC technicians refer to these conditions as *liquid slugging*.

Several causes of liquid slugging, (also cited at AIR CONDITIONING & HEAT PUMP NOISES) include:

- An overcharge of refrigerant in the system can result in liquid refrigerant entering the moving parts of the compressor motor where only a gas is expected .
- A crankcase heater that is burned out or that is not being turned on when it should by the system controls (which can also destroy a heat pump compressor that is trying to operate in cold temperatures)
- A bad therostatic expansion valve (or one that is improperly adjusted): Liquid slugging might also occur if a refrigerant metering device is not properly restricting refrigerant flow from the high side to the low side of the refrigerant piping system. Liquid refrigerant may not all turn to gas on the low side of the system - if liquid refrigerant enters the compressor motor it is likely to destroy it

Air Conditioner or Heat Pump Compressor Motor or other Electric Motor Runs Backwards?

An electric motor may start running backwards due to a failed start capacitor, a reaction to high refrigerant pressure (for refrigeration motors), or other electrical events.

High refrigerant pressure in an A/C unit or heat pump or some other refrigeration motors can cause the equipment to run backwards. Cooling compressors, heat pump compressors and some other electrical motors can run backwards too: well pumps, fans, even an A/C or heat pump compressor.

If the compressor motor is a *scroll-type* design and in some cases if the motor is a *rotary vane type* design high refrigerant pressure combined with a loss of electricity can, on return of power, start the motor backwards. Scroll type compressor motors use an anti-restart control (basically a timer) to prevent the compressor from starting to run backwards.

A scroll-type compressor (and possibly a rotary vane A/C compressor motor) can start to run backwards if the motor is suddenly stopped (due to brief power loss or because you foolishly switched its electrical power "off" and back "on" quickly. In that condition, high refrigerant pressure on the outlet side of the compressor motor gives it a backwards push. When power is restored that backwards push gets the motor running backwards.

And as we discuss at CAPACITORS for HARD STARTING MOTORS, a bad start capacitor can let a motor run backwards. We've also found cases of water well pump motors running backwards after a lightning strike. And at Questions & Answers about compressor/condenser unit fans we include a field report of a backwards running condenser unit fan.

Effects of Undercharging the Refrigerant Level in an Air Conditioner, Heat Pump, or other refrigeration equipment

Effect of too little refrigerant in the system

When we undercharge an air conditioner, heat pump, or other refrigeration equipment

- Improper operating refrigerant pressures, too low: surprisingly to the novice, too little refrigerant in the system can actually drop the temperature in the cooling coil below its normal operating range; that's why we mention at FROST BUILD-UP on AIR CONDITIONER COILS that a cause of coil frosting in the air handler might be an early sign of a refrigerant leak.

  Loss of cooling capability: eventually when enough refrigerant leaks out of the system temperatures rise again because we no longer have any heat exchange between the condenser coil and the outdoor air nor between the then empty cooling coil and the indoor air.
- More expensive operation: There is not enough refrigerant in the system, for example to properly fill the cooling coil - then we remove less heat (per unit of time operation of the equipment) so we are decreasing the operating efficiency of the system.

- Cooling Coil Frosting: Too-low refrigerant levels in some systems also can cause frosting and freezing at the cooling coil.
- Compressor motor damage: Too little refrigerant in an air conditioner, heat pump, refrigerator, or even a dehumidifier is likely to cause overheating of the compressor motor. That is because in a properly-charged refrigeration system, the refrigerant is cooling the electric motor that is sealed inside the compressor unit. An overheated A/C motor may trip a circuit breaker, may have trouble starting, and eventually will fail to run at all.

  Watch out: when an air conditioner or heat pump motor "burns out" the result is a costly contamination of the entire refrigeration system as burned lubricants and even shellac or coatings on motor windings will have been circulated through the refrigerant piping system. That's why an experienced HVAC repair person will insist on cleaing the entire system and installing one or more "burnout" refrigerant filter/driers (REFRIGERANT DRIERS & FILTERS) on the refrigerant lines when the compressor is replaced.

Bottom line about undercharging refrigerants: For residential equipment such as air conditioners, heat pumps, refrigerators, freezers, to work properly you must have exactly the correct charge in the system.

At FROST BUILD-UP on AIR CONDITIONER COILS we also explain that in a properly tuned and adjusted refrigeration system there will be liquid refrigerant found all the way to just at the end of the evaporator coil - this gives us maximum cooling efficiency of the equipment.

Guide to Using the Data Tag Information to Charge Refrigeration Equipment

Technical detail: refrigerators and some other equipment have a data tag that give a test pressure. Ignore this number when charging the system. This is a leak test pressure.

The data tag also gives the type of refrigerant that should be used in the system (no you cannot substitute). And the data tag will give the proper refrigerant charge quantity, typically in ounces. For a small residential equipment (a refrigerator) this may be 5-11 ounces.

Remember that the location of the frost line (on the cooling coil and refrigerant piping) can indicate evidence of overcharging.

Bottom line about overcharging refrigerants: even if you don't destroy the compressor motor by overcharging the system will be operating at a higher temperature and thus will be operating less efficiently. For residential equipment such as air conditioners, heat pumps, refrigerators, freezers, to work properly you must have exactly the correct charge in the system.

Technical Background on Air Conditioner Pressure Gauge Readings

In our illustration of air conditioner service equipment pressure test gauges at page top and at left, you notice that there are two gauges and two sets of connectors and control valves. "Gauge pressure" can read either the pressure inside the condenser unit (the "high side" of the system) or the pressure inside the evaporator (cooling coil) or "low side" of the system.

The gauge set accepts three connecting hoses:

1. Low pressure side (blue hose on my gauges)
2. High pressure side (red hose)
3. Refrigerant gas source (center fitting)

Note that gauge pressure is an absolute pressure reading before any correction for ambient temperatures around the unit. When comparing measured or gauge pressure with recommended refrigerant pressures it is necessary to correct gauge pressure for ambient temperature variations. A/C equipment, gauges, refrigerant charging manuals etc. include pressure charts to aid in this correction.

Low-side pressure calculation example

Using now-obsolete R-12 refrigerant gas as an example, looking at the low-side refrigerant pressure (the low side is the side at which the refrigerant liquid has boiled into a gaseous state), we can calculate the temperature at which the refrigerant should boil for given ambient conditions:

(38-45 degF example) - (18 degF temperature difference between inside the condenser and ambient) = 20 degF = the temperature at which the refrigerant must boil, i.e. the state change from liquid to vapor. Looking at 20 degF. in the table for R12 state changes shows us that we should see 21 pounds of pressure.

High-side pressure calculation example

At 80 to 100 psi pressure on the high side, if ambient temperature is 72 degF, heat will be transferred successfully to outdoor air at temperatures of 84 degF to 117 degF at the condenser coil.

More Notes About Residential Air Conditioner Compressor Pressures

Put another way, high temperature or high pressure on the air conditioner low side is a sign of a problem. That is, as pressure on the high side goes way up, low side pressure will increase as well, and we may exceed the operating temperature of the system. The Low side temperature must be low enough to get transfer of heat from the indoor air into the evaporator coil. The High Side temperature must be high enough to get transfer of heat into the outdoor air.

More Reading

- See SEER RATINGS & OTHER DEFINITIONS for additional definitions of the *high side* and *low side* of an air conditioning system.
- See COMPRESSOR CONDENSER for an explanation of how and why *high side* and *low side* pressures in the cooling system enable an air conditioner to move heat from indoors to outdoors.
- See OPERATING TEMPERATURES for a discussion of the typical temperatures at which various types of cooling systems operate.

If your air conditioning or heat pump system has lost its cooling capacity or won't start see REPAIR GUIDE for AIR CONDITIONERS. See How to determine the cooling capacity of air conditioning equipment if the system seems to be working but is inadequate to cool your building. Contact us to suggest text changes and additions and, if you wish, to receive online listing and credit for that contribution.

Questions & Answers about refrigerant pressure readings in air conditioners, heat pumps, & other refrigeration equipment

What are The Effects of Overcharging A/C Refrigerant In a Cooling or Refrigeration System

Question: What happens to an overcharged cooling system with too much refrigerant?

Could you describe what will happen with an over charged system? - S.F.

Reply: Here are the effects of overcharging with refrigerant

An expert inspection of any individual cooling or air conditioning system is likely to discover things that we miss by email discussions. That said, here are some things to consider:

- The most serious problem is damage to the A/C compressor. Damage could occur to the compressor piston or to the refrigerant control flow valve (A/C compressors use a reed type valve that seals the compressor high side outlet) - imagine sending a slug of liquid into any reciprocating piston engine or valve that is designed to move a gas - the piston comes up and slams into liquid - and is destroyed.
- Overcharging a residential A/C system or refrigerator can damage or even put the system out of operation - because these systems don't have a receiver, too much refrigerant risks sending a slug of liquid refrigerant+oil into the cap tube, the metering device, clogging it and leading to failure
- Overcharging a commercial system with a receiver - it depends. A small overcharge just rests in the receiver but a large one can result in Thermal Expansion Valve (TEV) damage or TEV freeze-up, leading to loss of system cooling entirely.
- We want just enough air conditioner or refrigerator refrigerant to cool the coil; too little can lead to coil frost-up (suction side pressure too low) and too much refrigerant can lead to cooling coil running warm over part of its surface (suction side pressure too high).
- Refrigerant overcharging can also result in liquid refrigerant running too far into the evaporator coil, leading to a too-low suction side pressure and a reduction in cooling capacity
- In other cases overcharging with a refrigerant can lead to unexpected condensation or frosting on some of the system parts and components both in the air handler and in the compressor/condenser unit. In HVAC school, with gauges in place and a means of adding or removing refrigerant we could watch the frost line advance or recede on a cooling coil from this effect.
- Some sources also cite higher compressor amps draw but that claim needs more research

Questions & Answers regarding this article

.

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(July 8, 2012) ZiggyMe said:

Most cars have a "wide open throttle" shutdown control so the compressor does not affect your acceleration. When you press hard on pedal, the ECU in the car tells the clutch of the compressor to release until you back off the pedal or the car does not require the power need to move faster. It's all up to the manufacturer to control that.

(June 19, 2012) DanJoeFriedman (mod) said:

Anon, the first thing to check is for a loose fan belt. Sometimes a combination of a failing compressor or compressor clutch (that is providing resistance) and a loose fan belt conspire together, but the fan belt is the first culprit I'd suspect.

(June 19, 2012) Anonymous said:

when my car accelarates the gas the cluctch of the compressor stops and no cooling at all?

(May 26, 2012) rick said:

have 410a heat pump the compressor trips the internal replaced compressor still same starts with good pressures 330 high 125 low then slowly drops to 225 high 25 low??????????????

(Apr 27, 2012) DanJoeFriedman (mod) said:

Not sure, but that hi pressure on the suction side sounds as if perhaps a refrigerant metering valve is stuck wide open.

(Apr 27, 2012) mazid said:

my new aircon daikin but whene i run aircon my aircon running pressure only suction 120psi and high side 180psi with R410a gas and not cooling aircon only 30% cooling only so now what i do so

(Apr 15, 2012) DanJoeFriedman (mod) said:

Glenn, several possible explanations for seeing "reversed" high and low refrigerant pressures on an air conditioner compressor include:

1. the refrigerant pressure test gauge set gauges are hooked up wrong or used incorrectly - crossing the tubes

2. the unit is a heat pump with its control set in "heating" mode or a malfunctioning reversing valve

3. the compressor is running backwards - this can happen with certain rotary compressors and a bad start capacitor. When the compressor is stopped then re-started with pressure in the system, the high side pressure combined with a bad start capactior, spins the motor the wrong direction.

4. something else we haven't thought of

Let me know what you find - it will certainly help other readers.

Toohot: take a look at the HVAC diganostic process suggested starting at "
LOST COOLING CAPACITY" - links at page left

Lopez: running an HVAC compressor without refrigerant risks overheating the compressor motor - it could have been damaged. HVAC compressor motors depend on both liquid refrigerant and lubricants entering the motor.

George: 0 psi on the high side sounds like a stuck or dead compressor or a bad valve. Or no refrigerant in the system, or a stuck refrigerant control valve.

(Apr 13, 2012) Glenn said:

Have a 2 ton R22 compressor with low pressure at 120. High side is at 80. What might be the problem?

(Jan 12, 2012) lopez said:

what happen if aircomprsor is runing witout refrigerant for half our?

(Jan 2, 2012) george said:

Hi have a goodman h/p high side im getting 0 psi what do think it is.

(showing 1 to 10)

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also list books on the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

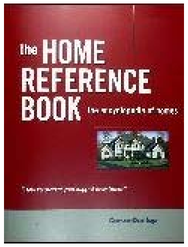
Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

REFRIGERANTS & PIPING
GAUGE, REFRIGERATION PRESSURE TEST
REFRIGERANT CHARGING PROCEDURE
REFRIGERANT DRIERS & FILTERS
REFRIGERANT LEAK DETECTION
REFRIGERANT LEAK REPAIR
REFRIGERANT METERING DEVICES TEVs
REFRIGERANT METERING CAPILLARY TUBES
REFRIGERANT PIPING & DISTANCES
REFRIGERANT PIPING INSULATION
REFRIGERANT PRESSURE READINGS
REFRIGERANT SIGHT GLASS

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.

- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia Bookstore.



- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

  Or choose the The Home Reference eBook for using this reference on PCs, Macs, Kindle, iPad, iPhone, or Android Smart Phones

Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

- Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982

- Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- Air Conditioning Inspection, Diagnosis, Repair, Efficiency all the basics for home owners, inspectors, new repairmen
- Air Conditioning SEER - New DOE Air Conditioner and Heat Pump Efficiency Standard
- Asbestos HVAC Ducts and Flues field identification photos and guide
- Fiberglass: Indoor Air Quality Investigations: Fiberglass in Indoor Air, HVAC ducts, and Building Insulation

Mobile View
AIR CONDITIONING & HEAT PUMP SYSTEMS

A/C COMPONENTS
A/C DATA TAGS
A/C - HEAT PUMP CRITICAL DEFECTS
A/C DIAGNOSTIC FAQs
A/C REFRIGERANTS
A/C TYPES, ENERGY SOURCES

AIR CONDITIONER BTU CHART
AIR FILTERS for HVAC SYSTEMS
AIR FLOW MEASUREMENT CFM
AIR HANDLER / BLOWER UNITS
DIRTY A/C BLOWERS
DAMAGED COOLING COIL
DIRTY COOLING COIL
DIRTY COIL CLEANING PROCEDURES
FROST BUILD-UP on AIR CONDITIONER COILS
INCREASING RETURN AIR

A/C or Heat Pump System Condensate Drains, Condensate Piping, Condensate Pumps - Inspect, Diagnose, Repair Guide

InspectAPedia® - ShareThis +1

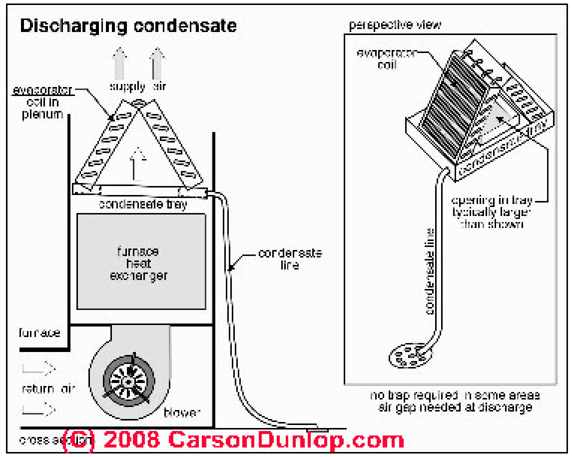
- Air Conditioning Condensate Handling Defects
- When & how to inspect the air conditioner condensate drain system
- A/C condensate piping, leaks, hazards
- Questions & Answers about recognizing defects in air conditioner and heat pump condensate drain line piping, connections, traps, or disposal destination

Air conditioner condensate handling & drainage defects: this air conditioning repair article discusses the inspection, diagnosis, and repair of air conditioning condensate drainage systems, including condensate leaks, condensate piping, traps, drains, condensate pumps, and the detection and hazards of air conditioning system condensate leaks in buildings. Condensate leak water health and safety concerns are also reviewed. This document describes the inspection of residential air conditioning systems (A/C systems) to inform home buyers, owners, and home inspectors of common cooling system defects.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

Condensate Handling: Air Conditioning / Heat Pump Condensate Handling Defects

At AIR CONDITIONING & HEAT PUMP SYSTEMS, the major components of an air conditioning system are described, and at A/C COMPONENTS sketches and photographs are provided, and common defects for each component are listed along with visual or other clues that may suggest a problem or probable failure of A/C components. Readers who need to clean or unclog a blocked or leaky overflowing A/C or heat pump condensate drain should see CONDENSATE DRAIN CLEAN & DE-CLOG.



Improper handling of air conditioning system condensate is one of the most commonly reported set of A/C system defects. Condensate problems can lead to leaks into the building, costly mold or insect damage, or even to complete A/C or heat pump system shutdown.

Perhaps we see lots of air conditioning condensate leaks and related problems in part because these defects are easily observed visually, and perhaps also because some A/C installers do not follow basic plumbing and building code requirements for handling the discharge of the condensate produced when an air conditioning system is operating.

Sketch courtesy of Carson Dunlop Associates.

Condensate leaks or discharge errors (such as the drips into the dog bowl and cooking pot in this attic) present several risks of ugly surprises in buildings.

Here are some inspection tips that can avoid a condensate leak or even a costly mold problem in the air conditioning system air handler, duct work, or in the building itself:

Locate how & where condensate discharge is carried for final disposal

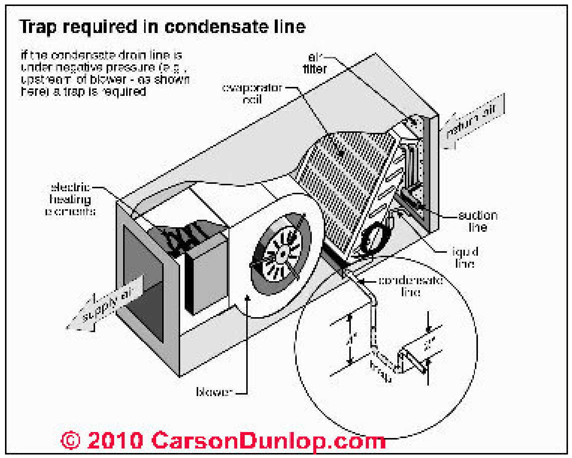
- A flexible plastic condensate drain line may be routed through building walls, ceilings, floors, at some installations such as split system wall-mounted air conditioners and heat pumps. At SPLIT SYSTEM AIR CONDITIONERS & HEAT PUMPS we describe the routing, slope, and protection from damage for in-wall condensate drain lines.

  Our photo (left) shows the condensate drain termination for a roof-mounted split system air conditioner - the white plastic condensate drain exits the building wall and is carried to the roof surface next to the roof-mounted inverter or compressor/condenser unit for the cooling system.
- a plastic line draining outside to an approved drain destination - see CONDENSATE DRAINS
- a floor drain

a sump pit

- a hole in the floor
- a reservoir lift pump (CONDENSATE PUMPS) which pipes condensate to: (a properly connected building drain; something else)
- the pump exit line is taken to the house main waste line
- a dirt floor or crawl space (a bad idea, asking for mold or insect damage)
- Problems with condensate drains themselves are detailed at CONDENSATE DRAINS

Check for a clogged A/C condensate drain line trap



One of the most common causes of air conditioning or heat pump condensate leakage and overflow is a clogged condensate drain line trap. And if the secondary or emergency condensate handling system is absent or defective, the result can be costly leak damage to the equipment or to the building.

Carson Dunlop Associates' sketch (left) illustrates the requirement for a trap on the A/C condensate primary drain line.

Look out for a missing condensate overflow pan or drip tray:

If there is no overflow pan under the air handler, especially in units installed on upper building floors or in an attic, when the condensate drain clogs or the condensate pump fails you can expect to have leaks into the building and possibly costly mold or water damage.

See DRIP TRAY DEFECTS for details.

Look out for an improper condensate overflow pan drain connection

A condensate pan should have its own independent drain to an approved location. Otherwise, for example if it shares the main condensate drain pipe, you have not gained much protection. An alternative to a drain on a condensate overflow pan is the installation of a Float Switch on Condensate Tray that will turn off the system if water is detected. See CONDENSATE DRAINS.

Look for corrosion or water stains on floor surfaces around the equipment

Check the condensate drip pan and at bottom of the "A frame" cooling coil, indicating that the drain may need cleaning and more important, indicating that the condensate is leaking out of the equipment or drains and not being carried to an acceptable disposal point.

Links below continue with detailed discussions of condensate handling components, defects, cleaning, maintenance, and repairs.

Periodic Inspection of the Air Conditioner Condensate Drain System - Some Suggestions

WINDOW / WALL A/C SUPPORTS

More Information

Question: how and when do we inspect the condensate drain?

I can't find a description of the method for inspecting the drain pipe leading out from the drain pan under the condenser coils.

I have been told that this pipe commonly blocks up and causes problems and that inspecting it is a part of a HVAC maintenance program. Would you describe for me, or maybe add to your site, how often and how this drain line should be inspected and maintained?

- R.B. Chattanooga, TN.,

Reply: check for a clogged condensate drain line trap, crimps in the line, or clogs in the line; check that the line is routed to a proper destination

The condensate drain line, trap, and evidence of blockage, leaks, overflow, or improper piping should be part of annual air conditioning system service, or should be performed immediately if there is evidence of a condensate spill or leak. It only takes a quick look by an experienced service technician to see trouble. Here are some signs of trouble that a visual inspection of the condensate drain system might pick at an inspection:

- Visual inspection for obvious debris at opening to the condensate drain, inside the air handler
- Visual inspection for evidence of condensate overflowing out of or backing up in the air handler when it should be passing out the drain - such as is shown in our photo at left.
- Visual inspection for condensate backup or spillage such as presence of condensate in an overflow pan
- Tripping off of the float switch in the overflow pan if you have one
- Some condensate drains have a removable cap on the trap to inspect in and clean the trap - traps are usually where blockages occur
- Visual inspection of the entire drain line to see its routing - and to assure it's taken to a proper destination. Our photo at the top of this section above shows a crimped condensate drain pump line - we were a bit worried that with even the slightest additional movement in this soft flexible plastic tube (connecting the condensate pump to a nearby laundry drain) would prevent the pump from working properly.
- Failure of any condensate to come out of the exposed end of the condensate drain line when the A/C system has been running during hot, humid weather
- If a condensate pump is installed, overflow of condensate out of the pump housing
- Check out the articles listed below for more detail about each type of condensate drain system defect.

Questions & Answers about handling air conditioner and heat pump condensate

Question: Our heat pump spills water onto the floor. What's wrong and how do we fix it?

I have a question regarding our heat pump. Last summer it started leaking water. The system otherwise runs fine but we have to keep a bucket where the water comes out a rubber tube. This also does not catch all the water because the carpet still gets wet. There is no problem with heating this past winter. Is there a pump of some kind that needs to be replaced.- M.M.

Reply:

It sure sounds as if your heat pump when in cooling mode is leaking condensate into the building. When warm moist indoor air passes through the cooling coil, moisture is removed from the air as it cools, condensing into water that must be drained away to an acceptable location - a floor drain or in some areas outdoors onto the ground.

A condensate leak that spills into the building interior could be caused by any of several problems such as a clogged condensate drain line or if a condensate pump is used to lift condensate from a receiving container up to a building drain, the pump could be switched off or broken.

You need to first diagnose the cause of the problem. If it's just a clogged drain line, clearing the line can get things working again quickly and probably at little or no cost. If you are unfamiliar with the equipment or can't find the condensate handling system, or if a condensate pump is not working you probably need a service call by an HVAC expert.

Look through the articles found in the links at page left under CONDENSATE HANDLING for more details about different condensate handling problems, diagnoses, and repairs.

Watch out: in a good heat pump/air conditioner installation, the installers make provision to protect the building interior from condensate leakage should the primary condensate drainage system fail. Usually that's in the form of a condensate drip tray that is placed under the indoor air handler where the cooling coil is located (and where condensate is produced). If the condensate drain system fails and condensate begins to leak out of the equipment, the drip tray either takes condensate safely away to a drain by a separate drain line or it uses a switch that shuts down the equipment so that you know repairs are needed. Condensate that leaks into building carpets, ceilings, walls, risks formation of a costly mold contamination issue. So get this matter repaired promptly.

Question: Water blowing down my HVAC Supply Ducts, What Can I Do to Stop It?

Why is water blowing down my supply duct system? I have solved the freezing up problem, I don't have a drain problem!! I added refrigerant to solve the freezing up problem, but it is still blowing water down my supply line. How do I stop this?? - C.T.

Reply: Check the A/C system sizing, check for abnormal indoor humidity sources

If you are sure that the condensate drain is in fact draining, I don't know a simple in-air-handler fix for this problem - it's common in some humid areas such as Florida. I'd take a look at these next steps:

1. Check whether or not your A/C system is oversized for the space being cooled; a cooling system that is oversized will not dehumidify adequately and that leaves too much water in your building air
2. If #1 is not the issue, look for and fix sources of abnormal indoor moisture: leaks, failure to use bath and kitchen vent fans, particular lifestyle that puts lots of moisture into the air (cooking?); and consider some auxiliary dehumidification

Question: our wall-mounted split system air conditioner leaks condensate down the interior wall

We noticed water stains and wet spots on the wall below our wall-mounted split system air conditioner. But condensate is also coming out of the drain line on the roof. What might be wrong? - Ed.

Reply: Common defects that cause leaks or blockages in wall-mounted air conditioner condensate drains

Check the following sources of condensation leaks at or near a wall-mounted air conditioner::

If the wall mounted air conditioner is not level, condensate may collect in its internal drain pan but may overflow the (relatively shallow) condensate pan edges before reaching the condensate drain opening. Check the unit for level, and watch out: the plastic cover may not be dead straight - it's the unit itself that should be level for the condensate drain pan to work properly. The photo at left is explained at SPLIT SYSTEM AIR CONDITIONERS & HEAT PUMPS. That white line is the condensate drain headed from the wall-mounted unit (not shown) to outdoors.

- Check for lint or crud blocking the opening to the condensate drain line inside the unit.
- Check for a blocked or clogged condensate drain line as it passes through the building wall to the building exterior.
- Check for punctures in the condensate drain line anywhere in its route but especially high on the wall near the unit where you see the leaks or wet spots
- Check for missing insulation on the refrigeration lines inside the wall-mounted unit. We describe this SNAFU at Interior Leaks On & In Wall Below a Split System Air Conditioner Wall-Mounted Unit

Questions & Answers regarding this article

Questions & Answers about recognizing defects in air conditioner and heat pump condensate drain line piping, connections, traps, or disposal destination.

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(July 23, 2012) DanJoeFriedman (mod) said:

Merritt,

It sounds as if your condensate drain or trap is / are clogged. Try cleaning the trip first.

Norma, some condensate blow by at the cooling coil is common in very humid weather, but leaking into the building or pooling on the floor outside the unit is clearly a problem. I'd start by checking to see what's wrong with the condensate drip tray and drain.

(July 23, 2012) Norma said:

My blower is sucking the condensation through the coils and it's puddling at bottom of my unit and water getting into the floor in my hall way.

(July 21, 2012) merritt said:

Our heat pump has condensate pooling below the unit. It has a PVC drain pipe installed running to a floor drain but I have some questions about the way it is routed. It has a "trap" (for lack of a better term) in it as shown in the 4th photo on this page. Is this correct and if so, why? It seems to me water could never drain past this. It also is routed on the level floor around three sides of the unit instead of taking the direct route to the drain. Again, is this correct, and why? Our unit does not have a condensation pump. Can I just clean out this pipe and reroute it straight to the drain w/o the up and down 90 elbows? BTW, we had a HVAC guy here and said it was working OK.

(June 5, 2012) DanJoeFriedman (mod) said:

Florida,

I suggest inspecting the interior of the air handler unit to see just what is rusting - you might catch a condensate leak problem or other damage before the unit rusts- through and thus avoid leak damage to your building.

(June 5, 2012) Florida dude.. said:

Is it normal to see a rust inside the drainage pipe coming from the evap coil?? My unit has a safety feature to stop the a/c unit if the drainage over flows and does not drain. I decided to pull the piping around the air handler to clean it better an noticed rusty water...But I also hand the evap coil replace last year..

(May 29, 2012) DanJoeFriedman (mod) said:

Gene, condensate production slows once the in-building air has been dehumidified when an A/C has been on for some time. If no condensate is ever produced you'd check for a blockage or leak in the condensate drain system.

(May 27, 2012) Gene O said:

I am not seeing any water draining from my Central Air unit when the A/C is running. It seems to be cooling but I haven't seen any drainage. Does this mean the condenser isn't working or do I just need to wait until the A/C has been on for a while?

(May 12, 2012) Cyndy Black said:

Can the evaporator coil be "fixed" or when it's shot, it's gone completely? Also, the pipe that leads from my outside a/c unit and goes into our furnace is leaking right at the joint. A small puddle of water is under the furnace. The a/c guy inspected everything: no freon leaks, no freezing up, pans and hoses are clear, etc. He said to tape and wrap that joint real good and see what happens. If it still leaks, the evap. coil will have to be replaced. Is this correct? Thank you.

(Mar 29, 2012) John T. said:

Sorry, I meant the coil in the air handler where the air returns (evaporator?). I took out the blower fan and the blades are rusty as well as the mount for the motor. The inside of the handler, made of that "furry" material, has plenty of mold also. Can I replace that material or do I need a whole new box or cabinet or whatever it's called--the thing that everything is encased in?

(Mar 28, 2012) Anonymous said:

John, I'm not sure what an "intake coil" is - perhaps you mean a cooling or evaporator coil in the air handler?

In any case, I think the immediate steps are:

- clean the coil
- install or make sure you have effective air filtration upstream from the coil, preferably at the return air inlet register(s)
- inspect the ductwork for damage or dirt or debris - depending on the duct material (metal, for example) it can be cleaned.

Let me know what you find and perhaps send along some photos (see the CONTACT US link at page top or bottom) - we may be able to suggest more steps.

(showing 1 to 10)

Recommend / Share this Article

+1 ShareThis

EMAIL

Print

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also include a list of recommended books for the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

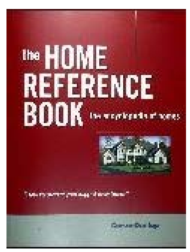
Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

- CARSONDUNLOP Carson, Dunlop & Associates Ltd., 120 Carlton Street Suite 407, Toronto ON M5A 4K2. (416) 964-9415 1-800-268-7070 info@carsondunlop.com. The firm provides professional home inspection services & home inspection education & publications. Alan Carson is a past president of ASHI, the American Society of Home Inspectors. Thanks to Alan Carson and Bob Dunlop, for permission for InspectAPedia to use text excerpts from *The Home Reference Book* & illustrations from *The Illustrated Home*. Carson Dunlop Associates' home inspection education products include
  - The ASHI-adopted Home Inspection Training Program, and Commercial Building Inspection Courses
  - The Home Inspection Home Study Course, and publications such as
  - The Home Reference Book, a reference & inspection report product for building owners & inspectors
  - The Home Reference *eBook*, an electronic version for PCs, the iPad, iPhone, & Android smart phones
  - Home Inspection Report writing materials, including the Horizon Software System that manages business

operations, scheduling, & inspection report writing using Carson Dunlop's knowledge base & color images. The *Horizon* system runs on always-available cloud-based software for office computers, laptops, tablets, iPad, Android, & other smartphones.
    - The Illustrated Home illustrates construction details and building components, a reference for owners & inspectors
- Thanks to reader RB in Chattanooga TN for discussing inspection procedures and inspection frequency for air conditioning condensate drain line systems - October 2010
- Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982
- Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- NEW!
  Air Conditioning SEER - New DOE Air Conditioner and Heat Pump Efficiency Standard
- Asbestos HVAC Ducts and Flues field identification photos and guide
- Fiberglass: Indoor Air Quality Investigations: Fiberglass in Indoor Air, HVAC ducts, and Building Insulation

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia Bookstore.



- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

  Or choose the The Home Reference eBook for using this reference on PCs, Macs, Kindle, iPad, iPhone, or Android Smart Phones

Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

- ...

Why We Like ***Gasketed*** Air Filters & Dirt in HVAC Systems and Effectiveness of ***Washable*** Air Filters

InspectAPedia® - ShareThis +1

- Benefits of gasketed air filters on HVAC systems
- Significance of dirt and debris in the return air plenum or ducts
- Washable air filters for HVAC systems
- Air conditioning / heating system filter product sources and recommendations
- Questions & answers about using gasketed & washable air filters and their effects of dirt & debris in HVAC duct systems.

Gasketed air conditionre or heating filters, leaky air filters, washable air conditioning or heater air filters: This article explains and explain leaky air filters and the value of gasketed air filters, followed by comments on the effectiveness of washable air filters. This website answers almost any question you might ask about air filters for heating or air conditioning systems. We explain how an air conditioning service technician will diagnose certain common air conditioning system failures or defects. In these articles we are referring to filters installed on central air conditioning or central heating systems that move air through air handlers and duct systems. Standalone or portable "air cleaners" or "air purifiers" are generally ineffective in buildings. We include photographs to assist readers in recognizing cooling system defects.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

at the left of each page to navigate ***within*** topics and documents at this website. Green links show where you are in a document series or at this website.

The Benefits of Gasketed Air Filters on HVAC Systems

Readers should also see our INDOOR AIR QUALITY IMPROVEMENT GUIDE article series. The page top photograph is of a low-MERV HVAC filter in an air handler.

A gasketed heating or air conditioning system air filter improves the filter effectiveness. The benefits of a high efficiency air filter material when used in an air handler and duct system are not fully realized if air bypasses the filter around its installation frame due to poor fit or poor installation.

[The filter shown here is *not* a high quality gasket-type air filter.] That's why some manufacturers emphasize the value of air-sealing gaskets on their products.

Simple observations made in the field will make for agreement with the manufacturers that filter bypass is an issue at some heating or air conditioning installations. When changing an air filter at a return air inlet or at an air handler, when the old filter has been removed, take a look inside the return duct at the return register, or inside the return plenum at the air handler, to see just how much debris is passing the filter.

[The photograph above shows how a badly-fit HVAC air filter can not only leak bypass air into the blower compartment but also it can collapse right into the blower fan - this is a potential fire hazard!]

Implications of dust and debris in the return air plenum

On an old heating or air conditioning system where filters have been ineffective, not properly installed, leaky, or not maintained and changed on schedule, we often find quite a bit of debris entering the air handler and duct system. This is in fact so common that most HVAC installers and technicians consider dirty ducts to be "normal". And they're quite correct: typical house dust that has collected inside of a duct system is not normally a toxic substance.

But
1) a high level of dust and debris inside of an air handler or duct system indicates that system filtration has not been effective,

2) the dust level indicates that the system has been delivering dust and debris to the occupants providing poorly-filtered air, and

3) there is an increased risk of mold in the duct or air handler system if moisture enters the system from a leak or from air conditioning condensate mishandling.

How Good are Washable air filters for heating and air conditioning systems

Washable re-usable air filters are very appealing from a cost viewpoint. I would look for data to indicate whether or not the washable filter runs at a lower MERV or filtering efficiency.

In our cascaded filter proposal (discussed at this website) we included and continued to use a washable filter that came with the equipment since it was not reducing the airflow CFM, but we preceded it with other filters for different purposes.

he photograph at above left shows a typical washable metal air filter used in central air conditioning systems, and at above right is a washable foam air conditioning filter used in a portable room air conditioner. Other types of washable air filters are available as well.

At left we illustrate a plastic and nylon washable air filter used in both window air conditioners and in wall-mounted split system air conditioner units.

Unlike the foam type air filter shown above, these plastic and nylon air filters withstand repeated cleaning without disintegrating.

The efficiency of these filters increases as debris begins to settle on the filter surface, but eventually the improvement in air filtration efficiency is offset by reduced airflow - so clean the air filters in accordance with the cooling unit manufacturer's instructions - typically monthly during constant use.

Also see Spit System Air Conditioner Air Filter Maintenance - How to Clean a Split System Air Conditioner Filter.

A metallic air filter (shown) is not very efficient (effective) at trapping airborne particles when it is clean, though efficiency improves as it gets dirty. Other pleated, fabric or paper air filters that are also washable are more efficient at trapping airborne debris.

Be sure to read Particle Sizes & IAQ for a description of the sizes and behaviors of some of the common particles that are an indoor air quality concern.

Questions & Answers regarding this article

Questions & answers about using gasketed & washable air filters and their effects of dirt & debris in HVAC duct systems..

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

No one has commented yet. Be the first!

Recommend / Share this Article

+1 ShareThis
EMAIL
Print

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also include a list of recommended books for the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

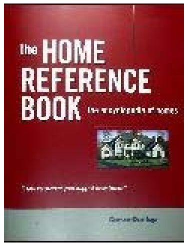
Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

- Thanks to Mark Cramer, Tampa Florida, for assistance in technical review of the "Critical Defects" section and for the photograph of the deteriorating gray Owens Corning flex duct in a hot attic. Mr. Cramer is a Florida home inspector and home inspection educator.
- Thanks to Jon Bolton, an ASHI, FABI, and otherwise certified Florida home inspector who provided photos of failing Goodman gray flex duct in a hot attic.
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and

cooling equipment ($69.00 U.S.).
- US EPA article on air filter efficiency: epa.gov/iaq/pubs/airclean.html 06/18/2010
- Wikipedia provided background information about the definition of HEPA and airborne particle interception.

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia Bookstore.



- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

  Or choose the The Home Reference eBook for using this reference on PCs, Macs, Kindle, iPad, iPhone, or Android Smart Phones

Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

- Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982
- Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- NEW!
  Air Conditioning SEER - New DOE Air Conditioner and Heat Pump Efficiency Standard
- Asbestos HVAC Ducts and Flues field identification photos and guide
- Fiberglass: Indoor Air Quality Investigations: Fiberglass in Indoor Air, HVAC ducts, and Building Insulation
- ...

InspectAPedia®

Free Encyclopedia of Building & Environmental Inspection, Testing, Diagnosis, Repair

Search
InspectAPedia

Ask a Question or Search InspectAPedia

Air Conditioner Condensing Coil Fins Damage

InspectAPedia® - ShareThis +1

- Air conditioner condensing coil fin damage
- Air conditioner compressor support pad defects
- Corrosion on Heating & Air Conditioning Heat Exchanger Coils & Condenser Coils
- Types of Air Conditioner, Heat Pump, & Refrigeration System Condensers / Condenser Coils
- Changing or replacing a bad condensing coil, advice for
- Questions & answers about diagnosing and repairing damaged HVAC coil fins

This air conditioning repair article discusses the damaged air conditioner condensing coil fin damage & compressor, including bent or clogged fins which can interfere with effective system operation and improper support such as tipped or leaning A/C compressors.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

 Use page top links to major topics or use links at the left of each page to navigate ***within*** topics and documents at this website. Green links show where you are in a document series or at this website.

Air Conditioner Condensing Coil Fins Damage & Repair

Which Cooling or Heat Pump "Coil" is Which: Condensing Coil &

Cooling/Evaporator Coils Defined

The CONDENSING COIL discussed here is normally on the outdoor or compressor portion of your air conditioning system. The job of the condensing coil is to cool high temperature refrigerant gas to condense it back to a liquid refrigerant form.

The COOLING COIL or EVAPORATOR COIL is the evaporator coil found inside the air handler, used to cool air blown across it and into the building occupied space. If your concern is with If your equipment is a heat pump these terms can be a bit confusing because in heating mode, your heat pump system's indoor coil is warming, not cooling the air blown across it

Shown here: an outdoor condensing coil with badly damaged cooling fins: If the condensing coil fins are extensively bent and damage, airflow across the coil is impeded, causing the same failures and operating cost issues described above for the compressor too close to the building wall.

When coil fins are sufficiently damaged as to be mostly blocked, the coil is not useable and needs replacement. Minor A/C coil fin damage can be repaired using special "combs" sold for that purpose - ask your air conditioner service technician to look at, evaluate, and repair fin damage.

Nova-Tech International and other companies sell coil fin straightening combs, but if your coil is as horrible as this one it needs replacement.

Condensing coils may also become blocked by dirt and debris, interfering with system cooling operation. There is a big payoff in cleaning dust, debris, grass clippings off of a dirty refrigeration condensing coil (this includes outdoor condenser/compressor units for air conditioners and heat pumps and also the condensing coil on a home refrigerator or freezer). A refrigeration system works by transferring heat from hot refrigeration gas/liquid to ambient air around the condensing coil. Remember that heat always flows from the warmer to the cooler substance.

A blocked condensing coil, regardless of the cause of blockage, can also cause the occurrence of refrigerant gas bubbles in the refrigerant piping system - a condition you might hear or see. See details at Bubbles seen or heard in the liquid refrigerant line?

Overheating, Blocked Coils May Cause Air Conditioner or Heat Pump Noise

Because dirt and debris block airflow across the coil, increasing the cost of heating or cooling the building and perhaps even overheating the compressor motor, it is important to keep leaves and debris off of this component. In severe cases cooling or condensing coils can become so blocked that air flow is seriously reduced, possibly also leading to an evaporator or cooling coil icing problem indoors or an overheated, damaged compressor outdoors, or simply loss of cooling capacity of the system.

We first mentioned at NOISES, COMPRESSOR CONDENSER that we had a field report from a reader who explained that a noisy outdoor compressor unit was, according to his HVAC service technician, traced to a blocked, clogged outdoor condensing coil. We speculate that perhaps the compressor was running hot and that correcting air flow across the condensing coil corrected that condition.

> *I have a National comfort Products CPO 2464-B unit which is an air conditioner and gas heating unit combined. The unit is about 5 years old. The air conditioner had become increasingly noisy. I called the party that installed the unit. After spending $90.00 for a service call I was informed the the external coils were dirty, opening up the unit light was not visible thru the coils.*
>
> *I was advised to use a garden hose and rinse the coils. I did not have that available so I turned the unit on*

and using a watering can, poured warm soapy water onto the coils. this was done several times. the unit now seems to work properly. I did not see this particular problem described on your website. There may be other means of cleaning the coils but this was all I could think of. - C.A.P., Norristown PA

Corrosion on Heating & Air Conditioning Heat Exchanger Coils & Condenser Coils

Corrosion on heat exchanging coils in heat pumps, air conditioners, or water-to-air heating coils eventually leads to leaks and costly repairs that require replacement of the coil and re-charging of the HVAC system refrigerant. Corrosion may occur as a function of age and use and failure to keep the coil clean, but there are some special sources of corrosion in HVAC systems that you should watch for:

- Corrosion of HVAC equipment coils due to their use at indoor swimming pools: chlorine used in pools is very volatile and rapidly leaves the pool water as chlorine gas. While the chlorine levels may be below a health hazard to humans at indoor pools, the operation of indoor HVAC systems that condition swimming pool room air exposes the coil to high volumes of possibly corrosive chlorine, reducing the equipment life.
- Corrosion of HVAC equipment coils due to presence of Chinese Drywall in the building. See CHINESE DRYWALL HAZARDS for details.

Types of Air Conditioner, Heat Pump, & Refrigeration System Condensers / Condenser Coils

Above we have explained the purpose and function of condensing coils and condensers used in air conditioners, heat pumps, and other refrigeration equipment such as dehumidifiers, refrigerators, and freezers. Here is more detail about the types of condensers and condensing coils and where they are used.

Static condensers rely on the natural movement of air across the condensing coil (such as in many residential refrigerators and freezers). For a static condenser to work you must leave air space on both sides and above the condensing coil to allow for airflow by natural convection (as no fans are used).

Oil cooler condensers are a type of static condenser that use two or three turns of tubing to cool oil that is then sent back into the compressor motor in a repeated cycle. These condenser (cooling) coils found on some compressors (commercial) also must have adequate airlfow.

Static condensers may also be found in a split in the compressor motor shell, between an inner and outer box shell - such as used in halo heaters - to reduce air condensation. You can identify a split shell or box shell static condenser because the box is warmer on the outside sides and at the compressor motor top than at the bottom. These static condensers also require airspace for natural air convection.

Forced air condensers require a fan to move air across the condensers' cooling fins and coils. On an air conditioner or heat pump compressor/condenser unit the fan typically draws outdoor air through the coil and out an exhaust side of the condenser unit. When used on a residential refrigerator or freezer the condenser coil may be at the bottom (or in some designs the top) of the unit where a fan blows air across the condensing coil and out of the box again.

Clean the refrigerator coils? In an expert witness court case involving a matrimonial dispute we [DF] testified that a refrigerator had overheated, burning the vinyl flooring in the kitchen when the condensing coils had been left plugged with animal hair and dust. One of the attorneys asked if it was our opinion that refusing to clean the coils had been a deliberate act of sabotage on the part of the building occupants. "Of course not," I answered, "most people never clean their refrigerator or freezer coils - they never think about it until the equipment fails."

Pets like to lie close to a bottom-mounted condenser coil/fan unit at refrigerators and freezers, to enjoy that nice warm

WINDOW / WALL AIR CONDITIONERS
WINDOW / WALL A/C SUPPORTS

More Information

exhaust air in cool weather. A result is a coil clogged with pet hair that needs more frequent cleaning. Even if it doesn't burn the floor under you refrigerator, a dirty condensing coil means a less efficient refrigerator or freezer operation and higher electrical bills.

Reinstall the airflow panels that you might remove to clean a refrigerator or freezer condenser coil. Failing to do so means air will no longer pass properly over the condensing coil. The result, as with pets, is a higher electrical bill.

Changing Out or Replacing a Bad Condenser Coil on an Air Conditioner or Heat Pump

As we also cite in our information about the COOLING COIL or EVAPORATOR COIL, a condensing coil can also need replacement due to damage, leaks, or corrosion. When replacing a condensing coil it is important to match the size of the original coil so that the air conditioner, heat pump, or other equipment remains properly balanced among compressor, condenser, and evaporator.

Condenser coil piping and tubing is smaller diameter than the suction lines, and are often made of steel. Keep in mind that when soldering steel to copper refrigerant piping you'll need to use silver solder or brazing.

See details about HVAC piping soldering discussed at REFRIGERANT PIPING & DISTANCES

More details about proper comprssor/condenser unit installation and placement are at INSTALLATION ERRORS, COMPRESSORS.

Frequently Asked Questions (FAQs) about compressor condensing coil damage

Question:

Questions & Answers regarding this article

Questions & answers about diagnosing and repairing damaged HVAC coil fins or coil tubing damage & repair.

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(July 28, 2012) DanJoeFriedman (mod) said:

Bobby, sounds like an electrical switch that uses a transformer or coil to operate the relay. The power board is not the power coil. The power board is a circuit board; sometimes a component on such a board fails or burns up - not something that is field repairable.

(July 21, 2012) Bobby said:

What's a Power coil? I had an A/c come in and change coils showed me a small rectangular thing that had copper wire attached to it. Told me the powerboard in the oustide unit was shot. and he tells me I can't heat but can cool normally. Sounds like BS.

(July 10, 2012) DanJoeFriedman (mod) said:

Good point, Sam, thanks. Also we see cooling coil corrosion from indoor pool chemicals and of course other corrosives in industrial settings. And from Chinese drywall outgassing.

(July 10, 2012) SamS said:

If you live near the beach the salty air from the ocean can cause premature disintigration of the aluminum condenser coil fins.

(June 10, 2012) DanJoeFriedman (mod) said:

Desha, urine is corrosive to aluminum - a common metal used on condenser coil fins.

The condenser coil and its fins are in the outdoor compressor/condenser unit - something a pet could certainly pee on.

The evaporator coil is the cooling coil that is inside the air handler or ductwork inside the building. Unless the pet got into the air handler or ductwork to urinate on the evaporator coil, that's a different section of your cooling system.

(June 8, 2012) Desha M. Smith said:

Can pet urine corrode condensor coil and as a result cause damage to the evaporator coil

(July 6, 2011) DanJoeFriedman (mod) said:

A/C condenser coil fins that flake and disintegrate on being touched must be very badly corroded - perhaps by exposure to a nearby corrosive gas - we have seen this problem in units installed at indoor swimming pool installations; sorry but it sounds as if you need a new condenser coil AND I'd want to look for the corrosion cause; did someone spray the condenser with an inappropriate and caustic cleaner??

(July 4, 2011) Jack said:

do residencial condenser coils need teflon coating, what would cause coils to flake and fall off just by touching them.

Recommend / Share this Article

+1 ShareThis
EMAIL
Print

...

Technical Reviewers & References

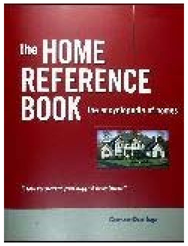
- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also include a list of recommended books for the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

Thanks to reader Charles A. Plinton, Norristown, PA, for discussing A/C compressor noise, coil cleaning, and system maintenance - August 2010

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia Bookstore.



- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

  Or choose the The Home Reference eBook for using this reference on PCs, Macs, Kindle, iPad, iPhone, or Android Smart Phones

Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

- Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982
- Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- NEW!
  Air Conditioning SEER - New DOE Air Conditioner and Heat Pump Efficiency Standard
- Asbestos HVAC Ducts and Flues field identification photos and guide
- Fiberglass: Indoor Air Quality Investigations: Fiberglass in Indoor Air, HVAC ducts, and Building Insulation

- ...

Mobile View
AIR CONDITIONING & HEAT PUMP SYSTEMS

A/C - HEAT PUMP CONTROLS & SWITCHES
Outside Switches, Fuses, Breakers
Inside Switches,Components
Air Handler / Blower Switches
Blower Door Switches
Backup Heat Controls
CAPILLARY TUBES
CIRCUIT BREAKER SIZE for A/C or HEAT PUMP
Compressor Condenser Switches, Controls
Condensate Overflow Switch
CONTACTOR RELAY DIAGNOSIS & REPAIR
CONTROL CIRCUIT BOARD, A/C
CRANKCASE HEATERS
FAN, COMPRESSOR/CONDENSER UNIT
Duct System Switches
Duct System Filters
OPERATING CONTROLS, A/C & HEAT PUMP

Complete List of All Air Conditioning & Heat Pump System Controls & Switches

InspectAPedia® - ShareThis +1

- Here is a full list of air conditioning system parts, controls and switches
- What is the function of each air conditioning control or air conditioning switch?
- What check first if your air conditioning won't start
- Key switches and controls to check if your air conditioner or heat pump is not working
- Questions & answers about how to find, identify, & use or troubleshoot each control or switch found on air conditioners or heat pumps.

HVAC system controls & switches: this article explains where to find and how to use the switches and controls for air conditioning and heat pump systems. We list and explain the function of each air conditioner or heat pump control or switch, including providing identification photographs and troubleshooting tips. HVAC control definitions & photos are organized by where they are found: indoors or outside of the building, and at the air handler/blower assembly or the outdoor compressor/condenser unit, or perhaps in other locations such as wall thermostats or electrical panel main switches.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

 Use page top links to major topics or use links at the left of each page to navigate *within* topics and documents at this website. Green links show

where you are in a document series or at this website.

Air Conditioning & Heat Pump CONTROLS & SWITCHES

We include photographs to assist readers in recognizing cooling system defects. Other articles at this website discuss certain of these controls in greater detail. See SYSTEM OPERATION for a discussion of thermostats, zone dampers, and circuit breakers on air conditioners and heat pumps. Also see THERMOSTATS and THERMOSTATIC EXPANSION VALVES.

If your air conditioning or heat pump system has lost its cooling capacity or won't start see REPAIR GUIDE for AIR CONDITIONERS. See How to determine the cooling capacity of air conditioning equipment if the system seems to be working but is inadequate to cool your building. CONTACT us to add HVAC system switches or controls or diagnostic suggestions you do not find here.

Detailed List of Air Conditioning & Heat Pump Parts, Switches and Controls

Here we list all of the controls and switches on a typical split system air conditioner with indoor and outdoor components include the items listed just below. If the A/C system won't operate, before requesting a service call check that it is turned on at every control, switch, or circuit breaker, and that the thermostat is properly set.

The main operating controls for HVAC systems and their functions are are discussed at SYSTEM OPERATION where you will find a discussion of thermostats, zone dampers, and circuit breakers on air conditioners and heat pump systems.

We explain these many electrical switches and controls that control an air conditioner or heat pump system. You'll need to check these first if your air conditioner won't start or won't keep running. Other air conditioning and heat pump diagnostic procedures are at LOST COOLING CAPACITY.

If the A/C or heat pump system will not run *check all of these control and safety switches listed here before calling your service technician.* If someone or some condition has turned one of these switches off, resetting it may be all that's needed. Not all of these switches will be present on every system; fuses may be used instead of circuit breakers; fuse pullouts may be used instead of a circuit breaker or fuse at some service switches.

Watch out: ***Safety warning**: do not put your fingers or hands inside of a heating furnace or air conditioner blower or blower compartment* without making certain that all electrical power to the unit has been shut off. If the blower starts turning you can lose a finger, and there are also electrical shock hazards in these areas.

Key Air Conditioner or Heat Pump Main Electrical Control Switches, Fuses, or Circuit Breakers

- Air handler circuit breaker: in the electric panel there will be a switch controlling power to the air handler/blower circuit, perhaps two different circuits, one for the air handler unit, and a second for the compressor/condenser unit (the next item listed below) - also see CIRCUIT BREAKER SIZE for A/C or HEAT PUMP
- A/C or Heat Pump Compressor circuit breaker: in the electric panel there will be a switch, circuit breaker or fuse controlling power to the outdoor compressor circuit - also see CIRCUIT BREAKER SIZE for A/C or HEAT PUMP
- A/C indoor Air handler service switch: usually indoors at or right on the indoor air handler/blower unit, this switch is normally always "on" except during equipment servicing.
- A/C outdoor compressor/condenser unit service switch typically on the unit or on a building wall surface close to it. This switch is normally always "on" except during equipment servicing. Also see Outside Switches, Fuses, Breakers
- Air conditioner or heat pump thermostat: one or more indoor wall mounted thermostats must be set properly to call for cooling (or heating). Split system air conditioners and heat pumps may use a remote control device to turn the equipment on or off and to set the desired temperature. See THERMOSTATS.
- Other electrical switches and controls such as an air conditioner or heat pump pressure safety switch found on or near the compressor/condenser unit and in some window and through-wall units can also shut down an air conditioner or heat pump system, as we discuss below in this article.
  - Electrical panel circuit breakers or fuses will be provided separately to control the air handler (blower system) circuit and the compressor/condenser circuit. Of these the compressor is usually supplied by a 240V circuit and the air handler by a 120V circuit.
  - Compressor safety shut off switch outside at the compressor/condenser. The switch may be a circuit breaker, fuse, or a simple "pull-out" disconnect located close to the compressor.
  - Air handler service switch inside on or close to the air handler unit itself
  - Air handler blower compartment safety switch: a safety interlock that will turn off electricity to the air handler or blower unit if the blower compartment door is not securely shut. If your air conditioner blower will not start this switch and the blower compartment doors should be checked. See BLOWER FAN OPERATION & TESTING
  - Air conditioner/heat pump contactor relay switch: turns on high amp drawing equipment such as the compressor motor. See CONTACTOR RELAY DIAGNOSIS & REPAIR
  - Air conditioner or heat pump pressure control & pressure safety switches: turns off the system at excessive refrigerant pressure and in some systems at too-low pressure. Also used in automotive air conditioning. See Pressure Controls & Safety Switches

List of ***Outside*** A/C or Heat Pump Service Switches, Fuses, Circuit Breakers

MOLD in AIR HANDLERS & DUCT WORK
MOLD INFORMATION CENTER

NOISE AIR CONDITIONER / HEAT PUMP
NOISE / SOUND DIAGNOSIS & CURE
Air Leak Noises
AIR CONDITIONING & HEAT PUMP NOISES

ODORS in AIR HANDLERS & DUCT WORK
OPERATING COST, AIR CONDITIONER
OPERATING DEFECTS, AIR CONDITIONING
OPERATING TEMPERATURES, AIR CONDITIONER

PORTABLE ROOM AIR CONDITIONERS
PRESSURE READINGS, REFRIGERANT

REPAIR GUIDE, AIR CONDITIONERS / HEAT PUMPS
REPAIR & DIAGNOSTIC FAQs for A/C
REFRIGERANTS & PIPING
RETROFIT SIZING for A/C or HEAT PUMPS

SEER RATINGS & OTHER DEFINITIONS
SOLAR ENERGY SYSTEMS
SPLIT SYSTEM AIR CONDITIONERS & HEAT PUMPS
SWAMP COOLERS
SYSTEM OPERATION
OPERATING CONTROLS
SAFETY CONTROLS

THERMOSTATS, HEATING / COOLING
Types of Building & Room Thermostats
How Thermostats Work
Detailed Guide to Room Thermostats
How to Set the Thermostat
COOL OFF HEAT Thermostat Switch
FAN ON AUTO Thermostat Switch
HEAT ANTICIPATOR Adjustment
HEAT ANTICIPATOR Mini Ammeter to Check
HEAT PUMP Thermostats - Outdoors
INSTALL & WIRE Thermostats
LOW VOLTAGE TRANSFORMER TEST
SWITCH FUNCTIONS on a Room Thermostat
TEMPERATURE RESPONSE of Room Thermostats

THERMOSTATIC EXPANSION VALVES

WATER COOLED AIR CONDITIONERS
WINDOW / WALL AIR CONDITIONERS
WINDOW / WALL A/C SUPPORTS

More Information


The pair of photographs just above show the outdoor air conditioner or heat pump compressor/condenser service control switch, in this case a circuit breaker, installed outside at a compressor for a ductless cooling system compressor. More photographs of a ductless or split system air conditioning system are at A/C TYPES, ENERGY SOURCES.

Our page top photograph is an important one to study further. The air conditioning system compressor/condenser service switch for this outdoor unit was a 240V fused circuit with outdoor fuses in the box shown in the photo. In this close up photograph you can just make out that someone has installed 1/2" copper pipes in place of the original fuses.

This *might* be a dangerous installation, risking fire as well as a burn up of the air conditioning equipment. But as Mark Cramer pointed out, if the circuit were properly protected by breakers or fuses at the main panel, the insertion of metal pipes in these fuse sockets just converts the device from a fuse box to a simple switch.

In any case, simply installing fuses would restore the proper safety device but it's likely that further testing and diagnosis of the electrical circuit and the compressor/condenser unit will be needed to determine why someone installed copper pipes where fuses belonged in the first place. When someone converts fuses to a switch in this location it may be because the air conditioning system was frequently blowing the fuses -- someone wanted to force the compressor/condenser to run.

Compressor Condenser Controls & Switches

Circuit breaker(s) at the electrical panel protect the circuit supplying power to the air conditioning system. Typically separate circuit breakers (or fuses) power the compressor/condenser unit and the indoor air handler/blower assembly.

Watch out: your HVAC equipment may be run out of a sub-panel rather than the main electrical panel. Be sure you have found all of the electrical panels, sub panels, and manual control switches for the equipment both inside the building and outdoors.

Watch out: really watch out: if you re-set a circuit breaker or replace a fuse and the breaker trips again or the fuse blows again, leave the equipment off and call a qualified service technician. You probably have an unsafe condition. Forcing electrical equipment to run can cause shock or fire.

Compressor/Condenser Unit: the "outside" portion of an air

conditioner or heat pump, the compressor re-compresses refrigerant gas back into a liquid and in the process, moves heat (in the refrigerant) either from indoors to outside (air conditioning mode) or from outdoors to inside (heat pump mode) if the system is a heat pump.

See COMPRESSOR CONDENSER for details of the diagnosis and repair of compressor problems.

Compressor service switch: The air conditioning system compressor service switch is located outdoors, at the compressor/condenser unit, typically on a building wall near the outdoor unit, this switch may be a circuit breaker, a fuse block pull-out, or a simple electrical switch.

Service switches permit a service technician to work safely on the equipment by turning off electrical power to the unit without having to run back and forth through the building to the main electrical panel. Where the compressor/condenser service switch is omitted some technicians are tempted to work on equipment while it is electrically "live", and a few of them get shocked. These switches are required by current electrical codes but may be absent on old A/C installations.

If no service switch is installed at the compressor/condenser you should have one installed at the next A/C service call or next electrical work done on the building.

In our photograph the A/C service switch is very unsafe for two reasons: first, because it is falling off of the wall it may be difficult to operate the switch. Second, ask yourself, "What happened to the screws that were used to fasten this switch to the building wall?" We've seen cases of the mounting screws falling *into* the switch box, causing a short circuit or even a fire. In this particular case the vinyl siding installers pulled the switch loose to install siding and didn't bother to reinstall it.

Air Conditioner/Heat Pump Contactor Relay Switch

A/C and heat pump systems use a *contactor relay* (circled at left) because the little 12-24V wall thermostat circuit and switches are not capable of handling the higher voltage used by the compressor/condenser motors.

The contactor relay is basically a low-voltage-operated switch [typically 12-14 volts] controlled by the low-voltage room thermostat) that switches a heavier-duty electrical relay to give 120V or 240V electrical power to the compressor/condenser unit.

Most A/C and heat pump contactor relays use an electromagnetic 24-volt two-pole contactor relay that is rated for 30 amps.

The "two poles" simply means that the relay switches two electrical wires simultaneously - which is what you'd expect if your heat pump motor is running on 240 Volts.

Tips for changing out or installing a new magnetic contactor relay on an air conditioner or heat pump

Match the part numbers correctly when installing a new contactor relay in an air conditioner or heat pump. If the coil that activates the relay is not the right one for the compressor motor, you can have either of these problems:

Coil strength is too low: the coil won't reliably energize the start circuit in the motor and the compressor will be hard to get started

Coil strength is too high: the contactor relay coil won't let go of the start circuit: it will keep the start circuit active in the system even after the compressor motor has started - resulting in burning out the starter circuit.

Also locate a *magnetic* contactor relay switch in the proper physical position (mount it like the original was mounted) don't just hang the relay by its wires (as in our photo above). Some relays may be affected by gravity, either holding points closed too long or not holding the points closed. A *current*-operated contactor relay (most new units) can be mounted in any position.

Watch out: Some of our readers report successfully replacing minor electrical components such as switches, relays, and contactors. But unless you are qualified to do so we do not recommend trying to do work on electrical systems and components in your home as there are potentially fatal electrical shock hazards. Because air conditioner compressor/condenser units include start/run capacitors (see CAPACITORS for HARD STARTING MOTORS), even when you have turned off power you can get a nasty shock if you're not careful.

Also see SAFETY for ELECTRICAL INSPECTORS and Using DMMs & VOMs Safely.

Air Conditioner, Heat Pump, Refrigeration System Operating Pressure Control Switches & Electrical Sensor Safety Switches

We distinguish between operating control pressure switches and safety switches that monitor against too-low or too-high refrigerant pressures in a refrigeration system. Both are described in detail at Pressure Controls & Safety Switches. Excerpts are just below.

Operating Pressure Control Switches for Air Conditioners, Heat Pumps, Refrigeration Equipment

Operating pressure control switches set the normal compressor cut-in and cut out pressures in commercial refrigeration systems including air conditioners, coolers, refrigerators freezers.

Commercial refrigeration equipment such as refrigerators (coolers) and freezers use a pressure control switch to set the cut-in and cut out pressures at which the compressor shall operate.

The pressure control switch and the thermostatic expansion valve may both need to be inspected, tested, and set to cooperate with one another, as I describe in an old field service call report described at REFRIGERANT METERING DEVICES TEVs

Shown at left is a Ranco™ single pressure control switch with an operating range of 12-50 psig and a differential range of 5-35 psig. Ranco produces a wide range of switches and controls including air conditioning controllers. This particular Ranco switch shown at left "opens" on low. Available from Grainger and other refrigeration equipment suppliers.

The Ranco Type "O" single function pressure controls are very widely used on refrigeration systems and can operate either as normal operating controls or as protection devices (see Pressure Controls & Safety Switches).

Refrigeration System Pressure Safety Switches: protect against over pressure or under pressure in air conditioning or heat pumps

Some HVAC systems (air conditioners, heat pumps, refrigeration equipment) include other sensor switches that may include an electrical pressure or temperature transducer/sensor (photo at left) or an air conditioning or heat pump pressure sensing switch that detects improper (too high) or [in some systems including automotive air conditioning] too-low refrigerant pressures in the system.

Details about these safety switches are at Pressure Controls & Safety Switches. Excerpts are just below.

For safety the air conditioning or heat pump pressure switch can shut off the system. When pressures return to normal the pressure safety switch normally auto-resets and operation can continue.

Watch out: As Ranco and others warn, both under pressure (that can damage the compressor) and overpressure (that can damage or eve blow something up) at an air conditioner or heat pump system - can be dangerous need to be guarded against.

List of ***Inside*** Air Conditioner or Heat Pump Controls, Switches, Major Parts

Control Circuit Board - Air Conditioner / Heat Pump

Control circuits (typically a "control board" shown in our photo at left) along with the contactor relay (discussed above) are used in the compressor/condenser to turn it off and on in response to the indoor thermostat's call for cooling.

While diagnosing a circuit or component problem *within* an air conditioner or heat pump control board is beyond the skill of most homeowners, a simple visual inspection might show you that the control board has been visibly burned, broken, or damaged. Of course the board may *look* OK and still be damaged.

See A/C - HEAT PUMP CONTROLS & SWITCHES for details.

Air Conditioner or Heat Pump Controls In or On the Air Handler Unit or Blower Compartment & At the Cooling Coil

Air Handler: the air conditioner or heat pump air handler is the "indoor" portion of the cooling (or heating) system whose job is to condition air from the living space by blowing air across a cooling coil

(air conditioning) or heating coil (heat pump), sending the conditioned air on through supply ducts into the occupied space. The primary parts of the air handler unit include:

- Return air plenum: return ducts from the occupied space bring building air to this collection point for passage into the air handler
- Air filter: may be located in or near the return air plenum or preferably, at return air registers. Additional air filtration equipment may be installed at the air handler on the return-air side, such as electrostatic air cleaners, UV light sterilizers, HEPA filters, or other air quality improvement devices. See AIR FILTERS for HVAC SYSTEMS for details. Watch out: some HVAC systems may include a clogged or blocked air filter switch that you'll want to check. This may be simply an indicator that pops out to indicate that the filter has become too dirty and is blocking air flow.

Thermostatic expansion valves & other refrigerant metering devices: An air conditioner thermal expansion valve or "TEV" or just "expansion valve" (tan colored device in the photo) is a device located at the cooling coil and connected between the incoming refrigerant line and the refrigerant inlet to the cooling coil in the air handler.

The thermostatic expansion valve is a refrigerant metering control device, and it is *not* a control or switch which can be directly operated when using an air conditioning system, but it is a critical control needed for metering refrigerant into the cooling coil, so we include its description here.

The TEV shown in this photo is used on a heat pump system so it includes extra tubing so that it can permit the refrigerant to reverse its flow of direction when changing from cooling mode (move indoor heat to outdoors) to heating mode (collect and move outdoor heat to indoors).

There is a variety of refrigerant metering devices and they're not all called "TEVs": See THERMOSTATIC EXPANSION VALVES for details about the function, inspection, and installation of thermostatic expansion valves, automatic expansion valves, CAPILLARY TUBES, manual and adjustable and non-adjustable expansion valves, high side and low side float valves, all of which are used to control refrigerant flow in refrigeration equipment such as heat pumps, air conditioners, refrigerators, freezers, and dehumidifiers.

A/C or Heat Pump Air Handler Blower Door Switches

- Blower compartment & blower fan: housing a fan, usually a round squirrel cage fan and electric motor (to operate the fan) which moves air from the return air plenum on towards the cooling or heating coil. An access door to the blower compartment should have a blower door interlock switch, a safety device which will prevent the blower from operating if the door is opened (see below). See FAN AUTO ON Thermostat Switch for details about what turns the blower fan on and off in normal use.
- Blower compartment door switch: an air handler blower compartment access door switch is present on newer units, and can be seen as a button or switch which is depressed when the blower compartment door or cover is properly in place. This switch shuts off the blower fan as a safety control if the door is opened. If your air conditioner won't run and someone has been fooling with it, be double sure that the blower compartment door is properly closed and that the interlock switch sensor button or lever is properly depressed to convey that fact to the system.

- Blower motor overload or overheat switch: a built-in overload protector used in some electric motors, especially the electric motor used to power the air handler's blower fan, may be tripped. See Blower Motor Switch for details.

- Cooling coil or heating coil (also called EVAPORATOR COIL or COOLING COIL) through which refrigerant is metered by a thermostatic expansion valve (see below) in order to cool and dehumidify (or in the case of heat pump mode, warm) air from the occupied space as air is blown across this coil.

Backup Heat Controls on Heat Pumps

- Heat Pump Heat & Backup Heat Controls: if your cooling is provided by a heat pump system, during the heating season the same equipment is used to provide heating as was used to provide cooling during hot weather. Heat pumps in climates where temperatures can get lower than the heat pump can handle include a backup heat source and all heat pumps include additional controls: an outdoor thermostat that monitors outside temperature and decides when to switch the backup heating system on; a reversing valve that switches the direction of refrigerant, and an indoor thermostat which can be set to auto, heat, cool, or off modes.

- Supply plenum: a compartment which receives conditioned air from the cooling (or heating) coil and delivers this air to one or more ductwork systems which in turn move air to various areas of the occupied space.

  See AIR HANDLER / BLOWER UNITS for details.

Condensate Overflow Pan Safety Switch

Condensate overflow tray sensor switch: at the air handler, especially in an attic or closet or upper floor air handler, installers may provide an electrical switch (rather than a separate drain pipe) to detect spillage of air conditioner condensate out of its normal air conditioning condensate drain pipe.

When we cool air inside the air handler, that step causes moisture in the air to condense out as a liquid condensate that must be collected and disposed-of.

The condensate overflow switch is a sensor which turns off the air conditioning system as soon as it detects water in the condensate drip tray - thus avoiding a costly leak into building ceilings or floors and perhaps avoiding a mold contamination problem. See DRIP TRAY DEFECTS and Float Switch on Condensate Tray. Thanks to Lester Richter for this tip.

Circuit breaker - compressor: in the building main electric panel there will be a switch controlling power to the compressor/condenser unit. Typically this is a 240V circuit operated by a double pole circuit breaker or a fuse pair.

Circuit breaker - air handler/blower: in the electric panel there will be a circuit breaker or fuse controlling power to the air handler/fan unit which distributes cool air in the building. This will typically be a separate 120V circuit dedicated to protecting the circuit which supplies electric power to this equipment

Duct System Components, Controls, Switches

Duct System: the air conditioning air ducts (or ductwork) (or heat pump duct work) carry conditioned air from the air handler to various rooms in the occupied spaces of the building.

Return air ducts bring air from the occupied space to the air handler. In some installations only a single return air register and return air duct may be installed, usually in the ceiling over a stairwell in a two-story home; where multiple return ducts are provided you will find two or more return registers in the building; If you observe that most rooms have only a supply register and duct and no individual return air ducts, keeping the room doors open will probably improve air circulation and reduce heating or cooling costs for the building.

Supply air ducts bring air from the air handler (where it has been cooled and dehumidified, or heated if a heat pump is in heating mode) back into the occupied spaces in the building. Where each supply duct enters a room through the room ceiling, wall, or floor, a finned supply register should be installed to permit control of the direction and amount of air that exits the duct at that location.

Zone dampers: HVAC ducts in some installations may include motorized zone dampers controlled by individual room thermostats or switches.

See ZONE DAMPER CONTROLS for details about these controls.

See DUCT SYSTEMS for details about inspecting, diagnosing, and correcting a broad range of HVAC air duct problems.

Duct System Filters on HVAC Systems

Filters: air filters provide one or more levels of air filtration should be found installed on any air conditioning or warm air heating system.

Our photo shows an electrostatic air cleaner installed on an air handler. This installation included a disposable air filter installed at a central return air inlet grille (not visible in this photo) so that the air cleaner itself needed cleaning less often.

Air filters may be installed at the return registers, at the air handler, or on occasion at other locations. See AIR FILTERS for HVAC SYSTEMS.

Starter Capacitors and Start/Run Capacitors on HVAC System Motors

A bad starter capacitor or the need for one where none is installed can be the cause of motors that fail to start, motors that chatter or stutter, or electric motors that won't keep running (bad run capacitor). See CAPACITORS for HARD STARTING MOTORS.

Thermostats & Controls on HVAC Systems

Thermostats for air conditioning systems or heat pumps:

An air conditioning system thermostat is a switch to turn on or off the A/C equipment as indoor air temperature varies around the thermostat's set point.

The left hand photograph above shows a typical indoor thermostat used to control heating or cooling. Note that in this photo the thermostat is switched to "heat" mode. The air conditioner will not run with the switch set to "heating". The right hand photo shows a remote control thermostat used indoors to control the indoor wall-mounted cooling unit of a ductless cooling system.

See THERMOSTATS for details of the operation of air conditioning, heat pump, and heating system thermostats and switches.

More photographs of a ductless air conditioning system are at A/C TYPES, ENERGY SOURCES.

Thermostatic Expansion Valves at A/C or Heat Pump Coils

Another type of thermostat that controls heating and cooling in your HVAC or heat pump system is the TEV or thermostatic expansion valve. This device monitors temperatures at the evaporator coil in the air handler and meters refrigerant into the coil accordingly. TEV devices can fail in several ways, Often involving a clogged sensor tube.

While it's possible to fool around with some TEV's, tap on them, adjust their metering rate, etc. this task should be left to your service technician since without proper training and test equipment you will have little idea where the adjustment has been set (if it can be set).

Thermostatic expansion valve: An air conditioner thermal expansion valve or "TEV" or just "expansion valve" (tan colored device in the photo) is a device located at the cooling coil and connected between the incoming refrigerant line and the refrigerant inlet to the cooling coil in the air handler.

The thermostatic expansion valve is a refrigerant metering control device, and it is *not* a control or switch which can be directly operated when using an air conditioning system, but it is a critical control needed for metering refrigerant into the cooling coil, so we include its description here.

The TEV shown in this photo is used on a heat pump system so it includes extra tubing so that it can permit the refrigerant to reverse its flow of direction when changing from cooling mode (move indoor heat to outdoors) to heating mode (collect and move outdoor heat to indoors).

See THERMOSTATIC EXPANSION VALVES for details about the function, inspection, and installation of thermostatic expansion valves.

Motors in HVAC Systems: Electric Motor Overload or Overheat Reset Switches

There are at least three electric motors in a conventional air conditioning or heat pump system, plus sometimes a fourth:

1. An indoor blower fan motor - causing air to move across the evaporator (cooling) coil [or heating coil in heat pump mode], and through the duct work into occupied spaces.
2. An outdoor compressor motor - compressing refrigerant gas back into a liquid
3. An outdoor compressor unit fan motor - draws air across the condensing coils to condense hot refrigerant gas back to liquid form.
4. Condensate pump motor: me systems also use a condensate pump or condensate drain pump to help remove condensate from the air handler to a building drain. A failure here that leads to lost cooling can be subtle: if the condensate removal system fails (bad pump, clogged drain) and if condensate spills into an overflow pan that uses a sensor switch to detect this condition, the failed condensate motor can actually stop an air conditioner from running.

Any of these motors can fail to start or may be "off on reset" due to a motor overload, or motor overheating.

Air conditioner fan or blower motor overload reset buttons: An air conditioner fan or blower motor overload reset button may be present on the blower motor in the air handler/blower compartment.

Look for a red or yellow button which is normally flat with the motor surface but which will pop up to show that the motor has been shut off by its internal overload protection circuit.

Some electric motors (such as submersible well pumps and some A/C or heat pump compressors) have an internal thermal reset switch that will reset automatically when the motor cools down. Others such as that shown in our photograph have to be reset manually by pushing the button in when the motor has cooled.

See ELECTRIC MOTOR OVERLOAD RESET SWITCH for details of how to find and how to reset this switch when necessary.

Zone Dampers & Zone Controls on Heating and Air Conditioning Systems

Some heating and air conditioning systems use manual or automatic zone dampers to control the flow of conditioned air to different building areas. A manual damper is just a lever somewhere in the duct work that opens or closes a baffle inside the duct to limit air flow through that duct section.

An automatic zone damper may be controlled by an individual thermostat for the area served by that zone. So if the heating or cooling system is not running, or if it is running but not sending air to an area in the building, look for and check out any manual and automatic zone damper controls.

Details about zone dampers used on ductwork: warm air zones and air conditioning zones and zone dampers are at ZONE DAMPER CONTROLS.

If the A/C system will not run *check all of these control and safety switches before calling your service technician.* If someone has turned one of these switches off, resetting it may be all that's needed. Not all of these switches will be present on every system; fuses may be used instead of circuit breakers; fuse pullouts may be used instead of a circuit breaker or fuse at some service switches.

Watch out: ***Safety warning****: do not put your fingers or hands inside of a heating furnace or air conditioner blower or blower compartment* without making certain that all electrical power to the unit has been shut off. If the blower starts turning you can lose a finger, and there are also electrical shock hazards in these areas.

How to diagnose and fix an air conditioning system that is not working

Since the failure of an air conditioner to turn on, loss of air conditioner cooling capacity, reduced air conditioning output temperatures, loss of cool air supply, or even loss of air flow entirely can be due to a variety of problems with one or more components of an air conditioner or air conditioning system, *after reviewing the lost air conditioner cooling diagnosis procedures described in this article,* be sure to also review the diagnostic procedures at each of the individual air conditioning diagnosis and repair major topics listed just below. To return to our air conditioning and refrigeration home page go to AIR CONDITIONING & HEAT PUMP SYSTEMS.

If your air conditioning or heat pump system has lost its cooling capacity or won't start select one or more of the diagnostic articles listed below.

- CONTROLS & SWITCHES: air conditioner controls and switches - begin here if your A/C won't start. Here's an important tip: *most refrigeration problems, in air conditioners, refrigerators, or freezers, are electrical, not mechanical.* In air conditioning school, we used to drive out and collect abandoned refrigerators that people were tossing out during our community's spring cleanup week. Taking these appliances back into the shop we found that almost always the problem that had caused the owner to dispose of their air conditioner or freezer was in an electrical connection or electrical control. So it's worth checking out switches and controls on an air conditioner before replacing more costly components.
- OPERATING DEFECTS: major air conditioning problem symptoms and how to get the air conditioning system working again,e.g. compressor or fan noises, failure to start, and inadequate cool air volume
- LOST COOLING CAPACITY: what to do when not enough cool air comes out of the system
    - What to check first if there is no cool air or not enough cool air
    - Compressor failure diagnosis: basic checks of the air conditioner compressor
    - Ducts & Air Handler diagnosis: basic checks of the indoor air handler (blower), air ducts, and filter systems
- COMPRESSOR CONDENSER: problems with air conditioner compressor/condenser units
- AIR HANDLER UNIT: problems with the air handler, air filters, and the cooling coil itself
- DUCT SYSTEM DEFECTS: problems with the air duct system, air filters, supply registers, return air registers
- A/C REFRIGERANT LEAK DETECTION: how to use a TIF5000 to detect air conditioning refrigerant gas leak
- A/C DIAGNOSTIC FAQs: air conditioning system diagnostic FAQs: Q&A about air conditioner repair - a detailed air conditioning system diagnostic checklist

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(July 18, 2012) DanJoeFriedman (mod) said:

Bobcat, thanks for helping out.

Tim: regarding "I have an outside unit that wont shut off without tripping the breaker. A friend suspected the thermostat so I replaced it, but it didnt solve the problem. Any suggestions? The inside fan kickc on and off within the set temp range, the outside motor just keeps going."

- if the indoor air temp never reaches the set temp on the thermostat the system will just keep running - so if that's the case we need to determine why the indoor cooling isn't satisfying the thermostat.

- if you turn the thermostat setting "up" to be sure that the indoor air temp is below the set temp on the cooling thermostat - that is, the thermostat is satisfied, and then if the equipment still never stops running, I suspect a bad control board or relay switch - and it's certainly time to call an HVAC/R service tech.

(July 18, 2012) Chris B. said:

This is a straight AC unit. Yeah, I should have checked the 24 volt. I will do that. I appreciate any help I can get here.

(July 18, 2012) Anonymous said:

This is straight AC with control that runs to the furnace

(July 17, 2012) Bobcat said:

To: Tim B
Is this a heat Pump or Straight AC? A heat Pump uses a circut board to control the outside fan, and a straight AC should operate the fan when ever the compressor runs(cooling).I will try to help

(July 17, 2012) Bobcat said:

Chris B. Is the condensing unit you refering to, a heat pump or straight AC. Either way you will need to measure voltage at the thermostat wires that attach inside the outdoor unit.

(July 17, 2012) Tim said:

I have an outside unit that wont shut off without tripping the breaker. A friend suspected the thermostat so I replaced it, but it didnt solve the problem. Any suggestions? The inside fan kickc on and off within the set temp range, the outside motor just keeps going. Thanks for any help.

(July 17, 2012) Chris Bauer said:

The unit won't start at all. I get 236.4 VAC coming in on the line, but the relay won't latch. So, I went and bought a new relay and replaced with not luck. I then used the manual push button on the relay to latch the connection and heard a light hum. I then gave the fan blade a little help and it started turrning. However, it did not get up to speed and the compressor never kicked on. The relay won't stay latched regardless. Any ideas for me here?

(July 11, 2012) Wallace said:

Actions that start ac are; repeated tripping of thermostat or tap on inside unit's control box which houses fan switch and heat/cool switch. Tap starts system every time. System is a 1976 Coleman Presidential 2 split unit in a mobile home. When this fault occurs, the familiar hum of the inside unit is not heard. Once system is started, it performs well and cycles off as desired. Fault occurs 75% of the time. Thanks.

(July 11, 2012) mary said:

my electric furnace the inside unit the fan runs all the time even if we shut the thirmasat of what would cause that.

(July 7, 2012) JK said:

How much is a 240/24 vac contactor and a run start cap installed?

(showing 1 to 10)

Recommend / Share this Article

+1 ShareThis
EMAIL

Print

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also list books on the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

- Thanks to Alan Carson and Bob Dunlop, Carson Dunlop, Associates, Toronto, for permission to use illustrations from their publication, *The Illustrated Home* which illustrates construction details and building components. Carson Dunlop provides home inspection education, publications, report writing materials, and home inspection services. Alan Carson is a past president of ASHI, the American Society of Home Inspectors.
- Thanks to Lester Richer, a professional home inspector, for the reminder that a bad air conditioner condensate drip tray switch can shut the whole system down.
- Behr Hella Service A/C pressure switches,
- Grainger, http://www.grainger.com/
- Ranco Corporation, http://www.invensyscontrolseurope.com/ranco/ Tel (Europe) +44 (0)845 130 5522
- Sensata Technologies, 529 Pleasant Street, B41 Attleboro, MA 02703-2964 Phone: 1-248-692-5600 Fax: 1-248-692-5630 Email: auto-mktg@sensata.com Web: www.sensata.com, pressure switches for automotive air conditioning systems
- Micro Pneumatic Logic, Inc., Pompano Beach, Florida Tel. (954) 973-6166 - pressure switches
- Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co.,

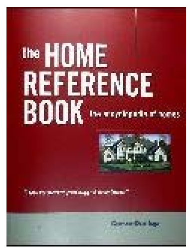
1982

- Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- NEW!
  Air Conditioning SEER - New DOE Air Conditioner and Heat Pump Efficiency Standard

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.

- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia Bookstore.



- The Home Reference Book - the Encyclopedia of Homes, Carson Dunlop & Associates, Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

  Or choose the The Home Reference eBook for using this reference on PCs, Macs, Kindle, iPad, iPhone, or Android Smart Phones

Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

- Asbestos HVAC Ducts and Flues field identification photos and guide
- Fiberglass: Indoor Air Quality Investigations: Fiberglass in Indoor Air, HVAC ducts, and Building Insulation

InspectAPedia®

Free Encyclopedia of Building & Environmental Inspection, Testing, Diagnosis, Repair

Search
InspectAPedia

Ask a Question or Search InspectAPedia

Mobile View
AIR CONDITIONING & HEAT PUMP SYSTEMS

A/C - HEAT PUMP CONTROLS & SWITCHES
A/C DATA TAGS
A/C - HEAT PUMP CRITICAL DEFECTS
A/C DIAGNOSTIC FAQs
A/C REFRIGERANTS
A/C TYPES, ENERGY SOURCE
AGE of AIR CONDITIONERS & HEAT PUMPS
AIR CLEANER PURIFIER TYPES
AIR CONDITIONER BTU CHART
AIR CONDITIONER COMPONENT PARTS
AIR CONDITIONER TYPES, ENERGY SOURCES
AIR CONDITIONER NOT WORKING
AIR FILTER EFFICIENCY
AIR FILTERS, FIBERGLASS PARTICLES
AIR FILTERS for HVAC SYSTEMS
AIR FLOW MEASUREMENT CFM
AIR HANDLER / BLOWER UNITS

Air Conditioning & Heat Pump Air Handler: Blower Assembly, Blower Fan, Cooling Coil / Evaporator Coil & Air Filter: inspection, diagnosis, & repair guide

InspectAPedia® - ShareThis +1

- Air conditioning air handlers - Fan Coil Unit Inspection, Diagnosis, Repair, Replacement
- Quick troubleshooting guide for air handling units or blower assemblies in air conditioners, heat pumps, some furnaces
- Dirty, contaminated air conditioner blower fans, reduced air output, fan cleaning advice
- Air Conditioning air handler unit (AHU) leaks and toxic black mold contamination
- Dirty or blocked air conditioner cooling coils (evaporator coils)
- Frost build-up on evaporator coils and its affect on cool air flow and mold
- Problems when adding retrofit air conditioning to a warm air heating system

This article discusses the *indoor* components of air conditioners and heat pumps: the air conditioning system indoor air handler units, blower units, or AHU's, (also called fan coil units) including the air conditioner blower fan, the indoor cooling coil or "evaporator coil", air conditioning system filters, and the causes, cures, and prevention of air handler leaks that lead to rust, damage, and mold contamination in the air conditioning system.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

- ADDING A/C: RETROFIT SIZING
- BLOWER FAN CONTINUOUS OPERATION
- BLOWER FAN OPERATION & TESTING
- BLOWER LEAKS, RUST & MOLD
- COOLING COIL or EVAPORATOR COIL
- DAMAGED COOLING COIL
- DIRTY A/C BLOWERS
  - Leaks, Rodents In Air Handlers
  - Mold Growth in Air Handlers
- DIRTY COOLING COIL
- DIRTY COIL CLEANING PROCEDURES
- FROST BUILD-UP on AIR CONDITIONER COILS
- INCREASING RETURN AIR
- NOISY AIR HANDLER / BLOWER FAN

APPLIANCE EFFICIENCY RATINGS
BACKDRAFTING HEATING EQUIPMENT
BACKUP HEAT for HEAT PUMPS
BLOWER DOORS & AIR INFILTRATION
BLOWER FAN CONTINUOUS OPERATION
BLOWER FAN OPERATION & TESTING
BOOKSTORE - Air Conditioning "How To" Books

CAPACITORS for HARD STARTING MOTORS
CAPILLARY TUBES
CHINESE DRYWALL HAZARDS
CIRCUIT BREAKER SIZE for A/C or HEAT PUMP
CLEANING & *Legionella* BACTERIA
CHINESE DRYWALL HAZARDS
COMBUSTION GASES & PARTICLE HAZARDS
COMPRESSOR & CONDENSING COIL, A/C
CONDENSATE HANDLING, A/C
CONTROLS & SWITCHES, A/C - HEAT PUMP
COOL OFF HEAT Thermostat Switch
COOLING CAPACITY, RATED
COOLING COIL or EVAPORATOR COIL
- DAMAGED COOLING COIL
- DIRTY COOLING COIL
- DIRTY COIL CLEANING PROCEDURES
- FROST BUILD-UP on AIR CONDITIONER COILS
- INCREASING RETURN AIR

DATA TAGS on AIR CONDITIONERS
DEFINITION of Heating & Cooling Terms
DEHUMIDIFICATION PROBLEMS
DEW POINT CALCULATION for WALLS
DEW POINT TABLE - CONDENSATION POINT GUIDE
DIAGNOSE & FIX AIR CONDITIONER / HEAT PUMP
DIAGNOSE & FIX HEATING PROBLEMS-BOILER
DIAGNOSE & FIX HEATING PROBLEMS-FURNACE
DUCT SYSTEM & DUCT DEFECTS
DUCTS - Asbestos
DUCT INSULATION, Asbestos Paper
DUCT INSULATION for SOUNDPROOFING
DUCT SYSTEM NOISES
DUCTS, Asbestos Transite Pipe
DUST CONTAMINATION FROM HVAC?

EDUCATION, HVAC SCHOOLS
ELECTRIC MOTOR DIAGNOSTIC GUIDE
ELECTRIC MOTOR OVERLOAD RESET SWITCH
ELECTRICAL POWER SWITCH FOR HEAT
ENERGY SAVINGS in buildings
EVAPORATOR COIL or COOLING COIL
EVAPORATIVE COOLING SYSTEMS

Air Handling Unit Troubleshooting - Quick Checks

Basic air handler unit or blower unit troubleshooting checks: Here we provide air handler unit or blower assembly troubleshooting by expanded annotated information from the US EPA [5] who provided suggestions for investigating the air handling unit during an indoor air quality investigation. Also see our complete HVAC cooling and heat pump diagnostic guide beginning at LOST COOLING CAPACITY.

- Is the system turned on? Check thermostat to see that it is calling for heat or cooling, service switches at the equipment, check fuses or circuit breakers serving the equipment; for cooling systems check for a condensate drip tray overflow switch that may have turned off the system.
- If your air conditioning or heat pump system has lost its cooling capacity or won't start see REPAIR GUIDE for AIR CONDITIONERS. See How to determine the cooling capacity of air conditioning equipment if the system seems to be working but is inadequate to cool your building. Contact us to suggest text changes and additions and, if you wish, to receive online listing and credit for that contribution.
- Is air flowing from the air supply registers? see DUCT SYSTEM & DUCT DEFECTS - also check for a clogged or dirty filter or blocked air return. Initial, simple diagnostic checks of the air handler system are also described at Ducts & Air Handler diagnosis: Basic checks of the indoor air handler (blower), air ducts, and filter systems.
- Is the blower assembly fan operating? You should hear the fan motor running and the fan assembly should be spinning.
- Are the air filters installed, proper size, clean? See AIR FILTERS for HVAC SYSTEMS
- Are the duct dampers working? Some HVAC systems use manual or automatic duct dampers or ZONE DAMPER CONTROLS to open or close airflow through individual duct system sections. Commercial and large building duct systems may include fire dampers that could be closed.
- Is the air handler or its condensate drip tray dirty? Are there moisture, debris, visible mold, or other contaminants (rodents, birds) in or around the air handler or blower assembly? See DIRTY A/C BLOWERS below in this article.
- Are the coils dirty or iced or blocked? Are the evaporator coils (cooling coils or heating coils) clean? See DIRTY COOLING COIL and see FROST BUILD-UP on AIR CONDITIONER COILS

  Also see COOLING COIL or EVAPORATOR COIL for a description of diagnosis and repair of cooling coil problems since this component is normally located within the air handler chassis as well. A cooling coil which is blocked by debris or ice and frost can obstruct air flow and reduce air conditioning system output

- Is the condensate pan clean and is condensate draining out of the pan? See CONDENSATE HANDLING, A/C
- Is the heating combustion equipment venting properly and does it have adequate combustion air supply? See CHIMNEY INSPECTION DIAGNOSIS REPAIR and BACKDRAFTING HEATING EQUIPMENT

  Outdoor components: For a discussion of the outdoor components of an air conditioning or heat pump system see COMPRESSOR & CONDENSING COIL, A/C.

DIRTY A/C BLOWERS - Dirt-blocked air conditioner air handler fans

We also discuss how to improve indoor air quality by installing a cascaded air filter system at the air conditioning (or heating system) air handler to provide optimal air particle filtration for people with asthma, allergies, or indoor mold or other IAQ concerns.

Filters protect the blower assembly: The typical A/C system circulates air through the building duct work using a "squirrel cage" blower fan. It is very important for you to check and change air filters at least monthly when the system is in use to protect the blower fan from dirt clogging.

Cupped fan blades can become blocked by debris: The blades of a squirrel-cage fan are cupped in order to cause the spinning cage to move air.

Dirt accumulation on the blades fills-in this cupped area, ultimately changing the "cup" to a simple flat area. The fan will spin just fine. I've seen the cubic feet per minute of air conditioning air-flow literally double when a very dirty squirrel cage fan fan of this type was cleaned or replaced.

Cleaning an air conditioner squirrel cage fan with compressed air? If the blower fan blades have significant dirt accumulation, you should have the system professionally cleaned. While this is a fairly costly service call (requiring blower disassembly and removal for cleaning) it can make a dramatic improvement in system performance.

Do not permit a simple "blow out" of the blower by compressed air if the air handler/blower are in the living area. Some HVAC service companies use a foaming cleaner for removing debris from an evaporator coil. That same material might assist in cleaning a squirrel cage fan.

Otherwise we recommend removing the fan and cleaning it thoroughly outside. Clean the remainder of the fan cabinet and housing before returning the air handler to service.

Leaks, Dirt, Rodents Getting Into HVAC Blowers, Blower Compartments, Air Plenums

Very dirty, wet, leaked-into, or rodent-infested blower compartments risk indoor air quality and health

WINDOW / WALL A/C SUPPORTS

More Information

issues in buildings. The air handler unit in the photo at left needs cleaning and a check for unsafe wiring due to leaks. Leaks into the blower compartment of an HVAC air handler invite mold problems too.

The return air plenum in the photo at right has both a dead mouse and some other sort of trash that probably fell down a return air floor grille. Mice in HVAC systems are a potential viral or bacterial hazard as well as an indicator of poor housekeeping. These conditions suggested that there had not been regular inspections of this equipment.

Causes & Photographs of Mold Growth in Air Conditioning Blower Fans

Notice the multiple colors and textures of mold growing on this air conditioner squirrel cage blower fan. Mold, depending on its genera/species, moisture conditions, and growth substrate material, can grow on many different surfaces where some organic material is available for "food".

We might find mold growing in an air conditioner on plastic, on air cabinet or duct insulation facing, hidden in fiberglass insulation, or on other materials.

Most likely the mold growing on this blower fan found a home in some of the organic constituents of common house dust: skin cells and dust mite fecals. Very often the mold we sample and identify in air conditioner blower cabinets is a very common genera, *Cladosporium sp.* - a mold so common it's called "the king of molds." Kicking up leaves outdoors exposes you to more *Cladosporium sp.* than the mold on this blower fan.

But we also find some genera/species of more toxic molds that will grow *right on top of* other molds that are already present. So while air cabinet conditions may start by producing one mold of not too much concern, other more highly allergenic or even toxic molds *could* be present.

The fact that the mold in this photograph includes multiple colors and textures of material suggests that more than one genera or species of mold is present.

How to Handle Small Areas of HVAC System Mold Contamination

If the total area of moldy material is small (say less than 30 sq.ft. of contiguous mold) we would not bother to take a mold sample back to our lab for identification. Instead we'd suggest that the moldy surfaces be cleaned or non-cleanable material like insulation, replaced, and the cause for its growth corrected. We might, however, sample even a small amount of visible mold as part of a larger building diagnostic program if there were illness or air quality complaints associated with the building.

Examples of condensate spill-over inside of an air handler blower compartment, a condition creating a risk of mold growth inside the HVAC system are at BLOWER LEAKS, RUST & MOLD

Information about the potential of toxic mold growth in fiberglass ducts or fiberglass HVAC duct insulation as well as other fiberglass insulation products and more example photographs of that condition are at Mold in Fiberglass in Insulation.

Basic Tips on Keeping the HVAC Blower Assembly Clean

BLOWER OPERATION: For effective operation of this system it is essential that it never be operated without air filters in place. See AIR FILTERS for HVAC SYSTEMS.

If you permit the filters to become very dirty you may need expensive special cleaning or other repairs. See BLOWER FAN OPERATION & TESTING.

COOLING MAINTENANCE TIP: The HVAC blower assembly should be serviced every two years. Without proper service the system may have no more than a five year lifetime.

ENERGY CONSERVATION: Keeping the fireplace flue closed (if you have one) when not in use will improve both heating and cooling efficiency in all buildings.

Questions & Answers regarding this article

.

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(4 days ago) DanJoeFriedman (mod) said:

Patsy, it sounds as if your unit condensate drain is clogged or the piping is undersized or clogged. Start there.

(July 31, 2012) Patsy said:

Lots of water pouring off several locations of the unit which is located in the attic and down to the drip pan under it. the pan fills up about 5x day as the drain cannot handle it. can't tell if water is going into the pvc pipe attached to the upper portion of the unit.

(July 20, 2012) DanJoeFriedman (mod) said:

Mike, from just your comment, I really don't know if there is any indication of a problem. If the system starts, runs, and cools the home and then shuts down when the thermostat is satisfied, you may be just fine.

(July 18, 2012) Mike said:

My fan used to run for 1 minute after compressor stops,now it shuts off right away. Is that something in the air handler?

(July 18, 2012) DanJoeFriedman (mod) said:

Mario,

"humming noise but will not start" usually means a bad motor or (check first) a bad start/run capacitor. But first with power off see that the motor and fan spin freely.

(July 18, 2012) Mario said:

Carrier A/C when selecting thermostat to cool with fan ON or Auto, outside compressor runs ok, steady red fault light on control board,Air blower will make humming noise but will not start, I jumped R and G at both the board and thermostat but blower still wont start, could it be a faulty capacitor or possibly faulty relay on cont. board....help is appreciated

(July 13, 2012) marshall mccants said:

my unit is leaking water and water not going in drain

(July 13, 2012) teri said:

We live in a newly constructed patio home. Our air has not worked properly since move in. We know for about three weeks the cons ruction crew ran this on 60degrees without a filter. We called our maintenance man to put a filter in. Upon move in the unit could not cool to 72. They AC company came out and found "a hole" when he was in the attic a distinct electrical/heat smell came through the vents. They said that should fix it. Several days have gone by and the unit runs constantly even in the 90's outside and it is working to cool. They came back out and put some more freon in it. ...said that should fix it. That still didn't help. A few more days went by still not cooling down the house. My husband noticed that the vents were barely nlowing air. The AC company back out and said they adjusted the blowers from low/med to high. They said set on your normal setting(72) and should be fine. The unit was set from 74 to 74. It took 2 and 1/2 hours to cool it to 72 and the unit went off and on all night every 7 minutes and finally shut off this morning. It was 75 degrees outside at 3:oo am and it was still going. This is a carrier heat pump. Is there any other diagnostics they can do?
They have been in our attic six times since June 17.

(July 8, 2012) Lee said:

Carrier 38TKB A/C, 12 yr old, dual speed blower, cools well most of time but when temp is above 95, blower seems stuck on low speed with reduced cooling capacity. Checked yearly-refrigeration good, appears to be working as expected, but no solution for these sometimes lack of cooling which results in rise in temp of 5-6 degrees before returning to normal cooling. Do you have answer for this?

(June 18, 2012) DanJoeFriedman (mod) said:

Jerry, check out CAPACITORS for HARD STARTING MOTORS (links at page left) and you'll see that we include the testing and replacement of start/run capacitors. You might actually see a bad capacitor - if it or its wires look burned or if the unit has swollen or cracked. But more often the symptom is that the electric motor the cap is supposed to support is having trouble starting or wont' start or won't run.

(showing 1 to 10)

Recommend / Share this Article

+1 ShareThis

EMAIL

Print

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also include a list of recommended books for the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

- Thanks to Mark Cramer, Tampa Florida, for assistance in technical review of the "Critical Defects" section and for the photograph of the deteriorating gray Owens Corning flex duct in a hot attic. Mr. Cramer is a Florida home inspector and home inspection educator.
- Thanks to Jon Bolton, an ASHI, FABI, and otherwise certified Florida home inspector who provided photos of failing Goodman gray flex duct in a hot attic.
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- Wikipedia provided background information about the definition of HEPA and airborne particle interception.

- [5] US EPA - Mold Remediation in Schools and Commercial Building [copy on file as /sickhouse/EPA_Mold_Remediation_in_Schools.pdf] - US EPA
- Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982
- Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- Air Conditioning SEER - New DOE Air Conditioner and Heat Pump Efficiency Standard

How to diagnose and fix an air conditioning system that is not working

Since the failure of an air conditioner to turn on, loss of air conditioner cooling capacity, reduced air conditioning output temperatures, loss of cool air supply, or even loss of air flow entirely can be due to a variety of problems with one or more components of an air conditioner or air conditioning system, *after reviewing the lost air conditioner cooling diagnosis procedures described in this article,* be sure to also review the diagnostic procedures at each of the individual air conditioning diagnosis and repair major topics listed just below. To return to our air conditioning and refrigeration home page go to AIR CONDITIONING & HEAT PUMP SYSTEMS.

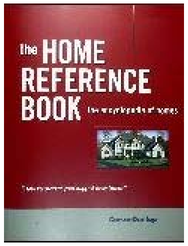
If your air conditioning or heat pump system has lost its cooling capacity or won't start select one or more of the diagnostic articles listed below.

- A/C - HEAT PUMP CONTROLS & SWITCHES: air conditioner controls and switches - begin here if your A/C won't start. Here's an important tip: *most refrigeration problems, in air conditioners, refrigerators, or freezers, are electrical, not mechanical.* In air conditioning school, we used to drive out and collect abandoned refrigerators that people were tossing out during our community's spring cleanup week. Taking these appliances back into the shop we found that almost always the problem that had caused the owner to dispose of their air conditioner or freezer was in an electrical connection or electrical control. So it's worth checking out switches and controls on an air conditioner before replacing more costly components.
- OPERATING DEFECTS: major air conditioning problem symptoms and how to get the air conditioning system working again,e.g. compressor or fan noises, failure to start, and inadequate cool air volume
- LOST COOLING CAPACITY: what to do when not enough cool air comes out of the system
    - What to check first if there is no cool air or not enough cool air
    - Compressor failure diagnosis: basic checks of the air conditioner compressor
    - Ducts & Air Handler diagnosis: basic checks of the indoor air handler (blower), air ducts, and filter systems

- COMPRESSOR CONDENSER: problems with air conditioner compressor/condenser units
- AIR HANDLER / BLOWER UNITS: problems with the air handler, air filters, and the cooling coil itself
- DUCT SYSTEM DEFECTS: problems with the air duct system, air filters, supply registers, return air registers
- A/C REFRIGERANT LEAK DETECTION: how to use a TIF5000 to detect air conditioning refrigerant gas leak
- A/C DIAGNOSTIC FAQs: air conditioning system diagnostic FAQs: Q&A about air conditioner repair - a detailed air conditioning system diagnostic checklist

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia Bookstore.



- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

  Or choose the The Home Reference eBook for using this reference on PCs, Macs, Kindle, iPad, iPhone, or Android Smart Phones

Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

- ...

Mobile View
AIR CONDITIONING & HEAT PUMP SYSTEMS

A/C - HEAT PUMP CONTROLS & SWITCHES
A/C DATA TAGS
A/C - HEAT PUMP CRITICAL DEFECTS
A/C DIAGNOSTIC FAQs
A/C REFRIGERANTS
A/C TYPES, ENERGY SOURCE
AGE of AIR CONDITIONERS & HEAT PUMPS
AIR CLEANER PURIFIER TYPES
AIR CONDITIONER BTU CHART
AIR CONDITIONER COMPONENT PARTS
AIR CONDITIONER TYPES, ENERGY SOURCES
AIR CONDITIONER NOT WORKING
AIR FILTER EFFICIENCY
AIR FILTERS, FIBERGLASS PARTICLES
AIR FILTERS for HVAC SYSTEMS
AIR FLOW MEASUREMENT CFM
AIR HANDLER / BLOWER UNITS

How to Diagnose & Repair Air Conditioner Compressor Hard Starting

InspectAPedia® - ShareThis +1

- Air conditioning compressor hard-starting
- How to diagnose air conditioner start-up problems
- Air conditioner stutters or makes noises at start-up
- When to install a hard-start air conditioner repair kit with starting capacitor
- Hard starting can indicate end of air conditioner life, or it may be just a small repair
- Air conditioner compressor defect diagnosis & repair guide
- Questions & answers about diagnosing and fixing hard-starting A/C or heat pump compressors

This air conditioning repair article explains procedures for the diagnosis and repair of hard-starting air conditioning compressors. If your air conditioner or heat pump compressor motor won't start or has trouble starting, humming at start-up for example, it may be damaged and at or near end of life. But a common repair performed to try to get such motors running and to keep them in use longer is the installation of an air conditioner or heat pump "hard start" kit - a start capacitor or a start/run capacitor that helps get the motor spinning. First it's useful to diagnose the cause of the compressor's hard-starting trouble.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

Also see CAPACITORS for HARD STARTING MOTORS. Contact us to suggest text changes and additions and, if you wish, to receive online listing and credit for that contribution.

APPLIANCE EFFICIENCY RATINGS

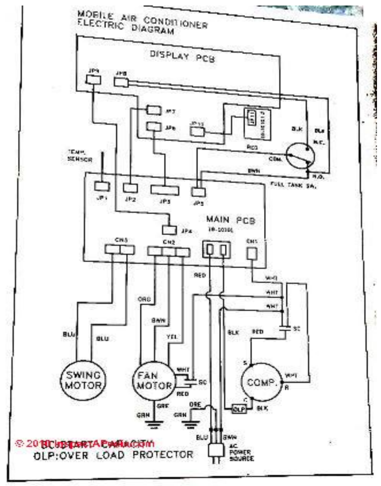
BACKUP HEAT for HEAT PUMPS
BLOWER DOORS & AIR INFILTRATION
BLOWER FAN CONTINUOUS OPERATION
BLOWER FAN OPERATION & TESTING
BOOKSTORE - Air Conditioning "How To" Books

CAPACITORS for HARD STARTING MOTORS
CAPILLARY TUBES
CHINESE DRYWALL HAZARDS
CIRCUIT BREAKER SIZE for A/C or HEAT PUMP
CLEANING & *Legionella* BACTERIA
CHINESE DRYWALL HAZARDS
COMBUSTION GASES & PARTICLE HAZARDS
CONDENSATE HANDLING, A/C
CONDENSATION or SWEATING PIPES, TANKS
COMPRESSOR & CONDENSING COIL, A/C
BURNED-OUT COMPRESSOR
CAPACITORS for HARD STARTING MOTORS
CONDENSING COIL REPAIR REPLACE
CONTACTOR RELAY DIAGNOSIS & REPAIR
CONTROL CIRCUIT BOARD, A/C
CRANKCASE HEATERS
FAN, COMPRESSOR/CONDENSER UNIT
HARD STARTING COMPRESSOR MOTORS
INSPECTION CHECKLIST - OUTDOOR UNIT
INSTALLATION ERRORS, COMPRESSORS
LEVELING REQUIREMENTS, COMPRESSOR
LONG-ON CYCLING AC COMPRESSOR
MOTOR OVERLOAD RESET SWITCH
NOISES, COMPRESSOR CONDENSER
Pressure Controls & Safety Switches
PRESSURE READINGS, COMPRESSOR
REPLACING A COMPRESSOR
SHORT CYCLING AC COMPRESSOR
TIGHT or SEIZED AC COMPRESSORS

CONDENSATE HANDLING, A/C
CONDENSATION or SWEATING PIPES, TANKS
COOL OFF HEAT Thermostat Switch
COOLING CAPACITY, RATED
COOLING COIL or EVAPORATOR COIL
COOLING LOAD REDUCTION by ROOF VENTS
COMBUSTION GASES & PARTICLE HAZARDS
CONDENSATE HANDLING, A/C
CONDENSATION or SWEATING PIPES, TANKS

DATA TAGS on AIR CONDITIONERS
DEFINITION of Heating & Cooling Terms
DEHUMIDIFICATION PROBLEMS
DEW POINT CALCULATION for WALLS
DEW POINT TABLE - CONDENSATION POINT GUIDE
DIAGNOSE & FIX AIR CONDITIONER / HEAT PUMP
DIAGNOSE & FIX HEATING PROBLEMS-BOILER
DIAGNOSE & FIX HEATING PROBLEMS-FURNACE
DUCT SYSTEM & DUCT DEFECTS
DUCTS - Asbestos
DUCT INSULATION, Asbestos Paper
DUCT INSULATION for SOUNDPROOFING
DUCT SYSTEM NOISES
DUCTS, Asbestos Transite Pipe
DUST CONTAMINATION FROM HVAC?

HARD STARTING - How to Diagnose & Repair Air Conditioner Compressor Hard Starting or Intermittent Running or Stuttering



- Stuttering or on-off at startup: A "hard starting" compressor may stutter or begin to cycle-on then stop, then restart. If a compressor is frequently tripping the circuit breaker (or blowing the fuse) which protects its circuit, compressor and wiring diagnosis and repair are needed.

  Also check: the start relay and all electrical wiring connections to the compressor motor. Loose wires or a bad start relay can also explain stuttering or "on-off" at compressor motor startup. (Thanks to Texas Red and his HVACR Technician for this tip.)

- A/C Compressor starts, runs just briefly, then shuts off: this condition too may be solved by adding a starting capacitor, but watch out: it may also be a sign of a compressor near end of life. See CAPACITORS for HARD STARTING MOTORS. As reader S.W. wrote:

  I had a curious condition whereby the compressor would run for a period of time...at least 5 minutes but usually longer, then suddenly shut down. The condenser fan which is essentially in parallel with it across the line continued to run. I tried to determine what sort of [overload] was in the Copeland U9X CR28K7 compressor. It appeared that the OL was opening but I didn't determine why. The compressor was not drawing excessive current and the house seemed to stay at the thermostat set point. I was been unable to obtain any details on the construction of the Copeland compressor. ... The problem was resolved - a simple matter of adding a hard start kit. Apparently the compressor increased slightly in start friction over the last year or so which made the problem appear intermittent.

- .Low line voltage: Abnormally low line voltage may also be causing a compressor to "hard start". Air conditioner supply voltage is typically checked using a VOM (voltage ohms meter) right at the air conditioner service disconnect box near the compressor/condenser unit. Voltage should be within 10% of the required number (on the compressor/condenser data tag). A service technician may also check line voltage again at the compressor terminals when the compressor has reached normal operating state to be sure that there is no voltage drop.

- Starting an air conditioner against compressor head-pressure: When an air conditioning compressor has been running long enough to reach its normal operating condition, it has pumped refrigerant to a high pressure condition in the compressor head.

  When an A/C system compressor is running and is unexpectedly shut off, perhaps by a human testing a thermostat or switch, if the system is immediately turned back on, some compressors, particularly older window and wall units, may be unable to re-start against this high head pressure.

  Simply waiting a few minutes for pressures to equalized may be all that's needed. So if the compressor is not starting in this condition we simply turn it off and wait. If this problem is happening often, a service technician may install one of several versions of "hard start kit".

- Do not just install a larger fuse or circuit breaker as doing so risks a fire or equipment burn up. Do not bypass fuses such as by installing copper tubing in place of fuses as some A/C service people recommend. This is a crazy electrical hazard risking fire, shock, and equipment burn-up. If new circuit breakers are to be installed to replace an older fuse-protection on an air conditioning circuit, the electrician should remove any obsolete, unused electrical equipment or devices to avoid future confusion or possible shock hazards.

- A "hard start kit" is basically a capacitor which gives an extra electrical "jolt" to the compressor motor to get it moving. A starter relay may also need to be installed or replaced. Some air conditioning compressor brands do not usually need a hard start kit. GE, Trane, and Manurope are examples that do not usually take this kit. See CAPACITORS for HARD STARTING MOTORS for photos, wiring diagram, and installation instructions for air conditioner compressor, fan, blower, refrigerator motor, freezer motor, or other electrical motor starting booster capacitors.

- Bad air conditioner starting capacitor: your air conditioning compressor may already have a starting capacitor installed, but the starting capacitor itself may have failed. While electric motor starting capacitors can fail in a variety of ways that may not be obvious without performing some electrical tests, on occasion the failed starting capacitor may be visually obvious.

  Most electric motor or compressor starting capacitors used on air conditioning equipment are in a round cylindrical shape. The two ends of the cylinder should be flat. If your starting capacitor is visibly bulged at its end(s) or anywhere else, or if it looks split or burned, it's almost certainly damaged and needs replacement.

  Watch out: other problems can cause the starting capacitor to fail, and some starter capacitor failures may not be visibly apparent. If your starting capacitor is replaced and fails again, further diagnosis of the failure source is needed.

  See CAPACITORS for HARD STARTING MOTORS where we explain how to select, install, or test an electric motor starting capacitor. There we also comment that in addition to hard starting or a non-starting air conditioner or heat pump compressor motor, a bad starter capacitor can also disable the fan in the outdoor compressor/condenser, or the blower fan in the indoor air handler unit. Thanks to reader George Fazio for this air conditioner start-up diagnosis suggestion and for the photo of an un-damaged starter capacitor (above left).

- Tight or Seized Air Conditioner Motors can be hard to start and may make a "humming" noise while trying to start-up and the compressor motor may fail to start at all, eventually tripping the circuit breaker or blowing the circuit fuse.

  It might be possible to get a slow or hard-starting tight or even seized AC compressor motor going again - see TIGHT or SEIZED AC COMPRESSORS for more details on how this is done. But in any case such a compressor is probably near the end of its life.

- End of air conditioning compressor life may be near: A compressor which has difficulty starting might be fixed by installing a "hard start" kit, but depending on the reason for hard starting it's possible that the entire compressor will have to be replaced soon. On a more optimistic note, some hard start kit manufacturers assert that installing a "hard start kit" on a compressor will extend its life.

  By assisting the compressor in starting at up to ten times faster than normal, Kickstart® hard start devices significantly reduce the amount of damaging heat that is generated in the motor windings with each and every start. Over time, this reduced stress on insulation, wiring, and other critical components of the compressor has the effect of increasing its reliability and extending its useful life." -- www.kickstartoem.com

Questions & Answers regarding this article

Questions & answers about diagnosing and fixing hard-starting A/C or heat pump compressors

Question: Could Loose Electrical Wiring (or a bad A/C start relay) Explain a Hard-Starting Air Conditioner or Heat Pump Compressor Motor?

SWAMP COOLERS
SYSTEM OPERATION

THERMOSTATS, HEATING / COOLING
THERMOSTATIC EXPANSION VALVES

WATER COOLED AIR CONDITIONERS
WINDOW / WALL AIR CONDITIONERS
WINDOW / WALL A/C SUPPORTS

More Information

I had a tech come out and install a hard-start kit to keep a 4-year-old 3-1/2 ton Carrier compressor from tripping the circuit breaker. The compressor failed this summer. A second tech was suspicious that a compressor less than five years old would be tripping the breaker. He discovered a loose connection in the cut-out switch. Would the hard-start kit have been necessary had the loose connection been tightened prior to it's installation? I'm wondering if the failure could have been avoided with proper diagnosis by the first tech

In 2009 tech # one had come to respond to my problem of a 4-year-old compressor kicking the circuit breaker. Without even looking at the connections in the shut-off box adjacent to the unit, he went straight into control panel, checked compressor current draw at start-up and installed a hard-start kit. I thought it odd that a compressor less than five years old would be drawing too much current. Had no problems in 2010 but last month the circuit breaker started kicking off again late in the day.

Tech #one returned, checked coolant pressures and return temp, added some freon and started to pack up. I asked if he wasn't going to check the current draws. He reluctantly removed the control cover, checked draw and voltages and pronounced the unit was running perfectly before leaving with my $168 check. When the circuit breaker kicked off again the next day, I started to suspect the breaker might be worn out. Called an electrician a few days later.

He replaced the breaker switch, again without checking the connections at the shut-off box, and within eight hours my compressor had died - coils shorted to ground - confirmed by tech # one who quoted me a price to replace the unit. Now I called a contractor I knew asking if he knew any good AC techs. He referred me to tech # 2 who, in my first call, was immediately suspicious that my original problem may have been in the wiring, not the unit. His reasoning was that a compressor less than 5 years old shouldn't have been giving me problems to begin with. He came over to confirm my compressor was shorted out. He then did what no other tech had done since I owned the house - popped the cover off the shut-off box and tightened the leads at the terminals - black wire loose, white wire "very loose."

My question is whether that may have been my problem all along and would a hard-start kit have temporarily relieved the symptom -tripped circuit breaker- without curing the problem.

Reply:

Tx Red: you and your second HVACR Tech have come across a useful diagnostic step: check for loose, or even burnt or arced wiring connections. I can't be sure of the answer to your question, as time has passed and we can't know for sure what conditions the first tech saw. A bad relay can cause compressor start problems, and I pose that its possible that arced, burned, or loose connections at the relay could make it misbehave.

Your thesis that a loose wire could have been misdiagnosed as a hard-starting A/C or heat pump compressor motor is reasonable but not, IMHO, absolutely proven by events. A compressor start relay (or most other switches) that are loosely wired will typically experience arcing at the loose connection (an event that can, by the way, when the circuit is active or the switch closed, draw higher amps than normal due to the resistance at the point of arcing and corrosion.)

Adding a start-capacitor is adding a device that gives a big voltage surge just during motor start-up. A voltage surge that normally is overcoming inertia in a still motor might also overcome a start relay contactor resistance, caused by damaged or burned connecting points, or by a loose connection that was in effect acting in that same fashion. The start capacitor is delivering voltage and pushing the motor into rotation.

So without being an E.E. but with some experience around this topic, my reply is "could be" but not that we can say for sure.

Also FYI even a brand new A/C compressor could become hard-starting due to other system problems that cause internal damage to the device or even by (perhaps less likely) a manufacturing defect, events at the property, even general power delivery conditions such as abnormally low voltage. To research the topic you'd look for events that can damage the start winding on an electric motor.

Finally, it's not a surprise that the first tech didn't check nor re-check for loose wiring but I agree it would have been a useful step. Often service techs, contractors, and some investigators become habituated to a short cut of trying the "fix" that usually works successfully and fast.

IF the original start relay or contacts that were found to have been loose is still installed, one could investigate further by inspecting that device for evidence of arc burning or damage.

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(July 27, 2012) DanJoeFriedman (mod) said:

Cristie

Regarding "how long can the unit stay on trying to reach set temp" the answer is ... it depends. It depends on quite a few variables such as

- the outside temperature
- the inside temperature
- the rate of heat gain of the building, sun exposure, weather, direction orientation of walls
- the SET temperature of the thermostat
- the capacity, design, of the cooling system
- the cleanliness of the air filter
- the presence or absence of duct defects such as crimps, or crushed ductwork or air leak

Since some of these variables are different from hour to hour and day to day - weather - and others vary by human action - thermostat settings - we can't expect there to be a standard number of minutes or hours that a cooling system will stay "on" trying to reach the set temperature. In fact if we make the set temperature low enough the cooling system will run forever without reaching it.

A more helpful question to ask is: does your system seem to be working differently than it used to - taking weather changes into consideration? and is there good air flow at supply registers and is that air cool?

(July 26, 2012) Cristie said:

I did slightly bend a few cooling fins but I fixed them back to normal but what else I need to know is b4 I cleaned dust off the evp , could dust have gotten sucked through cooling fins and clogged something? I know the outside drain hole isn't plugged up so maybe some other area? I know it ran great a yr ago new with 95+ degrees outside & now it doesn't get as cool as it should and my MAIN question was/is how long can the unit stay on trying to reach set temp I remember it cycled more frequent than before I cleaned evp... I don't want to blow my window unit ..any help, PLEASE

(July 25, 2012) Anonymous said:

Christie the equipment should be able to run as you describe. And while there may be more to your question than was evident, if dust was removed from the evaporator coil that's good, helpful, and not harmful - let's hope no one bent or crushed the cooling fins.

(July 25, 2012) Cristie said:

Will dust covering the evp coils but then sucked out cause a problem fo the window unit?

(July 25, 2012) Cristie said:

Is it ok for my window unit to run with cold air without taking a break even though the desired temp isn't reached. When I first bought unit it seemed to cycle off & on and now when on coldest setting it isn't cutting off is this going to break the unit does it have to cut off (the compressor) I guess or is it ok to keep running hours or until desired temp is achieved please tell me

(July 14, 2012) Roland said:

Thank you!!!! You saved me a lot of trouble and expense with your article on the capacitors and all the other excellent information

Thanks again

(July 8, 2012) Charles said:

Outdoor A/C unit. Temps in the high 90's. Found compressor running, but fan stopped. Found badly corroded connection between condenser fan and capacitor. Female connector was burned and barely in contact. Wire charred for about 1/2" at connector. Removed burned end of wire, scraped the copper, replaced connector. Unit ran normally until the next day.

Now starts normally, but 20 to 30 minutes later,the condenser fan shuts off. Feels hot from mounting point. Compressor still running. Shut system off for 30 minutes. Repeat, unit starts normally etc. When running, the inlet line is cold and dews normally.

Cleaned all contacts on capacitor. No change. Fan runs until the case temperature is around 130 degrees, then shuts down. Fan case temperature then climbs to 146 degrees before beginning to cool.

Tried to check capacitor. In checking resistance, got no reading. Then put voltmeter across terminals and registered a declining voltage. Capacitor MAY be okay.

Checked voltage. Ran 240V from T1 to T2, 108 to 112V from capacitor to T2.

Still not sure what the problem is, but starting to suspect the fan a bit more.

(July 1, 2012) Anonymous said:

if compressor and the fan motor donot come on what can be the problem

---

(June 30, 2012) DanJoeFriedman (mod) said:

ColdShot,

If the system runs for 10 minutes and stops, it could be overheating - maybe a failing motor; it's common to try swapping in a start/run cap first though.

(June 30, 2012) xXxColdShotxXx said:

I have been having problems with my outdoor A/C unit. It will start, but after 5 to 10 minutes the motor just stops turning and it just hums and it starts blowing warm air through the ducts. What do you think may be wrong with it, is it a bad capacitor or relay or what? Thanks for any help.

(showing 1 to 10)

Recommend / Share this Article

ShareThis

EMAIL

Print

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also include a list of recommended books for the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

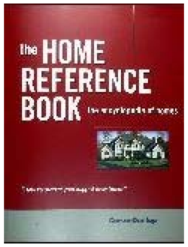
Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

- George Fazio, reader, contributed comments on failed starter capacitor diagnosis by noting the bulged capacitor ends. 09/25/2009
- Thanks to reader Skip Wallenburg for discussing repairs to hard-starting and intermittent-shut-down air conditioning compressors, August 2010.

- ALUMINUM WIRING HAZARDS - aluminum electrical wiring often burns-up at high-amperage electrical connections such as air conditioner wiring.
- Federal Pacific Electric (FPE) FPE Stab-Lok Circuit Breakers can increase the risk of a fire if these breakers are used on air conditioning or heat pump equipment
- Zinsco Electrical Circuit Breakers: overheating, failure to trip, burn-ups involving Zinsco and certain Sylvania electrical panel components. These components can also increase the risk of a fire if these breakers are used on air conditioning or heat pump equipment

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia Bookstore.



- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

  Or choose the The Home Reference eBook for using this reference on PCs, Macs, Kindle, iPad, iPhone, or Android Smart Phones

Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

- Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982
- Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- NEW!
  Air Conditioning SEER - New DOE Air Conditioner and Heat Pump Efficiency Standard
- Asbestos HVAC Ducts and Flues field identification photos and guide
- Fiberglass: Indoor Air Quality Investigations: Fiberglass in Indoor Air, HVAC ducts, and Building Insulation
- ...

InspectAPedia®

Free Encyclopedia of Building & Environmental Inspection, Testing, Diagnosis, Repair

Search
InspectAPedia

Ask a Question or Search InspectAPedia

HOME | AIR CONDITIONING | ELECTRICAL | EXTERIORS | HEATING | HOME INSPECTION | INTERIORS | PLUMBING | ROOFING | SEPTIC SYSTEMS | STRUCTURE | WATER SUPPLY

ENERGY SAVINGS | ENVIRONMENT | INDOOR AIR IAQ | INSULATION | MOLD INSPECT TEST REMOVE | NOISE | ODORS | SOLAR ENERGY | VENTILATION | EXPERTS DIRECTORY | CONTACT US

Mobile View
AIR CONDITIONING & HEAT PUMP SYSTEMS

A/C - HEAT PUMP CONTROLS & SWITCHES
A/C DATA TAGS
A/C - HEAT PUMP CRITICAL DEFECTS
A/C DIAGNOSTIC FAQs
A/C REFRIGERANTS
A/C TYPES, ENERGY SOURCE
AGE of AIR CONDITIONERS & HEAT PUMPS
AIR CLEANER PURIFIER TYPES
AIR CONDITIONER BTU CHART
AIR CONDITIONER COMPONENT PARTS
AIR CONDITIONER TYPES, ENERGY SOURCES
AIR CONDITIONER NOT WORKING
AIR FILTER EFFICIENCY
AIR FILTERS, FIBERGLASS PARTICLES
AIR FILTERS for HVAC SYSTEMS
AIR FLOW MEASUREMENT CFM
AIR HANDLER / BLOWER UNITS

How to Diagnose a Burned-out Air Conditioning Compressor

InspectAPedia® - ShareThis +1

- How to diagnose a burned-out air conditioning compressor
- When is a compressor at or near end of its life? Criteria for deciding that an air conditioner, heat pump, or refrigeration compressor needs to be replaced
- Hard starting air conditioner compressor
- Increased air conditioning electrical bills
- Air conditioner compressor defect diagnosis & repair guide
- Air conditioning condenser unit fan diagnosis/repair
- When to replace a failing or failed A/C or heat pump compressor
- Common causes of A/C or heat pump compressor motor failure
- Questions & Answers about air conditioning and heat pump compressors: diagnosis, failure, repair, replacement

This air conditioning repair article discusses the how to diagnose and replace a burned out air conditioner compressor, including evaluation of air conditioner compressor noises, hard starting, lost cooling capacity, and detection of a burned out compressor or A/C compressors at or near end of their life. Here we catalog and describe the causes of air conditioner or heat pump compressor failures and we suggest compressor motor diagnostic steps. Contact us to suggest text changes and additions and, if you wish, to receive online listing and credit for that contribution

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

 Use page top links to major topics or use links

at the left of each page to navigate ***within*** topics and documents at this website. Green links show where you are in a document series or at this website.

How to Diagnose a Burned-Out Air Conditioning Compressor

Air conditioner failure warning signs: Before an air conditioning compressor fails solid you may notice that the unit is hard-starting, particularly when starting against a head pressure (someone switched the system off while the compressor was running, then tried turning it right back on). See CAPACITORS for HARD STARTING MOTORS and see MOTOR OVERLOAD RESET SWITCH.

Another sign of a failing air conditioning compressor is noisy motor operation, such as buzzing or clanking sounds coming from the outside unit housing the compressor motor. See NOISES, COMPRESSOR CONDENSER.

Another sign that *might* indicate a failing air conditioner compressor motor is an increase in the building's electrical bills even though the air conditioning system "on" time has not changed. See TIGHT or SEIZED AC COMPRESSORS where we provide additional details about examining and measuring A/C and heat pump compressors to continue compressor condition diagnosis.

When a sealed compressor motor has "burned out" this means that the internal wiring of the motor has become irreparably damaged: the compressor motor windings may be burned and shorted together or shorted to the steel shell of the motor, or the windings may have burned and simply become "open" or disconnected. If the motor has burned out in either of these ways it needs to be replaced.

When an air conditioner / heat pump compressor can no longer develop proper pressures, even if its electric motor has not burned out, the unit will still need to be replaced. Below we give refrigerant pressure details that help make this decision.

Basic Diagnostic Clues Indicating a Failed A/C or Heat Pump Compressor Motor

Watch out for shock hazards or equipment damage: see USING DMMs VOMs SAFELY.

The compressor won't start, perhaps just hums, and the motor star/run capacitor(s) are ok or you've tried replacing that part

As soon as the compressor tries to start the circuit breaker trips or fuse blows. The compressor motor has burned out, is internally shorted or gounded. A service technician will use a VOM and typically will find low resistance (low Ohms) between one or more compressor terminals and ground.

A VOM connected to the compressor circuit indicates that no current is being drawn, but the condenser fan is running properly.
Watch out: before assuming that the compressor motor is bad, when the unit won't start at all, check for a loose or disconnected electrical connection or a bad contactor relay. An overheated motor may also leave the compressor motor "off" due to a tripped internal overload switch or a switch that has simply failed. If this is the problem, the motor should start normally once the unit has cooled down. (Some readers describe spraying water on the condenser unit to speed cooling - (don't wet electrical switches & components.)

Basic Electrical Tests on Air Conditioner or Heat Pump Compressor Motors

Watch out for shock hazards or equipment damage: see USING DMMs VOMs SAFELY.

When an air conditioning compressor has "burned out" by shorting of internal components - it will fail to start at all. This failure is detected by disconnecting all power and wiring from the unit and measuring resistance (ohms) between the motor start/common and run/common terminals.

Zero resistance: If there is zero resistance the winding is open or broken.

Infinite resistance: If you measure the resistance across a compressor winding and your meter's needle is stuck over at infinity, or "OL"/"OVER" on a digital meter, that would indicate the compressor winding is open (burned through). The same effect can be observed from simply connecting the meter to absolutely nothing. Typically if just one widing is "open" you'll see infinite resistance at one check point and in contrast (for the non-open windings) you will read zero resistance ("continuity") between the *Common* terminal and the *Start* or between the *Common* terminal and *Run* terminal.

Low resistance: If the resistance measured across the air conditioning compressor winding is too close to 0 ohms, it's shorted. The compressor should blow the fuse or trip the circuit breaker when power is turned back on. But watch out: we get field reports of equipment burn ups and even fires when the air conditioning circuit breaker for the compressor happens to be an old FPE Stab-Lok or Zinsco unit.

If there is resistance but not infinite resistance between the motor terminal and the motor casing, the motor has become shorted to ground internally and the unit needs to be replaced. If there is no resistance between the start and run terminals to common, but there is resistance between the start and run terminals, this means that the internal motor overload protection circuit is open. In this last case, allow the motor to cool and re-test it before replacing it. See REPLACING A COMPRESSOR.

For details about measuring RLA / FLA, and definitions of RLA, FLA, and LRA, see see TIGHT or SEIZED AC COMPRESSORS

Other (Non-Electrial) Refrigeration Compressor Failure Modes

Watch out: for a mechanically frozen compressor: a compressor may pass all of these electrical tests and still require replacement. The tests above only test electrical connections and windings. An air conditioner or heat pump or refrigeration compressor that has jammed up mechanically internally will still refuse to start (perhaps will hum) when all of the electrical tests, contactor relay, start capacitor, etc. are tested as perfecliy fine.

A compressor with broken internal parts may also not be frozen, that is its internal electrical motor may start and run, but the compressor fails to produce any refrigerant pressure at its outlet side. In this case internal parts or valves in the unit have broken without jamming the motor itself. In this case, all of the electrical components and tests will look "OK".

A compressor with broken internal motor mounts may make a rattling or clanking sound and needs replacement. It will continue to run but could become shrapnel at any time.

A compressor with bad internal valves will continue to run but is inefficient and should be replaced. The symptom is very quick equalization of high and low side pressure as soon as the motor stops.

When to replace a sealed-unit air conditioning or heat pump compressor?

Burned up electric motor in the HVAC compressor

Some compressor motor failures are so apparent that there's no question: an electric motor burnout that draws high amps or is internally shorted, for example.

Abnormal HVAC compressor pressures

But what about a compressor motor that may be just "worn" ? An HVAC compressor should be able to pull at least 15" of vacuum against 100 psi head pressure or else it is inefficient. Of course to make this test you must be able to isolate the compressor from the rest of the cooling or heat pump system, so this test is not rapidly made in the field.

Bad HVAC compressor refrigerant valves

Bad air conditioner reed valves will be unable to pull pressure down on the low side of the system. A leaky discharge reed valve (on the compressor output side) pulls hot gases back into the compressor cylinder and recompresses them, causing abnormally high head pressures at the compressor motor. And as a result the compressor won't be able to move vapor.

In sum, HVAC compressors do fail and need replacement, but only when you have tested and ruled out the other 80% of the causes of common air conditioning, heat pump, or refrigeration problems (usually electrical in nature) do you go ahead and replace the compressor unit.

General advice: Electrical Tests to Check HVAC Blower Fan Motor or Outdoor Compressor Fan Motor Winding on Heating or Cooling Equipment or on Other Electrical Motors

Air Conditioner Compressor/Condenser Fan Not Working?

Details of compressor/condenser unit fan inspection, diagnosis, and repair are at FAN, COMPRESSOR/CONDENSER UNIT. Basic advice follows:

A failed compressor/condenser fan can cause the air conditioning system to shut down due to an overheating compressor or excessive pressures developed inside the compressor. If your compressor/condenser unit does not include a safety override switch to perform this shutdown and if the condenser unit fan is not working, your compressor motor may be permanently damaged. At NOISES, COMPRESSOR CONDENSER we include some condenser fan noise problems are traced to the cooling fan motor, bearings, fan blades, obstructions, etc.

Watch out: if your compressor/condenser unit motor is running but the fan itself is not blowing air, the system will not work and may be seriously damaged. The outdoor cooling fan or condenser unit fan is needed not only to cool high pressure, high temperature refrigerant in gas form so that it can condense back to liquid form.

That cooling step also cools down the compressor itself and keeps the compressor internal pressure from becoming too high. Most modern compressor / condenser units include an overpressure sensor that will shut the equipment down if compressor pressures become too high. Some older models and some modern economy air conditioner compressors may lack this function.

See USING DMMs VOMs SAFELY. Example: testing a blower fan motor winding: referring to the electrical diagram for your equipment, unplug electrical connectors at the fan motor. Measure the resistance between each lead wire with a multimeter or VOM. The multimeter should be set in the X1 range. For accuracy, don't measure when the fan motor is hot, allow it to cool off.

When the resistance between each lead wire are those listed in the specifications for your equipment the fan motor should be normal. Zero resistance or infinite resistance are indicators of a problem. More examples of checking wiring: see BURNED-OUT COMPRESSOR. See HARD STARTING COMPRESSOR MOTORS also TIGHT or SEIZED AC COMPRESSORS for more details about old or failed compressor motors. Also see Test a Motor Starting Capacitor

Common Causes of Burned Out Air Conditioner Compressors

- Contamination of refrigerant, piping, or devices in the refrigeration system: contaminants, including air, moisture carried in by air, and dirt can enter the refrigeration system as contaminants due to a leak on the suction side or improper service procedures such as mis-handling of service port valves or opening the system for repairs without adequately drawing a vacuum and without proper use of filter/dryer canisters. Air in the system can also lead to refrigerant flooding discussed above.
- Cooling problems - compressor motor overheats: a compressor motor that keeps on running when the compressor/condenser fan has failed or when air flow through the condensing coil has become blocked by debris or damage can cause abnormally high compressor head pressures and operating temperatures. If the condenser fan is running but airflow is impaired the system may continue to "run" but at reduced cooling capacity and shortened compressor life. We found a stack of nine A/C compressors improperly installed without adequate cooling air flow at a wealthy client's home in Pawling, NY. Compressor motors were being replaced every year or two because the owner installed a stockade fence to "hide the ugly equipment". A compressor may also run too hot due to too-high temperatures at the suction line and low-side of the compressor system. Under-charged refrigerant levels or lack of insulation on the suction line piping can cause these problems as might a TEV that is not quite flooding the system but is releasing refrigerant too fast through the cooling coil. [2]
- Refrigerant Pressure problems - excessive high side pressure may be caused by a restriction or blockage such as in the condensing coil, refrigerant metering device, or even at the cooling coil. Excessive high side pressure causes hot compressor operation, lost cooling capacity, and ultimately damage.
- Refrigerant flooding - sending liquid refrigerant into the compressor motor is a quick way to destroy its moving parts or valves. We discuss refrigerant flooding and six common causes of liquid refrigerant slugging the compressor at THERMOSTATIC EXPANSION VALVES, and aside from TEV (TXV in some literature) problems, a mistake like overcharging the system can lead to liquid refrigerant can end up in the compressor bottom where only refrigerant gas is expected - causing the same failure problems. Christopherson, [2]
- Refrigeration oil lubricant - lost due to system leaks (most likely you'll know there has been a history of refrigerant leakage too); also refrigeration oil can travel in the refrigerant lines where it reaches a capillary tube or TEV , clogging it and causing abnormal system pressures that can damage the compressor. On commercial refrigeration systems that us a separate oil pump to deliver lubricant to the compressor motor, an oil pump failure also leads to compressor motor failure.
- Electrical problems that can damage A/C or heat pump motors are cited by Christopherson, including improper voltage (hooking up to an incorrect voltage level supply (110V to 220V or 230V applied to a 208V motor), poor power quality delivered to the system such as at homes subject to significant fluctuations in actual voltage levels in the incoming mains, loss of voltage on one phase of a three-phase electrical hookup (more common on commercial than residential refrigeration equipment), and finally, unbalanced current across the individual phases of a three-phase electrical hookup. [2]
- Worn out compressor internal parts - a compressor motor may fail due to mechanical wear, though in our OPINION and having seen some refrigeration compressor motors that ran for decades with no trouble, we think mechanical wear is likely to be traced to a refrigerant, lubrication, contamination, or perhaps mounting problem. See our contamination comments above.

The text above describing causes of refrigeration compressor damage is indebted to HVACR experts Norm Christopherson [2] and Joe Marchese [6], as well as Warren Hilliard [1].

Questions & Answers regarding this article

Questions & Answers about air conditioning and heat pump compressors: diagnosis, failure, repair, replacement

Question: My air conditioner compressor blew, the new system is icing up, what's going on?

I am a 100% service-connected disabled veteran who just spent over $3700. to replace a 4 ton trane xr12 air conditioner condenser and coil. My old condenser compressor blew up and the HVAC guy said it wasn't worth replacing since the unit was a 9 yr old r-22 system.

He talked me into a new trane xr13, 4 ton, r-410 condenser and a 5 ton evaporative coil for an extra $400. saying I'd get 10% more cooling capacity than the 4 ton coil. this was 5 weeks ago. three techs have been here since trying to figure out why the evaporative coil keeps icing up. the best cooling we get with the thermostat set at 72 degrees is only 15 degrees cooler than it is outside.this is with the front panel off the furnace.

With the panel in place, in 2 or 3 days the coil turns into a block of ice. even with the panel off, as the day wears on and the outside temperature drops, the inside temperature increases. right now, the thermostat is at 72, it's10:15 p.m. it's 73 degrees outside and 76 degrees inside.

The HVAC guys tried to blame my ductwork as unable to handle the airflow, then inadequate air returns, then too small a hole (10x12) above the coil going to the plenum. all solutions of course would require a 2nd mortgage. My response was . BULL. It's something they did wrong because before the compressor blew, if the outside temperature was 100 degrees, inside it was 78 degrees.(with the thermostat set at 72.

Not once in 9 years did it ice up or did I ever have to remove the front panel of the furnace to increase the airflow., It has to be one or both of the things they installed, like maybe a defective evaporator coil. Do you have any suggestions? Thanks - B.H.

Reply:

Cooling coil icing can be due to an improper refrigerant charge, inadequate air flow across the cooling coil, or a problem with a refrigerant metering device (or something else we haven't thought-of). Your HVAC guys might be right that your old duct system is not moving enough air across the coil, allowing it to ice up, but if that's the problem I'd ask them why they didn't think of that before selling you that extra big evaporative coil in the air handler. In a good-working air conditioner or heat pump system the components need to be in balance: compressor/condenser, air handler/evaporator, and ductwork.

If we hold off on the blame game for a bit, let's see if you can increase the airflow across the coil. Often I find on older cooling systems that the return air opening was too small or the connections from return register to the air handler small or cramped or twisty. A very crude "test" that I do NOT RECOMMEND for more than a few minutes of test operation is to see if the coil ices up if someone leaves the air handler blower compartment door off - to maximize the return air opening. Take a look under DUCT SYSTEM & DUCT DEFECTS for the article: RETURN AIR REGISTERS & DUCTS, and also take a look under COOLING COIL or EVAPORATOR COIL at the article: FROST BUILD-UP on AIR CONDITIONER COILS for more help.

Finally, at RETROFIT SIZING for A/C or HEAT PUMPS we touch on the importance of balancing the system components during a retrofit or upgrade of an air conditioner or heat pump system.

Let us know what you find - we'll both learn something.

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(3 days ago) DanJoeFriedman (mod) said:

Ann,
with just the info you provided - blowing hot air - first make sure your thermostat is set to COOLING mode - and presuming it is and that all of the equipment inside and out are turned on, check

DIAGNOSE & FIX AIR CONDITIONER / HEAT PUMP

the article link found at page left - for a starting point in diagnosing why an air conditioner is not working.

(4 days ago) ann said:

air conditioner blowing hot air

(July 14, 2012) Mike T. said:

I am troubleshooting a 7500BTU Danby portable air conditioner (the tall vertical unit with ducting out the back via flexible hose). It appears that the compressor itself is at fault, but I would like to be sure before replacing the unit. The start capacitor measures OK (meaures 46uF for a 45uF +/-5% unit) and appears in good condition. I measured the resistance between the three compressor terminals and they seem to be OK (C-S=2.8ohms, C-R=1.0ohms, S-R=3.7ohms) and there is high resistance between all terminals and ground. I applied 117Vac directly to the compressor (bypassing the control circuits) and the compressor just hums - the current draw was 30A. Being a protable unit, everything is jammed into the compartment and I don't see any way to access the compressor at all. I'm about to give up on the unit and look for a new one, but just wanted to see if there are any other things to try. The unit is probably about 9-10 years old, but has only seen regular use in the summer over the last 3 years.
Thank you for any help or advice.
Mike

(July 11, 2012) Anonymous said:

THE METERING DEVISE NEED TO MACH CONDENSER IF IS 4 TON SET A 4 TON METERING DEVISE EVEN ON A 5 TON EVAPORATOR.

(June 24, 2012) Doug S. said:

We had a service tech out for a inspection check up of our 8 yr old tempstar unit because we cannot seem to get the the house temp to the low 70s even when unit runs for 5+ hrs strait....
the tech said the coil needed cleaning or replaced and our compressor was not starting and that it was just humming & clicking when trying to start and recommended to us 2 options to remedy the problem...new compressor or new system and both were not cheap.

while he was testing the equip outside I was in my office and could hear and feel the vibration of the unit trying to start...

My son-in-law came over and we removed the coil and cleaned it thoroughly and then checked all the wiring on the outside unit compressor and found a green wire disconnected and stuffed into a hole (Hmmmmm!).
we reconnected the wire and fired the unit up and the compressor seemed to start with no problem (no humming or clicking).

So, if it is 98F outside we cannot get the inside house temp below 79f,,I put a refrigerator thermometer in front of an air duct and left it there for 30+ minutes and then checked it....it read 61F...I am at a loss of what to do....also the blowing air pressure does not seem to be strong.......what to do???

(June 17, 2012) DanJoeFriedman (mod) said:

JPI, I'm in no position to second guess the expert who was on the scene - s/he sees clues and performs test way beyond what we can do in a text Q&A. But here are some thoughts:

a failing compressor motor can become increasingly hard to start; the tech can install a hard-start capacitor to get the motor running again - for a time - and it might be worth a try: that's an inexpensive part and usually fairly straight-forward to install.

(June 16, 2012) JPI said:

my air handler works, but the outside ac unit does not come on all the time. It's intermintent. My HVAC guy did pressures and said I have a bad comprresser (20 year old unit) and I'm better off getting a new ac unit. Sometimes it will come on and stay on. Other times it will not come on at all.

(June 4, 2012) DanJoeFriedman (mod) said:

Salve I think you should get advice from a different and more experienced HVAC tech. Like many a good lie, this one has some truth in it: if a compressor motor fails, burned oils in the refrigerant can contaminate the refrigeration piping - that's why when a burned out unit is replaced the tech will pull a vacuum on the system, do his/her best to clean the lines, and a special compressor burnout-filter or two will be installed on the refrigerant lines to protect the new motor and other parts from damage or debris clogging.

But a system can fail in a variety of ways, and as I explained there are well known means of dealing with debris in the system. What you were told would make me look elsewhere for my HVAC maintenance and repair services.

(May 31, 2012) salve said:

I have 15 years old central AC unit. It is working fine. I was advised to replace it with a new one because there is a danger of refrigerant contamination of pipes if the old unit fails. If it happens,
to clean/replace pipes would cost additional 2000 dollars. How serious is it?

(May 30, 2012) DanJoeFriedman (mod) said:

Orios, if the compressor motor never runs, but the air handler unit is running and the thermostat calls for cooling, the problem is at the compressor / condenser unit. See the diagnostics under "COMPRESSOR & CONDENSING COIL, A/C" (article link at page left)

(showing 1 to 10)

Recommend / Share this Article

+1 ShareThis
EMAIL
Print

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also include a list of recommended books for the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

AIR CONDITIONING & HEAT PUMP SYSTEMS

A/C - HEAT PUMP CONTROLS & SWITCHES
A/C DATA TAGS
A/C - HEAT PUMP CRITICAL DEFECTS
A/C DIAGNOSTIC FAQs

- Thanks to Mark Cramer, Tampa Florida, for assistance in technical review of the "Critical Defects" section and for the photograph of the deteriorating gray Owens Corning flex duct in a hot attic. Mr. Cramer is a Florida home inspector and home inspection educator.
- CARSONDUNLOP Carson, Dunlop & Associates Ltd., 120 Carlton Street Suite 407, Toronto ON M5A 4K2. (416) 964-9415 1-800-268-7070 info@carsondunlop.com. The firm provides professional home inspection services & home inspection education & publications. Alan Carson is a past president of ASHI, the American Society of Home Inspectors. Thanks to Alan Carson and Bob Dunlop, for permission for InspectAPedia to use text excerpts from *The Home Reference Book* & illustrations from *The Illustrated Home*. Carson Dunlop Associates' home inspection education products include
  - The ASHI-adopted Home Inspection Training Program, and Commercial Building Inspection Courses
  - The Home Inspection Home Study Course, and publications such as
  - The Home Reference Book, a reference & inspection report product for building owners & inspectors
  - The Home Reference *eBook*, an electronic version for PCs, the iPad, iPhone, & Android smart phones
  - Home Inspection Report writing materials, including the Horizon Software System that manages business operations, scheduling, & inspection report writing using Carson Dunlop's knowledge base & color images. The *Horizon* system runs on always-available cloud-based software for office computers, laptops, tablets, iPad, Android, & other smartphones.
  - The Illustrated Home illustrates construction details and building components, a reference for owners & inspectors
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- Thanks to Scott at SJM Inspect for suggesting this EPA document and for technical editing remarks regarding our

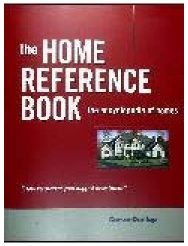
air conditioning website, SJM Inspection Service LLC, serves the entire state of CT, sjminspect.com 203-543-0447 or 203-877-4774 5/16/07

- Thanks to Diaz, Domingo I. CIV NAVAIR Bldg.2118, rm. 131: domingo.diaz@navy.mil - Ming Diaz, Great Falls, MD for editing help with the text about discharging air conditioning compressor capacitors - 3/07 DF]
- Thanks to Mark Cramer, Tampa Florida, for assistance in technical review of the "Critical Defects" section and for the photograph of the deteriorating gray Owens Corning flex duct in a hot attic. Mr. Cramer is a Florida home inspector and home inspection educator.
- Thanks to Jon Bolton, an ASHI, FABI, and otherwise certified Florida home inspector who provided photos of failing Goodman gray flex duct in a hot attic.
- Air Diffusion Council, 1901 N. Roselle Road, Suite 800, Schaumburg, Illinois 60195, Tel: (847) 706-6750, Fax: (847) 706-6751 - info@flexibleduct.org - www.flexibleduct.org/ -
  "The ADC has produced the 4th Edition of the ***Flexible Duct Performance & Installation Standards*** *(a 28-page manual) for use and reference by designers, architects, engineers, contractors, installers and users for evaluating, selecting, specifying and properly installing flexible duct in heating and air conditioning systems.*
  Features covered in depth include: descriptions of typical styles, characteristics and requirements, testing, listing, reporting, certifying, packaging and product marking.
  Guidelines for proper installation are treated and illustrated in depth, featuring connections, splices and proper support methods for flexible duct. A single and uniform method of making end connections and splices is graphically presented for both non-metallic and metallic with plain ends."
  The printed manual is available in English only. Downloadable PDF is available in English and Spanish.
- Owens Corning Duct Solutions - www.owenscorning.com/ductsolutions/ - provides current HVAC ductwork and duct insulating product descriptions and a dealer locator. Owens Corning Insulating Systems, LLC, One Owens Corning Parkway, Toledo, OH 43659 1-800-GET-PINK™
- "Flexible Duct Media Fiberglas™ Insulation, Product Data Sheet", Owens Corning - see owenscorning.com/quietzone/pdfs/QZFlexible_DataSheet.pdf
  "Owens Corning Flexible Duct Media Insulation is a lightweight, flexible, resilient thermal and acoustical insulation made of inorganic glass fibers bonded with a thermosetting resin."
- [1] "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author].
  Warren Hilliard was an HVACR instructor as well as operator of an HVACR repair company in Dutchess County, New York.
- [2] Christopherson, Norm, "Preventing Premature Compressor Failures, An Ounce of Prevention for Years of Service", web search & reader TN Goose referral, 08/12/2011, original source: http://www.hvacfun.com/a-once-prevent-years-service-comps.htm
  Quoting: *Norm Christopherson, CM, is a long-time hvacr instructor at San Jose City College, San Jose, CA*
- [6] Determining Compressor Amperage Ratings, Joe Marchese, *Air Conditioning, Heating, Refrigeration News*, 31 July 2003, web search 08/12/11, Joe Marchese is owner of Coldtronics of Pittsburgh. He can be reached at 412-734-4433, www.coldtronics.com, or joe@coldtronics.com. Original source: http://www.achrnews.com/Articles/Feature_Article /c229b8960ac5a010VgnVCM100000f932a8c0____ - quoting:

Books Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia Bookstore.

  - The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building



owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

Or choose the The Home Reference eBook for using this reference on PCs, Macs, Kindle, iPad, iPhone, or Android Smart Phones

Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

- Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982
- Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- NEW!
  Air Conditioning SEER - New DOE Air Conditioner and Heat Pump Efficiency Standard
- Asbestos HVAC Ducts and Flues field identification photos and guide
- Fiberglass: Indoor Air Quality Investigations: Fiberglass in Indoor Air, HVAC ducts, and Building Insulation

- ...

Mobile View
HEATING SYSTEMS

AGE of AIR CONDITIONERS & HEAT PUMPS
AGE of HEATERS, BOILERS, FURNACES
AGE of WATER HEATERS
AIR CONDITIONING & HEAT PUMP SYSTEMS
AIR FILTERS for HVAC SYSTEMS
ANODES & DIP TUBES on WATER HEATERS
AIR HANDLER / BLOWER UNITS
AIRBOUND HEAT SYSTEM REPAIRS
ANODES & DIP TUBES on WATER HEATERS
ANTI SCALD VALVES
ANIMAL ALLERGENS / PET DANDER
ANIMAL ENTRY POINTS in buildings
ANIMAL ODORS IN buildings
APPLIANCE EFFICIENCY RATINGS
ASBESTOS IDENTIFICATION IN buildings

BACKDRAFTING HEATING EQUIPMENT

Guide to Air Conditioning & Heating Blower Fan AUTO ON & COOL OFF HEAT Switches on Thermostats

InspectAPedia® - ShareThis +1

- What are the Other Little Switches For on a Room Thermostat: Heat, Air Conditioning like COOL OFF HEAT and FAN ON AUTO ?
- How does the MODE switch work on a digital thermostat to choose among OFF HEAT COOL AUTO ?
- What to do if the air conditioner blower fan runs continuously and won't turn off
- How & why to force an air conditioning or heating fan to run continuously
- What is the relationship between the wall thermostat and the low voltage power transformer connected to it?
- Questions & answers about using the fan switch on room wall thermostats

How to set the room thermostat switches: this article explains the use, setting, and adjustment of the FAN On-Off and MAN-AUTO switches on room thermostats. We provide A Guide to Finding, Using, and Adjusting Thermostats for Heating & Air Conditioning Furnaces & Boilers, Heat Pumps or Electric Furnaces or Boilers. This website answers most questions about central heating system troubleshooting, inspection, diagnosis, and repairs. We describe how to inspect, troubleshoot and repair heating and air conditioning systems to inform home owners, buyers, and home inspectors of common heating system defects.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

 Use page top links to major topics or use links at the left of each page to navigate ***within*** topics and documents at this website. Green links show

BACKFLOW PREVENTER VALVE, HEATING SYS
BACKFLOW PREVENTER, HEATER WATER FEEDER
BACKUP HEAT for HEAT PUMPS
BANGING HEATING PIPES RADIATORS
BAROMETRIC DAMPERS
BIOGAS PRODUCTION & USE
BLEVE EXPLOSIONS
BLOWER DOORS & AIR INFILTRATION
BLOWER FAN CONTINUOUS OPERATION
BLOWER FAN OPERATION & TESTING
BLUE vs YELLOW COMBUSTION FLAMES
BLUERAY Recall
BOILERS, HEATING
BOILER CONTROLS & SWITCHES
BOILER LEAKS CORROSION STAINS
BOILER LEAKS, HOW TO LOCATE
BOILER NOISE SMOKE ODORS
BOILER OPERATING PROBLEMS
BOILER OPERATION DETAILS
BOILER PRESSURE & TEMPERATURE SETTINGS
BOOKSTORE - InspectAPedia
BUILDING SAFETY HAZARDS GUIDE

CAPACITORS for HARD STARTING MOTORS
CARBON DIOXIDE - CO2
CARBON MONOXIDE - CO
CARBON MONOXIDE WARNING
CHIMNEY INSPECTION DIAGNOSIS REPAIR
CHIMNEYS & Flues - Asbestos Transite Pipe
CHINESE DRYWALL HAZARDS
CIRCULATOR PUMPS & RELAYS
COOL OFF HEAT, Thermostat Switch
COMBUSTION AIR
COMBUSTION AIR for TIGHT buildings
COMBUSTION GASES & PARTICLE HAZARDS
COMBUSTION PRODUCTS & IAQ
COMPLETE COMBUSTION, Stoichiometric
CONDENSING BOILERS/FURNACES
CONDENSING BOILERS/FURNACES DAMAGE
CONVECTOR HEATERS - HYDRONIC COILS
CREOSOTE FIRE HAZARDS

DEFINITION of Heating & Cooling Terms
DIAGNOSE & FIX AIR CONDITIONER / HEAT PUMP
DIAGNOSE & FIX HEATING PROBLEMS-BOILER
DIAGNOSE & FIX HEATING PROBLEMS-FURNACE
DIRECT VENTS / SIDE WALL VENTS
DIRECTORY of OIL TANK EXPERTS
DRAFT HOODS - gas fired
DRAFT MEASUREMENT, CHIMNEYS & FLUES
DRAFT REGULATORS, DAMPERS, BOOSTERS
DUCT SYSTEM & DUCT DEFECTS
DUST CONTAMINATION FROM HVAC?

ELECTRIC HEAT, DIAGNOSIS, REPAIR
ELECTRIC MOTOR DIAGNOSTIC GUIDE
ELECTRIC MOTOR OVERLOAD RESET SWITCH
ELECTRICAL POWER SWITCH FOR HEAT
ENERGY SAVINGS in buildings
EVAPORATIVE COOLING SYSTEMS

FAN, AIR HANDLER BLOWER UNIT
FAN AUTO ON Thermostat Switch
FAN, COMPRESSOR/CONDENSER UNIT

where you are in a document series or at this website.

FAN SWITCH: Guide to Air Conditioning, Heat Pump, or Heating System Blower FAN ON-AUTO or FAN ON-MAN Settings on Wall Thermostats

The articles at this website describe the basic components of a home heating system, how to find the rated heating capacity of an heating system by examining various data tags and components, how to recognize common heating system operating or safety defects, and how to save money on home heating costs. We include product safety recall and other heating system hazards.Because some controls are used in common on hot water heat, hot air heat, and steam boilers, readers should see these other articles: see BOILER CONTROLS & SWITCHES, and also see BOILER COMPONENTS & PARTS for a detailed list of heating boiler controls, other heating system components, parts such as circulator pumps & draft regulators. If your building uses warm air heat, see FURNACE CONTROLS & SWITCHES. If your building uses steam heat see STEAM HEATING SYSTEMS. Also see Heat Won't Turn Off - Stop Unwanted Heat.

How does the FAN switch work on a heating or cooling thermostat and how should I use the FAN switch? Details about this switch are at FAN ON AUTO Thermostat Switch wHere we explain how to to use it and how to determine how the switch has been set on a digital thermostat. The basics are just below.

The air conditioning or heating wall-mounted thermostat may have a fan or blower control switch with (usually) two set positions "ON" and "AUTO" or sometimes "MAN" or "AUTO"

On these switches located usually on the top, side, or bottom of air conditioning or heating thermostats, the "ON" position is not what you might think. But it's simple, as you'll see.

"ON" on the fan switch will cause the heating or air conditioning fan or blower to run continuously. "MAN" or "manual" is the same as "ON" in this situation. There are advantages of running an air conditioning or heating blower fan continuously - which we discuss at CONTINUOUS BLOWER FAN OPERATION.

"AUTO" on the fan switch on your thermostat is the normal switch position for the fan control. Setting the fan control to "AUTO" will allow the fan to turn on when the air conditioning system (or heating system) are ready to blow cool (or warm) air into the building, and to turn off automatically when cooling or heating are not needed.

Why Run an Air Conditioner or Heating Blower Fan Continuously?

There are reasons to leave the fan in the ON position on a heating or cooling system, but we do not recommend that you do this without first asking for advice from your heating and service technician. Details about continuous operation of heating or air conditioning blower fans are at CONTINUOUS BLOWER FAN OPERATION .

MODE SWITCH: Guide to Air Conditioning, Heat Pump, or Heating System COOL-OFF-HEAT Settings on Room Thermostat Switches

How does the COOL-OFF-HEAT Switch work on a heating or cooling thermostat? Details are just below.

The thing that confuses some building owners is that a thermostat that is used to control air conditioning as well as heating may have a "mode" switch that allows the occupant to change the thermostat between "Cooling" or "Air" or "Air Conditioning" mode and "Heat" or "Heating" mode.

There may be a third position labeled "Off" which instructs the heating or air conditioning system not to run at all.

"COOL" thermostat switch setting position: During the cooling season when you need air conditioning, set this switch to the "COOL" position. This tells the thermostat what to do as temperature rises above the thermostat's setting (turn on the air conditioning system) or when room temperature falls below the thermostat's set temperature (turn off the air conditioner).

It's a good idea not to turn your air conditioning system on in cooling mode when it has been cold outside in the last 24hours. Unless your system is a heat pump designed to switch back and forth in all seasons, or unless a special heater has been installed on your air conditioning compressor, suddenly turning the air conditioning system (and the compressor component of it) on when it has been cold can damage the compressor.

"OFF" switch on the thermostat or on the fan switch, if there is one, will tell the thermostat to keep the equipment it is controlling turned off regardless of whether we're in heating or cooling season. On thermostats usually the "OFF" position is in the middle between "COOL" and "HEAT" positions. Why do you think this might be? It's not smart to switch a heat pump or a combination heating and cooling system right from "COOL" over quickly to "HEAT" or vice-versa.

Imagine driving down the highway with the automatic transmission on your car set to the "D" for "drive" - would you switch the transmission into "R" for "Reverse" at 60 MPH? (No "R" does not stand for "Race"). Well you would only do it once - after which your transmission would perhaps be in the road behind the car.

DON'T DO THIS.

Taking photos for these articles I kept switching my digital thermostat between OFF HEAT COOL AUTO - which led to having no heat at all. I screwed up the control. The "fix": I turned everything off at the service switch at my heater for five minutes to reset the system, turned things back on, and re-set the thermostat to MODE=AUTO and FAN=AUTO.

"HEAT" thermostat switch setting position: During the heating season, when you will need warmth, set this switch to the "HEAT" position. This tells the thermostat what to do when temperatures fall (turn on the heating system) or when temperatures rise to the thermostat setting (turn off the heating system).

MODE BUTTON: Guide to Air Conditioning, Heat Pump, or Heating System COOL-OFF-HEAT-AUTO Settings on Room Thermostat Switches that use a MODE Button

Unlike the round or square wall thermostat shown above, your room thermostat might look like this Carrier wall thermostat shown below (photo at left). Notice the buttons in the closeup (below right)?

The MODE button is at the upper right on this Carrier programmable digital thermostat. Pressing the MODE button repeatedly will cycle the thermostat among these overall thermostat control settings:

OFF - turn everything off - no heating, no cooling, no fan, no nothing. Also see Heat Won't Turn Off - Stop Unwanted Heat explanation of why heat may continue to come out of radiators or baseboards even though you have turned down the thermostat. Stop wasted heat by making sure you are not delivering heat when it is not needed or not wanted.

HEAT - put the thermostat in HEATING mode

COOL - put the thermostat in COOLING mode

AUTO - put the thermostat into AUTOMATIC mode - the thermostat will call for the heat to turn on or the air conditioning to come on depending on the temperature set on the thermostat. For example if your thermostat is set to 68 degF and the room temperature drops below 68 degF the heat will come on. If temperature rises above 68 degF the cooling system will come on - presuming your building HVAC system includes both heating and cooling.

In our lab we leave this thermostat MODE set to AUTO.

WARNING: as we explained just above, don't keep cycling among these modes - you might make your thermostat get nauseous.

HEATING and COOLING Air Filtering Suggestions

See these articles about how to use air filters, where to buy them, and how to turn on and off HVAC blower fans

- AIR FILTERS for HVAC SYSTEMS - about air filters
- AIR FILTERS, OPTIMUM INDOOR - optimum filter designs for best filtration
- CONTINUOUS BLOWER FAN OPERATION - advantages of continuous air filtration in improving indoor air quality
- AIR FILTER EFFICIENCY - how air filter effectiveness is measured
- FIBERGLASS & AIR FILTERS - questions and opinions about fiberglass shedding hazards from air filters
- Heat Won't Turn Off - Stop Unwanted Heat - what if the heat won't turn off - keeps coming out of radiators?
- SOURCES FOR AIR FILTERS - where to buy air filters
- OTHER AIR CLEANERS
- Other Switches on a Room Thermostat - how to set the HVAC blower fan to continuous operation, and what to do if the blower fan won't turn on or won't turn off

What to do if the Air Conditioning or Heating System Blower Fan Runs Continuously and Won't Shut Off?

Some readers have written to say that their air conditioning blower was running continuously and they didn't know why.

If the blower or fan switch is set to MAN or ON, It could be that the FAN switch had simply been set to force the fan to run all of the time. Change the setting to AUTO and see what happens.

Other causes for an air conditioning blower fan that does not turn off could be a problem with the control circuit board for the air conditioning system, or there could be other operating system problems that are preventing the system from cooling air to the desired temperature.

If the blower or FAN switch is set to AUTO and the fan never turns off, call your air conditioning or heating repair company for diagnostic help.

For hot water heat or steam heat that won't stop, see Heat Won't Turn Off - Stop Unwanted Heat explanation of why heat may continue to come out of radiators or baseboards even though you have turned down the thermostat. Stop wasted heat by making sure you are not delivering heat when it is not needed or not wanted.

How to Troubleshoot Low Voltage Transformers for Heating & Air Conditioning Thermostats

Question: How do you tell if a transformer is bad? How do you test a low voltage transformer?

How do i tell if a transformer for thermostate is bad ?- Erwin 5/12/12

How do you test a low voltage transformer? - Den 7/16/12

Reply: how to test a low voltage transformer for heating or air conditioning

Erwin if you disconnect the low voltage wires connected to the transformer terminals and use a VOM you should find voltage, usually 14V. If the device looks burned, hot, or smells, don't even bother testing. If it has been buzzing that's another clue.

Den,

Remove *all* of the the low voltage wires from the two (or more) screws on the top of the transformer. Usually you'll see a small gauge red and white wire simply connected under two screws on the upper surface of the transformer itself.

Some heating transformers for thermostats that use more than two wires will have more than two screws and more than two low voltge wires connected or there may even be multiple sets of thermostat wires connected if the transformer is powering more than one room thermostat. (photo above left).

Check for output voltage: with power to the transformer "on", using the VOM on a low voltage scale (say 0-24VAC) check for voltage between the two screw terminals. If the transformer itself is receiving 120V power but there is no voltage between the two low voltage output screws, then it is not working.

And thank you for the question - we have answered your question more extensively and have added details about low voltage transformers used on heaters and air conditioners and how the transformer is located, wired, and tested at LOW VOLTAGE TRANSFORMER TEST.

To test for a bad low voltage transformer you simply need a volt-ohm meter or a digital VOM. See USING DMMs VOMs SAFELY for advice on how to use a volt-ohm meter, and see Guide to Electrical Test Equipment for advice on ow to electrical test equipment safely.

Questions & Answers regarding this article

Questions & answers about using the fan switch on room wall thermostats

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(July 17, 2012) DanJoeFriedman (mod) said:

Den,

To test for a bad low voltage transformer you simply need a volt-ohm meter or a digital VOM.

Remove the low voltage wires from the two screws on the top of the transformer.

With power to the transformer "on", using the VOM on a low voltage scale (say 0-24V) check for voltage between the two screw terminals. If the transformer itself is receiving 120V power but there is no voltage between the two low voltage output screws, then it is not working.

Also before a low voltage transformer fails you may hear it buzzing - a condition that can continue for some time but ultimately is likely to lead to failure.

Finally, by visual inspection you MIGHT see burn marks or evidence of overheating - but I wouldn't depend on visual inspection alone.

(July 5, 2012) DanJoeFriedman (mod) said:

Christie, you've asked a helpful question - let's clear up some confusion about wall thermostats: the thermostat is not an accelerator - it doesn't make the air conditioner run faster or slower, nor warmer or cooler. Nope. The thermostat is basically an "ON-OFF" switch that turns the air conditioner ON or OFF in response to room temperature.

First make sure your thermostat is the one that controls your air conditioner. In some homes different or separate thermostats control heating and cooling. If you are at the air conditioner thermostat be sure it is set in COOL mode;

typically the fan switch is set to AUTO. Then set the desired temperature to a number lower than room temperature and your A/C should operate. If at that point equipment does not turn on there is a problem to troubleshoot - but first let's summarize:

So if you SET the thermostat to call for a temperature lower than the actual room temperature, the A/C will run until the room temperature drops to the SET number.

Now if the A/C runs forever and never cools the room down to the SET temperature then either the SET number is lower than the capability of the air conditioning system (say setting the temp to 60 degF when it's 110 outside at a home that has a lot of heat gain)
OR
The air conditioner needs repair.

Before calling the repairman check for
- a dirty air filter or closed air supply registers - both of which reduce the cool air flow

And if you click on "Air Conditioning" in the links across the top of this page, then on the left side of that web page you'll see an article titled "LOST COOLING CAPACITY" that offers some homeowner diagnostic steps that can help figure out why the air conditioning system is not cooling as well as you'd like.

(July 5, 2012) Christie Evans said:

How do u change the Thermostat for it too blow cooler Air.

(May 13, 2012) Walt, Tunkhannock, PA said:

I have a 2 zone oil fired boiler, central heat/air. The 1st floor stat operates heat/air, fan comes on, everything ok. 2nd fl, when turning stat to heat, fan comes on but boiler doesn't come on.

(Feb 9, 2012) Sarah said:

i set the lever to "off", but still the heating wont go off.. before the heating was on and at auto and it was not turning off after a while and then getting on again automatically like it should.

(Oct 30, 2011) John said:

My heat won't turn on when its on AUTO mode.

(Oct 22, 2011) nina said:

about heat pump it on cool and why

(July 19, 2011) DanJoeFriedman (mod) said:

For a single-speed fan, Peter, at the Thermostast turn the FAN ON switch to ON to see the fan run; Or on some air handlers that combine heating and cooling there should be a fan limit switch that may include a white knob that can be pulled our pushed to turn on the fan.

On a system that has a dual speed fan, I find that if the thermostat SET temperature is significantly below the current room temperature the control board in the HVAC air handler will step up the fan to its faster speed.

(July 19, 2011) Peter, Sydney Australia said:

Hi,
Thanks for your reply,

To refine my question...where is the best place to start to look to get the
fan operating at full speed?

Cheers and thanks.
Peter

(July 12, 2011) DanJoeFriedman (mod) said:

Warren: first be sure that your new TT is in COOL mode and then try the fan in ON position to see if you can force it to run - if so move the switch to AUTO. Set the TT below room temp; If nothing is happening I'd double check the thermostat wiring and confirm that there is voltage on the TT wires too - if the wires were shorted during installation you could have blown the transformer.

Jitu: overloaded AC Compressor going off on reset -you certainly need a service call from a professional.

Peter:
Sorry to read about such aggravation but at this point you need a service call from an experienced tech. Call someone else, talk about your concerns with the service manager, don't bad-mouth the prior tech or the new ones may figure you're hard to work for. Just explain that prior attempts to get things running didn't work and that tech gave up. Keep us posted.

(showing 1 to 10)

Recommend / Share this Article

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also include a list of recommended books for the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- Carbon Dioxide Gas Toxicity
- Carbon Monoxide Gas Toxicity, exposure limits, poisoning symptoms, and inspecting buildings for CO hazards
- DUST CONTAMINATION FROM HVAC? An Investigation of Indoor Dust Debris Blamed on a Heating/Cooling System Reveals Carpet Dust
- *Fuel Oil & Oil Heating Magazine*, 3621 Hill Rd., Parsippany, NJ 07054, 973-331-9545
- Goodman Furnace High Temperature Plastic Vent HTPV safety recall US CPSC notice
- Home Heating System Should Be Checked *[for proper venting and for CO Carbon Monoxide Hazards - DJF]*
- Inspection Procedures for Oil-Fired Heating Systems Detailed step by step approaches for inspecting complex systems]

- Lennox Pulse Furnace Safety Inspection/Warranty Program: Carbon Monoxide Warning
- Oil Tanks - The Oil Storage Tank Information Website: Buried or Above Ground Oil Tank Inspection, Testing, Cleanup, Abandonment of Oil Tanks
- Oil Tanks Above Ground, UL Standards, guidance for home owners, buyers, and inspectors
- Plastic Heating Vent Pipe & Other Heating Safety Recall Notices
- Weil McLain Model GV Gas Boiler/gas valve CPSC recall/repair
- *Domestic and Commercial Oil Burners*, Charles H. Burkhardt, McGraw Hill Book Company, New York 3rd Ed 1969.
- *National Fuel Gas Code* (Z223.1) $16.00 and National Fuel Gas Code Handbook (Z223.2) $47.00 American Gas Association (A.G.A.), 1515 Wilson Boulevard, Arlington, VA 22209 also available from National Fire Protection Association, Batterymarch Park, Quincy, MA 02269. Fundamentals of Gas Appliance Venting and Ventilation, 1985, American Gas Association Laboratories, Engineering Services Department. American Gas Association, 1515 Wilson Boulevard, Arlington, VA 22209. Catalog #XHO585. Reprinted 1989.
- *The Steam Book*, 1984, Training and Education Department, Fluid Handling Division, ITT [probably out of print, possibly available from several home inspection supply companies] Fuel Oil and Oil Heat Magazine, October 1990, offers an update,
- *Principles of Steam Heating*, $13.25 includes postage. Fuel oil & Oil Heat Magazine, 389 Passaic Ave., Fairfield, NJ 07004.
- *The Lost Art of Steam Heating*, Dan Holohan, 516-579-3046 FAX
- *Principles of Steam Heating*, Dan Holohan, technical editor of *Fuel Oil and Oil Heat* magazine, 389 Passaic Ave., Fairfield, NJ 07004 ($12.+1.25 postage/handling).
- *"Residential Steam Heating Systems"*, Instructional Technologies Institute, Inc., 145 "D" Grassy Plain St., Bethel, CT 06801 800/227-1663 [home inspection training material] 1987
- "Residential Hydronic (circulating hot water) Heating Systems", Instructional Technologies Institute, Inc., 145 "D" Grassy Plain St., Bethel, CT 06801 800/227-1663 [home inspection training material] 1987
- "Warm Air Heating Systems". Instructional Technologies Institute, Inc., 145 "D" Grassy Plain St., Bethel, CT 06801 800/227-1663 [home inspection training material] 1987
- Heating, Ventilating, and Air Conditioning Volume I, Heating Fundamentals,
- Boilers, Boiler Conversions, James E. Brumbaugh, ISBN 0-672-23389-4 (v. 1) Volume II, Oil, Gas, and Coal Burners, Controls, Ducts, Piping, Valves, James E. Brumbaugh, ISBN 0-672-23390-7 (v. 2) Volume III, Radiant Heating, Water Heaters, Ventilation, Air Conditioning, Heat Pumps, Air Cleaners, James E. Brumbaugh, ISBN 0-672-23383-5 (v. 3) or ISBN 0-672-23380-0 (set) Special Sales Director, Macmillan Publishing Co., 866 Third Ave., New York, NY 10022. Macmillan Publishing Co., NY
- *Installation Guide for Residential Hydronic Heating Systems*
- *Installation Guide #200,* The Hydronics Institute, 35 Russo Place, Berkeley Heights, NJ 07922
- The ABC's of Retention Head Oil Burners, National Association of Oil Heat Service Managers, TM 115, National Old Timers' Association of the Energy Industry, PO Box 168, Mineola, NY 11501. (Excellent tips on spotting problems on oil-fired heating equipment. Booklet.)
- ...

Mobile View
AIR CONDITIONING & HEAT PUMP SYSTEMS

A/C - HEAT PUMP CONTROLS & SWITCHES
A/C DATA TAGS
A/C - HEAT PUMP CRITICAL DEFECTS
A/C DIAGNOSTIC FAQs
A/C REFRIGERANTS
A/C TYPES, ENERGY SOURCE
AGE of AIR CONDITIONERS & HEAT PUMPS
AIR CLEANER PURIFIER TYPES
AIR CONDITIONER BTU CHART
AIR CONDITIONER COMPONENT PARTS
AIR CONDITIONER TYPES, ENERGY SOURCES
AIR CONDITIONER NOT WORKING
AIR FILTER EFFICIENCY
AIR FILTERS, FIBERGLASS PARTICLES
AIR FILTERS for HVAC SYSTEMS
AIR FLOW MEASUREMENT CFM
AIR HANDLER / BLOWER UNITS

How to replace a burned-out air conditioning or heat pump compressor

InspectAPedia® - ShareThis +1

- How to replace a burned-out air conditioning compressor
- Air conditioner compressor repair or replacement procedure
- Questins & answers about how to replace a burned-out air conditioner or heat pump compressor motor

This air conditioning repair article describes the basic steps involved in replacing a burned out air conditioner compressor.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

 Use page top links to major topics or use links at the left of each page to navigate ***within*** topics and documents at this website. Green links show where you are in a document series or at this website.

What is Involved in Air Conditioner Compressor Replacement

Replacing an air conditioner compressor is a job for a trained service technician. Not only is the compressor motor often the most costly part in the system, but it is not a simple "bolt-in" replacement. The service technician will:

- Confirm that the compressor has failed and needs replacement (BURNED-OUT COMPRESSOR)

- Identify the compressor model and capacity so that a proper replacement can be obtained
- Shut down the air conditioning system, including turning off electrical power
- Remove all refrigerant from the system. Modern procedures require that the refrigerant be captured rather than released to the environment in order to reduce environmental pollutants
- If the air conditioner system used a now-obsolete refrigerant such as R11 or R22, a the new compressor will be one designed to use a new, approved refrigerant and other changes may be needed to the system to accommodate this change, such as changes in thermal-expansion valves, coils, or other components. Not all components need replacement, however; ducts and blower assemblies, for example, are retained.
- The refrigerant lines are cut and the old compressor is removed. (REFRIGERANT PIPING & DISTANCES)
- The new compressor is installed in place in the compressor/condenser unit (usually all of this equipment is located outside), and its refrigerant lines are connected (usually silver soldering) to the existing refrigerant lines. New coils or other controls may need to be cut out and replaced if the refrigerant is being changed too.
- A vacuum is pulled on the entire system both to evacuate all air from the refrigerant lines and compressor and to check for leaks in the system. Air contamination, if allowed to mix with the new refrigerant would change its operating characteristics and would prevent proper operation.
- Any water or moisture in the system is also removed and the technician may install a drier (REFRIGERANT DRIERS & FILTERS) in the system to remove any trace moisture that remains behind after reassembly. A special HVAC compressor burnout dryer / filter may be installed on the refrigerant line(s) to provide extra debris and moisture and oil filtering capacity to protect the new equipment from debris clogging. Capillary tubes and TEVs as well as coils and compressors are vulnerable to damage from debris, stray oil, or water in the system.
- Refrigerant is added to the system at the proper charge amount. Residential air conditioner systems, unlike commercial units, use a hermetically sealed compressor motor and there is no separate receiver to hold a large refrigerant charge, so the charge must be measured precisely (including temperature, pressure, and volume during charging) for the system to work properly. Both overcharging and under-charging refrigerants will lead to improper system operation.
- The air conditioning system, with its new compressor installed, will be re-started and checked for proper operation

Questions & Answers regarding this article

.

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(Nov 26, 2011) DanJoeFriedman (mod) said:

Jeremy the compressor replacement procedure involves some extra time and care for the replacement to be successful, including evacuating and cleaning the existing refrigerant system, possible replacement of other parts that may have been damaged during the burn-up such as refrigerant metering devices, and installation, perhaps even more than once, of filter/driers on the refrigerant piping. In sum, in my OPINION, the cost to replace a burned-out compressor with one of equal capacity, is probably a bit higher than the original installation cost - extra work is involved.

(Nov 20, 2011) Jeremy Emert said:

I am a claims adjuster. Writing an estimate to replace a 3 ton compressor (Goodman). Got an estimate for $1865.87 which seems high. I am putting in to remove and replace the compressor, recharge refrigerant, anything else needed? Does this price seem high?

(Aug 12, 2011) DanJoeFriedman (mod) said:

Donna your HVAC tech will select a replacement compressor of the same capacity as the original.

The "TX Valve" probably refers to the thermostatic expansion valve. That is the device, usually in the air handler, that meters refrigerant into the cooling coil. Details are at THERMOSTATIC EXPANSION VALVES (article link at page left near the bottom of the links list)

(Aug 12, 2011) Donna Gagnon said:

Could you please answer a few questions for me
I need to replace my compressor in my unit 2.5 ton unit model # KAC030KAK4 Kenmore
Which compressor will fit my unit
ZR38K5-PFV-830. ZR28K5-PFV-830

What is TX Valve

Thanks for your time
E- mail sillyone

(Aug 11, 2011) DanJoeFriedman (mod) said:

Samm, because we no longer use R12 / R22 refrigerants, your new compressor will be designed for one of the newer refrigerant gases. But in order to not have to change out many more components, discuss with your HVAC company installing a compressor motor that will allow use of R134 or a gas that can be used with the old cooling coil. Even so the refrigerant metering device may need adjustment.

THERMOSTATIC EXPANSION VALVES

WATER COOLED AIR CONDITIONERS
WINDOW / WALL AIR CONDITIONERS
WINDOW / WALL A/C SUPPORTS

More Information

IN any case replacement compressors are certainly available from your supplier including a compatible but not identical model.

(Aug 9, 2011) samm said:

my compressor carrier model 06DA502000 is burned-out 7.5 ton, can i found this type of model know? ,if i found it can replace it if the central hvac buliding snice 1987 and some corrision apear in evaporater fin

(Aug 6, 2011) DanJoeFriedman (mod) said:

Joe the "plain old orifice" is also referred to as a capillary tube or cap tube - easily blocked by debris or even a slug of refrigerant oil. Interesting to read there is no dryer on the system. SOP in many areas is that whenever we cut open refrigerant piping - say to replace a compressor unit - we install a filter/dryer at that time. In fact if a compressor has burned up and is being replaced we install a special burnout filter/dryer to try to catch the debris that the burn-up puts into the piping system. See REFRIGERANT DRIERS & FILTERS under "REFRIGERANTS" at page left links.

(Aug 6, 2011) Joe said:

Talked with the tech again today and he now thinks the blockage may be in the condensor coil right after the compressor. The plan is to disconnect the compressor back flush the condensor coil with high pressure nitrogen and see if the blockage can be discharged. This system does not have a TEV valve just a plain old orfice. It also does not have a dryer anywhere in the system. I also looked at the lines from the condensor to the evaporator and the do not appear to have any damage anywhere. (lines set runs from the evaporator in the ceiling to the condensor). The orginal compressor was locked up tight and the tech said he did not see any contamination in the lines. The high side pressure was running around 150 psig and low 22 in hg vacuum. Thanks for your help and will let you know how this one turns out. Oh, I am an automotive tech and do have some refrigation training however I was just watching and assisting the Tech on this job since he seemed to be having some trouble.

(Aug 6, 2011) DanJoeFriedman (mod) said:

Joe I'm reluctant to second guess the tech that was on the scene, but indeed it does sound as if there is a blockage. Other blockages occur besides at the TEV, such as at a dryer in the refrigerant piping, and on occasion a blocked coil.

(Aug 6, 2011) Joe said:

We just had a compressor failure on a 5 ton r-22 Ac unite only. The compressor was replaced by the tech lines purged and checked and recharged. The system quickly goes into Vacuum 20 plus inches Hg. Showing a blockage somewhere. I watched the tech take the orfice valve apart and check it again and purge the lines and revacuum.....still going into Vacuum on the low side. This man is an older tech who has been in the Ac business for 50 years and he seem to be puzzled. Oh, The tech said that on inspection of the orfice both times it was clear and their was no contamination. Any Help?

(showing 1 to 10)

Recommend / Share this Article

+1 ShareThis
EMAIL
Print

...

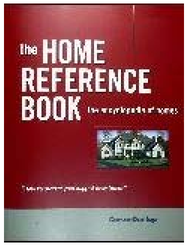
Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also include a list of recommended books for the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia Bookstore.



- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

  Or choose the The Home Reference eBook for using this reference on PCs, Macs, Kindle, iPad, iPhone, or Android Smart Phones

Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

- Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982
- Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- NEW!
  Air Conditioning SEER - New DOE Air Conditioner and Heat Pump Efficiency Standard
- Asbestos HVAC Ducts and Flues field identification photos and guide
- Fiberglass: Indoor Air Quality Investigations: Fiberglass in Indoor Air, HVAC ducts, and Building Insulation

- ...

  - n, an ASHI, FABI, and otherwise certified Florida home inspector who provided photos of failing Goodman gray flex duct in a hot attic.

Air Conditioner or Heating System Blower Fan Testing & Diagnosis

InspectAPedia® - ShareThis +1

- How to diagnose a blower fan that won't start
- Testing heating furnace air handler blower fans
- Testing cooling system or air conditioner blower fans
- Testing heat pump blower fans
- Problems when adding retrofit air conditioning to a warm air heating system
- How to find and test the blower fan in a furnace, air conditioner, or heat pump
- Questions & Answers about heating or cooling system air handler blower fans

HVAC blower fan testing & diagnosis guide: this article discusses how to inspect and test a heating or air conditioning indoor air handler blower fan that is not working. We also discuss squirrel cage blower fan squeaks and noises.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

HEATING or AIR CONDITIONER BLOWER FAN TEST & DIAGNOSIS PROCEDURE

Question: how do I fix my indoor air conditioning or furnace blower fan: the air conditioning (or heat pump or furnace) blower fan just won't run

Our page top photo shows an air handler unit located in a building's attic - we removed the cover to show the blower fan assembly just to the left of the red tag) in this image of a Lennox™ horizontal HVAC system. The blower fan is located inside a horizontal air conditioning unit in many home air conditioning systems, especially when the air handler is located in an attic or crawl area. The location of a blower fan in vertical "up flow" or "down flow" heating and cooling systems is illustrated in additional sketches and photographs below.

See AIR HANDLER / BLOWER UNITS for our complete list of indoor air handler inspection diagnosis and repair articles. Also see COOLING COIL or EVAPORATOR COIL for a description of diagnosis and repair of cooling coil problems since this component is normally located within the air handler chassis as well. A cooling coil which is blocked by debris or ice and frost can obstruct air flow and reduce air conditioning system output. If you need to diagnose and repair the outdoor compressor/condenser unit fan for an air conditioner or heat pump, see FAN, COMPRESSOR/CONDENSER UNIT

Initial, simple diagnostic checks of the air handler system are also described at Ducts & Air Handler diagnosis: Basic checks of the indoor air handler (blower), air ducts, and filter systems.

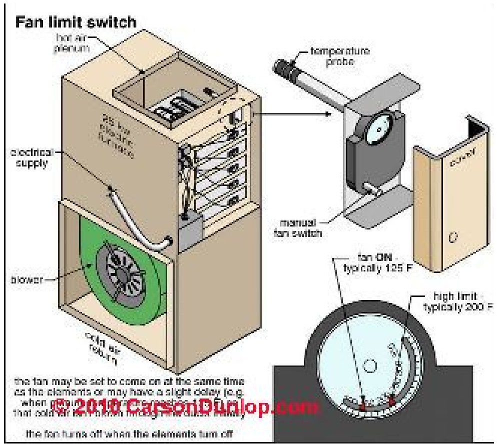
My issue is about an air conditioner fan that just won't start. The fan motor is not seized, and we had a recent blower motor starting capacitor change. The blower fan relay appears to pull in okay, the electrical connections reseated and tight.

But the cooling fan will still not start. This is an early 1990's York home air conditioning unit. - R.S.

Our photo (left), shows a modern blower assembly inside of an air handler. In this case the blower is a direct-drive unit - the electric motor that drives the air conditioner blower fan is mounted inside of and at the center of the blower assembly itself.

Other HVAC blower units may mount the motor separately from the squirrel cage fan, connecting the motor to the fan using a set of pulleys and a fan belt.

Reply:



For completeness we have listed some blower fan diagnostic steps that you have already tried, as well as additional things to check. The blower assembly is the green component in this illustration from Carson Dunlop Associates *The Illustrated Home*.

1. If your air conditioning or heat pump system has lost its cooling capacity or won't start see REPAIR GUIDE for AIR CONDITIONERS. Make sure that all electrical power switches for the system are "on" and that the thermostat is properly set.
2. If your heating system or heat pump (warm air heat) won't start, see the links above, or see HEATING LOSS DIAGNOSIS-FURNACES.
3. If it appears that it is specifically the blower fan for your HVAC system is not working, first be sure that the thermostat is calling for heating or cooling.
   - For heating systems the set-temperature on the thermostat must be

set higher than room temperature.

- For cooling or air conditioners the temperature must be set lower than room temperature. See THERMOSTATS.

4. Try overriding the thermostat by forcing the blower fan "on" using the thermostat (see FAN ON AUTO Thermostat Switch) or by using manual fan-on knob on the FAN LIMIT SWITCH. This switch is illustrated at How to Test the Fan & Limit Control.
5. If the blower fan motor won't turn on or is noisy, there may be a ELECTRIC MOTOR OVERLOAD RESET SWITCH that has tripped off. Don't forget also to look for other switches that could prevent the air conditioner from even starting, such as a condensate overflow pan sensor switch (see DRIP TRAY DEFECTS). If the blower motor is having trouble starting, also see CAPACITORS for HARD STARTING MOTORS. Keep in mind that if the blower motor or fan bearings are shot the wobbling fan can make a horrible noise and can eventually ruin the motor shaft bearings. And if your blower motor misbehaves after checking bearings and the start/run capacitor, consider that the motor itself may be bad. An expert can measure current draw as part of diagnosing a failing electric motor.
6. Check to see if voltage is present at the fan motor wires. If voltage is present and if none of these steps will turn the blower fan on, and if you are certain that the motor starting capacitor is good (see CAPACITORS for HARD STARTING MOTORS), then we suspect that the motor may be seized.

   Sometimes if we have to replace a starter capacitor that gets things going again for a while, but ultimately we discover that the motor itself was increasingly hard to start as it was moving towards seizing. ping the fireplace flue closed (if you have one) when not in use will improve both heating and cooling efficiency.

   This photo shows a blower fan assembly with a motor starter capacitor installed on the upper right side of the squirrel cage fan.
7. Blower Fan No Start / No Stop - weird blower behavior can also be diagnosed and fixed - this article provides a detailed list of things to check.
8. If the blower fan motor runs but little or no air is coming out of your heating or cooling supply registers, see LOST COOLING CAPACITY or HEATING LOSS DIAGNOSIS-FURNACES. The problem may be as simple as a dirty air filter, dirty squirrel cage fan itself, closed air supply registers, disconnected air ducts, a loose fan belt connecting the blower motor to the blower fan (if your fan is not a direct drive unit) or an iced cooling coil.

Thanks to reader Randy Shaffer for suggesting this topic.

Air Conditioner or Heater Wall Convector Unit Blower Fans

Our photo (left) illustrates dual squirrel cage blower fans typically found in the bottom of a fan/convector heating or cooling unit such as this one found in a New York City apartment.

If the convector fan motors run and the squirrel cage fans spin but not enough air is coming out of your convector unit, turn off power and take a closer look at the fan blades themselves - you may need a flashlight and a mirror to make this check without disassembling the unit further than shown here (we removed the convector unit cover). Dirt on the fan blades can significantly reduce airflow through the unit.

Also check the cooling or heating coil fins for blockage by dust and debris - a more common source of air flow blockage at heating and cooling convector units like the one shown.

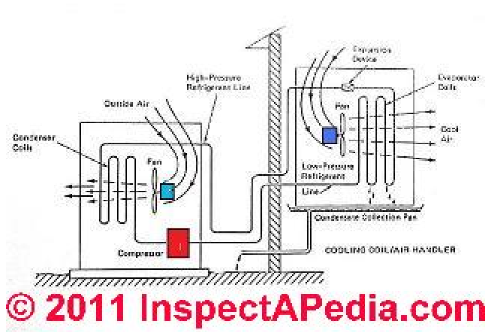
Our photo (left) illustrates a condensate handling problem in the cooling convector

unit for the same apartment unit introduced above.

Air conditioning condensate was leaking inside of the convector unit due to a clogged condensate drain line. The condensate leak exited the bottom of the convector, ran through a raised floor cavity, entered apartment building walls, and ran around the wall interiors in a metal stud-framed wall sill plate where it led to major toxic mold contamination over a wide area, floor damage, and the need for costly cleanup and repair work.

Also see CONDENSATE HANDLING, A/C for more about air conditioner or heat pump condensate drainage handling.

Frequently Asked Questions (FAQs) about heating or cooling system air handler blower fans



Which air conditioner, heat pump, or furnace fan is located where?

In our simple air conditioning (or heat pump) system sketch shown at left, the light blue fan shown at left in the sketch (above the red compressor box) is the outdoor compressor/condenser fan discussed at FAN, COMPRESSOR/CONDENSER UNIT.

The dark blue fan shown at right in the sketch is the indoor air handler or blower compartment or cooling coil fan found inside the building. This fan blows building air across the evaporator coil (or cooling coil) to cool and dehumidify indoor building air. We discuss this indoor fan at FAN, AIR HANDLER BLOWER UNIT.

In a warm air heating system that does not include air conditioning as well, the indoor fan is still located in the indoor air handler and is discussed at FAN, AIR HANDLER BLOWER UNIT.

Squeaky Squirrel Cage Blower Fan Noises: Diagnosis, Cure

Question: What do I do about a squeaking, squalling squirrel cage? It doesn't do it every time the A/C comes on but more frequently than not. Not alot of room to see in there. WD-40? Any suggestions? - Erma

Reply: Check for Loose Blower Fan Parts, Lubricate with the proper oil or grease

The squirrel cage fan to which Erma refers is found inside the indoor air handler unit. This fan moves building air through the duct system and across heating and/or cooling elements to condition the air as it is then supplied to the building through supply ducts and registers. In an air conditioning system this is the dark blue fan shown in the right side of our sketch above. For combined heating/cooling systems the same fan assembly can blow heated air into the building and an additional FAN LIMIT SWITCH will be found inside the furnace cabinet.

More about HVAC blower fans including squirrel cage fans is in this article, above beginning at BLOWER FAN

OPERATION & TESTING but to start addressing a squeaky blower fan, note that your fan may be repairable by tightening one or more allen screws that secure the fan cage assembly (or the bearings that carry the fan) to its housing through which passes the fan motor drive shaft.

With power OFF for safety, if the fan and all components appear to have no loose screws or mounts, but you can still wiggle the fan from side to side, then the bearings are worn and need replacement.

If your fan is pulley-driven, check also that the pulley is secure on the shaft and that the fan belt is not so loose as to be squeaking.

I would not use WD40 on or near electric motor parts nor on greased bearings as it's not intended for a motor or bearing lubricant, though to be honest, I've sprayed WD40 on almost every problem that has ever arisen at one time or another. Better would be a lubricant intended for motors and motor shafts.

Some HVAC blower fan assemblies use a grease fitting not oil. In that case your service tech may need to re-pack the bearing with grease; often on older units there is a grease cap over the fitting that, if tightened, forces more grease into the bearing, so if you see one of those, try first giving the cap a turn. .

At NOISY AIR CONDITIONER / HEAT PUMP and at NOISE CONTROL for HEATING SYSTEMS we discuss a range of noises can be traced to air conditioning and heating systems.

Air Handler Blower fan motor runs backwards

The cause of a backwards-running fan (and some other electric motors) could be a bad start-run capacitor (see CAPACITORS for HARD STARTING MOTORS) or a bad control board. More rare, incorrect wiring or internal damage to the fan motor windings.

Details about diagnosing and fixing a condenser fan that was running backwards are discussed in our companion article on compressor/condenser units, at Questions & Answers about compressor/condenser unit fans. Also see BLOWER FAN OPERATION & TESTING

My Heating Furnace Blower Fan Won't Start & Furnace Burner Shuts Off - what do I do?

Question: the furnace burners go on but the blower fan does not and then the flame shuts off what's wrong?

I have a american standard furnace freedom 80 the burners go on but the blower fan does not and then the flame shuts off what's wrong? - Robert.

Reply: the fan limit switch is turning off your heating furnace burner because the fan is not starting. Diagnose and fix the blower problem.

Robert, if the furnace blower fan will not start, the limit switch on your furnace will turn off the burner in order to avoid overheating and damaging the heat exchanger. You'll need to inspect and fix the blower fan problem. If your furnace blower uses a drive belt to connect the fan to the driving motor check that the belt is in place and not slipping. Other blower fans use a direct drive motor whose shaft spins the fan assembly. IN either case check that the motor is starting;

Question: adjusting blower fan speed in an air conditioner, heat pump, or furnace system

How do you adjust the blower gas furnace to speed it up a little bit? The reason is that I'm adding 300 sq feet. Also how do you open the cover of the cooling coil? - Hoa, 8/16/11

Reply: How to increase the heat output from a gas fired furnace or cool air output from an air conditioner

Hoa

If there is no removable access cover to give view of the cooling coil then a technician would have to cut away sheet metal to give access. That's not uncommon. A new cover is fabricated and screwed or taped in place afterwards.

While dual speed or variable speed fans can run at different RPMs and thus vary the delivery of air through the system, you can't speed up a one speed blower fan. But you can increase air output from the system by several measures:

- increase the return air provided to the system by adding more return ducts
- be sure your air filer is clean, not blocking airflow
- add booster fans at individual supply or return registers

As long as the total BTU requirements of the building don't significantly exceed the BTUh rating of your gas furnace (or air conditioner or heat pump system) you should be OK.

Reader follow-up:

Thank you for replying! I live in California and my concern is about the cooling system. The house I bought is 1-story, about 1500 sq ft. (originally, this house was 1100 sq ft but an extra room was added to the back of the house). What should I do to connect the air ducts of this new room to the original-sized air ducts in the rest of the house?

Also, the outdoors AC unit and indoors furnace are close together and they are two tons. Is it ok if I replace the furnace and cooling coil with 3 tons? 8/17/12

Reply:

Hoa the duct question needs to be answered by an on-site HVAC installer with some expertise and experience - I simply can't know enough from simple text Q&A to give a solid answer to sizing, routing, placement of registers, etc.

About changing the total BTUH rating of your cooling system, I would NOT change the total BTU capacity without discussing the heating and cooling loads of the whole house with an expert. If you make the new system too big, that is, provide an air conditioner with too much capacity for the size of the home, the unit may cool the air but it won't dehumidify properly, you won't be comfortable, and the short-cycling of the larger unit caused if an oversized unit is installed can damage the equipment.

See AIR CONDITIONER BTU CHART

Questions & Answers regarding this article

Questions & Answers about heating or cooling system air handler blower fans .

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(3 days ago) DanJoeFriedman (mod) said:

Anon,
Will the blower stay on if you set the thermostat switch to
Fan on or manual?

If so take the thermostat out of the circuit and then check for a loose wire, sensor, or control board or relay

(3 days ago) Anonymous said:

Sticker says the control board has been integrated with the blower motor.
Do i need to remove the entire motor now?

(4 days ago) DanJoeFriedman (mod) said:

Wes, honesty is best - I'm not sure. I suspect a control board or switch problem.

(5 days ago) wes said:

My blower cuts off and on constantly in 10 to 15 second intervals. It was still cooling the house till i turned it off to prevent further or more severe problems. The unit is less than 2years old. The fan wheel moves freely. Any suggestions? Carrier/Bryant

(July 28, 2012) DanJoeFriedman (mod) said:

Rick, check for a wiring or control or control board problem. Also check that the blower fan motor is spinning freely and not overheating, and that there is no loose safety door switch on the blower unit. Sometimes vibration or heat can cause the door sensor to open.

(July 24, 2012) RICK POLK said:

A/C starts fine but blower motor shuts off after about 1 minute

(July 20, 2012) DanJoeFriedman (mod) said:

Marco:

I would TURN OFF THE SYSTEM all electrical power IMMEDIATELY if you have not already done so. You are describing an electrical problem that could be unsafe.

I agree that a blower fan that is not working can, by moving little or no air across the cooling coil, allow the coil to ice up. You need a service call from a trained HVAC tech who will check the wiring, fan motor, etc.

(July 19, 2012) Marco said:

Last night I noticed the compressor was running on the Lennox AC unit, but not the blower. Off-On several times, etc. nothing. This morning I opened the access doors, checked the fuse near the door switch, OK. Then checked the condensate water pump, it was full, cleaned it out, checked that it worked. OK. Put everything back, and now nothing works. Opened the doors again, manually pressed the door switch and heard a click, then some green lights on the PC board there, then they went off and a red light started blinking, somewhat slowly, like once per second. Any thoughts?

(July 19, 2012) george said:

we came home from a trip. before coming in double wide mobile home i was wattering my dog. i saw ice on outside unit line going into home, wife said insde coile were frozen badly, i came in and it was. i saw squrile fan was turning, but slow. i turned it of an spunn the fan and it spun easy and fast, after turning it back om it was still really slow, so i took off bottom cover where breakers are and turned em on an off , fan still slow, after doing this several times i saw electricle sparks on left side of fan motor. turned it off an on , it sizzeled then stoped , but fan still ran @ slow rpm. please tell me what you think.

(July 18, 2012) DanJoeFriedman (mod) said:

Paul,

It may be useful to track down just where the noise is originating, more precisely - to a motor, a loose mount, a rattling duct, etc.

(showing 1 to 10)

Recommend / Share this Article

+1 ShareThis
EMAIL
Print

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also include a list of recommended books for the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

BLOWER DOORS & AIR INFILTRATION
BLOWER FAN CONTINUOUS OPERATION
BLOWER FAN OPERATION & TESTING

- CARSONDUNLOP Carson, Dunlop & Associates Ltd., 120 Carlton Street Suite 407, Toronto ON M5A 4K2. (416) 964-9415 1-800-268-7070 info@carsondunlop.com. The firm provides professional home inspection services & home inspection education & publications. Alan Carson is a past president of ASHI, the American Society of Home Inspectors. Thanks to Alan Carson and Bob Dunlop, for permission for InspectAPedia to use text excerpts from *The Home Reference Book* & illustrations from *The Illustrated Home*. Carson Dunlop Associates' home inspection education products include
    - The ASHI-adopted Home Inspection Training Program, and Commercial Building Inspection Courses
    - The Home Inspection Home Study Course, and publications such as
    - The Home Reference Book, a reference & inspection report product for building owners & inspectors
    - The Home Reference *eBook*, an electronic version for PCs, the iPad, iPhone, & Android smart phones
    - Home Inspection Report writing materials, including the Horizon Software System that manages business operations, scheduling, & inspection report writing using Carson Dunlop's knowledge base & color images. The *Horizon* system runs on always-available cloud-based software for office computers, laptops, tablets, iPad, Android, & other smartphones.
    - The Illustrated Home illustrates construction details and building components, a reference for owners & inspectors
- Thanks to reader Randy Shaffer, Manchester, PA for suggesting additional diagnostics for blower fan operation testing May 2010

How to diagnose and fix an air conditioning system that is not working

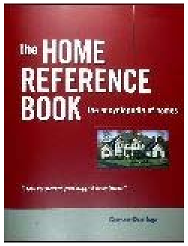
Since the failure of an air conditioner to turn on, loss of air conditioner cooling capacity, reduced air conditioning output temperatures, loss of cool air supply, or even loss of air flow entirely can be due to a variety of problems with one or more components of an air conditioner or air conditioning system, *after reviewing the lost air conditioner cooling diagnosis procedures described in this article,* be sure to also review the diagnostic procedures at each of the individual air conditioning diagnosis and repair major topics listed just below. To return to our air conditioning and refrigeration home page go to AIR CONDITIONING & HEAT PUMP SYSTEMS.

If your air conditioning or heat pump system has lost its cooling capacity or won't start select one or more of the diagnostic articles listed below.

- A/C - HEAT PUMP CONTROLS & SWITCHES: air conditioner controls and switches - begin here if your A/C won't start. Here's an important tip: *most refrigeration problems, in air conditioners, refrigerators, or freezers, are electrical, not mechanical.* In air conditioning school, we used to drive out and collect abandoned refrigerators that people were tossing out during our community's spring cleanup week. Taking these appliances back into the shop we found that almost always the problem that had caused the owner to dispose of their air conditioner or freezer was in an electrical connection or electrical control. So it's worth checking out switches and controls on an air conditioner before replacing more costly components.
- OPERATING DEFECTS: major air conditioning problem symptoms and how to get the air conditioning system working again,e.g. compressor or fan noises, failure to start, and inadequate cool air volume
- LOST COOLING CAPACITY: what to do when not enough cool air comes out of the system
    - What to check first if there is no cool air or not enough cool air
    - Compressor failure diagnosis: basic checks of the air conditioner compressor
    - Ducts & Air Handler diagnosis: basic checks of the indoor air handler (blower), air ducts, and filter systems
- COMPRESSOR CONDENSER: problems with air conditioner compressor/condenser units
- AIR HANDLER / BLOWER UNITS: problems with the air handler, air filters, and the cooling coil itself
- DUCT SYSTEM DEFECTS: problems with the air duct system, air filters, supply registers, return air registers
- A/C REFRIGERANT LEAK DETECTION: how to use a TIF5000 to detect air conditioning refrigerant gas leak
- A/C DIAGNOSTIC FAQs: air conditioning system diagnostic FAQs: Q&A about air conditioner repair - a detailed air conditioning system diagnostic checklist

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia Bookstore.



- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

  Or choose the The Home Reference eBook for using this reference on PCs, Macs, Kindle, iPad, iPhone, or Android Smart Phones

Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

- Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982
- Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York,

May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]

- Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- NEW!
  Air Conditioning SEER - New DOE Air Conditioner and Heat Pump Efficiency Standard
- Asbestos HVAC Ducts and Flues field identification photos and guide
- Fiberglass: Indoor Air Quality Investigations: Fiberglass in Indoor Air, HVAC ducts, and Building Insulation
- ...

" />

InspectAPedia®

Free Encyclopedia of Building & Environmental Inspection, Testing, Diagnosis, Repair

Search

InspectAPedia

Ask a Question or Search InspectAPedia

HOME | AIR CONDITIONING | ELECTRICAL | EXTERIORS | HEATING | HOME INSPECTION | INTERIORS | PLUMBING | ROOFING | SEPTIC SYSTEMS | STRUCTURE | WATER SUPPLY

ENERGY SAVINGS | ENVIRONMENT | INDOOR AIR IAQ | INSULATION | MOLD INSPECT TEST REMOVE | NOISE | ODORS | SOLAR ENERGY | VENTILATION | EXPERTS DIRECTORY | CONTACT US

Mobile View

Air Conditioning Cooling Coil or Evaporator Coil Cleaning Methods

InspectAPedia® - ShareThis

- A/C coil cleaning chemicals & procedures
- How to clean a dirty or moldy air conditioning cooling coil or evaporator coil, or a dirty condensing coil
- Use of spray foam cleaners & deodorizers on cooling coils
- Use of liquid cleaners on cooling coils
- Use of compressed air to clean cooling or condensing coils
- Use of pressure washers or steam to clean HVAC Coils
- Questions & answers about cleaning methods for air conditioner or heat pump cooling and condensing coils

Air conditioner or heat pump cooling coil / evaporator coil cleaning methods: this article discusses the how the cooling coil (evaporator coil) in the air conditioning air handler unit is cleaned. These same methods will work on the outdoor coil or condensing coil as well. Our photo at page top shows a very dirty cooling coil in the attic air handler component of a central air conditioning system.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

 Use page top links to major topics or use links at the left of each page to navigate ***within*** topics and documents at this website. Green links show where you are in a document series or at this website.

How & Why Air Conditioning & Heat Pump Evaporator Coils (Cooling coils) are Cleaned

If your air conditioning or heat pump system has lost its cooling capacity or won't start see REPAIR GUIDE for AIR CONDITIONERS. See How to determine the cooling capacity of air conditioning equipment if the system seems to be working but is inadequate to cool your building.

Which Cooling or Heat Pump "Coil" is Which: Condensing Coil & Cooling/Evaporator Coils Defined

The COOLING COIL or EVAPORATOR COIL discussed here is the evaporator coil found inside the air handler, used to cool air blown across it and into the building occupied space. If your concern is with If your equipment is a heat pump these terms can be a bit confusing because in heating mode, your heat pump system's indoor coil is warming, not cooling the air blown across it

The CONDENSING COIL is normally on the outdoor or compressor portion of your air conditioning system. The job of the condensing coil is to cool high temperature refrigerant gas to condense it back to a liquid refrigerant form.

Why do we clean the HVAC evaporator or cooling coil, or the condenser coil?

Dirt and debris accumulating on an air conditioner or heat pump coil block airflow across the coil, increasing the cost of heating or cooling the building. In severe cases cooling or condensing coils can become so blocked that air flow is seriously reduced, possibly also leading to an evaporator or cooling coil icing problem indoors or an overheated, damaged compressor outdoors, or simply loss of cooling capacity of the system.

In addition, a blocked evaporator coil can cause the HVAC compressor to run at higher than normal temperatures - a condition that over time can break down lubricants circulating inside the system, thus shortening the life of the compressor motor itself.

BLOCKED COOLING COIL - Air Conditioner Evaporator Coil Blocked by Debris

Ice on the cooling coil is not the only (nor even the most common) cause of blocked air flow in an air conditioner. This photograph shows how easily debris can stick to and clog the inlet side of the cooling coil in an air conditioning system. This evaporator coil was nearly totally blocked with dust and debris. How does this happen?

There was no air filter installed in the system. Ordinary house dust is comprised largely of fabric fibers and skin cells.

These and other debris in building dust such as soot and organic particles like pollen and mold spores all join to form a gray mat on the fins of the cooling coil in an air handler.

Debris sticks particularly quickly to this surface because of the combination of close spacing of the cooling fins (about 1/16" apart) and the fact that condensate forming on the coil keeps the surface damp.

Details about the detection and cleaning of dirt and debris which block an air conditioner cooling coil are at DIRTY COOLING COIL.

Guide to Procedures for Cleaning Air Conditioner or Heat Pump Evaporator Coils: Using Air, Brushes, Chemicals, or Detergents

to Clean A/C Coils

Thorough cooling coil or A/C evaporator coil cleaning can require cutting refrigerant lines, removal of the coil and other components for cleaning, and reinstallation, pulling a vacuum on the refrigerant lines, and recharge with refrigerant. Such service and repair may involve significant expense. For this reason there are several "in place" cleaning methods using foams and sprays that are a simpler procedure for cleaning an air conditioning or heat pump coil.

Watch out: be sure that electrical power is off to the HVAC equipment before opening access panels or working on the system. Relying only on the door safety interlock switch to turn off equipment power may be unsafe as wiring inside the unit will still be "live" in some locations.

Using Air: Compressed air for cleaning HVAC evaporator coils

Some HVAC technicians clean an evaporator coil by blowing it off with compressed air. This is a quick and probably effective method to clean the coil, which has the additional feature of blowing dust, debris, and possibly mold into the building air - not something we approve.

Air is sprayed from the cleaner side of the coil towards the dirty side - or in other words, in the opposite direction from the normal air flow across the coil. Be sure to spray from the correct side of the coil or you'll just be forcing dirt and debris more deeply into the coil fins.

Watch out: if you are using high pressure air to try to clean a coil, be sure you blow air at right-angles or straight through the coil fins. Blowing high pressure air (or water or steam) at the HVAC coil fins on an angle is likely to bend over the fins, clogging the coil and possibly ruining it. If just a few fins have been bent on a coil they can often be straightened by working gently with an HVAC coil comb designed for that purpose.

Watch out: if you are not careful, just using compressed air to blow off a coil may leave a large amount of dust and debris inside the air handler where it collects anew on coil surfaces, or in your eyes (dangerous). Using a shop vac in concert with the compressed air sprayer and moving carefully (to avoid damaging coil fins) can reduce dust and debris spillover and make cleaning up easier.

Condenser coil cleaning: We don't have a complaint about using compressed air to clean an outdoor evaporator coil since we don't have the same concern about blowing debris into the building or its duct work.

Brush-cleaning of A/C or heat pump cooling or heating coils

When the coil is soiled by a fairly light coating of dust and debris, it can often be successfully cleaned using a soft brush. If you clean you A/C or heat pump coil every three or four months using this method you may reduce cooling (or heating) costs and you may be able to avoid more costly or troublesome coil cleaning procedures.

If your HVAC equipment is operating in a dusty area or if no one has been maintaining proper filters in the system it is likely that you'll need to clean the coil more frequently, perhaps even monthly to keep the A/C or heat pump system at peak operating efficiency and effectiveness.

We have tried using a shop vac with a soft brush attachment to clean the A/C coils, but if your coil is mounted in the air handler so as to not leave much room to access all of its surface this approach doesn't work well.

Watch out to avoid damaging coil fins when using any tools, brushes, or vacuum cleaners around the equipment.

Using Chemicals to Clean A/C Coils

There are plenty of coil cleaning chemicals sold for cleaning A/C or heat pump systems, both acid and alkaline-based.

Watch out: We do not recommend using strong chemicals on an A/C or heat pump coil because of the risk of corrosion damage to the coil or the production of noxious odors & fumes. To be safe, check with your HVAC equipment manufacturer to be sure that your cleaning approach is one they approve.

Field Report: Using Hydrogen Peroxide to Clean an HVAC Coil?

> I used Hydrogen peroxide 3% to do the job and it gave a bad smell. Kind of a chemical smell. I think the peroxide reacted with the zinc,aluminum, copper or nickel metal in the cooling coils. Is it OK to use peroxide to clean cooling coils besides the conventional HVAC tech cleaning methods? I live in an apartment and sometimes my AC air starts to get a moldy smell to it.
>
> The first time I cleaned it out myself there was all this orange yucky fungal sludge in the drip tray and there was so much of it that it had clogged the drain pipe which I had to clear out. I cleaned it out with 5% hydrogen peroxide and whatever it was it bubbled like crazy so I believe the peroxide was reacting with a biological agent. It also reacted with something between the fins of the cooling coil to give a smell slight of sulphur and burned gunpowder. What are your thoughts on the matter? - N.M.

While we have read reports that the oxide on the surface of aluminum HVAC coil parts reduces the severity of chemical reaction between an acid or base cleaner and the metal, we have also had reports of problems with corrosion and odors when this approach was tried.

So while the "bubbling" action of hydrogen peroxide is appealing as a cleaner, we are warned that chemical reactions between some coil cleaning products and the aluminum or copper A/C or heat pump coil parts can corrode the fins or tubing, damaging the system, ultimately leading to leaks and the need for a costly coil replacement.

Chemical reactions between some coil cleaning products and the aluminum or copper A/C or heat pump coil parts can also produce obnoxious odors or fumes, possibly toxic or irritating fumes, and in some cases may leave an odor in the system that itself becomes an issue.

See our discussion of detergents and foam sprays for coil cleaning, below - those are safer approaches to coil cleaning, especially if you're not an expert.

Using Detergents or Water for cleaning A/C coils

Using a simple hand sprayer or garden sprayer (these produce a gentle spray) it may be possible to clean your A/C or heat pump coil effectively using tap water or a mild detergent. The advantage of using these gentle solutions is that there is little risk of damaging the coil fins or tubing compared with the use of more harsh chemicals.

Wet the A/C or heat pump coil surfaces with your spray-on detergent, let it soak in for 15 minutes or so (but not long enough to dry out), then rinse the coil and coil fins clean. Remove spillover and debris from the condensate pan where your spray and debris land, using a shop vac or hand wiping.

Watch out: don't bang around inside the air handler with your shop vac or you may damage the evaporator/cooling coil or coil fins; and be careful when wiping by hand that you don't get cut on sharp fin edges.

If using water or a non-sudsing mild detergent doesn't work to clean off your coil, you may need to use a more aggressive coil cleaning method such as those described below.

Using Foam or spray HVAC coil and fin cleaners

Using a garden sprayer (or a sprayer that may be included in some pre-packaged A/C coil cleaning systems and products), the coils are sprayed with a foaming cleaner specifically designed for HVAC systems. An advantage of this approach is that it is mechanically gentle, reducing the risk of damage to the coil or its fins. And if you select a benign cleaner it is also chemically gentle, avoiding corrosion damage to the coil.

Where to Buy HVAC and Refrigeration Equipment Coil Cleaning Products

List of HVAC coil cleaning chemicals and sprays:

- Superior Industries offers FCC-300™ non-toxic foaming spray coil cleaner and "conditioner".
- Nova-Tech International sells a dry powder used to make an alkaline HVAC coil cleaning liquid that can be sprayed onto the coil.
- C-Shine is a mix of chemicals produced in India and intended to remove dirt, grease, and debris from A/C coils in a process the manufacturer, ICC, describes as "chemical de-scaling" or (misspelled at their website) chemical de-scaling
- CoilShine is described by Goodway as "a [non-acidic blend of powerful, fast acting detergents, specifically formulated for use with the CC-140 CoilPro power washer] biodegradable, expanding foam detergent specifically formulated for use with the CoilPro. This is a non-acidic, non-fuming solution that can be safely washed down drains. CoilShine-BC is a commercial grade, ready-to-use mold inhibitor for HVAC systems that helps prevent the growth of odor, stain and damage causing organisms such as mold, mildew and fungi."
- CONTACT us to suggest additional coil cleaning products

The HVAC coil spray approach has the appeal that the total cleaning cost is low, no rinsing is necessary with some products, and the coil looks nice.

Where does the debris and run-off cleaner go? It should drip into the condensate pan for disposal through the condensate drain system. The manufacturer says the coil and fin cleaner also removes odors from the system, but if your HVAC system is quite dirty additional steps will be needed to clean the blower assembly and the ductwork.

After the coil cleaning foam has worked on the coil surfaces and dripped to the condensate pan below, use a wet-dry shop vac to clean up the mess from the pan, followed by careful wiping as we cited above.

Using Pressure Washers to Clean A/C or Heat Pump Coil Fins & Tubing

Professional HVAC service companies often use a portable A/C coil pressure washer designed for that purpose. Unlike cleaning detergents or foams, a pressure washer is physically more aggressive coil cleaning method and is perhaps the most thorough or effective method for cleaning a badly soiled or blocked HVAC evaporator or condenser coil.

A portable pressure washer unit such as Goodway's CC-140 contains both a coil cleaning solution (typically a detergent mix) and a battery-operated pressure sprayer that can deliver as much as 140 psi. Heavier-duty coil cleaning pressure sprayers are available for commercial units and larger, or heavier, wider coils.

Watch out: as we warned earlier, if you are using high pressure air, water, or steam to try to clean a coil, be sure you blow air at right-angles or straight through the coil fins. Blowing high pressure air (or water or steam) at the HVAC coil fins on an angle is likely to bend over the coil fins. And don't over-do it and don't spray more cleaner than needed - you'll just have more liquid cleanup to do after the coil has been treated.

Using Steam-Cleaning of A/C or Heat Pump Coils

Steam is used by some technicians to clean HVAC coils, in a process similar to that we described above for compressed air.

Watch out: as we warned earlier, if you are using high pressure air, water, or steam to try to clean a coil, be sure you blow air at right-angles or straight through the coil fins. Blowing high pressure air (or water or steam) at the HVAC coil fins on an angle is likely to bend over the coil fins.

Frequently Asked Questions (FAQs) About Dirty HVACR Cooling

Coils & Evaporator Coil Cleaning Methods

Question: When cleaning a cooling coil do you blow air or water from inside or outside the unit?

Do you blow the pressure air or pressure water from the inside out or from the outside in on the unit? I sprayed it from the outside in I think It may have been the wrong direction. - Sherry 6/7/11

Reply:

If you are trying to clean a dirt-clogged A/C coil, the best result is achieved if you can blow from the clean side so that you are pushing the dirt and debris back off instead of forcing it in between the coil fins. However sometimes it is so difficult to access the clean or outlet side of the cooling coil that technicians use cleaning foams and water instead. In that case they may spray from the most accessible side.

Ultimately, if you can see that the spaces between the coil fins is free of dirt and debris, and you've cleaned the crud out of the housing, and you haven't soaked and shorted electrical components, you've been successful at cleaning the air conditioner coil.

Question: Don't confuse a dirt-blocked coil from ice or frost formation on cooling coils

I cleaned the outside unit by removing the panel and the fan which was attached to some wires. I didn't disconnect or damage anything. I collected 1/4 a garbage bag with the dirt and debris found to the bottom. In attempting to clean the inside unit and fan, I noticed lots of ice on a grid like thingy and some tubes or lines. The inside however looks to be pretty clean but I will wipe it down anyways. I purchased this house in 2006 and so far had to change the compositor battery looking thingy professionally. 2 years ago but still have freezing when it is about 100 degrees outside or more. What else could I do? How do I know if I need freon or refrigerant and where does it goes? Please help ...thank you! - Pamela 6/10/11

Reply:

Pamela it sounds as if you are describing frost and ice formation on the cooling coil (evaporator coil) inside the indoor air handler unit.

Icing coils are caused by low air flow (dirty cooling coil, dirty air filter or duct defects) or by a low refrigerant charge. Adding freon is something that needs a service call from a trained HVAC technician - it's not something a homeowner can or should try to do.

While ice or frost on on the coil could be caused by a dirty coil, the technician needs to defrost the system and inspect the coil as part of diagnosing and fixing the trouble. If on defrost (just leave the system turned off for an hour or so) shows that the evaporator coil is actually clean, then the problem is elsewhere in the system and you'll want to see the diagnostic advice at FROST BUILD-UP on AIR CONDITIONER COILS.

Question: Can chemicals or cleaning products damage a cooling coil in an air conditioner or heat pump?

I recently had some problems with the AC unit. At one point the tech cleaned the coils and etc. and I remember him saying that he used some kind of coil cleaner. After this was done, I started having a major problem of toxic or exhaust like fumes coming through the ducts. I had to turn the unit off because it started burning my eyes, skin and throat. The techs have checked several times and can find nothing wrong.

I read above where it says "Chemical reactions between some coil cleaning products and the aluminum or copper A/C or heat pump coil parts can also produce obnoxious odors or fumes, possibly toxic or irritating fumes, and in some cases may leave an odor in the system that itself becomes an issue". My question is, If this is the problem, what needs to be done to get rid of the fumes and clear out my system? Any help is appreciated. Thanks. - M.B. 6/20/11

Reply:

MB: there are more benign foaming cleaning agents that should not corrode or otherwise damage a cooling coil when used according to directions. If your technician has already used a caustic agent (which is what your question indicates) it may be necessary to further clean the coil and air handler with a non-caustic cleaner to neutralize any ongoing corrosion and to stop generating the odors and fumes you described.

If the service technicians are sure that the odors and irritants you describe are not due to the cooling coil cleaning procedure then it's appropriate to perform some further diagnosis, perhaps by technicians with more experience. That procedure should address the question "Why did the fumes begin only after the coil was cleaned?"

Reader follow-up:

I used vinegar. It has an low acid base, yet it produces some results to smell. I also come back with baking soda to off set any acid. I heard where it was good for drains so I tried it. I like the garden sprayer idea, may use it next time. I used a spray bottle this time and it worked fair. I vacuumed with a shop vac and it still was as clean as I wanted but over time, maybe.

Reply:

Indeed further coil cleaning with a more gentle cleaner to remove left-over chemicals from the coil cleaning job may help; take a further look at the coil fins for damage.

Question: using WEB coil cleaner containing 2-butoxyethanol and diethylene glycol to clean frozen A/C coils

Is it safe to use WEB Coil Cleaner on the Heat Coil (inside)? It contains 2-butoxyethanol and diethylene glycol. The heat pump cooling coils are frozen. I already cleaned the condensate drain pipes.

Reply:

Anon, if your coil(s) are frosting or frozen, the cleaner is not designed to remove ice; you'll need to turn off the system, let the ice melt, inspect the coils for dirt and debris or other damage, and clean them if that's the case. It's odd to have simultaneous icing on both condensing and cooling coils; has anyone checked the refrigerant charge level?

Question: using Simple Green to clean a cooling coil or evaporator A-coil in an air conditioner

Question: I want to clean my evaporator coil,(A-Coil) inside the air handler, with Simple Green and tap water. I'm concerned about the water washing down into unit and damaging the blower motor and electronics. I know there is a narrow drip pan around the base of the coil but i'm afraid of the overflow. Are my fears unfounded or.? - Paul - 10/19/11

Reply:

Cleaning with simple Green or even plain water will risk damage to the blower motor and electronics if you get them wet - they are not intended to be immersed nor soaked in liquid. You should be able to keep water and cleaner on the coil and fins and in the condensate pan. If you do so and there is trivial overspray onto the motor just wipe it off. If you can't clean in the air handler without spraying more water about then you'll want to use taped up plastic to protect electrical components from the spraying procedure.

Question:

My air conditioner coils and fins are still freezing or icing up after cleaning them with water ...could there be something else wrong that it still freeze or ice up? I have to turn on and off the A/C 's thermostat every 15 minutes or so just to melt the ice and for it to cool up again. anything else i can do to fix this problem? - Jack 10/20/11

Reply:

Jack,

if the A/C or heat pump cooling coil is clean and air is flowing across it but it's icing, then I suspect that there has been either a loss of refrigerant (low refrigerant can cause icing at low charge until there is simply too little refrigerant left in the system, then no icing and no cooling)OR there is a problem with the refrigerant metering device such as a sticking thermostatic expansion valve. Either of those diagnoses and repairs will need a service call from a trained HVAC tech. Keep us posted - what you learn will help other readers.

Question: Is using an evaporator coil cleaner regulated by environmental discharge regulations?

During a recent audit finding, and regarding our regular and routine coil cleaning, we were told it is a code violation if you discharge any pollutant or cause, permit, or allow a discharge of any pollutant from a point source without a permit. I don't think this is true or even applicable to coil cleaning...your input is greatly appreciated. 10/18/11

Reply:

Frank, that's a new one on me. Who defined HVAC coil cleaning as a polluting process? If you used soap and water would that be a pollutant? Typically coil cleaners are a foaming agent that is used to help lift dirt off of coil fins. The material is water soluble. If you give us the name of the coil cleaning product you or your HVAC tech intends to use we can further research this question by taking a look at the MSDS for that cleaner. That ought to put an end to what sounds like a bit of an odd question. Finally, I suspect that someone might have been worried that you were going to dump refrigerant into the environment. If that's the case then s/he does not understand that HVAC coil cleaning is an external cleaning procedure that does not address the interior of the HVAC refrigerant piping system.

Question:

Usually, how often should you acid wash the inside air conditioning coils? Please don't tell me when they're dirty.... THANK YOU - Terry 5/6/12

Reply:

Terry: well "when the coils are dirty" is nevertheless the right answer, sort-of.

Really you want your service technician to inspect visually for the presence of enough dust and crud that air passage through (between) the fins has become partly blocked.

Light dusting on the cooling coils is not worth a wash.

Watch out: And we want to "acid wash" coils as seldom as possible because you are using a corrosive material. I'd look into less corrosive cleaning methods.

Question: cooling coils on HVACR equipment in a cement company environment

What should be the recommended fin material and fpi for condenser coils in cement company enviroment?

Reply:

Matthew,
to specify a cooling coil fin material you'd want to list the corrosive ingredients you expect to be in the air. Caustic dust is one possibility but there may be others. With that information I'd call the HVAC manufacturer to ask their advice. I suspect you're looking at a lower heat transfer rate and using stainless steel, or going with a conventional coil and water-washing the outside unit.

Question: Can a dirty cooling coil cause HVAC system vibration? Also the service policy & warranty I purchased is not being honored by the service company.

I have a question concerning the A/C unit. When the A/C Unit turned on (inside furnace located in hallway) had a noise (vibration on the A/C Unit) I have a warranty plan and they send a technician.

Technician checked the blower by sliding the blower from its position and stated blower was OK. Technician went on and check Other parts of the furnace and was unable to determined what was causing the vibration. He had a device (camera) to check inside air handler and notice that the coils were dirty. He stated that it is possible that dirty coils (A/C Unit still operating OK) could cause the vibration on the unit. Technician stated that A/C unit must be pulled/removed from its location in order to clean the Coils, which would cost over $1000.00 to include cleaning coils plus the labor.

Unfortunately the Warranty plan does not cover cleaning the Coils (maintenance), the Warranty Company interpretation of dirty coils is "Clogged coils", which technician stated coils were not clogged just dirty.

My question is: Could dirty coils (unit still cooling & running OK) can cause the vibration? R.V. 5/11/12

Reply:

The assertion that a dirty coil caused the unit to vibrate leaves me baffled. How did the tech explain that?

Indeed if the coil is really dirty and blocked it may frost over or fail to pass enough air and your cooling air will be reduced, but that's not vibration.

Look for loose parts that move when motors or fans run, including a bad blower fan bearing, mounts, loose duct work, etc. Try pressing gently on components to see if the vibration stops - DO NOT GET YOUR FINGERS CUT OFF IN MOVING PARTS - so you may want to have a more qualified tech take a look.

Reader Follow-Up:

Thank so much for your response. As I mention on my email below that the Warranty plan does not cover cleaning the Coils (maintenance), and their interpretation of the technician report that vibration is because of dirty (clogged) coils. I complained to the Customer Service Rep that the technician DID NOT correct the vibration problem and was not sure what Was causing it. Customer Service Rep suggested to contact the technician and re-submit a report on what could be causing the vibration.

I did contacted the technician, and explained to him that Customer Service denied the claim because of his report stating that the coils were 100% dirty. The technician contacted Customer Service but the claim was still denied based on this report.

As I stated to customer Service and the technician that the Vibration was not FIXED, I still have to PAY $75

Deductable (service Fee) and the vibration problem was not fixed.

My conclusion is that the technician stop searching to determined what was causing the vibration after he saw that the coils needed to be clean and stated that could cause the vibration and he stated that it should be cover under the warranty (technician estimate cost for cleaning the coils $850.00 submitted on his report).

Again, I mention to the technician that he did not fix the vibration problem. I did read the Warranty Plan and it states that cleaning of the coils is not cover under the plan, but my point was to customer service and technician that the vibration problem was not fix. Again, thank you for your response. 5/31/12

Reply:

You can inform the customer service people that a dirty coil blocks airflow but does not cause vibration in the system. I would ask that a more qualified, experienced tech be sent to the job. It sounds from your description as if the tech you had knew that he could blame an excluded item and thus escape honoring the warranty.

Reader Follow-Up:

I agree. When I spoke to the Customer Service Rep, I clearing stated that the A/C Unit was working Ok and the technician verify that A/C air flow/cooling was working ok.

Bottom line is that Customer Service Rep concluded (their interpretation based on report) that warranty plan does not cover dirty coils, and totally ignored the vibration problem.

Do you have an idea about how much (an estimate) it would cost to get the coils clean? I as mention on my previous

Email that the technician estimated about $850 (to include 4 labor hours), he claimed that the entire unit must

be remove and remove all panels in order to the clean the coils, and if it took more than 4 hours, it could cost

more around $1000 to complete the job. I told him he was just cleaning coils not replacing the coils.

Reply:

I would not touch the coils before seeing myself that they are actually dirty and blocked with debris. This whole transaction sounds suspicious. I'd like to see some well-lit sharp focus photos of the cooling coil. Also, when the time comes to clean the coils, there are procedures for cleaning in place.

Reader Follow-Up:

The technician had a device (about two feet flexible tube with camera at the
end) that he insert inside the area where the coils are located, where it shows the coils were dirty. I am sure the coils in any A/C unit after Long period time (5 to 7 years) could get.

I know for a fact that during a semi/annual A/C checkup or Service the technician don't inspect the coils, they just conduct an external checkup.

I agree with you that the whole transaction sounds suspicious to me also.
The company(where technician work for) make a quick $75 and Warranty Plan did not have pay for it.

Reply:

It's a disturbing topic - too often in the news we read reports of companies that sell insurance but who pull out all the stops to resist actually paying on a claim. As you describe no ready access to the cooling coil, cleaning would require cutting and making a (reusable) access cover for an appropriate side of the unit; there are procedures for cleaning the coil in place that should be much less costly. If you choose that approach take some photos and send them along and we may be able to offer other comment.

Please keep me posted on how things progress, and send along photos if you can. Such added details can help us understand what's happening and often permit some useful further comment. What we both learn may help me help someone else. - Ed. 6/2/12

Question: can a bad fan capacitor cause cooling coil frosting?

A tech replaced the dual run capacator on the outside unit of my heat pump system. The fan would not spin and he needed help over the phone to get the unit running again. Could an improper installation of the dual run capacator cause frost and icing? Previous to his visit I never had a problem with frost or icing. - Mike 5/24/12

Reply:

Mike, maybe in some way I don't fully understand. The fan on the outdoor comprressor/condenser cools the outdoor half of the system and thus permits condensing high pressure high temperature refrigerant back to a liquid form. One would think that if the refrigerant didn't condense back to a gas it would not be properly metered into the indoor cooling coil and I'd guess that the result would be reduced cooling, not more cooling.

Usually an iced coil results from
- slower air flow across the indoor coil because of a dirty air filter or fan unit or an indoor blower fan that is not working properly
- a problem with the refrigerant metering device (TEV)
- low but not zero refrigerant in the system

In the link at page left under COOLING COIL see the article FROST BUILD-UP on AIR CONDITIONER COILS where we list other causes of coil frosting such as a dirty air filter or lost air movement capacity due to dirt build-up on the air handler's blower fan blades.

Let us know what your tech finds - it will assist other readers

Question: What's the best way to clean the A-coil without removing it from the air handler?

Would like to know the best way to clean the A-coil without having to remove it fron the air handler. I want to use a foam spray that does not need to be rinsed out, are these types of foams o.k. for the coil? - Mark 6/22/12

Reply:

Mark, some of the foaming A/C coil cleaner sprays are intended to clean the coil fins, drip into the tray below and exit at the condensate drain, some without rinsing. But I'd watch for sending blobs of crud that, if it does not fully dissolve, such as clots of lint and dust, may clog the condensate drain. If you can get good view access to the whole assembly you can be confident of the result.

Question: Water leaks out of air handler traced to dirty cooling coil?

thank you for your detail explanation. I had water beneath the coils on the concrete. The Tech said it was coming from the condensate drain line. It wasn't wet ! I cleaned the water up and stuck my head inside the handler and the water was dripping from the inlet side of the coils. I read where this condition was from dirty coils. I used your article to clean the coils and just a few droplet of condensate remain. I'm going to clean them a 2nd time but I have to rest my back. Thanks for your article that so comprehensible

Reply:

David thanks so much for the feedback.

It makes sense that reduced airflow through a cooling coil might in some arrangements reduce the push through of condensate to the coil inner face where it has an easier time dripping into the condensate tray.

But if you can, send me a photo of what you see of the condensate tray beneath the inlet side of the system coil.

Because the air handler's condensate collection tray ought to extend far enough on all sides of the cooling coil to catch condensate on the front end or inlet side too.

When there are condensate leaks below or out of an air handler and the condensate drain is not clogged, it makes sense to also check too for a tipped or leaky condensate pan.

Questions & Answers regarding this article

Questions & answers about cleaning methods for air conditioner or heat pump cooling and condensing coils

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(3 days ago) DanJoeFriedman (mod) said:

David thanks so much for the feedback. It will help others and I will find a way to incorporate your comments in the text. It makes sense that reduced airflow thuu a cooling coil might in some arrangements reduce the push through of condensate to the coil inner face where it has an easier time dripping into the condensate tray. But if you can, send me a photo of what you see of the condensate trau ceneath the inlet side of the system coil. Because the tray ought to extend far enoughn to catch condensate there too. Check too for a tipped or leaky pan.

(3 days ago) david n. simmons said:

thank you for your detail explanation. I had water beneath the coils on the concrete. The Tech said it was coming from the condensate drain line. It wasn't wet ! I cleaned the water up and stuck my head inside the handler and the water was dripping from the inlet side of the coils. I read where this condition was from dirty coils. I used your article to clean the coils and just a few droplet of condensate remain. I'm going to clean them a 2nd time but I have to rest my back. Thanks for your article that so comprehensible

(July 1, 2012) Anonymous said:

RV check for build up on blower wheel

Recommend / Share this Article

+1 ShareThis

EMAIL

Print

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also include a list of recommended books for the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

COOLING COIL or EVAPORATOR COIL
DAMAGED COOLING COIL
DIRTY COOLING COIL
DIRTY COIL CLEANING PROCEDURES
FROST BUILD-UP on AIR CONDITIONER COILS
INCREASING RETURN AIR

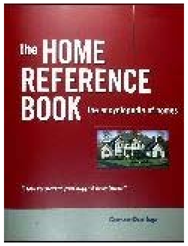
- Thanks to to Guy Benfante, Chesapeake, VA 8/26/07 for the photograph of an ice-blocked air conditioning system evaporator coil and for his suggestion that we provide an air conditioning system troubleshooting FAQ.
- Thanks to Mark Cramer, Tampa Florida, for assistance in technical review of the "Critical Defects" section and for the photograph of the deteriorating gray Owens Corning flex duct in a hot attic. Mr. Cramer is a Florida home inspector and home inspection educator.
- CARSONDUNLOP Carson, Dunlop & Associates Ltd., 120 Carlton Street Suite 407, Toronto ON M5A 4K2. (416) 964-9415 1-800-268-7070 info@carsondunlop.com. The firm provides professional home inspection services & home inspection education & publications. Alan Carson is a past president of ASHI, the American Society of Home Inspectors. Thanks to Alan Carson and Bob Dunlop, for permission for InspectAPedia to use text excerpts from *The Home Reference Book* & illustrations from *The Illustrated Home*. Carson Dunlop Associates' home inspection education products include
  - The ASHI-adopted Home Inspection Training Program, and Commercial Building Inspection Courses

- The Home Inspection Home Study Course, and publications such as
- The Home Reference Book, a reference & inspection report product for building owners & inspectors
- The Home Reference *eBook*, an electronic version for PCs, the iPad, iPhone, & Android smart phones
- Home Inspection Report writing materials, including the Horizon Software System that manages business operations, scheduling, & inspection report writing using Carson Dunlop's knowledge base & color images. The *Horizon* system runs on always-available cloud-based software for office computers, laptops, tablets, iPad, Android, & other smartphones.
- The Illustrated Home illustrates construction details and building components, a reference for owners & inspectors

- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- Wikipedia provided background information about the definition of HEPA and airborne particle interception.
- Thanks to reader Charles A. Plinton, Norristown, PA, for discussing A/C compressor noise, coil cleaning, and system maintenance - August 2010
- Thanks to reader Nichalus-Michael for discussing use of hydrogen peroxide to clean an HVAC coil, October, 2010.
- C-Shine, Industrial Compressor Component, Mr. Vilas, 706, Atharva Society, Hawa Hira Park, Kurar Village, Near Zam Zam Bakery, Malad East Mumbai, Maharashtra - 400 097, India, Email : icc2006@rediffmail.com, kvilas.icc@gmail.com Telephone : +(91)-(22)-40214595 Mobile : +(91)-9819821666/ 9320520201 Fax : +(91)-(22)-28769485. Web search 10/27/2010, http://www.industrialcompressorcomponent.com/
- CoilShine, described by Goodway, a provider of HVAC coil cleaning equipment and solutions. Tel: 800-333-7467, web search 10/27/2010, http://www.goodway.com/coilpro_chemicals.aspx

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia Bookstore.



- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

  Or choose the The Home Reference eBook for using this reference on PCs, Macs, Kindle, iPad, iPhone, or Android Smart Phones

Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

- Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982
- Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages

Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).

- NEW! Air Conditioning SEER - New DOE Air Conditioner and Heat Pump Efficiency Standard
- Asbestos HVAC Ducts and Flues field identification photos and guide
- Fiberglass: Indoor Air Quality Investigations: Fiberglass in Indoor Air, HVAC ducts, and Building Insulation

- ...

InspectAPedia®

Free Encyclopedia of Building & Environmental Inspection, Testing, Diagnosis, Repair

Search
InspectAPedia

Ask a Question or Search InspectAPedia

HOME | AIR CONDITIONING | ELECTRICAL | EXTERIORS | HEATING | HOME INSPECTION | INTERIORS | PLUMBING | ROOFING | SEPTIC SYSTEMS | STRUCTURE | WATER SUPPLY

ENERGY SAVINGS | ENVIRONMENT | INDOOR AIR IAQ | INSULATION | MOLD INSPECT TEST REMOVE | NOISE | ODORS | SOLAR ENERGY | VENTILATION | EXPERTS DIRECTORY | CONTACT US

Mobile View
AIR CONDITIONING & HEAT PUMP SYSTEMS

A/C - HEAT PUMP CONTROLS & SWITCHES
AIR CONDITIONER BTU CHART
AIR CONDITIONER COMPONENT PARTS
AIR CONDITIONER TYPES, ENERGY SOURCES
AIR CONDITIONER NOT WORKING
AIR FILTER EFFICIENCY
AIR FILTERS, FIBERGLASS PARTICLES
AIR FILTERS for HVAC SYSTEMS
AIR FLOW MEASUREMENT CFM
AIR HANDLER / BLOWER UNITS
ADDING A/C: RETROFIT SIZING
BLOWER FAN CONTINUOUS OPERATION
BLOWER FAN OPERATION & TESTING
BLOWER LEAKS, RUST & MOLD
COOLING / EVAPORATOR COIL DEFECTS
DAMAGED COOLING COIL
DIRTY A/C BLOWERS

Air Conditioning & Heat Pump Air Handler Cooling Coil Blockage

InspectAPedia® - ShareThis +1

- Dirty or blocked air conditioner cooling coils (evaporator coils), how to diagnose & repair
- Frost build-up on evaporator coils - its effect on cool air flow and mold
- Air conditioning air handlers - Fan Coil Unit Inspection, Diagnosis, Repair, Replacement
- Other causes of reduced airflow across the cooling coil
- Questions & answers about blocked, damaged, dirty A/C or heat pump cooling coils/evaporator coils

This air conditioning repair article discusses the problem of dirt or debris blockage of the air conditioning system's cooling coil or evaporator coil in an air conditioning system air handler, how the dirt gets there, what problems it causes, how to clean a cooling coil (or evaporator coil), and how to prevent future dirt on the coil.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

For A/C or heat pump cooling coil blockage problems, also see DIRTY COIL CLEANING PROCEDURES and FROST BUILD-UP on AIR CONDITIONER COILS . If your air conditioning or heat pump system has lost its cooling capacity or won't start see REPAIR GUIDE for AIR CONDITIONERS. See How to determine the cooling capacity of air conditioning equipment if the system seems to be working but is inadequate to cool your building. Contact us to suggest text changes and additions and, if you wish, to receive online listing and credit for that contribution.

BLOCKED COOLING COIL - Air Conditioner Evaporator Coil Blocked by Debris

This photograph shows how easily debris can stick to and clog the inlet side of the cooling coil in an air conditioning system. This evaporator coil was nearly totally blocked with dust and debris. How does this happen?

There was no air filter installed in the system. Ordinary house dust is comprised largely of fabric fibers and skin cells.

These and other debris in building dust such as soot and organic particles like pollen and mold spores all join to form a gray mat on the fins of the cooling coil in an air handler.

Debris sticks particularly quickly to this surface because of the combination of close spacing of the cooling fins (about 1/16" apart) and the fact that condensate forming on the coil keeps the surface damp.

Here is a close up photograph showing how fibers in building dust readily cross the blades of the cooling coil and how the fibers themselves then collect smaller particles to rapidly block air flow across the coil. The same principles that make an air filter work can also clog the cooling coil of an air conditioning system.

As a cooling coil (or evaporator coil) in an air conditioner becomes blocked with dust and debris the air flow across the coil is reduced.

This reduced air flow (in cubic feet per minute or CFM) across the coil means that the cooling capability of the whole air conditioning system is reduced.

How do we clean a dirty air conditioner or heat pump cooling coil or evaporator coil? See DIRTY COIL CLEANING PROCEDURES.

What Else Causes a Blocked Air Conditioning Evaporator Coil or Reduced Air-flow Across the Coil?

Dirty air filter: can be mistaken for a blocked cooling coil. Always check your air filter first. Replace it if it's clogged and dirty and check the filter regularly. See AIR HANDLER / BLOWER UNITS

Air Conditioner Evaporator Coil Frost or Ice Formation: When the coil becomes sufficiently blocked with debris as to slow down the air flow enough, the coil may actually become so cold that the condensate forming on its surface freezes, completely blocking the coil.

That's because the rate of release of refrigerant into the evaporator coil was designed with an assumption of a sufficient volume of air moving across the coil to keep it from becoming too cold.

When the surface temperature of an air conditioning cooling coil drops below 32 degF or 0 degC, condensate forming on the coil surface begins to freeze, leading to sometimes some pretty weird behavior of the cooling system as we discuss at FROST BUILD-UP on AIR CONDITIONER COILS where we explain that there can be more than one reason that a cooling coil ices-up but none of those conditions is desirable.

Damaged air conditioner coil fins: can occur on both the evaporator (cooling) coil and the outside condensing coil. See CONDENSING COIL REPAIR REPLACE for discussion of repairing bent or damaged coil fins. Only in extreme cases will fin damage be so severe that air flow across the cooling coil is severely blocked - enough to cause loss of function or coil icing.

Dirty air handler blower fan: see AIR HANDLER / BLOWER UNITS and its section titled DIRTY A/C BLOWERS This article describes the very significant reduction in airflow across a cooling coil that can occur if the squirrel cage fan blades are dirty on the blower fan in the air handler. A dirty blower fan can be the cause of reduced airflow across the cooling coil and can even lead to coil icing.

Air leaks or unnoticed duct openings: in the duct system can interfere with proper airflow through the duct system, reducing air delivery into the building, and can be mistaken for a blocked or dirty cooling coil. Details are at DUCT SYSTEM & DUCT DEFECTS.

Questions & Answers regarding this article

Questions & answers about blocked, damaged, dirty A/C or heat pump cooling coils/evaporator coils

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(1 days ago) DanJoeFriedman (mod) said:

Greg, the condensate drain may be blocked or if the A/C has been running for a long time you may have dehumidified the indoor air enough that the rate of condensate production has slowed.

(1 days ago) Greg said:

Air still is blowing out cool but water is not coming out the tube and is running down the side of the furance.

(July 28, 2012) DanJoeFriedman (mod) said:

Dave where is the filter in relation to the cooling coil and the blower? One wonders if

- your system is splashing water onto the blower fan that is then spraying it onto a nearby filter on the intake or return plenum side

- the condensate system is backing up leading to deep water where there should be none

Make sure that condensate is draining

(July 22, 2012) Dave said:

AC filter in attic has water on it causing rust to appear on the filter and then dripping onto the side. The secondary pan has no water in it. The condensate line with the p-trap and runs to the sump pump(I think)seems to work well. The house is comfortable when the unit is running. Appears to be one clean coil. Haven't been able to check the coil pan for blockage.

(Aug 15, 2011) DanJoeFriedman (mod) said:

Sal if the holes are small enough and a protruding sheet metal screw wouldn't contact anything you can sometimes immediately seal small holes using a stainless steel sheet metal screw and rubber washer; galvanized screws and washers of larger diameter are also sold for patching holes in water tanks using this method. If conditions permit, I prefer to clean and dry the surface and use silicone or a similar product.

(Aug 13, 2011) sal said:

As always thank you DJF. MY new dilemma - there are 2 small holes slightly larger then screw size in the metal drain pan on the lip. Its at the part of the pan lip that buts up against the outer sheet metal of the air handler. It's almost like there are two plugs for these holes that got lost in the shuffle. Could this be? This is where my leaks are coming from. PIcture a backwards letter L. At the top of the L is the drain line which is clear. At the right angle part of the L are the two holes. Just wanted to say that had I initially followed DJF's tips instead of listening to the lazy tech from the gas company I could have avoided ALL of the unnecessary cutting, and all of the related trouble I'm having now. DJF is the real deal. I apologize if this posts twice, as my initial post has seemingly disappeared.

(Aug 13, 2011) DanJoeFriedman (mod) said:

Good work Sal. At AIR HANDLER / BLOWER UNITS (link at page left) we illustrate the effects of dirty blower fans on reduced airflow and recommend blower cleaning. I have added some tips on reduced airflow across the cooling coil - things that may be mistaken for a blocked coil, just above.

If your condensate drain line is leaking by overflow it's blocked and needs to be cleared. If it's leaking at a joint or trap that's a plumbing repair. If the pan is leaking it needs to be dried, cleaned, patched, or replaced.

(Aug 12, 2011) Sal/Anon said:

Hello Don Joe Friedman. After imposing on a buddy (an HVAC) tech we acted on the previous info given me by the tech who stated it 99,9% had to be a dirty coil causing poor airflow we cut away and checked the coil. Low and behold - not dirty at all. It was a combo of a caked up dirty fan blower (yes the tech told me it was clean, go figure) and the fact that the unnecessarily open vent in my garage was sucking most of the airflow from the rest of the house. We used shurtape (HVAC type) to seal up the air handler temporarily as I plan to put the ancient singer out of its misery come september/october. Low and behold, the unit is leaking inside the house. I carefully shop vac'd out the drain line yet the unit is still leaking like crazy. Cooling house better than ever, but any suggestions are welcome. Thanks in advance.

(Aug 8, 2011) DanJoeFriedman (mod) said:

Anon, if your whole AC system is going to be condemned anyway because nobody wants to try to access and clean the coil, you don't have much to lose in trying to find a way in.

First remove the humidifier and see what you can see - send along some sharp photos of your whole system from each side and I might be able to suggest other approaches.

Second, it's common for a service tech to cut away the side of the cooling plenum on an air conditioner to expose the coil - and working with care to cut just sheet metal, after inspecting from the humidifier opening you may see which side is going to give access to the coils for cleaning.

Don't bang around the coil with a shop vac - it's too easy to bend over the cooling fins making the coil unusable. Any vacuuming has to be very gentle and with a good view of what you're doing so as to not smash the fins.

(Aug 7, 2011) Anonymous said:

Dan Joe Friedman, Thanks for your advice. After having someoneone else check out the basics, they too said it's most likely a dirty coil causing the greatly reduced airflow. They too said they wouldn't touch it because it involves cutting etc. Needless to say I have no idea where to cut or what to do as it's seemingly sealed off behind sheet meatal above the air handler. Just an idea, there is an ancient, non working humidifier attached aboved the air handler way up top. Do you think if I remove it at least temporarily (as it serves no purpose), I would be able to access the coil from above? Also, how do you feel about delicately shop vac' ing and or using a foam spray cleanser IF I'm able to access the coil at all? The worst part of this is I'm willing to pay a pro and nobody wants to go through the ordeal of getting to and cleaning the coil. Thanks for your time, SP.

(showing 1 to 10)

Recommend / Share this Article

ShareThis

EMAIL

Print

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also include a list of recommended books for the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

MANUALS & PARTS GUIDES - HVAC
MOTOR OVERLOAD RESET SWITCH
MOLD in AIR HANDLERS & DUCT WORK
MOLD INFORMATION CENTER

NOISE AIR CONDITIONER / HEAT PUMP
NOISE / SOUND DIAGNOSIS & CURE
Air Leak Noises
AIR CONDITIONING & HEAT PUMP NOISES

ODORS in AIR HANDLERS & DUCT WORK
OPERATING COST, AIR CONDITIONER
OPERATING DEFECTS, AIR CONDITIONING
OPERATING TEMPERATURES, AIR CONDITIONER

PORTABLE ROOM AIR CONDITIONERS
PRESSURE READINGS, REFRIGERANT

REPAIR GUIDE, AIR CONDITIONERS / HEAT PUMPS
REPAIR & DIAGNOSTIC FAQs for A/C
REFRIGERANTS & PIPING
GAUGE, REFRIGERATION PRESSURE TEST
REFRIGERANT CHARGING PROCEDURE
REFRIGERANT DRIERS & FILTERS
REFRIGERANT LEAK DETECTION
REFRIGERANT LEAK REPAIR
REFRIGERANT METERING DEVICES TEVs
REFRIGERANT METERING CAPILLARY TUBES
REFRIGERANT PIPING & DISTANCES
REFRIGERANT PIPING INSULATION
REFRIGERANT PRESSURE READINGS
REFRIGERANT SIGHT GLASS
RETROFIT SIZING for A/C or HEAT PUMPS

SEER RATINGS & OTHER DEFINITIONS
SYSTEM OPERATION
SWAMP COOLERS

THERMOSTATS, HEATING / COOLING
THERMOSTATIC EXPANSION VALVES

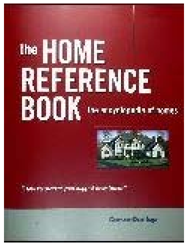
WATER COOLED AIR CONDITIONERS
WINDOW / WALL AIR CONDITIONERS
WINDOW / WALL A/C SUPPORTS

- Thanks to Mark Cramer, Tampa Florida, for assistance in technical review of the "Critical Defects" section and for the photograph of the deteriorating gray Owens Corning flex duct in a hot attic. Mr. Cramer is a Florida home inspector and home inspection educator.
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- Wikipedia provided background information about the definition of HEPA and airborne particle interception.

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia

Bookstore.



- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

  Or choose the The Home Reference eBook for using this reference on PCs, Macs, Kindle, iPad, iPhone, or Android Smart Phones

Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

- Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982
- Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- NEW!
  Air Conditioning SEER - New DOE Air Conditioner and Heat Pump Efficiency Standard
- Asbestos HVAC Ducts and Flues field identification photos and guide
- Fiberglass: Indoor Air Quality Investigations: Fiberglass in Indoor Air, HVAC ducts, and Building Insulation
- ...

Mobile View
AIR CONDITIONING & HEAT PUMP SYSTEMS

A/C - HEAT PUMP CONTROLS & SWITCHES
A/C DATA TAGS
A/C - HEAT PUMP CRITICAL DEFECTS
A/C DIAGNOSTIC FAQs
A/C REFRIGERANTS
A/C TYPES, ENERGY SOURCES
AGE of CHIMNEYS & FIREPLACES
AGE of AIR CONDITIONERS & HEAT PUMPS
AIR CLEANER PURIFIER TYPES
AIR CONDITIONER BTU CHART
AIR CONDITIONER COMPONENT PARTS
AIR CONDITIONER TYPES, ENERGY SOURCES
AIR CONDITIONER NOT WORKING
AIR FILTER EFFICIENCY
AIR FILTERS, FIBERGLASS PARTICLES
AIR FILTERS for HVAC SYSTEMS
AIR FILTERS, OPTIMUM INDOOR

Refrigerant line insulation installation for air conditioners, heat pumps, refrigeration equipment

InspectAPedia® - ShareThis +1

- Requirements for insulation on refrigerant gas or liquid piping lines, Proper Method for Installing Insulation on Air Conditioning & Heat Pump Refrigeration Lines & Condensate Drains
- Examples of defects in refrigerant piping insulation
- Problems caused by defective refrigerant piping insulation
- Recommended installation practices for refrigerant tubing insulation in building walls or cavities as well as outdoors where exposed to the weather
- Interior Leaks On & In Wall Below a Split System Air Conditioner Wall-Mounted Unit Traced to Missing Insulation
- Questions & Answers about installing insulation on refrigerant piping

Guide to proper installation of insulation on refrigerant piping: why is refrigerant piping insulation needed, what problems occur if the insulation is incomplete, missing, crimped, or otherwise improperly installed, and how do we fix these problems.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

 Use page top links to major topics or use links at the left of each page to navigate ***within*** topics and documents at this website. Green links show where you are in a document series or at this website.

Proper Method for Installing Insulation on Air Conditioning & Heat Pump Refrigeration Lines & Condensate Drains

Avoid gaps and missing insulation along the refrigeration lines

Proper placement and securing of insulation on air conditioner or heat pump refrigeration lines is important to avoid condensation leaks into the building. One, or on some systems both refrigeration lines can be cool or cold under some operating conditions.

The cold copper tubing in contact with warm humid air causes moisture in the air to condense onto and then drip off of the refrigration lines.

The result can be leaks into the building, as our photo at left illustrates.

Missing or damaged refrigerant line insulation insulation on the refrigerant lines, particularly on the larger suction line, will cause condensation and drips from the lines in humid areas.

In our photo at above left where refrigerant line insulation is incomplete, the drip stains on the attic floor may well indicate a point at which leak stains or even mold appear on the ceiling below.

In our photo at left none of the refrigerant lines are insulated where they emerge from the building wall. If the lines were also uninsulated within the wall, depending on their location and the wall's dew point properties, a condensation, leak, mold, rot, or insect problme can ensue.

We have seen very costly building damage where lines were not properly insulated indoors: condensate drips wet gypsum board walls, leading to a costly mold remediation project.

Missing refrigerant line insulation also may increase system operating cost or in addition to a condensation worry, uninsulated high pressure refrigerant lines may result in unwanted heat transmission into some building areas.

At left we illustrate a neat insulation job visible on the outdoor portion of refrigerant piping for a split system ductless air conditioner installlation.

According to McQuay International, a large producer of refrigeration equipment,

Suction lines are cold – 40°F (4.4°C) SST – and cause condensation, even in conditioned spaces. In addition, any heat that enters the refrigerant adds to the superheat and reduces system efficiency.

For these reasons, suction lines should be insulated with a vapor *proof insulation. This is a requirement of many building codes. Rubratex is the most common form of refrigerant line insulation.*

Liquid lines generally are insulated. They are warm to hot (110°F (43.3°C) for air-cooled). If liquid lines pass through a space that is warmer than the refrigerant (i.e. the roof of a building at roof level), or if they could be considered hot enough to pose a safety risk, then insulation should be added.

Discharge lines are generally uninsulated. They may be very hot, in excess of 150°F (66°C), so insulation may be warranted as a safety consideration, or if the heat loss from the discharge gas line would be considered objectionable to the space.

Hot gas bypass lines should be insulated, especially if the runs are long or if the piping is exposed to cold temperatures.

Do Not Compress Insulation on A/C or Heat Pump Refrigeration Lines

The same split system air conditioner installer we described above at A/C Condensate Disposal for Split System Air Conditioners violated the manufacturer's recommendations against compressing the insulation on the refrigerant lines - one more picky issue that we decided to let go since the wall was to be insulated with blown-in foam.

But he made the same mistake on the insulation on the refrigeration lines and condensate drain where they extend outdoors between the building wall and the compressor/condenser unit.

Our photographs illustrate that the importance of not compressing refrigeration line insulation is no joke. In our photo at below left, notice those drip stains below the condensate lines at each location where the insulation was compressed by a too-tight plastic tie?

And in the two photos at below right, notice the incomplete insulation on the refrigeration line? It leaves me worried about condensation and water accumulation *inside* the wall cavity as well. Since I know this installer is not stupid we're left thinking he has a bit of contempt for his customers, or a limited concept of workmanship.

Imagine that same dripping and accumulation of water where the installer made the same mistake in a fiberglass-batt

THERMOSTATS, HEATING / COOLING
THERMOSTATIC EXPANSION VALVES

WATER COOLED AIR CONDITIONERS
WINDOW / WALL AIR CONDITIONERS
WINDOW / WALL A/C SUPPORTS

More Information

insulated wall or a wall or ceiling inside which the dew point may be reached on the refrigeration lines? The accumulation of water in a building cavity is asking for a costly mold, insect, or rot damage problem later on.

Missing insulation on the refrigeration lines outdoors is not a catastrophe - at least for a short un such as at this split system compressor/condenser unit. Perhaps a little loss in efficiency of the system operation in some weather conditions. On a long refrigeration line run, say between an attic air handler and a ground level compressor/condenser, the effects may be more significant.

We removed the leaky, incomplete, and ugly squashed insulation on the refrigeration lines for this system (above left), replacing the squashed foam insulating tubing with new insulation (above right).

Incidentally, just clipping off the old plastic wire ties to "release" the squashed refrigerant line foam insulation won't work: after a few months the insulating foam remains permanently squashed, as you can see in our photo at left.

We paid particular attention to sealing and insulating the refrigeration line at the exit point from the building wall, reducing the chances of leaks into the wall at that point. To keep the refrigeration line insulation in place you can still use a plastic tie if you like - just don't tighten it so far as to squash the insulation.

The manufaturer (Sanyo) recommends covering the foam insulation on the refrigeration line with weatherproof tape which we did at the end of this job.

I admit that we "over-designed" the final insulation job shown in our last photo with that extra layer of foam that surrounds both lines, as we used more thickness of insulation than necessary.

We did so to end with a neat, weather-protected job that, combined with the application of black weatherproof tape, should last for a long time.

Notice that the aluminum or plastic ties used to hold components in place were left loose - we did not squash the new refrigerant line insulation, and we made sure it was continuous, neat, and protected from the weather.

A neat installation takes what, maybe five minutes longer than a sloppy one, but it took about an hour to buy the replacement refrigerant line insulation, remove the original sloppy installation, and do the job right the second time.

Protect outdoor refrigerant line insulation from the weather

Manufacturers also recommend wrapping the insulated refrigerant lines exposed to outdoor weather, using an appropriate weatherproof tape.

Interior Leaks On & In Wall Below a Split System Air Conditioner Wall-Mounted Unit Traced to Missing Insulation

Watch out: The split system air conditioner installer we described at A/C Condensate Disposal for Split System Air Conditioners violated the manufacturer's recommendations against compressing the insulation on the refrigerant lines not just outside or in the walls, but also inside the wall-mounted unit itself. During the first season of use of the newly-installed Sanyo split system air conditioner the building occupants noticed water stains and rippled wall paint extending down the wall below the indoor air handler cooling unit.

Our photo (left) shows where the refrigerant lines rise in the wall to enter the wall-mounted half of the split system air conditioner (that larger white area below the left end of the unit) and the blue tape marks where we first saw condensate water dripping from the unit.

On inspection we ran the air conditioner for an hour or so on a hot humid day, then inspected the wall surface for moisture. Simply touching or pressing on the plastic bottom of the wall-mounted cooling unit sent a cascade of water droplets down the building wall interior surface.

We gave our A/C installer a call and asked for help. To his credit, the tech came immediately to the job site. Disassembling and inspecting the indoor cooling unit by removing its plastic cover and then lifting it carefully away from the wall mounting bracket (watch out to avoid bending refrigerant lines and causing a refrigerant leak), he found that there was no insulation whatsoever on the refrigeration lines that ran horizontally along the rear bottom of the unit. The result was condensation on the refrigeration lines that did not drip into the unit's condensate tray but rather fell into the plastic bottom where water leaked out onto and into the building wall.

The condensate tray in a wall-mounted split system air conditioner or heat pump unit is designed to catch water condensing on the cooling coils, directing it to a drip pan and then to the condensate drain line. But depending on routing of the refrigerant lines, these may provide another source of condensation that does not fall into the tray.

The "fix" for this condensate leak was the installation of foam insulation along the refrigerant lines inside the unit, from their point of exit from the building interior wall surface to their point of connection to the cooling coil. The leak was stopped.

Frequently Asked Questions (FAQs) about installation of insulation on refrigerant piping for air conditioners & heat pumps

.

Questions & Answers regarding this article

Questions & Answers about installation of insulation on refrigerant piping for air conditioners & heat pumps

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(21 hours ago) derek terveer said:

I tested which lines the HP uses for heating and cooling and in both modes the vapor line is used for sending heat into the building (heating mode) and cool into the building (cooling mode). So, that works out nicely - I insulated the vapor line only. I made some calculations based on 1 meter of uninsulated and poorly insulated copper tubing (3/4" in my case) and it worked out to 51 W/m for uninsulated and I guesstimated 10W/m for the partially insulated pipe. After insulating, I estimated that I had brought that value down to 1.5W/m. The savings was on the order of 15 seconds of running of my furnace, per hour. That was around 0.16% (not 16%, but point one six percent) of my furnace capacity (at -7C). So, given the savings, at least percentage-wise, I'm not surprised that my local contractor didn't bother insulating more.

(1 days ago) DanJoeFriedman (mod) said:

Derek

Interesting question. Considering that at times the heat pump is trying to send heat from outside into the building, it would make perfect sense to insulate all of the refrigerant piping. But I'm not a MN HP expert - I'd also ask the local HVAC techs.

(2 days ago) derek terveer said:

What about recommended insulation of the liquid and vapor lines for a HP that is primarily used for heating in a cold-weather area (MN). The large line was insulated at install-time (and I added another layer, and a loose fitting, flexible aluminum dryer hose over that for protection against the sun and environment. But, should the small line also be insulated? 99% of the run-time on this unit, it is heating.

Recommend / Share this Article

+1 ShareThis
EMAIL
Print

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also list books on the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

REFRIGERANTS & PIPING
GAUGE, REFRIGERATION PRESSURE TEST
REFRIGERANT CHARGING PROCEDURE
REFRIGERANT DRIERS & FILTERS
REFRIGERANT LEAK DETECTION
REFRIGERANT LEAK REPAIR
REFRIGERANT METERING DEVICES TEVs
REFRIGERANT METERING CAPILLARY TUBES
REFRIGERANT PIPING & DISTANCES
REFRIGERANT PIPING INSULATION
REFRIGERANT PRESSURE READINGS
REFRIGERANT SIGHT GLASS
RETROFIT SIZING for A/C or HEAT PUMPS

THERMOSTATIC EXPANSION VALVES

- CARSONDUNLOP Carson, Dunlop & Associates Ltd., 120 Carlton Street Suite 407, Toronto ON M5A 4K2. (416) 964-9415 1-800-268-7070 info@carsondunlop.com. The firm provides professional home inspection services & home inspection education & publications. Alan Carson is a past president of ASHI, the American Society of Home Inspectors. Thanks to Alan Carson and Bob Dunlop, for permission for InspectAPedia to use text excerpts from *The Home Reference Book* & illustrations from *The Illustrated Home*. Carson Dunlop Associates' home inspection education products include
  - The ASHI-adopted Home Inspection Training Program, and Commercial Building Inspection Courses
  - The Home Inspection Home Study Course, and publications such as
  - The Home Reference Book, a reference & inspection report product for building owners & inspectors
  - The Home Reference *eBook*, an electronic version for PCs, the iPad, iPhone, & Android smart phones
  - Home Inspection Report writing materials, including the Horizon Software System that manages business operations, scheduling, & inspection report writing using Carson Dunlop's knowledge base & color images. The *Horizon* system runs on always-available cloud-based software for office computers, laptops, tablets, iPad, Android, & other smartphones.
  - The Illustrated Home illustrates construction details and building components, a reference for owners & inspectors

- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- HVAC brands discussed here include but are not limited to: Lennox, American Standard, Amana, Everrest, Goodman, Frigidaire, Coleman and Gibson. Brands of related air handling equipment include Honeywell, Aprilaire, White-Rogers, Broan. Nutone, Fantech, Venmar, Arzel, Hi-Velocity, Vanguard, Wirsbo, Weil McLain, Unico, Heat Link, A.O. Smith, Water Furnace, ClimateMaster, Geo-Excel, Command Aire, Friedrich, LG, Mitsubishi, Sanyo, Hart &
Cooley, Munchkin, Superstor Ultra, Lochinvar and Knight HVAC equipment.
- HVAC Employment: U.S. Department of Labor website describes HVAC jobs and the employment outlook for HVAC technicians.
- HVAC Education, Training Accreditation agencies: Quoting the U.S. DOL HVAC website above::
After completing the programs below, new technicians generally need between 6 months to 2 years of field experience before they are considered proficient. Three accrediting agencies have set academic standards for HVACR programs:

  - *HVAC Excellence. 1701 Pennsylvania Ave NW, Washington, DC 20006* Tel: (800) 394-5268. Quoting: *HVAC Excellence is a not for profit organization that has been serving the HVACR industry since 1994. It is our goal to improve competency through validation of the technical education process. By setting standards and verifying that they have been met, we inspire the industry to excel. We know that all of the challenges that face our industry are achievable by continuous improvement in the way that we prepare technicians.*

  - *National Center for Construction Education and Research, 3600 NW 43rd Street, Bldg. G, Gainesville, FL 32606, Tel: 888.622.3720, Quoting:*
  NCCER is a not-for-profit education foundation created to develop industry-driven standardized craft training programs with portable credentials and help address the critical workforce shortage facing the construction industry.
  - *The Partnership for Air-Conditioning, Heating, and Refrigeration Accreditation, (PAHRA) 2111 Wilson Blvd., Suite 500 Arlington, VA 22201-3001 (703) 524-8800, Quoting: The Partnership for Air-Conditioning, Heating, Refrigeration Accreditation (PAHRA) is an independent, third party organization that is a partnership between heating, ventilation, air-conditioning and refrigeration (HVACR) educators and the HVACR industry that will award accreditation to programs that have met and/or exceeded industry validated standards. This programmatic accreditation program is the only one that is supported by the major industry associations.*

  Licensure. Heating, air-conditioning, and refrigeration mechanics and installers are required to be licensed by some States and localities. Requirements for licensure vary greatly, but all States or localities that require a license have a test that must be passed. The contents of these tests vary by State or locality, with some requiring extensive knowledge of electrical codes and others focusing more on HVACR-specific knowledge. Completion of an apprenticeship program or 2 to 5 years of experience are also common requirements.

  In addition, all technicians who purchase or work with refrigerants must be certified in their proper handling. To become certified to purchase and handle refrigerants, technicians must pass a written examination specific to the type of work in which they specialize. The three possible areas of certification are: Type I—servicing small appliances; Type II—high-pressure refrigerants; and Type III—low-pressure refrigerants. Exams are administered by organizations approved by the U.S. Environmental Protection Agency, such as trade schools, unions, contractor associations, or building groups.

- HVAC Training Courses, Schools: HVAC Technician Training Schools [http://technicianschool.net/hvac-technician-training-schools/], lists thefollowing schools offering technical courses may offer specific training programs for potential careers, including HVAC technicians. Among HVAC schools that website lists are

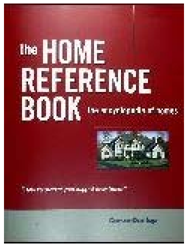
  - Everest Colleges [http://www.everest.edu],
  - Florida Career College 7891 Pines Blvd Hollywood, FL 33024 http:// www.careercollege.edu/,

  - Lincoln Institute 2299 Vauxhall Road Union, NJ 07083 http:// www.lincolnedu.com/
  - NOTE: when considering an HVAC training course or school, check the HVAC education accrediting associations listed above.

- [1] "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- [2] Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982
- [3] Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- [4] "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning andRefrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages
- [5] "Falling Air-Conditioners Rattle Tenants", Chris Palmer, *The New York Times*, 2 July 2012, p. A12.
- [6] Refrigerant Piping Design Guide, Application Guide AG-31-011, McQuay Air Conditioning, Daikin McQuay International Equipment, 13600 Industrial Park Blvd. Minneapolis, Minnesota 55441 800-432-1342 (Toll Free), Website: http://www.daikinmcquay.com/, [Copy on file as http://www.inspectapedia.com/aircond/AC_Guide_McQuay.pdf]

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia Bookstore.



- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

  Or choose the The Home Reference eBook for using this reference on PCs, Macs, Kindle, iPad, iPhone, or Android Smart Phones

Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

- Ratib Bakera is member of Refrigeration Service Engineers Society (RSES), an International training organization for the HVACR industry provides educational and certification programs to HVACR professionals of all experience levels. www.rses.org provides information on the organization and its training materials. Independent testing and certification of HVAC technicians is provided by North American Technician Excellence - NATE - see www.natex.org. NATE is supported by ASHRAE, the US EPA, and a host of other trade and professional associations.
- Singer brand HVAC equipment brand history: Singer was bought by & became the climate control unit of Dallas-based Snyder General Corp. (founded by a former Singer HVAC manager) in 1982. The name Singer was dropped in 1984. In 1984 Snyder General operations included Arcoaire, Comfortmaker, and McQuay. In 1991 Snyder General sold Arcoaire & Comfortmaker to Inter-City Products. In 1994 Snyder General was acquired by Hong Leong Group Malaysia. Snyder General is at 2001 Ross Avenue Dallas, TX 75201.
- Lennox air conditioning and heat pump owners manuals for air conditioners, air handlers, furnaces, heat pumps,

indoor air quality systems, packaged units, water heaters, zone controls and other controls such as thermostats, are provided by Lennox at http://www.lennox.com/support/manuals.asp

- ...

Mobile View
AIR CONDITIONING & HEAT PUMP SYSTEMS

AGE of AIR CONDITIONERS & HEAT PUMPS
AGE of HEATERS, BOILERS, FURNACES
AGE of WATER HEATERS
AIR CONDITIONER BTU CHART
AIR CONDITIONER COMPONENT PARTS
AIR CONDITIONER TYPES, ENERGY SOURCES
AIR CONDITIONER NOT WORKING
AIR FILTER EFFICIENCY
AIR FILTERS, FIBERGLASS PARTICLES
AIR FILTERS for HVAC SYSTEMS
AIR FLOW MEASUREMENT CFM
AIR HANDLER / BLOWER UNITS
APPLIANCE EFFICIENCY RATINGS

BACKUP HEAT for HEAT PUMPS
BLOWER DOORS & AIR INFILTRATION
BLOWER FAN CONTINUOUS OPERATION

Air Conditioning & Heat Pump Data Tags: BTUs, Tons, Equipment Age

InspectAPedia® - ShareThis +1

- How to read, decode, & translate A/C & heat pump data tags & stickers
- Air conditioner BTUs, Tons, Age: decoded on data tags
- Air conditioner electrical requirements
- Air conditioner refrigerant needs
- Air conditioner cooling capacity coded in model numbers
- Air conditioner and heat pump manufacturer's information; serial number gives A/C age
- References providing complete decoding of manufacturers' equipment tags on HVAC equipment
- Questions & answers about HVAC equipment data tag decoding

HVAC data tag decoding: This article explains and translates all of the data found on information tags and stickers used on air conditioning and heat pump equipment. This website answers most questions about air conditioning systems.For help in decoding air conditioner, boiler, furnace, heat pump, water heater data tags and determining the age, model, or specifications of that equipment, see AGE of AIR CONDITIONERS & HEAT PUMPS, AGE of AIR CONDITIONERS & HEAT PUMPS, AGE of HEATERS, BOILERS, FURNACES, and AGE of WATER HEATERS. There we provide documents with extensive equipment data tag decoding information.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

 Use page top links to major topics or use links at the left of each page to navigate ***within*** topics and documents at this website. Green links show

where you are in a document series or at this website.

A/C DATA TAGS - Air conditioner & heat pump data tags

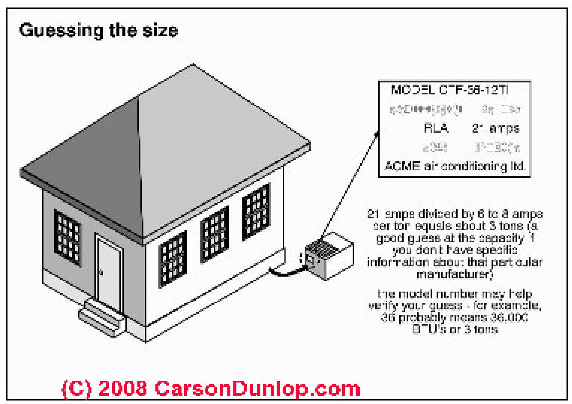
Here we explain the meaning of each of the data names and contents of typical air conditioner system data tags. We include examples of how to make use of the data to estimate equipment age, capacity, and even its condition. (Not all of the terms we define below will appear on all equipment or motor tags.)

The photo at page top shows the main data sticker from a 1997 split system air conditioning compressor/condenser unit.

This model, made by Sanyo, Inc., provides easy-to-read basic data about the system including its year of manufacture, refrigerant, electrical requirements, and service information.

The photo shown here is for a conventional (non-split) residential air conditioning compressor unit. Unless it has been painted-over or lost, on most air conditioners and heat pumps, a metal, foil, or plastic tag or data sticker is usually affixed to the outdoor air conditioner or heat pump compressor/condenser housing.

Depending on the age and equipment manufacturer the format and content of data on this tag varies, but typically the tag will allow you to discover some or all of the considerable amount of data listed here:



- Manufacturer: The air conditioning equipment manufacturer.

  Sketch at left on guessing the size of an air conditioner system is compliments of Carson Dunlop Associates. As we cite below, Carson Dunlop also provide a Technical Reference Guide with extensive details that aid in decoding HVAC equipment serial numbers and data tags.

- Model Number, Serial Number, and Cooling Capacity: sometimes cooling capacity is coded into the model number but on most newer units including the Sanyo compressor shown here, cooling capacity is stated explicitly. On older equipment the BTUH cooling capacity may be encoded in the model numbers.

  RATED COOLING CAPACITY discusses how to read the cooling capacity in BTUH or tons from air conditioning or heat pump tags. The serial number of modern HVAC equipment encodes the year and month of manufacture - thus the age of the equipment is shown. For equipment where the month and year of manufacture is not stated in plain English, Carson Dunlop provides a Technical Reference Guide manual that decodes that data.

- Voltage or VAC for the compressor and separately for the blower fan. In addition to specifying voltage, the cycles (50HZ or 60HZ) and current phases (typically one phase for residential equipment) may be specified.

- Branch Circuit Selection Current- BCSC: recommended for determining the required size of the branch circuit conductors (wiring) supplying the equipment.

ODORS in AIR HANDLERS & DUCT WORK
OPERATING COST, AIR CONDITIONER
OPERATING DEFECTS, AIR CONDITIONING
OPERATING TEMPERATURES, AIR CONDITIONER

PORTABLE ROOM AIR CONDITIONERS
PRESSURE READINGS, REFRIGERANT

REPAIR GUIDE, AIR CONDITIONERS / HEAT PUMPS
REPAIR & DIAGNOSTIC FAQs for A/C
REFRIGERANTS & PIPING
RETROFIT SIZING for A/C or HEAT PUMPS

SEER RATINGS & OTHER DEFINITIONS
SYSTEM OPERATION
SWAMP COOLERS

THERMOSTATS, HEATING / COOLING
THERMOSTATIC EXPANSION VALVES

WATER COOLED AIR CONDITIONERS
WINDOW / WALL AIR CONDITIONERS
WINDOW / WALL A/C SUPPORTS

More Information

- Locked Rotor Amperage - LRA specifies the *maximum current* that the motor will draw when the motor's rotor is unable to move [locked] (or under any other condition). [NEC Table 430-152-A]. LRA on an air conditioning compressor describes the amperage drawn by the motor briefly during motor startup. Locked rotor amperage is also called *inrush current*. Because it takes a lot of energy (torque) to get the still parts of an electric motor turning, LRA will always be higher than the current used to keep the motor turning once it has started (FLA or RLA). This is particularly true if the motor has an additional load (resistance to turning) at startup, such as trying to start an air conditioning compressor against refrigerant head pressure inside the compressor unit.

  The LRA of electric motors is 700% - 850% of rated current of the motor (or in some sources 5 to 7 times greater than RLA or FLA - a lot. The motor's circuit breaker, especially on an air conditioning system which can draw high initial amps (LRA) will be sized to protect the electrical wiring of the motor circuit, but the breaker also will be chosen to tolerate a brief, high initial current draw to avoid nuisance tripping. In other words, the inrush current, because it is brief, does not need to figure in the selection of the wire sizing when wiring or fusing the motor, except to avoid nuisance tripping.

  The relationship between the LRA and full load amperage (FLA) varies depending on the design of the electric motor being rated. Motors built to NEMA standards are assigned codes A through H. Each letter can be translated into multiplier x FLA to give LRA.

  To assist in avoiding nuisance tripping during compressor startup when high current is drawn momentarily, A/C compressor circuit breakers may be permitted to be one size larger than the circuit breaker required by the wire size itself.

  LRA also affects the choice of the electric motor starter. Finally, an air conditioner motor will also draw its LRA current if the motor is frozen or stuck or has bad bearings - which we hope will quickly trip the circuit breaker or blow the circuit fuse. -- Thanks to Patrick Greaux for requesting clarification of LRA.

- Minimum Circuit Ampacity - MCA: MCA *can* be used to determine the required size of branch circuit conductors (wiring and also control switches) supplying the equipment. [For example, using NEC Table 310-16 in the 60 degree column as required in 110-14]. However some experts recommend using BCSC. [Using the "minimum permitted" sized wire rather than the optimum-size to a compressor may save a few dollars at installation but may increase system operating costs and it may be less safe than using a larger conductor.]

- Maximum Fuse or HACR type Breaker: specifies the maximum overcurrent protection or MOP to be used to protect the equipment. The permitted ampacity of the equipment electrical circuit protection (fuse or circuit breaker amps) expressed as MOP or Maximum Overcurrent Protection. If MOP is specified, the breaker or fuse protecting the equipment should match this number.

  A hermetic compressor draws varying amounts of current as its internal pressure changes during operation. Current draw is higher when starting the motor, and highest if the motor is starting against its highest back pressure such as when a unit is turned off and then back on in the middle of operation. Because fusing an air conditioning compressor at the minimum level can result in blown fuses or tripped breakers during these intervals of heavy current draw during compressor startup, compressors are either protected by a slow-blow fuse or a somewhat larger than minimum circuit breaker.]

  On some older equipment MOP is not specified. *Only* in the case that MOP is not specified can the overcurrent protection required be determined by the alternative means: [RLA OR BCSC whichever is greater x 175%], or if the compressor keeps tripping that device or blowing that fuse, RLA x 225% might be used. The National Electrical Code (NEC) specifies the degree to which a breaker or fuse may exceed the RLA.

- Rated Load Amperage or Running Load Amperage - RLA, also called Rated Load Current or RLC on some equipment. This is the manufacturer's anticipated load during normal usage, that is, the current drawn when the motor is running normally. RLA is usually similar to FLA in amount.

Typically RLA is about about 64% of the maximum load current. See NEC section 440-2.

We sometimes can guess the size (tons of cooling capacity) of an air conditioning compressor by dividing the RLA number by 6, 7, or 8. For example a compressor RLA of 21 amps may be about 3 tons of cooling capacity (21/7). For more accurate means of determining air conditioner cooling capacity by several means including decoding the data tag, see COOLING CAPACITY, RATED. In air conditioning systems, typically a motor provides about one horsepower (HP) per ton of cooling capacity.

- Full Load Amperage - FLA full load motor current draw, level at which the motor can be operated without damage. FLA is similar to RLA in amount. The FLA amperage is the current the motor will draw when the motor is
  loaded up to its rated horsepower. If an electric motor is running at less than its rated horsepower it will draw less than its FLA current.

  If an electric motor is trying to run at more than its rated horsepower, it will draw more than its FLA current. A technician can measure the actual motor amperage (current draw) and compare it to the FLA to quickly tell if a motor is overloaded - in the case of air conditioning a running current draw above FLA may mean that the compressor is near its end of life.

- Maximum Continuous Current - MCC not usually supplied, this is the most current that the compressor can draw without being damaged. [Typically about 150% of RLA.]

- BTUH Cooling Capacity: The A/C system cooling capacity, either explicitly stated in thousands of BTU's (British Thermal Units) per hour (BTUH) or implicitly given by other data, or coded in the unit's model number.

- The month and year of manufacture, possibly also encoded in the unit serial number. Since the typical life of an A/C compressor is about ten years, one would like to know the probable age of the equipment.

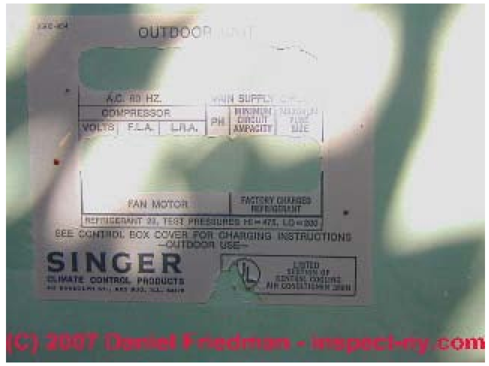
- The Energy Efficiency Ratio of cooling equipment is basically the amount of electricity you consume to obtain a given amount of cooling ability. It's expressed as (KW per hour of electricity used) / Thousand BTUs - this number is probably not going to be found on the equipment itself but may be in its documentation. Also see SEER RATINGS & OTHER DEFINITIONS

- Refrigerant type is shown somewhere on every air conditioner, heat pump, or other cooling compressors. The tag shown here notes that the system uses [the now obsolete] R22 refrigerant.

- Voltage - the voltage at which the motor is intended to be operated. Motors can normally operate fine at voltages within 10% of the rated voltage level on the data plate.
- Month and year of manufacture is shown either explicitly as on the Sanyo compressor data tag shown here or this data may be encoded in the unit's serial number. Carson Dunlop provides a manual that decodes more of that data so that you can know the age of the compressor or air handler. That is, the date of its manufacture, not the date of its installation. The installation date of air conditioning equipment may be recorded on a service company's data tag, on receipts, or even inked inside of the steel cabinet of the equipment.

Modified, damaged, or torn air conditioning equipment information data tags can make age, capacity, and repair of any equipment more difficult. For the air conditioning compressor unit shown here, all we know is that the manufacturer was Singer. Model numbers and serial number appear to have been cut away from the data tag. Why?

Sometimes when equipment data labels are removed or obscured a building buyer or a home inspector may raise a concern that the unit installed was different than that which the was ordered or that it is of



questionable origin. On rare occasion that might be the case..

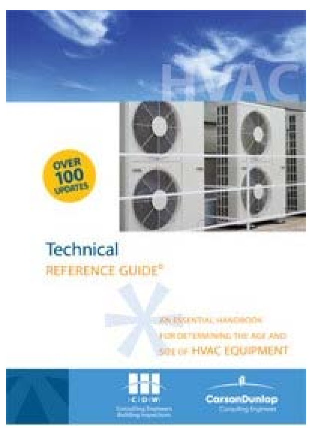
But Ratib Baker, a member of member of Refrigeration Service Engineers Society (RSES), informs us that during the 1980's HVAC equipment manufacturers used a type of label which lacked UV resistance, faded, cracked, and eventually peeled away from the equipment, making equipment identification and ordering of replacement parts difficult.

Mr. Baker wrote (October 2008) that in the 1980's "the [HVAC compressor] label's protective mylar surface was damaged by the printing of the model and serial numbers and the electrical data which allowed the UV from the sun to destroy those areas. Upon discovering that they did not stand up to weather, most manufacturers started putting a second label inside the electrical compartment. Eventually better labels were designed, but some of the better manufacturers still put a second label in the unit."

Where a data tag or label on equipment is damaged or missing, check further for more label data including inside the unit's enclosure. Service technicians may have written the model and serial number data in indelible marker, or the manufacturer may have provided a second data label inside the unit - check HVAC equipment with lost or damaged labels to see if you can find that data elsewhere. You may also find equipment identification details in the installation and service manuals for the equipment if those have been kept in the building. Look around the indoor equipment for those documents.

What we can say from the label in the photograph above is that by 2007 when the photo was taken by an ASHI inspector, this particular equipment was at least 23 years old - older than its usual anticipated life expectancy: the Singer brand on air conditioners was dropped in 1984.

Book that Decodes the Data Tags on Air Conditioners, Heat Pumps, Furnaces, Boilers, Water Heaters



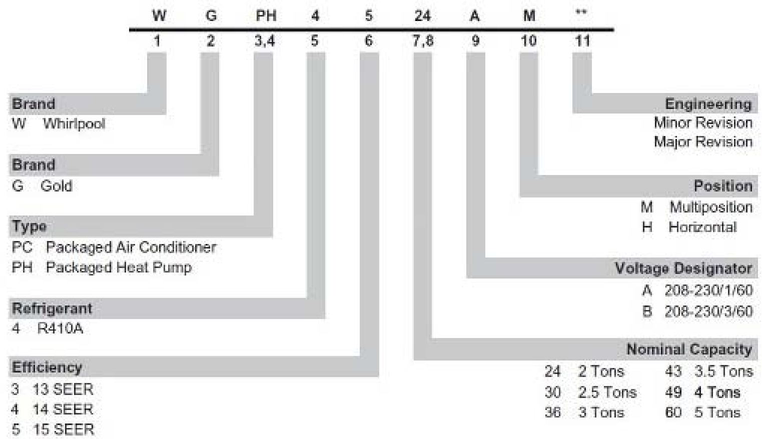
- Recommended: For the most complete and very detailed HVAC equipment data tag and age decoding information anywhere, Alan Carson and Bob Dunlop, Carson Dunlop, Associates, Toronto, offer Carson Dunlop Weldon & Associates Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).

  Other References:

- See OPERATING CONTROLS, A/C & HEAT PUMP Air Conditioning A/C System Operating Controls & Overcurrent Protection discusses the electrical power controls, fusing, fuse sizing, and amperage or current measurements on air conditioning equipment (in the section on SAFETY CONTROLS on that page).
- A/C - HEAT PUMP CONTROLS & SWITCHES - Switches and Controls on a typical split system with indoor and outdoor components were listed in the first chapter at A/C COMPONENT LIST

Example HVACR Air Conditioning & Heat Pump Equipment Data Tags & Decoding Tips

Whirlpool Corporation Equipment Data Tag Translator



Source: Whirlpool WGPH45 Packaged Heat Pump, Product Specifications [17]

Watch out for Confusing or MisReading Letters & Numerals on Old HVAC Equipment Data Tabs

Especially when equipment is old or has been located outside where its data tag can become obscured, faded, or damaged, it is easy to confuse as certain numeric digits some alphabetic characters, and vice versa.

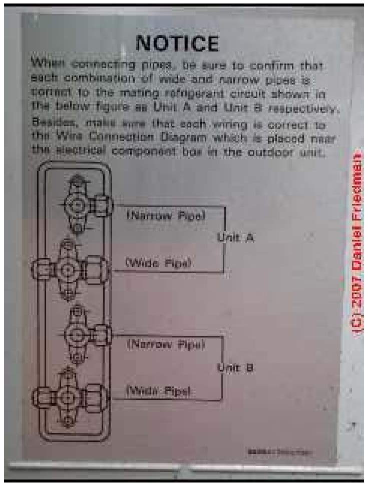
Our table below gives some confusion examples to watch for. So if information about model numbers or serial numbers for a given manufacturer specifies that that company use a mix of alphabetic and numeric characters (E.G. General Electric), and you see only numeric, look again to see if you're making a mistake.

Numeric Character	Confused With alphabetic or numeric
Numeric 0 - zero	Alphabetic O
1	I
1	L
2	S
2	Z
3	E (reading upside down)
3	8

5	S
6	9 (reading upside down)
6	G
7	2
8	B
9	6 (reading upside down)

Other information tags and stickers on air conditioners and heat pumps

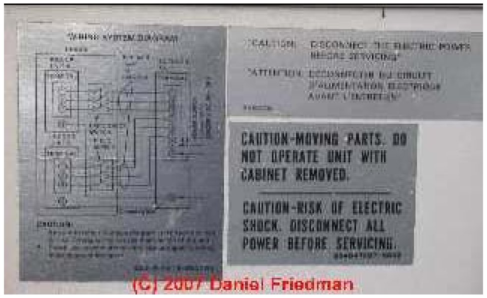
Service and refrigerant connections



Service information and/or refrigerant piping hook-up may be provided by a separate sticker on the air conditioner compressor/condenser unit, such as the piping arrangements shown on this split-unit compressor side.

More critical service data such as refrigerant type and operating pressures are recorded in the main data tag shown earlier.

Air conditioner or heat pump basic wiring diagrams

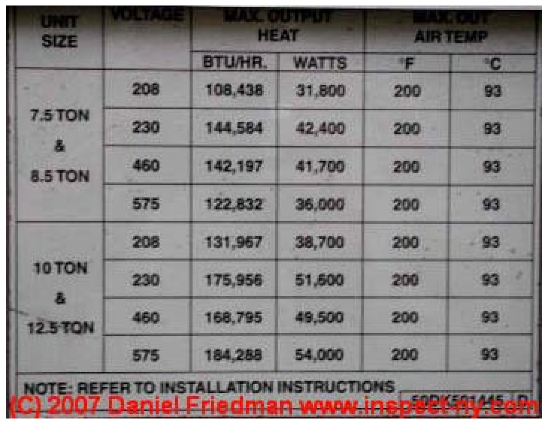


A basic hook-up wiring diagram may be provided by the manufacturer on a separate sticker on the air conditioner compressor/condenser unit such as this one from the Sanyo unit.

Air conditioner or heat pump safety warnings

Safety warnings for consumers and service people also appear on tags or stickers on modern air conditioning and heat pump units, such as shown in the photo above.

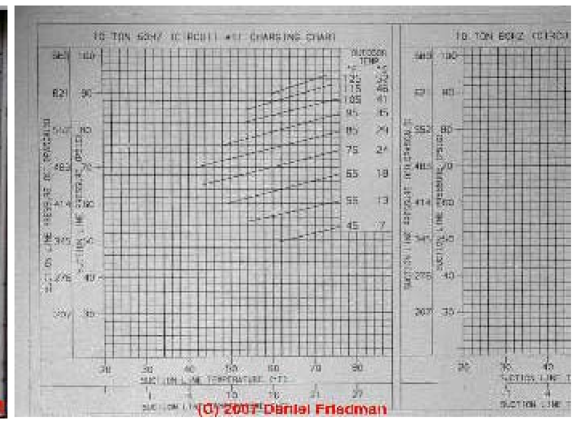
Data information tags on commercial air conditioning and heat pumps



UNIT SIZE	VOLTAGE	MAX. OUTPUT HEAT		MAX. OUT AIR TEMP	
		BTU/HR.	WATTS	°F	°C
7.5 TON & 8.5 TON	208	106,438	31,800	200	93
	230	144,584	42,400	200	93
	460	142,197	41,700	200	93
	575	122,832	36,000	200	93
10 TON & 12.5 TON	208	131,967	38,700	200	93
	230	175,956	51,600	200	93
	460	168,795	49,500	200	93
	575	184,288	54,000	200	93

NOTE: REFER TO INSTALLATION INSTRUCTIONS

(C) 2007 Daniel Friedman www.inspect-ny.com



Commercial air conditioning or A/C/Heat pump units such as the rooftop unit from which these data tag photos were taken often provides additional and critical capacity and service data.

The first or left hand tag shows the equipment's operating capacity in both BTUH and watts, and shows a maximum air temperature at the unit. The second photo at right shows a refrigerant charging chart that must be consulted by the service technician who monitors suction line (low pressure or return line) temperature and pressure.

Frequently Asked Questions about reading air conditioning or heating equipment data tags & labels to decode the age of the equipment, equipment type, BTU capacity, year of manufacture, etc.

Question:

Could you help us determine the age of a General Electric central air condenser.
Model TA36H1F01 S/N 205100925
This unit appears to be extremely old, but would appreciate any help you can give me. - John 6/1/12

Reply:

John, Carson Dunlop's Technical Reference Guide has several pages of GE equipment data decoding information, including the observation that

> beginning in 1944 GE coded the age in the last three digits of the serial number, with the year in the third from last position.

But the GE serial number codes on air conditioners & heat pumps used letters (N-Z = months Jan-Dec) and Year A-Y = 1944-1964, then repeated). Your serial number does not conform to the known codes for General Electric air conditioners. GE used letters not digits for month and year as I explained above.

Is it possible you are mis-reading a letter "Z" as a numeric "2" or a P or R as a "9" and an "S" as a "5" ?

Examples of troubles reading old fuzzy or partly obscured serial numbers or model numbers on HVAC equipment are in our article just above. So if your 2 and 5 are really SS the unit could be as old as May 1959 or perhaps more likely, as recent as 1980.

Send us a sharp focused photo of the entire label if you can and I'll comment further.

The *Model Number* you provided indicates in the two digits following the TA (TA36) 36,000 BTU/h

GE no longer makes A/C units - heat pumps were sold to Trane, Canada.

Questions & Answers regarding this article

Questions & answers about HVAC equipment data tag decoding

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(July 20, 2012) DanJoeFriedman (mod) said:

KeviP

Normally we'd look up the Magic Chef model number decode for your unit in our copy of Carson Dunlop's Technical Reference Guide (listed in the references section at the end of this article) but I'm working on assignment out of office for a time. You can

- contact Magic Chef and ask them directly
- pick up a copy of Carson Dunlop's Technical Reference Guide (recommended)

- pick up a copy of Preston's HVAC decoding guide (absurdly expensive, more details)

Typically on older Magic Chef AC equipment the year and place of manufacture are in the end of the serial number; the BTUH capacity is in the model number but may be encoded.

(July 18, 2012) KeviP said:

trying to find out size of AC from lable off coil Magic Chef MODEL YA583T-2 COIL NUMBER AT582-2 SERIAL NUMBER A 07212KCC

(June 1, 2012) DanJoeFriedman (mod) said:

Andy, the compressor type may be coded in the model number for some manufacturers. If you pass on that data to me, better yet, with a sharp focus photo of the data tag(s) I'll see what I can find.

(May 8, 2012) Andy Tran said:

Hi Dan. Great Info. Do you know if there is way to determine whether the compressor is a 2 stage or 1 stage unit based on looking at the data plate? Thanks a lot, Andy - Carson Dunlop.

(Sept 20, 2011) Mike said:

What is the calculation for the additional charge of R410A for a sanyo SPWUR484GXH56 outdoor unit with pipe runs as follows:1" - 56M/0.375" - 31M and 0.25" - 9M

(Aug 31, 2011) DanJoeFriedman (mod) said:

John that's an interesting question. The LRA is the current drawn just for a moment at startup; But if your generator cannot handle that brief surge the A/C may simply fail to start.

(Aug 31, 2011) john said:

Do I need to consider the full LRA when choosing a generator for back up power?

(Aug 3, 2011) georgec5370@gmail.com said:

love this site lots of helpful information. thanks for putting it up.

Recommend / Share this Article

+1 ShareThis

EMAIL

Print

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also include a list of recommended books for the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

DATA TAGS on AIR CONDITIONERS

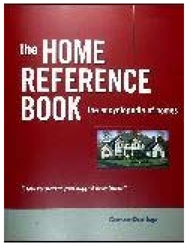
- CARSONDUNLOP Carson, Dunlop & Associates Ltd., 120 Carlton Street Suite 407, Toronto ON M5A 4K2. (416) 964-9415 1-800-268-7070 info@carsondunlop.com. The firm provides professional home inspection services & home inspection education & publications. Alan Carson is a past president of ASHI, the American Society of Home Inspectors. Thanks to Alan Carson and Bob Dunlop, for permission for InspectAPedia to use text excerpts from *The Home Reference Book* & illustrations from *The Illustrated Home*. Carson Dunlop Associates' home inspection education products include
    - The ASHI-adopted Home Inspection Training Program, and Commercial Building Inspection Courses
    - The Home Inspection Home Study Course, and publications such as
    - The Home Reference Book, a reference & inspection report product for building owners & inspectors
    - The Home Reference *eBook*, an electronic version for PCs, the iPad, iPhone, & Android smart phones
    - Home Inspection Report writing materials, including the Horizon Software System that manages business operations, scheduling, & inspection report writing using Carson Dunlop's knowledge base & color images. The *Horizon* system runs on always-available cloud-based software for office computers, laptops, tablets, iPad, Android, & other smartphones.
    - The Illustrated Home illustrates construction details and building components, a reference for owners & inspectors
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and

cooling equipment ($69.00 U.S.).

- Thanks to Scott at SJM Inspect for suggesting this EPA document and for technical editing remarks regarding our air conditioning website, SJM Inspection Service LLC, serves the entire state of CT, sjminspect.com 203-543-0447 or 203-877-4774 5/16/07
- Thanks to Patrick Greaux 02/02/2009 for suggesting clarification of LRA - Locked Rotor Amperage.
- Ratib Bakera is member of Refrigeration Service Engineers Society (RSES), an International training organization for the HVACR industry provides educational and certification programs to HVACR professionals of all experience levels. www.rses.org provides information on the organization and its training materials. Independent testing and certification of HVAC technicians is provided by North American Technician Excellence - NATE - see www.natex.org. NATE is supported by ASHRAE, the US EPA, and a host of other trade and professional associations.
- Singer brand HVAC equipment brand history: Singer was bought by & became the climate control unit of Dallas-based Snyder General Corp. (founded by a former Singer HVAC manager) in 1982. The name Singer was dropped in 1984. In 1984 Snyder General operations included Arcoaire, Comfortmaker, and McQuay. In 1991 Snyder General sold Arcoaire & Comfortmaker to Inter-City Products. In 1994 Snyder General was acquired by Hong Leong Group Malaysia. Snyder General is at 2001 Ross Avenue Dallas, TX 75201.
- Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982
- Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages
- [18] N Lu, YL Xie, Z Huang, "Air Conditioner Compressor Performance Model", U.S. Department of Energy, August 2008, [copy on file as PNNL-17796.pdf] Available to the public from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161 ph: (800) 553-6847, fax: (703) 605-6900 email: orders@ntis.fedworld.gov online ordering: http://www.ntis.gov/ordering.htm

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia Bookstore.



- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

  Or choose the The Home Reference eBook for using this reference on PCs, Macs, Kindle, iPad, iPhone, or Android Smart Phones

Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

- ...

- ...

Mobile View
AIR CONDITIONING & HEAT PUMP SYSTEMS

A/C - HEAT PUMP CONTROLS & SWITCHES
A/C DATA TAGS
A/C - HEAT PUMP CRITICAL DEFECTS
A/C DIAGNOSTIC FAQs
A/C REFRIGERANTS
A/C TYPES, ENERGY SOURCE
AGE of AIR CONDITIONERS & HEAT PUMPS
AIR CLEANER PURIFIER TYPES
AIR CONDITIONER BTU CHART
AIR CONDITIONER COMPONENT PARTS
Indoor A/C Components
Outdoor A/C Components
AIR CONDITIONER TYPES, ENERGY SOURCES
AIR CONDITIONER NOT WORKING
AIR FILTER EFFICIENCY
AIR FILTERS, FIBERGLASS PARTICLES
AIR FILTERS for HVAC SYSTEMS

Air Conditioning & Heat Pump System Components Guide

InspectAPedia® - ShareThis

- What are the indoor and outdoor components of an air conditioning or heat pump system?
- What does each air conditioner or heat pump component do?
- Photographs of air conditioning & heat pump components
- Sketches / drawings of air conditioner & heat pump components
- Questions & Answers about the components that are found on heat pumps and air conditioners

HVAC heating, ventilation, air conditioning & refrigeration system component identification guide: this article lists and explains the function of the basic components of an air conditioning or heat pump systems and provides detailed inspection, diagnostic, and repair advice. We include photographs to assist readers inrecognizing cooling system defects.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

 Use page top links to major topics or use links at the left of each page to navigate ***within*** topics and documents at this website. Green links show where you are in a document series or at this website.

1. A/C COMPONENT LIST - Basic Air Conditioning & Heat Pump

AIR FILTERS, OPTIMUM INDOOR
CONTINUOUS BLOWER FAN OPERATION
AIR FILTER EFFICIENCY
FIBERGLASS & AIR FILTERS
SOURCES FOR AIR FILTERS
AIR HANDLER / BLOWER UNITS
APPLIANCE EFFICIENCY RATINGS
ASBESTOS IDENTIFICATION IN buildings

BACKUP HEAT for HEAT PUMPS
BLOWER DOORS & AIR INFILTRATION
BLOWER FAN CONTINUOUS OPERATION
BLOWER FAN OPERATION & TESTING
BOOKSTORE - Air Conditioning "How To" Books

CAPACITORS for HARD STARTING MOTORS
CAPILLARY TUBES
CLEANING & *Legionella* BACTERIA
COMPRESSOR & CONDENSING COIL, A/C
CONDENSATE HANDLING, A/C
CONDENSATION or SWEATING PIPES, TANKS
COOL OFF HEAT Thermostat Switch
COOLING CAPACITY, RATED
COOLING COIL or EVAPORATOR COIL
COOLING LOAD REDUCTION by ROOF VENTS
COMBUSTION GASES & PARTICLE HAZARDS
CONDENSATE HANDLING, A/C
CONDENSATION or SWEATING PIPES, TANKS

DATA TAGS on AIR CONDITIONERS
DEFINITION of Heating & Cooling Terms
DEHUMIDIFICATION PROBLEMS
DEW POINT CALCULATION for WALLS
DEW POINT TABLE - CONDENSATION POINT GUIDE
DIAGNOSE & FIX AIR CONDITIONER / HEAT PUMP
DIAGNOSE & FIX HEATING PROBLEMS-BOILER
DIAGNOSE & FIX HEATING PROBLEMS-FURNACE
DUCT SYSTEM & DUCT DEFECTS
DUCTS - Asbestos
DUCT INSULATION, Asbestos Paper
DUCT INSULATION for SOUNDPROOFING
DUCT SYSTEM NOISES
DUCTS, Asbestos Transite Pipe
DUST CONTAMINATION FROM HVAC?

EDUCATION, HVAC SCHOOLS
ELECTRIC MOTOR DIAGNOSTIC GUIDE
ELECTRIC MOTOR OVERLOAD RESET SWITCH
ELECTRICAL POWER SWITCH FOR HEAT
ENERGY SAVINGS in buildings
EVAPORATOR COIL or COOLING COIL
EVAPORATIVE COOLING SYSTEMS
EXPANSION VALVES, REFRIGERANT

FAN, AIR HANDLER BLOWER UNIT
FAN AUTO ON Thermostat Switch
FAN, COMPRESSOR/CONDENSER UNIT
FAN CONVECTOR HEATERS - HYDRONIC COILS
FAN LIMIT SWITCH
FAN NOISES
FURNACES WARM AIR HEATING SYSTEMS

GAS EXPOSURE EFFECTS, TOXIC
GAS DETECTION & MEASUREMENT

Components Inspection List, Photos, Sketches

Example home inspection report language is provided to describe common air conditioning system components and their defects.

If your air conditioning or heat pump system has lost its cooling capacity or won't start see REPAIR GUIDE for AIR CONDITIONERS. See How to determine the cooling capacity of air conditioning equipment if the system seems to be working but is inadequate to cool your building. Contact us to suggest text changes and additions and, if you wish, to receive online listing and credit for that contribution.

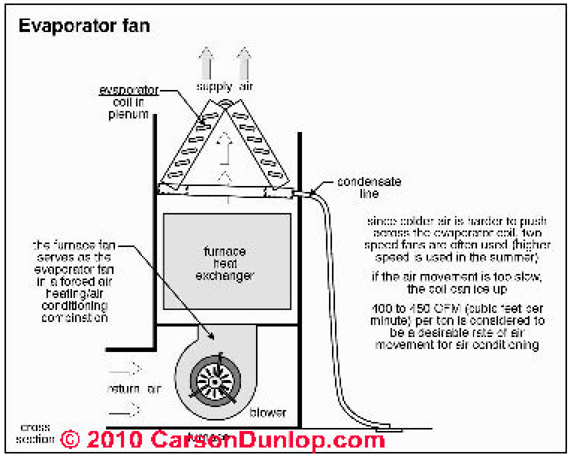
At What are the Parts of an Air Conditioning System and How do Air Conditioners Work? we explained the main parts of an air conditioning system and we described the sequence of steps that make an air conditioner work to cool indoor air. Below we begin a more detailed A/C system inspection list of air conditioning system components. If your air conditioning system is not working properly, see REPAIR GUIDE for AIR CONDITIONERS

Conventional cooling systems include the following components:

The air conditioning system (and heat pump) components introduced here are discussed in detail and are illustrated by photographs and drawings throughout this website using the links at the left of these pages. We explain how to inspect, diagnose, repair, or select, purchase, and install air conditioning systems or their individual parts and components.

List of Indoor Components of an Air Conditioning or Heat Pump System

- AIR HANDLER / BLOWER UNITS (AHU) (shown at left above and in the Carson Dunlop sketch below) which typically includes the following
    - Condensate system: water, or condensate is produced when we cool warm moist air by blowing it over the evaporator coil. The condensate runs down the coil to a collecting pan which drains to piping used to route condensate to an approved drain for disposal
    - Condensate pump on some air conditioning systems a small pump is used to collect and then pump condensate up to a building drain or other location for disposal. Condensate pumps are needed for systems which cannot dispose of the condensate by simple

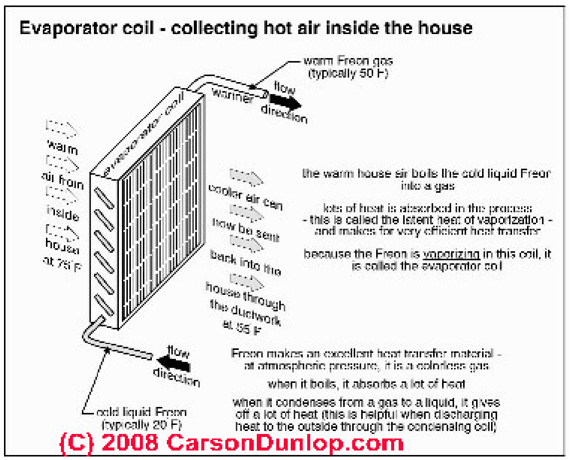


gravity flow down a drain line.

- Condensate overflow pan or tray is a container placed below the air handler when that unit is located in an attic or in other building locations where condensate leakage or overflow would otherwise spill onto building floors or into a building ceiling. The condensate overflow pan is a safety device intended to prevent unwanted spillage; normally it does not contain condensate. The condensate overflow pan should have either an independent drain to an approved location or a float switch to shut down the air conditioner should the pan become full.

- Blower fan (evaporator fan) in a blower compartment circulates building air into itself from the return ducts and return plenum, and moves that air across the evaporator coil and onwards to the supply plenum and supply ducts in the building. Blowers may be single speed, multiple speed, or variable speed, and may need to move air at different rates if the blower is used for both heating and cooling in the same duct system. Some air blowers are also rated for continuous operation.

- Electrical controls for an air conditioning system include shut-off switch(es) for service at the unit and fuses or circuit breaker(s) at the electrical panel. The fuse or circuit breaker protects the air conditioner circuit from overheating due to an overcurrent or other electrical failure.



- EVAPORATOR COIL or COOLING COIL (also called the "cooling coil" is connected to high pressure and low pressure (suction) refrigerant lines.

  High pressure refrigerant liquid, released into the cooling coil by the thermal expansion valve changes state from a liquid to a gas, causing a drop in temperature of the refrigerant and thus cooling the evaporator coil so that when we move air across the coil the air will, in turn, be cooled.

  Sketch courtesy of Carson Dunlop

- Return Plenum, connected to return duct system, is the air receiving compartment which provides air to the blower fan.

- Supply plenum connected to supply duct system, is the air collecting compartment to which building supply ducts are connected. Think of the return plenum and supply plenum as junction boxes to which return ducts or supply ducts respectively can be connected.

- Support system is the means by which an attic-mounted air handler is supported or held in place, for example

REFRIGERANT SIGHT GLASS
RETROFIT SIZING for A/C or HEAT PUMPS

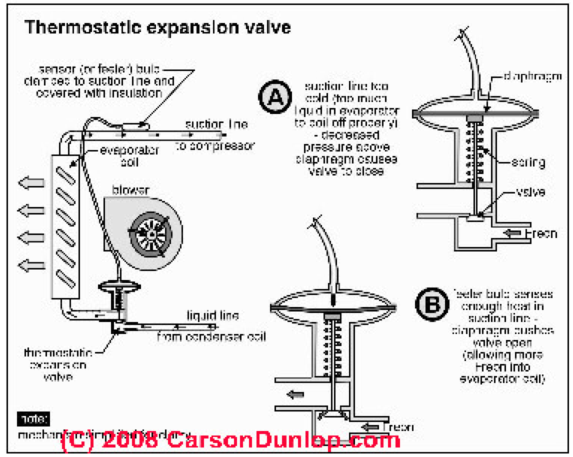
SEER RATINGS & OTHER DEFINITIONS
SYSTEM OPERATION
OPERATING CONTROLS
SAFETY CONTROLS

THERMOSTATS, HEATING / COOLING
THERMOSTATIC EXPANSION VALVES

WATER COOLED AIR CONDITIONERS
WINDOW / WALL AIR CONDITIONERS
WINDOW / WALL A/C SUPPORTS

More Information

by being suspended from the roof rafters (a quiet installation) or perhaps by being placed on supporting wood beams laid across ceiling joists.

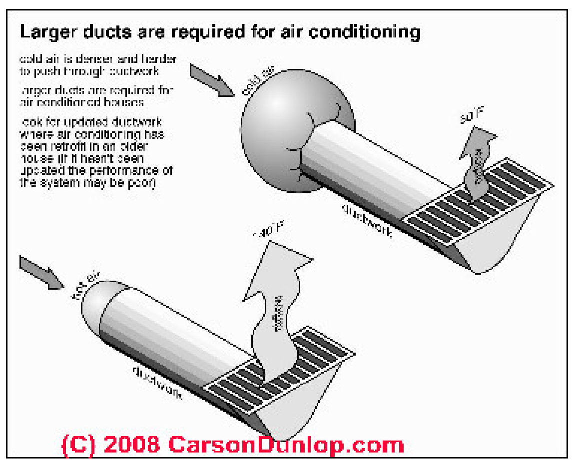


- Thermal expansion valve: an air conditioner thermal expansion valve is a device located at the cooling coil and connected between the incoming refrigerant line and the refrigerant inlet to the cooling coil in the air handler.

  The air conditioning system thermal expansion valve or "TEV" is a metering device which regulates the flow of refrigerant from the incoming high pressure side (from the compressor/condenser) into the low pressure side (in the cooling coil).

  Sketch courtesy of Carson Dunlop

- Air Filters located at the return duct air inlets, at one or more central return air inlets, or at the air handler unit itself are used to remove dust and debris from building air.
- Access ports to duct interior Commercial ducts and some residential duct systems may have inspection/cleaning access ports; residential HVAC ducts may have plugs indicating that the ducts have been cleaned in the past.
- Ductless air conditioning systems, which may also be called "split A/C systems" may employ one or more wall mounted cooling units such as shown at right above



- Return air ducts and registers collect warm moist air from the occupied space and return it to the air handler unit. Some air conditioning installations do not provide return air registers and ducts in every room and use one or more "central air return inlets" instead.

  Central air returns are most common on air conditioning retrofit installations (adding A/C to an existing building). Sketch courtesy of Carson Dunlop

- Supply air ducts and supply air registers deliver cooled air to the occupied space.

  Supply registers have the dual function of spreading out and directing the air flow into a location and permitting the regulation of air flow by opening or closing the register. Some air conditioning duct systems use small-diameter, "high velocity" ducts to deliver conditioned air to the living space.

- Supply air balancing dampers, manual and motorized zone dampers may be installed inside the supply ducts at varying locations in to permit balancing the air flow among different duct sections and thus among different building areas.

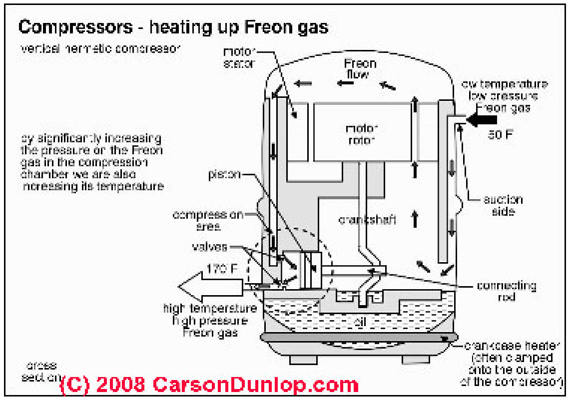
- Thermostat(s) are used to turn the air conditioning on and off and to set the desired indoor temperature. One thermostat will be located in each different air conditioning zone and will control an individual air handler unit's operation.

These components are discussed in detail and are illustrated by photographs and drawings throughout this website using the links at the left of these pages.

List & Photos of Outdoor Air Conditioning & Heat Pump System Components

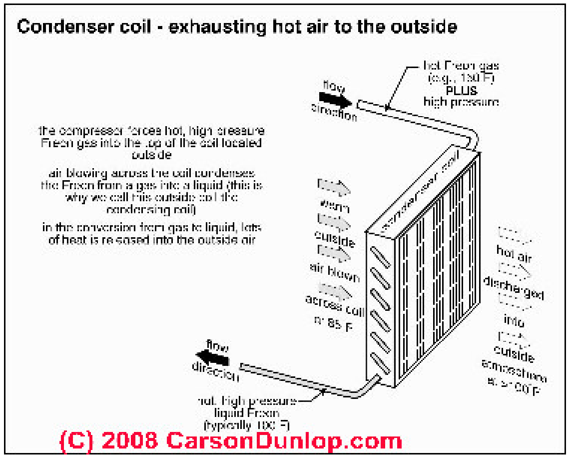
Above we show two typical compressor/condenser units outdoors. The main internal components of the compressor/condenser unit are listed below:

Compressor motor - on residential units this is normally a hermetically-sealed motor-compressor combined in a single unit like the Carrier(TM) unit shown at above left. If a ductless split-system is installed an outside compressor/condenser unit is still required, typically containing the very same functions but perhaps more compact, looking like the Sanyo(TM) unit shown at above right. Sketch courtesy of Carson Dunlop Associates.



An air conditioning compressor is a specialized pump which draws refrigerant gas back to the compressor/condenser unit from the in-building air handler and evaporator coil. The compressor compresses the returning low-pressure refrigerant gas to a high pressure (and high temperature) form.

In a "split" air conditioning system, multiple indoor evaporator coils and blower units may be served by a single outdoor compressor unit such as the Sanyo unit shown at the top of this page. That unit was handling the compressor/condenser function for two wall-mounted, ductless indoor cooling units, one of which is shown in the right hand photo at "List of Indoor Components" above. Split systems like this do not make use of ductwork.



Sketch of the condenser coil courtesy of Carson Dunlop Associates.

Condensing coil receives high pressure refrigerant gas from the compressor and cools this refrigerant gas back to a liquid state.

Electrical controls: shut-off switch(es) for service at the unit are provided to permit maintenance and repair of the equipment. Circuit breaker(s) at the electrical panel protect the circuit supplying power to the air conditioning system.

Fan an outdoor cooling fan in the compressor/condenser unit moves outdoor air across the condensing coil to cool it and assist in condensing the high pressure, high temperature refrigerant gas back into a liquid. It is this process which completes the transfer of heat through the refrigerant from indoor air to outdoor air as the compressor/condenser unit compresses and then cools the refrigerant back to a liquid.

Refrigerant lines: these pipes, typically made of copper, include a low-pressure "suction line" which returns low pressure refrigerant gas from the indoor evaporator coil (cooling coil) outlet to the outdoor compressor motor inlet.

The high pressure refrigerant line connects the compressor outlet to the outdoor condensing coil inlet (gas) and further connects the condensing coil outlet to the indoor thermal expansion valve which meters high pressure refrigerant into the "low-side" evaporator coil (cooling coil) in the air handler unit in the building.

Service valves or ports are usually present on the refrigeration lines near the compressor. These valves permit testing the condition of the air conditioning system and permit removal, replacement, or additions to the refrigerant in the system.

This photograph of a split system compressor/condenser outdoor unit shows four refrigerant lines and their sets of service ports. The larger diameter copper pipes are the low pressure or suction lines and the smaller diameter pipes are the high pressure lines returning refrigerant to the indoor cooling units.

The screw caps visible at the piping connectors where they enter the unit can be removed to provide access to special connecting valves to which the service technician can connect her set of gauges to measure system operating pressures on these lines.

Do not mess with these refrigerant service ports unless you're a trained A/C service technician. You may lose refrigerant or contaminate the system, leading to improper system operation or a costly service call.

These components are discussed in detail and are illustrated by photographs and drawings throughout this website using the links at the left of these pages.

Questions & Answers regarding this article

Questions & Answers about the components that are found on heat pumps and air conditioners.

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(July 7, 2012) DanJoeFriedman (mod) said:

Jim,

Weak air flow sounds like a coil frost blockage problem. Temp fix that is also diagnostic is to turn the system off for a few hours to let all the ice melt. If airflow rate is back to normal the coil was ice blocked - that still needs diagnosis and repair. Replace any dirty air filters and ask the tech if s/he agrees to check for a loss of refrigerant or a refrigerant metering device problem.

(July 7, 2012) Jim Grammas said:

large ball of ice around the low pressure line at the plenum, water on floor, weak air flow through registers

(June 5, 2012) DanJoeFriedman (mod) said:

Rickey, several problems can cause high current draw at an A/C system; some high current is normal at motor start-up at the compressor/condenser unit, for example. But if the run current is abnormally high, I'd suspect that the comopressor is binding, or there is a refrigerant metering valve control problem causing high head pressure.

(June 5, 2012) Rickey said:

My AC is rated at 8.5 ampere. But now it is consuming up to 13 amperes of current. Due to this stabilizer gets overheated within 1 hour. please tell me about the defects.

(May 29, 2012) DanJoeFriedman (mod) said:

Matt, some fan motors may incorporate a reset button, or you may be talking about a different reset switch for the whole unit - it'd be described in the operating manual for the unit and is model dependent.

There are other failures, such as a bad contactor relay, that can prevent the outside unit from starting.

(May 27, 2012) matt said:

i cant get my outside unit to work checked all wiring and fuses the only thing i cant find is
the reset pressure button according to the schematics its optional on my unit

---

(May 2, 2012) DanJoeFriedman (mod) said:

Bobby, try the diagnostic starting point link at page left titled DIAGNOSE & FIX AIR CONDITIONER / HEAT PUMP

(May 1, 2012) bobby said:

when the uni t ,it starts and gets cold ,and alittle while,then the fan on the outside unit stops it stops cooling

---

(Feb 18, 2012) DanJoeFriedman (mod) said:

Hema I agree;

(Nov 9, 2011) Hema said:

If the A/C keeps running but never reaches the set temperature of the thermostat first be sure that y our air filter is clean or just replace it and that you have good airflow. If you have good airflow but the air never cools you need a service call.

(showing 1 to 10)

Recommend / Share this Article

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also include a list of recommended books for the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

AIR CONDITIONING & HEAT PUMP SYSTEMS

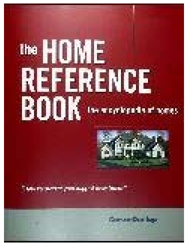
- Carson, Dunlop & Associates Ltd., 120 Carlton Street Suite 407, Toronto ON M5A 4K2. (416) 964-9415 1-800-268-7070 info@carsondunlop.com. The firm provides professional home inspection services & home inspection education & publications. Alan Carson is a past president of ASHI, the American Society of Home Inspectors. Thanks to Alan Carson and Bob Dunlop, for permission for InspectAPedia to use text excerpts from *The Home Reference Book* & illustrations from *The Illustrated Home*. Carson Dunlop Associates' home inspection education products include
  - The ASHI-adopted Home Inspection Training Program, and Commercial Building Inspection Courses
  - The Home Inspection Home Study Course, and publications such as
  - The Home Reference Book, a reference & inspection report product for building owners & inspectors
  - The Home Reference *eBook*, an electronic version for PCs, the iPad, iPhone, & Android smart phones
  - Home Inspection Report writing materials, including the Horizon Software System that manages business operations, scheduling, & inspection report writing using Carson Dunlop's knowledge base & color images. The *Horizon* system runs on always-available cloud-based software for office computers, laptops, tablets, iPad, Android, & other smartphones.
  - The Illustrated Home illustrates construction details and building components, a reference for owners & inspectors
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- Thanks to Scott at SJM Inspect for suggesting this EPA document and for technical editing remarks regarding our air conditioning website, SJM Inspection Service LLC, serves the entire state of CT, sjminspect.com 203-543-0447 or 203-877-4774 5/16/07

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia

Bookstore. Also see our Book Reviews - InspectAPedia.

- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia Bookstore.



- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

  Or choose the The Home Reference eBook for using this reference on PCs, Macs, Kindle, iPad, iPhone, or Android Smart Phones

Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

- Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982
- Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- NEW!
  Air Conditioning SEER - New DOE Air Conditioner and Heat Pump Efficiency Standard
- Asbestos HVAC Ducts and Flues field identification photos and guide
- Fiberglass: Indoor Air Quality Investigations: Fiberglass in Indoor Air, HVAC ducts, and Building Insulation

- ...

InspectAPedia®

Free Encyclopedia of Building & Environmental Inspection, Testing, Diagnosis, Repair

Search
InspectAPedia

Ask a Question or Search InspectAPedia

HOME | AIR CONDITIONING | ELECTRICAL | EXTERIORS | HEATING | HOME INSPECTION | INTERIORS | PLUMBING | ROOFING | SEPTIC SYSTEMS | STRUCTURE | WATER SUPPLY
ENERGY SAVINGS | ENVIRONMENT | INDOOR AIR IAQ | INSULATION | MOLD INSPECT TEST REMOVE | NOISE | ODORS | SOLAR ENERGY | VENTILATION | EXPERTS DIRECTORY | CONTACT US

Mobile View
AIR CONDITIONING CONTROLS & SWITCHES

BLOWER FAN CONTINUOUS OPERATION
BLOWER FAN OPERATION & TESTING
BOILER CONTROLS & SWITCHES

Circulator Pumps & Relays
CAPACITORS for HARD STARTING MOTORS
COMPRESSOR & CONDENSING COIL, A/C
CONDENSATE PUMPS
COOL OFF HEAT Thermostat Switch

DIAGNOSE & FIX AIR CONDITIONER / HEAT PUMP
DIRECT VENTS / SIDE WALL VENTS
DIRECTORY of OIL TANK EXPERTS

ELECTRIC MOTOR DIAGNOSTIC GUIDE
ELECTRIC MOTOR OVERLOAD RESET SWITCH
ELECTRICAL POWER SWITCH FOR HEAT

How to Find & Reset the Thermal Overload Switch on Electric motors

InspectAPedia® - ShareThis +1

- How to find and reset the thermal overload switch found on many electric motors
- Electric Motor Troubleshooting Guide - Diagnostic Table
- How to reset the motor switch on a furnace or air conditioner blower fan unit
- How to reset the motor switch on water pumps and well pumps
- Electric motor troubleshooting guide for electric motors that won't start
- Electric motor troubleshooting guide for electric motors that overheat
- Questions & answers on electric motor problems, motor overheating, thermal overload protection devices

This article describes how to find and reset the thermal overload button on an electric motor and we give suggestions for repairing hard-starting or non-starting electric motors such as on air conditioning condenser fans and blower fans.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

The page top photo was taken of of an oil burner electric motor not an air conditioning blower fan motor or pump motor, but you'll see that all of these electric motors look a lot alike. Sometimes the reset button on an electric motor is hard to find, and *sometimes there is no reset button*!. But this photo shows the red reset button most clearly. We provide a diagnostic guide to problems with electric motors at ELECTRIC MOTOR DIAGNOSTIC GUIDE.

In addition to our discussion of the ELECTRIC MOTOR OVERLOAD RESET SWITCH discussed here, if you are looking for

Float Switch on Condensate Tray
FURNACE CONTROLS & SWITCHES

HEATING SYSTEMS

LIGHT, GUIDE to FORENSIC USE
LOST COOLING CAPACITY
LOW VOLTAGE TRANSFORMER TEST

MANUALS & PARTS GUIDES - HVAC

NO HEAT - BOILER
NO HEAT - FURNACE
NOISE / SOUND DIAGNOSIS & CURE

OIL BURNERS

Reset Switch - Heater Primary Control
Reset Switch Broken - Quick Repair
Reset Switch - Electric Motors
Reset Switch - Stack Relays

Spill Switches - gas fired heaters
Stack Relay - Heater Control Reset Switch

THERMOSTATS, HEATING / COOLING
THERMOSTATS, WATER HEATER

WATER HEATERS
WATER PUMP CONTROLS & SWITCHES
WATER PRESSURE LOSS DIAGNOSIS & REPAIR
WATER PRESSURE PROBLEM DIAGNOSIS TABLE
WATER PUMP TYPES & LIFE EXPECTANCY

More Information

the *main burner reset button* on heating equipment you'll want to see: Aquastat Functions and Cad Cell Relay Switch Flame Sensors (hot water boilers and some water heaters), Stack Relay Switch on older oil fired boilers and furnaces, SPILL SWITCHES (gas fired equipment), and LOW WATER CUTOFF CONTROLS on steam heating systems. Controls on well pumps and water supply equipment that may require reset or repair are discussed at CONTROLS & SWITCHES on WATER TANKS. And see CAPACITORS for HARD STARTING MOTORS for advice on adding or replacing a start/run capacitor for an electric motor that has trouble starting.

 Use page top links to major topics or use links at the left of each page to navigate ***within*** topics and documents at this website. Green links show where you are in a document series or at this website.

How to Find and Reset a Heating System or Air Conditioning Electric Motor

Electric motor overload reset buttons - how to find and reset motor overload switches

An electric motor used in lots of equipment may include overload reset button on the motor body. If the motor is overloaded or if it overheats, this button will pop "out" indicating that an internal electric safety device has tripped,shutting the motor off.

Once the motor has cooled sufficiently it can be re-started, usually by pushing the popped-out reset switch back down.

If the motor turns off again on re-set you should not keep running it as it may be damaged and the system may be unsafe.

Tips for Finding the Motor Reset Button

Find the electric motor that operates the device that has been shut down. For example on a warm air heating system or central air conditioning system look in the air handler/blower compartment.

On the blower motor itself, look for a red or yellow button which is normally flat with the motor surface but which will pop up to show that the motor has been shut off by its internal overload protection circuit.

If the installer rotated the motor so that the button is facing away from you and impossible to see, feel around on the bottom and back side of the motor for the button's presence. Especially if the motor's internal protection has tripped, it should be easy to feel the button since it'll be sticking up about 1/2".

When and How to Reset the Electric Motor on a Heating Blower, Air Conditioner Blower, or Water Pump

When the air conditioner fan or blower motor has cooled sufficiently this button can usually be simply pressed back down to "reset" the switch. If the motor overload switch won't reset (stay depressed) either the motor is still too hot (wait) or there is another failure that needs diagnosis. Sometimes the reset button is present but hard to find, depending on the position in which the motor was bolted in place.

What the Reset Button Looks Like When it has Not Tripped

You can see that in this picture the button is flush with the motor surface. Sometimes these buttons are hard to find but they are usually present on heating and air conditioning system electric motors for fans and blowers.

Electric Motor Troubleshooting Guide

Some of the electric motor troubleshooting suggestions in this list can be found at the Betta-Flo Jet Pump Installation Manual from the National Pump Co.

See ELECTRIC MOTOR DIAGNOSTIC GUIDE for full details. Excerpts below.

Things to Check if an Electric Motor Will Not Start

Using a well pump motor as an example, most of these troubleshooting tips pertain to other electric motor applications in buildings too such as in an air conditioning air handler blower compartment

Motor Trouble Cause	Diagnostic Procedure	Repair Procedure
Electrical Power is Off	Check that all service switches for the equipment are in the "on" position. Check for voltage at the pump motor or pump controls. If no voltage is found, check for voltage at the electric panel. If power is on to the building, check fuse or circuit breaker serving the electric motor that won't run. Check for local reset button on the motor (popped out = off) Check for other power reset or power off buttons such as an access door compartment safety switch that turns off power to the equipment (found on A/C blower compartment doors)	Turn on "off" switches. Replace bad fuse. Reset circuit breaker; if necessary replace bad circuit breaker. Let hot electric motor cool down, then push in its reset button. Be sure all safety interlock switches such as on compartment doors are depressed and that the doors are securely shut. Replace a bad safety switch. See ELECTRICAL POWER SWITCH FOR HEAT FAN AUTO ON Thermostat Switch WATER PUMP ELECTRICAL SWITCHES CIRCUIT BREAKER FAILURE ELECTRIC PANEL INSPECTION
Blown fuse, tripped breaker	Replace fuse or breaker - does the pump run and keep running normally?	Be sure proper breaker or fuse size in ampacity is installed - ELECTRIC PANEL INSPECTION
Low voltage to the motor	Check with VOM at the pressure control switch or at the motor wiring	Be sure the proper size of wire is used for the ampacity and length of circuit; Test for low voltage to the building.
Loose, improper, or broken motor wire	Check wiring against the motor installation manual diagram, check all connections for tightness, shorts, burns, damage	Rewire or repair or replace wiring
	Check the control switch contacts for burning or wear.	For water pumps, adjust or replace the pressure control switch.

Bad motor control switch	If the motor control is a well pump pressure control switch,check the pressure control switch settings - cut-in and cut-out; inspect for burned, pitted switch contacts or for dirt or wear.	Temporary emergency repair by cleaning the switch contacts may be possible. See WATER PUMP PRESSURE CONTROL
Bad water pump control switch tubing	Clogged or leaky tubing connecting a water pump pressure control switch to the water system results in failure to properly sense and respond to water pressure. Debris clogging can also occur in the bottom of the pressure control switch where it mounts or connects to the tubing.	Check and clear tubing blockage (blow air through tubing). Or install new tubing. Be sure tubing is proper diameter and type to seal properly with other fittings. Tighten tubing fittings to be sure there are no water or air leaks. Soap solution may help find air leaks in tubing fittings. Clear or replace clogged pressure control switch if the bottom sensor opening is clogged and cannot be cleared. See WATER PUMP PRESSURE CONTROL REPAIR PUMP PRESSURE CONTROL REPLACE
Bad mechanical parts being turned by the motor - e.g. blower assembly or well water pump impeller	Turn off electric power to motor, see if you can move the impeller or blower assembly or motor shaft - if it won't turn it is jammed or damaged	Remove obstruction in mechanical components, inspect for and replace damaged parts or a frozen electric motor itself
Bad electric motor starting capacitor	Use a VOM in ohms setting to check resistance across the capacitor. If the meter does not move (no current flows) the capacitor is "open". If there is zero resistance the capacitor is shorted.	Replace the starting capacitor. See CAPACITORS for HARD STARTING MOTORS
Electric motor is shorted out, jammed, burned out, or defective	Fuse blows or breaker trips as soon as the motor tries to turn on. If the external wiring is ok (no short circuits) the motor is shorted internally Check that the pump pressure control switch is trying to turn on the pump and that there is voltage at the pump wiring	Replace the electric motor or have it repaired and rebuilt by a specialist
Bad thermal overload protection device	History of heavy electric motor usage, overheating, going off on thermal reset. The thermal protection device may itself have failed from frequent usage and tripping.	Replace the thermal overload protection device and test the motor for good operation.

Things to Check if an Electric Motor Starts but Overheats and Trips its Reset Button		
See ELECTRIC MOTOR OVERLOAD RESET SWITCH for how to find and reset this button		
Bad line voltage	Use a VOM to check the voltage level at the pressure control switch	If voltage is too low, check voltage at the electrical panel and check that the proper size wiring was used for the ampacity and length of run and that there are no partial shorts or damaged wires or connectors
Incorrect motor wiring	Check the actual electrical wiring against the motor wiring diagram or the installation manual for the equipment	Reconnect wiring properly
Motor is too hot due to surroundings - inadequate ventilation	Check the air temperature where the motor is located. If the air temperature is over 100 degF, the pump may be too hot and its thermal overload switch tripping because of the environment, not a pump problem.	Install adequate ventilation, or if needed, shading, or relocate the motor/equipment to a cool location
Motor subjected to repeated overloading, overheating	A motor subjected to overloading due to very long duty on-cycles may run hot and trip the thermal overload protection device. Eventually the thermal overload switch may itself fail and the motor will no longer restart nor can you reset the thermal overload switch.	Check the recommended duty cycle and loading on your motor; check also for abnormally low voltage levels in the electrical supply. If necessary, replace the motor with a heavier-duty unit.
Motor for a water pump operates too long at low water pressure	If the well recovery rate is too poor and the pump is operating at low water pressure, possibly because a tailpiece is installed to prevent air injection and pump burnup, the pump may be overheating.	Install a valve on the water discharge line and reduce water flow to increase water pressure inside the pump itself. See WATER PRESSURE PROBLEM DIAGNOSIS TABLE

General advice: Electrical Tests to Check HVAC Blower Fan Motor or Outdoor Compressor Fan Motor Winding on Heating or Cooling Equipment or on Other Electrical Motors

See USING DMMs VOMs SAFELY. Example: testing a blower fan motor winding: referring to the electrical diagram for your equipment, unplug electrical connectors at the fan motor. Measure the resistance between each lead wire with a multimeter or VOM. The multimeter should be set in the X1 range. For accuracy, don't measure when the fan motor is hot, allow it to cool off.

When the resistance between each lead wire are those listed in the specifications for your equipment the fan motor should be normal. Zero resistance or infinite resistance are indicators of a problem. More examples of checking wiring: see BURNED-OUT COMPRESSOR. See HARD STARTING COMPRESSOR MOTORS also TIGHT or SEIZED AC COMPRESSORS for more details about old or failed compressor motors. Also see Test a Motor Starting Capacitor

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

DIAGNOSE & FIX AIR CONDITIONER / HEAT PUMP

ELECTRIC MOTOR DIAGNOSTIC GUIDE
ELECTRIC MOTOR OVERLOAD RESET SWITCH
ELECTRICAL POWER SWITCH FOR HEAT

Float Switch on Condensate Tray
FURNACE CONTROLS & SWITCHES

HEATING SYSTEMS
LIGHT, GUIDE to FORENSIC USE
LOST COOLING CAPACITY
LOW VOLTAGE TRANSFORMER TEST

MANUALS & PARTS GUIDES - HVAC
NO HEAT - BOILER
NO HEAT - FURNACE
NOISE / SOUND DIAGNOSIS & CURE
Air Leak Noises
AIR CONDITIONING & HEAT PUMP NOISES
AIR HANDLER / BLOWER NOISES
COMPRESSOR CONDENSER NOISES
DUCT SYSTEM NOISES
FAN NOISES

OIL BURNERS

Reset Switch - Heater Primary Control
Reset Switch Broken - Quick Repair
Reset Switch - Electric Motors
Reset Switch - Stack Relays

Spill Switches - gas fired heaters
Stack Relay - Heater Control Reset Switch

WATER HEATERS
WATER PUMP CONTROLS & SWITCHES
WATER PRESSURE LOSS DIAGNOSIS & REPAIR
WATER PRESSURE PROBLEM DIAGNOSIS TABLE
WATER PUMP TYPES & LIFE EXPECTANCY

Questions & Answers regarding this article

Questions & answers on electric motor problems, motor overheating, thermal overload protection devices

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(2 days ago) DanJoeFriedman (mod) said:

Kim, that's a relief. In that case it sounds as if either there is a shorted wire or the motor is binding up and drawing high current at start-up. There is a chance that the service tech can get the motor running for a while longer by installing a hard-start capacitor on the motor - but it sounds as if the motor is going to need replacement.

(3 days ago) Kim said:

Hi Dan. Sorry! I didnot make it clear. It is the individual circuit breaker tripping. The breaker that assign to the furnace/Ac unit only. Thank.

(3 days ago) DanJoeFriedman (mod) said:

Kim,

An unsafe electrical circuit or bad breaker is certainly part of your problem - you should shut down the system and call a licensed electrician.

I infer this because you say that the MAIN breaker is tripping off - which means that within the electrical panel you have an overcurrent on the blower circuit but that individual circuit breaker is NOT TRIPPING - a dangerous condition asking for a fire.

So even if the root problem is a bad blower motor, a hard starting motor, a bad atart/run capacitor, or a seized motor, the fact that the individual circuit breaker doesn't trip means bigger trouble.

(4 days ago) Kim said:

My blower unit keep tripping off the main circuit breaker power switch. After resetting the circuit, the unit works fine. It happens more frequent now. What is the probable cause?

(July 19, 2012) DanJoeFriedman (mod) said:

Larry I see by your noting on this particular page that we're on the same track - if the blower doesn't run indeed the coil can ice over. The fact that the fan runs on manual makes it sound as if there is a control switch or relay problem, maybe even a bad wiring connection. I'd spend some time tracking down that wiring and control in the air handler.

(July 19, 2012) Larry said:

my air conditioner will run fine until it kicks off after it cools the house to the temp setting. The fan will not kick on so it freezes up. You can let it unthaw and put fan on manuel and it works fine for days until you put fan back to auto. Have changed thermostat, switch and compasitor but will still freeze up on auto, also checked freon no leaks.

(July 12, 2012) vjm said:

FIXED!!! stuck limit switch on the furnace door.

(July 12, 2012) vjm said:

Outside Carrier condenser unit working fine. Fan blades running. Normal sounds. No cool air in the house because the blower fan located in the (Payne) furnace compartment will not turn on. Won't go on either with "fan auto" setting or with "fan on" setting. Triple digits today! TIA

(July 11, 2012) Cindi said:

Our Carrier unit is only 5 yrs old. Outside unit motor running but the fan blades are not turning. Some cool air is blowing out but not much. Inside fan working. Could this be a bad fan motor. Really not wanting to have to buy another unit.

(June 19, 2012) DanJoeFriedman (mod) said:

John you are writing about thermostat wiring on a page about electric motor resets. You might want to check out the diagnostic articles found under THERMOSTATS, HEATING / COOLING - link at page left.

If you shorted a wire you could have damaged the thermostat, its transformer, or another component.

(showing 1 to 10)

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also list books on the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- CARSONDUNLOP Carson, Dunlop & Associates Ltd., 120 Carlton Street Suite 407, Toronto ON M5A 4K2. (416) 964-9415 1-800-268-7070 info@carsondunlop.com. The firm provides professional home inspection services & home inspection education & publications. Alan Carson is a past president of ASHI, the American Society of Home Inspectors. Thanks to Alan Carson and Bob Dunlop, for permission for InspectAPedia to use text excerpts from *The Home Reference Book* & illustrations from *The Illustrated Home*. Carson Dunlop Associates' home inspection education products include
  - The ASHI-adopted Home Inspection Training Program, and Commercial Building Inspection Courses
  - The Home Inspection Home Study Course, and publications such as
  - The Home Reference Book, a reference & inspection report product for building owners & inspectors
  - The Home Reference *eBook*, an electronic version for PCs, the iPad, iPhone, & Android smart phones
  - Home Inspection Report writing materials, including the Horizon Software System that manages business operations, scheduling, & inspection report writing using Carson Dunlop's knowledge base & color images. The *Horizon* system runs on always-available cloud-based software for office computers, laptops, tablets, iPad, Android, & other smartphones.
  - The Illustrated Home illustrates construction details and building components, a reference for owners & inspectors
- Additional technical contributors & reference sources listed below

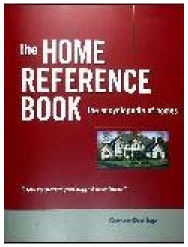
Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

AIR CONDITIONING CONTROLS & SWITCHES
BOILER CONTROLS & SWITCHES
ELECTRIC MOTOR OVERLOAD RESET SWITCH
FURNACE CONTROLS & SWITCHES
MANUALS & PARTS GUIDES - HVAC
OIL BURNERS
Reset Switch - Heater Primary Control
Reset Switch Broken - Quick Repair
Reset Switch - electric motors
Spill Switches - gas fired heaters
Stack Relay - Heater Control Reset Switch
WATER PUMP CONTROLS & SWITCHES

- Typical Deep Well Two Line Jet Pump Installation, Grove Electric, G&G Electric & Plumbing, 1900 NE 78th St., Suite 101, Vancouver WA 98665 www.grovelectric.com - web search -7/15/2010 original source: http://www.groverelectric.com/howto/38_Typical%20Jet%20Pump%20Installation.pdf

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia Bookstore.



- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

  Or choose the The Home Reference eBook for using this reference on PCs, Macs, Kindle, iPad, iPhone, or Android Smart Phones

Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

- Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982
- Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- NEW!
  Air Conditioning SEER - New DOE Air Conditioner and Heat Pump Efficiency Standard
- Asbestos HVAC Ducts and Flues field identification photos and guide
- Fiberglass: Indoor Air Quality Investigations: Fiberglass in Indoor Air, HVAC ducts, and Building Insulation

- ...

InspectAPedia®

Free Encyclopedia of Building & Environmental Inspection, Testing, Diagnosis, Repair

Search
InspectAPedia

Ask a Question or Search InspectAPedia

HOME | AIR CONDITIONING | ELECTRICAL | EXTERIORS | HEATING | HOME INSPECTION | INTERIORS | PLUMBING | ROOFING | SEPTIC SYSTEMS | STRUCTURE | WATER SUPPLY

ENERGY SAVINGS | ENVIRONMENT | INDOOR AIR IAQ | INSULATION | MOLD INSPECT TEST REMOVE | NOISE | ODORS | SOLAR ENERGY | VENTILATION | EXPERTS DIRECTORY | CONTACT US

Mobile View
AIR CONDITIONING & HEAT PUMP SYSTEMS

A/C - HEAT PUMP CONTROLS & SWITCHES
A/C DATA TAGS
A/C - HEAT PUMP CRITICAL DEFECTS
A/C DIAGNOSTIC FAQs
A/C REFRIGERANTS
A/C TYPES, ENERGY SOURCE
AGE of AIR CONDITIONERS & HEAT PUMPS
AIR CLEANER PURIFIER TYPES
AIR CONDITIONER BTU CHART
AIR CONDITIONER COMPONENT PARTS
AIR CONDITIONER TYPES, ENERGY SOURCES
AIR CONDITIONER NOT WORKING
AIR FILTER EFFICIENCY
AIR FILTERS, FIBERGLASS PARTICLES
AIR FILTERS for HVAC SYSTEMS
Air Filter Accessibility
Air Filter Bypass Leakage

Continuous HVAC Blower Fan Operation for Optimum Indoor Air Quality

InspectAPedia® - ShareThis

- How to improve indoor air quality by continuous blower fan operation in the heating or cooling air handler
- Indoor air filtration using the heater or air conditioner blower fan
- Why & how to run the blower fan continuously indoors
- Warnings about proper blower fan duty cycle and fan speed to avoid blower fan motor failure
- Can condensate in the air handler raise indoor humidity?
- Questions & Answers about whether or not to run the heating or air conditioning blower fan continuously

Continuous blower unit fan operation guide: this article explains how and why to set your air conditioning or heating system blower fan to continuous operation in order to improve indoor air quality by increased and continuous indoor air filtration. (Naturally if there is an IAQ problem source in the building it is essential to also find and correct that condition. This website answers almost any question you might ask about air filters for heating or air conditioning systems.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

 Use page top links to major topics or use links at the left of each page to navigate ***within*** topics and documents at this website. Green links show where you are in a document series or at this website.

Why Run an Air Conditioner or Heating Blower Fan Continuously?

For maximum IAQ improvement in buildings: for the new blower installation we selected a fan unit which had both the capability of delivering adequate CFM of air flow and a blower fan motor duty cycle which permits continuous operation if we wish to run the system that way. Running the blower continuously at low speed resulted in continual air scrubbing in the building. When the heating or cooling needs of the building require, the fan shifts automatically to high speed. Here are the details:

There are reasons to leave the fan in the ON position on a heating or cooling system, but we do not recommend that you do this without first asking for advice from your heating and service technician.

If your air conditioner or heating system fan blower unit was designed to permit the fan to run all of the time that's great and you can consider the benefits of continuous fan operation we list just below.

But if your fan motor was not intended for continuous duty and you run the fan that way, you may find the motor fails prematurely.

Here are some possible advantages of continuous blower fan operation

- Improved air filtration, lower indoor dust levels - this is particularly true if you have a good air filter system installed. In our forensic lab when we installed a new gas furnace we asked the installer to include a multi speed fan (the fan chooses the needed speed automatically), a fan rated for continuous duty cycle, and we specified that the air filter system include HEPA filtration as well as an electrostatic air cleaner. We also included a cheap disposable filter at the air returns.

  This fan plus filter design permitted us to run the blower fan continuously in our lab, regardless of whether or not the heat was running (we don't need central air). We measured airborne dust levels in the building before and after installation of the new system and found that indoor dust levels improved by at least one order of magnitude.

  This system was enormously more effective than the dust filtration capacity of any free-standing "air cleaner" found on the popular consumer product market. That's because a warm air central heating system or central air conditioning system blower and duct work move many more cubic feet of air per minute through the filter system than a free-standing room "air cleaner" or "air purifier" can handle.

- Increased building comfort: especially if a multi-speed or variable speed fan motor is included in the system design, the continuous movement of air in the building avoids sudden hot or cold blasts when heating or air conditioning turns on; indoor air temperatures tend to be more even.

Here are some disadvantages of continuous air conditioner or heating system blower fan operation

- Energy use: A downside of continuous blower fan operation is higher electrical costs. On the other hand, if we needed to reduce building dust and allergen levels and/or increase comfort levels, this approach might avoid wasting money on other attempts at air cleaning that are expensive and less effective. More careful study is needed to really evaluate the claim that continuous blower fan operation uses more overall energy. In some cases there may be a net energy savings, depending on how hard the heating or cooling system has to work to satisfy the thermostat (and occupants) during "on" cycles.

- Equipment life: if the blower motor is not rated for continuous duty operation, it may need replacement sooner when continuous fan operation is used. In this case be sure the new blower is rated for continuous duty.

How to Put the Air Conditioner or Heat Pump Blower Fan into Continuous-On Operation

Most heating or cooling systems have one or perhaps two methods for turning the blower fan to continuous "on":

1. The thermostat may include a "Fan On" position - try moving the fan switch from "Auto" to "Fan On". See our photo at the top of this page.
2. The fan limit switch located in the blower compartment may include a "Manual Fan" Switch.

To find this manual fan switch, see the articles, photos, and sketches in these articles How to Test the Fan & Limit Control and see How to Install the Fan & Limit Control found in our article series about the FAN LIMIT SWITCH . See the white knob at lower left in our fan limit switch photo at left. The cover has been removed from the switch in this picture.

Air Filtration Suggestions

See these articles about how to use air filters, where to buy them, and how to turn on and off HVAC blower fans

- AIR FILTERS for HVAC SYSTEMS - about air filters
- AIR FILTERS, OPTIMUM INDOOR - optimum filter designs for best filtration
- CONTINUOUS BLOWER FAN OPERATION - advantages of continuous air filtration in improving indoor air quality
- AIR FILTER EFFICIENCY - how air filter effectiveness is measured
- FIBERGLASS & AIR FILTERS - questions and opinions about fiberglass shedding hazards from air filters
- SOURCES FOR AIR FILTERS - where to buy air filters
- OTHER AIR CLEANERS
- Other Switches on a Room Thermostat - how to set the HVAC blower fan to continuous operation, and what to do if the blower fan won't turn on or won't turn off
- OZONE AIR PURIFIER WARNINGS

Questions & Answers regarding this article

Questions & Answers about whether or not to run the heating or air conditioning blower fan continuously

Question: what is the relationship between continuous blower fan operation and indoor humidity where central air is installed? Can condensate in the air handler raise indoor humidity?

Edgardo:

A disadvantage I found running the AC fan continuously in my residence, was a noticeable increase in the humidity in the house. The fan would blow across the wet coils and drain pan while the compressor wasn't running and put the water it had removed from the air during the prior cooling cycle back into the living space. So I stopped doing that. - Edgardo

Reply: from DF

Edgardo, thanks for the comment, it's an opportunity to clear up some confusion.

When your compressor is not running the cooling coil in your air handler is not cool and NO condensate will be produced in the unit. So if you are seeing too much water in the air handler, including as you say, while the compressor is not running, then more likely your condensate drain system is not draining adequately and a reservoir of condensate is remaining in the air handler condensate drip tray.

You should not see standing water there ever. If you do, the drip tray is not draining and the tray or drain system need to be cleared and repaired. Details about condensate handling are in the article titled CONDENSATE HANDLING, A/C and details about target levels for indoor humidity are at HUMIDITY LEVEL TARGET.

Edgardo:

Hi Dan The pan drains fine, and the backup secondary pan is dry. I am not seeing any unusual amount of water. The problem I mentioned is caused simply by evaporation back into the living space of the residual condensation left on the coils and in the pan when the compressor shuts off. The parts can't be instantly dry when the compressor shuts off. Anyway I do run the fan more continuously in the winter, as between cycles the air will settle in the house and can be close to 50° at the floor when it's 75° 5 feet off the floor. Keeping the fan on keeps the air mixed up and I can run the heat a degree or two lower.

Dan:

Edgardo I'm surprised that the volume of water left on the cooling coil after the A/C system shuts off would provide a measurable quantity of total humidity in the living space. Consider the total volume of water that's resting on the coils (as you explain the drain pan is dry) - it has to be less than a quart. Evaporate a quart of water into the cubic feet of air in even a small home - it just would not be likely to explain an indoor humidity problem.

I agree that running the fan gives much better air distribution and more even temperatures (and RH) throughout the home.

If you are seeing high indoor RH I'd look at whether or not the system is dehumidifying adequately when it's running. Incidentally, as we explain at DEHUMIDIFICATION PROBLEMS, an oversized A/C unit will cool but won't dehumidify the space.

Try making some actual RH measurements throughout the A/C cycle and let us know what you're seeing. See Tools for Measuring Humidity.

Edgardo:

I mentioned before that the main pan drains fine, but it will still be wet until the residual evaporates, and the secondary pan is dry which is there in case the primary pan drain gets clogged. There should never be water in that secondary catch pan otherwise the main drain is clogged. Anyway, all that is normal. I have access to the condensate drain pipe, and yesterday afternoon I put it into a gallon jug and captured almost a half-gallon of condensate water in 1 hour.

Relative humidity in the house right now is 42%. Temperature is 78°. I have a 1953-built frame house that I think cost about $8,000 new when it was built. Needless to say it has lousy insulation and leaks air everywhere, and moisture up from the crawl space. So I think the AC does well all things considered. Oversized system? Don't think so. It can just keep up with the heat load, and cycle off once in a while when it's 100°+ outside. We have some pretty extreme summer weather and humidity conditions in Texas and the system handles it pretty well with reasonably low electricity usage.

Dan:

Edgardo I agree that if your RH is down to 42% that's a suggestion that the A/C is both cooling and dehumidifying and is not oversized. Perhaps taking some RH measurements at regular intervals and when the system is cycling on and off will give a more clear picture of the indoor RH.

It just doesn't seem likely to me that the volume of moisture residual in a wet but otherwise drained condensate pan would explain a measurable variation in indoor RH in the rest of the building. That volume of water evaporated into the volume of air in a building could not explain high indoor RH. It may be more likely that if the home is poorly insulated and more, drafty, indoor Rh climbs along with temperature between cooling cycles.

Also if the RH was coming from the ductwork as a prime source when the system is off, you'd find higher RH at the duct openings as well as evidence of airflow out of the ducts when the cooling system was off. But be sure to measure RH at both the return and supply sides and registers so we're not confused by cycling higher RH house air with moisture coming from other sources or outdoors. Some measurements ought to clear that up.

Please also be sure to take a look at DEHUMIDIFICATION PROBLEMS where we describe some sources of and cures for high indoor humidity in buildings.

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(1 days ago) DanJoeFriedman (mod) said:

Rob

Interesting. I suppose thermostat contact bounce or a bad heat anticipator or bad TT could be at fault - I'd try removing the TT wires from the TT and tying them together to call for cooling - if the system runs ok then we know it's the thermostat. If the problem continues it's the TT wiring or a control board.

And of course check out and clean/free up that zone damper.

(2 days ago) Rob said:

Thanks DanJoe,
It sounds more like the Auto setting is sending Open and close signals to the zone damper and the zone damper is stuck or something and gives off a rythmic ping 1 2 ping 1 2 ping etc. Also, I have noticed condensation water splashing out from around the white drain pipe, almost like the drain is clogged and water is trying to find a place to go. I think something shorted out from the water maybe?

(3 days ago) DanJoeFriedman (mod) said:

Rob, if you heard the vent/duct noise when the equipment was not running then it's probably not the equipment itself but perhaps duct noises that occur due to a temperature change (cooling night air, shrinking sheetmetal).

(4 days ago) Rob said:

Last night we were awoken by a pinging noise coming from the vents that stopped as soon as we clicked the fan switch to on. When we switched back to auto the ping noise happened again. It sounds like something is broken somewhere in a damper or something. Anyone know what could cause this?

(July 5, 2012) DanJoeFriedman (mod) said:

Not sure, Linda. I think you're saying the A/C works with the thermostat (TT) set in "AUTO" but when you turn the fan to full-time "ON" the A/C will not turn on at all. If that thermostat control setting is the ONLY thing you're changing, and provided you're not in the process moving the system out of COOL mode, I'd suspect a switch problem in the thermostat, in a relay or control board in the equipment. Perhaps you can send me a photo of your thermostat and its controls.

(July 5, 2012) Linda said:

The air conditioner is working fine and delivering cold air but when I have the fan on the "on" position, it just won't come on. What might the problem be?

(May 29, 2012) DanJoeFriedman (mod) said:

Annie Marie B.

If you have no cool air or not enough cool air the system will just keep running as the thermostat is never satisfied. Provided both indoor and outdoor units are running, and airflow is not blocked (say by a dirty filter) you need a service call. Diagnostic details are at LOST COOLING CAPACITY (article link at page left).

(May 29, 2012) Annie Marie Bonniville said:

about my centeral air conditioner if the weather is 80 out side and I set my thermo at 72 my air conditioiner never cut's off HELP HELP THANK'S

(May 3, 2012) Bart said:

Hi,
My A/C isn't coming on, so we first checked the thermostat. I used a jump wire and when I jumped R and W together the fan blower came on but the unit itself didn't kick on. I then jumped the Y and G terminals to test the thermostat, but the fan blower didn't come on. I read where if the blower doesn't come on when jumping the Y and G terminals that the problem was not likely the thermostat. We are going to buy a new thermostat(probably need a newer one anyhow) and intall it. If this does not work, what would be the most obvious problems that I could check myself? We don't have the money for a repairman.. Thank you

(May 2, 2012) Greg said:

AC and fan run continouley what should I check?

(showing 1 to 10)

Recommend / Share this Article

+1 ShareThis

EMAIL

Print

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also include a list of recommended books for the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts

and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

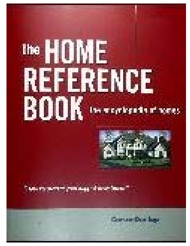
Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

- Thanks to Mark Cramer, Tampa Florida, for assistance in technical review of the "Critical Defects" section and for the photograph of the deteriorating gray Owens Corning flex duct in a hot attic. Mr. Cramer is a Florida home inspector and home inspection educator.
- Thanks to Jon Bolton, an ASHI, FABI, and otherwise certified Florida home inspector who provided photos of failing Goodman gray flex duct in a hot attic.
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- Wikipedia provided background information about the definition of HEPA and airborne particle interception.

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia Bookstore.

- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450



illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

Or choose the The Home Reference eBook for using this reference on PCs, Macs, Kindle, iPad, iPhone, or Android Smart Phones

Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

- Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982
- Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- NEW!
  Air Conditioning SEER - New DOE Air Conditioner and Heat Pump Efficiency Standard
- Asbestos HVAC Ducts and Flues field identification photos and guide
- Fiberglass: Indoor Air Quality Investigations: Fiberglass in Indoor Air, HVAC ducts, and Building Insulation
- ...

Guide to Heating & Cooling Electrical Power Switches

InspectAPedia® - ShareThis
EMAIL

- A guide to finding and using electrical power switches for heating and cooling systems
- Where do we find the emergency-off switch for heating furnaces and boilers?
- What are the basic components of hot air heating systems?
- Troubleshooting heating system furnace controls
- How to inspect & repair hot air heating systems - Furnaces
- Questions & Answers about the emergency off switch on heating equipment

This article describes the usual location and function of electrical switches that control power to all types of heating equipment. We explain the purpose and use of heating system emergency "off" switches.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

 Use page top links to major topics or use links at the left of each page to navigate ***within*** topics and documents at this website. Green links show where you are in a document series or at this website.

A Guide to Finding & Using Electrical Power Switches to Turn On or Off Heaters for Furnaces & Boilers, Heat Pumps or Electric Furnaces or Air Conditioners

If your building has lost heat, checking that the heating equipment is actually turned "on" at all of these switches is a first step in diagnosing the problem. This website answers most questions about central heating system troubleshooting, inspection, diagnosis, and repairs. We describe how to inspect, troubleshoot and repair heating and air conditioning systems to inform home owners, buyers, and home inspectors of common heating system defects.

The articles at this website describe the basic components of a home heating system, how to find the rated heating capacity of an heating system by examining various data tags and components, how to recognize common heating system operating or safety defects, and how to save money on home heating costs. We include product safety recall and other heating system hazards.

Because some controls are used in common on hot water heat, hot air heat, and steam boilers, readers should see these other articles: see BOILER CONTROLS & SWITCHES, and also see BOILER COMPONENTS & PARTS for a detailed list of heating boiler controls, other heating system components, parts such as circulator pumps & draft regulators. If your building uses warm air heat, see FURNACE CONTROLS & SWITCHES. If your building uses steam heat see STEAM HEATING SYSTEMS. Also see Heat Won't Turn Off - Stop Unwanted Heat.

Readers needing to find and fix un-wanted air leaks, heat losses, or other energy wasters should see HEAT LOSS DETECTION TOOLS. Readers should see ENERGY SAVINGS RETROFIT CASE STUDY and also see HEAT LOSS DETECTION TOOLS and INSULATION INSPECTION & IMPROVEMENT for energy saving retrofit detailed guides. Also see GAS PIPING, VALVES, CONTROLS for more details on how to inspect and test LP and natural gas piping, controls, valves, and tanks.

Electrical power switches on heating and cooling systems: where will the power switches be located, how do we know if we have turned on power to the heating or cooling system?

Our page top photo shows a typical emergency off switch for a heating system. Our photo at left shows a fuse box that is used to accomplish the same purpose, though this older switch is more likely to be found near the entry to a basement where heating equipment is located.

Electrical switches that turn off electric power that operates any type of heating system: furnace, boiler, steam boiler, heat pump, electric heat, are required for both safety and for service.

An emergency off switch for the building heating system should be found outside of the basement or other boiler or furnace room location and accessible so that an occupant can, in an emergency, turn off heat without having to enter a possibly smoky or dangerous area.

A second electrical "off" service switch should be found on or very close to the heating equipment itself. This second service switch is used by the heating service technician.

A third electrical switch or fuse turns off power to the heating equipment service at the building electrical panel. If a circuit breaker has tripped or a fuse has blown on the heating equipment's electrical circuit, you may be able to restore heat at the electrical panel.

But for safety reasons it is important to determine why the fuse blew or the circuit breaker tripped. If you replace a fuse or re-set a circuit breaker and the fuse blows or circuit breaker trips again, do not restore electrical power to that circuit - call a service technician to diagnose and repair the problem.

Questions & Answers about the emergency off switch on heating equipment

Question: My mom turns the boiler “service” red switch on and off all the time

My mom turns the boiler “service” red switch on and off all the time and I am worried that it is a danger. She has oil heat that primes a burner and I'm afraid that she is turning it off when the system is still on and demanding heat (programmed thermostat in other apt. units)and that this will create fumes, or some kind of buildup or off gassing. There is no need for her to do this. She is elderly and is not thinking rationally. Can you advise please? Thank you in advance, Her daughter, K.E.

Reply: What sort of problems may be caused by frequent turning of the oil heat switch "on" and "off"?

A competent onsite inspection by an expert usually finds additional clues that help accurately diagnose a problem or in this case that might indicate whether frequent "on-off" switching of the oil heater emergency off switch has caused an operating problem such as sooting-up of the combustion chamber or oil burner nozzle.

That said, here are some things to consider about using the emergency off switch on an oil fired heating system or oil fired water heater:

Infrequent (once a day or less often) turning on or off of an oil fired heating appliance (heating boiler or water heater, for example) at the service switch like the one you describe would not cause damage to the equipment though, of course, if someone leaves heat off in freezing weather a freeze-up in the building could lead to very costly damage.

Just turning off the oil burner, provided the system has reached full operating temperature, would not be expected to cause a problematic level of fumes or smells in the building.

Watch out: But frequent "on-off" switching of an oil fired appliance when it is in use (calling for heat or calling for hot water) could lead to a more subtle operating problem: it takes about five minutes for an oil fired heating appliance to reach full operating temperature.

Up until that time the system is not running as cleanly as it does at full temperature, it's a bit more smoky/sooty. So if someone keeps turning the system on and off frequently such that it does not sufficiently often reach full operating temperature, the result could be sooting and ultimately a clogged oil burner nozzle, leading to improper operation, inefficient operation, or even in the most extreme case, loss of heat.

Why don't you ask your mom why she's been turning the system on and off to see if you can find another way to ease her concerns.

How to Identify, Reset, or Adjust Heating or Air Conditioning System Controls and Switches

For details about the setting, re-setting, or function of the controls and switches commonly found on hot air heating systems see these articles:

- A/C - HEAT PUMP CONTROLS & SWITCHES - list of controls and switches found on air conditioners and heat pumps
- Air Bleeder Valves for Hot Water Heating Systems: Radiators, Baseboards, Convectors
- Aquastats Heating Boiler Primary Controls: A guide to Aquastats for control of hot water heating boilers and tankless coils
- BLUE vs YELLOW COMBUSTION FLAMES - the Blueray history and blue flame vs. yellow flame combustion, flame color & combustion efficiency, & how oil competes with gas as a heating fuel.
- BOILER CONTROLS & SWITCHES - list of controls and switches found on hot water heating systems
- CAD CELL RELAY SWITCH on oil fired furnaces or boilers as flame sensors & safety devices
- Check Valves Guide to check valves and backflow preventers on hydronic hot water heating systems gas or oil fired
- Draft Hoods on gas fired heating equipment, function and safety
- Draft Regulators & barometric dampers on oil fired heating equipment

- ELECTRICAL POWER SWITCH FOR HEAT - emergency heat on-off switches and equipment service switches
- Expansion Tanks Guide to pressure control and expansion tanks on hydronic hot water heating systems gas or oil fired
- Fan Limit Switch on hot air furnace heating systems gas or oil fired
- Flue Gas Spill Switch on gas fired heating equipment sense combustion and protect from blocked flues
- FURNACE CONTROLS & SWITCHES - list of the controls and switches found on hot air heating systems
- Gas Piping, Valves, Controls including gas regulator assembly and other controls
- Heat Won't Turn Off - Stop Unwanted Heat explanation of why heat may continue to come out of radiators or baseboards even though you have turned down the thermostat
- Heating Boiler System Components - dictionary of heating boiler components
- Hot Air Heating Furnace Basic Operating Steps
- MIXING / ANTI-SCALD VALVES: Guide to mixing valves on hot water heating systems and radiant heat systems
- Power Switches to turn on or off heaters for furnaces & boilers, oil & gas fired, heat pumps or electric furnaces or boilers
- RELIEF VALVES - TP VALVES: A guide to temperature and pressure relief valves & safety controls on hot water and steam heating systems
- Stack Relay Switches Explained on oil fired furnaces or boilers as flame sensors & safety devices
- STEAM HEATING SYSTEMS - steam heating system components, switches, diagnosis & repair guides
- Thermostats & Heat Controls for furnaces & boilers, oil & gas fired, heat pumps or electric furnaces or boilers
- Water Feed Valves: A guide to water-feeding/pressure-reducing valves on hot water and steam heating systems
- Zone Dampers: A guide to automatic or electrical zone dampers in heating or air conditioning ductwork
- Zone Valves: A guide to zone valves for heating zone control on hot water heating systems

Questions & Answers regarding this article

.

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(Apr 15, 2012) DanJoeFriedman (mod) said:

Could be power is off, or the thermostat is set to a temp higher than the current actual room temp, or an actual equipment problems. Search InspectAPedia for "How to Diagnose & Repair Loss of Air Conditioner / Heat Pump Cooling Capacity or an Air Conditioner that is Not Working". To see a diagnostic procedure

WATER SOFTENERS & CONDITIONERS
WINTERIZE A BUILDING
WOOD, COAL STOVES & FIREPLACES
WOOD STOVE SAFETY

ZONE VALVES

More Information

(Apr 15, 2012) wanda said:

what would be the problem if you turn on your ac is on auto and your fan in your unit is not running?

Recommend / Share this Article

+1 ShareThis
EMAIL
Print

...

Technical Reviewers & References

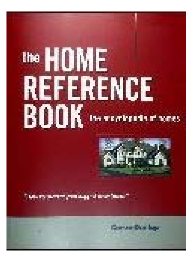
- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also include a list of recommended books for the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

ELECTRICAL POWER SWITCH FOR HEAT

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.



- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 2010, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. InspectAPedia.com® author/editor Daniel Friedman is a contributing author. Field inspection worksheets are included at the back of the volume.

- Carbon Monoxide Gas Toxicity, exposure limits, poisoning symptoms, and inspecting buildings for CO hazards

DUST CONTAMINATION FROM HVAC? An Investigation of Indoor Dust Debris Blamed on a Heating/Cooling System Reveals Carpet Dust

- *Fuel Oil & Oil Heating Magazine*, 3621 Hill Rd., Parsippany, NJ 07054, 973-331-9545
- Goodman Furnace High Temperature Plastic Vent HTPV safety recall US CPSC notice
- Home Heating System Should Be Checked *[for proper venting and for CO Carbon Monoxide Hazards - DJF]*
- Inspection Procedures for Oil-Fired Heating Systems Detailed step by step approaches for inspecting complex systems]
- Lennox Pulse Furnace Safety Inspection/Warranty Program: Carbon Monoxide Warning
- Oil Tanks - The Oil Storage Tank Information Website: Buried or Above Ground Oil Tank Inspection, Testing, Cleanup, Abandonment of Oil Tanks
- Oil Tanks Above Ground, UL Standards, guidance for home owners, buyers, and inspectors
- Plastic Heating Vent Pipe & Other Heating Safety Recall Notices
- Weil McLain Model GV Gas Boiler/gas valve CPSC recall/repair
- *Domestic and Commercial Oil Burners*, Charles H. Burkhardt, McGraw Hill Book Company, New York 3rd Ed 1969.
- *National Fuel Gas Code* (Z223.1) $16.00 and National Fuel Gas Code Handbook (Z223.2) $47.00 American Gas Association (A.G.A.), 1515 Wilson Boulevard, Arlington, VA 22209 also available from National Fire Protection Association, Batterymarch Park, Quincy, MA 02269. Fundamentals of Gas Appliance Venting and Ventilation, 1985, American Gas Association Laboratories, Engineering Services Department. American Gas Association, 1515 Wilson Boulevard, Arlington, VA 22209. Catalog #XHO585. Reprinted 1989.
- *The Steam Book*, 1984, Training and Education Department, Fluid Handling Division, ITT [probably out of print, possibly available from several home inspection supply companies] Fuel Oil and Oil Heat Magazine, October 1990, offers an update,
- *Principles of Steam Heating*, $13.25 includes postage. Fuel oil & Oil Heat Magazine, 389 Passaic Ave., Fairfield, NJ 07004.
- *The Lost Art of Steam Heating*, Dan Holohan, 516-579-3046 FAX
- *Principles of Steam Heating*, Dan Holohan, technical editor of *Fuel Oil and Oil Heat* magazine, 389 Passaic Ave., Fairfield, NJ 07004 ($12.+1.25 postage/handling).
- *"Residential Steam Heating Systems"*, Instructional Technologies Institute, Inc., 145 "D" Grassy Plain St., Bethel, CT 06801 800/227-1663 [home inspection training material] 1987
- "Residential Hydronic (circulating hot water) Heating Systems", Instructional Technologies Institute, Inc., 145 "D" Grassy Plain St., Bethel, CT 06801 800/227-1663 [home inspection training material] 1987
- "Warm Air Heating Systems". Instructional Technologies Institute, Inc., 145 "D" Grassy Plain St., Bethel, CT 06801 800/227-1663 [home inspection training material] 1987
- Heating, Ventilating, and Air Conditioning Volume I, Heating Fundamentals,
- Boilers, Boiler Conversions, James E. Brumbaugh, ISBN 0-672-23389-4 (v. 1) Volume II, Oil, Gas, and Coal Burners, Controls, Ducts, Piping, Valves, James E. Brumbaugh, ISBN 0-672-23390-7 (v. 2) Volume III, Radiant Heating, Water Heaters, Ventilation, Air Conditioning, Heat Pumps, Air Cleaners, James E. Brumbaugh, ISBN 0-672-23383-5 (v. 3) or ISBN 0-672-23380-0 (set) Special Sales Director, Macmillan Publishing Co., 866 Third Ave., New York, NY 10022. Macmillan Publishing Co., NY
- *Installation Guide for Residential Hydronic Heating Systems*
- *Installation Guide #200,* The Hydronics Institute, 35 Russo Place, Berkeley Heights, NJ 07922
- The ABC's of Retention Head Oil Burners, National Association of Oil Heat Service Managers, TM 115, National Old Timers' Association of the Energy Industry, PO Box 168, Mineola, NY 11501. (Excellent tips on spotting problems on oil-fired heating equipment. Booklet.)
- Links to our list of additional information on heating system inspection, repair, maintenance
- ...

- HOME
- AIR CONDITIONING
- ELECTRICAL
- EXTERIORS
- HEATING
- HOME INSPECTION
- INTERIORS
- PLUMBING
- ROOFING
- SEPTIC SYSTEMS
- STRUCTURE
- WATER SUPPLY

- ENERGY SAVINGS
- ENVIRONMENT
- INDOOR AIR IAQ
- INSULATION
- MOLD INSPECT TEST REMOVE
- NOISE
- ODORS
- SOLAR ENERGY
- VENTILATION
- EXPERTS DIRECTORY
- CONTACT US

Guide to Air Conditioning & Heat Pump Refrigerant Gases, Refrigerant Metering Devices, Refrigerant Piping & Leak Detection

InspectAPedia® - ShareThis +1

- Consumer Information about A/C Refrigerant Gases and R-22 substitute gases, US EPA information updated to 2012.

Mobile View
AIR CONDITIONING & HEAT PUMP SYSTEMS

A/C - HEAT PUMP CONTROLS & SWITCHES
A/C DATA TAGS
A/C - HEAT PUMP CRITICAL DEFECTS
A/C DIAGNOSTIC FAQs
A/C REFRIGERANTS
A/C TYPES, ENERGY SOURCE
AGE of AIR CONDITIONERS & HEAT PUMPS
AIR CLEANER PURIFIER TYPES
AIR CONDITIONER BTU CHART
AIR CONDITIONER COMPONENT PARTS
AIR CONDITIONER TYPES, ENERGY SOURCES
AIR CONDITIONER NOT WORKING
AIR FILTER EFFICIENCY
AIR FILTERS, FIBERGLASS PARTICLES
AIR FILTERS for HVAC SYSTEMS
AIR FLOW MEASUREMENT CFM
AIR HANDLER / BLOWER UNITS
APPLIANCE EFFICIENCY RATINGS

BACKUP HEAT for HEAT PUMPS
BLOWER DOORS & AIR INFILTRATION
BLOWER FAN CONTINUOUS OPERATION
BLOWER FAN OPERATION & TESTING
BOOKSTORE - Air Conditioning "How To" Books

CAPACITORS for HARD STARTING MOTORS
CAPILLARY TUBES
CLEANING & *Legionella* BACTERIA
COMPRESSOR & CONDENSING COIL, A/C
CONDENSATE HANDLING, A/C
CONDENSATION or SWEATING PIPES, TANKS
COOL OFF HEAT Thermostat Switch
COOLING CAPACITY, RATED
COOLING COIL or EVAPORATOR COIL
COOLING LOAD REDUCTION by ROOF VENTS
COMBUSTION GASES & PARTICLE HAZARDS
CONDENSATE HANDLING, A/C
CONDENSATION or SWEATING PIPES, TANKS

DATA TAGS on AIR CONDITIONERS
DEFINITION of Heating & Cooling Terms
DEHUMIDIFICATION PROBLEMS
DEW POINT CALCULATION for WALLS
DEW POINT TABLE - CONDENSATION POINT GUIDE
DIAGNOSE & FIX AIR CONDITIONER / HEAT PUMP
DIAGNOSE & FIX HEATING PROBLEMS-BOILER
DIAGNOSE & FIX HEATING PROBLEMS-FURNACE
DUCT SYSTEM & DUCT DEFECTS
DUCTS - Asbestos
DUCT INSULATION, Asbestos Paper
DUCT INSULATION for SOUNDPROOFING
DUCT SYSTEM NOISES
DUCTS, Asbestos Transite Pipe
DUST CONTAMINATION FROM HVAC?

EDUCATION, HVAC SCHOOLS
ELECTRIC MOTOR DIAGNOSTIC GUIDE
ELECTRIC MOTOR OVERLOAD RESET SWITCH
ELECTRICAL POWER SWITCH FOR HEAT
ENERGY SAVINGS in buildings
EVAPORATOR COIL or COOLING COIL
EVAPORATIVE COOLING SYSTEMS
EXPANSION VALVES, REFRIGERANT

- R22 refrigerant phase-out schedule; photographs of R12 and R22 dispenser canisters & charging gauges
- Alternatives to R22 refrigerant - "R" refrigerants: R-410A (GENETRON AZ-20, SUVA 410A, and Puron), R-134A R-407C.
- Properties of R410-A Puron® refrigerant and usage advice
- List of all common and historic air conditioning refrigerants & their characteristics
- Questions & answers about air conditioning, heat pump & refrigeration equipment gases, refrigerant metering devices, capillary tubes, TE valves, and refrigerant leak detection

Refrigerant gases, metering devices & piping: this article series describes the properties of common and historic air conditioning refrigerants. We combine U.S. EPA information with supplemental data and descriptions of refrigerants, refrigerant replacement options for R12 and R22, and their basic data. Air conditioning refrigerants and agents to transfer heat from one place to another have been in use for a long time and include Ammonia, Sulfur Dioxide, Hydrocarbons like methane, methyl chloride, and methylene chloride, and safer (inert gas) HFCs like R11 (common in older refrigerators and some air conditioners) and R22 (common in older cooling equipment. Since the realization that HFC's contribute to greenhouse gas problems in the environment, R11 and R22 have been discontinued and are being replaced with alternatives including R-410A (GENETRON AZ-20, SUVA 410A, and Puron (R-410A)), R-134A R-407C.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

 Use page top links to major topics or use links at the left of each page to navigate *within* topics and documents at this website. Green links show where you are in a document series or at this website.

Guide to HVACR Gases, Refrigerants, Metering, Piping, & Leaks

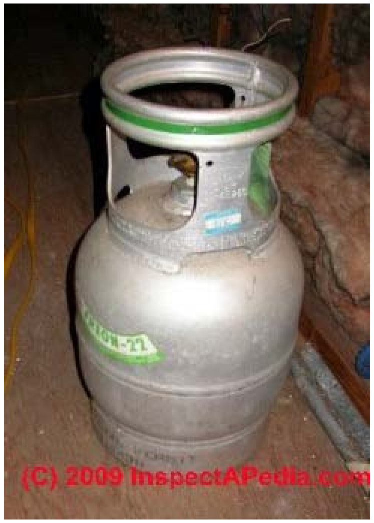
Properties of Various Air Conditioning Gases and Cooling Refrigerants

See REFRIGERANT LEAK REPAIR see PRESSURE READINGS, COMPRESSOR, and A/C REFRIGERANT LEAK DETECTION for more details.

- **Ammonia** is the oldest-known refrigerant. (Ammonia can generate cooling by simple mechanical movement). Ammonia vapor can be flammable, explosive, and toxic. Ammonia is lighter than air (so less likely to accumulate at a dangerous level near the floor). Ammonia is still used as a refrigerant in some large refrigeration systems.

- **Sulphur dioxide** SO_2 is obsolete and would be unusual to encounter except in very old cooling equipment. SO_2 is not flammable nor explosive but with moisture is very corrosive and can injure plants. If you have refrigeration equipment using SO_2 you should junk it - few or no service people will try to service or fix this equipment.

- **Hydrocarbons** such as methane CH_4, isobutane C_4H_{10}, and propane C_3H_8 are often used as fuels and sold as bottled gas. Methyl chloride CH_3CL has also been used as has methylene chloride CH_2CL_2. These halogenated hydrocarbons are less flammable; Carrene No.1 was a popular trade product version of methylene chloride (the safest of these).



- **Freon & Genetron**: Chemists also tried using carbon tetrachloride CCL_4 as a refrigerant by adding two chlorine atoms to produce CCL_2F_2 which founded the "R" refrigerant family R12 (by convention in a white canister) and R22 (by convention green canisters or the antique green-labeled canister shown at left).

  R-12 refrigerant has a boiling point of -21degF at 1ATM of pressure (sea level). And R12 has the cute property of being at 70 psi when at 70 degF temperature. Our photo at page top shows an old R-12 refrigerant canister and our air conditioning compressor charging and test gauge set.

  R-14 refrigerant (automotive & other uses such as in the semiconductor industry as Tetrafluoromethane) has a boiling point of -128 C and a latent heat of vaporization (1.013 bar at boiling point) = 135.7 kJ/kg

  R-22 refrigerant: Our photo (left) shows an antique R-22 refrigerant dispensing canister. R22 has the not quite as cute property of being at 122 psi when at a temperature of 70 degF.

  These HCFC or "CFC" refrigerants were very safe (non combustible, non-toxic to humans except as an oxygen displacer) and were the most widely used until their effects in the atmosphere were understood as a serious environmental problem. The 1987 Montreal Protocol which banned their use is discussed below.

- **Puron®, R-410, R-134, R134A, R407 R407C,** Modern refrigerants replacing the original "R" Freon series include R-410A (GENETRON AZ-20, SUVA 410A, and Puron®), R-134A R-407C. These new gases have wide use. For example, the refrigerant gas R-134A is used in medications such as propellant in bronchiodialators for asthmatics like Xopenex HFA™.

  Modern refrigerants are sold in canisters ranging in size including 10lb, 15lb, 30lb and 100lb, typically at a cost per pound for liquid refrigerant. These canisters are not normally intended to be refilled, and you should not return used refrigerant gases to them either, as you risk contaminating the new refrigerant with moisture or debris.

  Details about the properties & usage guidelines for Puron®, R-410, are provided below at Properties Puron® (R-410A) Refrigerant Gas

- **Water** as a refrigerant was used and continues to be used to effect heat transfers in cooling tower type air conditioning systems and in "swamp coolers" which work effectively where ambient humidity is low enough to produce a good evaporation rate, such as in the American southwest. (Concerns for bacterial hazards such as *Legionella* occur in these systems and are discussed at CLEANING A/C EQUIPMENT

DISCLAIMER: EPA [and this website reproducing this public-domain article] seeks to promote energy efficiency and

WATER COOLED AIR CONDITIONERS
WINDOW / WALL AIR CONDITIONERS
WINDOW / WALL A/C SUPPORTS

More Information

the safe use of ozone- friendly substances, and does not endorse any particular company or its products.

Safety Warnings & Other Caveats about Using Refrigerant Liquids or Gases & When Servicing Refrigeration Equipment

Watch out: any refrigerant gas and gas container, including the small refrigerant canisters sold for automotive use in charging automobile or truck air conditioners can be dangerous if not properly handled.

Liquid refrigerant can injure an eye and can also cause frostbite. You should cover refrigerant lines or connectors or valves when opening them so that if liquid refrigerant escapes it is controlled. And on at least some refrigerant containers such as the automotive maintenance canisters you'll see warnings about the need for eye protection and other protective measures.

Also some refrigerant gases form highly toxic phosgene gas if released across an open flame, so if a flame is present near where refrigerant gases are being used for service be sure there is good fresh air ventilation.

Refrigerant Gas Asphyxiation hazards: Modern refrigerant gases are heavier than air as well as being odorless and colorless. The gases themselves, such as the Freon family, are not toxic and not explosive. But because the gases are heavier than air, if you were so foolish as to release a sufficient volume of gas into an enclosed space or even a low-lying outdoor area where there is no wind or indoors no ventilation, you could become asphyxiated with little or no warning.

Do not mix refrigerant gases. Each refrigerant gas has its own unique properties. If you were to mix gases within a refrigeration system the properties of the mixture would be unpredictable, making it impossible to properly adjust and operate the equipment.

Do not arbitrarily substitute refrigerant gases by charging refrigeration equipment with a gas other than the one for which it is labeled, for the same reason as above. We discuss replacement refrigerants below.,

Background: Ban on Production and Imports of Ozone-Depleting Refrigerants

In 1987 the Montreal Protocol, an international environmental agreement, established requirements that began the worldwide phase out of ozone-depleting CFCs (chlorofluorocarbons). These requirements were later modified, leading to the phase out in 1996 of CFC production in all developed nations. In addition, a 1992 amendment to the Montreal Protocol established a schedule for the phase out of HCFCs (hydrochlorofluorocarbons). HCFCs are substantially less damaging to the ozone layer than CFCs, but still contain ozone-destroying chlorine. The Montreal Protocol as amended is carried out in the U.S. through Title VI of the Clean Air Act, which is implemented by EPA.

An HCFC known as R-22 has been the refrigerant of choice for residential heat pump and air-conditioning systems for more than four decades. Unfortunately for the environment, releases of R-22 that result from system leaks contribute to ozone depletion. In addition, the manufacture of R-22 results in a by-product that contributes significantly to global warming.

As the manufacture of R-22 is phased out over the coming years as part of the agreement to end production of HCFCs, manufacturers of residential air conditioning systems are beginning to offer equipment that uses ozone-friendly refrigerants. Many homeowners may be misinformed about how much longer R-22 will be available to service their central A/C systems and heat pumps. This fact sheet provides information about the transition away from R-22, the future availability of R-22, and the new refrigerants that are replacing R-22. This document also assists consumers in deciding what to consider when purchasing a new A/C system or heat pump, or when having an existing system repaired.

Phase out Schedule for HCFCs used in Air Conditioning Equipment, Including R-22

Under the terms of the Montreal Protocol, the U.S. agreed to meet certain obligations by specific dates that will affect the residential heat pump and air-conditioning industry:

January 1, 2004 HCFC Refrigerant Reduction Target

In accordance with the terms of the Montreal Protocol, the amount of all HCFCs that can be produced nationwide must be reduced by 35% by 2004. In order to achieve this goal, the U.S. is ceasing production of HCFC-141b, the most ozone-damaging of this class of chemicals, on January 1, 2003. This production ban will greatly reduce nationwide use of HCFCs as a group, making it likely that the 2004 deadline will have a minimal effect on R-22 supplies.

January 1, 2010 HCFC Refrigerant Reduction Target

After 2010, chemical manufacturers may still produce R-22 to service existing equipment, but not for use in new equipment. As a result, heating, ventilation and air-conditioning (HVAC) system manufacturers will only be able to use pre-existing supplies of R-22 to produce new air conditioners and heat pumps. These existing supplies would include R-22 recovered from existing equipment and recycled.

January 1, 2020 HCFC Refrigerant Reduction Target

Use of existing refrigerant, including refrigerant that has been recovered and recycled, will be allowed beyond 2020 to service existing systems, but chemical manufacturers will no longer be able to produce R-22 to service existing air conditioners and heat pumps.

For more information about this phase out, see fact sheets about the HCFC Phase out Schedule and Frequently Asked Questions on the HCFC Phase out

What Does the R-22 Phase out Mean for Consumers?

Availability of R-22

The Clean Air Act does not allow any refrigerant to be vented into the atmosphere during installation, service, or retirement of equipment. Therefore, R-22 must be recovered and recycled (for reuse in the same system), reclaimed (reprocessed to the same purity levels as new R-22), or destroyed. After 2020, the servicing of R-22-based systems will rely on recycled refrigerants.

It is expected that reclamation and recycling will ensure that existing supplies of R-22 will last longer and be available to service a greater number of systems. As noted above, chemical manufacturers will be able to produce R-22 for use in new A/C equipment until 2010, and they can continue production of R-22 until 2020 for use in servicing that equipment. Given this schedule, the transition away from R-22 to the use of ozone-friendly refrigerants should be smooth. For the next 20 years or more, R-22 should continue to be available for all systems that require R-22 for servicing.

Cost of R-22

While consumers should be aware that prices of R-22 may increase as supplies dwindle over the next 20 or 30 years, EPA believes that consumers are not likely to be subjected to major price increases within a short time period. Although there is no guarantee that service costs of R-22 will not increase, the lengthy phase out period for R-22 means that market conditions should not be greatly affected by the volatility and resulting refrigerant price hikes that have characterized the phase out of R-12, the refrigerant used in automotive air-conditioning systems.

Using Alternatives to R-22 in Residential Air Conditioning

As R-22 is/ was gradually phased out, non-ozone-depleting alternative refrigerants are / were being introduced. Under the Clean Air Act, EPA reviews / reviewed alternatives to ozone-depleting substances like R-22 in order to evaluate their effects on human health and the environment.

EPA has reviewed several of these alternatives to R-22 and has compiled a list of substitutes that EPA has determined are acceptable.

> One of these R-22 substitutes is R-410A, a blend of hydrofluorocarbons (HFCs), substances that do not contribute to depletion of the ozone layer, but, like R-22, contribute to global warming. R-410A is manufactured and sold under various trade names, including GENETRON AZ-20®, SUVA 410A®, and Puron®.

Additional refrigerants on the list of acceptable substitutes include R-134a and R-407C. These two refrigerants are / were not yet available for residential applications in the U.S., but are commonly found in residential A/C systems and heat pumps in Europe. EPA will continue to review new non-ozone-depleting refrigerants as they are developed.

Watch out: Using an alternative refrigerant to R-22 in older air conditioners and heat pumps requires more than just using a different gas (such as Puron R410-A). Other components in the system (such as refrigerant metering devices) will usually require change or adjustment. Be sure to consult the individual air conditioner or heat pump application guidelines and installation or service manual – Air Conditioners and Heat Pumps Using Puron Refrigerant [Carrier or other manufacturer] to obtain required unit changes for specific applications and for R--22 retrofit.

Properties Puron® (R-410A) Refrigerant Gas [updated 2012]

- Puron refrigerant operates at 50 - 70 percent higher pressures than R-22. Be sure that servicing equipment and replacement components are designed to operate with Puron refrigerant
- Puron refrigerant cylinders are rose colored.
- Recovery cylinder service pressure rating must be 400 psig, DOT 4BA400 or DOT BW400.
- Puron refrigerant systems should be charged with liquid refrigerant. Use a commercial type metering device in the manifold hose when charging into suction line with compressor operating
- Manifold sets should be 700 psig high side and 180 psig low side with 550 psig low--side retard.
- Use hoses with 700 psig service pressure rating.
- Leak detectors should be designed to detect HFC refrigerant.
- Puron refrigerant, as with other HFCs, is only compatible with POE oils.
- Vacuum pumps will not remove moisture from oil.
- Do not use liquid-line filter driers with rated working pressures less than 600 psig.
- Do not leave Puron suction line filter driers in line longer than 72 hours.
- Do not install a suction-line filter drier in liquid line.
- POE oils absorb moisture rapidly. Do not expose oil to atmosphere.
- POE oils may cause damage to certain plastics and roofing materials.
- Wrap all filter driers and service valves with wet cloth when brazing.
- A factory approved liquid--line filter drier is required on every unit.
- Do NOT use an R--22 TXV.
- If indoor unit is equipped with an R--22 TXV or piston metering device, it must be changed to a hard shutoff balanced port Puron TXV.
- Never open system to atmosphere while it is under a vacuum.
- When system must be opened for service, recover refrigerant, evacuate then break vacuum with dry nitrogen and replace filter driers. Evacuate to 500 microns prior to recharging.
- Do not vent Puron refrigerant into the atmosphere.
- Do not use capillary tube coils.
- Observe all warnings, cautions, and bold text.
- All indoor coils must be installed with a hard shutoff balanced port Puron TXV metering device.

Source: PURONR (R--410A) REFRIGERANT QUICK REFERENCE GUIDE-[5]

Other Replacements for R12 Refrigerants

There are replacement gases for certain of the now banned refrigerants discussed in this article. Quoting Zeller 1998 [1]

> *Suva MP39 and Suva MP66 are a mixture of 3 components, HCFC-22, HFC- 152A and ACFH-124, which have been created to replace CFC-12 in medium temperatures. The majority of compressors for CFC-12 can adapt to the use of MP39 and MP66 easily and economically. This allows for the equipment already installed to continue in service during their lifetime.*

The two new refrigerants demonstrate many properties which have been im- proved towards the ozone and the environment, in comparison with CFC-12.

The MP mixtures are compatible with the majority of the materials used for the construction of the CFC systems. The composition of each mixture has been selected to be compared with the efficiencies of CFC-12 in specified applications, in energetic capacity and efficiency. This gives as a result a minimal mechanical interruption when CFC-12 is replaced with MP66 or MP39. Other refrigerants like the HCFC-22 or the HCFC-134A, require an extensive mechanical intervention in the systems when they are replaced, which will at times be expensive.

MP66 and MP39 give the user the chance to change refrigerants without spend- ing much in modifications to the CFC-12 systems. CFC-134A can also be used in evaporation temperatures lower than -7 C and 20 F but can demonstrate less capacity in these temperatures than the CFC-12, to cover the whole range of temperatures of the CFC-12, we also have the MP66 and the MP39. [1]

Servicing existing A/C units

Existing units using R-22 can continue to be serviced with R-22. There is no EPA requirement to change or convert R-22 units for use with a non-ozone-depleting substitute refrigerant. In addition, the new substitute refrigerants cannot be used without making some changes to system components. As a result, service technicians who repair leaks to the system will continue to charge R-22 into the system as part of that repair.

Installing new Air Conditioning units

The transition away from ozone-depleting R-22 to systems that rely on replacement refrigerants like R-410A has required redesign of heat pump and air conditioning systems. New systems incorporate compressors and other components specifically designed for use with specific replacement refrigerants. With these significant product and production process changes, testing and training must also change. Consumers should be aware that dealers of systems that use substitute refrigerants should be schooled in installation and service techniques required for use of that substitute refrigerant.

A Common Sense Approach To Servicing Your System

Along with prohibiting the production of ozone-depleting refrigerants, the Clean Air Act also mandates the use of common sense in handling refrigerants. By containing and using refrigerants responsibly -- that is, by recovering, recycling, and reclaiming, and by reducing leaks -- their ozone depletion and global warming consequences are minimized.

The Clean Air Act outlines specific refrigerant containment and management practices for HVAC manufacturers, distributors, dealers and technicians. Properly installed home comfort systems rarely develop refrigerant leaks, and with proper servicing, a system using R-22, R-410A or another refrigerant will minimize its impact on the environment. While EPA does not mandate repairing or replacing small systems because of leaks, system leaks can not only harm the environment, but also result in increased maintenance costs.

One important thing a homeowner can do for the environment, regardless of the refrigerant used, is to select a reputable dealer that employs service technicians who are EPA-certified to handle refrigerants. Technicians often call this certification "Section 608 certification," referring to the part of the Clean Air Act that requires minimizing releases of ozone-depleting chemicals from HVAC equipment.

A Common Sense Approach To Purchasing New Air Conditioning Systems

Another important thing a homeowner can do for the environment is to purchase a highly energy-efficient system. Energy-efficient systems result in cost savings for the homeowner. Today's best air conditioners use much less energy to produce the same amount of cooling as air conditioners made in the mid-1970s.

Even if your air conditioner is only 10 years old, you may save significantly on your cooling energy costs by replacing it with a newer, more efficient model. Products with EPA's Energy Star(R) label can save homeowners 10% to 40% on their heating and cooling bills every year. These products are made by most major manufacturers and have the same features as standard products but also incorporate energy saving technology. Both R-22 and R-410A systems may have the Energy Star(R) label. Equipment that displays the Energy Star(R) label must have a minimum seasonal energy efficiency ratio (SEER). The higher the SEER specification, the more efficient the equipment.

You should consider energy efficiency, along with performance, reliability and cost, in making your decision. And don't forget that when purchasing a new system, you can also speed the transition away from ozone-depleting R-22 by choosing a system that uses ozone-friendly refrigerants.

Frequently Asked Questions about HVAC System Refrigerants

x

Questions & Answers regarding this article

Questions & answers about air conditioning, heat pump & refrigeration equipment gases, refrigerant metering devices, capillary tubes, TE valves, and refrigerant leak detection.

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(June 26, 2012) **DanJoeFriedman (mod)** said:

Richard, I think the tech was saying that a refrigerant leak can lower the pressure in the system and cause icing on the cooling coil as well as on the refirgerant lines. (Missing insulation can also cause line icing). 3 Days? Gee that's odd. Typically if you shut off the system, in an hour or less the ice is long gone - especially in hot weather.

A/C refrigerants that use modern refrigerant gases are rather inert and are not carcinogens. Where did that worry arise? The hazards of breathing refrigeration gases occur when the gas, which is odorless, is released at sufficient quantity in an enclosed room - replacing oxygen and risking asphyxiating occupants. In a private home that sounds rather far fetched but it has occurred in industry. To read of a similar example search InspectApedia for "Toxicity of Carbon Dioxide Gas Exposure, CO2 Poisoning "

(June 25, 2012) **Richard Wilson** said:

MY A/C unit was not cooling my house as much as it was a week ago. A tecvhnician examined my outside fan and basement A/C, noted ice on both units and on tubing lines. He and stated it would not be possible to determine the exact sourse of the leak until the ice melted, which will probably take 3 days. If my children and I stay in the house during the next 3 days is there any danger that we may inhale a carcinogenic gas or be exposed to any other health risks? Thank you!

(June 22, 2012) **DanJoeFriedman (mod)** said:

Manuel, the refrigerants used inside of HVAC equipment are encapsulated and besides, chemically pretty inert - freon is not likely to directly explain the cough or IAQ complaint you describe.

BUT indirectly, a malfunctioning air conditioning system can include moisture, water, or even ice formation in the air handler at the cooling coil - in a few cases we've seen that lead to problematic mold contamination in the duct system.

Similarly, failure to properly maintain and clean the system, such as leaving dirty filters in place, or no air filters at all, can be a source of complaints.

Finally, picking up return air for the system at a location that picks up and transports any airborne contaminant can redistribute it through the building - more or less depending on the quality of filtration.

(June 22, 2012) **Manuel Ortiz** said:

My heat pump system was recently serviced and found to need low about 4 lbs of refrigerant. I noticed that my small grandchildren who live with me start having a chronic cough about oa month before i had the service accomplished. Now that we had it serviced both ther mom and myself have developed a cough we can't get rid of. Could this possibly be from a freon leak in my system possible releasing gas inside my home?

(June 16, 2012) **Anonymous** said:

Thermostatic expansion valves IS OKY USE 410 IN E22 O R22

(May 25, 2012) **DanJoeFriedman (mod)** said:

Tim, in commercial and some other refrigeration systems the refrigerant delivers lubricant oils to the compressor's moving parts. If there is a refrigerant leak, the oil carried in the liquid refrigerant may be left behind and show up as a dusty dirty oily coating in the areas near the leak point.

(May 23, 2012) **tim** said:

What can cause a system to have oil come out with refrigerant?

(May 23, 2012) **tim** said:

Is it normal for new R410a system to have oil come out with refrigerant when detaching gauges.

(Oct 3, 2011) **DanJoeFriedman (mod)** said:

No.

(Sept 29, 2011) **Good site. Have question.** said:

Is it true that all new appliances are mandated to have chips that operate with wireless transmitter smart meters (that are being forced on us) ?

(showing 1 to 10)

Recommend / Share this Article

+1 ShareThis
EMAIL
Print

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- **Critique, contributions wanted**: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Document derived from material courtesy of the U.S. EPA

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

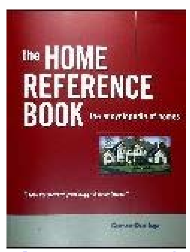
- [1] *Commercial Air Conditioning Systems*, Julio O. Zeller, May 1, 1998, University of Notre Dame, web search

07/27/2011, original source: http://www.nd.edu/~msen/Teaching/DirStudies/AirConditioning.pdf

- [2] Theoretical Analysis of Replacement Refrigerants for R22 for Residential Use, U.S. EPA, January 1992, EPA/400/191/041, web search 07/27/2011, original source: National Service Center for Environmental Publications (NSCEP), http://nepis.epa.gov/
- Carson, Dunlop & Associates Ltd., 120 Carlton Street Suite 407, Toronto ON M5A 4K2. (416) 964-9415 1-800-268-7070 info@carsondunlop.com. The firm provides professional home inspection services & home inspection education & publications. Alan Carson is a past president of ASHI, the American Society of Home Inspectors. Thanks to Alan Carson and Bob Dunlop, for permission for InspectAPedia to use text excerpts from *The Home Reference Book* & illustrations from *The Illustrated Home*. Carson Dunlop Associates' home inspection education products include
  - The ASHI-adopted Home Inspection Training Program, and Commercial Building Inspection Courses
  - The Home Inspection Home Study Course, and publications such as
  - The Home Reference Book, a reference & inspection report product for building owners & inspectors
  - The Home Reference *eBook*, an electronic version for PCs, the iPad, iPhone, & Android smart phones
  - Home Inspection Report writing materials, including the Horizon Software System that manages business operations, scheduling, & inspection report writing using Carson Dunlop's knowledge base & color images. The *Horizon* system runs on always-available cloud-based software for office computers, laptops, tablets, iPad, Android, & other smartphones.
  - The Illustrated Home illustrates construction details and building components, a reference for owners & inspectors
- [5] Carrier 24ANA Infinity™ Series Air Conditioners with Puron® Refrigerant, 2 to 5 Nominal Tons (Sizes 24-60) Installation Instructions, Carrier Corporation, [copy on file as 24ana-6si.pdf]
- [6] Refrigerant Piping Design Guide, Application Guide AG-31-011, McQuay Air Conditioning, Daikin McQuay International Equipment, 13600 Industrial Park Blvd. Minneapolis, Minnesota 55441 800-432-1342 (Toll Free), Website: http://www.daikinmcquay.com/, [Copy on file as http://www.inspectapedia.com/aircond/AC_Guide_McQuay.pdf]

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia Bookstore.



- **The Home Reference Book** - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

  Or choose the **The Home Reference eBook** for using this reference on PCs, Macs, Kindle, iPad, iPhone, or Android Smart Phones

  Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

- Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982
- Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- NEW! Air Conditioning SEER - New DOE Air Conditioner and Heat Pump Efficiency Standard
- Asbestos HVAC Ducts and Flues field identification photos and guide
- Fiberglass: Indoor Air Quality Investigations: Fiberglass in Indoor Air, HVAC ducts, and Building Insulation
- ...

Mobile View
AIR CONDITIONING & HEAT PUMP SYSTEMS

A/C - HEAT PUMP CONTROLS & SWITCHES
Outside Switches, Fuses, Breakers
Inside Switches,Components
Air Handler / Blower Switches
Blower Door Switches
Backup Heat Controls
CAPILLARY TUBES
CIRCUIT BREAKER SIZE for A/C or HEAT PUMP
Compressor Condenser Switches, Controls
Condensate Overflow Switch
CONTACTOR RELAY DIAGNOSIS & REPAIR
CONTROL CIRCUIT BOARD, A/C
CRANKCASE HEATERS
FAN, COMPRESSOR/CONDENSER UNIT
Duct System Switches
Duct System Filters
OPERATING CONTROLS, A/C & HEAT PUMP

Air Conditioning A/C System & Heat Pump Operating & Safety Controls

InspectAPedia® - ShareThis +1

- Air conditioning system operation controls: thermostats, zone dampers, electrical switches
- What are all of the controls and switches found on A/C & heat pump systems, where is each control found, what does it do, and which controls should be used by the building occupants
- Air conditioning safety switches
- Rules of thumb for sizing air conditioner fuses or circuit breakers
- Examples of "hidden" or hard-to-find switches or controls on heating & cooling systems
- Questions & answers about finding, using, repairing, or replacing air conditioner or heat pump controls & switches

Air conditioner & heat pump controls & switches: this article explains the function, location, identification & use of all air conditioning & heat pump system operating controls. Photos and text help you to find & recognize each of these controls and the text explains what the control does. We include links to detailed diagnosis & repair articles related to the various HVACR controls & swtiches. We also review the basic air conditioning safety switches, contactors, relays, refrigerant metering devices, motor overolad switches, relays, resets.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

 Use page top links to major topics or use links at the left of each page to navigate ***within*** topics and documents at this website. Green links show

where you are in a document series or at this website.

List & Purpose of All of the Air Conditioning & Heat Pump System *Operating & Safety Controls*

Also see A/C - HEAT PUMP CONTROLS & SWITCHES where we list all Air Conditioning & Heat Pump System Controls & Switches, and see THERMOSTATS. This chapter is part of our extensive air conditioning inspection, diagnosis, & repair document which describes the inspection, diagnosis, and repair of residential air conditioning systems (A/C systems) for home buyers, owners, and home inspectors.

If your air conditioning or heat pump system has lost its cooling capacity or won't start see REPAIR GUIDE for AIR CONDITIONERS. See How to determine the cooling capacity of air conditioning equipment if the system seems to be working but is inadequate to cool your building. Contact us to suggest text changes and additions and, if you wish, to receive online listing and credit for that contribution.

Basic air conditioning inspection and inspection report information for A/C controls:

- Thermostats: The air conditioning system is operated by thermostat in the living area. If multiple air handling units and compressors are installed you should find a thermostat for each area served by that equipment. See THERMOSTATS for details about thermostatic controls. If your Air conditioner or heat pump won't turn on or off properly this is a good place to start. Also see A/C - HEAT PUMP CONTROLS & SWITCHES

- Air conditioning system zone dampers: Some air conditioning system designs may use a single air handler and compressor, but may add zone dampers in the duct work to provide individual "zoning" of cool air distribution. In this case each zone thermostat both calls for the system blower/compressor to operate and also causes a motorized zone damper to open to direct cool air to a particular portion of the building.

  An ordinary home inspection is unlikely to address proper operation of motorized zone dampers. See ZONE DAMPER CONTROLS for details about automatic and manual heating and air conditioning air zone controls.

- Manual or automatic duct dampers may also be present in duct work to manually (or automatically under thermostat control) open or close to balance heating or cooling air distribution among building areas.

  Be sure to look for these duct dampers when diagnosing poor cool air delivery to an area.) Also see our note below about the presence of multiple switches and controls. See ZONE DAMPER CONTROLS for details about automatic and manual heating and air conditioning air zone controls.

- Electrical switches for air conditioning systems will often be found as follows: (some of these may be absent on some systems). For details see A/C - HEAT PUMP CONTROLS & SWITCHES

DUST CONTAMINATION FROM HVAC?

EDUCATION, HVAC SCHOOLS
ELECTRIC MOTOR DIAGNOSTIC GUIDE
ELECTRIC MOTOR OVERLOAD RESET SWITCH
ELECTRICAL POWER SWITCH FOR HEAT
EVAPORATOR COIL or COOLING COIL
EVAPORATIVE COOLING SYSTEMS
EVAPORATOR COIL or COOLING COIL
EXPANSION VALVES, REFRIGERANT

FAN, AIR HANDLER BLOWER UNIT
FAN AUTO ON Thermostat Switch
FAN, COMPRESSOR/CONDENSER UNIT
FAN CONVECTOR HEATERS - HYDRONIC COILS
FAN LIMIT SWITCH
FAN NOISES
FURNACES WARM AIR HEATING SYSTEMS

GAS EXPOSURE EFFECTS, TOXIC
GAS DETECTION & MEASUREMENT
GAUGE, REFRIGERATION PRESSURE TEST

HEAT LOSS (or GAIN) in buildings
HEAT LOSS (or GAIN) INDICATORS
HEAT LOSS R U & K VALUE CALCULATION
HEAT PUMPS
HEATING SMALL LOADS
HOUSEWRAP AIR & VAPOR BARRIERS
HUMIDITY LEVEL TARGET

INDOOR AIR QUALITY IMPROVEMENT GUIDE
INSPECTION CHECKLIST - OUTDOOR UNIT
INSPECTION LIMITATIONS, A/C SYSTEMS

LIGHT, GUIDE to FORENSIC USE
LOST COOLING CAPACITY
LOW VOLTAGE TRANSFORMER TEST

MANUALS & PARTS GUIDES - HVAC
MOTOR OVERLOAD RESET SWITCH
MOLD in AIR HANDLERS & DUCT WORK

NOISE AIR CONDITIONER / HEAT PUMP
NOISE / SOUND DIAGNOSIS & CURE

ODORS in AIR HANDLERS & DUCT WORK
ODORS in AIR HANDLERS & DUCT WORK
OPERATING COST, AIR CONDITIONER
OPERATING DEFECTS, AIR CONDITIONING
OPERATING TEMPERATURES, AIR CONDITIONER

PORTABLE ROOM AIR CONDITIONERS
PRESSURE READINGS, REFRIGERANT

REPAIR GUIDE, AIR CONDITIONERS / HEAT PUMPS
REPAIR & DIAGNOSTIC FAQs for A/C

Electrical panel circuit breakers or fuses will be provided separately to control the air handler (blower system) circuit and the compressor/condenser circuit. Of these the compressor is usually supplied by a 240V circuit and the air handler by a 120V circuit.

- Compressor safety shut off switch outside at the compressor/condenser. The switch may be a circuit breaker, fuse, or a simple "pull-out" disconnect located close to the compressor.
- Air handler service switch inside on or close to the air handler unit itself
- Air handler blower compartment safety switch: a safety interlock that will turn off electricity to the air handler or blower unit if the blower compartment door is not securely shut. If your air conditioner blower will not start this switch and the blower compartment doors should be checked. See BLOWER FAN OPERATION & TESTING
- Air conditioner/heat pump contactor relay switch: turns on high amp drawing equipment such as the compressor motor. See CONTACTOR RELAY DIAGNOSIS & REPAIR
- Air conditioner or heat pump pressure control safety switch: turns off the system at excessive refrigerant pressure and in some systems at too-low pressure. Also used in automotive air conditioning. See A/C - HEAT PUMP CONTROLS & SWITCHES

- "Hidden" controls on air conditioning & heat pump systems: HVAC equipment also includes internal or "hidden" (from the user) controls and switches that are necessary for proper system operation. Just knowing that these items exist is the first step in diagnosing & repairing an air conditioner, heat pump, refrigerator, freezer or other HVACR equipment that is not working or not working properly.

  These controls are also discussed in detail at InspectApedia, in individual HVACR diagnosis and repair articles of the major components of the system where the controls appear or are used. Examples include

  - Blower door safety swtich (described above)
  - Condensate overflow tray safety switch or condensate pump float switch - a failure of the overflow tray sensor and switch can leave the A/C system mysteriously "off" but it's a simple repair - a photo of this switch is shown at the top of this page
  - Fan limit switch on an air handler used for both heating and cooling; many of these switches, intended for use during the heating cycle, include a manual "fan-on" control that can be used to turn the blower to a constant-on position during the cooling season
  - Fuses, circuit breakers, thermal overload devices and "reset switches" are built into or sometimes wired near the compressor motor, and electric motors such as fan or blower motors
  - Relays/contactors - heavy duty electrical switches that turn on high-current drawing devices such as the compressor motor and sometimes the condenser/comperssor cooling fan
  - Thermostatic expansion valve or capillary tube - meters refrigerant flowing through the system.

SAFETY CONTROLS - Air Conditioning Automatic Safety Controls - Cooling System Fuse or Circuit Breaker Size Requirements

Electric Power Controls - Safety Disconnects for Air Conditioners

Safety disconnects should installed outside next to the compressor/condenser unit and are often also installed next to or mounted on the air handler/blower unit.

If you cannot find an outside electrical disconnect at your compressor/condenser unit, one should be installed. These controls are recommended for safety to reduce the temptation to open the cabinet and work on the equipment with power on.

Working on electrically "live" cooling equipment risks both shock and mechanical injury such as being cut by the fan if the motor starts unexpectedly. Safety shutoffs are required for new equipment.

See A/C - HEAT PUMP CONTROLS & SWITCHES for details.

How to Specify the Breaker or Fuse Size for Air Conditioning Circuits

Our photograph of a modern circuit breaker panel (left) shows where your search for the air conditioning or heat pump system main circuit breakers would typically begin. Look for two control circuits for the air conditioner or heat pump system that will typically include:

1. A circuit, 120V or 240V serving the indoor air handler
2. A circuit, usually 240V, serving the outdoor compressor/condenser unit.

The Amperage Rating of safety disconnects and A/C or Heat Pump circuit breakers

The safety switch on newer equipment may be a simple pull-out fuse-block type power disconnect, leaving circuit protection to be provided only at the circuit breaker or fuse for the A/C circuit where it originates in the electrical panel. Where the actual overcurrent protection is provided (at older circuit breakers used as auxiliary safety disconnects at the equipment, and at the main panel at the origin of the cooling circuit for the compressor/condenser unit) electrical overload protection size (circuit breaker or fuse amperage rating) for modern A/C equipment is specified by the manufacturer.

The Maximum Fuse or HACR type Breaker: specifies the maximum overcurrent protection or MOP to be used to protect the equipment. The permitted ampacity of the equipment electrical circuit protection (fuse or circuit breaker amps) expressed as MOP or Maximum Overcurrent Protection. If MOP is specified, the breaker or fuse protecting the equipment should match this number.

As we explained at the beginning of this document, a hermetic compressor draws varying amounts of current (measured in amps) as its internal pressure changes during operation. We said that current draw is higher when starting the motor than when the system is in steady state operation.

Current draw is highest if the motor is starting against its highest back pressure such as if the air conditioning system has been turned off and then back on in the middle of operation. Because fusing an air conditioning compressor at the minimum level can result in blown fuses or tripped breakers during these intervals of heavy current draw during compressor startup, compressors are either protected by a slow-blow fuse or a somewhat larger than minimum circuit breaker.]

Rules of thumb for over sizing air conditioning system breakers or fuses:

On some older equipment MOP is not specified. *Only when MOP has not been specified* can the overcurrent protection required be determined by alternative means such as [RLA OR BCSC whichever is greater x 175%], or if the compressor keeps tripping that device or blowing that fuse, RLA x 225% might be used.

The National Electrical Code (NEC) specifies the degree to which a breaker or fuse may exceed the RLA. [For example, if the MOP or fuse size is specified by the manufacturer to be 40 amps, then a 40 amp breaker must be installed with no increase or change in that rating.]

Multiple switches are often present on cooling systems. As we reminded in the previous chapter, if the air conditioning system won't run, before requesting a service call check all of the switches as well as the thermostat for proper settings.

Air Conditioner Fuse or Circuit Breaker Size Details

Generally, what is the ampacity we see in the field when inspecting an air conditioning compressor circuit?

When the air conditioning system is running, if you measured the amperage, it would be roughly 80% of the RLA. The breaker size is typically about 125% of the total of the compressor RLA and the condenser fan FLA (full load amperage).

We are referring here to the main circuit breaker that controls the air conditioner compressor/condenser unit - a switch that is typically located in the main electrical panel or in a sub-panel serving the air conditioning or heat pump equipment.

Our photo at left shows a different switch: an outside service switch that incorporates a circuit breaker next to the compressor/condenser.

This circuit is for use by the service technician and because it is downstream of the wire bringing power to the compressor/condenser unit, it is not protecting that wire from an overcurrent. While both of these circuit circuit breakers must be properly served, don't confuse their role nor their location.

The rationale is that the circuit breaker protecting the air conditioner compressor unit should trip in the event of a locked rotor [the revolving axle of a compressor motor, for example] or some significant electrical event, but should not trip during start up loads which, as we know can be significantly higher than the RLA momentarily [as the compressor motor draws higher amperage to get itself started].

Why can we put an "oversized" fuse or circuit breaker on an air conditioning compressor circuit?

An air conditioning electrical circuit is different than a general household circuit in that we have a known current load.

[There is only one device connected to the air conditioning electrical circuit, and we can read its operating characteristics.] We are not worried about an overload situation where people plug several appliances into receptacles on a single circuit. Generally speaking, the amperage draw is fine or is way too big.

Code Citatin: Section E3602.10 of the IRC says,

> ***Branch circuits for air conditioning and heat pump equipment.*** *The ampacity of the conductors supplying a multi motor and combination load equipment shall not be less than the minimum circuit and capacity marked on the equipment.*
>
> *The branch-circuit overcurrent device rating shall be the size and type marked on the appliance and shall be listed for the specific purpose." In short, do what it says on the data plate.*

Thanks to Alan Carson for these details.

Questions & Answers regarding this article

Questions & answers about finding, using, repairing, or replacing air conditioner or heat pump controls & switches.

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(July 27, 2012) DanJoeFriedman (mod) said:

Marc, I am grateful to see a question that is so far beyond my expertise, meaning guys smarter than me are helping with this website. I just don't know what you ought to see by way of voltage in the case you describe. I'd use the Arcoaire company's contact information to obtain the installation and service manual and wiring diagrams for the unit model and serial number you have installed. Or call their tech support hotline.

I can see why you're asking us - the company's website studiously and disappointingly avoids making it possible for a customer or anyone else to contact them directly: no address, no telephone, no email, no online documents except product sales descriptions and warranty information - often ten years. The company does provide a dealer locator web page and some specific dealer contacts (such as Precise Cooling Inc. in Port Charlotte Florida - (941) 626-6916) You should go to the arcoaire website to find the dealer closest to you. arcoaire [dot] com.

Please let us know what you find - what you learn will help other readers.

(July 27, 2012) DanJoeFriedman (mod) said:

Brad: because A/C equipment causes a brief current draw surge at the time of start-up of the compressor motor, installers are permitted to slightly "over-fuse" the system beyond its running current requirements. Usually the circuit wiring is sized to the running load amps not the higher value. For an authoritative citation start with the installation manual for your unit as doubtless it includes a wiring size recommendation.

Note this exception: for long wire runs it can become necessary to go to a larger wire size.

(July 24, 2012) Marc said:

Hi,
I have a 2 ton arcoaire hp with a scroll compressor. It just doesn't seem to be cooling correctly and I'm suspecting the control board on the condensor. The Reversing valve is supposed to be energized on a call for cooling and the correct calls are getting to the board. R-O-G have 25v on the input taps. If the valve is energized shouldn't the RV tap on the output side have 25v also? It shows 25 when the thermostat is set to off but nothing when set to cool. Also when I turn the system off it sounds like the valve is moving. It's kind of a deep sigh. I think it's always done that though. I just can't remember if it was when I turned it on or off. Any way to safely test the valve by jumpering to 25v? Thanks.

(May 14, 2012) Brad said:

I replaced an old Gaffers & Sattler 4-Ton compressor with a new Goodman 4-Ton (SEER 13) unit, but the city inspector is requiring that I replace the exisiting 10-gauge wiring with 8-gauge. He's going by the label on the unit which specifies a Maximum fuse size of 40 Amps. But the label also specifies a Minimum circuit size of 23.9 Amps, well under the 30 Amp current capacity of the exising 10-gauge wiring. To me it seems unreasonable to require larger wiring for a newer, more energy-efficient unit of the same size. What do you think?

(May 11, 2012) dan said:

I ordered a replacement contactor for my home a/c. The original part had A FLA rating of 25 and RES of 30. The new contactor has FLA 0f 30 and RES of 40. Can the new one be used?

(May 4, 2012) Anonymous said:

My compressor will not come on, it keep kicking off breaker . Do you think that could be the thermo, or the compacitor?

(Apr 16, 2012) DanJoeFriedman (mod) said:

Allan I wouldn't keep pressing the reset button if the system does not start and run on its own. If you are talking about the reset button on an electric motor, if it's going off on reset that usually means the motor is overheating or is unable to start (perhaps a bad start capacitor).

(Apr 13, 2012) allan said:

I have changed my thermostat and the transformer has electricity to all approiate wires but neither my central air or m,y heat will come on. if I go outside and push the reset button in and hold it the compressor works fine. what next?

(Dec 7, 2011) Bill said:

Does form installation have anything to do with the size of ac unit united needed for 3300 sqft coverage?

(Sept 3, 2011) DanJoeFriedman (mod) said:

If your heat is from different equipment (that is you have an air conditioner and separate heater not heat pump system) then it sounds as if heat works but your A/C does not. In that case take a look at the diagnostics beginning at LOST COOLING CAPACITY (article link at page left)

(showing 1 to 10)

Recommend / Share this Article

+1 ShareThis

EMAIL

Print

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also include a list of recommended books for the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

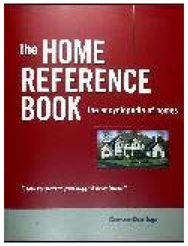
Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

CONTROLS & SWITCHES, A/C - HEAT PUMP- see detailed links at page left

- Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982
- Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 page

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia Bookstore.



- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

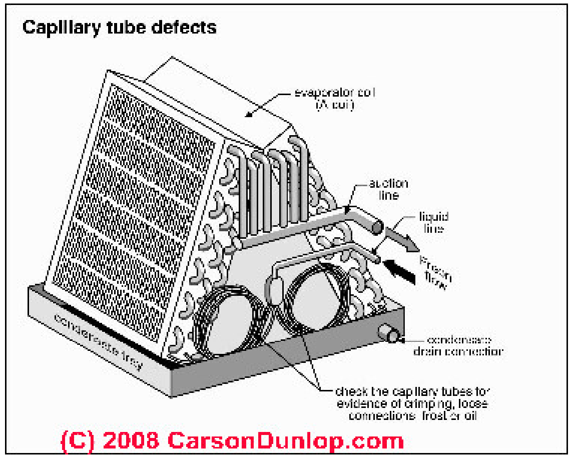
  Or choose the The Home Reference eBook for using this reference on PCs, Macs, Kindle, iPad, iPhone, or Android Smart Phones

Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- ...

Mobile View
AIR CONDITIONING & HEAT PUMP SYSTEMS

A/C - HEAT PUMP CONTROLS & SWITCHES
A/C DATA TAGS
A/C - HEAT PUMP CRITICAL DEFECTS
A/C DIAGNOSTIC FAQs
A/C REFRIGERANTS
A/C TYPES, ENERGY SOURCES
AGE of AIR CONDITIONERS & HEAT PUMPS
AIR CLEANER PURIFIER TYPES
AIR CONDITIONER BTU CHART
AIR CONDITIONER COMPONENT PARTS
AIR CONDITIONER TYPES, ENERGY SOURCES
AIR CONDITIONER NOT WORKING
AIR FILTER EFFICIENCY
AIR FILTERS, FIBERGLASS PARTICLES
AIR FILTERS for HVAC SYSTEMS
AIR FLOW MEASUREMENT CFM
AIR HANDLER / BLOWER UNITS



Installation & Service Guide to Capillary Tubes as Refrigerant Metering Devices

InspectAPedia® - ShareThis +1

- What is a capillary tube and how do they work on air conditioners, heat pumps, refrigerators, freezers, dehumidifiers?
- Where are capillary tubes used in refrigeration systems & where exactly are they installed
- Guide to Diagnosing, Servicing & Repairing Capillary Tube Refrigerant Metering Devices
- How to select and install a replacement capillary tube, How the capillary tube metering rate is set: tube diameter and length
- Air Conditioner or Refrigeration System Pressure Equalization, Capillary Tubes & the Function of the Accumulator
- What's the Difference Between a Refrigerant Capillary Tube or "Cap Tube" and a Refrigerant Expansion Valve or TEV / AEV?
- Questions & answers about cap tubes or capillary tubes used for refrigerant metering in HVACR equipment

Air conditioner & refrigeration equipment capillary tubes: this air conditioning repair article explains the function and installation of capillary tubes or "cap tubes" used to control or meter the release of refrigerant into the evaporator coil of an air conditioning or heat pump system, home refrigerator, freezer, dehumidifier, or other refrigeration equipment of up to 6 tons in cooling capacity. We define and explain the function, installation, servicing, and replacement procedures for capillary tubes.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

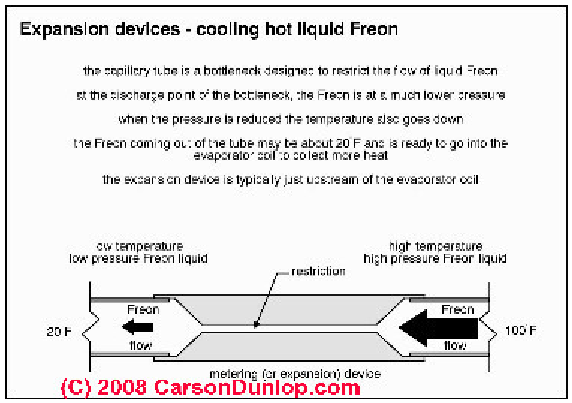
 Use page top links to major topics or use links at the left of each page to navigate ***within*** topics and documents at this website. Green links show where you are in a document series or at this website.

Guide to Air Conditioner, Heat Pump, & Refrigeration System Capillary Tubes: How Does a Capillary Tube Work to Meter Refrigerant?

Other refrigerant metering devices like thermostatic expansion valves TEVs, automatic expansion valves AEVs, manual and adjustable expansion valves, and float valves are discussed at THERMOSTATIC EXPANSION VALVES. Also see FROST BUILD-UP on AIR CONDITIONER COILS or start diagnosing air conditioning problems at LOST COOLING CAPACITY.

Our page top sketch of common visibly detectable capillary tube defects is provided courtesy of Carson Dunlop Associates.

Here we explain how capillary tubes are used to meter refrigerant in air conditioners, dehumidifiers, refrigerators, & freezers. We include a description of the operating properties of cap tubes, we contrast their use and function with thermostatic expansion valves or similar devices, and we include cap tube problem diagnostic tips for air conditioning service and repair purposes.



Capillary tubes are the most simple refrigerant metering device used in air conditioners and other refrigeration equipment. There are no moving parts, just a very small diameter tube that meters refrigerant from the high side into the cooling coil.

Systems using a cap tube do not have a liquid refrigerant receiver and the amount of refrigerant charge must therefore be exact.

Our sketch simplifies the concept of the an expansion valve down to a simple capillary tube - this is the simplest possible refrigerant metering device. Sketch courtesy of Carson Dunlop Associates.

A simple capillary tube (sketch at left) or a more sophisticated and typically adjustable thermostatic expansion valve (shown in our sketch at below and sometimes improperly called *thermal expansion valve*) valve maintains the pressure difference (high and low) at the entry point to the cooling coil, thus assuring that as the high-pressure refrigerant enters the low pressure space of the cooling coil, it can "evaporate" from a refrigerant liquid to a gaseous form, thus producing the temperature drop that cools the cooling coil itself.

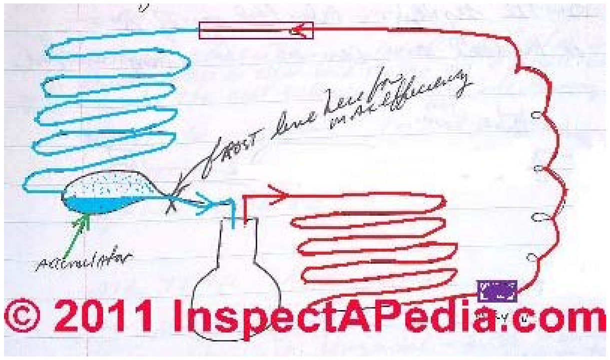
Synonyms for devices similar to capillary tubes and used to meter refrigerant on some air conditioners, heat pumps, and other refrigeration equipment are "refrigerant orifice", "refrigerant actuator", or even "refrigerant metering piston".

None of these refrigerant metering devices handle a wide range of on-site conditions and refrigerant charge levels as well as THERMOSTATIC EXPANSION VALVES. TEVs adjust the level of refrigerant being released into the cooling coil as needed under varying compressor output pressures and refrigerant charge levels (up to a point - they can't handle serious undercharging or overcharging).

Capillary tubes used to meter refrigerant and control its flow are most likely to be found on

- Room air conditioners or through-wall air conditioners
- Portable air conditioners
- Portable dehumidifiers
- Residential refrigerators
- Residential freezer
- Refrigeration systems of various types in up to 6-tons of cooling capacity

How the capillary tube metering rate is set: tube diameter and length



The air conditioning system or refrigeration system *capillary tube*, like the TEVs and AEVs and other devices discussed here, is a simple refrigerant liquid metering device which regulates the flow of refrigerant from the incoming high pressure side (from the compressor/condenser) into the low pressure side (in the cooling coil).

So how is the refrigerant metering rate set when a cap tube is used?

The refrigeration engineer who designed the system specifies the internal diameter and the length of the capillary tube to be used - that's it. The flow rate through the cap tube will be fixed and is a function of the tube length, diameter, and operating pressure at which the liquid refrigerant is being delivered.

In the field, capillary tubing comes in a pack of given diameter tubing size. The technician cuts off the desired length to carefully solder in place if field replacement is needed.

Our capillary tube refrigeration system schematic sketch (above left) shows the location of the capillary tube (red box at center top of the sketch) and a refrigerant accumulator (green arrow at lower left) at the end of the evaporator coil and ahead of the compressor motor.

In the capillary schematic we note that the appearance of the frost line just at the end of the refrigerant accumulator indicates the maximum - efficient refrigeration system design. The purple rectangle (lower right) is the position of the dryer canister at the outlet of the [red] condenser coil.

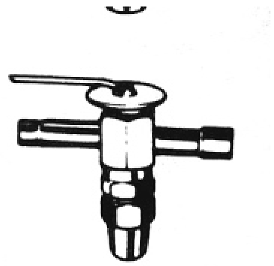
Air Conditioner or Refrigeration System Pressure Equalization, Capillary Tubes & the Function of the Accumulator

During the off cycle, the refrigerant continues to flow through the cap tube since there is no mechanical closing of this device. Therefore pressures on the high side and low side of the system will equalize.

An accumulator in the refrigeration system [green arrow points to the accumulator, the blue object at center left of our sketch above] will hold liquid refrigerant on the low side to keep liquid refrigerant out of the compressor bottom during the off cycle - thus avoiding damage to the compressor motor and its valves.

Preferably the accumulator is positioned horizontally in order to prevent a refrigerant oil-trap forming at the accumulator outlet opening.

What's the Difference Between a Refrigerant Capillary Tube or "Cap Tube" and a Refrigerant Expansion Valve or TEV / AEV?



To the capillary tube the TEV adds a level of control - the TEV can open or shut in response to an attached bulb which actually monitors temperatures in the refrigerant tubing. Capillary tubes are found on residential refrigerators, dehumidifiers, and many window air conditioners. TEVs are found on larger air conditioners and central air conditioning systems where more control is needed.

In our TEV sketch (left) the small diameter tube at the top of the thermostatic expansion valve is connected to a temperature sensing bulb (not shown) that is located at the outlet end of the cooling or evaporating coil in the air handler.

The tubing at the left and right permit liquid refrigerant to flow into the valve from the compressor/condenser and, metered by the TEV, onwards into the evaporator coil. The large nut on the bottom of this TEV covers an adjustment screw that can change the latent heat settings and thus the behavior of the valve once it is installed. (Normally you should leave the valve at its factory setting.)

As refrigerant liquid is metered into the entry point of the evaporator coil it is entering the *low side* of the air conditioning system. The change from high pressure to low pressure permits the refrigerant to evaporate, changing from a liquid to a gas. [The boiling point of R12 refrigerant is -21 degF, and the boiling point of R22 refrigerant is -41 degF. Newer refrigerants will have similar characteristics.]

It is this state change, from liquid to gas, occurring inside of the cooling coil (evaporator coil on the A/C system's *low side*) that absorbs latent heat, thus cooling the evaporator coil itself.

The job of the refrigerant metering device such as a capillary tube or a TEV is to provide a restriction in the refrigerant tubing system so that there will be a pressure difference maintained between the high side and low side of the system. The air conditioning compressor, by pulling on the suction line or low pressure side of the closed refrigerant piping system is causing pressure to be low on that side. The same compressor is delivering high pressure liquid refrigerant to the high side of the system. The TEV is between these two pressure systems.

Latent heat, state change, high side and low side are defined in more detail at SEER RATINGS & OTHER DEFINITIONS.

All cooling systems using refrigerants use some type of expansion valve, of varying complexity. Even a simple window air conditioner or a refrigerator make use of an expansion valve, in the form of a small-diameter capillary tube or "cap tube" which meters refrigerant into the cooling coil.)

Some Advantages & Disadvantages of Capillary Tubes for Refrigerant Metering

A capillary tube is a less costly refrigerant metering device than a refrigerant metering valve such as a TEV or AEV and it's patently simpler in operation.

A capillary tube design also allows the use of a smaller compressor motor since the motor does not face the same head pressure start-up load: pressure equalizes when the system is off, so there is no high head pressure at the compressor motor during start-up.

However where a capillary tube is metering refrigerant, the cooling load needs to be more or less constant - because of the precisely measured charge of refrigerant and the absence of a large refrigerant storage receiver canister, you don't have a large volume of refrigerant available for varied or increased release into the evaporator coil at times of high cooling load. In other words, variations in cooling load are not so easily compensated-for in a capillary tube refrigeration system design.

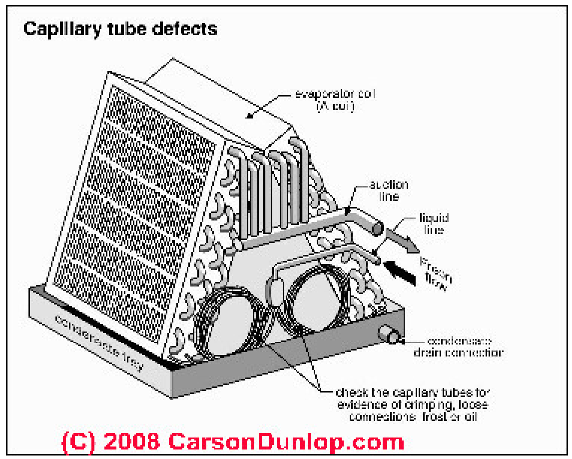
Guide to Diagnosing, Servicing & Repairing Capillary Tube Refrigerant Metering

Devices

Refrigerant overcharge on a capillary tube system: if the system has been overcharged you'll see higher pressure on the low-side of the system and an increased temperature in the system there.

The refrigeration system will run longer to reach the desired cooling temperature (refrigerator runs longer than it used-to, for example).

That's because we are seeing a higher compressor head pressure since we've put more refrigerant into a fixed volume space. Our sketch illustrates a cap tube and accumulator ready to be connected into a refrigeration system: the left end of the tube will be soldered into the refrigerant line using a flare or swage connection and the right end of the accumulator has a connector intended for soldering to the compressor suction line.



Refrigerant undercharge on a capillary tube system: if the system is undercharged, you will see lower pressure on the low side but not enough refrigerant, so in this case too the system will run longer than normal.

Plugged capillary tube diagnosis: if the cap tube becomes plugged with oil, debris, [or solder due to improper installation] the symptom will be that the low side will run in a deep vacuum. The compressor is unable to pull refrigerant through the capillary tube. And of course no cooling will be taking place at all.

An oil trap anywhere in a refrigeration system: oil traps (refrigerant oil has blocked refrigerant piping or metering device) will produce the same symptom as a plugged capillary tube - that is, the system will run at a deep vacuum on the suction side or low side. If you are diagnosing a capillary tube metered appliance, check the position of the accumulator. If it's become bent or moved out of horizontal, it's outlet end may be oil-trapped.

Visible capillary tube defects: where the cap tube is visible such as in Carson Dunlop Associates' sketch (left), there are several defects that you can spot by simple visual inspection

- A crimped capillary tube will not perform properly as the crimp obstructs or restricts refrigerant flow below the design point and also increases the chances of debris blockage
- Loose capillary tubing risks ultimately a refrigerant leak as vibration can wear through the tubing
- Frost visible on the cap tube is an abnormal condition (as there should be liquid refrigerant in the tube) and probably means low refrigerant and a leak or partial tube blockage
- A punctured capillary tube will bring the whole cooling system to its knees as you'll lose refrigerant and will lose cooling ability entirely.

Replacing a Capillary Tube on an Air Conditioner - Service Tips

Capillary Tubing Sizes inches diameter[1]	

Capillary tubing for refrigeration systems comes in a package that will include a chart that will help you specify the correct length to use.

We have made up an example cap tube length table of sizes based on Gemline™

GC-1	0.031
GC-2	0.042
GC-3	0.05
GC-4	0.064
GC-5	0.026
GC-6	0.036
GC-7	0.049
GC-8	0.054
GC-9	0.070
GC-10	0.075
GC-11	0.080
GC-12	0.085
[1] Gemline™ GCPK	

Capillary tubing.

Some capillary tubing service packs such as GCPK will include multiple sizes or diameters of capillary tubing in standard 12-inch lengths.

Generally on small refrigeration systems that use a capillary tube to meter refrigerant into the cooling coil, the suction line is soldered to the capillary tube line.

This is done to increase vapor temperature going back to the compressor and to decrease refrigerant temperature going into the evaporator - both conditions that improve the operating efficiency of the refrigeration system.

But because of this co-soldering of the cap tube to the suction line, if the cap tube has to be replaced, generally both lines are replaced together.

OR, if the evaporator itself is OK, you can just snip off the capillary tube out of the system and install a new one in parallel, giving up the benefit of that side-by-side soldering of the new cap tube to the old suction line.

The length (and of course diameter) of the new capillary tube is important, but if you're off an inch or two on most appliances it's not going to be critical.

But a 12" change in capillary tube length will certainly change the behavior of the refrigeration system. If you make the cap tube too short the system run time will be increased beyond its normal or design point.

"Non-Adjustable" & Manually Adjustable Expansion Valves: How they are Set

Singer and other manufacturers point out that TEVs are adjusted at the factory before shipment. The factory setting of a thermostatic expansion valve is printed on a label found on the head of the valve and for most installations the factory superheat settings should be left alone.

How & When to set "Non-Adjustable" Thermostatic Expansion Valves

Non-adjustable TEVs (such as Singer TEV models 226, 326, 426) can actually be adjusted before the valve is installed, by turning an adjustment screw through the valve outlet opening. Once these valves have been installed, however, adjusting the valve would require removing it from the system, thus also requiring an evacuation and recharge of system refrigerant - not something to do casually.

How to Set Manually Adjustable Thermostatic Expansion Valves

Manually adjustable TEVs permit the device to be set to continuously maintain the proper refrigerant level entering the evaporator coil or cooling coil. Automatic expansion valves are discussed below.

- Adjustable TEVs include an adjusting stem that can be turned with a screwdriver. Some valves may require that a covering cap be first removed to provide access to the adjusting screw or stem. On Singer adjustable TEVs (other controls will be similar),
- Turn the adjusting screw only one turn at time to prevent over adjustment. We make a tiny scratch on the valve bottom at the start end of the screw slot so that we can keep careful track of how far a screw has been turned.
- To increase the superheat setting, turn the TEV valve stem clockwise. When you turn the valve stem "in" or "clockwise" you are increasing pressure on the spring - the bellows will need more pressure to force the needle

off of the seat, so the frost line will recede (less refrigerant is passing through) - and vice versa.

- To decrease the superheat setting, turn the TEV valve stem counter-clockwise. Normally the TEV is set for 7 to 12 degrees of superheat across the cooling coil (evaporator coil).
- Allow the air conditioning or heat pump system to stabilize for half an hour after each adjustment turn before trying to adjust the valve further.

More on Diagnosing Problems with Thermostatic Expansion Valves and Capillary Tubes for Refrigerant Metering

See REFRIGERANT LEAK DETECTION where we describe the effects of dirt and moisture on TEVs and capillary tubes. A quick test for a moisture/ice jammed TEV is to add some heat to see if the device will begin working again.

Watch out: as we discuss at REFRIGERANT LEAK DETECTION, water or dirt in the system can cause serious and costly problems.

See THERMOSTATS for other details of the operation of primary air conditioning thermostats and switches.

At A/C - HEAT PUMP CONTROLS & SWITCHES we explain the many electrical switches and controls that control an air conditioner or heat pump system. You'll need to check these if your air conditioner won't start.

At OPERATING DEFECTS we take you through the major air conditioning problem symptoms and how to get the air conditioning system working again.

At a companion article, LOST COOLING CAPACITY, our focus is on the case in which the air conditioning system seems to be "running" but not enough cool air, or no cool air at all is being delivered to the occupied space.

Questions & Answers regarding this article

Questions & answers about cap tubes or capillary tubes used for refrigerant metering in HVACR equipment.

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(July 27, 2012) DanJoeFriedman (mod) said:

Anon I may be missing something in your question or we are confused about why you are working with a piston kit.

An air conditioning system "piston kit" in my lingo refers to a piston and probably rings intended for use in rebuilding a compressor motor - not something we'd see on a residential cooling system (where techs replace the entire hermetically sealed compressor).

On some air conditioner compressor motors failures of the piston ring can lead to a compressor failure and damage to the piston cylinder wall. Rebuild kits can be similar to automobile engine rebuild kits - the cylinder is bored, smoothed and an oversized piston and ring kit are installed. Without a piston repair a commercial refrigeration compressor motor may be unable to develop full head pressure.

About interchangability, the answer may seem a bit obvious, but basically if the piston shape and measurements match the compressor motor design specs it's "interchangable". If not, not.

(July 27, 2012) Anonymous said:

received a piston kit with the new ac condenser size 065 my a coil from another manufacture look to have a number 69 on it . Could this cause a problem with pressure or frost and are pistons interchangeable with different equipment makers

(May 30, 2012) DanJoeFriedman (mod) said:

Wayne I'm not certain I have a clear understanding - perhaps you could send us some sharp photos of the cap tube system you describe? Use the CONTACT US link found at page top or bottom of any of our web pages.

Often a cap tube is branched into several smaller distribution lines that meter refrigerant into different sections of a cooling coil - it's simply a means of efficient distribution to improve coil efficiency, and shouldn't affect the charge quantity.

(May 30, 2012) DanJoeFriedman (mod) said:

Thanks so much Jaya for the nice comment; we work hard to make InspectApedia information accurate, unbiased and useful. For that reason, we welcome questions or suggestions from our readers - that feedback also helps us see where to focus more research and writing.

Daniel

(May 29, 2012) jaya said:

i would like to say. this kind of lessen is very helpful to carryout our job.
thanks,
jaya.

(May 8, 2012) Wayne said:

I just replaced a compressor (R22 wet) and condenser unit on an old system. The coil has what I believe is cap tube metering. The liquid line (3/8") enters a manifold of sorts which splits into four small line imediatly before the coil. The manifold as I call it can be dis-assembled (no I did not take it apart) it look like a couple of plumbing fitting. The HVAC vendor I bought the condenser unit from said to release all the freon into the system. I think it has to be charged just right to get the high and low pressure correct. The house is out in west texas so its difficult to get a tech (nearest) to drive 100 miles. Sound like I'm going to have to beg one to make the trip unless someone can help on line. Please advise and thank you.

Recommend / Share this Article

ShareThis

EMAIL

Print

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also list books on the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

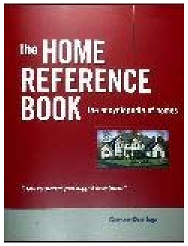
AIR CONDITIONING & HEAT PUMPS

- "Thermostatic Expansion Valve Installation Instructions", Singer Controls Division, Schiller Park IL, 197
- CARSONDUNLOP Carson, Dunlop & Associates Ltd., 120 Carlton Street Suite 407, Toronto ON M5A 4K2. (416) 964-9415 1-800-268-7070 info@carsondunlop.com. The firm provides professional home inspection services & home inspection education & publications. Alan Carson is a past president of ASHI, the American Society of Home Inspectors. Thanks to Alan Carson and Bob Dunlop, for permission for InspectAPedia to use text excerpts from *The Home Reference Book* & illustrations from *The Illustrated Home*. Carson Dunlop Associates' home inspection education products include
  - The ASHI-adopted Home Inspection Training Program, and Commercial Building Inspection Courses
  - The Home Inspection Home Study Course, and publications such as
  - The Home Reference Book, a reference & inspection report product for building owners & inspectors
  - The Home Reference *eBook*, an electronic version for PCs, the iPad, iPhone, & Android smart phones
  - Home Inspection Report writing materials, including the Horizon Software System that manages business

operations, scheduling, & inspection report writing using Carson Dunlop's knowledge base & color images. The *Horizon* system runs on always-available cloud-based software for office computers, laptops, tablets, iPad, Android, & other smartphones.
    - The Illustrated Home illustrates construction details and building components, a reference for owners & inspectors
- Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982
- Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages
- Air Conditioning SEER - New DOE Air Conditioner and Heat Pump Efficiency Standard

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.



- The Home Reference Book - the Encyclopedia of Homes, Carson Dunlop & Associates, Toronto, Ontario, 2010, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. InspectAPedia.com ® editor Daniel Friedman is a contributing author. Field inspection worksheets are included at the back of the volume.

- ...

InspectAPedia®

Free Encyclopedia of Building & Environmental Inspection, Testing, Diagnosis, Repair

Search
InspectAPedia

Ask a Question or Search InspectAPedia

HOME | AIR CONDITIONING | ELECTRICAL | EXTERIORS | HEATING | HOME INSPECTION | INTERIORS | PLUMBING | ROOFING | SEPTIC SYSTEMS | STRUCTURE | WATER SUPPLY

ENERGY SAVINGS | ENVIRONMENT | INDOOR AIR IAQ | INSULATION | MOLD INSPECT TEST REMOVE | NOISE | ODORS | SOLAR ENERGY | VENTILATION | EXPERTS DIRECTORY | CONTACT US

Mobile View
PLUMBING SYSTEM INSPECT DIAGNOSE REPAIR

AGE of PLUMBING MATERIALS & FIXTURES
AGE of CHIMNEYS & FIREPLACES
AGE of AIR CONDITIONERS & HEAT PUMPS
AGE of FOUNDATION MATERIALS
AGE of FRAMING MATERIALS
AGE of FLOORING MATERIALS
AGE of ELECTRICAL WIRING
AGE of HEATERS, BOILERS, FURNACES
AGE of WATER HEATERS
AIR DISCHARGE at FAUCETS, FIXTURES
AIR INLET VALVE, WATER TANK
AIR VOLUME CONTROLS, WATER TANK
ANTI SCALD VALVES
ANTI SCALD VALVE PROTECTION, Best Practices
ANODES & DIP TUBES on WATER HEATERS
APPLIANCE EFFICIENCY RATINGS
AQUASTAT CONTROL Functions

Condensation or "Sweating" Plumbing Pipes & Water Tanks

InspectAPedia® - ShareThis +1

- What is Sweating or Condensation on Plumbing Pipes, Tanks, Toilets?
- What Causes Condensation on Plumbing System Components like Pipes, Tanks, Toilets?
- What is the Significance of Condensation for Diagnosing Building Conditions?
- What Problems does Condensation Cause in buildings?
- How to Cure Condensation or Sweating on Plumbing Pipes, Tanks, Toilets
- Questions & answers about sweating pipes & condensation on plumbing system components, pipes, tanks, toilets: cause & cure

Condensation on plumbing pipes, tanks, toilets: here we explain the causes, significance, and cures for condensation or "sweating" on plumbing system components like pipes, water tanks, and toilets. A certain amount of moisture condensation on building plumbing systems is normal in areas of warm humid weather and cold or chilly incoming water supply. But as we explain here, excessive condensation on plumbing systems can cause costly problems in buildings. The articles at this website will answer most questions about plumbing drain, waste, vent, water supply & septic systems.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

 Use page top links to major topics or use links at the left of each page to navigate *within* topics and documents at this website. Green links show

where you are in a document series or at this website.

What is Sweating or Condensation on Plumbing Pipes, Tanks, Toilets

Related articles: HUMIDITY CONTROL TO PREVENT MOLD. Also see DEW POINT TABLE - CONDENSATION POINT GUIDE for an explanation of dew points and indoor humidity in buildings, and see MOISTURE PROBLEMS: CAUSE & CURE and HOUSEWRAP AIR & VAPOR BARRIERS and VENTILATION in buildings.

Our sweating toilet tank photo (left) illustrates where condensation may form on the tank of a toilet that is in frequent use during hot humid weather, or on a toilet whose flush valve leaks, allowing the toilet to "run" continuously.

Condensation, the collection of airborne moisture on cool surfaces can happen anywhere in the plumbing system where components are cooler than surrounding, moist air. Common places where we see condensation or "sweating" include toilet tanks, cold water pipes, and water storage or water pressure tanks.

Carson Dunlop Associates in their Home Reference Book point out that in some homes, the cold water piping is insulated to avoid sweating of pipes.

On a warm humid day, cold water running through a pipe will cool the adjacent air, causing condensation on the pipes, tanks, toilets etc.

Our photo (left) shows a close-up of condensation on the exterior of a steel water pressure tank..

This ‘sweating’ can be annoying, and if allowed to continue, can damage ceilings, floors, furniture or storage below. Condensation that drips off of these locations can even lead to building rot, insect attack, or to the need for a costly mold cleanup job.

So Do Water Pipes Actually "Sweat" in buildings?

No. Pipes and tanks don't literally "sweat". "Water pipes do not "sweat" as people say - water is not exuding out of pores in the pipe. Water is condensing from moist air onto the surface of the cold water pipe. Insulate your cold water pipes to avoid condensation and drips onto the floor. What people popularly refer to as "sweating pipes" really is airborne moisture that is condensing out of humid air onto a cool pipe, tank, or other surface.

Where Does Condensation Occur on Plumbing Systems?

- Cold water supply piping: Condensation can occur on all types of cold water supply piping materials, but we see the most significant condensation on metal cold water pipes (copper, galvanized steel) and a bit less on plastic piping, probably because the plastic does not so quickly conduct water temperature to the outside of the pipe.

  Our photo (left) illustrates that "sweating" cold water pipes can be a serious hazard. These cold water pipes are dripping condensate (red arrow at left) right

into the electrical panel (down-pointing red arrow at left), risking corrosion of the circuit breakers and other electrical components. Corrosion can lead to failure of a breaker to trip in event of an over-current. So water pipe condensation could actually contribute to a building fire! Details are at CORROSION in ELECTRICAL PANELS.

- Copper and some cast iron plumbing drains: condensation may occur on metal drain/waste/vent piping if there is a cold water plumbing fixture leak that keeps sending cold water through the building drain piping.
- Running plumbing fixtures, particularly toilets that are either in very frequent use or toilets that have a leaky flush valve or defective fill valve.
- Water pressure tanks or water storage tanks, particularly water tanks that are in a building where water is being run at high volume or frequency, where incoming water is cold (thus condensation is less likely to be a problem in the Southwestern U.S. or in Mexico where air is very dry and incoming water is often tepid)

What Causes Condensation on Plumbing System Components like Pipes, Tanks, Toilets?

Why does water *condense* on your cold water pipes overhead in the basement before it condenses on the steel Lally columns supporting your main girder? It's because the cold water pipe surfaces are colder than the Lally column surfaces exposed to the same moisture-laden air.

When cold water (at 40 deg.F.) is running through the water pipe, the pipe surface is cooled to a lower temperature (40 deg.F.) than that of the Lally column (perhaps 55 deg.F. or higher in a typical residential building basement).

When the temperature of air reaches the dew point (a function of the combination of a particular air temperature and the amount of moisture in the air), moisture condenses out of the air onto nearby cooler surfaces. See DEW POINT TABLE - CONDENSATION POINT GUIDE for more details.

It looks like sweat, but it's not. It's condensation.

[Note: Another definition of "sweating pipes" is used by plumbers to refer to the process of soldering copper plumbing joints.]

What is the Significance of Condensation for Diagnosing Building Conditions?

Condensation May Indicate Plumbing Leaks or Private Well Piping Problems

Running toilets: if a toilet fill or flush valve is leaky the toilet may run continuously or intermittently. A telltale sign that a toilet is running is the observation of water rippling in the toilet bowl long after the toilet was flushed.

CLOGGED SUPPLY PIPES, HOT WATER
CONDENSATION or SWEATING PIPES, TANKS
CROSS CONNECTIONS, PLUMBING
DEBRIS in WATER SUPPLY, Water Heater
DIAELECTRIC PIPE FITTINGS

DRAIN & SEWER PIPING
CAST IRON DRAIN PIPING
CAST IRON DRAIN LEAK, ODOR, REPAIR
COPPER PIPING in buildings
DRAIN LINE DEPTH
DRAIN NOISES
FLOOR DRAIN / TRAP ODORS
FREEZE-PROOF PIPES
LEAD PIPES in buildings
PLUMBING DRAIN CLEANOUTS
PLUMBING DRAIN VENTS
PLUMBING DRAIN NOISE DIAGNOSIS
PLUMBING DRAIN NOISE REPAIR
PLUMBING DRAIN NOISE DIAGNOSIS
PLUMBING DRAIN NOISE REPAIR
PLUMBING NOISE CHECKLIST
PLUMBING NOISE CONTROL
SEPTIC BACKUP PREVENTION
SEPTIC BACKUP REPAIR
SEWER BACKUP PREVENTION
SEWER GAS ODORS
SEWER LINE LEAKS & ODORS
SEWER LINE REPLACEMENT
SOUND CONTROL for PLUMBING
TRAPS on DRAINS
VENT PIPING

SUPPLY PIPING
BRASS WATER PIPES
COMPRESSION FITTINGS
COPPER PIPING in buildings
GALVANIZED STEEL WATER PIPING
LEAD PIPES in buildings
LEAD IN DRINKING WATER, HOW to REDUCE
LEAD POISONING HAZARDS GUIDE
LEAD WATER PIPING HAZARDS & REMEDIES
LEAK TYPES, Water Supply/Drain Pipe
OIL TANK PIPING & PIPING DEFECTS
PLASTIC PIPING
PLASTIC PIPE LEAK CAUSES
Transite Pipe Water Supply Piping
VALVES, PLUMBING
WATER HAMMER NOISE DIAGNOSE & CURE
WATER PIPES, Clogs Leaks Types
Water pipe clog diagnosis
Water pipe clog repair guide
WELL PIPING LEAK DIAGNOSIS
WATER PRESSURE LOSS DIAGNOSIS & REPAIR

PLUMBING FIXTURES, KITCHEN, BATH
Plumbing Materials & Fixtures, Age, Types
PLUMBING NOISE CONTROL

The condensation visible on the toilet tank in our photo (Left) was present even when the toilet had not been flushed for 24 hours, leading to an investigation and cure of a leaky toilet flush valve.

But some toilet leaks are slow and subtle and may not be so visually obvious. But if a toilet is leaky or running, in warm humid weather you may notice that the toilet tank is wet with condensation even when the toilet has not been flushed for several hours or more.

Toilet tank condensation, if chronic and significant, can lead to bathroom floor tile damage, subfloor rot, and even attack by wood destroying insects or mold. See Toilet Runs Continuously for details.

Hidden water supply pipe leaks: similar to the case above, a plumbing fixture with a running faucet is pretty obvious. But a hidden supply piping leak may be dripping or leaking into a building wall cavity or even outside or underground.

If the cold water pipes in your building are wet with condensation even though you think no water has been running for hours, there may be a hidden plumbing leak. A great time to check for this condition is on first arising in the morning, before plumbing fixtures have been used.

Our photograph of stains on an interior wall (left) is an example of indoor stains caused by moisture on building plumbing pipes.

Private well piping or well problems: intermittent cycling of a well pump when no water is being run is often a sign of either a running plumbing fixture in the building, or a leak in the well piping itself. If you see condensation on water piping entering the water pressure tank and hear intermittent well pump cycling for no apparent reason, further investigation is warranted. See INTERMITTENT CYCLING WATER PUMPS and WELL PIPING LEAK DIAGNOSIS.

Indoor stains in ceilings or walls, flooring damage, and even hidden mold are all problems that can be caused by hidden plumbing leaks or by condensation on cold water piping where it passes through building cavities.

How to Cure Condensation or Sweating on Plumbing Pipes, Tanks, Toilets

Insulate Cold Water Piping

For at least two reasons, that of energy efficiency and to prevent moisture drips and possible mold growth inside basement ceiling cavities, you might want to insulate your hot water and heating pipes in a basement as well, though in some conditions we are so desperate to warm and dry a problem area that we deliberately leave the hot water and heating pipe insulation off of those pipes so that we can steal some of their heat to warm and dry an area.

Carson Dunlop suggest that if a basement is to be finished, the cold water piping

above the ceiling should be insulated.

Foam insulating tubes that snap around plumbing piping are widely available and work very nicely for this purpose. We advise against wrapping pipes in fiberglass insulation.

Insulate the Water Pressure Tank?

Where a water pressure tank is located in a finished basement or similar area, having puddles of condensate on the floor around the water tank can be a problem. If you have made sure that there are no plumbing leaks or well pump short cycling problems that are keeping the water tank cold and subject to condensation too much of the time, insulating the water tank with an insulation blanket may be helpful.

Watch out: we have inspected properties where the water pressure tank was located in a finished basement, enclosed in a closet, and surrounded with fiberglass insulation. Wetting fiberglass insulation is inviting a hidden mold contamination problem. Insulating such "closets" with solid foam insulation may be a more mold-resistant approach. See INSULATION MOLD for details.

Insulate Toilet Tanks?

Some toilet models currently sold include an insulated toilet tank and may be appropriate if you live in an area where weather is hot and humid for much of the year, as toilet tank condensation can be a problem even if the toilet is not leaky or running. But before going to the cost and trouble of changing out a toilet tank or trying to insulate the exterior of the tank, make triple sure that your toilet is not leaky and running.

Fix Plumbing Leaks

Find and fix running toilets, hidden plumbing leaks, well piping problems or municipal water piping problems that we listed earlier.

Use a Dehumidifier, Add Heat, Increase Air Circulation

Our preferred method for reducing condensation on plumbing pipes, tanks, toilets indoors is to reduce the level of indoor humidity to an appropriate level using either a local portable dehumidifier, or the building's central air conditioning system. See HUMIDITY LEVEL TARGET for details.

In some circumstances increasing the air circulation around a condensation-prone water tank can reduce the total quantity of condensation, at least if the condensation is from normal use and not from a plumbing leak. In some commercial installations and in a few private homes where condensation people add heat where spot condensation is a particular problem.

More Cures Sweating (Condensation) Problems on Toilets

As noted in Chapter 6 of Best Practices Guide to Residential Construction:

TRAPS on PLUMBING FIXTURES

WATER HEATERS
WATER, WELLS, WATER TANKS: TESTING GUIDE
WATER PRESSURE LOSS DIAGNOSIS & REPAIR
WATER PRESSURE PROBLEM DIAGNOSIS TABLE
WATER PRESSURE & FLOW MEASUREMENT
WATER PUMPS & TANKS
WATER PUMP CONTROLS & SWITCHES
WATER PUMP TYPES & LIFE EXPECTANCY
WATER PUMP SAFETY
WATER PUMP SHORT CYCLING
WATER PUMP & WATER TANK REPAIRS
WATER PRESSURE LOSS DIAGNOSIS & REPAIR
WATER PRESSURE PROBLEM DIAGNOSIS TABLE
WATER PRESSURE & FLOW MEASUREMENT
WATER SOFTENERS & CONDITIONERS
WATER SOURCE ALTERNATIVES
WATER SOFTENERS & CONDITIONERS
WATER SOURCE ALTERNATIVES
WATER SUPPLY & DRAIN PIPING
WATER SHUTOFF VALVE LOCATION, USE
WATER SHUTOFF VALVE, WELL PUMP
WATER TESTS, CONTAMINANTS, TREATMENT
WELLS CISTERNS & SPRINGS
WINTERIZE A BUILDING

More Information

In humid areas with cold incoming water, sweating on the outside of the porcelain tank can be a significant problem, in some cases rotting the flooring around the toilets. Some of the new flushing strategies alleviate the problem somewhat:

- In gravity toilets that store 3 or more gallons of water in the tank, the incoming 1.6 gallons of cold water is tempered by the retained water in the tank.
- In pressure-assisted toilets, the incoming water resides in a small tank within the larger porcelain tank, so the porcelain tank is not chilled. However, condensation can form around the inner tank, leading to mold growth.

One approach to avoiding "sweating" or condensation problems with older toilets is to add special foam insulation inserts inside the tank. These may not work with low-flow designs, however. Also this does not prevent dripping from the bowl or water supply line. Where the problem persists, consider added an anti sweat valve (Beacon Valves) that tempers the incoming cold water with a little bit of hot water to bring it up to room temperature.

Questions & Answers regarding this article

.

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(June 21, 2012) DanJoeFriedman (mod) said:

Jo, since it is usually not at all cost feasible to chop up a concrete floor to insulate below it, what remains to stop condensation on a cool floor surface is to reduce the indoor humidity level. That means running a dehumidifier as well as finding and fixing any indoor leaks or moisture sources. In a small bathroom where there is not good air circulation, the condensation problem may be worse than elsewhere on the same floor. A small fan that increases air circulation across the floor might also help. But try a dehumidifier.

(June 20, 2012) Jo said:

The tile flooring in our toilet sweats alot I think this is due to the clay base if it has been raining for some time. How can we prevent this.

(May 7, 2012) Lemastre said:

In a nursing home I noted a 3/4" copper pipe protruding an inch or so down from the ceiling and dripping water into the sink directly below. The nursing home uses a tempered-water heating/cooling system, so there are pipes and maybe even a heat-exchanger in the ceiling over each living area. What does a building code usually say about disposing of condensate in such a system?

Recommend / Share this Article

ShareThis

EMAIL

Print

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also include a list of recommended books for the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

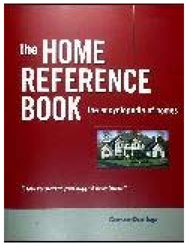
CONDENSATION or SWEATING PIPES, TANKS - see detailed links at page left

- Thanks to Mark Cramer, Tampa Florida, for assistance in technical review of the "Critical Defects" section and for the photograph of the deteriorating gray Owens Corning flex duct in a hot attic. Mr. Cramer is a Florida home inspector and home inspection educator.
- CARSONDUNLOP Carson, Dunlop & Associates Ltd., 120 Carlton Street Suite 407, Toronto ON M5A 4K2. (416) 964-9415 1-800-268-7070 info@carsondunlop.com. The firm provides professional home inspection services & home inspection education & publications. Alan Carson is a past president of ASHI, the American Society of Home Inspectors. Thanks to Alan Carson and Bob Dunlop, for permission to InspectAPedia to use illustrations from *The Illustrated Home* which illustrates construction details and building components. Carson Dunlop Associates' home inspection education products include
  - The ASHI-adopted *Home Inspection Training Program*, and Commercial Building Inspection Courses
  - The Home Inspection Home Study Course, and publications such as
  - The Home Reference Book, a reference & inspection report product for building owners & inspectors

- The Home Reference *eBook*, an electronic version for PCs, the iPad, iPhone, & Android smart phones
- Home Inspection Report writing materials including the *Horizon report writer*

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia. er
- Plumbing Diagnosis & Repair: Water supply, drainage, septic systems, water testing, water contamination, defective plumbing materials & products.



- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

  Or choose the The Home Reference eBook for using this reference on PCs, Macs, Kindle, iPad, iPhone, or Android Smart Phones

Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

- Water pump and pressure tank repair diagnosis & cost an specific case offers an example of diagnosis of loss of water pressure, loss of water, and analyzes the actual repair cost
- Water pressure tank failures & water pump short cycling diagnosis and repair
- Cheating on water tests: Testing Water for Real Estate Transactions - make sure your water test is valid
- Drinking Water Testing Advice for home buyers home owners home inspectors
- Interpreting Drinking Water Test Results and Correcting Unsatisfactory Water
- Drinking Water Contaminant Levels - Maximum Allowed
- Lead Contamination in Drinking Water: Testing & Correction - Advice (This Article)
- Lead Testing & Correcting Contamination from Lead Water Supply Lines/Entry Mains - Lead Pipe Problems/Advice
- Water pump and pressure tank repair diagnosis & cost an specific case offers an example of diagnosis of loss of water pressure, loss of water, and analyzes the actual repair cost
- Water testing for Pesticides: comprehensive and pesticides-example parameters
- Water Testing: background comments on classes of water contaminants, & links to home buyer advice about water testing, drinking water, water supply
- When and How to Shock or Chlorinate a Well - Procedure for Shocking a Well to (temporarily or maybe longer) "Correct" Bacterial Contamination
- Water Requirements, Home & Outdoor Living
- Typical Water Tests & Fees this water test fee schedule applies when testing is combined with other onsite building inspection services
- Drinking Water testing, contamination, correction - all topics
- General water testing and corrective measure advice: contact your local health department.
- ...

InspectAPedia®

Free Encyclopedia of Building & Environmental Inspection, Testing, Diagnosis, Repair

Search
InspectAPedia

Ask a Question or Search InspectAPedia

Mobile View
AIR CONDITIONING & HEAT PUMP SYSTEMS

A/C - HEAT PUMP CONTROLS & SWITCHES
AIR CONDITIONER BTU CHART
AIR CONDITIONER COMPONENT PARTS
AIR CONDITIONER TYPES, ENERGY SOURCES
AIR CONDITIONER NOT WORKING
AIR FILTER EFFICIENCY
AIR FILTERS, FIBERGLASS PARTICLES
AIR FILTERS for HVAC SYSTEMS
AIR FLOW MEASUREMENT CFM
AIR HANDLER / BLOWER UNITS
ADDING A/C: RETROFIT SIZING
BLOWER FAN CONTINUOUS OPERATION
BLOWER FAN OPERATION & TESTING
BLOWER LEAKS, RUST & MOLD
COOLING COIL or EVAPORATOR COIL
DIRTY A/C BLOWERS
BACKUP HEAT for HEAT PUMPS

Air Conditioning Cooling Coil or Evaporator Coil Diagnosis & Repair

InspectAPedia® - ShareThis +1

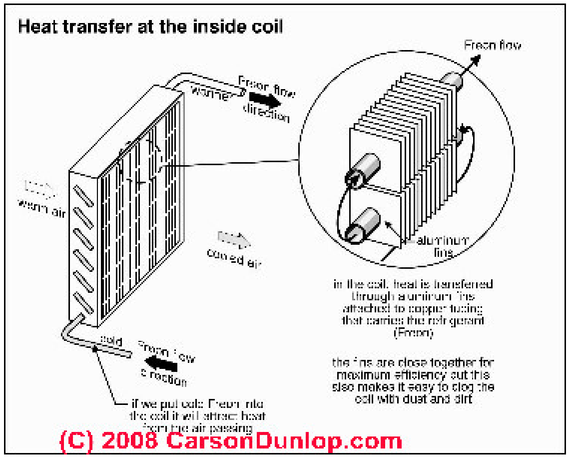
- How to diagnose & repair problems with the air conditioning cooling coil or evaporator coil [found in the indoor air handler]
- Frost or ice build-up on cooling coils and its effect on cool air flow and mold
- Frost or ice formation at air conditioning compressor/condenser units
- Ice and condensate problems in air conditioning duct work, why it forms, how bad it can get, how to prevent it
- Frosting & non-frosting evaporator coil designs
- How frosting type evaporator/cooling coils are defrosted
- Dirt or debris-blocked cooling coil/evaporator coil cleaning & repair methods
- Types of evaporator coils/cooling coils: dry vs flooded evaporator coil design differences; frosting vs non-frosting cooling coils & frosting-coil defrosting methods & controls
- How cooling coils are changed-out or replaced
- Questions & Answers about cooling coils (evaporator coils) in air conditioners, heat pumps, refrigeration systems

This article discusses the diagnosis and repair of cooling coil or evaporator coil problems that occur in the air conditioning or heat pump air handler unit such as frost or icing, dirt, blockage, refrigerant leaks, or improper sizing. Our photo at page top shows the cooling coil in the attic air handler component of a central air conditioning system.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

at the left of each page to navigate ***within*** topics and documents at this website. Green links show where you are in a document series or at this website.

Cooling Coil (Evaporator Coil) Basics for Air Conditioning & Heat Pump Systems



If your air conditioning or heat pump system has lost its cooling capacity or won't start see REPAIR GUIDE for AIR CONDITIONERS. See How to determine the cooling capacity of air conditioning equipment if the system seems to be working but is inadequate to cool your building. Contact us to suggest text changes and additions and, if you wish, to receive online listing and credit for that contribution. Page top photo of an iced-up air conditioning evaporator coil are courtesy Guy Benfante.

The cooling coil or evaporator coil is where building indoor air cooling actually takes place.

The liquid air conditioning refrigerant entering the cooling coil through the metering device (a capillary tube or THERMOSTATIC EXPANSION VALVE) is increasingly changed to gas form as it "boils" or evaporates as the liquid refrigerant flows through the cooling or "evaporator" coil, so that at the end of the cooling coil the refrigerant is totally in gaseous form.

This state change (liquid to gas refrigerant) absorbs energy, cooling the tubing and fins of the cooling coil and thus indirectly, cooling and dehumidifying indoor air that is blown across the coil.

A cooling coil which is blocked by debris or ice and frost, or which is damaged can obstruct air flow and reduce air conditioning system output. The air conditioning system evaporator coil and problems include ice and frost build-up, dirt or debris blocking air flow through the coil, and damaged or leaky cooling coils.

We also discuss how cooling coils may be cleaned in-place and what to watch out for during that procedure. Cooling coils which are part of an air conditioning retrofit installation onto an existing warm air heating system can also present special problems of sizing and air flow, discussed further at ADDING A/C: RETROFIT SIZING. Sketch of heat transfer at the inside coil, also called the cooling coil or evaporator coil, courtesy of Carson Dunlop Associates.

If ice, dirt, or damage block air flow across or through the cooling coil (evaporator coil) in an air conditioner, the cool air output will be substantially reduced or may even stop entirely.

Below we describe how the cooling coil works, what goes wrong with this component, and how its problems are diagnosed by simple visual inspection (inside of the air handler) or by some simple temperature measurements.

How To Inspect, Test, & Diagnose Cooling Coil (Evaporator Coil) Air Conditioner or Heat Pump Problems

Where to look for cooling coil problems: First, make a visual inspection of the cooling coil. Most air handlers provide an access panel or cover that can be removed to give at least partial view of the cooling coil surfaces. Turn off electrical power to the system to be safe from electrical shock. On opening an access cover or panel on the air handler you can recognize the cooling coil from our photos and sketches shown here and elsewhere on this website. You may need to use a flashlight and mirror to see the coil surfaces.

Remember to inspect the cooling coil from the incoming-air side - the side of the coil facing the blower fan assembly. That's because any dirt or debris entering the coil will come principally from this direction. If you inspect the wrong side of the coil it may look perfectly clean even though it is totally blocked by debris on its other surface. DIRTY COOLING COIL has photos of just how blocked a cooling coil can become in an air conditioner or heat pump.

Here are some common defects to look for at the evaporator coil (cooling coil) in an air conditioner or heat pump:

- Dirt or debris blocking air flow through the coil (DIRTY COOLING COIL)
- Ice or frost formation blocking air flow through the coil (FROST BUILD-UP on AIR CONDITIONER COILS)
- Damaged cooling / evaporator coil fins over more than 10% of the coil surface, blocking air flow (shown in our photo at left in this case, the damage is to a condensing coil, not an evaporator coil). Small areas of damaged cooling fins can be straightened and cleaned-up using a cooling coil comb. Cooling coils with extensive physical damage such as shown in our photograph need to be replaced.
- Evidence of refrigerant leaks (visual evidence may include stains from refrigerant oil left at the point of leakage) (REFRIGERANT LEAK DETECTION)
- Evidence of mold growth on organic debris on the coil or elsewhere in the blower compartment (Mold Growth in Air Handlers)
- Presence of unusual materials on the coil surface such as rodent debris, bird feathers and debris, fiberglass insulation, large trash fragments like paper or leaves confirming a duct or air filter problem. Some of these may indicate potentially serious health risks such as rodent or bird feces and debris which risk bacterial and viral hazards in building air. (Leaks, Rodents In Air Handlers)
- Obvious coil-to-air-handler size mismatch of an add-on cooling coil onto an existing warm air system (ADDING A/C: RETROFIT SIZING)
- Evaporator coil or cooling leaks or holes: if an evaporator coil is leaking (or also if the condensing coil is leaking) you'll find out pretty quickly as refrigerant will be lost and the cooling system will stop providing cool air. You'll need expert diagnosis by an HVAC service technician.
    - A lot depends on where the refrigerant leak has occurred and what caused the leak. If the cooling coil has a single point leak caused by some mechanical damage (one of our readers accidentally drilled a hole in his coil while trying to drill a drain hole in his air handler), it may be possible to find the hole and repair it using silver solder.
    - If the refrigerant leak is in copper tubing anywhere in the cooling or heat pump system that is not too close to an evaporator coil or condensing coil, it should be possible to solder a repair, then evacuate and recharge the cooling system.
    - If the refrigerant leak is in copper tubing in or close to the cooling coil (or in a condensing coil) a solder repair is hard to complete because the heat of the soldering process tends to de-solder other nearby connections. It might be possible if the technician is very expert and if s/he knows how to keep nearby surfaces cooled (we've used a wet rag).
    - If the refrigerant leak is in an aluminum part, soldering aluminum is more tricky and may not be feasible. Ordinary procedures using a torch, for example, just melt the aluminum. Expert welders use inert gas welding methods.
    - If the refrigerant leak is due to severe corrosion anywhere in an HVAC system we're not optimistic that a solder repair is possible. The conditions that caused a corrosion-related leak are likely to have thinned and weakened other parts. The cost of an attempted repair may be wasted.
    - Replacement of the cooling coil (or condensing coil) is more often going to be recommended by your HVAC technician because of these difficulties.

Temperature measurements at the cooling coil: see OPERATING TEMPERATURES for a discussion of where and how air temperature measurements are made to diagnose cooling coil or other air conditioner operating problems.

Below we introduce some of the more common air conditioner or heat pump cooling coil or evaporator coil defects and repairs.

Air flow requirements across the air conditioning evaporator coil: if airflow is weak for any reason (dirty coil, duct system defects, blower fan defects, dirty blower squirrel cage fan), the air conditioning system will not operate properly. Some experts write that there should be between 350 and 400 cubic feet of air per minute (CFM) moving across the evaporator (cooling) coil for each ton of air conditioner capacity.

One ton of cooling or heating capacity = 12,000 BTUH so if your AC unit or heat pump is a 24,000 BTUH unit it is a "two ton" unit and needs to see 700 to 800 CFM of air across the evaporator coil.

Some home inspectors and air conditioning service technicians carry a small airflow meter that can actually measure this number with fair accuracy. (The same tool is nice for comparing air flow and balancing air flow at various building supply ducts and registers.

How Air Conditioning & Heat Pump Evaporator Coils (Cooling coils) are Cleaned

Evaporator coil cleaning often requires cutting refrigerant lines, removal of the coil and other components for cleaning, and reinstallation, pulling a vacuum on the refrigerant lines, and recharge with refrigerant. Such service and repair may involve significant expense, although there are some "in place" cleaning methods using foams and sprays that are a simpler procedure. See DIRTY COIL CLEANING PROCEDURES for details of this topic.

FROST BUILD-UP - Frost Build-up on the Evaporator Coil in an Air Conditioner

The ice or frost formed on a cooling coil in an air conditioner air handler unit is usually caused by an improper refrigerant charge, possibly by inadequate air flow across the cooling coil, or by a thermostatic expansion valve (TEV) or other air conditioner or heat pump control defect.

Ice blocks air flow through the coil, thus reducing air conditioner output; if the ice formation is extreme nearly all of the airflow across the coil is blocked and the air conditioner system runs but does not produce cool air flowing into the occupied space.

Frost and ice can also form on refrigerant tubing at other locations, and frost and ice can form inside air conditioning duct work itself, leading to troublesome leaks into the building.

Details of what causes frost on air conditioning equipment, what problems that creates, and how to diagnose and repair icing or frost on cooling coils or other air conditioner parts are provided at FROST BUILD-UP on AIR CONDITIONER COILS. TThis article explains locations and causes of condensate, frost or ice formation in air conditioning systems, air handlers, compressor/condensers, refrigerant lines, and in air ducts.

Note that frost formation at some cooling coils (not air conditioners or dehumidifiers) may be normal. We discuss frosting and non-frosting cooling coil types and coil defrosting methods further at Frosting vs. Non-Frosting Types of Evaporator Coils

BLOCKED COOLING COIL - Air Conditioner Evaporator Coil Blocked by Debris or Dirt

Ice is not the only (nor even the most common) cause of blocked air flow in an air conditioner. This photograph shows how easily debris can stick to and clog the inlet side of the cooling coil in an air conditioning system. This evaporator coil was nearly totally blocked with dust and debris. How does this happen?

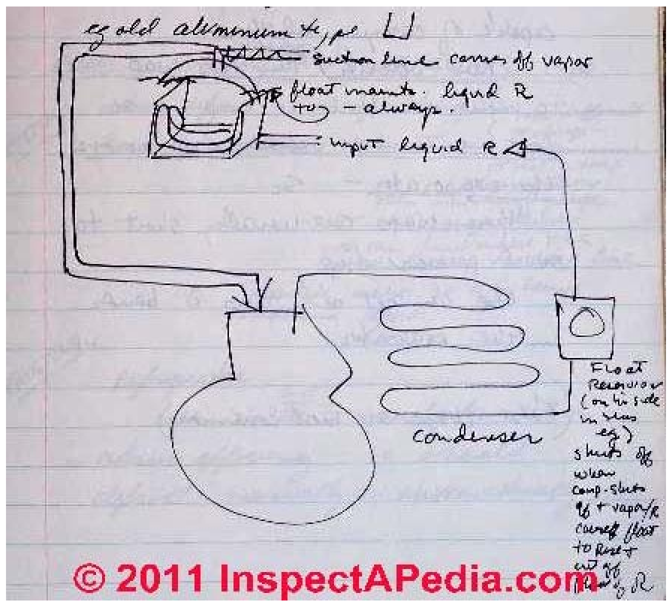
There was no air filter installed in the system. Ordinary house dust is comprised largely of fabric fibers and skin cells.

These and other debris in building dust such as soot and organic particles like pollen and mold spores all join to form a gray mat on the fins of the cooling coil in an air handler.

Debris sticks particularly quickly to this surface because of the combination of close spacing of the cooling fins (about 1/16" apart) and the fact that condensate forming on the coil keeps the surface damp.

Details about the detection and cleaning of dirt and debris which block an air conditioner cooling coil are at DIRTY COOLING COIL.

Types of Evaporators or Evaporator Coils or Cooling Coils: Dry vs Flooded Evaporator Coil Designs



There are two types of evaporators used in refrigeration systems: flooded and dry evaporator coils.

Dry Evaporator Coils: in a dry evaporator coil design, all of the refrigerant entering the evaporator coil enters as a vapor (or gas).

In a dry type evaporator coil (or cooling coil) the refrigerant oil travels constantly in the system along with the refrigerant, and some oil is discharged into the condenser. That is, only liquid refrigerant can actually carry oil.

In the evaporator the refrigerant is vaporized and the oil travels through, but the vapor is less capable of actually carrying the oil through the coil.

For the oil to pass through we need refrigerant gas velocity and turbulence in the evaporator coil, so we do not want much pressure drop across the evaporator coil.

Therefore dry evaporator type coils are usually short - to avoid much pressure drop.

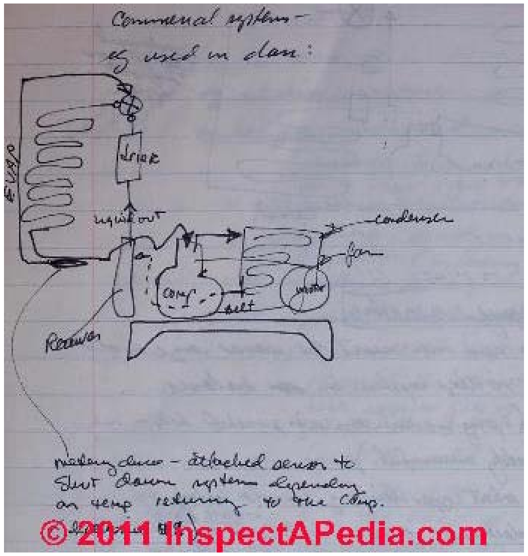
Otherwise we get oil traps at the bends in the evaporator coil.

These are the more common type of evaporator coil or cooling coil in refrigeration systems. So, for example, for a small air conditioner that has to be packed into a small space, to keep the evaporator length short the manifold system may used to run several short evaporator loops in parallel - to avoid long individual tubing runs that might cause an ensuing refrigerant pressure drop and oil traps in the system.

[An oil trap will clog or prevent refrigerant flow through the evaporator and thus will prevent the system from working. A symptom might be loss of cooling and high refrigerant pressures on the high side]

Flooded Evaporator Coils: in a flooded evaporator coil design, the evaporator is constantly full of refrigerant, whether the cooling system is "on" or "off". See our cooling coil sketches shown here.

Frosting vs. Non-Frosting Types of Evaporator Coils



Our sketch (left) shows the basic layout of a commercial refrigeration system. Here we detail the difference between frosting and non-frosting evaporator coils and we explain how frosting-type systems must be defrosted to keep working.

Non-Frosting Evaporator or Cooling Coils - No Defrosting Needed

Dehumidifiers are examples of non-frosting type cooling coil designs. These devices are basically little "air conditioners" or cooling systems in their design (though their warm air output is exhausted directly into the same space). The dehumidifier system is a refrigeration system designed such that the coil will never form ice or frost.

Room air conditioners (portable or window or through wall units) are also examples of non-frosting type cooling coil designs.

These "frost-proof" or non-frosting systems (in normal operation) ar more difficult to charge: you must use a precisely measured charge or a temperature-sensing device and matching gauge with the temperature-sensing device - you find where the liquid ends in the evaporator line - where there is no further change in temperature in the evaporator coil tubing, there is no more liquid refrigerant present.

If you see ice or frost on these cooling coils it's an abnormal condition that needs to be diagnosed and repaired. See our diagnostic advice at FROST BUILD-UP on AIR CONDITIONER COILS

Defrosting Methods for Cooling Coils (Evaporator Coils) in Refrigeration Systems

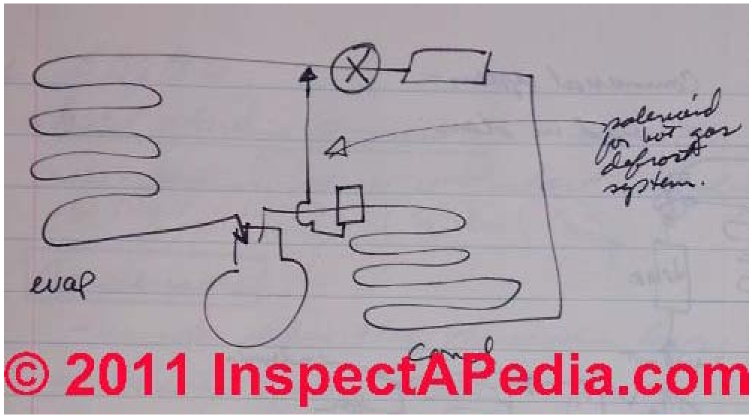
Frosting Evaporator or Cooling Coils Require a Defrost Cycle

Examples of frosting evaporator coils or cooling coils include refrigerators (or freezers). When more than 1/4 of the surface is ice or frost that condition acts as an insulator that reduces the efficiency of the appliance, so the appliance will have to defrost itself - either automatically or manually.

There are two defrosting methods commonly used in frosting-evaporator coil designs:

Defrost by electrical resistance heating (common on refrigerators, including frost-resistance for door faces and jambs using extra resistance heating elements in those areas too);

Defrost by hot gas: a solenoid in the compressor discharge line shuts [sketch above left] down vapor from the condenser and deposits high pressure/high temperature refrigerant gas directly into the evaporator coil, bypassing the refrigerant metering valve (TEV or cap tube).



The problem with dumping high temperature refrigerant vapor into the cold (iced, needs defrosting) evaporator is that it causes it to begin to condense - back pressure of the gas goes up and head pressure at the condenser goes down - now liquid refrigerant can back up to the compressor (where it would cause damage).

To avoid compressor damage from liquid refrigerant during this defrost cycle we add heat at the end of the evaporator coil (cooling coil) to insure that refrigerant reenters the compressor as a vapor, never as a liquid. Typically, setting a maximum of 20 minutes of defrost cycle adds protection against warming up food in the refrigerator or freezer where this design is used.

The refrigeration compressor continues to run during the defrost cycle in the hot gas method case, but the compressor will not keep running during the defrost cycle in the electrical resistance defrost cycle method.

When is cooling coil frosting abnormal?

Note that on dehumidifiers and air conditioners or heat pumps frost or ice formation on the cooling coil is not normal and is an indication of the need for repairs. See our diagnostic advice at FROST BUILD-UP on AIR CONDITIONER COILS

How cooling coils are changed-out or replaced

When an evaporator coil or cooling coil needs replacement (perhaps because the old one is damaged or leaky):

- Because replacing a cooling coil or evaporator coil is a lot of work (and costly) first see if the old coil can be preserved. Combs can straighten out damaged cooling coil fins if they are not corroded too badly; and special expoxies are available to seal punched holes - a moderately successful repair attempt. If the coil is leaking due to corrosion, epoxy is probably a waste of time - replace the coil.
- The new cooling coil must be the same size as the old one it replaces in order to keep the system in balance.
- A short copper line is connected to the coil (at the factory) - use a wet rag or a flare block as a heat sink to avoid putting excess heat on this copper line (which may be connected to an aluminum coil by epoxy) during soldering the new evaporator coil to the existing refrigerant supply and suction lines.
- On newer HVAC and refrigeration systems you will usually have to cut out the old coil in place, removing both the coil and the foam poured around it. On older systems there may be screws and an access panel, usually on the freezer side of the coil in that equipment.

Questions & Answers about cooling coils (evaporator coils) in air conditioners, heat pumps, refrigeration systems

Question: what should the air temperature be when leaving the cooling coil of an air conditioning system?

What is normally the air temperature leaving the evaporator?

I never looked into it but I think it should be as close to 32F (freezing) as possible (-- with out reaching freezing - Not to cause ice accumulation on the evaporator fins).

I want to put a thermometer by the evaporator fins and see how good the air cooling is, its probably an good indirect way to see if there is sufficient refrigerant in the system or if there is air or other gases mixed in with it -- making the cooling inefficient. - E.K.

Reply: look at the air temperature drop across the cooling coil rather than looking for an absolute or specific air temperature

Air temperature leaving the evaporator: there may be some standards that I don't know (probably are) but the way I look at it, because of variation in refrigerants, air speed across the evaporator, and temperature of the incoming air aimed at the evaporator, we look more at the temperature difference across the evaporator to see if it's doing its job.

Figure that 15-20 degF would be a good temperature drop across the coil for a typical air conditioning system. Other experts add that the temperature difference across an evaporator (cooling coil) may be as little as 14 degF or as much as 22 degF.

To a beginner HVAC servicve tech [DF] it was striking to see how dramatic and critical was the effect of airflow across the evaporator coil on coil behavior and coil frosting or icing. During an actual case of refrigeration system diagnosis [1] (the coil was icing over and the system was not cooling) I sought to adjust the TEV to bring the frost line to the end of the cooling coil where it belonged. But one learns immediately that only if the blower fan was sending air across the cooling coil could one expect the system to behave as designed. Without that airflow, at just about any TEV setting of refrigerant flow rate into the evaporator coil the coil would ice up quickly.

Temperature measurements at the cooling coil: see OPERATING TEMPERATURES for a detailed discussion of where and how air temperature measurements are made to diagnose cooling coil or other air conditioner operating problems.

Questions & Answers regarding this article

.

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(1 days ago) Anonymous said:

Judy:

Do air filters block air from flowing over the evaporator coils?

Well maybe: if the air filters are dirty they restrict air flow. If the air filters are reasonably clean then the amount of air flow restriction is within the design limits of the equipment. Certainly DO NOT operate the system with no air filters installed. Doing so will allow dust and crud to accumulate inside the equipment, leading to more serious blocked air flow and an expensive cleaning bill.

Sweaty Jane:

Indeed the freon leak needs to be repaired - otherwise your system is both contaminating the environment and creating a regular delivery route for the A/C guy. I can't say if the leak is in the coils or elsewhere - so before replacing the coils, ask to be shown where the leaks are occurring.

(1 days ago) Judy said:

Do the air filters for the evaporator coils restrict the air flow around the coils on my manufactured home nordyne unit as the handy man who came to repair the outside unit told me?

(July 11, 2012) Sweaty Jane in GA said:

After one year, our HVAC multi-zone unit(Bryant) is not running at all. Last year our tech had to put in more freon and then in December 2011, he had to add more, because the heat was not working. It worked fine for 3 months, then out again in April. Now, he says we have a freon leak, and need new evaporator coils, after a supposed spring tune-up and more freon. Will the new coils fix the leaking freon or could it be elsewhere?

(June 17, 2012) DanJoeFriedman (mod) said:

Thanks Anon, we agree completely. When airflow in an air conditioning system is inadequate the place to start is with a dirty air filter.

Other sources of reduced airflow include:

a dirty blower fan assembly
damaged, leaky, or crimped ductwork
an electrical problem causing slow fan speed
iced cooling coil

(June 17, 2012) Anonymous said:

check ur filters Dan and the inside coil/evaporator and see if it's dirty

(June 14, 2012) Dan said:

My air conditioner blower motor is running but there is inadequent air flow coming through the vents, this just started today and was running fine prior

(June 3, 2012) joe g said:

After I turn my a/c unit on sometimes my evaporator unit will turn off then on again maybe once or twice or sometimes never?? While the compressor would be running with out going off .

(Jan 15, 2012) Tommy said: 2

David S
Sounds like there is a problem with zoning system causing system to freeze and the system is also overcharged causing the noisy compressor and compressor not to start. Compressor is pumping liquid when it starts and it is designed to pump only gas.

(Aug 18, 2011) David S said: 2

). I called consumer affairs and pleaded for a new unit but the person on the phone told me that all Lennox would do is “furnish a replacement compressor”. I ask to speak to a supervisor and held for one hour and got cut off, I called back twice and left two messages and never got a call back.

When we took the door off the air handler to get the nomenclature off of the new evaporator coil we found found that it is substantially smaller that the original coil and I thinking that this could be the reason the unit keeps freezing up.

Our tech put in the new compressor and the unit ran for a week and now it is down again. This unit has cost us well over $10,000.00 now and we still don’t have a reliable HVAC system and will probably loose our tenants and they will potentially take legal action against us.

(Aug 3, 2011) DanJoeFriedman (mod) said: 2

Mark it sounds as if there are two problems:

1. you may be getting condensate blown down the ductwork during system operation

2. your condensate drain is clogged or undersized and the pan may also be undersized.

I'd ask an HVAC tech to look at and correct both problems, though first you might see if you can clear your condensate drain yourself.

(showing 1 to 10)

Recommend / Share this Article

ShareThis

EMAIL

Print

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also include a list of recommended books for the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

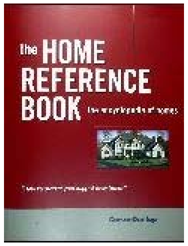
COOLING COIL or EVAPORATOR COIL
DAMAGED COOLING COIL
DIRTY COOLING COIL
DIRTY COIL CLEANING PROCEDURES
FROST BUILD-UP on AIR CONDITIONER COILS
INCREASING RETURN AIR

- Thanks to to Guy Benfante, Chesapeake, VA 8/26/07 for the photograph of an ice-blocked air conditioning system evaporator coil and for his suggestion that we provide an air conditioning system troubleshooting FAQ.
- Thanks to Mark Cramer, Tampa Florida, for assistance in technical review of the "Critical Defects" section and for the photograph of the deteriorating gray Owens Corning flex duct in a hot attic. Mr. Cramer is a Florida home inspector and home inspection educator.
- CARSONDUNLOP Carson, Dunlop & Associates Ltd., 120 Carlton Street Suite 407, Toronto ON M5A 4K2. (416) 964-9415 1-800-268-7070 info@carsondunlop.com. The firm provides professional home inspection services & home inspection education & publications. Alan Carson is a past president of ASHI, the American Society of Home Inspectors. Thanks to Alan Carson and Bob Dunlop, for permission for InspectAPedia to use text excerpts from *The Home Reference Book* & illustrations from *The Illustrated Home*. Carson Dunlop Associates' home inspection education products include

The ASHI-adopted Home Inspection Training Program, and Commercial Building Inspection Courses
  - The Home Inspection Home Study Course, and publications such as
  - The Home Reference Book, a reference & inspection report product for building owners & inspectors
  - The Home Reference *eBook*, an electronic version for PCs, the iPad, iPhone, & Android smart phones
  - Home Inspection Report writing materials, including the Horizon Software System that manages business operations, scheduling, & inspection report writing using Carson Dunlop's knowledge base & color images. The *Horizon* system runs on always-available cloud-based software for office computers, laptops, tablets, iPad, Android, & other smartphones.
  - The Illustrated Home illustrates construction details and building components, a reference for owners & inspectors
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- Wikipedia provided background information about the definition of HEPA and airborne particle interception.
- [1] At Example Refrigeration Equipment Field Diagnosis & Repair: Thermostatic Expansion Valve we include an old case history of observations made during tests and adjustments of the TEV on a commercial refrigeration cooler/freezer - way back during refrigeration school in 1982 [DJF].

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia Bookstore.



- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

  Or choose the The Home Reference eBook for using this reference on PCs, Macs, Kindle, iPad, iPhone, or Android Smart Phones

Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

- Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982
- Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- NEW!
  Air Conditioning SEER - New DOE Air Conditioner and Heat Pump Efficiency Standard
- Asbestos HVAC Ducts and Flues field identification photos and guide

- Fiberglass: Indoor Air Quality Investigations: Fiberglass in Indoor Air, HVAC ducts, and Building Insulation
- ...

InspectAPedia®

Free Encyclopedia of Building & Environmental Inspection, Testing, Diagnosis, Repair

Search
InspectAPedia

Ask a Question or Search InspectAPedia

Mobile View
HEATING SYSTEMS

Combustion Products from Heating Appliances: Indoor Air Quality Hazards

InspectAPedia® - ShareThis +1

- Flue gas hazards from heating equipment
- Combustion product gas hazards: carbon monoxide, nitrogen dioxide, sulphur dioxide (sulfur dioxide), soot and combustion particles
- INDOOR AIR QUALITY IMPROVEMENT, KEY STEPS
- Questions & answers about flue gases & combustion products produced by burning home heating oil, natural or LP gas, wood or wood pellets, or coal in home heating appliances

This article explains flue gases and particles produced by various heating appliances and their impact on safety and indoor air quality in homes.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

 Use page top links to major topics or use links at the left of each page to navigate ***within*** topics and documents at this website. Green links show where you are in a document series or at this website.

What are the Products of Burning Heating Oil, LP Gas, Natural Gas, What is in "Flue Gases" and What are the Hazards?

This article includes excerpts or adaptations from Best Practices Guide to Residential Construction, by Steven Bliss, courtesy of Wiley & Sons.

See our summary table of INDOOR COMBUSTION PRODUCTS & IAQ and see ENVIRONMENTAL HAZARDS - INSPECT, TEST, REMEDY for our full list of environmental hazard identification and remedy related to buildings. See COMBUSTION AIR for additional details about the requirement for combustion air. COMBUSTION AIR for TIGHT buildings explains how to provide outside combustion air for tight buildings. See COMBUSTION GASES & PARTICLE HAZARDS for an explanation of the dangers of inadequate combustion air. See COMBUSTION PRODUCTS & IAQ for the relationship between fuel burning appliances and building indoor air quality. More about carbon monoxide - CO - is at CARBON MONOXIDE - CO and at CARBON MONOXIDE WARNING.

As stated in Best Practices Guide to Residential Construction:

A combustion appliance is any device that burns fuel for heating, cooking, or decorative purposes. This includes central-heating systems, space heaters, water heaters, ovens and cooktops, woodstoves, and fireplaces. The major pollutants associated with combustion are carbon monoxide, nitrogen dioxide, sulfur dioxide, and particles. See INDOOR COMBUSTION PRODUCTS & IAQ for a Table of Combustion Products & Indoor Air Quality Hazards that accompanies this article.

Unvented space heaters and gas stoves without range hoods dump combustion products directly into the living space and have no place in the modern home. Vented appliances, such as boilers, water heaters, and fireplaces, are designed to exhaust combustion products to the outdoors, but they are vulnerable to backdrafting in today's tightly built houses. When appliances are malfunctioning or out of adjustment, they produce more pollutants, including carbon monoxide. The combination of backdrafting and the high production of carbon monoxide can be deadly.

Health Effects of Combustion Products. Possible health effects from combustion products include eye and respiratory irritation, persistent coughing, headaches, fatigue, and dizziness. In the case of carbon monoxide, symptoms can include nausea and confusion, and, at very high levels, loss of consciousness and death. Effects associated with specific pollutants are discussed below:

- Carbon monoxide. CO is a colorless, odorless gas produced by incomplete combustion. Common sources include blocked chimneys or vents, cracked or rusted heat exchangers, poorly adjusted appliances, smoldering fireplaces, and auto exhaust from an attached garage.
- CO interferes with the blood's ability to deliver oxygen to the body. Low concentrations may increase chest pain in people with heart disease. Sustained concentrations above 70 ppm can cause fatigue, headache, weakness, and nausea, and may be confused with the flu or food poisoning.

  Fetuses, infants, the elderly, and people with anemia or heart disease are especially vulnerable. At very high levels, CO causes confusion, loss of consciousness, and death. CO alarms are programmed to sound before levels reach 100 ppm for 90 minutes, 200 ppm over 35 minutes, or 400 ppm over 15 minutes.

  see CARBON MONOXIDE - CO for details about carbon monoxide standards, exposure, testing, and remediation.

- Nitrogen dioxide. NO_2 is a colorless gas with an acrid odor at high levels.

  T he primary source of NO_2 in homes is unvented gas and kerosene space heaters, gas stoves without a range hood, and stoves with continuously burning pilot lights. Studies have shown that homes with unvented gas appliances have elevated NO_2 levels, and there is some evidence linking

FILTERS, AIR for HVAC SYSTEMS
FILTERS, OIL on HEATING EQUIPMENT

FIRE SAFETY CONTROLS
FIREPLACES & HEARTHS
FLAME COLOR, BLUE vs YELLOW COMBUSTION
FLOODED HEATING EQUIPMENT REPAIR

FLUE SIZE SPECIFICATIONS
FLUE VENT CONNECTORS
FREEZE-PROOF A BUILDING
FUEL OIL TYPES & CHARACTERISTICS
FUEL UNIT, HEATING OIL PUMPS

FURNACES, HEATING

GALVANIC SCALE & METAL CORROSION
GAS BURNER Flame & Noise Defects
GAS FIRED WATER HEATERS
GAS PIPING, VALVES, CONTROLS
GAUGES ON HEATING EQUIPMENT
GEOTHERMAL HEATING SYSTEMS

HEAT EXCHANGER LEAKS
HEAT LOSS in buildings
HEAT LOSS DETECTION TOOLS
HEAT LOSS INDICATORS
HEAT LOSS PREVENTION PRIORITIES
HEAT LOSS R U & K VALUE CALCULATION
HEAT PUMPS, DiAGNOSIS, REPAIR
HEAT TAPES, Heat, Insulation prevent Freeze-Up

HEATING COST FUEL & BTU Cost Table
HEATING COST SAVINGS METHODS
HEATING LOSS DIAGNOSIS-BOILERS
HEATING LOSS DIAGNOSIS-FURNACES
HEATING OIL CLOUD WAX GEL POINT
HEATING OIL EXPOSURE HAZARDS, LIMITS
HEATING OIL - OLD, USEABLE?
HEATING OIL PIPING TROUBLES
HEATING OIL SHELF LIFE
HEATING OIL SLUDGE
HEATING OIL TANKS
HEATING OIL USAGE RATE
HEATING SMALL LOADS
HEATING SYSTEM INSPECT DIAGNOSE REPAIR
HEATING SYSTEM NOISES
HEATING SYSTEM SERVICE & MAINTENANCE
HEATING SYSTEM TYPES

HIGH EFFICIENCY BOILERS/FURNACES
HOT WATER HEATERS
HOT WATER IMPROVEMENT
HUMIDITY LEVEL TARGET

ICE DAM PREVENTION
INSULATION INSPECTION & IMPROVEMENT

LP & Natural Gas Safety Hazards

MANUALS & PARTS GUIDES - HVAC
METHANE GAS SOURCES
MIXING / ANTI-SCALD VALVES

this with impaired lung function and increased respiratory infections in children. At high levels, NO_2 is an eye, nose, and respiratory irritant.

Children and people with asthma and other respiratory problem are more susceptible to exposure. Common Indoor Pollutants and Sources 293

see Nitrogen Oxides Gas for details.

- Sulfur dioxide. SO_2 is a colorless gas with a pungent odor and is primarily associated with oil- and coal- burning appliances. At low levels of exposure, SO_2 can cause eye, nose, and respiratory tract irritation. At high exposures, it can cause the airways to narrow, leading to chest tightness and breathing problems. People with asthma are particularly susceptible to SO_2 exposure. See Sulfur Dioxide Gas.

- Particles. The health effects of breathing particles depend on several factors, including the size and chemical makeup of the particles.

  In general, suspended particles can cause eye, nose, and throat irritation, and increased respiratory symptoms for people with chronic lung or heart disease. In addition, a number of pollutants, including the carcinogens radon and benzo(a)pyrene, attach themselves to small particles and are then inhaled and carried deep into the lungs.

Guide to Reducing Exposure to Combustion Gases & Particles Indoors

The three main sources of combustion products in household air are unvented appliances, appliances or flues that are broken or poorly adjusted, and backdrafting. To minimize exposure, follow these general guidelines:

- Unvented space heaters. Do not use unvented space heaters in living spaces. If required for temporary use, closely follow manufacturer's directions, open a window, and open doors to adjoining rooms. A persistent yellow-tipped flame is generally an indicator of poor adjustment and increased pollutants.
- Cooking. With gas ranges and cooktops, always use a range hood vented to the exterior. Choose appliances with electronic ignition rather than a continuously burning pilot light. Or replace with electric appliances.
- Sealed combustion. In new construction, avoid the use of atmospherically vented boilers, furnaces, or water heaters. Instead, use power-vented appliances, preferably with sealed combustion.
- Inspections and maintenance. Have central heating systems and water heaters inspected and adjusted annually. Inspect all flues and chimneys for blockages or damage and promptly repair any problems.

  Blocked or leaking chimneys or flues can result in serious illness or death from carbon monoxide poisoning. See DRAFT HOODS - gas fired for gas fired heating equipment, and see DRAFT REGULATORS, DAMPERS, BOOSTERS for oil fired heating equipment. Also see GAS MEASUREMENT TOOLS for a discussion of gas leak testing instruments.
- Woodstoves. Make sure doors in older woodstoves are tight fitting with intact gaskets. New stoves should meet EPA emissions standards. Burn only seasoned wood. Make sure there is adequate air for combustion and that the house is not depressurized by exhaust fans (see Backdrafting and also page 295 of Best Practices Guide to Residential Construction).
- Fireplaces. Fireplaces should have inserts with tight- fitting doors and a dedicated outside air

supply. Fireplaces should not be used if the house is depressurized by exhaust fans (see Backdrafting and also page 295 of Best Practices Guide to Residential Construction, by Steven Bliss, Wiley & Sons).

-- Adapted with permission from Best Practices Guide to Residential Construction.

See INDOOR COMBUSTION PRODUCTS & IAQ for a Table of Combustion Products & Indoor Air Quality Hazards. At CHIMNEY INSPECTION DIAGNOSIS REPAIR we discuss chimney inspection and diagnosis including unsafe venting and fire hazards.

Questions & Answers regarding this article

Questions & answers about flue gases & combustion products produced by burning home heating oil, natural or LP gas, wood or wood pellets, or coal in home heating appliances.

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

No one has commented yet. Be the first!

Recommend / Share this Article

+1 ShareThis
EMAIL
Print

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- Steven Bliss served as editorial director and co-publisher of *The Journal of Light Construction* for 16 years and

THERMAL IMAGING, THERMOGRAPHY
THERMAL IMAGING MOLD SCANS
THERMAL MASS in BUILDINGS
THERMAL TRACKING & HEAT LOSS
THERMOSTATS, HEATING / COOLING
THERMOSTATIC EXPANSION VALVES
Transite Pipe Chimneys & Flues

VIDEO GUIDES: Heating System Videos
VIDEO GUIDES - InspectAPedia.com

WATER HEATERS
WATER HEATER SAFETY
WATER HEATERS for HOME HEATING USE?
WATER HEATER NOISES
WATER HEATER SCALE - De-Liming Procedure
WATER HEATER SCALE PREVENTION
WATER SOFTENERS & CONDITIONERS
WINTERIZE A BUILDING
WOOD, COAL STOVES & FIREPLACES
WOOD STOVE SAFETY

More Information

previously as building technology editor for Progressive Builder and Solar Age magazines. He worked in the building trades as a carpenter and design/build contractor for more than ten years and holds a masters degree from the Harvard Graduate School of Education. Excerpts from his recent book, Best Practices Guide to Residential Construction, Wiley (November 18, 2005) ISBN-10: 0471648361, ISBN-13: 978-0471648369, appear throughout this website, with permission and courtesy of Wiley & Sons. Best Practices Guide is available from the publisher, J. Wiley & Sons, and also at Amazon.com.

- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also include a list of recommended books for the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

CHIMNEY INSPECTION DIAGNOSIS REPAIR
COMBUSTION AIR
COMBUSTION AIR for TIGHT buildings
COMBUSTION GASES & PARTICLE HAZARDS
COMBUSTION PRODUCTS & IAQ
COMPLETE COMBUSTION, Stoichiometric

- Carbon Monoxide Gas Toxicity, exposure limits, poisoning symptoms, and inspecting buildings for CO hazards
- DUST CONTAMINATION FROM HVAC? An Investigation of Indoor Dust Debris Blamed on a Heating/Cooling System Reveals Carpet Dust
- *Domestic and Commercial Oil Burners*, Charles H. Burkhardt, McGraw Hill Book Company, New York 3rd Ed 1969.
- *National Fuel Gas Code* (Z223.1) $16.00 and National Fuel Gas Code Handbook (Z223.2) $47.00 American Gas Association (A.G.A.), 1515 Wilson Boulevard, Arlington, VA 22209 also available from National Fire Protection Association, Batterymarch Park, Quincy, MA 02269. Fundamentals of Gas Appliance Venting and Ventilation, 1985, American Gas Association Laboratories, Engineering Services Department. American Gas Association, 1515 Wilson Boulevard, Arlington, VA 22209. Catalog #XHO585. Reprinted 1989.
- *The Steam Book*, 1984, Training and Education Department, Fluid Handling Division, ITT [probably out of print, possibly available from several home inspection supply companies] Fuel Oil and Oil Heat Magazine, October 1990, offers an update,
- "Residential Hydronic (circulating hot water) Heating Systems", Instructional Technologies Institute, Inc., 145 "D" Grassy Plain St., Bethel, CT 06801 800/227-1663 [home inspection training material] 1987
- "Warm Air Heating Systems". Instructional Technologies Institute, Inc., 145 "D" Grassy Plain St., Bethel, CT 06801 800/227-1663 [home inspection training material] 1987
- Heating, Ventilating, and Air Conditioning Volume I, Heating Fundamentals,
- Boilers, Boiler Conversions, James E. Brumbaugh, ISBN 0-672-23389-4 (v. 1) Volume II, Oil, Gas, and Coal Burners, Controls, Ducts, Piping, Valves, James E. Brumbaugh, ISBN 0-672-23390-7 (v. 2) Volume III, Radiant Heating, Water Heaters, Ventilation, Air Conditioning, Heat Pumps, Air Cleaners, James E. Brumbaugh, ISBN 0-672-23383-5 (v. 3) or ISBN 0-672-23380-0 (set) Special Sales Director, Macmillan Publishing Co., 866 Third Ave., New York, NY 10022. Macmillan Publishing Co., NY
- *Installation Guide for Residential Hydronic Heating Systems*
- *Installation Guide #200,* The Hydronics Institute, 35 Russo Place, Berkeley Heights, NJ 07922
- The ABC's of Retention Head Oil Burners, National Association of Oil Heat Service Managers, TM 115, National Old Timers' Association of the Energy Industry, PO Box 168, Mineola, NY 11501. (Excellent tips on spotting problems on oil-fired heating equipment. Booklet.)
- Goodman Furnace High Temperature Plastic Vent HTPV safety recall US CPSC notice
- Home Heating System Should Be Checked *[for proper venting and for CO Carbon Monoxide Hazards - DJF]*
- Inspection Procedures for Oil-Fired Heating Systems Detailed step by step approaches for inspecting complex

systems]
- Lennox Pulse Furnace Safety Inspection/Warranty Program: Carbon Monoxide Warning
- Plastic Heating Vent Pipe & Other Heating Safety Recall Notices
- Weil McLain Model GV Gas Boiler/gas valve CPSC recall/repair

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

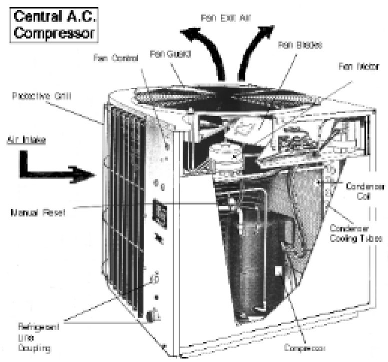
- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- Best Practices Guide to Residential Construction, by Steven Bliss. John Wiley & Sons, 2006. ISBN-10: 0471648361, ISBN-13: 978-0471648369, Hardcover: 320 pages, available from Amazon.com and also Wiley.com. See our book review of this publication.
- ...

HOME | AIR CONDITIONING | ELECTRICAL | EXTERIORS | HEATING | HOME INSPECTION | INTERIORS | PLUMBING | ROOFING | SEPTIC SYSTEMS | STRUCTURE | WATER SUPPLY

ENERGY SAVINGS | ENVIRONMENT | INDOOR AIR IAQ | INSULATION | MOLD INSPECT TEST REMOVE | NOISE | ODORS | SOLAR ENERGY | VENTILATION | EXPERTS DIRECTORY | CONTACT US

Mobile View
AIR CONDITIONING & HEAT PUMP SYSTEMS

A/C - HEAT PUMP CONTROLS & SWITCHES
AIR CONDITIONER BTU CHART
AIR CONDITIONER COMPONENT PARTS
AIR CONDITIONER TYPES, ENERGY SOURCES
AIR CONDITIONER NOT WORKING
AIR FILTER EFFICIENCY
AIR FILTERS, FIBERGLASS PARTICLES
AIR FILTERS for HVAC SYSTEMS
AIR FLOW MEASUREMENT CFM
AIR HANDLER / BLOWER UNITS
ANIMAL ALLERGENS / PET DANDER
ANIMAL ENTRY POINTS in buildings
ANIMAL ODORS IN buildings
APPLIANCE EFFICIENCY RATINGS
ASBESTOS IDENTIFICATION IN buildings
BACKUP HEAT for HEAT PUMPS
CLEANING & *Legionella* BACTERIA



Heat Pump Backup Heat: Diagnosis, Inspection, Repair Guide

InspectAPedia® - ShareThis +1

- Troubleshooting backup heat problems on heat pump systems that provide both air conditioning and heating

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

This article discusses the diagnosis & repair of backup heat systems used on heat pumps - how to find out if your backup heat is working or partly working, or not working at all. . This website answers most questions about central air conditioning & heat pump system troubleshooting, inspection, and repairs. We describe how to inspect residential air conditioning systems (A/C systems) to inform home buyers, owners, and home inspectors of common cooling system defects.

Also see our list of heat pump inspection, diagnosis, and repair articles beginning at HEAT PUMPS. CONTACT us to suggest text changes and additions and, if you wish, to receive online listing and credit for that contribution.

 Use page top links to major topics or use links at the left of each page to navigate ***within*** topics and documents at this website. Green links show where you are in a document series or at this website.

How to diagnose and fix the backup heat in a heat pump

system that is not working

Diagnosing no backup heat working or not enough backup heat

If you are getting no backup heat at all, or the heat is inadequate, your system may not be switching on the backup heat at all, or it may be trying to switch on the backup heat but the backup heat is not working.

- Backup heat controls not working: when outdoor temperatures drop below a set point (varies by geographic location) the heat pump system will switch from cooling mode to heating mode. In heating mode a heat pump is running pretty much the same as it did as an air conditioner, except in reverse. That is, all of the same controls and components are involved.

  In *cooling mode* where a heat pump is installed, the indoor evaporator coil is *cooled* in order to cool air blown across it. This is normal heating mode for the heat pump and backup heat is not called-for.

  In *heating mode* the heat pump warms the indoor coil so that it will *warm* air blown across it, transferring heat from outside to inside. When temperatures outside become too low for the heat pump to efficiently extract heat from outdoor air, a temperature sensor in the outdoor unit turns on the backup heat system.

  Some of the critical *controls* that have to work in order for the heat pump to heat at all in cool weather, or to switch to backup heat mode include:

  - the indoor thermostat - see THERMOSTATS
  - the outdoor temperature sensor - see Heat Pump Thermostats - Outdoors
  - the reversing valve that switches direction of refrigerant flow - see THERMOSTATIC EXPANSION VALVES

- Electric Backup Heat Not Working: If the backup heat for your heat pump system is provided by electric heaters see Staged Electric Furnaces below for an outline of the diagnostic steps needed. The temperature at which backup heat should come on varies by where you live. Perhaps 35 degF. would be common. If debugging the thermostats and temperature sensor do not lead to a fix, then the problem may be with the backup heater itself. For electric backup heat see Staged Electric Furnaces below.
- Hot water heat or water to air heat not working: If your backup heat is an oil or fired water-to-air system you'll need to check the operation of the heating boiler. See HEATING LOSS DIAGNOSIS-BOILERS for a detailed diagnostic procedure. You will need to examine no-heat diagnosis first of the controls and fuel source and then of the boiler fuel type itself, oil, or gas.
- Warm air backup heat not working: If your backup heat is an oil or fired warm air system you'll need to check the operation of the furnace. See HEATING LOSS DIAGNOSIS-FURNACES for a detailed diagnostic procedure. As above, you will need to examine no-heat diagnosis first of the controls and fuel source and then of the furnace fuel type itself, oil, or gas (propane or natural gas) or electric.

Diagnosing backup heat that turns on when it should not.

- Heat Pump Provides Heat when in Cooling Mode: if your heat pump is heating when it should be cooling there may be a simple problem with a thermostat, thermostat setting, or with a temperature sensor or control inside or outside the building. "Only gets heat when in cooling mode."

The following diagnostic tips were provided by a thoughtful reader, Neal Renn who describes the problem of a heat pump that insists on turning on backup heat when it is not needed. That is, during the cooling season, the heat pump insists on providing warm air rather than cool air to the building.

The family woke up to an 85 degree house even though the weather remained in cooling season. The occupants found that the heat pump system was running in heat mode. (A Goodman™ 5 ton heat pump and Goodman indoor air handler with propane backup heat.

1. The indoor thermostat was checked to be sure it was set to cooling mode. (Thermostats might be set to "heat", "cool", "Auto", or "OFF" depending on the model.)
2. Backup heat on: The occupants observed that the propane heater was running even though their indoor thermostat was set for cooling and outdoor temperatures and indoor temperatures were high enough that cooling was required.
3. Examine the dual fuel relay and terminal block.
4. Examine the outside compressor condenser unit - check the outside thermostat (GE Morrision). If the outdoor thermostat is not responding properly the system defaults to heat.

see Detailed Case of a Heat Pump that Put out Heat when Cooling was Required for a step by step guide to diagnosing the cause of this particular "heat output only, no cooling" problem at a heat pump. Diagnostic details provided by a thoughtful reader, Neal Renn.

Here is a photograph of the heat pump outdoor thermosatt. It is housed in the control box corner of the outside heat pump compressor/condenser unit.

This heat pump outdoor unit has a control board, a contactor, a start capacitor and the outdoor thermostat which is used to determine when backup heat is needed.

Photographs courtesy of Neal Renn show a Goodman Manufacturing Corp. outdoor thermostat # OT18-60A (below left) and a back view of the control showing additional part numbers #B13708-66 (below right

For photographs of other air conditioning and heat pump parts, and for an explanation of where these air conditioning components are physically located, see A/C COMPONENTS which discusses Indoor A/C Components and Outdoor A/C Components

Since the failure of the heat pump's backup heat to turn on, loss of heating capacity, reduced air conditioning output temperatures, loss of cool air supply, or even loss of air flow entirely can be due to a variety of problems with one or more components of an air conditioning or heat pump system, *after reviewing the lost backup heat diagnosis procedures described in this article,* be sure to also review the diagnostic procedures at each of the individual air conditioning diagnosis and repair major topics listed just below.

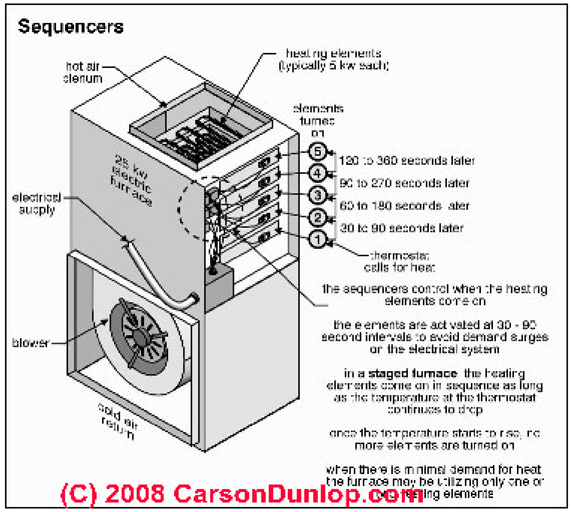
To return to our air conditioning, heat pump, and refrigeration home page go to AIR CONDITIONING & HEAT PUMP SYSTEMS.

Staged Electric Furnaces Using Sequencers to Control Heat

If the backup heat source for your heat pump system is provided by an electric furnace, use the diagnostic details below when the backup heat is not working properly. This information is discussed further at ELECTRIC HEAT.

1146s.jpg

For economy, as Carson Dunlop's sketch shows, electric furnaces often use a gang of electric heating elements that are



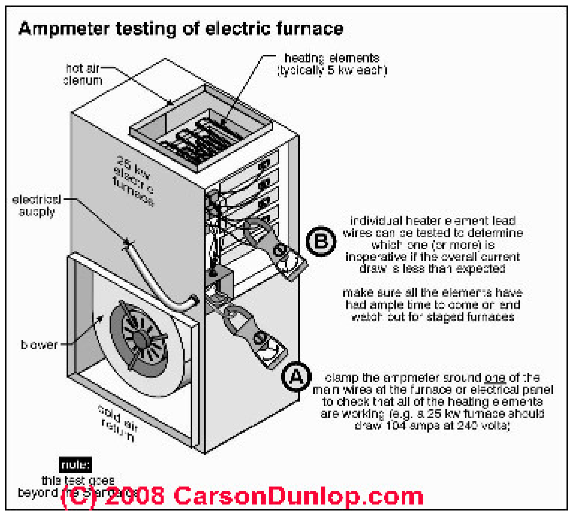
turned on in stages rather than all at once.

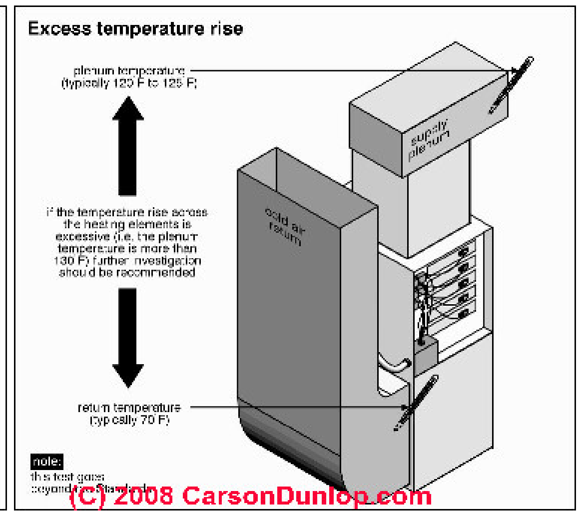
As temperatures fall and more heat is needed in the building, more heating stages turn on. By leaving heating stages turned off when not needed we reduce electrical consumption and energy cost.

On a staged electric heating furnace each heating stage typically provides about 5,000 watts (5KW) of heating energy.

The fan limit switch that controls an electric furnace may have a built-in delay so that on a call for heat the blower fan won't turn on until the heating element(s) have warmed up. We discuss fan limit switches in more detail at FAN LIMIT SWITCH

How to Diagnose & Repair Electric Heat that Has Stopped Working or is Not Hot Enough





What do we check if our electric heat is not working? There are a few basic things to check yourself. Other steps require an expert. Sketches courtesy of Carson Dunlop.

- Is the thermostat asking for heat? Be sure you know where all of the thermostats for your electric heat are located. Some heaters such as flush-in-floor electric heaters may use a wall-mounted thermostat while other electric baseboard heaters may have individual thermostats on each baseboard unit. In a bathroom with electric radiant heat in the floor, Carson Dunlop suggests finding that hidden thermostat, perhaps inside the sink vanity.
- Is electrical power on to the heater? Check the fuses or circuit breakers that supply each electric heater.
- If the electric furnace does not seem to be making heat, the electrician or heating technician will use an ammeter to test each of the heating elements to see if one or more of them is not working. She will also check first to confirm that electrical power is on to the unit. If one or more of the staged electric heaters in the

furnace has failed, the furnace may make warm air, but not enough warm air in very cold conditions.

- Check the air temperature rise across the electric furnace. When the furnace has been operating for 20 minutes or longer, typically the temperature at the return plenum (the lower thermometer in the sketch) will show about 70 deg .F. and the supply plenum temperature will be between 120 deg .f. and 125 deg .f. If the supply plenum temperature is too high (over130 deg .f.) something's wrong and you should call a heating service technician.
- Check radiant heat ceiling panels for wire interruptions. If someone drove an nail into a radiant panel heat ceiling or in the attic above they damaged a wire or heating panel, you may find that that room no longer has heat. We use a hand-held infra-red thermometer scanner to quickly check radiant heat floors and ceilings.

If your air conditioning or heat pump system has lost its cooling capacity or won't start select one or more of the diagnostic articles listed below.

- A/C REFRIGERANT LEAK DETECTION: how to use a TIF5000 to detect air conditioning refrigerant gas leak
- A/C DIAGNOSTIC FAQs: air conditioning system diagnostic FAQs: Q&A about air conditioner repair - a detailed air conditioning system diagnostic checklist
- AIR HANDLER UNIT: problems with the air handler, air filters, and the cooling coil itself
- BACKUP HEAT: on heat pumps, types of backup heat; problems with backup heat; begin here if your heat pump is not providing enough heat or if your air conditioning system provides heat when it should be providing cooling.
- COMPRESSOR CONDENSER: problems with air conditioner compressor/condenser units. Also see FAN, COMPRESSOR/CONDENSER UNIT for help in diagnosing and fixing problems with the outdoor compressor/condenser *fan and fan motor.*
- A/C - HEAT PUMP CONTROLS & SWITCHES: air conditioner controls and switches - begin here if your A/C won't start. Here's an important tip: *most refrigeration problems, in air conditioners, refrigerators, or freezers, are electrical, not mechanical.* In air conditioning school, we used to drive out and collect abandoned refrigerators that people were tossing out during our community's spring cleanup week. Taking these appliances back into the shop we found that almost always the problem that had caused the owner to dispose of their air conditioner or freezer was in an electrical connection or electrical control. So it's worth checking out switches and controls on an air conditioner before replacing more costly components.
- Dehumidification Problems - Air conditioner cools but does not dehumidify
- DUCT SYSTEM DEFECTS: problems with the air duct system, air filters, supply registers, return air registers
- Fire dampers, and Heating and Cooling Air Duct Controls such as manual and automatic duct dampers, zone dampers, and fire dampers are discussed and distinguished at DRAFT REGULATORS - barometric damper
- LOST COOLING CAPACITY: what to do when not enough cool air comes out of the system
    - What to check first if there is no cool air or not enough cool air
    - Compressor failure diagnosis: basic checks of the air conditioner compressor
    - Ducts & Air Handler diagnosis: basic checks of the indoor air handler (blower), air ducts, and filter system
- OPERATING DEFECTS: major air conditioning problem symptoms and how to get the air conditioning system working again,e.g. compressor or fan noises, failure to start, and inadequate cool air volume
- ZONE DAMPER CONTROLS . discusses manual and automatic air duct zone controls

Questions & Answers regarding this article

.

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

No one has commented yet. Be the first!

Recommend / Share this Article

+1 ShareThis

EMAIL

Print

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also include a list of recommended books for the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

- Thanks to Mark Cramer, Tampa Florida, for assistance in technical review of the "Critical Defects" section and for the photograph of the deteriorating gray Owens Corning flex duct in a hot attic. Mr. Cramer is a Florida home inspector and home inspection educator.
- Thanks to Neal Renn who described diagnosing the problem of a heat pump that "only gets backup heat and no cooling" to describe the problem of a heat pump that insists on turning on backup heat when it is not needed.
- Carson, Dunlop & Associates Ltd., 120 Carlton Street Suite 407, Toronto ON M5A 4K2. (416) 964-9415 1-800-268-7070 info@carsondunlop.com. The firm provides professional home inspection services & home inspection education &

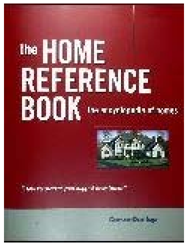
publications. Alan Carson is a past president of ASHI, the American Society of Home Inspectors. Thanks to Alan Carson and Bob Dunlop, for permission for InspectAPedia to use text excerpts from *The Home Reference Book* & illustrations from *The Illustrated Home*. Carson Dunlop Associates' home inspection education products include

- The ASHI-adopted Home Inspection Training Program, and Commercial Building Inspection Courses
- The Home Inspection Home Study Course, and publications such as
- The Home Reference Book, a reference & inspection report product for building owners & inspectors
- The Home Reference *eBook*, an electronic version for PCs, the iPad, iPhone, & Android smart phones
- Home Inspection Report writing materials, including the Horizon Software System that manages business operations, scheduling, & inspection report writing using Carson Dunlop's knowledge base & color images. The *Horizon* system runs on always-available cloud-based software for office computers, laptops, tablets, iPad, Android, & other smartphones.
- The Illustrated Home illustrates construction details and building components, a reference for owners & inspectors

- Thanks also to Alan Carson, Carson Dunlop, Associates, Toronto, for technical critique and for providing a copy of Carson Dunlop Weldon & Associates Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- Thanks to Scott at SJM Inspect for suggesting this EPA document and for technical editing remarks regarding our air conditioning website, SJM Inspection Service LLC, serves the entire state of CT, sjminspect.com 203-543-0447 or 203-877-4774 5/16/07

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia Bookstore.



- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

  Or choose the The Home Reference eBook for using this reference on PCs, Macs, Kindle, iPad, iPhone, or Android Smart Phones

Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

- Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982
- Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon &

Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).

- NEW!
  Air Conditioning SEER - New DOE Air Conditioner and Heat Pump Efficiency Standard
- Asbestos HVAC Ducts and Flues field identification photos and guide
- Fiberglass: Indoor Air Quality Investigations: Fiberglass in Indoor Air, HVAC ducts, and Building Insulation

- ...

InspectAPedia®

Free Encyclopedia of Building & Environmental Inspection, Testing, Diagnosis, Repair

Search
InspectAPedia

Ask a Question or Search InspectAPedia

HOME | AIR CONDITIONING | ELECTRICAL | EXTERIORS | HEATING | HOME INSPECTION | INTERIORS | PLUMBING | ROOFING | SEPTIC SYSTEMS | STRUCTURE | WATER SUPPLY

ENERGY SAVINGS | ENVIRONMENT | INDOOR AIR IAQ | INSULATION | MOLD INSPECT TEST REMOVE | NOISE | ODORS | SOLAR ENERGY | VENTILATION | EXPERTS DIRECTORY | CONTACT US

How to Improve Inadequate Return Air in Air Conditioning or Heating Systems

InspectAPedia® - ShareThis +1

- How to increase air conditioning or heating return air flow to improve system performance
- Defects in return air ducts & registers for heating or cooling systems
- Return air adequacy on heating and air conditioning duct systems
- What is the recommended air flow rate for air conditioning systems?
- How is HVAC air flow rate, air velocity, or CFM (cubic feet per minute) measured?
- Questions & answers about how to improve heating or cooling air supply by improving the return air into the HVAC system

HVAC return air improvement guide: how to increase HVAC system return air to increase heating or cool air output by improving the flow of return air to the air handler. This article describes problems with return air inlet size, location, and ductwork. Inadequate return air seriously limits both air flow rates and also the degree to which building air is cooled (or heated) by the HVAC system. The photograph above shows a return air inlet grille for a commercial office space after the air conditioning return register and ducts were increased in size as part of improvements in the building cooling system.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

Mobile View
AIR CONDITIONING & HEAT PUMP SYSTEMS

A/C - HEAT PUMP CONTROLS & SWITCHES
A/C DATA TAGS
A/C - HEAT PUMP CRITICAL DEFECTS
A/C DIAGNOSTIC FAQs
A/C REFRIGERANTS
A/C TYPES, ENERGY SOURCES
AGE of AIR CONDITIONERS & HEAT PUMPS
AGE of HEATERS, BOILERS, FURNACES
AGE of WATER HEATERS
AIR CONDITIONER BTU CHART
AIR CONDITIONER COMPONENT PARTS
AIR CONDITIONER TYPES, ENERGY SOURCES
AIR CONDITIONER NOT WORKING
AIR FILTER EFFICIENCY
AIR FILTERS, FIBERGLASS PARTICLES
AIR FILTERS for HVAC SYSTEMS
AIR FLOW MEASUREMENT CFM

How to Increase ***Return Air*** Flow or Supply in Heating or Air Conditioning Duct Systems

List of "Improvements" to "fix" inadequate return air ducts & airflow for air conditioners and furnaces

Also see AIR FLOW IMPROVEMENT, HVAC and RETURN AIR REGISTERS & DUCTS and the suggestions listed at RETURN DUCT AIR LEAKS. At SUPPLY DUCTS & REGISTERS we discuss how to increase the supply of warm or cool air in buildings by addressing the blower and supply duct system.

Add More Return Air Inlets & Ducting

Adding additional return air inlets and ducts to increase airflow to the air handler is an effective way to improve air conditioning or or warm air heating system performance, provided that the system is in fact running "air starved".

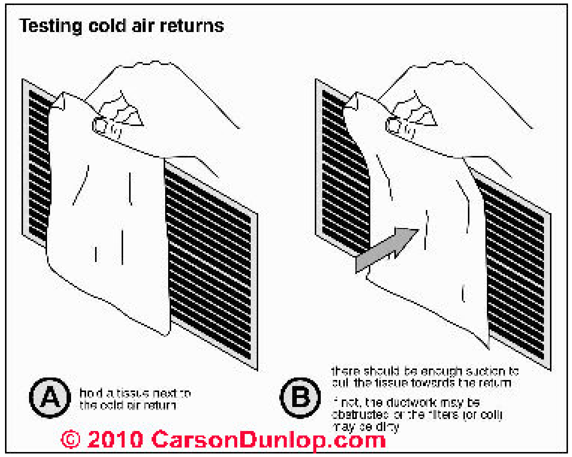
There are several easy and amateur ways to check for an air conditioning or warm air heating system that is not getting enough return air.

1. Visual inspection for inadequate return air: if there is only a single air return inlet, where is it located? Is the return isolated from some rooms in the building if the doors to those rooms are closed? Is the return air inlet size (length x width) smaller than the cross section of the air inlet end of the air handler or blower assembly? A mismatch in return air inlet grille or duct size will reduce the system's effectiveness.
2. Visual inspection for prior attempts to "improve" return air such as holes cut into an existing return air duct, or worse, openings cut to admit more "makeup" air into the air handler from an un-conditioned space such as an attic or crawl area. These are discussed at Adding return air at the air handler.
3. Temporarily or momentarily opening an air handler cover: if by opening the cover on a blower assembly or air handler unit you feel a dramatic increase in the airflow coming out of the building's air supply registers, then the system is probably return[-air starved. We have opened a cover just a few inches and released it to hear it *slam* with tremendous force against the blower cabinet when the system lacked adequate return air. Watch out: See our safety warnings just below.
4. Have the HVAC system examined by a professional: really this is the best approach once you've eliminated very obvious mistakes like those listed at RETURN DUCT AIR LEAKS.

Watch out: don't leave the cover off of an air handler - it's potentially very dangerous, as we explain at Adding return air at the air handler. Also keep in mind that a properly-working air handler or blower assembly will always be running with negative air pressure in the blower compartment - otherwise it wouldn't be moving any air through the duct system. So a certain amount of "pull" of air rushing into the blower that also wants to re-close the blower compartment door is normal.

Watch out: it may be necessary to temporarily tape or bypass a blower door compartment interlock switch to try this subjective test. Don't leave the door interlock switch bypassed or taped - doing so is dangerous. Details about this switch are at Blower Door Switches.

How to Check Air Flow at the Return Register Inlets



- A simple test for air movement at the return air inlet is illustrated in our sketch. Just hold a tissue or piece of toilet paper near the inlet grille face. If air is moving into the grille the tissue will be pulled against the opening.

Sketch at left courtesy Carson Dunlop Associates.

Adding Return Air at the Air Handler - Sometimes a Dangerous Idea

When the cooling ability of an air conditioning system is inadequate, particularly when the volume of air being delivered in the building seems too low, we often see evidence of an attempt to boost heating or cooling air delivery in this "stopgap" manner.

We find extra return air openings having been cut in the return plenum right at the air handler unit at a combination air conditioning and hot air heating furnace or at an attic or basement air conditioning-only air handler.

Indeed this boosts the air coming out of the system if the air handler was "air starved" due to insufficient return ducts in the first place. An example of this poor practice is shown in the photograph.

But this is a very inefficient way to operate the system since a significant portion of the air volume is moving only "one way" from an attic or basement into the cooling unit and out to a remote living area.

This is an expensive way to run an air conditioning system: keep taking "new" air, cool it, and blow it where it's wanted. Proper design re circulates air from the occupied space which permits it to be cooled and filtered.

Watch out: Worse than inefficient, the approach of taking return air from a basement or crawl space utility area where gas or oil fired heating equipment is located can be dangerous, in particular if by the location of the "new" return air opening draws flue gases from a nearby draft hood or barometric damper, or if the heating equipment is located in a small enclosed space where drawing return air can interfere with the provision of adequate combustion air for the heating equipment.

Flue gases: may be drawn into the duct system if these "improvement" openings are cut too close to heating equipment, particularly gas-fired furnaces, boilers, and water heaters. We say more about this at UNSAFE OPENINGS below (see link at left).

Causes of Poor Return Air Flow in Air Conditioning or Heating Systems

PRESSURE READINGS, REFRIGERANT

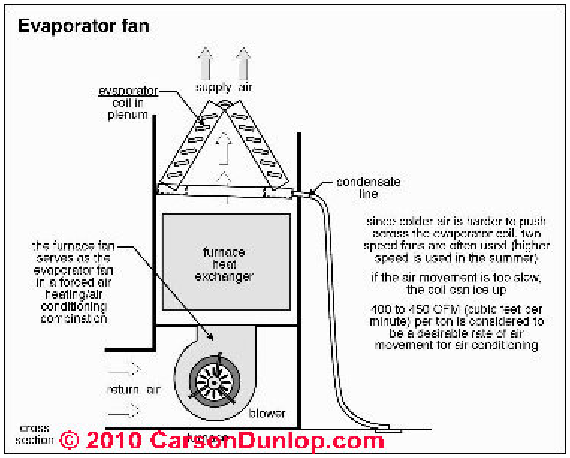
REPAIR GUIDE, AIR CONDITIONERS / HEAT PUMPS
REPAIR & DIAGNOSTIC FAQs for A/C
REFRIGERANTS & PIPING
RETROFIT SIZING for A/C or HEAT PUMPS

SEER RATINGS & OTHER DEFINITIONS
SOLAR ENERGY SYSTEMS
SPLIT SYSTEM AIR CONDITIONERS & HEAT PUMPS
SWAMP COOLERS
SYSTEM OPERATION

THERMOSTATS, HEATING / COOLING
THERMOSTATIC EXPANSION VALVES

WATER COOLED AIR CONDITIONERS
WINDOW / WALL AIR CONDITIONERS
WINDOW / WALL A/C SUPPORTS

More Information



Blower Fan too Slow for Cooling Season

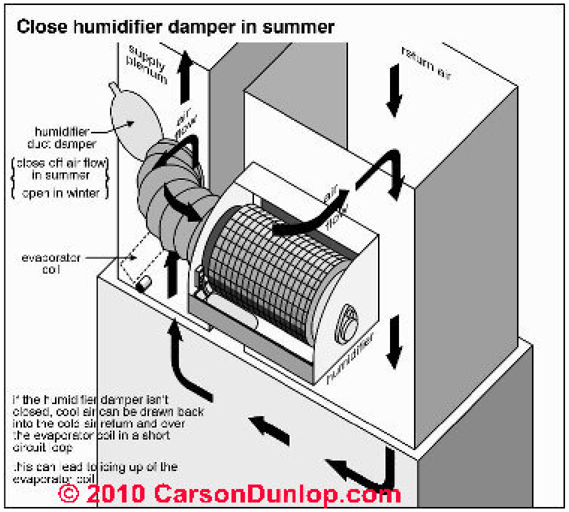
An HVAC system that is simply not capable of moving enough cubic feet of air per minute will not be able to adequately cool or warm the occupied space. Higher air speeds are needed during the cooling season.

Carson Dunlop Associates' sketch (left) points out that the (typical) desirable rate of cool air flow in an air conditioning system is around 400 to 450 cubic feet per minute. The illustration also points out that if air flow is too slow across the cooling coil, that component may become ice or frost-blocked. See FROST BUILD-UP on AIR CONDITIONER COILS for details.

What slows down the air speed in an air conditioning or warm air heating system?

Here we provide a list of causes of inadequate air flow, including conditions that slow the speed of movement of air through the duct system as well as other HVAC duct system defects. For our complete list of HVAC duct system inspection, diagnosis, and repair topics see DUCT SYSTEM & DUCT DEFECTS.

- Air filter or other item that has been sucked into the duct system will block air flow and can risk a fire if drawn into the blower assembly fan, Dirty Air Filter Problems are perhaps the most common cause of unsatisfactory airflow in an HVAC system.

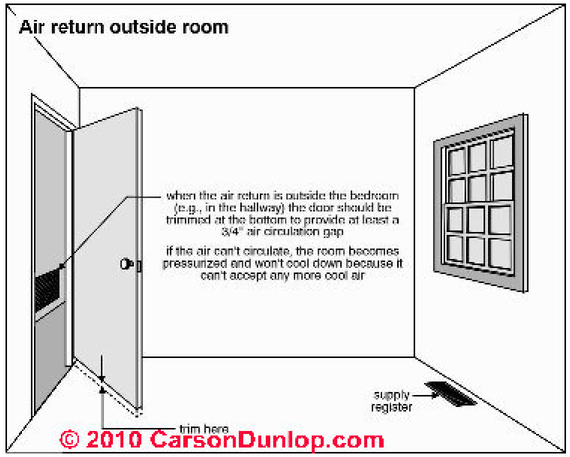


- Air leaks from unconditioned space into the air supply system mean that cool air is diluted in summer or warm air is diluted in winter.

  The sketch at left illustrates a common diluting air leak that can reduce the effectiveness of air conditioning during the cooling season: a humidifier intended for winter use that short-circuits return air right over into the supply air duct without passing it through the cooling coil.

  Sketch at left courtesy Carson Dunlop Associates.

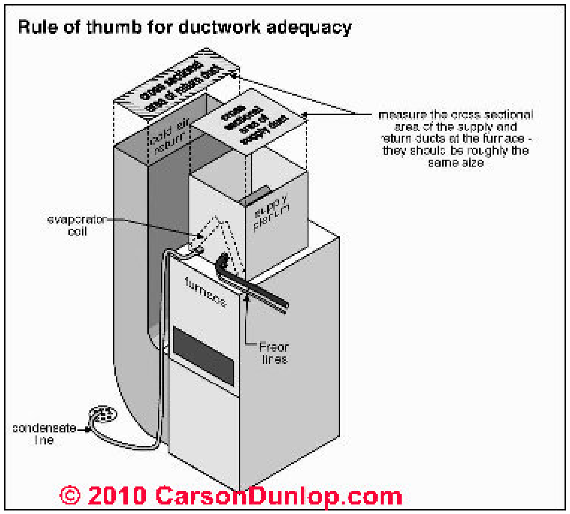
- Air Registers Located Outside the Room (return air) mean that if the room door is closed and not under-cut, both heating and cooling capacity in that room will be reduced.



To understand the effect of a room that has only air supply registers and no return registers when the room door is shut, just imagine the air conditioning or warm air heating system having to blow air into a pressurized space.

Sketch at left courtesy Carson Dunlop Associates.

- Blower Fan: dirty blades on a squirrel cage blower assembly fan significantly reduce the blower fan's ability to move air into the HVAC system from the return-air side as well as reducing its ability to push conditioned air into the occupied space. DIRTY A/C BLOWERS

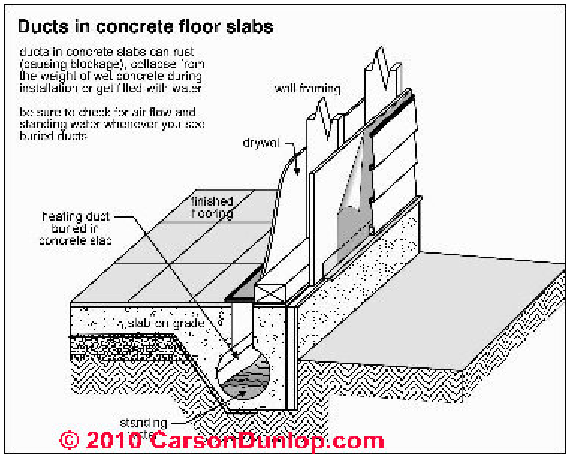


- Ductwork too small or duct sizes mismatched between the air handler, supply plenum, return air plenum, blower assembly, cooling coil. See the sketch at left: the cross sectional areas of the supply ducts and return ducts at the furnace or air handler should be about the same size.

Sketch at left courtesy Carson Dunlop Associates.

- Flex duct defects: Collapsed sections of flex duct block or stop airflow in either supply or return air systems DUCT ROUTING & SUPPORT (see our photo, above-left).
- Insulation loose in air ducts: Collapsed duct interior insulation, (FIBERGLASS DUCT, RIGID CONSTRUCTION
- Leaks in the supply air duct system are a very common HVAC duct defect that results in poor heating or cooling air flow. LEAKY DUCT CONNECTIONS. Also see these defective duct materials that may lose insulation and also may develop leaks:
  - ALLOY SYSTEMS FLEXDUCT
  - GOODMAN GRAY FLEXDUCT
  - OWENS CORNING FLEXDUCT
  - OWL FLEXDUCT
- Return air inlets: Return air inlet grilles that are obstructed with dirt, debris, or furniture or that are improperly located or are just too small mean that because the heating or cooling system is "starved for air", the supply air

flow into occupied spaces will also be reduced. RETURN AIR REGISTERS & DUCTS



- HVAC return air ducts located inside concrete slab floors may have collapsed; and in slab ducts also invite flooding, mold, insects, and where transite - cement asbestos - ductwork was used, asbestos particle contamination or collapsed ductwork.

See ASBESTOS DUCTS, Transite Pipe for details.

Sketch at left courtesy Carson Dunlop Associates.

Frequently Asked Questions (FAQs) about heating or air conditioning air supply and air flow

Definitions & Measurements for Air Flow in Buildings

Question: how do we measure air flow in CFM (cubic feet per minute) in an HVAC system such as air conditioners or warm air heaters?

How is CFM measured? - Anon.

Reply:

Definition of Air Flow Rate Measurement:

Air flow rates for HVAC systems are expressed as a volume of air being delivered at some rate, typically cubic feet per minute (CFM) or m/sec (meters per second), ft/sec (feet per second), or ft/min (feet per minute).

A nice clear technical answer of how we measure flow rate is provided by Flow Kinetics:

> Flow rate is measured by calculating an average velocity for the conduit of interest, and then, multiplying this velocity by the cross sectional area of the duct at the measurement location. The velocity value may estimated using a single reading, or a survey across the duct at a station.[12]

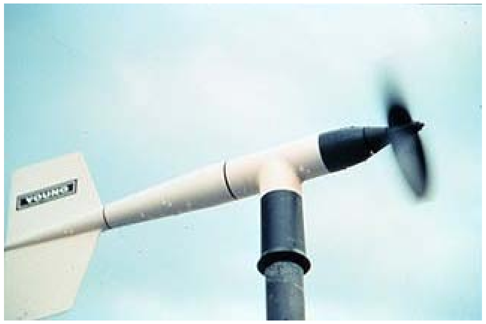
Here's a simplistic example: If I held up a one-foot square sensor in front of an air source (say an air supply register) and the sensor measured air velocity at 12 inches per minute, I'd be measuring 1 CFM of airflow. (One cubic foot = 12 x 12 x 12 inches). Or if we measured an air velocity at an air supply register of one foot per minute and we knew that the duct work was a 12-inch square duct, we'd figure we were seeing one cubic foot per minute of air supply at that location.

Actually here are more than one answer to your question about *how* airflow is measured in an HVAC system because there is a range of air flow measurement instruments on the market. The measuring devices vary in price, accuracy, and in operating principle, and there are also of course multiple sources of CFM data: manufacturers specifications, theoretical numbers, and actual measurements. We are most interested in the last category.

Manufacturer's Air Flow Rate CFM Specifications for HVAC equipment

Fans such as a blower assembly, are rated at a cubic feet per minute of air that the fan can move, presuming a particular rotating speed. Watch out: the true CFM of a squirrel cage blower fan in a central warm air heating or cool air conditioning system can be 50% less than rated if the fan blades are dirty however.

Air Flow Rate CFM Measurement Devices & Approaches



Vane or Fan Blade Anemometers, for Fan type air flow measurement: these are the most commonly used lower-cost CFM measurement devices used by home inspectors and HVAC technicians. At left is a wind speed anemometer - Wikipedia.

Some anemometers are comparatively small inexpensive (and less precise) air flow measurement devices that use a hand-held fan like instrument such as the Kanomax vane anemometers 6800 series) to measure air flow in CFM or equivalent rates on other scales.

The device is held in the air path and moving air rotates a fan blade. The instrument measures fan blade rotation to calculate a flow rate or pressure equivalent that is combined with the known cross sectional area of the measurement device. An advantage of measuring CFM with an anemometer is that you don't need to correct the measurement for temperature (variation in air density).

Swing Vane Anemometers. using a vane or ball that moves along a curved scale are used to measure low velocity air (25 to 400 feet per minute) for checking wind speed or for measuring the air flow rate in duct work, at air filters (is the air filter dirty and needing replacement?), and to meet safety ventilation requirements for OSHA and the US EPA for safety exhaust hoods, spray booths and similar applications.

Pitot tube probes: a Pitot tube (invented by Henri Pitot (1732)) is a device that measures air (or other flowing gas or liquid) pressure when the tube is inserted or placed in the proper position (pointed *into* the direction from which air flow emanates) for sensing airflow.

The pressure is converted to a flow rate by considering the cross-sectional area of the duct or opening through which air is being delivered. (There are some assumptions behind this including that air flow rate is uniform across the cross section of the opening.) By comparing the dynamic (moving air) pressure to static (non-moving air) pressure a pitot tube can give very accurate air flow velocity data. Quoting Flow Kinetics who offer instruments for air flow measurement as well as excellent technical publications on this topic illustrate a device used fro CFM measurement by measuring air pressure.[12][13]

> "The (incompressible) velocity measured by a Pitot tube is calculated from the recorded differential pressure, Dp, and density, r, of the fluid."

Of course in our case the "fluid" is air and we're interested in air movement through ductwork or out of a supply register into a building space. Pitot tubes are familiar to air travelers who have noticed that little tube sticking down and pointing forward from the bottom of many aircraft where the pitot tube is used to measure the air speed of the craft. Indeed pitot tubes are used for high velocity airflow measurements where a vane anemometer could not possibly be up to the task. Pitot tubes are the most accurate technology for measuring air flow rates and are generally used to provide the accuracy standard for comparison with other CFM measurement devices.

Pressure transducers: also measure pressure from a flowing gas or air and permit conversion to CFM measurements in the same manner as a pitot tube - knowing the cross sectional area of the duct or opening. Pressure sensors measure the force exerted by a "fluid" including air or liquid by measuring the force that would be necessary to stop that movement. These devices are also called pressure transmitters, pressure senders, pressure indicators, piezometers, and in HVAC equipment and testing, manometers.[14]

Actual measurements of airflow in an HVAC system or at air supply registers are expressed in cubic feet per minute and are most often made in the field using a hand held flow meter through which air moves. The flow meter is calibrated based on the its input area and the resistance offered by its own fan blades. As air, say coming out of an air supply duct, blows through the handheld device it causes the device fan or sensor to move, giving a measurement of calculated air flow in cubic feet per minute at that location and time.

Watch out however: measuring cfm at a supply register is not at all the whole story since air flow varies throughout the system as it is affected by internal resistances such as bends, crimps, surface smoothness, duct length, etc. And air flow through rectangular duct work is not identical to air flow CFM through a round duct of the same cross-sectional area.

"Hot wire" CFM measurements: an anemometer type device that uses a heated wire and measures the cooling effect of low velocity air flow can also be used to estimate air flow rates provided that air temperature is also considered to provide a correct estimate of air flow rate. The GrayWolf Advanced Sense HVAC differential pressure manometer works on this principle using a hot wire probe inserted into the HVAC duct.

Capture Hoods can be used to make accurate measurements of air flow rates at HVAC system air supply registers. Capture hoods cover the entire supply air register and use a differential pressure device or a hot wire device to obtain an air flow CFM number.

Liquid Column gauges - liquid column manometers are a special form of liquid-column manometer used to measure low velocity air flow by comparing air pressure inside and outside of two spaces. At left the U-shaped plastic tube filled with a blue liquid is connected at its left end to the interior of a 6" plastic vertical exhaust duct forming part of a radon mitigation system.

The right end of the liquid column gauge is simply open to the atmosphere of the room, in this case a basement. The differential in air pressure between the two ends of the tube is marked on a scale indicating the air flow rate inside of the column.

The difference in height between the two ends of the column of blue liquid is always in direct proportion to the difference between the two air pressures (inside & outside of the exhaust duct). If no air were flowing inside of the white exhaust duct, the two ends of the blue liquid would be at the same level.

n this application, air flowing past the end of the flexible plastic tube inserted into the column interior causes a reduction of air pressure in the tube that is a function of the speed of air flow past the tube opening. In this application the liquid column gauge reading of differential air pressure does not have to be precise as its function is simply to indicate that there is some difference in air pressure between the room interior and the exhaust duct interior.

As long as the room is at higher pressure than the column interior, the exhaust system is working and any radon gas below the floor slab (in this application) tends to exhaust through the duct rather than enter the room.

Accuracy of CFM or other air flow measurements on HVAC systems such as air conditioners or heaters

CFM measurements on HVAC systems should be considered an approximation not precision measurements. There are a number of sources of uncertainty even in the measurement itself. For most HVAC air flow troubleshooting or air balancing applications, we are more interested in comparison measurements of air flow between different locations in the HVAC duct system than in high precision in statement of air flow itself.

OPINION: Therefore while pitot-tube type instruments and some electronic air flow measurement instruments can offer both precision and accuracy in HVAC or building air flow measurements, all of the instruments described in our article above can work suitably for heating and air conditioning design and maintenance.

Where to Buy Air Flow CFM Measurement Devices for HVAC Systems

- Dwyer Instruments, 102 Indiana Hwy. 212 (P.O. Box 373) Michigan City, IN 46360 (46361) USA, Website: www.dwyer-inst.com/flowmeters distributes Kanomax Anemometer Air Flow Meters such as the Anemometer LITE Model 6006 or for HVAC testing their vane anemometer, the Anemometer Model A031.
- Extech Instruments Corporation 9 Townsend West Nashua, NH 03063 U.S.A., Tel: 877-239-8324, Website: http://www.extech.com, Email: sales@extech.com
- FlowKinetics LLC, 528 Helena Street Bryan, Texas 77801 USA, Tel: (979) 680-0659, Email: inform@flowkinetics.com, Website: www.flowkinetics.com
- GrayWolf Sensing Solutions, 6 Research Dr., Shelton CT 06484, USA, Tel: 800-218-7997, email: salesteam@wolfsensing.com differential pressure manometers, Website: www.wolfsense.com (hot wire air velocity probes). The company has offices in Clare, Ireland as well.
- Omega.com, Tel: 800-TC-OMEGA, website: http://www.omega.com, offices world wide
- Contact Us to add a listing here. No fees, no conflicts of interest.

Questions & Answers regarding this article

Questions & answers about how to improve heating or cooling air supply by improving the return air into the HVAC system.

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(July 16, 2012) DanJoeFriedman (mod) said:

How to measure CFM - cubic feet per minute of air flow - is a helpful question - I've moved our reply to the bottom of the article above where we can include references & more details.

(July 15, 2012) Anonymous said:

How is cfm measured

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also include a list of recommended books for the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

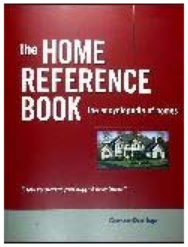
INCREASING RETURN AIR - see detailed links at page left

- CARSONDUNLOP Carson, Dunlop & Associates Ltd., 120 Carlton Street Suite 407, Toronto ON M5A 4K2. (416) 964-9415 1-800-268-7070 info@carsondunlop.com. The firm provides professional home inspection services & home inspection education & publications. Alan Carson is a past president of ASHI, the American Society of Home Inspectors. Thanks to Alan Carson and Bob Dunlop, for permission for InspectAPedia to use text excerpts from *The Home Reference Book* & illustrations from *The Illustrated Home*. Carson Dunlop Associates' home inspection education products include
    - The ASHI-adopted Home Inspection Training Program, and Commercial Building Inspection Courses
    - The Home Inspection Home Study Course, and publications such as
    - The Home Reference Book, a reference & inspection report product for building owners & inspectors
    - The Home Reference *eBook*, an electronic version for PCs, the iPad, iPhone, & Android smart phones
    - Home Inspection Report writing materials, including the Horizon Software System that manages business operations, scheduling, & inspection report writing using Carson Dunlop's knowledge base & color images. The *Horizon* system runs on always-available cloud-based software for office computers, laptops, tablets, iPad, Android, & other smartphones.
    - The Illustrated Home illustrates construction details and building components, a reference for owners & inspectors

- [1] Thanks to Mark Cramer, Tampa Florida, for assistance in technical review of the "Critical Defects" section and for the photograph of the deteriorating gray Owens Corning flex duct in a hot attic. Mr. Cramer is a Florida home inspector and home inspection educator.
- [2] Thanks to Jon Bolton, an ASHI, FABI, and otherwise certified Florida home inspector who provided photos of failing Goodman gray flex duct in a hot attic.
- [3] Air Diffusion Council, 1901 N. Roselle Road, Suite 800, Schaumburg, Illinois 60195, Tel: (847) 706-6750, Fax: (847) 706-6751 - info@flexibleduct.org - www.flexibleduct.org/ -
  "The ADC has produced the 4th Edition of the ***Flexible Duct Performance & Installation Standards*** *(a 28-page manual) for use and reference by designers, architects, engineers, contractors, installers and users for evaluating, selecting, specifying and properly installing flexible duct in heating and air conditioning systems.*
  Features covered in depth include: descriptions of typical styles, characteristics and requirements, testing, listing, reporting, certifying, packaging and product marking.
  Guidelines for proper installation are treated and illustrated in depth, featuring connections, splices and proper support methods for flexible duct. A single and uniform method of making end connections and splices is graphically presented for both non-metallic and metallic with plain ends."
  The printed manual is available in English only. Downloadable PDF is available in English and Spanish.
- [4] Engineering toolbox properties of water - http://www.engineeringtoolbox.com/water-thermal-properties-d_162.html and email: editor.engineeringtoolbox@gmail.com web search 09/16/2010
- [5] Owens Corning Duct Solutions - www.owenscorning.com/ductsolutions/ - provides current HVAC ductwork and duct insulating product descriptions and a dealer locator. Owens Corning Insulating Systems, LLC, One Owens Corning Parkway, Toledo, OH 43659 1-800-GET-PINK™
- [6] "Flexible Duct Media Fiberglas™ Insulation, Product Data Sheet", Owens Corning - see owenscorning.com/quietzone/pdfs/QZFlexible_DataSheet.pdf
  "Owens Corning Flexible Duct Media Insulation is a lightweight, flexible, resilient thermal and acoustical insulation made of inorganic glass fibers bonded with a thermosetting resin."
- [7] Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982
- [8] Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- [9] Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages
- [10] Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- [11] IMG HSPACE="3" VSPACE="0" BORDER="0" WIDTH="28" HEIGHT="11" SRC="/graphics/new.gif" ALT="New" />Air Conditioning SEER - New DOE Air Conditioner and Heat Pump Efficiency Standard
- [12] FlowKinetics LLC, 528 Helena Street Bryan, Texas 77801 USA, Tel: (979) 680-0659, Email: inform@flowkinetics.com, Website: www.flowkinetics.com, "FKS 1DP-PBM Multi-Function Meter Pressure, Velocity & Flow User's Manual", web search 07/16/2012, original source: http://www.flowkinetics.com/FKS_1DP_PBM_Manual.pdf [copy on file] and "FKT Series Flow Measurement And Pressure Acquisition System User's Manual" http://www.flowkinetics.com/FKTSeriesManual.pdf [copy on file]
- [13] *Histoire de l'Académie royale des sciences avec les mémoires de mathématique et de physique tirés des registres de cette Académie*: 363–376. Retrieved 2009-06-19.- Pitot Tubes, Henri Pitot (1732)
- [14] Wikipedia provided background information about some topics discussed at this website provided this citation is also found in the same article along with a " retrieved on" date. NOTE: because Wikipedia entries are fluid and can be amended in real time, we cite the retrieval date of Wikipedia citations and we do not assert that the information found there is necessarily authoritative.
  "Pressure sensor", retrieved 7/16/2012
- [18] N Lu, YL Xie, Z Huang, "Air Conditioner Compressor Performance Model", U.S. Department of Energy, August 2008, [copy on file as PNNL-17796.pdf] Available to the public from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161 ph: (800) 553-6847, fax: (703) 605-6900 email: orders@ntis.fedworld.gov online ordering: http://www.ntis.gov/ordering.htm

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia Bookstore.



- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

  Or choose the The Home Reference eBook for using this reference on PCs, Macs, Kindle, iPad, iPhone, or Android Smart Phones

Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

Blue vs Yellow Flames & Efficient Oil or Gas Fuel Combustion

InspectAPedia® - ShareThis +1

- Theory of Blueray & What It Means to be Combustion Efficient
- Comparing the true efficiency of oil burning vs. gas burning heating equipment
- Efficient oil burner & gas burner combustion theory
- Stoichiometric Combustion
- Theoretical Fuel to Air Ratios for Complete Combustion applied to the design of the BlueRay heating equipment line
- Questions & answers about Blue vs Yellow flames in heating equipment

Here, courtesy of aerospace engineer Herman Vogel, we discuss the relation of blue flame and efficient oil or gas combustion in engines or in heating equipment. Mr. Vogel explains how the blue flame theory found its way into the later unsafe BlueRay Heating equipment line (see BLUERAY Recall). Our page top photo shows a blue-colored flame photographed on a heating boiler burner using natural gas fuel.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

 Use page top links to major topics or use links at the left of each page to navigate ***within*** topics and documents at this website. Green links show where you are in a document series or at this website.

BACKFLOW PREVENTERS
BACKDRAFTING HEATING EQUIPMENT
BACKUP HEAT for HEAT PUMPS
BAROMETRIC DAMPERS
BASEBOARD HEAT

BIOGAS PRODUCTION & USE
BLEVE EXPLOSIONS
BLOWER DOORS & AIR INFILTRATION
BLOWER FAN CONTINUOUS OPERATION
BLOWER FAN OPERATION & TESTING
BLUE vs YELLOW COMBUSTION FLAMES
BLUERAY Recall

BOILERS, HEATING
BOILER LEAKS CORROSION STAINS
BOILER LEAKS, HOW TO LOCATE
BOILER NOISE SMOKE ODORS
BOILER OPERATING PROBLEMS
BOILER OPERATION DETAILS
BOILER PRESSURE & TEMPERATURE SETTINGS
BOOKSTORE - InspectAPedia
BUILDING SAFETY HAZARDS GUIDE

CAPACITORS for HARD STARTING MOTORS
CARBON DIOXIDE - CO2
CARBON MONOXIDE - CO
CHIMNEY INSPECTION DIAGNOSIS REPAIR
CHIMNEYS & Flues - Asbestos Transite Pipe
CHINESE DRYWALL HAZARDS
CIRCULATOR PUMPS & RELAYS
COOL OFF HEAT, Thermostat Switch
COMBUSTION AIR
COMBUSTION PRODUCTS & IAQ
COMPLETE COMBUSTION, Stoichiometric
CREOSOTE FIRE HAZARDS
CONDENSING BOILERS/FURNACES
CONDENSING BOILERS/FURNACES DAMAGE
CONVECTOR HEATERS - HYDRONIC COILS

DEFINITION of Heating & Cooling Terms
DIAGNOSE & FIX AIR CONDITIONER / HEAT PUMP
DIAGNOSE & FIX HEATING PROBLEMS-BOILER
DIAGNOSE & FIX HEATING PROBLEMS-FURNACE
DIRECT VENTS / SIDE WALL VENTS
DIRECTORY of OIL TANK EXPERTS

DRAFT HOODS - gas fired
DRAFT MEASUREMENT, CHIMNEYS & FLUES
DRAFT REGULATORS, DAMPERS, BOOSTERS
DRAFT MEASUREMENT, CHIMNEYS & FLUES
DRAFT REGULATORS, DAMPERS, BOOSTERS
DUCT INSULATION, Asbestos Paper

DUCT SYSTEM & DUCT DEFECTS
DUCTS, Asbestos Transite Pipe
DUST CONTAMINATION FROM HVAC?

ELECTRIC HEAT, DIAGNOSIS, REPAIR
ELECTRIC MOTOR DIAGNOSTIC GUIDE
ELECTRIC MOTOR OVERLOAD RESET SWITCH
ELECTRICAL POWER SWITCH FOR HEAT
EVAPORATIVE COOLING SYSTEMS

Theory of Blueray and What it Really Means to be Combustion Efficient

Also see COMPLETE COMBUSTION, Stoichiometric - discussing the complete combustion of fossil fuels and the details as well as the significance (to non-engineers) of Stoichiometric Combustion. Readers should also see CARBON MONOXIDE WARNING. This website answers most questions about central heating and water heating systems to aid in troubleshooting, inspection, diagnosis, and repairs. Contact us to suggest text changes and additions and, if you wish, to receive online listing and credit for that contribution.

Herman Vogel, Aerospace Engineer

I used to design combustors for Pratt&Whitney Aircraft (P&WA). Later on it was top-secret government work for the InfraRed Countermeasure world where we created combustor-driven systems that would confuse heat seeking missiles from acquiring hot jet-engine targets. This was back in the late 60's early 70's, a few years before the concept of BlueRay came out!

Why Blue Flames Indicate Superior Combustion Efficiency

Our combustors used JP [jet propulsion] fuel and always ran a blue flame (yellow flames existed only in-between re-setting for new thrust states requiring readjustments in fuel and air flows).

Our sketch (at left) shows how an oil burner gun atomizes and sprays heating oil into the combustion chamber - Audel Oil Burner Guide.

Measure a blue flame temperature and you get around 3,000F. Measure a yellow flame temperature and you get about 1,400 to 2,000F at best (depending on how well the combustor atomizes liquid fuel and mixes it with oxygen). Just from temperature alone, one recognizes the superior aspects of blue flames.

Blue flames run closer to stoichiometric conditions of combustion, that is they burn as if using a pure gaseous fuel as opposed to liquid. (See COMPLETE COMBUSTION, Stoichiometric for details).

Gases basically burn 100% efficient or stoichiometrically. Jet engine manufacturers like P&WA, GE, and RR all take great pains in trying to design their combustors to first convert liquid fuel into fine atomized liquid droplets, then convert these droplets into pure vapor before they are allowed to mix with pressurized air (only oxygen part of air) for near complete combustion.

This yields about 95+% efficient combustion today. What happens here is that the fuel surface area, available for mixing with oxygen and burning more effectively, increases by factors of 1000 over that available with only atomized droplets of fuel.

Blue Flame Efficiency and the History of BlueRay Heating Boilers in the 1970's

The BlueRay folks got wind of these concepts back in the early 70's (perhaps even hiring some of the jet engine engineers?) to create their widely touted and highly efficient combustion process technology.

It's a shame that their product couldn't survive the rigors required by both the residential and commercial heating furnace customers. Unfortunately, it took a lot more tender loving care to keep the BlueRay flame "blue" than your typical yellow flamed combustors. And as is pointed out at BLUERAY Recall, poorly tuned BlueRay's had a tendency to burn sooty and rich, emitting Carbon, CO and NOx in their exhaust.

FAN, AIR HANDLER BLOWER UNIT
FAN AUTO ON Thermostat Switch
FAN, COMPRESSOR/CONDENSER UNIT
FAN CONVECTOR HEATERS - HYDRONIC COILS
FAN LIMIT SWITCH
FAN NOISES

FILTERS, AIR for HVAC SYSTEMS
FILTERS, OIL on HEATING EQUIPMENT

FIRE SAFETY CONTROLS
FIREPLACES & HEARTHS
FLAME COLOR, BLUE vs YELLOW COMBUSTION
FLOODED HEATING EQUIPMENT REPAIR
FLOODED WATER HEATER REPAIR
FLUE SIZE SPECIFICATIONS
FLUE VENT CONNECTORS
FREEZE-PROOF A BUILDING
FUEL OIL TYPES & CHARACTERISTICS
FUEL UNIT, HEATING OIL PUMPS

FURNACES, HEATING
FURNACE CONTROLS & SWITCHES
FURNACE EFFICIENCY, HIGH vs MID
FURNACE HEAT EXCHANGER LEAKS
FURNACE OPERATION DETAILS
FURNACE OPERATING TEMPERATURES

GALVANIC SCALE & METAL CORROSION
GAS BURNER Flame & Noise Defects
GAS FIRED WATER HEATERS
GAS PIPING, VALVES, CONTROLS
GAUGES ON HEATING EQUIPMENT

HEAT LOSS in buildings
HEAT LOSS DETECTION TOOLS
HEAT LOSS INDICATORS
HEAT LOSS PREVENTION PRIORITIES
HEAT LOSS R U & K VALUE CALCULATION

HEAT PUMPS, DiAGNOSIS, REPAIR
HEAT TAPES & CABLES on Roofs for Ice Dams
HEATING COST FUEL & BTU Cost Table
HEATING COST SAVINGS METHODS

HEATING LOSS DIAGNOSIS-BOILERS
HEATING LOSS DIAGNOSIS-FURNACES

HEATING OIL CLOUD WAX GEL POINT
HEATING OIL EXPOSURE HAZARDS, LIMITS
HEATING OIL - OLD, USEABLE?
HEATING OIL PIPING TROUBLES
HEATING OIL SHELF LIFE
HEATING OIL SLUDGE
HEATING OIL USAGE RATE
HEATING SMALL LOADS

HEATING SYSTEM NOISES
HEATING SYSTEM SERVICE & MAINTENANCE

HEATING SYSTEM INSPECT DIAGNOSE REPAIR
HEATING INSPECTION CONCEPTS

Two Measurements of Combustion Efficiency

If I burn a pound of fuel, and get 3,000F flame temperature out of it as opposed to 2,000F, I'm getting more heat (efficiency) out of the same amount of fuel. In fact, true thermodynamic combustion efficiency of any combustor (jet engine, car, furnaces, etc.) can be measured in two ways, with both relying on the stoichiometric chemical reaction formula for complete combustion;

1. We theoretically calculate the released adiabatic ideal heating value (IHV), per unit fuel, assuming complete burning and compare it to its measured heating value (MHV) obtained from a furnace-gun and calorimetric system, the absolute combustion efficiency is then simply MHV/IHV
2. We theoretically calculate the released adiabatic ideal flame temperature (IFT) value per unit fuel with complete burning and compare it to its measured flame temperature (MFT) value using a high temperature, platinum-rhodium thermocouple (Pt-Rh TC) held directly into the flame, the absolute combustion efficiency is then simply (MFT - Tin)/ (IFT - Tin). Since a TC is simpler and easier to use than gathering data with a calorimetric setup, option#2 is recommended. For JP fuels: IHV = 18,950 BTU/Lbm, and IFT = 3,850F.

   Therefore yellow flames have an absolute maximum burning efficiency of roughly (2,000 - 70) / (3,850 - 70) = 51%, while blue flames have an absolute maximum burning efficiency of (3,000 - 70) / (3,850 - 70) = 78%.

What is the True Efficiency Indicated by Yellow Flames? - How Oil Competes with Gas as a Heating Fuel

Now, if a yellow furnace system (with heat gun, combustion-chamber and exhaust-pipe) can at best only deliver about 51% efficient running, according to absolute thermodynamic principles, how do furnace companies and maintenance technicians claim efficiencies of 85% or even 90% or better? They have collaborated, industry wide, to re-define oil-burning efficiency according to more favorable terms that can compete with the gas industry.

While there is nothing wrong with that, the basic problem lies in allowing them to conveniently forget that they should not compare their home-grown heating oil efficiency to "real" and absolute efficiency values as with burning methane or natural gas in furnaces or even JP-fuels in jet engines.

A Comparison of Oil Fuel vs Gas Fuel Efficiency in Heating Equipment

Consumers don't know what they are really getting when the oil industry compare apples to pears. When a fuel-oil furnace that is burning No#2 home heating oil is said to burn 100% efficient (based on non-stoichiometric reactions, defined by the furnace industry as standard, and using CO and CO_2 exhaust product ratios to "relatively" redefine efficiency), their real furnace flame temperature would actually measure only about 2,000F at best.

Obviously, this is nowhere near 100% operation based on the above calculated theoretical analysis. Now as their hypothetical flame decreases in temperature, the CO and CO_2 fractions will change, and, depending upon the ratio of these changes, a new burner efficiency of under 100% gets quoted.

Again, these are not absolute thermodynamic values, rather they are relative burning efficiencies based on a reference flame temperature of 2,000F which was arbitrarily chosen to represent 100% combustion efficiency. One may as well state that if your furnace has been tuned and reads 85% efficiency, as arbitrarily based on its emissions of CO and CO_2 , it is really burning at [51% x 0.85 or] 43% efficiency in terms of "absolute thermodynamic efficiency".

Compare this to any gas furnace burning 100% in "absolute thermodynamic efficiency" and you are effectively throwing out almost half of your heating oil value.

How Oil Fuel is Competitive with Gas Fuel for Heating buildings

HEATING INSPECTION PROCEDURE
HEATING SYSTEM INSPECTION DETAILS
HOT WATER HEATERS
HOT WATER IMPROVEMENT

INSULATION INSPECTION & IMPROVEMENT

LOW VOLTAGE TRANSFORMER TEST
LP & Natural Gas Safety Hazards

MANUALS & PARTS GUIDES - HVAC
MIXING / ANTI-SCALD VALVES
MOTOR OVERLOAD RESET SWITCH

Natural Gas Combustion Products
NO HEAT - BOILER
NO HEAT - FURNACE
NOISE / SOUND DIAGNOSIS & CURE
NOISE AIR CONDITIONER / HEAT PUMP
NOISE, DUCT VIBRATION DAMPENERS
NOISE, HEATING SYSTEMS
NOISE, PLUMBING
NOISE, WATER HEATER

ODORS GASES SMELLS, DIAGNOSIS & CURE
ODORS FROM HEATING SYSTEMS
OIL BURNERS
OIL BURNER FUEL UNIT
OIL BURNER INSPECTION & REPAIR
OIL BURNER NOISE SMOKE ODORS
OIL BURNER NOZZLE & ELECTRODES
OIL BURNERS, RETENTION HEAD
OIL BURNER SOOT & PUFFBACKS
OIL FILTERS on HEATING EQUIPMENT
OIL FILTER MISSING
OIL FUEL TYPES & CHARACTERISTICS
OIL & GAS PIPING
OIL LINE CLOGGING FIX
OIL LINE QUICK STOP VALVES
OIL LINE SAFETY VALVES
OIL ODORS, LEAKY OIL TANK PIPING
OIL PUMP FUEL UNIT
OIL SPILL CLEANUP / PREVENTION
OIL TANKS

PLASTIC HEATER VENT
PULSE COMBUSTION HEATERS
PASCAL CALCULATIONS

RADIANT BARRIERS
RADIANT HEAT
RADIANT HEAT Floor Mistakes to Avoid
RADIANT HEAT TEMPERATURES
RADIANT SLAB FLOORING CHOICES
RADIANT SLAB TUBING & FLUID CHOICES
RADIATORS
RELIEF VALVES - TP Valves on Boilers
RELIEF VALVES - STEAM TP VALVES
RELIEF VALVES - Water Heaters
RELIEF VALVES - TP Valves on Boilers
RELIEF VALVES - STEAM TP VALVES
RELIEF VALVES - Water Heaters
RELIEF VALVES - Water Tanks
Reset Switch - Heater Primary Control

While this is shocking and true, remember that oil heat has as yet certain redeeming qualities.

It is still cheap enough to allow this disparity to happen and yet be competitive in heating your home because of its 40% greater heating value and 7% greater flame temperature (IHV=18,950 BTU/Lbm, IFT=3,850F) compared to natural gas (IHV=13,660 BTU/Lbm, IFT=3562F). (See Natural Gas Combustion Products)

While BlueRay technology tried to take advantage of this disparity in efficiency, sadly they lost out to the need for frequent maintenance visits and to keep the unforgiving technology properly tuned or produce killing CO gases.

Bad Design and BlueRay - Design Products For What People are Likely to Actually Do

OPINION-DF: Perhaps the BLUERAY Recall and carbon monoxide hazards had as a root cause, the mistake of designing an oil burner that required a high level of expertise and great care in following tuning instructions precisely.

For example, when adjusting the air-fuel mix by changing the air shutter opening on the oil burner, the direction of change, from more lean to more rich versus adjusting from the more rich to the more lean position could be enough to leave the oil burner adjusted to an unsafe position that would produce dangerous carbon monoxide. Here is what the company's service bulletin said:

> *When setting the unit for proper air mixture always start with the air band fully open, close it until proper CO_2 reading is reached. Close it further - if CO_2 continues to climb you are on the "right side of the curve" and should then re-open the air band to proper CO_2 reading. If it does not continue to climb you are on the "wrong side of the curve" in air-starved mode and are producing carbon monoxide (CO).*

The subtlety of having to care about the *direction* from which one makes an adjustment to a common oil burner device, when either way the adjustment appeared to end at the same setting was perhaps too much to ask of traditional oil heat service technicians who were accustomed to more than sixty years of oil burners hat were wonderfully tolerant of rough handling.

Across a very wide range of discussions of construction problems and failures, we often return to this point. Good product design should provide for what people are *likely to do* (in installation, service, maintenance, use) rather than what the designer thinks they *should do*.

Questions & Answers regarding this article

.

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(June 14, 2012) Richard Turner said:

So we have 43% actual efficiency in our home furnaces, while jet planes have over twice that much. How about diesel engines which also burn #2 fuel and their burning efficiency? I assume they are better than gasoline engines?

Recommend / Share this Article

+1 ShareThis
EMAIL
Print

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also list books on the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

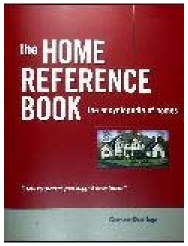
- Also see these safety articles
  CARBON MONOXIDE - CO
  CHIMNEY INSPECTION DIAGNOSIS REPAIR
  COMBUSTION GASES & PARTICLE HAZARDS
  COMBUSTION PRODUCTS & IAQ

- Thanks to aerospace engineer Herman Vogel, August 2010, for providing this explanation of blue vs yellow fossil fuel combustion flames, what flame color means for combustion efficiency, and an insight into the history and failure of the Blueray oil burner product line. Also see COMPLETE COMBUSTION, Stoichiometric - discussing the complete combustion of fossil fuels and the details as well as the significance (to non-engineers) of Stoichiometric Combustion

- *Audels Oil Burner Guide*, Installation, Servicing, Repairing, Frank D. Graham, 1940's edition (obsolete). Updated versions of this guide are available in various editions, 1947, 1950, 1955, 1958, 1959, 1962, 1965, 1967, and at prices from around $3.00 to nearly $70.00 - useful for simple, clear, but not current, explanation of how heating equipment works. The original retail price was $1.00. Used copies are available at Amazon.com

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.



- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 2010, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. InspectAPedia.com ® author/editor Daniel Friedman is a contributing author. Field inspection worksheets are included at the back of the volume.

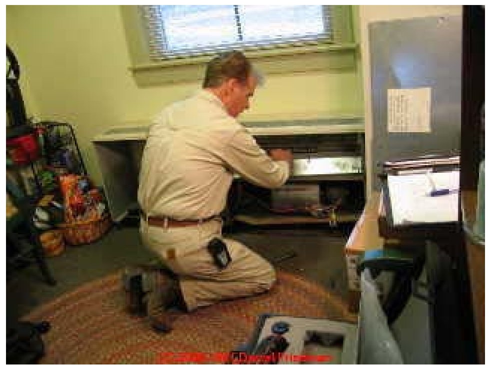
- Carbon Monoxide Gas Toxicity, exposure limits, poisoning symptoms, and inspecting buildings for CO hazards
- DUST CONTAMINATION FROM HVAC? An Investigation of Indoor Dust Debris Blamed on a Heating/Cooling System Reveals Carpet Dust
- *Fuel Oil & Oil Heating Magazine*, 3621 Hill Rd., Parsippany, NJ 07054, 973-331-9545
- Goodman Furnace High Temperature Plastic Vent HTPV safety recall US CPSC notice
- Home Heating System Should Be Checked *[for proper venting and for CO Carbon Monoxide Hazards - DJF]*
- Inspection Procedures for Oil-Fired Heating Systems Detailed step by step approaches for inspecting complex systems]
- Lennox Pulse Furnace Safety Inspection/Warranty Program: Carbon Monoxide Warning
- Oil Tanks - The Oil Storage Tank Information Website: Buried or Above Ground Oil Tank Inspection, Testing, Cleanup, Abandonment of Oil Tanks
- Oil Tanks Above Ground, UL Standards, guidance for home owners, buyers, and inspectors
- Plastic Heating Vent Pipe & Other Heating Safety Recall Notices
- Weil McLain Model GV Gas Boiler/gas valve CPSC recall/repair
- *Domestic and Commercial Oil Burners*, Charles H. Burkhardt, McGraw Hill Book Company, New York 3rd Ed 1969.
- *National Fuel Gas Code* (Z223.1) $16.00 and National Fuel Gas Code Handbook (Z223.2) $47.00 American Gas Association (A.G.A.), 1515 Wilson Boulevard, Arlington, VA 22209 also available from National Fire Protection Association, Batterymarch Park, Quincy, MA 02269. Fundamentals of Gas Appliance Venting and Ventilation, 1985, American Gas Association Laboratories, Engineering Services Department. American Gas Association, 1515 Wilson Boulevard, Arlington, VA 22209. Catalog #XHO585. Reprinted 1989.
- *The Steam Book*, 1984, Training and Education Department, Fluid Handling Division, ITT [probably out of print, possibly available from several home inspection supply companies] Fuel Oil and Oil Heat Magazine, October 1990, offers an update,
- *Principles of Steam Heating*, $13.25 includes postage. Fuel oil & Oil Heat Magazine, 389 Passaic Ave., Fairfield, NJ 07004.
- *The Lost Art of Steam Heating*, Dan Holohan, 516-579-3046 FAX
- *Principles of Steam Heating*, Dan Holohan, technical editor of *Fuel Oil and Oil Heat* magazine, 389 Passaic Ave., Fairfield, NJ 07004 ($12.+1.25 postage/handling).
- *"Residential Steam Heating Systems"*, Instructional Technologies Institute, Inc., 145 "D" Grassy Plain St., Bethel,

CT 06801 800/227-1663 [home inspection training material] 1987

- "Residential Hydronic (circulating hot water) Heating Systems", Instructional Technologies Institute, Inc., 145 "D" Grassy Plain St., Bethel, CT 06801 800/227-1663 [home inspection training material] 1987
- "Warm Air Heating Systems". Instructional Technologies Institute, Inc., 145 "D" Grassy Plain St., Bethel, CT 06801 800/227-1663 [home inspection training material] 1987
- Heating, Ventilating, and Air Conditioning Volume I, Heating Fundamentals,
- Boilers, Boiler Conversions, James E. Brumbaugh, ISBN 0-672-23389-4 (v. 1) Volume II, Oil, Gas, and Coal Burners, Controls, Ducts, Piping, Valves, James E. Brumbaugh, ISBN 0-672-23390-7 (v. 2) Volume III, Radiant Heating, Water Heaters, Ventilation, Air Conditioning, Heat Pumps, Air Cleaners, James E. Brumbaugh, ISBN 0-672-23383-5 (v. 3) or ISBN 0-672-23380-0 (set) Special Sales Director, Macmillan Publishing Co., 866 Third Ave., New York, NY 10022. Macmillan Publishing Co., NY
- *Installation Guide for Residential Hydronic Heating Systems*
- *Installation Guide #200,* The Hydronics Institute, 35 Russo Place, Berkeley Heights, NJ 07922
- The ABC's of Retention Head Oil Burners, National Association of Oil Heat Service Managers, TM 115, National Old Timers' Association of the Energy Industry, PO Box 168, Mineola, NY 11501. (Excellent tips on spotting problems on oil-fired heating equipment. Booklet.)
- Links to our list of additional information on heating system inspection, repair, maintenance
- ...

Mobile View
AIR CONDITIONING & HEAT PUMP SYSTEMS

A/C - HEAT PUMP CONTROLS & SWITCHES
A/C DATA TAGS
A/C - HEAT PUMP CRITICAL DEFECTS
A/C DIAGNOSTIC FAQs
A/C REFRIGERANTS
A/C TYPES, ENERGY SOURCES
AGE of AIR CONDITIONERS & HEAT PUMPS
AIR CLEANER PURIFIER TYPES
AIR CONDITIONER BTU CHART
AIR CONDITIONER COMPONENT PARTS
AIR CONDITIONER TYPES, ENERGY SOURCES
AIR CONDITIONER NOT WORKING
AIR FILTER EFFICIENCY
AIR FILTERS, FIBERGLASS PARTICLES
AIR FILTERS for HVAC SYSTEMS
AIR FLOW MEASUREMENT CFM
AIR HANDLER / BLOWER UNITS



Cleaning & Prevention of *Legionella* Bacteria in Air Conditioners & Heat Pumps

InspectAPedia® - ShareThis +1

- Cleaning procedures for air conditioning condensate trays
- Cleaning procedures for air conditioning cooling towers
- Legionella, mold, and other pathogenic risks
- Use of chlorine, bromine, inspections, cleaning of A/C drip trays and condensate systems
- Questions & answers about *Legionella* bacteria contamination in air conditioners

This article explains cause, hazards, & prevention of *Legionella* bacteria contamination in air conditioners, how to clean air conditioning systems, Legionnaire's disease prevention & cleaning suggestions for air conditioning equipment and condensate trays, including condensate piping, traps, drains, condensate pumps, and concerns for mold, Legionella bacteria, and other hazards associated with air conditioning systems, cooling towers, and evaporative coolers.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

 Use page top links to major topics or use links at the left of each page to navigate ***within*** topics and documents at this website. Green links show where you are in a document series or at this website.

CONDENSATE TRAY CLEANING - Cleaning suggestions for A/C System Condensate Systems

The health hazards associated with Legionella and other biological contaminants in HVAC systems are at *Legionella sp.* Health Concerns and also at Legionnaires' Disease Information from CDC. Here we discuss cleaning procedures.

Should we disinfect cooling system equipment or condensate trays?

Should we be putting bromide or chlorine tablets in our condensate trays to keep bacteria from growing?

If we should be, then do we need to alternate bromide with chlorine on some type of frequency to prevent development of resistant bacteria?

We're discussing condensate trays from mechanical equipment like heat pumps, fan coil units and air handlers with AC coils.

These pieces of equipment have condensate trays which are then drained through a small pipe, usually clear, but not always, with a trap in it, to a drain.

These condensate trays have some standing water in them when the AC is functioning. Should these condensate trays be treated with an algaecide of some sort?

There are risks beyond mold and algae, in particular Legionella bacteria (legionnaire's disease) which can have an alarmingly high mortality rate, and also potential hazard sources such as biofilms that can include other bacterial and maybe other pathogens.

However the risk of formation of problem levels of mold, bacteria, or other pathogen is probably not the same across all buildings nor types of equipment, and much of the risk may depend on installation and maintenance details at individual installations.

Particularly in climates with a high humidity and a heavy cooling load, and depending on details of the design and installation of the air handler unit and duct work, there is risk of blowing pathogen-contaminated water droplets downstream inside the air conditioning duct work and thus exposing building occupants.

With rooftop-mounted cooling units such as cooling towers using water, conditions may be still more attractive for growth of pathogens and there is some risk of movement of pathogens out of the cooling equipment to people located nearby and downwind from the equipment, even if they are outside the building which the equipment actually serves.

While I am not expert on this topic I have collected and provide here some key information and opinions to help sort out these questions. Use the links at page left to read additional details on this topic including recommended cleaning procedures and details of the Legionella hazard in air conditioning systems, humidifiers, etc.

Details on how to clean A/C and heat pump systems to prevent bacterial hazards are at Wisconsin Protocol for Cleaning A/C. Also review CONDENSATE HANDLING, A/C.

Questions & Answers regarding this article

Questions & answers about *Legionella* bacteria contamination in air conditioners.

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

No one has commented yet. Be the first!

Recommend / Share this Article

+1 ShareThis
EMAIL
Print

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Thanks to remaining contributors/references who are listed just below

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

- Thanks to Mark Cramer, Tampa Florida, for assistance in technical review of the "Critical Defects" section and for the photograph of the deteriorating gray Owens Corning flex duct in a hot attic. Mr. Cramer is a Florida home inspector and home inspection educator.
- http://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_7.html is OSHA"s technical manual re Legionnaire's disease US EPA Safe Drinking Water Hotline: 800-426-4791
- "Legionella in NY - How to Conduct a Legionella Risk Assessment", Mark Hodgson, LSC, Naperville IL & Diane Miskowski, MPH, EMSL Analytical, Inc., Westmont NY, Crown Plaza, White Plains, 8 May 2007. Course description: "Guidelines for the control of Legionella in critical care hospitals in New York have been in place for

SWAMP COOLERS
SYSTEM OPERATION

THERMOSTATS, HEATING / COOLING
THERMOSTATIC EXPANSION VALVES

WATER COOLED AIR CONDITIONERS
WINDOW / WALL AIR CONDITIONERS
WINDOW / WALL A/C SUPPORTS

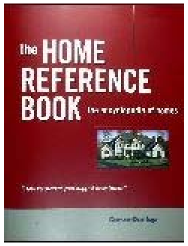
More Information

two years. In October 2006, these guidelines were extended to include nursing homes and long term care facilities. Join us for this 8 hour seminar to learn all you need to know to conduct a Legionella health risk assessment, control it in your facility, and remediate it. This course will describe the ecology of the [Legionella] organism, the epidemiology of the disease [Legionnaire's disease], a discussion of some recent outbreaks, and the proper sampling methods and analysis of the bacteria. A significant amount of time will be spent discussing how to actually perform a Legionella risk assessment, and an overview of cooling towers and potable water system design and how that contributes to growth of the [Legionella] organism. Discussion will include where Legionella can be found in the engineered environment, and the use of biocides and other controls."

- Thanks to Craig Balchunas, AHI Accurate, LLC., a home inspection firm in Hyde Park, NY. - (800) 360-3998
- "Legionella", a public information poster provided free by LA Testing, an California environmental testing lab - www.LATesting.com.

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia Bookstore.



- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

  Or choose the The Home Reference eBook for using this reference on PCs, Macs, Kindle, iPad, iPhone, or Android Smart Phones

Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

- Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982
- Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- NEW!
  Air Conditioning SEER - New DOE Air Conditioner and Heat Pump Efficiency Standard
- Asbestos HVAC Ducts and Flues field identification photos and guide
- Fiberglass: Indoor Air Quality Investigations: Fiberglass in Indoor Air, HVAC ducts, and Building Insulation

- ...

InspectAPedia®

Free Encyclopedia of Building & Environmental Inspection, Testing, Diagnosis, Repair

Search InspectAPedia

Ask a Question or Search InspectAPedia

HOME | AIR CONDITIONING | ELECTRICAL | EXTERIORS | HEATING | HOME INSPECTION | INTERIORS | PLUMBING | ROOFING | SEPTIC SYSTEMS | STRUCTURE | WATER SUPPLY

ENERGY SAVINGS | ENVIRONMENT | INDOOR AIR IAQ | INSULATION | MOLD INSPECT TEST REMOVE | NOISE | ODORS | SOLAR ENERGY | VENTILATION | EXPERTS DIRECTORY | CONTACT US

Mobile View
INSULATION IDENTIFICATION GUIDE
INSULATION INSPECTION & IMPROVEMENT

ACOUSTICAL SEALANT CHOICES
AGE of a BUILDING - how to determine
AIR BYPASS LEAKS
AIR LEAK DETECTION TOOLS
AIR LEAK MINIMIZATION
AIR LEAK SEALING PROCEDURE
AIR SEALING STRATEGIES
ANIMAL ALLERGENS
ANIMAL ENTRY POINTS in buildings
ANIMAL ODORS IN buildings
APPLIANCE EFFICIENCY RATINGS
ARCHITECTURE & BUILDING COMPONENT ID
ASBESTOS CEILING TILES, Asbestos-Containing
ASBESTOS DUCTS, HVAC
ASBESTOS FLOORING HAZARD REDUCTION
ASBESTOS-FREE INSULATION MATERIALS

Definitions Heating & Cooling Terms: BTU, Calorie, R U& K Values, Design Temperature, Degree Day, Tons of Cooling Capacity

InspectAPedia® - ShareThis

- Standard definitions of heating & cooling terms: BTU, Calorie, R U& K Values, Design Temperature, Degree Day, Tons of Cooling Capacity
- How to measure or calculate heat loss (or gain) in a building
- How to measure heat transmission in materials: definition of R-values, U-values, K-values, BTU, calorie, and rates of heat loss or gain
- Building design temperatures & how to use a home energy audit or heat loss analysis
- What insulation "R" values should be used in a building insulation?
- Questions & answers about heating & cooling terms, measurements, values & definitions

This article defines Heat Loss, R-value, U-value, & K-Value measures of heating loss rate or insulation effectiveness and provides basic building insulation and heat loss guidelines including how to measure or calculate heat loss in a building, defines thermal terms like BTU and calorie, provides measures of heat transmission in materials, gives desired building insulation design data, and shows how to calculate the heat loss in a building with R values or U values.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

ASBESTOS IDENTIFICATION IN buildings
ASBESTOS ROOFING / SIDING DUST
ASBESTOS REMOVAL, Wetting Guidelines
ATTIC LEAKS, CONDENSATION & MOLD
ATTIC VENTILATION

BASEMENT CEILING VAPOR BARRIER
BASEMENT HEAT LOSS
BASEMENT LEAKS, INSPECT FOR
BASEMENT WATERPROOFING
BATH & KITCHEN DESIGN GUIDE
BATHROOM VENTILATION
BEST CONSTRUCTION PRACTICES GUIDE
Best Interior Finish Practices
BLOWER DOORS & AIR INFILTRATION
BLOWER FAN CONTINUOUS OPERATION
BLOWER FAN OPERATION & TESTING
BLOWN-IN INSULATION
BRICK LINED WALLS
BRICK VENEER WALL INSULATION
BRICK VENEER WALL Loose, Bulged
BRICK WALL DRAINAGE WEEP HOLES
BUCKLED FOUNDATIONS due to INSULATION?
BUILDING NOISE DIAGNOSIS & CURE

CASEWORK, CABINETS, SHELVING INSTALLATION
CATHEDRAL CEILING INSULATION
CATHEDRAL CEILING VENTILATION
CEILING FINISHES INTERIOR
CEILINGS, DROP or SUSPENDED PANEL
CEILINGS, PLASTER TYPES
CEILINGS, PLASTER, LOOSE HAZARDS
CEILING TILES - Asbestos-Containing
CHIMNEY INSPECTION DIAGNOSIS & REPAIR
CHINESE DRYWALL HAZARDS
COMBUSTION AIR for TIGHT buildings
CONDENSATION or SWEATING PIPES, TANKS
CONDENSATION on WINDOWS & SKYLIGHTS
CORROSION in ELECTRICAL PANELS
CORROSION & MOISTURE SOURCES in PANELS
COOLING LOAD REDUCTION by ROOF VENTS
CRAWL SPACES

DECK & PORCH CONSTRUCTION
DEW POINT CALCULATION for WALLS
DEW POINT TABLE - CONDENSATION POINT GUIDE
DEFINITION of Heating & Cooling Terms
Definition of BTUs, BTUH, & Calories
Definition of K value K-coefficient heat transmission
Definition of U value or U-coefficient heat loss resistance
Definition of R-Values for Insulation or buildings
Definition of Design Temperature for buildings
Definition of Heating or Cooling "Degree Day"
SEER RATINGS & OTHER DEFINITIONS
Definition of Tons of Cooling Capacit

ELECTRICAL INSPECTION, DIAGNOSIS, REPAIR
ENERGY SAVINGS in buildings
ENVIRONMENTAL HAZARDS - INSPECT, TEST, REMEDY

FIBERGLASS INSULATION
FIBERGLASS HAZARDS
FIBERGLASS INSULATION MOLD
FIREPLACES & HEARTHS

Definitions of BTUs, BTUH, and Calories for Discussing Building Heat Gain or Heat Loss Analysis

Because no amount of insulation can keep a drafty building warm, also review ENERGY SAVINGS PRIORITIES. Also see HEAT LOSS INDICATORS (where is the building losing heat during the heating season, or gaining un-wanted heat during the cooling season), and see HEAT LOSS R U & K VALUE CALCULATION for a guide to calculating heat loss (or gain) rates for buildings and building insulation. For a discussion of air conditioner, heat pump and other appliance SEER and EER energ efficiency ratings see SEER RATINGS & OTHER DEFINITIONS.

Formula-R™ and Owens Corning™ which may be visible in this photograph of pink Styrofoam™ insulation boards are registered trademarks of Owens Corning® and were photographed at a Home Depot® building supply center.

When we are evaluating the quality and effectiveness of insulation in a building or the adequacy of a building heating or cooling system, we need to use measurements that permit us to describe the rate at which a building loses heat under various conditions (such as outdoor temperature, wind velocity, how leaky the building is, the area of its windows and perhaps doors, and the amount of insulation in the building walls, floors, and ceilings. A few of these critical definitions is given just below, followed by some simple formulas used to calculate the heat loss in a building.

Definition of BTUs and BTUH: a BTU is one "British Thermal Unit" which is defined as the quantity of heat that would be required to increase the temperature of *one pound of water* by *one degree Fahrenheit.*

A BTUH is defined as the number of BTU's lost (if we're talking about heat loss or air conditioning), or provided (if we're talking about providing heat for a building) *in one hour*. You'll often see BTUH as a number on data plates on air conditioners and on heating systems.

Also see our examples of BTU data used in air conditioning and heat pump calculations discussed at What is a BTU or British Thermal Unit? What is a Joule? for details about BTUs and various examples of BTU and BTUh calculations. There we give definitions of related terms such as latent heat, superheat, latent heat of condensation, sensible heat, and specific heat.

One BTU is also equal to 252 calories. So what's a calorie?

Definition of Calorie or Calories: a calorie is defined as the quantity of heat needed to raise the temperature of *one gram of water* by *one degree Centigrade*

Definitions of R-Value, U-Value, K-Value

R values and heat loss: The "R" value of a material is its resistance to heat flow through the material. When buying various insulation materials you will almost always see an "R" value quoted for the material. In general, higher "R" means more resistance to heat loss and therefore lower heating or cooling bills for the building.

Mathematically, "R" is simply the reciprocal of the two measures discussed in more detail below:

- U - the measure of heat transfer (the ability of a substance to conduct heat) discussed above and also at "U"
- K - the coefficient of heat transmission discussed at "K"

"K" (R = 1/K) or "U" ($R_{(\text{whole building})} = 1/U$)

FLAT ROOF MOISTURE & CONDENSATION
FLOOD DAMAGE ASSESSMENT, SAFETY & CLEANUP

FLOOR TYPES & DEFECTS
FLOOR, CERAMIC TILE
FLOOR, CONCRETE SLAB CHOICES
FLOOR, CONCRETE SLAB POURED FINISH
FLOOR DAMAGE DIAGNOSIS
FLOOR, ENGINEERED WOOD & LAMINATES
FLOOR FRAMING & SUBFLOOR for TILE
FLOOR, KITCHEN & BATH OPTIONS
FLOOR, LAMINATE PLASTIC
FLOOR RADIANT HEAT Mistakes to Avoid
FLOOR, RESILIENT VINYL or CORK
FLOOR, STONE, GRANITE, MARBLE, AGGLOMER
FLOOR & SUBFLOOR MOLD, HIDDEN
FLOOR TILE ASBESTOS IDENTIFICATION
FLOOR TILE HISTORY & INGREDIENTS
FLOOR WOOD AGE TYPES HISTORY
FLOOR WOOD, DAMAGE DIAGNOSIS
FLOOR, WOOD ENGINEERED, LAMINATE, INSTALL
FLOOR, WOOD FINISHES
FLOOR, WOOD INSTALLATION GUIDE
FLOOR, WOOD MOISTURE
FLOOR, WOOD RADIANT HEAT
FLOOR, WOOD SOLID STRIP, PLANK
FLOOR, WOOD TYPES
FLOORING MATERIALS, Age, Types
FORMALDEHYDE HAZARDS
FOOTING & FOUNDATION DRAINS
FOUNDATION BULGE or LEAN MEASUREMENTS
FOUNDATION CRACKS & DAMAGE GUIDE
FOUNDATION WATERPROOFING
FRENCH DRAINS

FRAMING DETAILS for BETTER INSULATION
FRAMING DETAILS for DOUBLE WALL HOUSES
FRAMING METAL STUD PERFORMANCE
FREEZE-PROOF A BUILDING
FROST HEAVES, FOUNDATION, SLAB

GREEN BUILDING CONSTRUCTION CODES GUIDES
GREENHOUSE DESIGN for SOLAR HEATING
GREENHOUSE / SUNSPACE GLARE

HEAT LOSS RATE CALCULATIONS
HEAT LOSS in buildings
AIR LEAK DETECTION TOOLS
Air Leaks & Building Heat Loss
Attic Energy Losses - InfraRed
Basement Energy Losses- IR & Visual
Blower Door Test Data Results
Convective Loops & Thermal Bypass Leaks
Duct System Air Movement
Energy Savings Retrofits
HEAT LOSS DETECTION TOOLS
HOUSE DOCTOR, how-to be
Insulation Air & Heat Leaks
INVESTIGATION SEQUENCE, Heat Loss
Living Space Heat Loss
PASCAL CALCULATIONS
Smoke Gun for Air Leaks
Smoke Pencil / Smoke Gun Suppliers
Targets & Hidden Leak Points

As you'll read below, the heat transmission coefficient "K" measures the heat flow through an individual substance and "U" measures the *overall* building heat loss by adding all of the various areas and substances together.

Reader Peter J. Collins has noted in clarification of the definition of "R" value that

> *The R-value of a material is a measure of its thermal resistance.*
>
> *The U-value (or U-factor), more correctly called the overall heat transfer coefficient*

We add that R-value measures the resistance of a material to transfer heat (in any direction). Higher R-vales are more resistant to heat transfer. When we are discussing building insulation, an insulation with a higher R-value would be expected to resist heat loss more than one of a lower R-value, if all other factors such as air leakage or heat radiation are the same.

And as Mr. Collins elaborates,

> *R-value = resistance to the movement of heat*
>
> *U = the ability to transfer heat, obviously an inverse condition, to resistance, or in other words, or to allow the transfer of heat*

But as we elaborate below at Definition of U value or U-coefficient of heat loss resistance, the NFRC (National Fenestration Council) in discussing solar heat gain at windows, describes the U-Factor (U) as follows:

> *U-Factor measures how well a product prevents heat from escaping a home or building. U-Factor ratings generally fall between 0.20 and 1.20. The lower the U-Factor, the better a product is at keeping heat in. U-Factor is particularly important during the winter heating season. This label displays U-Factor in U.S. units. Labels on products sold in markets outside the United States may display U-Factor in metric units.*

Definition of Insulation R-Values or Building R-Values: Rate of Heat Loss Per Hour for a Building

How to Calculate the R value U value & K value for a Building & How to Use These Numbers

If you like, read below this section to see our details about "K" values, "U" values, and "R" values as measures of heat movement in buildings. Actually calculating a building's actual rate of heat loss is pretty simple - it's a "cookbook" process that uses the following formula: (Also see HEAT LOSS in buildings)

Heat Loss using "R" values:
(Building Heat Loss in BTU's per hour) =
(Building Total Surface Area in sq.ft.) / (Surface Area "R" value) x (Temperature Difference)

Temperature Difference = the difference in temperature in deg F. on the two sides of the building surface, typically indoors and outdoors

Surface Area "R" value = the "R" value of the surface area being evaluated (say an insulated wall).

Heat Loss using "U" values:
(Building Heat Loss in BTU's per hour) U = 1/R, - or in other words -
(Building Total Surface Area in sq.ft.) / (Surface Area "U" value) x (Temperature Difference)

More considerations when measuring home energy use or heat

loss

But there's more work to do for a complete answer to building heat loss. We need to make up a simple table which will contain the total surface area of each *type* of material (since each will have it's own "R" value) and then plug in the area's "R" value and the temperature difference. Usually we assume the same temperature difference for all of the areas of the building though this might be a simplification since that may not be exactly true.

How to include the effect of wind on home energy use or heat loss

We're also missing, from this simple calculation, the effects of *wind* on a building's heat loss, though a more sophisticated version of this approach might simply adjust the temperature difference to include the wind factor.

For example, you could use a wind/temperature chart to derive the effective outdoor temperature when it's also windy. In cold conditions, adding a wind velocity will *lower* the effective outdoor temperature and thus it will *increase* the temperature difference across the building wall.

Use any "wind chill factor" chart for this data. Still more sophistication of measures of heat loss are possible by adding the effects of moisture on heat loss from a surface, but while this is important for a (sweaty) human in cold conditions it is generally ignored when considering building heat loss.

Using a spreadsheet to accurately calculate building heat loss or heat gain

This is a perfect application for an Excel or similar spread sheet, listing each building surface type (wall, window, door), it's R, K, or U value, and its total area. Adding temperature difference across these surfaces permits a calculation of the heat loss (or gain) through each surface type. These are simply added together to represent the entire building's heat loss or gain.

Heat loss vs. heat gain in buildings: applying the simple laws of thermodynamics

You may have noticed we keep talking about heat loss and then we add "or heat gain" in the same sentences or headings. That's because heat loss analysis works just fine for both building heating and building cooling. The *only* differences between looking at heat loss and heat gain for a building are the *direction of heat flow* and the fact that we may be using different equipment with different equipment efficiencies (a heating furnace or boiler versus an air conditioner).

If we're in a heating climate and are in the heating season, heat will flow from the building interior to the outdoors.

If we're in a cooling climate and are in the cooling season, heat will flow from the outdoors to the building interior. Just remember that (according to the laws of thermodynamics), heat (or energy) *always* flows from the warmer (or more exited state) into the cooler (or less excited state) area of a building.

Definition of the K value or K-coefficient of heat transmission

A building's K value or K-coefficient of heat transmission is one way to express the heat loss in a building. "K" is defined as the number of BTU's of heat moving through any material with these details:

- Per square foot of area of the material
- Per degree Fahrenheit of temperature difference
- Per inch of thickness of the material

So "K" takes a lot of variables into consideration and gives us the rate of heat loss per square foot of building surface,

FOUNDATION INSULATION OPTIONS
FRAMING DETAILS for BETTER INSULATION
FRAMING DETAILS for DOUBLE WALL HOUSES
FRAMING METAL STUD PERFORMANCE
HEATING COST SAVINGS METHODS
HIGH MASS TRADEOFFS, HEATING vs COOLING
HOUSE DOCTOR, how-to be
Inspect Attics for Moisture or Mold
Inspect Attics for Blocked Soffit Intake Vents
Inspect Basements for Moisture or Mold
Inspect Building Exterior - Roof Venting
Inspect the Ridge Vent System from the Attic
Inspect the Soffit Vent System from the Attic
Insects & Foam Insulation
Insulation Air & Heat Leaks
INSULATION for GREENHOUSE or SOLARIUM
INSULATION CHOICES
INSULATION FACT SHEET- DOE
INSULATION PLACEMENT in buildings
INSULATION R-Values & Properties
LOG HOME WALL INSULATION VALUES
MOISTURE in BUILDING WALLS, EFFECTS
MOISTURE in CELLULOSE INSULATION
Mold in Fiberglass Insulation
Mold on Books, Book Conservation
Mold on Fiberboard Insulating Sheathing
MOLD in Foam Insulation
MOLD in INSULATION
Mold Resistance of Foam Insulation
MOLD PREVENTION AFTER FLOODING
MOLD RESISTANT CONSTRUCTION
PASCAL CALCULATIONS
PHENOLIC FOAM INSULATION
POLYISOCYANURATE FOAM INSULATION
POLYISOCYANURATE FOAM BELOW SLABS
POLYSTYRENE FOAM INSULATION
RADIANT BARRIERS
REFLECTIVE INSULATION
RIGID FOAM USE INDOORS
ROOF VENTING ENERGY SAVING DETAILS
ROOF VENTING NEEDED?
ROOF VENTILATION SPECIFICATIONS
PASSIVE SOLAR DESIGN KEY ELEMENTS
PASSIVE SOLAR DESIGN METHOD
PASSIVE SOLAR ENERGY MONITORING
PASSIVE SOLAR FLOOR TILES, PHASE CHANGE
PASSIVE SOLAR HEAT PERFORMANCE
PASSIVE SOLAR HOME, LOW COST
PASSIVE SOLAR PERFORMANCE PROBE
PASSIVE SOLAR Roof & Window Overhangs
PHOTOVOLTAIC POWER SYSTEMS
POLYCARBONATE GLAZING
REMOTE ELECTRIC POWER, PHOTOVOLTAIC
ROCK-BED SOLAR HEAT STORAGE DESIGN
SLAB INSULATION, PASSIVE SOLAR
SLATE THERMAL MASS for SOLAR HEAT STORAGE
SOUND CONTROL in buildings
STRESS SKIN INSULATED PANELS
STUCCO OVER FOAM INSULATION
SUPER HI-R INSULATION
SUPERINSULATION RETROFIT
Urea Formaldehyde Foam Insulation UFFI
URETHANE FOAM Deterioration, Outgassing

per inch of thickness of material in that building surface, per degree of temperature difference in Fahrenheit, in BTUs per hour.

By "degree of temperature difference in Fahrenheit" we mean that we are taking into consideration the *difference* in temperature on the two sides of our building surface. For example, if the *indoor* temperature in a building is 68 deg. F. and the *outdoor* temperature is 48 deg. F., then we have a 20 degree temperature difference on the two sides of the building (wall or roof for example).

This temperature difference on the two sides of a surface, say an insulated building wall, for example, is very important in understanding how a building loses heat (in the heating season) or gains heat (in the cooling season). That's because the rate of heat transfer through a material increases exponentially as a function of the temperature difference. This is intuitively obvious and is confirmed by physicists.

For example, if the temperatures on either side of a building wall were the same, there would be no heat loss or gain through the building wall. As the temperature difference on either side of that same wall increases, say from one degree of difference to 20 degrees of difference the *rate of heat transfer increases*.

An interesting version of this heat transfer theory was shared with the author in a class on how to minimize building heating costs when the instructor told us that "the thermal conductivity of finned copper heating baseboard is exponentially greater at higher temperatures".

He was saying that if we ran heating water from our heating boiler through the baseboards at 200 deg.F. we would see *much more efficient heat transfer from the heating baseboards into the building.* There are other factors involved in heating system efficiency such as the length of boiler on cycle (longer is more efficient), so there was more to think about, but the instructor was applying classic heat transfer theory that is reflected in the "K" values of building insulation as we've discussed here.

Definition of U value or U-coefficient of heat loss resistance

U-value measures the ability to transfer heat, an inverse condition, to heat movement resistance, or in other words, or U-value measures the ability of a substance to allow the transfer of heat

The NFRC (National Fenestration Council) in discussing solar heat gain at windows, describes the U-Factor (U) as follows:

> *U-Factor measures how well a product prevents heat from escaping a home or building. U-Factor ratings generally fall between 0.20 and 1.20. The lower the U-Factor, the better a product is at keeping heat in. U-Factor is particularly important during the winter heating season. This label displays U-Factor in U.S. units. Labels on products sold in markets outside the United States may display U-Factor in metric units.*

Computing "K" values (discussed above) tells us the heat loss rate for *a specific material, thickness, area, and temperature difference* but while we need to be able to calculate "K" values, those alone don't tell us what's going on in an actual building. We need to be able to *combine* all of the rates of heat loss (or gain) across all of the types of surfaces, insulation, and building material for the whole building - at least for all of its external or perimeter surfaces including roofs, walls, and floors as well as windows and doors. That's where the "U" value makes its appearance.

A building's "U" value or U-coefficient of resistance of heat loss is a related measure of resistance to thermal energy or heat flow out of a building (if it's warmer inside than outside) or conversely the same concept works in a warm climate where air conditioning is in use, except that we expect *outside* heat to be flowing *into* the building.

A building's "U" value is much more complete, and therefore useful than "K" values alone because a building's "U" value *combines* the "K" factors for *all* of the building's surfaces and materials. In other words, we add the effects of heat loss (or gain), still expressed in the number of BTU's per hour per square foot of area, and still expressed per degree of Fahrenheit of temperature difference and still expressed per inch of thickness of material (just as with "K" values), for all of the substantial areas and surfaces of the exterior of a building's floors, walls, windows, doors,

VAPOR BARRIERS & AIR SEALING at BAND JOISTS
VAPOR BARRIERS & CONDENSATION in buildings
VAPOR BARRIERS & HOUSEWRAP
VAPOR CONDENSATION & BUILDING SHEATHING
VERMICULITE INSULATION
INSULATION LOCATION - WHERE TO PUT IT
BLOWN-IN INSULATION
INSULATION CHOICES
INSULATION FACT SHEET- DOE
INSULATION LOCATION & QUANTITY for ATTICS
INSULATION LOCATION for BASEMENT FLOORS
INSULATION LOCATION for BASEMENT WALLS
INSULATION LOCATION for BRICK or BLOCK WALL CAVITY
INSULATION LOCATION for BRICK VENEER WALLS
INSULATION LOCATION for CAPES, CRAWLSPACES
INSULATION LOCATION for CATHEDRAL CEILINGS
INSULATION LOCATION for GREENHOUSE or SOLARIUM
INSULATION LOCATION for PASSIVE SOLAR FLOOR SLAB
INSULATION LOCATION & EXTENT for SLABS
INSULATION LOCATION for SOUND CONTROL
INSULATION LOCATION for SUSPENDED PANELS
INSULATION LOCATION for SWIMMING, INDOOR
INSULATION MOLD
INSULATION R-Values & Properties

LOG HOME GUIDE

MOBILE HOME INSPECTIONS
MOISTURE CONTROL in BUILDINGS
MOLD: A COMPLETE GUIDE TO MOLD
MOLD ACTION GUIDE - WHAT TO DO ABOUT MOLD
MOLD APPEARANCE - WHAT MOLD LOOKS LIKE
MOLD CLEANERS - WHAT TO USE
MOLD CLEANUP GUIDE- HOW TO GET RID OF MOLD
MOLD COUNT NUMBER GUIDE
MOLD CONSULTANTS/INSPECTORS
MOLD CULTURE TEST KIT VALIDITY
MOLD DETECTION & INSPECTION GUIDE
MOLD or INDOOR AIR EMERGENCY RESPONSE
MOLD EXPERT, WHEN TO HIRE
MOLD FAQ's
MOLD LEVEL IN AIR, VALIDITY
MOLD ODORS, MUSTY SMELLS
MOLD PREVENTION GUIDE
MOLD RELATED ILLNESS GUIDE
MOLD SAFETY WARNINGS
MOLD SPRAYS, SEALANTS, PAINTS
MOLD STANDARDS
MOLD TEST KITS for DIY MOLD TESTS
MOLD TESTING METHOD VALIDITY

Nanomaterials Hazards
NOISE / SOUND DIAGNOSIS & CURE

ODORS & SMELLS DIAGNOSIS & CURE

PAINT FALURE, DIAGNOSIS, CURE, PREVENTION
PASCAL CALCULATIONS
PLASTER & BEAVERBOARD & DRYWALL
PLASTER BULGES & PILLOWS
PLASTER LATH, METAL

ceilings, or roofs (if cathedral ceilings are present).

To calculate the "U" value, or overall heat loss (or gain if we're air conditioning) for a building, we need to add the "R" values for each material in the structure, and to factor in the total area of each material in the structure. We discuss this procedure in more detail below at "Calculating Heat Loss for a Building".

Definition of Design Temperature for buildings and Building Insulation?

The "indoor design temperature" for a building refers to the assumed target indoor temperature that the building owner or occupants want. Typically 70 deg.F. is used unless the owner specifies something different.

The "outdoor design temperature" for a building is (for heating purposes) assumed to be the average lowest recorded temperature for each month between October and March (the heating season in most climates). If we are specifying a "design temperature" for cooling climates we'd use the average outdoor highest recorded temperature during the heating season, perhaps April through September.

Watch out when calculating building or room heating needs. In a recent review of the number of linear feet of heating baseboard needed for a New York building addition we tried out an excellent heat loss analysis program provided by SlantFin. The program considers most of the key variables you'd want examined for an accurate and reliable heating design. But we found that our building had properties not considered by the heat loss software, including

- The specific R-value of the insulation we used in a cathedral ceiling and in a floor as well as in 2x6-framed walls
- The effects of the surprise by our plumber who installed 1/2-inch diameter heating supply and return piping instead of the 3/4" diameter pipes we anticipated, and his assumption that the flow rate was 1 gph through the system would be OK instead of the design point of 4 gph.
- A designed variation in placement of windows to provide more solar gain on South and West walls and less glazing (and heat loss) through the building's North wall
- Effects of using an insulation method and other building design features that minimized air leaks (foam insulation, and detailing around window and door openings, for example)

Fortunately simpler rules of thumb analysis by consultants at our heating equipment and parts supplier indicated that the modified design would adequately heat the space.

Definition of Heating Degree Day or Cooling "Degree Day"

Some building insulation designers and architects look at the number of "degree days" as an easy way to get at the average outdoor temperatures for an area and a season. A "degree day" is the daily average number of degrees Fahrenheit that the outdoor temperature is below 65 deg.F.

The number of "degree days" during a heating season is easy to obtain: call your local oil delivery company or utility company. These energy providers keep close tabs on degree days for their area since this number is used in planning for the automatic delivery of energy. It's the number of "degree days" that have occurred in a given period, combined with a building's historic rate of heating oil use, for example, that tells an oil company when to schedule that building for an automatic delivery of heating oil.

Definition of Tons of Cooling Capacity

"One ton" of cooling capacity, historically, referred to the cooling capacity of a ton of ice. Re-stated we can define one ton of cooling capacity as the amount of heat energy absorbed in the melting of one ton of ice over a 24-hour period.

PLASTER, LOOSE FALL HAZARDS
PLASTER TYPE IDENTIFICATION
PLASTER VENEER Best Practices
PORCHES & Sunrooms
PORCH CONSTRUCTION & SCREENING

RADIANT BARRIERS
RADIANT HEAT
RADIANT HEAT Floor Mistakes to Avoid
RADIANT HEAT TEMPERATURES
RADIANT SLAB FLOORING CHOICES
RADIANT SLAB TUBING & FLUID CHOICES
REFLECTIVE INSULATION
RIGID FOAM USE INDOORS

ROOF VENTILATION SPECIFICATIONS
ROT, FUNGUS, TERMITES
ROT RESISTANT LUMBER
ROT, TIMBER FRAME
ROT, TIMBER ASSESSMENT

SAFETY HAZARDS & INSPECTIONS
SEARS KIT HOUSES
SEER RATINGS & OTHER DEFINITIONS
SHEATHING, FOIL FACED - VENTS
SOLAR ENERGY SYSTEMS
BLOCKBED RADIANT FLOORS - SOLAR DESIGN
FLOOR, CONCRETE SLAB CHOICES
FLOOR, CONCRETE SLAB POURED FINISH
GLASS vs HEAT MIRROR SOLAR GAIN/Loss
GREENHOUSE DESIGN for SOLAR HEATING
GREENHOUSE / SUNSPACE GLARE
PASSIVE SOLAR DESIGN KEY ELEMENTS
PASSIVE SOLAR DESIGN METHOD
PASSIVE SOLAR ENERGY MONITORING
PASSIVE SOLAR FLOOR TILES, PHASE CHANGE
PASSIVE SOLAR HEAT PERFORMANCE
PASSIVE SOLAR HOME, LOW COST
PASSIVE SOLAR PERFORMANCE PROBE
PASSIVE SOLAR Roof & Window Overhangs
PHOTOVOLTAIC POWER SYSTEMS
POLYCARBONATE GLAZING
REMOTE ELECTRIC POWER, PHOTOVOLTAIC
ROCK-BED SOLAR HEAT STORAGE DESIGN
SLAB INSULATION, PASSIVE SOLAR
SLATE THERMAL MASS for SOLAR HEAT STORAGE
SOLAR COLLECTOR AIR or GAS COLLECTION
SOLAR COLLECTOR EFFICIENCY COMPARISONS
SOLAR COLLECTOR FILMS
SOLAR COLLECTOR OUTGASSING
SOLAR COLLECTOR WOOD HOUSINGS
SOLAR GAIN CALCULATION
SOLAR HEATING SYSTEM DESIGNS
SOLAR HOT WATER HEATERS
SOLAR HOUSE EVALUATION
SOLAR MODULE MANUFACTURERS
SOLAR SHADES & SUNSCREENS
SOLAR SHADES, LOW-E EFFECTIVENESS
SOLAR WATER DISINFECTION
SOLAR HOT WATER HEATERS
SUNSPACE DESIGN for SOLAR HEATING
SUNSPACE GLAZING for SUNTANNING
STORM WINDOW INTERIOR
STORM WINDOW PLASTIC CHOICES

One ton of cooling capacity is the same as 12,000 BTU's *per hou*r of cooling capacity or 288,000 BTUs of cooling capacity provided over a period of 24 hours (12,000 x 24 hours = 288,000).

What is the Relationship of Cooling Capacity and Dehumidification?

Tons of ice does not, however, explain an important factor in the comfort produced by air conditioning systems, reduction of indoor humidity - that is, removing water from indoor air. Cool air holds less water (in the form of water molecules or gaseous form of H2O) than warm air.

Think of the warmer air as having more space between the gas molecules for the water molecules to remain suspended. When we cool the air, we in effect are squeezing the water molecules out of the air. When an air conditioner blows warm humid building air across an evaporator coil in the air handler unit, it is not only cooling the air, it is removing water from that air. Both of these effects, cooler air and drier air, increase the comfort for building occupants. One ton of cooling capacity equals 12,000 BTU's/hour of cooling capacity.

Also see
DEW POINT CALCULATION for WALLS
DEW POINT TABLE - CONDENSATION POINT GUIDE

How do we measure cooling or heating efficiency: the relationshop between BTUs and cooling or heating operating cost?

Note that the BTU rating of an air conditioner itself does not tell you how economically those tons of cooling capacity are being produced. For the answer to that question see SEER RATINGS & OTHER DEFINITIONS for air conditioners and heat pumps.

Questions & Answers regarding this article

Questions & answers about heating & cooling terms, measurements, values & definitions.

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(Nov 22, 2011) DanJoeFriedman (mod) said:

Garth I appreciate your offered correction but as your statement contradicts what we learned from a heat transfer expert and in oil burner school, I'd be really grateful if you can give me a citation or technical reference to read and cite. We are dedicated to making our information as accurate, complete, useful, and unbiased as possible: we very much welcome critique, questions, or content suggestions for our web articles. Working together and exchanging information makes us better informed than any individual can be working alone.

(Nov 21, 2011) Garth said:

This article states the following, which is incorrect: "the rate of heat transfer through a material increases exponentially as a function of the temperature difference". The correct statement is that heat transfer increases linearly as a function of the temperature difference.

Recommend / Share this Article

ShareThis
EMAIL
Print

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also include a list of recommended books for the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

- Thanks to reader Peter J. Collins for discussing and helping clarify definitions of R U and K - August 2010
- Asbestos pipe insulation in buildings
- Brick "Insulation" in Building Walls
- HEAT LOSS CALCULATIONS, Insulation Properties, Definitions of R, K, U values, Insulation Design
- How to Choose an Air Conditioner - BTU Chart

DEW POINT TABLE - CONDENSATION POINT GUIDE
FELT 15# ROOFING, as HOUSEWRAP/VAPOR BARRIER
HOUSEWRAP AIR & VAPOR BARRIERS
HOUSEWRAP INSTALLATION DETAILS
HOUSEWRAP PRODUCT CHOICES
HOUSEWRAP at SILLS, SOLES, TOP PLATES
HUMIDITY LEVEL TARGET
MOISTURE CONTROL in BUILDINGS
RAIN SPLASH-UP SIDING DAMAGE
VAPOR BARRIERS & AIR SEALING at BAND JOISTS
VAPOR BARRIERS & CONDENSATION in buildings
VAPOR BARRIERS & HOUSEWRAP
VAPOR CONDENSATION & BUILDING SHEATHING
WATER BARRIERS, EXTERIOR
WOOD SIDING FLASHING DETAILS
VENTILATION in buildings

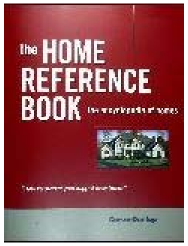
WALL FINISHES INTERIOR
WATER ENTRY in buildings
WIND WASHING INSULATION At EAVES
WINDOWS & DOORS
WINTERIZE A BUILDING
WOOD Burning Heaters Fireplaces Stoves
WOOD FLOOR DAMAGE

More Information

- How to Detect and Correct Attic Condensation & Prevent Ice Dam Leaks in buildings
- How to Inspect Building Interiors and Building Insulation/Ventilation list of articles about building insulation inspection, defects, design, and ventilation requirements
- Insulation Materials as Indicators of Building Age
- Indoor Air Quality Investigations: Fiberglass in Indoor Air, HVAC ducts, and Building Insulation
- Insulation Identification Photographs - Cellulose insulation photos, Mineral wool insulation photos, rock wool insulation photos, cotton insulation photos, balsam wool insulation photos
- Insulation Identification Photographs - Vermiculite insulation photos
- LP or Natural Gas Pressures & BTUH per Cubic Foot
- Insulation Properties, Table of R-Values, density, moisture permeability, fire safety, aging effects on various insulation materials
- Mold in Fiberglass in Insulation
- Radiant Heat Floor Mistakes to Avoid
- Rated Cooling Capacity - How to Determine Air Conditioning Equipment Rated Cooling Capacity
- "Solar Heat Gain & Windows, the facts about", NFRC, National Fenestration Rating Council, January 2005, NFRC website: www.nfrc.org retrieved 12/4/2010, original source: http://www.nfrc.org/documents/SolarHeatGain.pdf.
- Un-Vented Roof Solutions - How to Prevent Attic Condensation, Ice Dam Leaks, Roof Mold, & Roof Structural Damage in buildings with Un-vented Roof Cavities
- Vermiculite Building Insulation & Asbestos

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.



- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 2010, $69.00 U.S., is available from Carson Dunlop, and from the InspectAPedia bookstore. The 2010 edition of the Home Reference Book is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. InspectAPedia.com ® author/editor Daniel Friedman is a contributing author. Field inspection worksheets are included at the back of the volume.

- Asbestos: How to find and recognize asbestos in Buildings - visual inspection methods, list of common asbestos-containing materials
- Asbestos HVAC Ducts and Flues field identification photos and guide
- Asbestos products and their history and use in various building materials such as asphalt and vinyl flooring includes discussion which draws on Asbestos, Its Industrial Applications, D.V. Rosato, engineering consultant, Newton, MA, Reinhold Publishing, 1959 Library of Congress Catalog Card No.: 59-12535 (out of print).
- Asbestos Identification and Testing References
  - Asbestos Identification, Walter C.McCrone, McCrone Research Institute, Chicago, IL.1987 ISBN 0-904962-11-3. Dr. McCrone literally "wrote the book" on asbestos identification procedures which formed the basis for current work by asbestos identification laboratories.
  - Stanton, .F., et al., National Bureau of Standards Special Publication 506: 143-151
  - Pott, F., Staub-Reinhalf Luft 38, 486-490 (1978) cited by McCrone
- ASHRAE resources on building insulation, dew point and wall condensation - see the *ASHRAE Fundamentals Handbook*, available in many libraries. The following three ASHRAE Handbooks are also available at the InspectAPedia bookstore in the third page of our Insulate-Ventilate section:

- 2005 ASHRAE Handbook : Fundamentals : Inch-Pound Edition (2005 ASHRAE HANDBOOK : Fundamentals : I-P Edition) (Hardcover), Thomas H. Kuehn (Contributor), R. J. Couvillion (Contributor), John W. Coleman (Contributor), Narasipur Suryanarayana (Contributor), Zahid Ayub (Contributor), Robert Parsons (Author), ISBN-10: 1931862702 or ISBN-13: 978-1931862707
- 2004 ASHRAE Handbook : Heating, Ventilating, and Air-Conditioning: Systems and Equipment : Inch-Pound Edition (2004 ASHRAE Handbook : HVAC Systems and Equipment : I-P Edition) (Hardcover) by American Society of Heating, ISBN-10: 1931862478 or ISBN-13: 978-1931862479
  "2004 ASHRAE Handbook - HVAC Systems and Equipment The 2004 ASHRAE HandbookHVAC Systems and Equipment discusses various common systems and the equipment (components or assemblies) that comprise them, and describes features and differences. This information helps system designers and operators in selecting and using equipment. Major sections include Air-Conditioning and Heating Systems (chapters on system analysis and selection, air distribution, in-room terminal systems, centralized and decentralized systems, heat pumps, panel heating and cooling, cogeneration and engine-driven systems, heat recovery, steam and hydronic systems, district systems, small forced-air systems, infrared radiant heating, and water heating); Air-Handling Equipment (chapters on duct construction, air distribution, fans, coils, evaporative air-coolers, humidifiers, mechanical and desiccant dehumidification, air cleaners, industrial gas cleaning and air pollution control); Heating Equipment (chapters on automatic fuel-burning equipment, boilers, furnaces, in-space heaters, chimneys and flue vent systems, unit heaters, makeup air units, radiators, and solar equipment); General Components (chapters on compressors, condensers, cooling towers, liquid coolers, liquid-chilling systems, centrifugal pumps, motors and drives, pipes and fittings, valves, heat exchangers, and energy recovery equipment); and Unitary Equipment (chapters on air conditioners and heat pumps, room air conditioners and packaged terminal equipment, and a new chapter on mechanical dehumidifiers and heat pipes)."
- 1996 Ashrae Handbook Heating, Ventilating, and Air-Conditioning Systems and Equipment: Inch-Pound Edition (Hardcover), ISBN-10: 1883413346 or ISBN-13: 978-1883413347 ,
  "The 1996 HVAC Systems and Equipment Handbook is the result of ASHRAE's continuing effort to update, expand and reorganize the Handbook Series. Over a third of the book has been revised and augmented with new chapters on hydronic heating and cooling systems design; fans; unit ventilator; unit heaters; and makeup air units. Extensive changes have been added to chapters on panel heating and cooling; cogeneration systems and engine and turbine drives; applied heat pump and heat recovery systems; humidifiers; desiccant dehumidification and pressure drying equipment, air-heating coils; chimney, gas vent, fireplace systems; cooling towers; centrifugal pumps; and air-to-air energy recovery. Separate I-P and SI editions."
- Principles of Heating, Ventilating, And Air Conditioning: A textbook with Design Data Based on 2005 AShrae Handbook - Fundamentals (Hardcover), Harry J., Jr. Sauer (Author), Ronald H. Howell, ISBN-10: 1931862923 or ISBN-13: 978-1931862929
- 1993 ASHRAE Handbook Fundamentals (Hardcover), ISBN-10: 0910110964 or ISBN-13: 978-091011096

* Best Practices Guide to Residential Construction, by Steven Bliss. John Wiley & Sons, 2006. ISBN-10: 0471648361, ISBN-13: 978-0471648369, Hardcover: 320 pages, available from Amazon.com and also Wiley.com. See our book review of this publication.
* Construction Waterproofing Handbook, Michael T. Kubal. Quoting:
  ... an all-inclusive, project-simplifying guide for waterproofing and construction professionals. This comprehensive answer-packed resource is loaded with the up-to-date, clearly-defined information you need on every project, including work on the building envelope, below-grade, above-grade, and remedial waterproofing.
* Brick nogging used as soundproofing is mentioned in this article on Popular Forest
* Brick Nogging, Historical Investigation and Contemporary Repair, *Construction Specifier*, April 2006. Historical use of brick in timber-framed buildings, drawing on the investigations of the Kent Tavern in Calais, VT. "Brick nogging is a European method of construction which was brought to the new world in the early-nineteenth century. It was a common construction method that employed masonry as infill between the vertical uprights of wood framing." -- quoting the web article review.
* Photo of very rough in-wall brick nogging at an architects website
* Dust from the World Trade Center collapse following the 9/11/01 attack: the lower floors of this building contained spray-on fire-proofing asbestos materials.
* "Energy Savers: Whole-House Supply Ventilation Systems [copy on file as /interiors/Energy_Savers_Whole-

House_Supply_Vent.pdf] - ", U.S. Department of Energy energysavers.gov/your_home/insulation_airsealing/index.cfm/mytopic=11880?print
- "Energy Savers: Whole-House Exhaust Ventilation Systems [copy on file as /interiors/Energy_Savers_Whole-House_Exhaust.pdf] - ", U.S. Department of Energy energysavers.gov/your_home/insulation_airsealing/index.cfm/mytopic=11870
- "Energy Savers: Ventilation [copy on file as /interiors/Energy_Savers_Ventilation.pdf] - ", U.S. Department of Energy
- "Energy Savers: Natural Ventilation [copy on file as /interiors/Energy_Savers_Natural_Ventilation.pdf] - ", U.S. Department of Energy
- "Energy Savers: Energy Recovery Ventilation Systems [copy on file as /interiors/Energy_Savers_Energy_Recovery_Venting.pdf] - ", U.S. Department of Energy energysavers.gov/your_home/insulation_airsealing/index.cfm/mytopic=11900
- "Energy Savers: Detecting Air Leaks [copy on file as /interiors/Energy_Savers_Detect_Air_Leaks.pdf] - ", U.S. Department of Energy
- "Energy Savers: Air Sealing [copy on file as /interiors/Energy_Savers_Air_Sealing_1.pdf] - ", U.S. Department of Energy
- Fiberglass: Indoor Air Quality Investigations: Health Concerns About Airborne Fiberglass: Fiberglass in Indoor Air from HVAC ducts, and Building Insulation
- From the walls in, Charles Wing
- Humidity: What indoor humidity should we maintain in order to avoid a mold problem?InspectAPedia Bookstore (Amazon.com)
- Insulate & Weatherize (Taunton's Build Like a Pro), Bruce Harley. Review quoted:
  An engineer who trains builders in energy-efficient construction, Harley offers a wealth of information that will allow readers to improve their home's efficiency, saving both money and natural resources. After an introductory section that explains the underlying principles of heat transfer, insulation, and air quality, Harley demonstrates basics such as weather-stripping and moves forward through advanced projects including insulation and major upgrades. Short "Pro Tips" as well as sections labeled "Trade Secrets," "What Can Go Wrong," and "In Detail" provide a great deal of helpful information. Increasing energy efficiency is one of the easiest ways for homeowners to save money
- "Insulation: Adding Insulation to an Existing Home," U.S. Department of Energy - tips on how to do your own check for the presence of absence of insulation in a home
- Insulation: Selecting Insulation for New Home Construction, U.S. Department of Energy - "Your state and local building codes probably include minimum insulation requirements, but to build an energy-efficient home, you may need or want to exceed them. For maximum energy efficiency, you should also consider the interaction between the insulation and other building components. This is called the whole-house systems design approach."
- Insulation Types, table of common building insulation properties from U.S. DOE. Readers should see INSULATION R-Values & Properties our own table of insulation properties that includes links to articles describing each insulation material in more detail.
- The National Institute of Standards and Technology, NIST (nee National Bureau of Standards NBS) is a US government agency - see www.nist.gov
  - "A Parametric Study of Wall Moisture Contents Using a Revised Variable Indoor Relative Humidity Version of the "Moist" Transient Heat and Moisture Transfer Model [copy on file as/interiors/MOIST_Model_NIST_b95074.pdf] - ", George Tsongas, Doug Burch, Carolyn Roos, Malcom Cunningham; this paper describes software and the prediction of wall moisture contents. - PDF Document from NIS
- Nogging: See this photo of exposed bricks on a building exterior on a building exterior in Canada. [Thanks to Carson Dunlop, Toronto - see References below].
- Piquet Wall Construction: See this photo of piquet wall construction - involving timber-framed wall construction with long top girts, diagonal timber bracing, and small diameter logs placed vertically along with concrete chinking to fill in the wall plane.
- Plank House Construction: weblog from plankhouse.wordpress.com/2009/01/25/plank-house-construction/ and where plank houses were built by native Americans, see
  Large 1:6 Scale Plank House Construction / P8094228, Photographer: Mike Meuser
  06/12/2007 documented at yurokplankhouse.com where scale model Museum quality Yurok Plank Houses are

being sold to raise money for the Blue Creek - Ah Pah Traditional Yurok Village project.

- Principles of Heating, Ventilating, And Air Conditioning: A textbook with Design Data Based on 2005 ASHRAE Handbook - Fundamentals, Harry J., Jr. Sauer, Ronald H. Howell, William J. Coad. Quoting
  ... textbook for college level HVAC courses or independent study and review, especially when combined with the 1997 ASHRAE Fundamentals Handbook. Contains the most current ASHRAE procedures and definitive, yet easy to understand, treatment of building HVAC systems -- from basic principles through design and operation. Dual units of measurement.
- Re-Bath, tub lining products is a bath tub relining manufacturer and distributor located in Tempe, Arizona - see rebath.com
- Rubblestone Wall Filler: See this Lartigue House using exterior-exposed rubblestone filler between vertical timbers of a post and beam-framed Canadian building.
- Super-Insulated Retrofit Book: A Homeowner's Guide to Energy-Efficient Renovation, Robert Argue
- The super-insulated retrofit book: A homeowner's guide to energy-efficient renovation (Sun builders series), Brian Marshall
- Understanding Ventilation: How to Design, Select, and Install Residential Ventilation Systems, John Bower, Quoting:
  Understanding Ventilation is the only book that covers all aspects of exchanging the air in houses: infiltration, equipment selection, design, heat-recovery ventilators, sizing, costs, controls, whole-house filters, distribution, and possible problems that a ventilation system can cause--all in easy-to-understand language.
- "Weather-Resistive Barriers [copy on file as /interiors/Weather_Resistant_Barriers_DOE.pdf] - ", how to select and install housewrap and other types of weather resistive barriers, U.S. DOE
- Weaver: Beaver Board and Upson Board: Beaver Board and Upson Board: History and Conservation of Early Wallboard, Shelby Weaver, APT Bulletin, Vol. 28, No. 2/3 (1997), pp. 71-78, Association for Preservation Technology International (APT), available online at JSTOR.
- ...

InspectAPedia®

Free Encyclopedia of Building & Environmental Inspection, Testing, Diagnosis, Repair

Search
InspectAPedia

Ask a Question or Search InspectAPedia

HOME | AIR CONDITIONING | ELECTRICAL | EXTERIORS | HEATING | HOME INSPECTION | INTERIORS | PLUMBING | ROOFING | SEPTIC SYSTEMS | STRUCTURE | WATER SUPPLY

ENERGY SAVINGS | ENVIRONMENT | INDOOR AIR IAQ | INSULATION | MOLD INSPECT TEST REMOVE | NOISE | ODORS | SOLAR ENERGY | VENTILATION | EXPERTS DIRECTORY | CONTACT US

Mobile View

AIR CONDITIONING & HEAT PUMP SYSTEMS

A/C - HEAT PUMP CONTROLS & SWITCHES
A/C DATA TAGS
A/C - HEAT PUMP CRITICAL DEFECTS
A/C DIAGNOSTIC FAQs
A/C REFRIGERANTS
A/C TYPES, ENERGY SOURCE
AGE of AIR CONDITIONERS & HEAT PUMPS
AIR CLEANER PURIFIER TYPES
AIR CONDITIONER BTU CHART
AIR CONDITIONER COMPONENT PARTS
AIR CONDITIONER TYPES, ENERGY SOURCES
AIR CONDITIONER NOT WORKING
AIR FILTER EFFICIENCY
AIR FILTERS, FIBERGLASS PARTICLES
AIR FILTERS for HVAC SYSTEMS
AIR FLOW MEASUREMENT CFM
AIR HANDLER / BLOWER UNITS

How to Choose a Room Air Conditioner - BTU Chart

InspectAPedia® - ShareThis +1

- How to choose an air conditioner that fits the building and your cooling needs?
- Typical BTU Cooling Capacity Range for Types of Room Air Conditioners
- Room Air Conditioner or Window Air Conditioner Sizing and Choosing Chart
- How Much Cooling Capacity do we need Per Square Foot of Building Area? How Much Space can a Ton of Cooling Capacity Serve?
- How To Calculate the BTUs needed to cool a given space: follow this procedure:
- How big an air conditioner do I need? How much air conditioning do I need? How many BTUs or Tons of Air conditioning?
- Can an air conditioner be *too powerful* for the building? Watch out: Don't Buy an Oversized or "Too Big" Air Conditioner
- Questions & answers about how to determine the necessary cooling capacity in BTUs for a room or building area cooled by a window air conditioner or a portable air conditioning unit

Air conditioner BTU requirements: this article provides an air conditioner BTU chart shows how to choose a room air conditioner for window or through-wall mounting. We also show how to calculate how much BTU capacity you need based on building area or square feet, and we warn about dehumidification problems if you buy an air conditioner that is too big for the space you are cooling. Also see WINDOW / WALL AIR CONDITIONERS.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

Typical BTU Cooling Capacity Range for Types of Room Air Conditioners

Also see COOLING RULES OF THUMB to guesstimate how many tons or BTUs of cooling a building needs and see RATED COOLING CAPACITY to determine the cooling capacity of existing air conditioning equipment. We discuss the air conditioning system sizing problem at AIR CONDITIONER BTU CHART and while details are found at DEHUMIDIFICATION PROBLEMS, we also introduce the oversized air conditioner problem at LOST COOLING CAPACITY. At ADDING A/C: RETROFIT SIZING we discuss home cooling system sizing mis-match on retrofit jobs.

Portable, window, or through-wall air conditioners are typically described by their manufacturer as suited for:

- Single Room Air Conditioner Capacity - typically for rooms up to 20' x 20' or 400 sq.ft. in area. BTUs in this product range are typically from 6,000 BTUh to 10,000 BTUh.
- Portable room air conditioners - 7,500 to 14,000 BTUH, portable, using one or in some cases two flexible ducts to move heat from the room, through cooling coil and the compressor, to outdoors
- Multiple Room Air Conditioner Capacity - typically for a total area of up to 800 sq.ft. BTUs in this product range are typically from 10,000 BTUh to 16,000 BTUh.
- Large Capacity Air Conditioner Capacity - typically for multiple rooms or very large rooms up to a total area from 900 sq. ft. to 2,000 sq.ft. BTUs in this product range are typically from 16,000 to 28,000 BTUh.
- Central Air Conditioning - typically to cool an entire floor or multiple floors in a home. Also see A/C TYPES, ENERGY SOURCES

Room Air Conditioner Sizing and Choosing Chart

The table below gives recommended air conditioning BTU's necessary to cool a single room. The data in the table assumes that the ceiling over the room is insulated and that the room is not over or is not itself a special heat-producing area such as a kitchen or boiler room.

Table 1: Base BTUs - Recommended Air Conditioner BTUs			
Number of Rooms Cooled	Room Area MINimum sq.ft.	Room Area MAXimum sq.ft.	BTUs Needed
One	.	100	4,000 - 6,000
One	100	180	6,000 - 7,500
One	180	270	7,500 - 9,000
One	270	400	9,000 - 10,500
Several	.	400	10,500 - 12,000

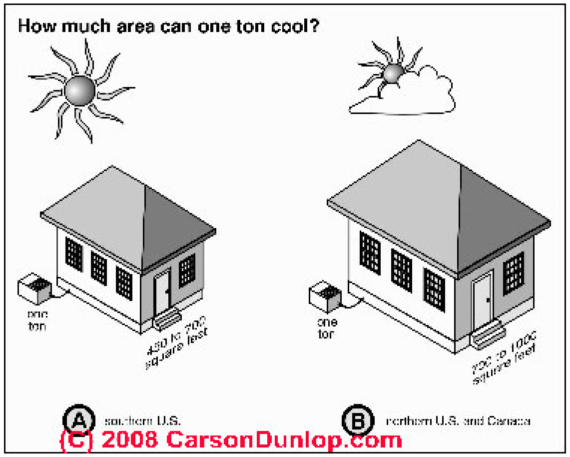
Several	400	500	12,000 - 13,500
Several	500	700	13,500 - 15,000
Several	700	800	15,000 - 16,500
Large Areas	.	900	16,500 - 18,000
Large Areas	900	1000	18,000 - 19,500
Large Areas	1,000	1,100	19,500 - 21,000
Large Areas	1,000	1,100	19,500 - 21,000
Large Areas	1,100	1,200	12,000 - 22,500
Large Areas	1,200	1,500	22,500 - 24,000
Large Areas	1,500	1,700	24,000 - 25,500
Large Areas	1,700	1,900	25,500 - 27,000
Large Areas	1,900	2,200	27,000 - 28,500

How To Calculate the BTUs needed to cool a given space: follow this procedure:

1. Calculate the total square feet to be cooled: Measure the size of the room (or rooms) to be cooled, to obtain total square feet. Multiply room length by width for each room and if there are multiple rooms, add the room areas together to get a single number.
2. Read the Base BTUs needed from Table 1 below
3. Add additional BTUs for these factors:
   - + 4,000 BTUs for each room below a ceiling or roof which is not insulated
   - + 4,000 BTUs for a home or residential kitchen included in the cooled area
   - + 1,500 BTUs for each window which receives significant daily sunshine
   - + 1,500 BTUs for a room over a kitchen or boiler room IF the kitchen or boiler room is actively producing heat during the cooling period
   - + 600 BTUs per person over two, if more than two occupants will be occupying the room during the cooling period
4. Subtract BTUs from the total required if these factors are present:
   - - 1,000 BTUs if the room is on the shaded side of the building
5. Calculate the final total BTUh needed from the above steps. This should place you in the right range of cooling capacity needed. Review the warning below about buying an oversized air conditioner.

How Much Cooling Capacity do we need Per Square Foot of

Building Area? How Much Space can a Ton of Cooling Capacity Serve?

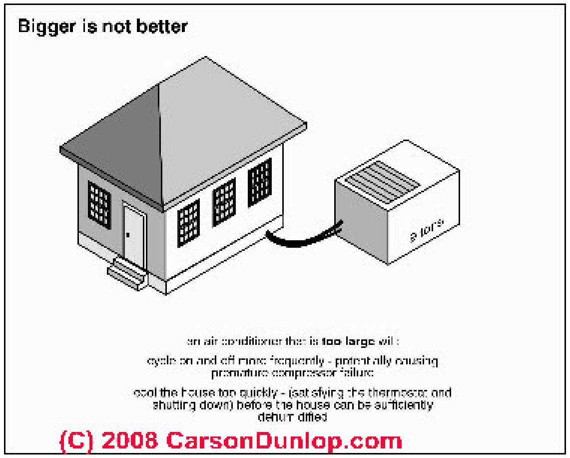


Maybe 450 sq.ft. to 1000 sq.ft. of a typical home can be cooled per ton of cooling capacity: that is, one ton (or 12,000 btuh) of air conditioning can cool about 500 sq.ft. of space. Sketch courtesy of Carson Dunlop Associates.

But the real answer is, it depends. Some of the factors that affect the ability of an air conditioner to cool a space need to be considered besides just the number of square feet. These include at least the following questions about air conditioning load and cooling requirements:

- What are the sun and heat characteristics of the geographic area where the building is located (southern U.S. vs. northern U.S. or Canada, for example)?
- How much direct sunlight is falling on the building?
- Is it bright hot sun or only partly sunny?
- What are the exterior colors of surfaces on which sunlight is falling?
- How well the building is insulated?
- How drafty is the building?
- How many occupants are in the building?
- What other heat sources (or cooling sources) are in the building?
- How high are the interior ceilings?
- How does air circulate within the occupied spaces?
- What defects in the air conditioning system need to be overcome, such as duct system errors or damage, dirty filters, blocked cooling coils, etc. ?

Watch out: Don't Buy an Oversized or "Too Big" Air Conditioner



Watch out: Do not buy an air conditioner which is oversized (too many BTUh) for the area you need to cool. You may think that bigger is better, but not in the case of air conditioning.

To make a room comfortable the air conditioner needs to both *cool the room air* AND *dehumidify the room air*.

If the air conditioner is too large for the space to be cooled, the temperature will drop quickly and the A/C unit will shut off before the air has become adequately dry.

The room will be either too cold or too humid for comfort. Sketch courtesy of Carson Dunlop Associates.

More detail about how to diagnose and cure an air conditioner that is not dehumidifying can be found at DEHUMIDIFICATION

PROBLEMS

Other types of portable or individual-area air conditioners

- Heating & Cooling units - capable of both cooling or heating a room using electricity. Basically these units are small heat pumps that are mounted in a building window or wall. Heating/Cooling units will give two different BTUh figures, one for cooling and one for heating.

  These figures will differ, for example, producing 18,000 BTUh in cooling mode but only 12,000 BTUh in heating mode. The difference between heating and cooling, and the amount of heat actually available will depend also on the outdoor temperatures when in heating mode (as with any heat pump system, the unit cannot provide heat below certain temperatures.)"

- Slider or Casement Window units - narrow tall cooling systems which are designed to fit into the narrow space provided by casement or slider windows.

- Through-wall air conditioners - air conditioning units which are designed to be installed into a metal sleeve which is then itself installed in an opening cut into the building wall, leaving windows unobstructed, or perhaps for use in a room without a suitable window in which an air conditioner could be placed. BTU output is typically a bit more than the smallest window air conditioners but otherwise is similar in range.

- Portable air conditioners - units on wheels which are plugged into an outlet but can be moved room-to-room and do not require a window for their exhaust. These cooling units are of modest cooling ability, typically around 10,000 BTUh though some producers such as Sunpentown offer units up to 14,000 BTUh. See PORTABLE ROOM AIR CONDITIONERS for details about portable room air conditioners.

How to Determine BTUs or Tons of Cooling Capacity of an Air Conditioner from its Data Tags

See RATED COOLING CAPACITY for an explanation of how to determine the cooling capacity of an air conditioner that is already installed at a building or go directly to these links within that article:

FROM MODEL # - how to determine the BTU capacity or Tons of cooling capacity of an air conditioner from model number
FROM EQUIPMENT RLA # - how to determine the BTU capacity or Tons of cooling capacity of an air conditioner from the RLA number
COOLING RULES OF THUMB - how to guesstimate how many tons or BTUs of cooling a building needs

Questions & Answers regarding this article

Questions & answers about how to determine the necessary cooling capacity in BTUs for a room or building area cooled by a window air conditioner or a portable air conditioning unit.

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(July 10, 2012) Anonymous said:

We don't agree Abdul. Calculating the cubic volume to be cooled is important in sizing an air conditioner as is special factors that affect building heat gain such as ceiling shape, cathedral ceilings, dark colored roofs, number of windows, sunlight direction, etc. Just consider that cooling a room with a 15 foot cathedral ceiling may require more BTUs than a roof of the same square foot floor area that has just an 8-foot high flat ceiling.

(July 3, 2012) abdul qadir said:

u have explained in thist article for a.c. Calculate the s.f. But no need to take area complete volume.l*b*h.

(May 19, 2012) Angel said: 3

how I can find how many tons is my unit?

(May 17, 2012) DanJoeFriedman (mod) said: 3

Tom, indeed it's difficult to vent a flat roof -

but an air conditioner does not "get out" the hot air - in your climate more likely the A/C unit recycles indoor air through the cooling unit until air temp. at the thermostat has reached the set temperature.

If your A/C is too BIG, indeed it won't dehumidify adequately. You'll just have cool damp indoor air.

But if it's way undersized it may not be up to the dehumidifying job either. I'd measure the sqft. and use the smaller end of recommended BTUH capacity for your space, solar gain, and heat loss or gain properties - that is if you have a lot of glass facing the sun you need more capacity.

(May 16, 2012) Tom said:

We live near the beach in CA and it does not get over 85 but it gets very humid but we have an old house poorly insulated and late afternoon sun blasts the flat roof house through big windows and it's very hard to get the hot air out. So the air conditioner is more to get out the hot air and dehumidify. I'm thinking 12,000 BTU's window ac should

handle the front of the house, dining room and living room connected by large opening. The square footage is 346.
Would 12,000 be overkill?
Thanks
Tom

(Apr 16, 2012) DanJoeFriedman (mod) said:

Chandrasekhar, I am not sure, but in general I like the multiple unit approach for operating efficiency - when the cooling load is lower you can run a smaller, more efficient unit. Ask your HVAC engineer to do the calculations for you, comparing SEER, local energy rates, and the payback period for the added cost of a pair of systems as opposed to one large one.

(Apr 16, 2012) Chandrasekhar said:

Insulated ware house measuring 15 m Length x 8 m width x 6 m Height
Entrance – large door with air curtain
Climate –6 summer months, when daytime temperature go up to 50ºC (122 ºF), night time temperature in summer up to 35 ºC (85 ºF)
Is it advisable to go for a single unit (4 ton / 5 ton A/C) or multiple units (2 or 2.5 ton A/C x 2 units)?
Which combination will be power efficient?

(Mar 22, 2012) jacques said:

I am doing a restauramt of 1200sqf with 50 seat, and commercial kitchen with a exaust fan. The ceiling is of 21foot with all insulation in place in the roof and wall and wall of the partition of the kitchen. How much ac do I need??
Thank you for your help

(Dec 4, 2011) donna said:

hi, i have a outside storage room (12x17) that i have re-roofed and insulated. it has 2 windows, 35x48 inches, and your standard door opening. it is probably a littly drafty around door and windows.
As i had this room repaired , i decided-- hey, i would like to use it year round for an art studio and/or exercise room/ bridge card room. This room has one regular electrical outlet. PROBLEM: how can i heat and cool this area most of the months of the year. i live in alabama . please help me if you can. any input you could give me would be greatly appreciated. i have searched the net but am lost! however, i did find your article enlightening thank you again donna

(Dec 1, 2011) DanJoeFriedman (mod) said:

Duane based under 700 sqft, in an insulated conventional structure, you'd figure 13,500 t0 15,000 btuh or about 1 to 1.5 tons. But your installer may figure that your building has minimal insulation and that there is no insulation and a lot of heat gain in the Florida room. You don't mention what part of the country you're in but that would be a related factor.

If your system is oversized you'll find that it will cool nicely but you won't be comfortable because it won't dehumidify adequately.

Why not give the installer a call and ask their reasoning for a unit this large. Keep us posted - it will assist other readers.

(showing 1 to 10)

Recommend / Share this Article

+1 ShareThis

EMAIL

Print

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also include a list of recommended books for the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

AIR CONDITIONER BTU CHART
COOLING CAPACITY, RATED
DATA TAGS on AIR CONDITIONERS

- Thanks to Mark Cramer, Tampa Florida, for assistance in technical review of the "Critical Defects" section and for the photograph of the deteriorating gray Owens Corning flex duct in a hot attic. Mr. Cramer is a Florida home inspector and home inspection educator.
- CARSONDUNLOP Carson, Dunlop & Associates Ltd., 120 Carlton Street Suite 407, Toronto ON M5A 4K2. (416) 964-9415 1-800-268-7070 info@carsondunlop.com. The firm provides professional home inspection services & home inspection education & publications. Alan Carson is a past president of ASHI, the American Society of Home Inspectors. Thanks to Alan Carson and Bob Dunlop, for permission for InspectAPedia to use text excerpts from *The Home Reference Book* & illustrations from *The Illustrated Home*.

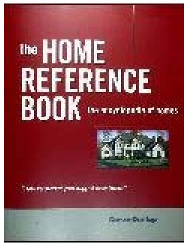
Carson Dunlop Associates' home inspection education products include

- The ASHI-adopted Home Inspection Training Program, and Commercial Building Inspection Courses
- The Home Inspection Home Study Course, and publications such as
- The Home Reference Book, a reference & inspection report product for building owners & inspectors
- The Home Reference *eBook*, an electronic version for PCs, the iPad, iPhone, & Android smart phones
- Home Inspection Report writing materials, including the Horizon Software System that manages business operations, scheduling, & inspection report writing using Carson Dunlop's knowledge base & color images. The *Horizon* system runs on always-available cloud-based software for office computers, laptops, tablets, iPad, Android, & other smartphones.
- The Illustrated Home illustrates construction details and building components, a reference for owners & inspectors

- Thanks to various industry and air conditioner sales publications and consumer pamphlets including Sears Kenmore(R) air conditioning sales
- Sunpentown International (SPT), 21415 Baker Parkway, City of Industry, CA 91789, 800-330-0388 / 909-468-5288, produces portable room air conditioners. Web search 12/31/2010. FAQ for portable room air conditioners: http://www.sunpentown.com/learnmore.html

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia Bookstore.



- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

  Or choose the The Home Reference eBook for using this reference on PCs, Macs, Kindle, iPad, iPhone, or Android Smart Phones

Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

- Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982
- Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- NEW!
  Air Conditioning SEER - New DOE Air Conditioner and Heat Pump Efficiency Standard
- Asbestos HVAC Ducts and Flues field identification photos and guide
- Fiberglass: Indoor Air Quality Investigations: Fiberglass in Indoor Air, HVAC ducts, and Building Insulation

- ...

InspectAPedia®

Free Encyclopedia of Building & Environmental Inspection, Testing, Diagnosis, Repair

Search

InspectAPedia

Ask a Question or Search InspectAPedia

HOME | AIR CONDITIONING | ELECTRICAL | EXTERIORS | HEATING | HOME INSPECTION | INTERIORS | PLUMBING | ROOFING | SEPTIC SYSTEMS | STRUCTURE | WATER SUPPLY

ENERGY SAVINGS | ENVIRONMENT | INDOOR AIR IAQ | INSULATION | MOLD INSPECT TEST REMOVE | NOISE | ODORS | SOLAR ENERGY | VENTILATION | EXPERTS DIRECTORY | CONTACT US

Mobile View

Air Conditioning & Heat Pump Refrigerant Leak Repair Procedures

InspectAPedia® - ShareThis +1

- How to diagnose & repair refrigerant leaks in the air conditioning or heat pump system
- Leak repair tips for the HVAC cooling coil or evaporator coil
- Causes of leaks in air conditioning or refrigeration equipment
- How to find air conditioning leaks
- How to fix air conditioning or refrigerator refrigerant gas leaks
- Where do leaks occur in refrigeration equipment?
- Why do leaks occur in refrigeration equipment?
- Questions & answers about how to find and fix leaks in air conditioner or heat pump refrigeration piping systems

Refrigerant gas or liquid leaks: this article discusses how to repair refrigerant leaks in air conditioning and cooling systems, using as an example, repairing a leaky or damaged air conditioning the cooling coil (evaporator coil) in the air conditioning air handler unit. Our photo at page top shows the cooling coil in the attic air handler component of a central air conditioning system.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

 Use page top links to major topics or use links at the left of each page to navigate ***within*** topics and documents at this website. Green links show where you are in a document series or at this website.

How To Repair HVAC Air Conditioner Refrigerant Leaks

If your air conditioning or heat pump system has lost its cooling capacity or won't start see REPAIR GUIDE for AIR CONDITIONERS. See How to determine the cooling capacity of air conditioning equipment if the system seems to be working but is inadequate to cool your building. Also see REFRIGERANTS & PIPING, see PRESSURE READINGS, COMPRESSOR, and A/C REFRIGERANT LEAK DETECTION for more details.and see REFRIGERANT PIPING & DISTANCES. Contact us to suggest text changes and additions and, if you wish, to receive online listing and credit for that contribution.

As we explain in our articles on lost cooling capacity or air conditioning systems or heat pumps that are not working (see AIR CONDITIONING & HEAT PUMP SYSTEMS), a refrigerant leak in your air conditioner or heat pump means that eventually it will just not produce cool air (during air conditioning) nor warm air (during heating if it's also a heat pump).

First we need an accurate diagnosis of the air conditioning problem. If your air conditioning or heat pump system has lost cooling (or heating) capacity, there can be various causes besides loss of the refrigerant in the system.

1. First, see LOST COOLING CAPACITY to diagnose just why the system is not working.
2. If you know that the refrigerant level is low or zero, don't just re-charge the system. Find and fix the refrigerant leak. See REFRIGERANT LEAK DETECTION. While it's quick (and cheap) to just add refrigerant to a system, we were taught at HVAC school to scorn earning a living by developing a refrigerant gas delivery route.

   An air conditioning or heat pump system is normally completely sealed and should never "use" refrigerant. Refrigerant gases are *not* a substance which is "consumed" in an HVAC system.

   In an emergency, such as at a commercial establishment needing time to move frozen food, one might just add refrigerant, but the proper repair is to find and fix the refrigerant leak.
3. If the refrigerant gas leak is in a valve or access port, such as the service ports to which the HVAC technician connects her gauge set, the valves there may be able to be cleaned and salvaged, or the valves may need to be replaced.

   Replacing a refrigerant gas service port valve is a soldering job similar to what we describe just below. In our AC repair career we never had to replace one of these valves but we did have to install them on some systems where they were not already in place.

   Our photo at left shows refrigerant gauge access ports on a compressor/condenser unit.
4. If the refrigerant gas leak is in the air conditioning or heat pump copper tubing a repair should be easy - the damaged line is re-soldered using high silver content solder and a high temperature torch. (We used MAPP gas for silver soldering of copper fittings, some technicians use Acetylene or other gases).

   A damaged section of refrigerant line may need to be cut out and replaced. The repair is about the same regardless of whether the leak was in the larger diameter suction line or the smaller diameter high pressure line.
5. If the refrigerant gas leak is in the condensing coil or in the evaporator coil, repair might be possible, but we're less optimistic that repair is possible, but it might be, as we explain just below.
6. Use a halogen gas leak detector to pinpoint refrigerant gas leaks and for thorough inspection & testing of the entire refrigerant piping system, including the condensing and evaporating coils. Details are at Using the TIF 5000 Gas Detector.

Should We Just Add Refrigerant Rather Than Finding and Fixing the Leak in our Air Conditioner or Heat Pump?

At HVAC school we were taught that some HVAC technicians, in the opinion of the instructor (and our own as well), like the idea of a "delivery route" business, coming around periodically to replace lost refrigerant. In our view in many circumstances this can be a questionable practice.

Air conditioners and heat pumps are designed as a closed, hermetically sealed system - they are not supposed to leak refrigerant, and refrigerant leaks are an abnormal condition. The refrigerant leak can be found and repaired.

If the technician was in a hurry, perhaps given many service call assignments, or if s/he didn't want to be hassled by a customer complaining over an "attempt convert a simple recharge to a costly service call", or if the company just likes to deliver refrigerant (lots of repeat business), or finally, if the system with the refrigerant leak is large, commercial, complex, and old - at end of life, s/he may not have mentioned that refrigerant leak repair is even possible.

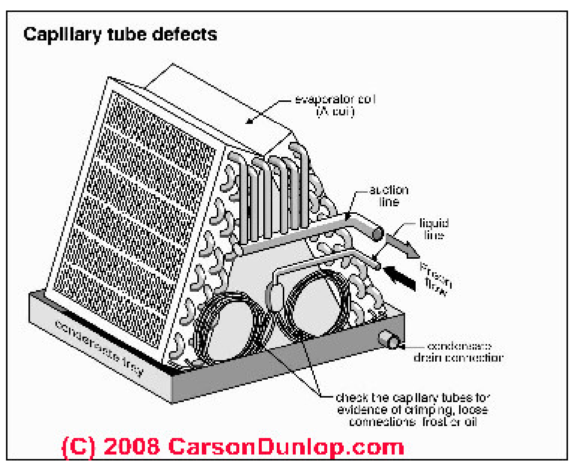
If you are faced with a costly service call or repair on an old air conditioning system (such as the need to replace a corroded, leaky evaporator coil) on a system that is at or near end of life, it is understandable that you might just prefer to wait and replace the whole system.

But it is not air conditioner or heat pump system age that makes a refrigerant leak able to be found or not, it is system complexity. Sometimes, especially with large complex commercial systems, because tracing all of the piping and tubing and looking for leaks is time consuming, some people opt to just add refrigerant.

Just adding refrigerant is not the best practice. And with old freon-based cooling or heat pump systems such leaks might be illegal as you are damaging the environment and making a prohibited release of Freon gases to the air.

The refrigerant gauge set photo above is discussed in detail at GAUGE, REFRIGERATION PRESSURE TEST.

Guide to Repairs of an Air Conditioning or Heat Pump Evaporator Coil or Condensing Coil



1. Review the coil inspection, diagnosis, and repair tips at COOLING COIL or EVAPORATOR COIL. We find that the terms "cooling coil" and "evaporator coil" are used as synonyms in most cases. Sketch at left courtesy of Carson Dunlop Associates.

   Even if the cooling or condensing coil has a repairable leak, if the coil is badly damaged such as having all crushed fins, it may be best to replace it.

   Damaged cooling / evaporator coil fins over more than 10% of the coil surface, blocking air flow may be a reason to replace the coil.

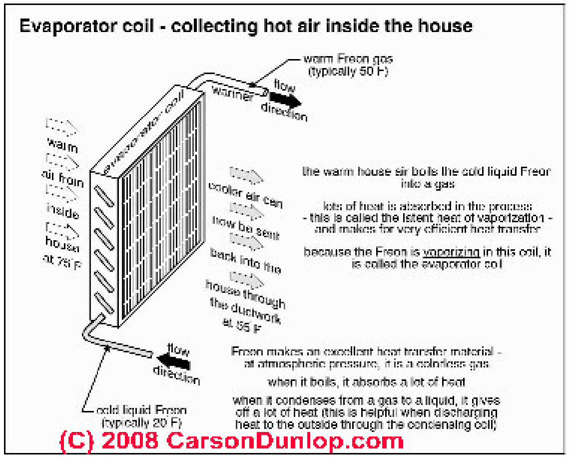
2. If the cooling coil or condensing coil is in good physical condition but it's dirty, it needs to be cleaned

before it can be repaired. Spray-on coil cleaners are used by lots of HVAC technicians.

If the coil is dirty with moldy dust and debris and especially if the building is occupied by people at extra health risk, we don't like to see an indoor coil cleaned by blowing it off with compressed air, as you're simply sending all of this moldy junk into the building. See DIRTY COOLING COIL and see Mold Growth in Air Handlers. You may also want to check out Leaks, Rodents In Air Handlers.

3. Next check the cooling coil or evaporator coil for visual evidence of refrigerant leaks. Visual evidence of a refrigerant leak on a coil may include stains from refrigerant oil left at the point of leakage. See REFRIGERANT LEAK DETECTION.
4. When the one or more places where the cooling coil or evaporator coil is leaking refrigerant gas have been found, it's time to decide if we can perform a solder repair of if the coil has to be replaced. We offer some suggestions just below at Guide to Evaluating Evaporator Coil or Condensing Coil Refrigerant Leaks

Guide to Evaluating Evaporator Coil or Condensing Coil Refrigerant Leaks and Deciding to Repair or Replace a Coil



Evaporator coil or cooling leaks or holes: if an evaporator coil is leaking (or also if the condensing coil is leaking) you'll find out pretty quickly as refrigerant will be lost and the cooling system will stop providing cool air.

You'll need expert diagnosis by an HVAC service technician. Sketch at left courtesy of Carson Dunlop Associates.

- How easily a cooling system refrigerant leak repair will be depends on where the refrigerant leak has occurred and what caused the leak.

If the cooling coil has a single point leak caused by some mechanical damage (one of our readers accidentally drilled a hole in his coil while trying to drill a drain hole in his air handler), it may be possible to find the hole and repair it using silver solder.

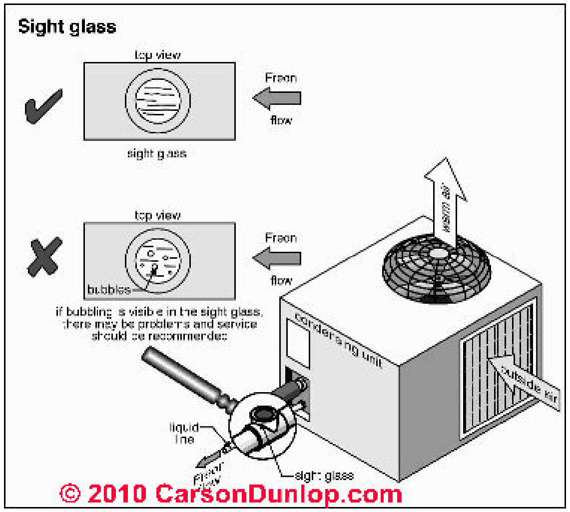
- If the refrigerant leak is in copper tubing anywhere in the cooling or heat pump system that is not too close to an evaporator coil or condensing coil, it should be possible to solder a repair, then evacuate and recharge the cooling system.
- If the refrigerant leak is in thin copper tubing that just melts when you try to solder it, as suggested by one of our readers, your technician may fabricate a copper sleeve that slips over the damaged tubing and is then soldered in place.
- If the refrigerant leak is in copper tubing in or close to the cooling coil (or in a condensing coil) a solder repair is hard to complete because the heat of the soldering process tends to de-solder other nearby connections. It might be possible if the technician is very expert and if s/he knows how to keep nearby surfaces cooled (we've used a wet rag).
- If the refrigerant leak is in an aluminum part, soldering aluminum is more tricky and may not be feasible. Ordinary procedures using a torch, for example, just melt the aluminum. Expert welders use inert gas welding methods.

- If the refrigerant leak is due to severe corrosion anywhere in an HVAC system we're not optimistic that a solder repair is possible. The conditions that caused a corrosion-related leak are likely to have thinned and weakened other parts. The cost of an attempted repair may be wasted.

Replacement of the cooling coil (or condensing coil) is more often going to be recommended by your HVAC technician because of these difficulties.

Bubbles seen or heard in the liquid refrigerant line?

Clean Dust & Dirt Off of the Condensing Coil - Air conditioning and refrigeration performance &maintenance tip



As we also introduce at CONDENSING COIL REPAIR REPLACE, there is a big payoff in cleaning dust, debris, grass clippings off of a dirty refrigeration condensing coil (this includes outdoor condenser/compressor units for air conditioners and heat pumps and also the condensing coil on a home refrigerator or freezer).

Because a refrigeration system works by transferring heat from hot refrigeration gas/liquid to ambient air around the condensing coil, if the condenser coil is blocked by dirt and debris, this can prevent complete cooling of the high temperature refrigerant gas back to a liquid state.

The result is you'll get refrigerant gas bubbles passing through the refrigerant metering valve. On refrigeration systems that include a sight glass you can actually see these gas bubbles passing through the system.

More details are at REFRIGERANT SIGHT GLASS.

Incidentally a second source of bubbling sounds heard in the refrigerant piping suction line near the compressor could be refrigerant oil pooling in that location.

This oil pooling is not usually a consequential problem provided the collection of oil does not block passage of refrigerant in the system. In good HVACR design the refrigerant piping slopes back from the evaporator unit (cooling unit or air handler) towards the compressor/condenser unit so that refrigerant oil in the line finds its way back to the compressor motor.

Recharging the HVAC System after Refrigerant Leak Repair

In case you didn't realize it, in order to solder a repair in an air conditioner or heat pump piping, tubing, evaporator coil/cooling coil, or condensing coil, it will first be necessary to remove all of the refrigerant from the system.

The HVAC technician will connect a pump to pull a vacuum on the system to remove as much air, gas, debris, and moisture as possible. An evacuator pump is needed for this step. [We made our own vacuum pump using a particularly good performing Frigidaire rotary compressor retrieved from an abandoned antique refrigerator.]

The HVAC technician will probably want to install a refrigerant filter/drier (see our photo below) to remove any moisture that leaked into the system while it was open to the atmosphere, and perhaps she will install other filtration equipment on the system at this time. It's a good idea.

See GAUGE, REFRIGERATION PRESSURE TEST for details about the refrigerant charging procedure using a gauge set and charging cylinder or scale.

Installing a Refrigerant Dryer / Filter Unit on the Air Conditioning or Heat Pump Refrigerant Line

Once a system refrigerant leak has been repaired, it will be necessary to flush the refrigerant piping system (usually using nitrogen), pull a new vacuum on the system, and then re-charge the system with the proper type and quantity of refrigerant.

Our photo at left shows that a Catch-All™ C-163_S refrigerant dryer and filter has been installed on the high pressure refrigerant line leaving the outdoor compressor/condenser unit. This is where we usually see this device installed. Notice that the refrigerant dryer, which removes un-wanted moisture from the refrigeration system, is labeled with the types of refrigerant with which it is designed to be used.

Most driers are designed to be soldered in place, as is the unit shown at left. Some driers may permit connection using flare fittings - a connection we consider less secure and more leak prone.

When a refrigeration system is or has been "open" - has been emptied of refrigerant for re-charging, for example, the last repair step before re-charging the repaired air conditioning or heat pump system with refrigerant is to install a filter/drier such as shown in our photo at left.

The purpose of a refrigerant drier is to absorb (and thus remove) moisture in the refrigeration system. The effects of moisture on refrigeration systems are detailed at REFRIGERANT LEAK DETECTION but in sum we can say that moisture in the system can prevent proper operation and can even completely stop the system from working at all, even causing costly damage.

We also find a drier installed on refrigeration systems that have been serviced for a refrigeration leak, especially a low-side piping leak, because of the increased chance that the system has been contaminated by moisture and perhaps dirt. In fact if the system was open and badly contaminated the HVAC technician may install a drier right after the repair and may install a new or *second* drier on the same system a few months later.

While some technicians always install a filter/drier on the refrigerant system, even at original installation, more often when we see a refrigerant drier canister on a system (usually at the compressor/condenser unit) we assume that the system has undergone some service or repair as that's most often when the device is added.

Refrigerant Debris Filtering and Installation Position

Refrigerant Driers not only remove moisture, they also are intended to filter debris from the refrigerant piping system. Filtering the refrigerant liquid leaving the compressor/condenser protects the Thermal Expansion Valve or capillary tube from clogging. In at least some refrigerant drier/filter models, the presence of the strainer means that the drier/strainer device has to be installed in a particular direction such that particles of the desiccant do not break free and travel through the refrigerant piping system.

Why is a filter-dryer critical on an air conditioner or refrigeration system that has been worked-on?

Water anywhere inside the refrigerant handling system (tubing, compressor, condenser, or refrigerant metering cap tube or thermostatic expansion valve) freezes, making the system inoperative. The inside of any refrigeration system must be pure refrigerant: no air, no dirt, no water, and no mix of various refrigerant gases other than a single gas for which the system is designed.

Watch out: above we mentioned that on a badly contaminated refrigeration system the technician may install a new or a second drier a few months after the original repair/service. If a drier has become saturated in the course of doing its job (of removing moisture from the refrigerant system), it begins to restrict the flow of refrigerant through the system. This refrigerant flow restriction will cause pressure changes indicated by a temperature difference on either side of the drier - that's one way you could quickly test for a clogged refrigerant drier.

Watch out: if you change the size of the drier that you have installed on a refrigeration system that does not use a refrigerant receiver (as is the case with most residential appliances and air conditioners/heat pumps, you will have to compensate in the charge used in the system (if it is a "critically-charged" or precise charge system as we've discussed here). For example if you install a larger drier than was previously in place you'd need more refrigerant charge in order to assure that the frost line will still extend to the end of the evaporator.

Special Filters Used after a Compressor Motor Replacement

A "burnout drier" is a special drier installed on refrigeration systems when a compressor motor has burned out and the compressor is changed out. In this case we have to clean the acid and lacquer out of the refrigeration system. (Using Karene-R11). The system is washed out and then the burnout drier is put in *temporarily* in the low side or return refrigerant line, replaced one or more times as needed, until the system is cleaned. Therefore you might not normally see a drier in this position on a system except during that repair process.

More details about what moisture and contaminants do to a refrigeration system are discussed at REFRIGERANT LEAK DETECTION

What is the Life Expectancy of a Refrigerant Drier Installed on an Air Conditioner or Heat Pump or Refrigerator/Freezer?

Ordinarily a drier should last the life of the equipment, given no leaks or problems with the system that require that the refrigerant piping be cut. (The piping will be cut and the system opened, for example, if a cooling coil or condensing coil has to be replaced.)

Where is the Drier Usually Located on an Air Conditioning, Heat Pump, or other Refrigeration System?

The drier is installed at the coolest location on the system, on the liquid line, outside of the refrigerated space, and ahead of any refrigerant metering devices like thermostatic expansion valves or capillary tubes.

In our photo (left) you can see that the drier has been installed outdoors, at the point where the high side liquid refrigerant line is exiting the compressor/condenser unit.

Replacing an HVAC Cooling Coil or Evaporator Coil

If the decision is to replace the cooling coil or the evaporator coil, be sure that the new coil is the proper size and shape to match the condenser or evaporator unit itself. See ADDING A/C: RETROFIT SIZING for an example of a mismatch that means poor heating or heat pump system operation.

Questions & Answers regarding this article

Questions & answers about how to find and fix leaks in air conditioner or heat pump refrigeration piping systems.

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(July 28, 2012) DanJoeFriedman (mod) said:

Richard your suggestion makes sense - though there should be almost no wrench nut fittings except at the very ends of the refrigerant piping - all the rest are more often brazed.

YOu can often spot a leak at a threaded fitting because the leaking refrigerant gas also brings along a bit of lubricating oil that leaves the fitting dark and sticky. The oily surface on the outside of the fitting around the leak also collects dirt and dust.

(July 22, 2012) Richard O'Hara said:

In looking for an a/c leak in a central a/c unit, why not first check for a loose wrench nut fitting? See if any of the nut connections are loose? You didn't even mention that.

(July 22, 2012) Jim said:

I have a micro leak in the small diameter line from the outside compressor to the inside unit. the hole is at the junction of the tube to the connector, bad weld. I want to try and re solder it but I don't know what would happen to all the freon in the pipes. I doubt that it is flammable but the molecules could break down to something bad. I still have sufficient freon so I don't want it to go to waste.

(July 16, 2012) Anonymous said:

Shelly think about low refrigerant and pressure equalizing after shutdown

(July 16, 2012) Anonymous said:

Anon I've seen this question once before and am sure we don't have all the answers but look for a TEV stuck wide open or a heat pump stuck in heating mode

(July 16, 2012) Anonymous said:

frostonhighsidetubing

(Sept 1, 2011) DanJoeFriedman (mod) said:

Maria,

I'd sure like to know what product your technician used as a magic refrigerant leak fix. The methods I'm familiar with all involve soldering or brazing. There may be other products and approaches, and if so they might "work" if applied exactly as the manufacturer instructs.

A repair of a refrigerant leak that works should "stay" sealed and continue to work for the life of the equipment, with these exceptions (HVAC techs may have more to add)

- if the HVACR system piping or coils are corroded then no leak repair will be durable as we're facing ever thinning, fragile materials

- if the leak was caused by vibration or repetitive movement of parts that rubs and wears through then the problem may recur

- if the leak is a a fitting such as a service valve or (used in some areas) a flare fitting, then more likely that valve or fitting needs to be replaced or the connection re-made to seal the leak.

I'm reluctant to judge on ethics without more information, but surely it'd be reasonable for you to expect the technician to return and fix the problem (provided it's the same problem not a new one) given that you were promised a year and didn't make even six weeks of no-leaking. It sounds more as if the guarantee should have been ... "... until my truck reaches the end of your driveway"

(Aug 26, 2011) maria holt said: 3

my technician told us we had a leak in the coil and after he added refrigerant he used something that cost us $465.00 and designed to seal the leak for at least a year. It worked for not even six weeks. Is that ethical? Is the product useful?

(Aug 19, 2011) earl brown said:

i am building a new home, should a filter/dryer be installed with new system. My previous two new homes the a coil leaked after about 4 years. A/c repair said if I had dryer installed when house was built wouldn't had this problem. Home builder says he's never heard of them?

(Aug 6, 2011) tungnguyen said:

air conditioning motor no work

(showing 1 to 10)

Recommend / Share this Article

+1 ShareThis

EMAIL

Print

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also include a list of recommended books for the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

REFRIGERANT PIPING INSULATION
REFRIGERANT PRESSURE READINGS
REFRIGERANT SIGHT GLASS

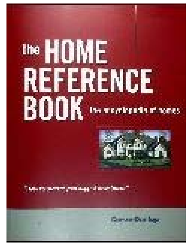
- Thanks to to Guy Benfante, Chesapeake, VA 8/26/07 for the photograph of an ice-blocked air conditioning system evaporator coil and for his suggestion that we provide an air conditioning system troubleshooting FAQ.
- Thanks to Mark Cramer, Tampa Florida, for assistance in technical review of the "Critical Defects" section and for the photograph of the deteriorating gray Owens Corning flex duct in a hot attic. Mr. Cramer is a Florida home inspector and home inspection educator.
- Carson, Dunlop & Associates Ltd., 120 Carlton Street Suite 407, Toronto ON M5A 4K2. (416) 964-9415 1-800-268-7070 info@carsondunlop.com. The firm provides professional home inspection services & home inspection education & publications. Alan Carson is a past president of ASHI, the American Society of Home Inspectors. Thanks to Alan Carson and Bob Dunlop, for permission for InspectAPedia to use text excerpts from *The Home Reference Book* & illustrations from *The Illustrated Home*. Carson Dunlop Associates' home inspection education products include
    - The ASHI-adopted Home Inspection Training Program, and Commercial Building Inspection Courses
    - The Home Inspection Home Study Course, and publications such as
    - The Home Reference Book, a reference & inspection report product for building owners & inspectors
    - The Home Reference *eBook*, an electronic version for PCs, the iPad, iPhone, & Android smart phones
    - Home Inspection Report writing materials, including the Horizon Software System that manages business operations, scheduling, & inspection report writing using Carson Dunlop's knowledge base & color images. The *Horizon* system runs on always-available cloud-based software for office computers, laptops, tablets, iPad, Android, & other smartphones.
    - The Illustrated Home illustrates construction details and building components, a reference for owners & inspectors
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- Thanks to reader Don Jackson for HVAC refrigerant leak soldering repair tips (Aug-Sept 2008).
- [6] Refrigerant Piping Design Guide, Application Guide AG-31-011, McQuay Air Conditioning, Daikin McQuay International Equipment, 13600 Industrial Park Blvd. Minneapolis, Minnesota 55441 800-432-1342 (Toll Free), Website: http://www.daikinmcquay.com/, [Copy on file as http://www.inspectapedia.com/aircond/AC_Guide_McQuay.pdf]
- Wikipedia provided background information about the definition of HEPA and airborne particle interception.

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia Bookstore.

- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

  Or choose the The Home Reference eBook for using this reference on PCs, Macs,



Kindle, iPad, iPhone, or Android Smart Phones

Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

- Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982
- Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- NEW!
  Air Conditioning SEER - New DOE Air Conditioner and Heat Pump Efficiency Standard
- Asbestos HVAC Ducts and Flues field identification photos and guide
- Fiberglass: Indoor Air Quality Investigations: Fiberglass in Indoor Air, HVAC ducts, and Building Insulation

- ...

Mobile View
AIR CONDITIONING & HEAT PUMP SYSTEMS

A/C - HEAT PUMP CONTROLS & SWITCHES
AIR CONDITIONER BTU CHART
AIR CONDITIONER COMPONENT PARTS
AIR CONDITIONER TYPES, ENERGY SOURCES
AIR CONDITIONER NOT WORKING
AIR FILTER EFFICIENCY
AIR FILTERS, FIBERGLASS PARTICLES
AIR FILTERS for HVAC SYSTEMS
AIR FLOW MEASUREMENT CFM
AIR HANDLER / BLOWER UNITS
APPLIANCE EFFICIENCY RATINGS

BACKUP HEAT for HEAT PUMPS
BLOWER DOORS & AIR INFILTRATION
BLOWER FAN CONTINUOUS OPERATION
BLOWER FAN OPERATION & TESTING
BOOKSTORE - Air Conditioning "How To" Books

Guide to Refrigeration Gas Leak Detection & Tips for Using the TIF 5000 halogen leak detector

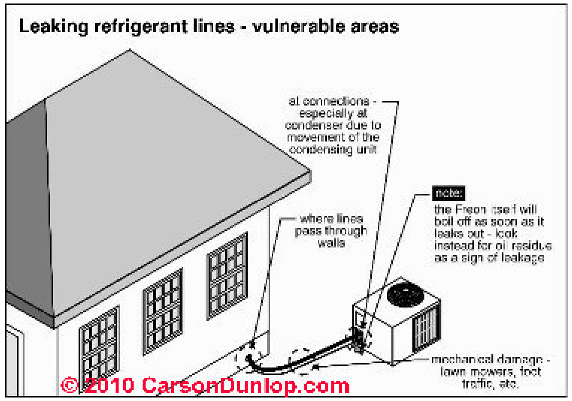
InspectAPedia® - ShareThis +1

- Recommendations for gas measurement instruments, gas detection methods
- Guide to using the TIF 5000 Gas Detector for air conditioning and refrigerant gas leaks
- Warnings about using instruments for detection of toxic gases
- How do we detect leaks in air conditioning or refrigeration equipment
- What are the common causes of refrigerant gas leaks in HVAC systems?
- Where to look first for leaks in air conditioning or heat pump refrigeration piping systems (also refrigerators & freezers)
- What are the effects of refrigerant leaks on operation of the equipment: moisture, dirt in the system, and what goes wrong
- What are the effects of air, moisture, or dirt contamination in the refrigeration system?
- Other refrigerant gas leak detection methods
- Questions & answers about buying and using refrigerant gas detection equipment to test for refrigerant leaks at air conditioners, heat pumps, and other refrigeration equipment

Refrigerant gas leak detection, location, & repair: this article describes refrigerant gas leak detector tools and the methods used to find refrigerant gas leaks such as Freon leaks and other halogen gas leaks. We also discuss where refrigerant leaks most often occur. We explain the effects of refrigerant leaks on air conditioners and heat pumps, refrigerators, freezers, etc. including both the effects of lost refrigerant and the effects of refrigerant piping leaks that admit moisture and dirt contamination into the system. We also explain how a refrigeration gauge set should be connected to HVAC equipment to avoid contamination damage.

InspectAPedia tolerates no conflicts of interest. We have no relationship with advertisers nor with topics or services discussed at this website.

Guide to Refrigerant Leak Detection & Types & Tips for Using the TIF 5000 automatic halogen gas leak detector



In related documents we give references and explanation regarding toxicity of several of the most common indoor gases, based on literature search and obtained from the U.S. government and expert sources. This text may assist readers in understanding these topics. However it should by no means be considered exhaustive.

Readers should see LOST COOLING CAPACITY, also see REFRIGERANT LEAK REPAIR at our discussion of REFRIGERANTS & PIPING under AIR CONDITIONING & HEAT PUMP SYSTEMS.

As we explain in our articles on lost cooling capacity or air conditioning systems or heat pumps that are not working (see AIR CONDITIONING & HEAT PUMP SYSTEMS), a refrigerant leak in your air conditioner or heat pump means that eventually it will just not produce cool air (during air conditioning) nor warm air (during heating if it's also a heat pump).

Carson Dunlop Associates' sketch (left) illustrates some of the common areas where vibration or other stresses or damage are often the cause of leaks in refrigerant piping at a home air conditioner or heat pump.

Before assuming that you need to add refrigerant, see the diagnostic steps at LOST COOLING CAPACITY.

Refrigerant leak detection methods

Using a sensitive instrument such as the TIF 5000 is a useful way to quickly find refrigerant gas leaks on air conditioning and heat pump systems. Alternative leak locating methods are also useful, such as a thorough visual inspection for stains or discoloration at HVAC refrigerant piping, evaporator or cooling coils, condensing coils, and fittings. In addition, some HVAC technicians include a leak-detecting oil in the refrigerant charge in order to (possibly) provide visual evidence of where leaks are occurring in the system.

Some common causes of air conditioner or heat pump refrigerant leaks include:

- refrigerant lines rubbed together due to vibration
- ice pick damage from an inexpert "repairman" trying to get ice off of a cooling coil
- corrosion at either the condensing or evaporating coil

Refrigerant leaks occur at a number of locations on cooling equipment, including

- Corroded cooling coil in the air handler unit - costly repair, usually need to replace the coil
- Corroded condensing coil in the condenser unit - costly repair, usually need to replace the coil
- Mechanically damaged refrigerant lines, for example due to vibration against hard surfaces

- Poorly soldered fittings or controls
- Leaky connections at controls or control valves

Practical tips for checking for refrigerant gas leaks

What most refrigerant gas leak testing instrument instructions fail to point out is a practical procedure for actually examining air conditioning or refrigeration systems for refrigerant gas leaks.

- The refrigerant piping and cooling and condensing coils will need to be exposed for ready access.
- The leak detector is turned on and its proper operation confirmed.
- The detector tip is held close to the refrigerant piping and cooling coil surfaces, sequentially, starting at a convenient point and following all of the piping and tubing throughout its length.
- Look for stains on refrigerant piping or controls which may indicate a history of leaks (and refrigerant oil leakage too) at those locations.
- Listen for a whistling thermostatic expansion valve - a sign of low refrigerant discussed in detail at Thermostatic Expansion Valve (TEV) or Capillary Tube Installation, Inspection, & Testing Guide

How to Diagnose Types of Leaks of Refrigerant Leaks in HVAC Systems

Effects of refrigerant leaks or loss of charge show up in different ways depending on where the refrigerant leak is occurring.

Leaks on the high side of a refrigeration system show up as loss of refrigerant and will be discovered.

Leaks on the low side of a refrigeration system are harder to discover until enough air leaks into the refrigerant piping system. At that point the compressor head pressure goes way up until a safety device shuts down the compressor motor or a service tech discovers a problem. A leak on the low side is ugly because now the whole system has become contaminated with air, moisture, and dirt.

Effects of Refrigerant Leaks: Dirt & Moisture on Thermostatic Expansion Valves or Capillary Tube Refrigerant Metering Devices

Moisture freezes in the refrigerant metering device, further interfering with proper cooling system operation, and dirt can also jam up a TEV or clog a capillary tube. When moisture is freezing up a thermostatic expansion valve the system will stop working (and thus begin to warm up) until the ice melts. The system may run normally for some time - until water droplets pass through the system and again reach the TEV and cause it to freeze again.

Unlike moisture, dirt in the refrigeration system is more likely to cause the Thermostatic Expansion Valve to clog and just stop working permanently, as it can also do a capillary tube metering system.

You might diagnose a moisture-in-expansion valve or cap tube problem by adding heat to the device to see if it will thaw and begin operating.

See THERMOSTATIC EXPANSION VALVES for details about these devices.

Moisture in the refrigerant piping system also mixes with the refrigerant to form an acid which can short out compressor motor windings by dissolving the lacquer on the wire windings. Refrigerant combined with moisture becomes a black stinky liquid.

Effects of Air in the refrigeration system; how we diagnose the presence of air inside the air conditioner or heat pump

The pressure of air is additive to the pressure of the refrigerant in any refrigeration system. And of course the amount of air pressure that is added to the system depends on the temperatures of the refrigerant gas, compressor, coils, etc. Put simply, air inside the refrigerant handling system (piping, controls, compressor, coils) raises the pressure on both the HIGH and LOW sides of the system even if the air is not also adding moisture. The result is that the air conditioner or heat pump operates at a lower efficiency.

For example, at 70 degF and using R12 refrigerant, we would expect the static or idle (compressor not running) pressure of the refrigerant in the system to be at 70 psi.

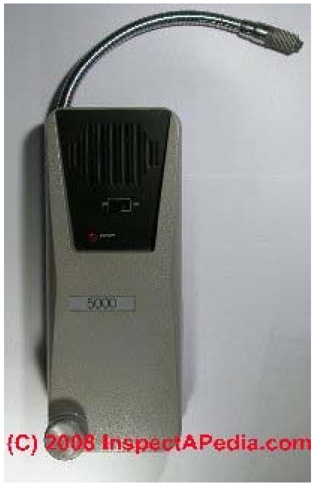
How We Know Air has Contaminated the Refrigerant System

If you know that your refrigerant is R12 and that the pressure *should be* 70 psi when the A/C or heat pump has not run in some time, and ambient temperature is also 70F.

So provided there are no blockages or clogs in the system refrigerant piping, coils, compressor, controls, (see
REFRIGERANT DRIERS & FILTERS
for a blockage example) then IF you see a gauge pressure (GAUGE, REFRIGERATION PRESSURE TEST) higher than 70 psi that suggests you have air in the system. You may in fact see high head pressure and high back pressure if there is significant air contamination in the refrigerant.

And if the air conditioner/heat pump or other refrigeration system is contaminated by any of the problem materials we've discussed: air, moisture, dirt and debris, you will need to evacuate and vacuum the system to remove these contaminants.

Suggestions for Using the TIF5000 to detect refrigerant leaks



The TIF 5000 automatic halogen leak detector is used for air conditioning and cooling system refrigerant leak detection. The TIF 5000 replaces and combines functions previously provided by the TIF HLD440 halogen leak detector, with an added circuit which TIF refers to as "automatic ambient control". This feature "adjusts and corrects for the atmospheric ambient refrigerant in the vicinity of the tip." [TIF 5000 product literature].

As you'll notice in our photograph of our instrument, its external appearance is similar to the TIF 8800 except that the 8800 detects a wide range of combustible gases while the TIF 5000 is designed to focus on the halogen gases - air conditioning refrigerants such as the now discontinued R12 and R22. The instrument weighs about 28 ounces and is 8" x 3" x 1.8" in size, not counting the length of the flexible sensor tip.

What gases does the TIF 5000 leak detector detect?

The TIF 5000 halogen leak detector is used principally on air conditioning and refrigeration equipment, heat pumps, and possibly dehumidifiers.

This leak detector also detects the following halogen gases or halogen gas mixtures:

- Ethylene Oxide gas leaks (hospital sterilizing equipment - detects the freon mixture)
- Most gases containing Chlorine
- Most gases containing Fluorine

- Most gases containing Bromine
- Dry cleaning industry cleaning agent or solvent gases can also be detected using this instrument

Step by Step Guide to Using the TIF 5000 Leak Detector on Refrigeration and Air Conditioning Equipment

Instructions for use of the TIF5000 to check for refrigerant gas leaks couldn't be much simpler, and they are printed on a label affixed to the device:

1. Turn the TIF 5000 on.

   a. If the red LED does not light, replace the batteries in the detector. The instrument has a virtually instant "on" feature and should not require a warm-up time.

   b. If the red LED lights but the instrument does not emit a tone, replace the sensing tip

2. Begin searching for leaks of refrigerant gas or halogens

But as with other gas leak detection devices of this type, if you're using the TIF 5000 refrigerant gas leak detector in an area which may already be contaminated with a high level of gas leakage, special (but simple) steps are needed to permit the leak detector to find the point of refrigerant gas leakage:

> *In an area heavily contaminated with refrigerant, (when a rapid, high pitched beeping signal [is heard]), turn [the] instrument off and then back on [while in the contaminated area] and resume testing for leaks.*

This procedure is the opposite of what we do with the TIF8800 when testing for combustible gases (and the hazards are different since halogen gases do not present an explosion hazard).

Critical Maintenance Tips for Refrigerant Gas Leak Detectors

The sensing tip on the TIF 5000 and some of the electronics of the instrument therefore are of course different.

Because debris contamination will interfere with proper operation of the TIF5000 halogen leak detector (refrigerant gas leak detector) the sensor is supplied with filter paper pre-cut into a cross shape which is inserted around the sensing tip under its protective spring cover. When the paper is soiled it is simply replaced.

The glass vial shown in our photo contains a substance used to confirm that the sensing tip will respond to a halogen gas (refrigerant gas) leak as it should.

Here are some tips from TIF for maintenance of the TIF 5000 Halogen Leak Detector

To change the sensing tip: turn of the TIF 5000 leak detector before changing the sensing tip. Turn the tip counter-clockwise to remove it, and attach the new tip by turning it clockwise when screwing it in place. Screw the new tip finger tight. Do not contaminate the new tip with oil or grease such as hand cleaner or refrigerant oil, and do not get your sweat on the tip. To protect the tip from contamination by dust and grease during use, use the filter paper we show in the photo above. Use a new filter paper when installing a new sensor tip.

Spare sensor tips: A spare leak detector sensing tip can be stored in the battery compartment.

Batteries: Use two fresh "C" alkaline batteries to power the TIF 5000. Batteries are installed by removing a battery cover on the back of the instrument. If the batteries are fresh you should see the red LED turn on when the power switch is turned on.

If the LeD does not light, change the batteries.

If the LeD lights but the unit does not operate (won't respond to refrigerant or test gases) change the sensing tip. If that doesn't work you'll need to return the instrument to TIF for repairs.

Operating temperature range: the TIF 5000 is rated to operate between 30 deg. F. and 100 deg. F. This warmer temperature function can be important when sniffing around a hot compressor motor.

Other specialized gas detection methods include use of solid state circuitry, CMS chips, and special instruments which may be designed to give a quick alarm or a reading in PPM for specific gases.

Other gas and air monitoring equipment use pumps which collect and insert a specific volume of air into a vacuum container for later analysis. We've found that for typical field use, the colorimetric gas detector tube method is extremely convenient and very accurate, and it presents minimal requirements for instrument calibration.

Questions & Answers regarding this article

Questions & answers about buying and using refrigerant gas detection equipment to test for refrigerant leaks at air conditioners, heat pumps, and other refrigeration equipment

Ask a Question or Search InspectAPedia

Search

Comments

name

enter your comment here

comment

(6 days ago) DanJoeFriedman (mod) said:

Maria, it sounds as if you are describing condensation on a cool or cold refrigeration line pipe - it'd be better if it were insulated, both for system operating efficiency and to avoid condensate leaks into the wall or onto the floor where damage may ensue.

(July 30, 2012) Maria said:

Im not sure what brand of central AC we have - there is a pipe that runs from the unit to the wall that goes into the house is exposed / the foam cover is old. The pipe sweats, is that okay?

(July 18, 2012) DanJoeFriedman (mod) said:

Matt I have sympathy for both sides of your point; it's often a nightmare trying to work on 16 year old equipment - everything you touch turns to crud and the bill climbs and the client is angry and thinks you're gouging them.

On an old system there are issues about which refrigerant gas is used too.

On the other hand, I've seen A/C units still chugging along after 20 years, so if it were "just a little problem" you'd think the equipment could be inspected and repaired. But still no one wants to touch them, as I explained above.

You certainly should call a few service companies, tell them up front you've got old equipment, ask if they are willing to give it a try, make CLEAR that you will understand if the tech finds that the ultimate repair costs are likely to be so high that replacement is in order.

(July 16, 2012) Matt said:

My AC unit is leaking freon. It was manufactured in 1996. I called a tech out here in Indiana, and he just wanted to charge me 3-4 grand for a new system without me even knowing what the system looks like, or even looking at my current system. He just looked at the manufactured date, and said it was too old to repair. So my question is, how can I find a tech who will attempt to repair the leak, instead of just wanting to charge me for a brand new system?

(Nov 28, 2011) DanJoeFriedman (mod) said:

Ted it sounds as if you're on a better course. Indeed the coil cracking you describe is not a problem of which we've received many reports. One wonders if there was either a manufacturing defect or a system installation or adjustment problem that caused vibration that in turn damaged the coil.

It's interesting and not quite so common to see an HVAC installer go with obsolete R22 equipment. Perhaps s/he plans to use one of the newer substitute refrigerants intended to replace R22?

(Sept 9, 2011) Ted said:

As an update, I've found a new R22, 3ton unit for less than a grand that I am going to ask my contractor to buy and hook up to my existing system and evap coil.

(Sept 8, 2011) DanJoeFriedman (mod) said:

Anon, SOP would be for the HVACR tech to check that it's lost refrigerant that's the concern, possibly pull a vacuum to clean the system, find and fix the leak if it's repairable, and recharge the system. Just how big the repair costs would go depend in part on just what's leaking and where. For example a low side leak can contaminate the system and require more careful cleanout; a leaky cooling or condensing coil may not be repairable and could need replacement.

Ted: thanks for the follow-up. As long as the new components match appropriately you should be ok.

(Sept 8, 2011) Ted said:

The tech confirmed my suspicions and said the entire coil cracked inside the condenser, along the manifold. He said hes only seen it once before. He said since its a 2003 Carrier unit it would be just as expensive to replace the whole system than the condenser coil. Quoted me about $7K for a new RUUD 3ton 13 SEER system. We would keep my original Carrier furnace/blower unit.

(Sept 7, 2011) Anonymous said:

Since my cooling capacity is basically 0, I am assuming I lost most or all of the refrigerant and the leak is pretty bad. I guess it depends where the leak is, but can these things be repaired/recharged on the spot or am I going to be stuck with a giant replacement bill? I'll let you know what happens tomorrow.

(Sept 7, 2011) DanJoeFriedman (mod) said:

Ted

because the A/C compressor often relies on an oil lubricant that can travel in refrigerant lines, a visible oil leak or even smudges and accumlulating dirt (in an oil spot) on the equipment piping and fittings can be an indicator of a refrigerant leak.

So you're right, it could be refrigerant oil.

I'd prefer that the tech find and fix the leak, not just add refrigerant. Most likely the quantity of oil that has leaked out won't itself be a problem for the compressor.

keep us posted.

(showing 1 to 10)

...

Technical Reviewers & References

- InspectAPedia.com® - Daniel Friedman - Publisher & Editor.
- InspectAPedia Bookstore lists recommended books, organized by topic & available for purchase. Most of our articles also include a list of recommended books for the specific article topic as well as other references, and information sources.
- Critique, contributions wanted: Contact Us to suggest corrections or additions to articles at this website, and if you wish, to receive online listing and credit as a contributor. Particular thanks are due to the many experts and also consumers who read and critique technical articles at InspectAPedia.com.
- Additional technical contributors & reference sources for this article are listed below.

Use links just below or at the left of each page to navigate this document or to view other topics at this website. Green links show where you are in our document or website.

GAS DETECTION & MEASUREMENT
Use of a Drager pump
GAUGE, REFRIGERATION PRESSURE TEST
How Colorimetric gas detection tubes work
Using the TIF 5000 Gas Detector
Warnings re instruments for detection of gases
Warning: choose the right tube for gas detection

REFRIGERANTS & PIPING
GAUGE, REFRIGERATION PRESSURE TEST
REFRIGERANT CHARGING PROCEDURE
REFRIGERANT DRIERS & FILTERS
REFRIGERANT LEAK DETECTION
REFRIGERANT LEAK REPAIR
REFRIGERANT METERING DEVICES TEVs
REFRIGERANT METERING CAPILLARY TUBES
REFRIGERANT PIPING & DISTANCES
REFRIGERANT PIPING INSULATION
REFRIGERANT PRESSURE READINGS
REFRIGERANT SIGHT GLASS

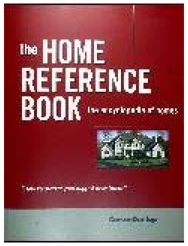
- TIF Instruments, Inc., 9101 NW 7th Avenue, Miami, Florida 33150 (This is where we've sent our TIF 8800 and TIF 5000 for repairs).
- Jennifer Moore, Sales Administrator, Nextteq, LLC, Tampa FL, www.nextteq.com 813-249-5888. Nextteq is the master Distributor for Gastec in the United States. According to the company's website, Gastec Gas Sampling Pumps are the industry's first and only pumps to provide on-the-spot measurement of ambient temperature. [Private email, JM to DF 5/23/08]
- "Choosing and Using a Carbon Monoxide CO Monitor," Dan Friedman, *The ASHI Technical Journal*, Vol. 2 No. 1, July1991
- "Heat Exchanger Testing, Who's Right?" Dan Friedman, *The ASHI Technical Journal*, Vol. 2 No. 1, July1991
- "Case History: LP Gas Leak - Using the TIF 8800," Dan Friedman, *The ASHI Technical Journal*, Vol. 2 No. 1, July1991
- CARSONDUNLOP Carson, Dunlop & Associates Ltd., 120 Carlton Street Suite 407, Toronto ON M5A 4K2. (416) 964-9415 1-800-268-7070 info@carsondunlop.com. The firm provides professional home inspection services & home inspection education & publications. Alan Carson is a past president of ASHI, the American Society of

Home Inspectors. Thanks to Alan Carson and Bob Dunlop, for permission for InspectAPedia to use text excerpts from *The Home Reference Book* & illustrations from *The Illustrated Home*.
Carson Dunlop Associates' home inspection education products include

- The ASHI-adopted Home Inspection Training Program, and Commercial Building Inspection Courses
- The Home Inspection Home Study Course, and publications such as
- The Home Reference Book, a reference & inspection report product for building owners & inspectors
- The Home Reference *eBook*, an electronic version for PCs, the iPad, iPhone, & Android smart phones
- Home Inspection Report writing materials, including the Horizon Software System that manages business operations, scheduling, & inspection report writing using Carson Dunlop's knowledge base & color images. The *Horizon* system runs on always-available cloud-based software for office computers, laptops, tablets, iPad, Android, & other smartphones.
- The Illustrated Home illustrates construction details and building components, a reference for owners & inspectors

Books & Articles on Building & Environmental Inspection, Testing, Diagnosis, & Repair

- Our recommended books about building & mechanical systems design, inspection, problem diagnosis, and repair, and about indoor environment and IAQ testing, diagnosis, and cleanup are at the InspectAPedia Bookstore. Also see our Book Reviews - InspectAPedia.
- Complete List of Air Conditioning & Heat Pump Design, Inspection, Repair Books at the InspectAPedia Bookstore.



- The Home Reference Book - the Encyclopedia of Homes, Carson, Dunlop & Associates Ltd., Toronto, Ontario, 25th Ed., 2012, $69.00 U.S., is a bound volume of more than 450 illustrated pages that assist home inspectors and home owners in the inspection and detection of problems on buildings. The text is intended as a reference guide to help building owners operate and maintain their home effectively. Field inspection worksheets are included at the back of the volume.

  Or choose the The Home Reference eBook for using this reference on PCs, Macs, Kindle, iPad, iPhone, or Android Smart Phones

Note: InspectAPedia.com ® editor Daniel Friedman is a contributing author.

- Modern Refrigeration and Air Conditioning, A. D. Althouse, C.H. Turnquist, A. Bracciano, Goodheart-Willcox Co., 1982
- Principles of Refrigeration, R. Warren Marsh, C. Thomas Olivo, Delmar Publishers, 1979
- "Air Conditioning & Refrigeration I & II", BOCES Education, Warren Hilliard (instructor), Poughkeepsie, New York, May - July 1982, [classroom notes from air conditioning and refrigeration maintenance and repair course attended by the website author]
- Refrigeration and Air Conditioning Technology, 5th Ed., William C. Whitman, William M. Johnson, John Tomczyk, Cengage Learning, 2005, ISBN 1401837654, 9781401837655 1324 pages
- Carson Dunlop, Associates, Toronto, have provided us with (and we recommend) Carson Dunlop Weldon & Associates' Technical Reference Guide to manufacturer's model and serial number information for heating and cooling equipment ($69.00 U.S.).
- ...

