METROPOLITAN
Community College

Residential Energy Code – Session 5

Mechanical Systems

Instructor – Matt Belcher

February 23, 2021: 6:30 – 8:30 pm

Housekeeping

- Attendees are muted upon entry
- Questions? Enter them in the chat box
- Webinar is being recorded – slides and recording will be sent to attendees
- CEU's will be available upon request (ICC)
  - Information at end of presentation
- Email nwestfall@mwalliance.org with questions

Today's Agenda

- Overview / Review
- HVAC Systems
- HVAC Equipment
- HVAC Load and Sizing
- HVAC Distribution Systems
- Ventilation Requirements (ASHRAE 62.2)
- Q&A and Review

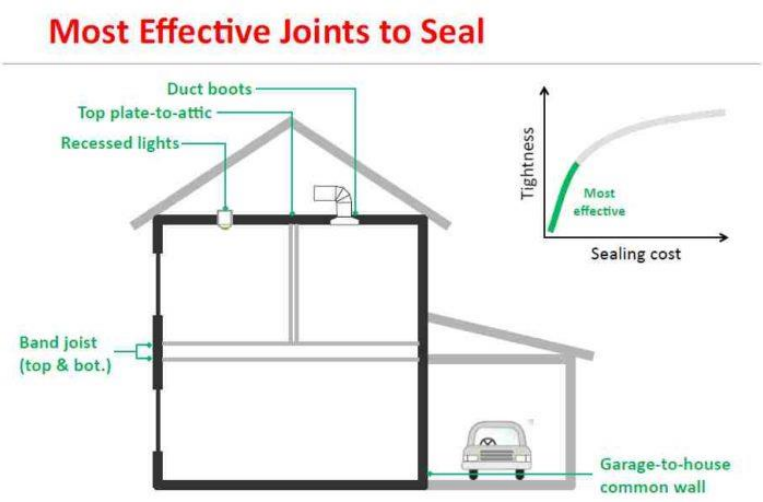
REVIEW AND HVAC OVERVIEW

Modern HVAC Systems – 3 Basic Goals

- **Temper the air**
  - Maintain indoor temperature within the range of human comfort
- **Remove / disperse indoor contaminants**
  - Chimney
  - Windows / doors
  - Mechanical ventilation
- **Control humidity**
  - Impacts comfort, which impacts thermostat, which effects energy use
  - System has to run long enough to dehumidify

Images: medium.com; kent.co.in, 4fedco.com

Review - Importance of Air Sealing

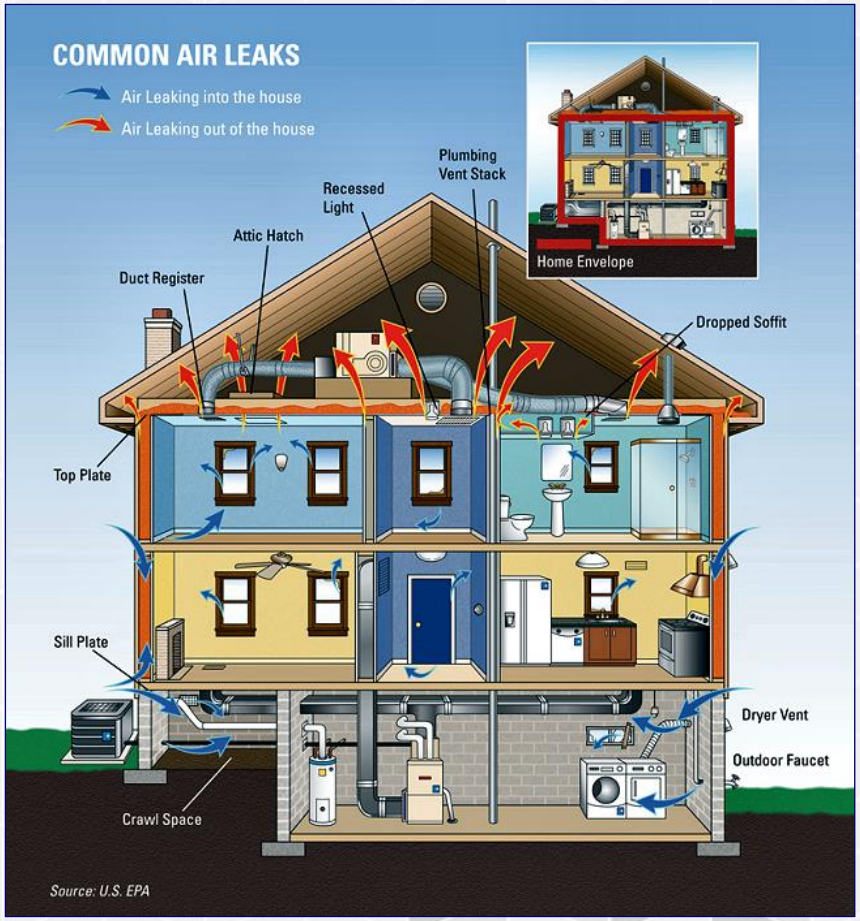


- You can not control the indoor environment if you let the outside in
- Continuous air barrier and thermal barrier are essential
- They will define the HVAC system requirements
- The only way to know envelope tightness is a blower door test

Images: barriersciences.com; energy.gov

Review - Air Barrier Strategies

- Sealed joist bays
- Sealed HVAC supply and return outlets
- Sealed soffits and chases
- Sealing around the backside of tubs, knee walls and garages
- Sealed off garages
- Sealed recessed lighting cans



Courtesy of U.S. Environmental Protection Agency

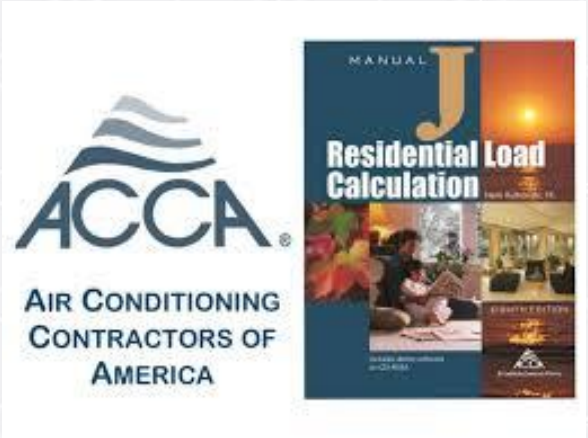
HVAC SYSTEMS

HVAC and the Energy Code

- The energy code and the mechanical code work together to create an effective and efficient HVAC system

- The energy code addresses the thermal envelope, air sealing and duct sealing
  - These directly impact load and equipment sizing

- The energy code requires:
  - load and sizing calculations
  - all ducts be sealed, regardless of whether inside or outside the thermal envelope



Images: phcppros.com; takecontrolandsave.coop

Common HVAC Systems

- The most common HVAC system in a new home in Nebraska is forced-air split system
  - Furnace inside and AC outside
- Hydronic systems
  - "Wet" system
  - "Dry" system
- Package systems
  - All mechanical components outside
- Electric resistance
- Geothermal and solar systems

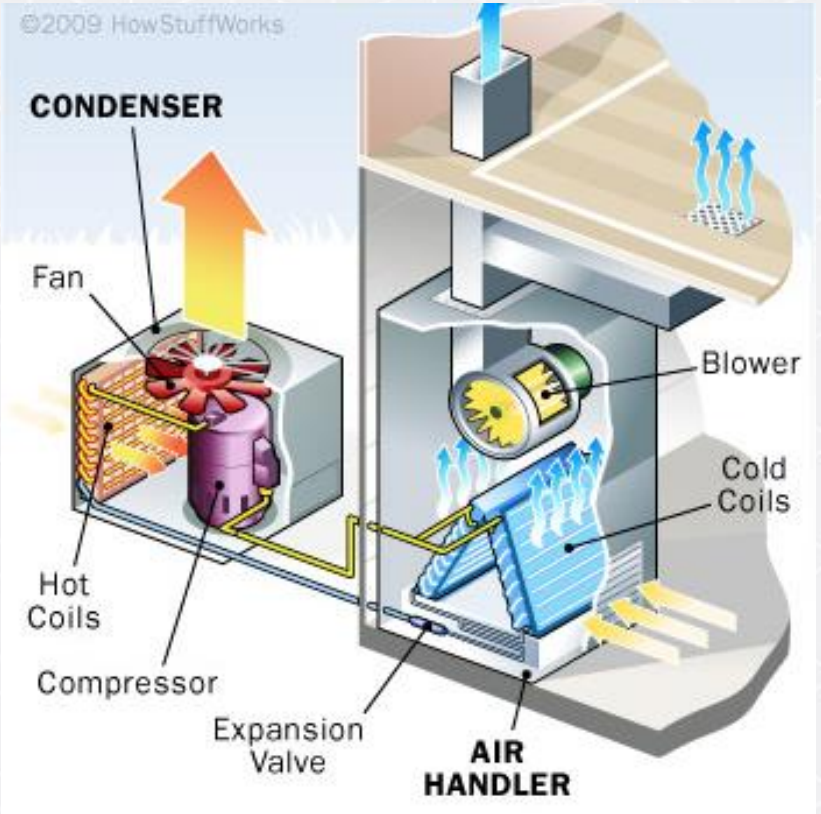


Image: home.howstuffworks.com

Equipment Efficiency Ratings

Efficiency ratings based on standard tests are included on product labels to aid purchasers

- Gas Furnaces: Annual Fuel Utilization Efficiency (**AFUE**) –Seasonal or annual energy efficiency of fossil-fueled furnaces
  - Medium efficiency furnaces employ efficient heat exchangers, better intake air control and/or blowers to exhaust combustion
- Heat Pumps: Heating Seasonal Performance Factor (**HSPF**) – energy efficiency of heat pumps during a full heating season
  - Variable speed heat pumps have ratings as high as 10 HSPF
- Air Conditioning: Seasonal Energy Efficiency Ratio (**SEER**) – energy efficiency of equipment over cooling season

	AFUE	HSPF	SEER
Minimum Efficiency	78%	6.6 (single package) or 6.8 (split systems)	13
Medium Efficiency	80-82%	7.2 – 7.8	14-16
High Efficiency	> 90% (Condensing furnace)	> 8.0	17-20+

Types of Split Systems

- Furnace and Air Conditioner
  - Furnace, usually gas, inside and condensing unit outside
  - Two-stage / modulating improves efficiency
- Heat Pump and Air Handler
  - Air handler inside and heat pump outside
  - Needs back up for very cold climates
- Furnace and Heat Pump (Hybrid System)
  - Furnace/air handler inside
  - Heat pump outside
  - Good for very cold climates
  - Furnace typically serves as backup heat
- Mini-Split
  - Single outside unit with multiple
  - Indoor units
  - Precise zoned control

Image: airconditioningarizona.com

Components of a Traditional Split System

- **Furnace** (typ. gas)
  - Provides heat (BTUs)
  - Blows air
- **Condenser** (electric)
  - Rejects heat to outdoors (provides cooling)
  - Line sets connect to furnace cooling coils
- **Ductwork**
  - Sealed pathway to get tempered air to destination
  - Dampers to balance system
- **Filter**
  - Removes contaminants
  - MERV, HEPA, electrostatic
- **Thermostat**
  - Turns system on and off
  - Setback, smart

Image: godirectappliance.com

Components of a Heat Pump Split System

- **Heat Pump** (typ. electric)
  - Provides both heating and cooling
  - Back-up heat required in cold climates
- **Air Handler** (electric)
  - Blows air
  - Line sets connect to heat pump
- ***All the rest is the same as a traditional split system***
  - Ductwork
  - Filter
  - Thermostat

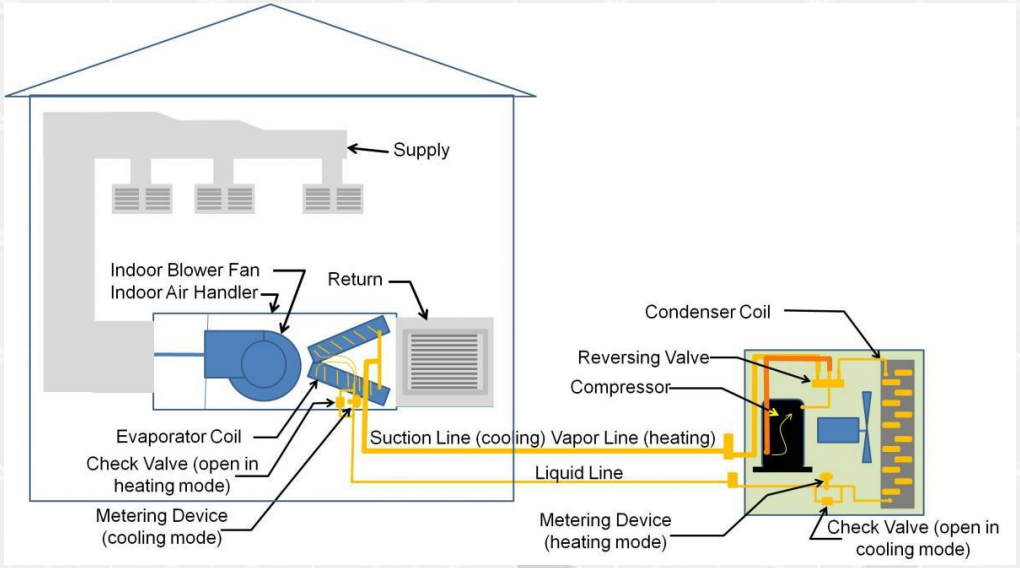
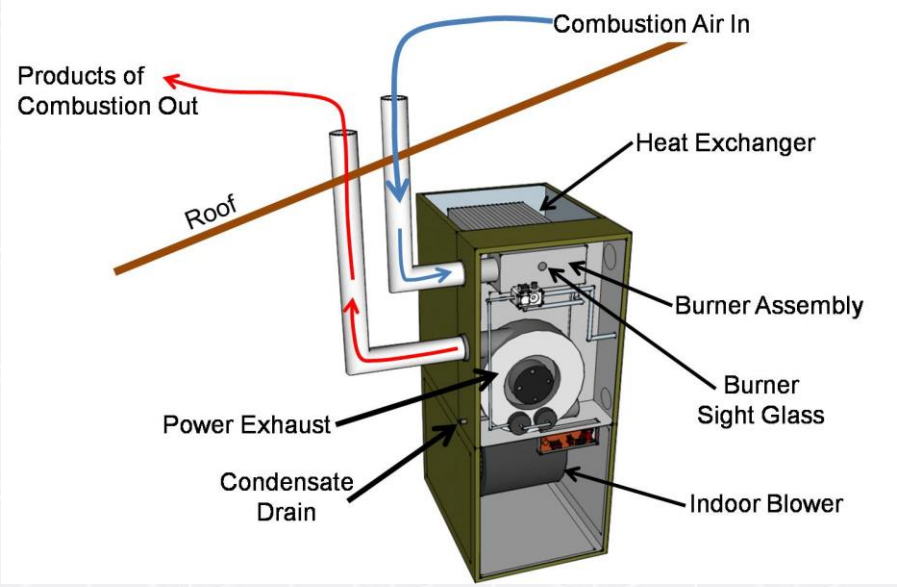


Image: basc.pnnl.gov

HVAC EQUIPMENT

Furnaces

- Sized by BTUs – input and output
- Gas burns inside a combustion chamber and heat exchanger transfers heat to the air
  - Fan “forces” heated air to living space
  - Electric Furnaces
- Annual Fuel Utilization Efficiency (AFUE) ratio determines efficiency
  - 80 AFUE to 98 AFUE (higher is better)
- Sealed combustion unit at >90 AFUE



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Variable Speed Motors

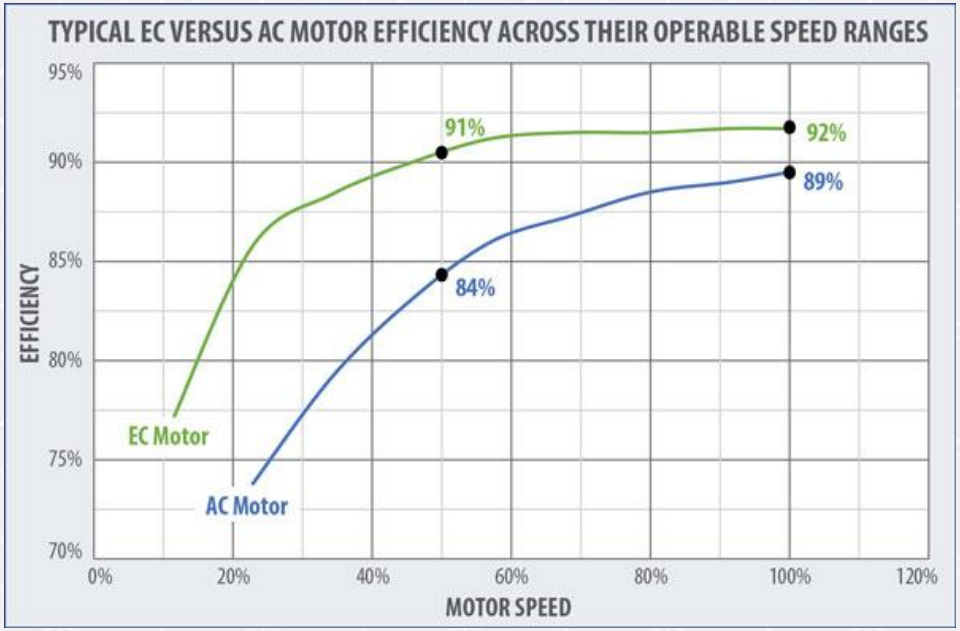


Image: continentalfan.com

- While a conventional unit moves the air at one constant pace, a variable speed unit can move the air at a wide range of different speeds
- Adjusting speed to meet need is more efficient that running full on / full off

Condensers

How They Work:

- Sized by “tons”
  - One ton = 12,000 BTUh
- Range from 1.5 to 5 tons
- Seasonal Energy Efficiency Ratio (SEER) is the efficiency metric
  - Ranges from 13 to 21+ SEER (higher number = more efficient)
- Cooling cycle rejects heat to outside, expanding (cooling) refrigerant
- Cool refrigerant transfers cool to inside (warming refrigerant)
- Then cycle starts over

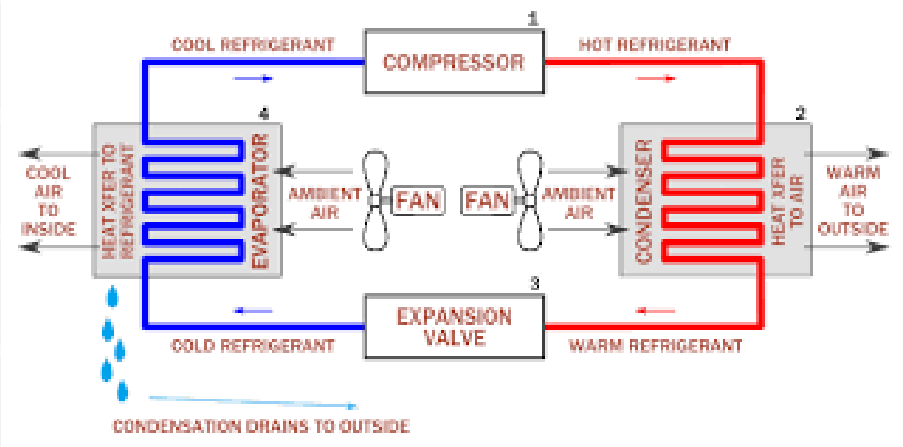


Image: medium.com

Types of Air Conditioners

CENTRAL

A central air conditioner circulates cool air through a home using a system of ducts and registers.

LIFE SPAN: 15-20 years

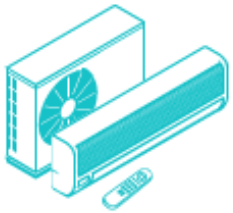
COST	CHOOSING YOUR A/C	PRO	CON
$$$	A central A/C system will provide the most even cooling throughout the home. If already you have ductwork, it can be a cost-effective option.	Quiet, convenient to operate and more efficient than window units.	Can be expensive to install if you don't have ductwork already.

ROOM

The most popular cooling system, a room air conditioner provides spot cooling and can be either a window unit or a portable air conditioner.

LIFE SPAN: 10-15 years

COST	CHOOSING YOUR A/C	PRO	CON
$	If you don't currently have an air conditioner, a room unit can provide cooling to select spaces at an affordable cost.	Inexpensive way to cool a room or an addition to your home.	Improper installation can result in significant air leakage – increasing it by as much as 10 percent.



DUCTLESS, MINI-SPLIT

Mounted on a wall, a ductless, mini-split air conditioner provides zoned cooling without the ductwork.

LIFE SPAN: 12-15 years

COST	CHOOSING YOUR A/C	PRO	CON
$$$$	Ductless mini-splits can provide cooling as well as heating. They are highly efficient, work in all climate zones and can be an affordable alternative to installing a ducted system.	Easy to install and avoids energy loss associated with ductwork.	Is expensive – in homes with existing ductwork, a mini-split can cost 30 percent more than adding an air conditioner unit to the existing system.

EVAPORATIVE COOLER

An evaporative cooler (also called a swamp cooler) cools outdoor air using evaporated water and circulates it throughout the house.

LIFE SPAN: 15-20 years

COST	CHOOSING YOUR A/C	PRO	CON
$$	If you live in an arid climate, an evaporative cooler can be a cost-effective cooling option. In addition to cooling the air, they add moisture, which can improve comfort.	Costs about ½ as much to install and uses about ¼ of the energy of a central air conditioner.	Requires more frequent maintenance and is only suitable for areas with low humidity.

Image: energy.gov

Heat Pumps

- Heat pumps are ***very efficient*** and can provide both heating and cooling
  - Cold climate models effective as low as -15 degrees F
  - Back up heat in very cold climates
- Both air-to-air and air-to-water (hydronic) systems
- Air source heat pumps (ASHP)
  - Heating Mode: Absorbs heat from outside air and releases it inside
  - Cooling Mode: Absorbs heat from inside building and releases it outside
  - Heat transfer is done by high-efficiency two-stage compressor
  - 18 to 27+ SEER
  - 8.5 to 12.5+ Heating Season Performance Factor (HSPF)

Air Source Heat Pump

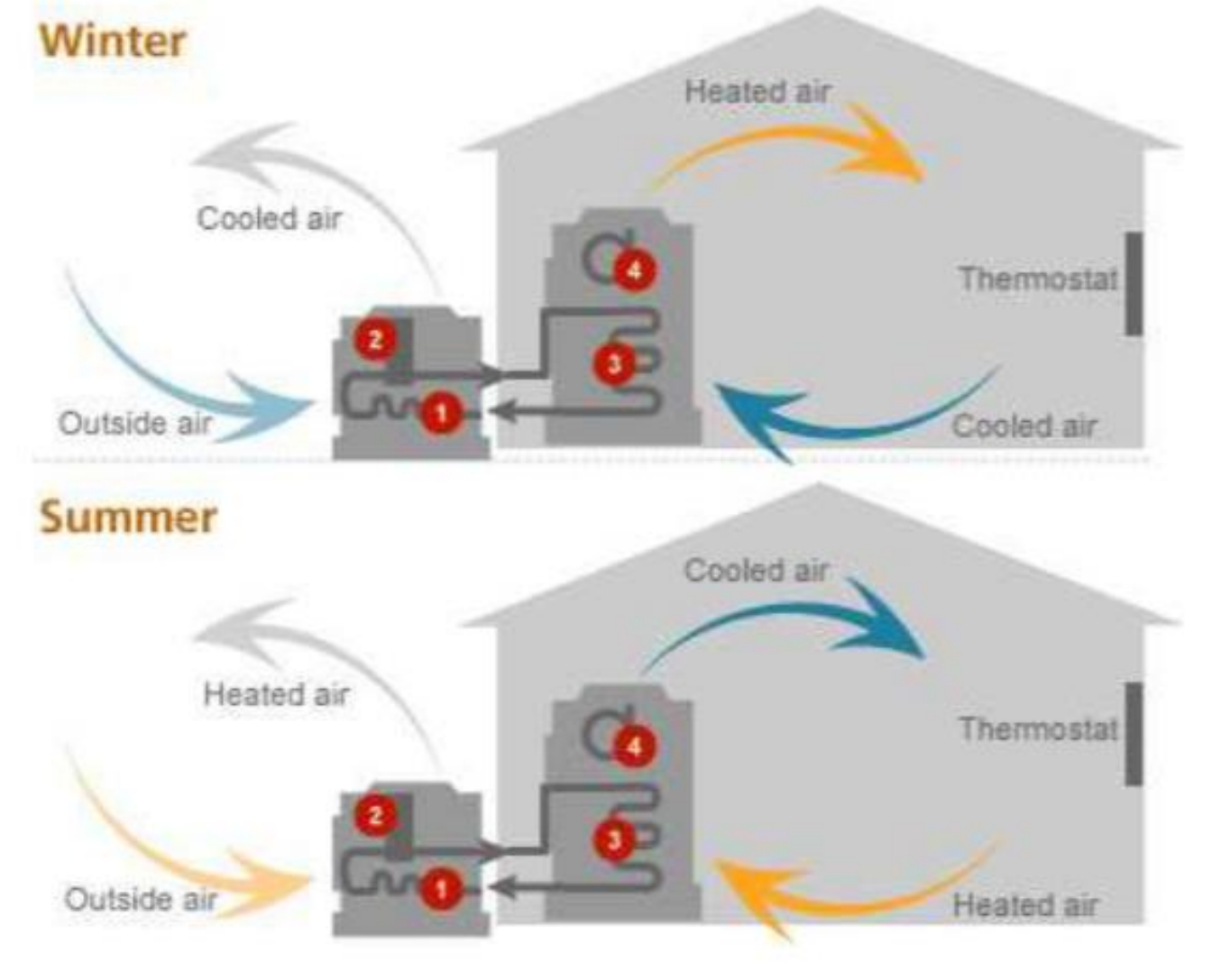


Image: mncee.org

Heat Pumps

- **300% to 400% efficient!**
  - For every unit of electricity used by the heat pump, three to four units of heat are captured and transferred
  - Furnaces max out at 100%
- Ground source heat pumps (GSHP)
  - Open- and closed-loop systems
  - Uses stable below grade temperature as heat sink
  - Vertical or horizontal layout
- Water source heat pumps (WSHP)
  - Uses stable deep water temperature as heat sink

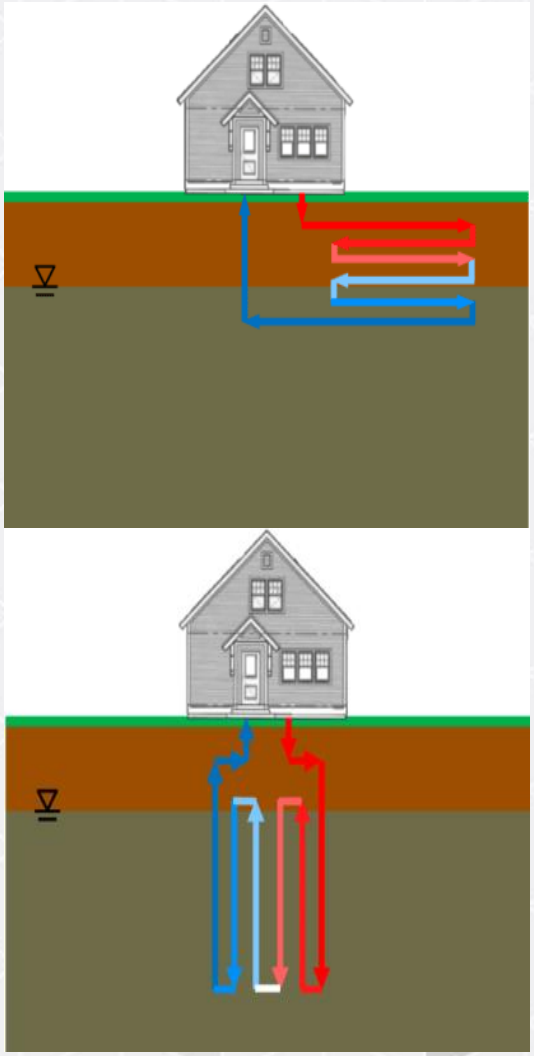


Image: researchgate.com

Heat Pumps – Mini Splits

- Mini-splits are split system heat pumps
  - Air-sourced systems
  - Both outdoor and indoor components
  - Ductless and ducted
  - Low static pressure
- Allow for easy zoning control
- Highly efficient: 15 to 38+ SEER
- Can provide less invasive cooling to homes with non-duct heating systems

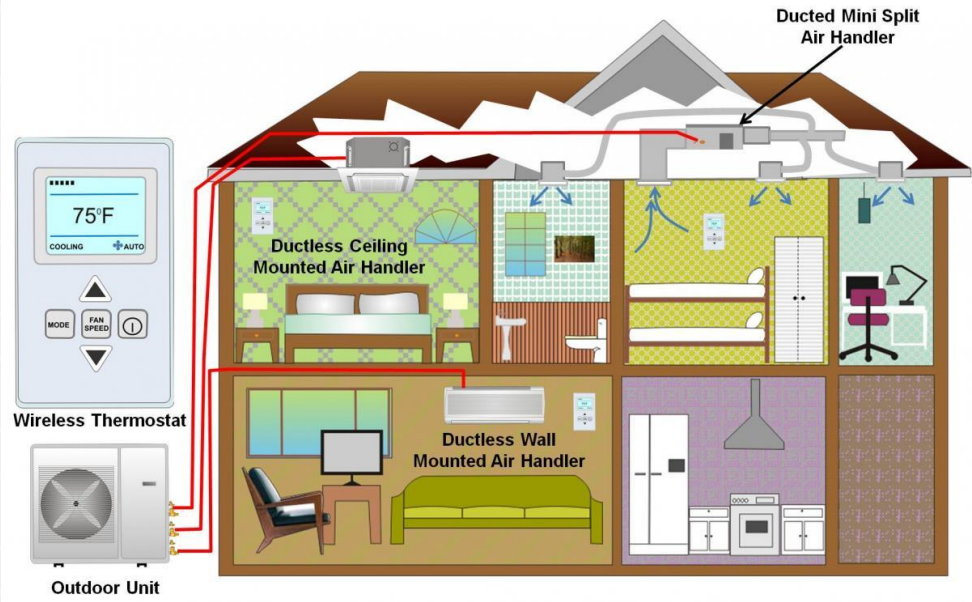
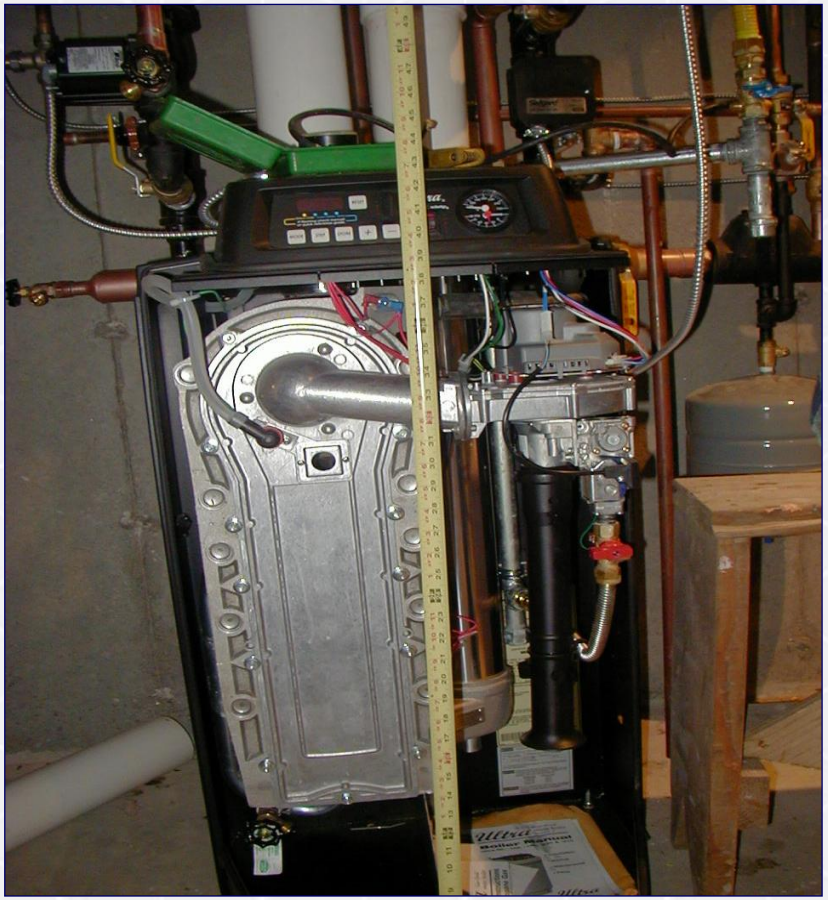


Image: basc.pnnl.gov

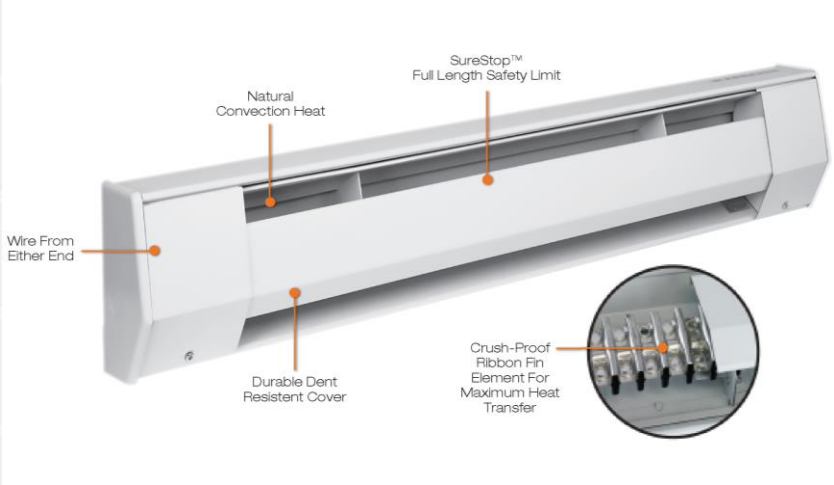
Boilers



- Variety of fuels
- Most common:
  - Baseboard fin tube radiators
  - In-floor radiant systems
  - Hydro-air applications
- Condensing capabilities
- Modulating controls

Electric Resistance Heaters

- Available options:
  - Baseboard fin tube
  - In-floor radiant panels
  - Ceiling-mounted radiant panels
  - Wall-mounted room heaters
- No use of ducts
- Zoning advantages
- Typically expensive to operate and has high carbon footprint

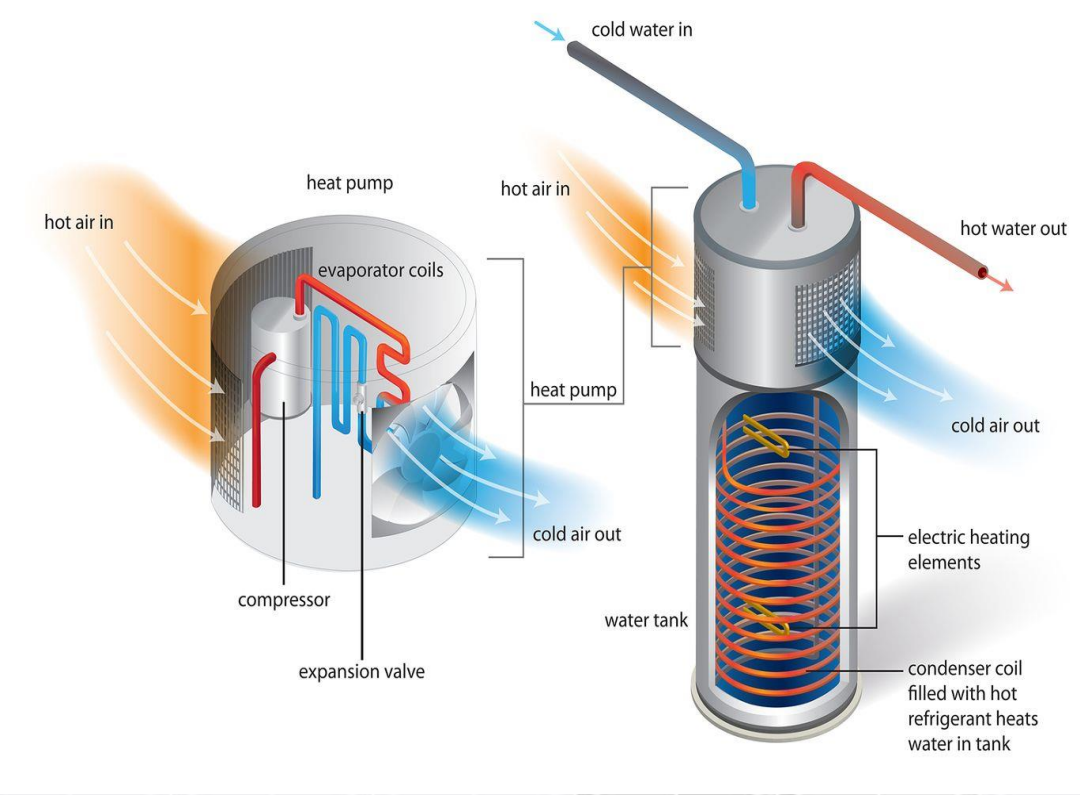


Images: northamptonma.gov

Water Heaters

- Available options:
  - Storage gas
  - Storage electric
  - Tankless gas
  - Tankless electric
  - Heat Pump

- Piping Insulation
  - R-3 if fluid is >105° or <55°



Heat Pump Water Heater

Image: thisoldhouse.com

Water Heaters – Typical Efficiencies

Water Heater Type	Efficiency (EF)
Conventional Gas Storage	0.60
Condensing Gas Storage	0.86
Condensing Gas Storage	0.86
Conventional Oil-Fired Storage	0.55
Minimum Efficiency Electric Storage	0.90
High-Efficiency Electric Storage	0.95
Electric Heat Pump Water Heater	2.20
Solar with Electric Back-up	1.20

Source: georgebrazilplumbingelectrical.com

HVAC LOAD AND SIZING

First Step – The ACCA Manuals

- The Air Conditioning Contractors of America (ACCA) provide guidance on system design
- The energy code requires that system be based on:
  - **Manual J** load calculations
    - Block load
    - Room by Room load
    - Based on hottest/coldest day scenario
  - **Manual S**: Equipment sizing and selection
- **Other Calculations:**
  - **Manual D**: Duct design and layout
  - **Manual T**: Air Distribution

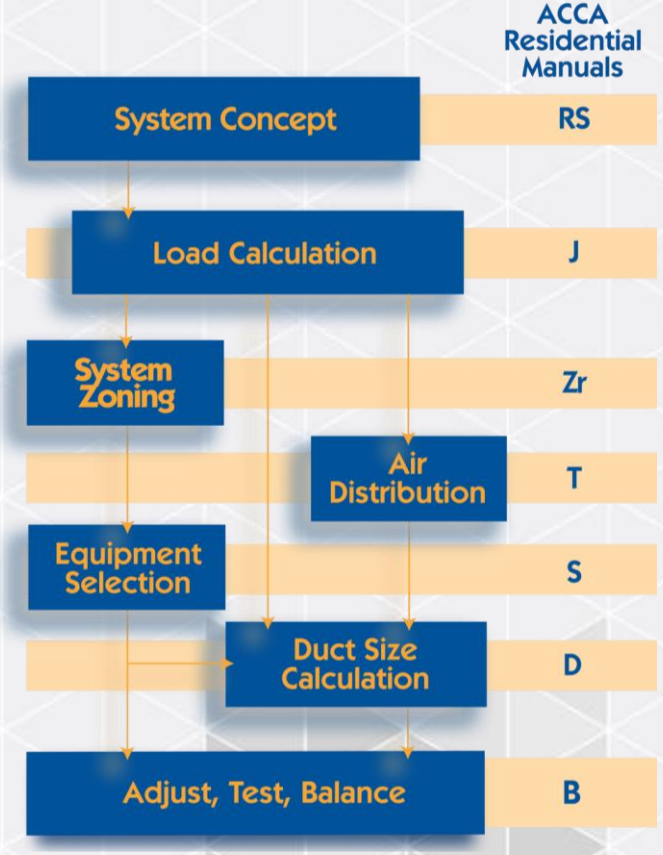


Image: ACCA.org

Considering HVAC Design and Loads

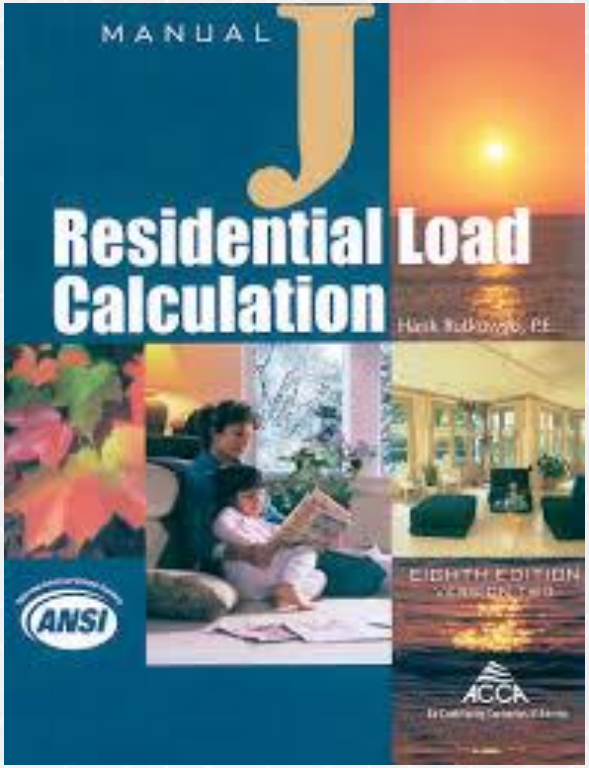


Image: acca.org

- Properly designed HVAC systems rely on scientific criteria and a systematic method to match the loads required for health and comfort
- The *Manual J* report should be used as basis of your request for bid from the HVAC contractors
- The *Manual J* report should be included with permit submittal

Selecting HVAC Equipment

Careful selection of heating and cooling equipment can:

- Reduce initial costs
- Increase homeowner comfort
- Increase operating efficiency
- Reduce utility costs

Image: mdr4you.com

Selecting HVAC Equipment

Image: Verdatek Solutions

- Selection must consider:
  - Equipment efficiency
  - Fuel sources
  - Distribution mechanisms
  - Equipment options
  - Life cycle costs
- Life cycle analysis considers:
  - Equipment and installation prices
  - Annual heating and cooling expense
  - Maintenance costs

Considering HVAC Design and Loads

- Right Sized Systems :
  - Sized for the worst case scenario (hottest/coldest possible design temperatures)
  - Offer better operating efficiencies
  - Create more comfort through more uniform heating and cooling
  - Help maintain healthier indoor environments by dehumidifying the air
  - Cost less than oversized equipment

Considering HVAC Design and Loads

- Oversized systems
  - Less comfort due to formed pockets of warm and cold air and temperature spikes
  - Draw more moisture into the conditioned space by only cooling the air
  - Result in premature equipment failure due to the constant on and off operation

Image: climatedesign.com

HVAC DISTRIBUTION SYSTEMS

Forced Air Distribution

- ACCA Manual D (duct sizing/layout) and Manual T (air distribution)
- Duct design principles
  - Duct design goals:
    - Occupant comfort
    - Proper air distribution
    - Economical system operation
  - Considerations:
    - Structural framing
    - Plumbing
    - Electrical wiring

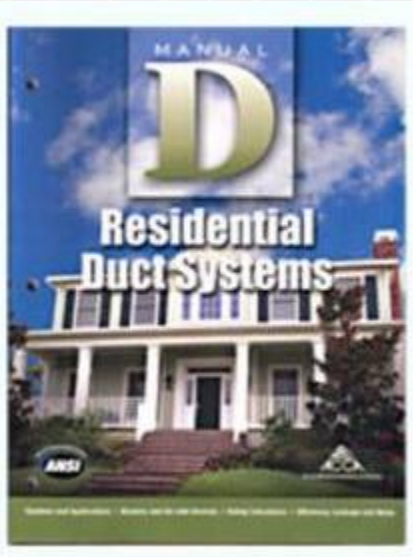
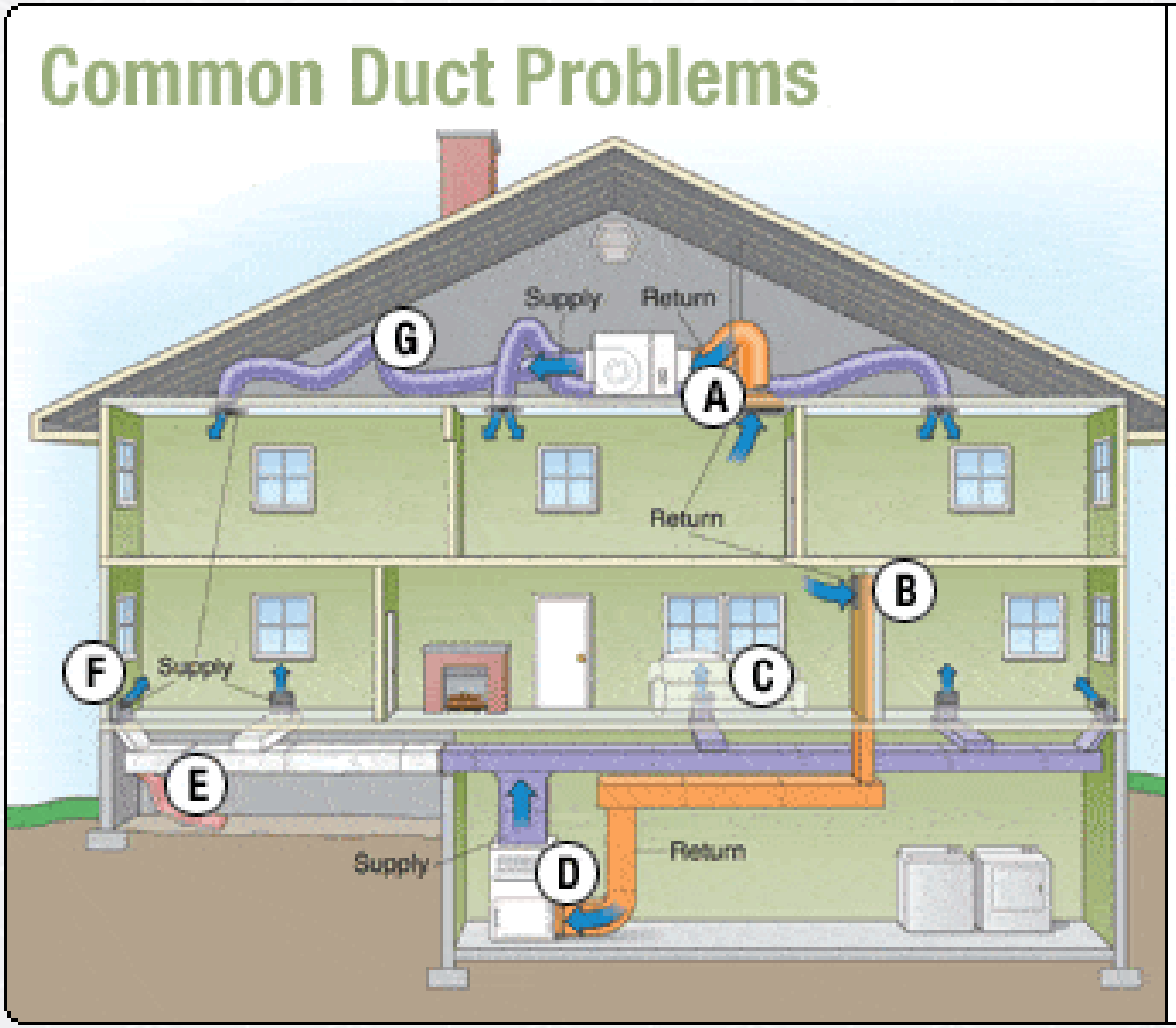


Image: load-calculations.com

Forced Air Distribution

- **Supply Air**
  - Delivers tempered air to living spaces
  - All ducts must be sealed
  - If any part of the system is outside conditioned space, the system **must be tested**
  - Ducts outside of conditioned space must be insulated
  - Supply must be sized and balanced for each room load
  - Duct runs must be sized for flow and static pressure
  - Supply CFM must equal return CFM
  - Building cavities cannot be used as supply ducts

Common Duct Problems



- **A** Leaky duct connection and air handler/ducts in attic
- **B** Return leaks
- **C** Furniture blocking register
- **D** Leaks at furnace & filter slot; duct sealing failure
- **E** Fallen duct insulation
- **F** Supply leaks
- **G** Kinks in ductwork restricting airflow

Source: EnergyStar

Image: willardductcleaing.com

Forced Air Distribution

- **Return Air**
  - Delivers air back to the heating and cooling equipment
  - All ducts must be sealed
  - Ducts outside of conditioned space must be insulated
  - Flow must be balanced with supply air
  - Individual room or central return
  - Using building cavities as returns is **not allowed in 2018 IECC**
    - Also, a really bad idea!
    - Virtually impossible to seal properly
    - If not completely sealed can introduce indoor pollutants and contaminants into system

Interior of a Panned Return

Image: jclonline.com

Performance Testing for HVAC Systems

Testing and Balancing (TAB)

- **Energy Efficiency Testing** - An energy efficiency test will check your HVAC system to make sure your energy usage is as low as possible without hindering maximum occupant comfort. If your energy bills are too high, you may want to order an energy efficiency test.

- **Acoustical and Airflow Testing** - The acoustical and airflow test will check the airflow within your home to determine whether your HVAC system is performing optimally.

- **Air Cleaner Testing** - Your HVAC system cleanses the air to keep indoor air quality ideal. Homeowners who have young children with asthma should have a test performed to evaluate the effectiveness of their system's air filter or cleaner.

Image:ceproinc.com

Hydronic System Distribution

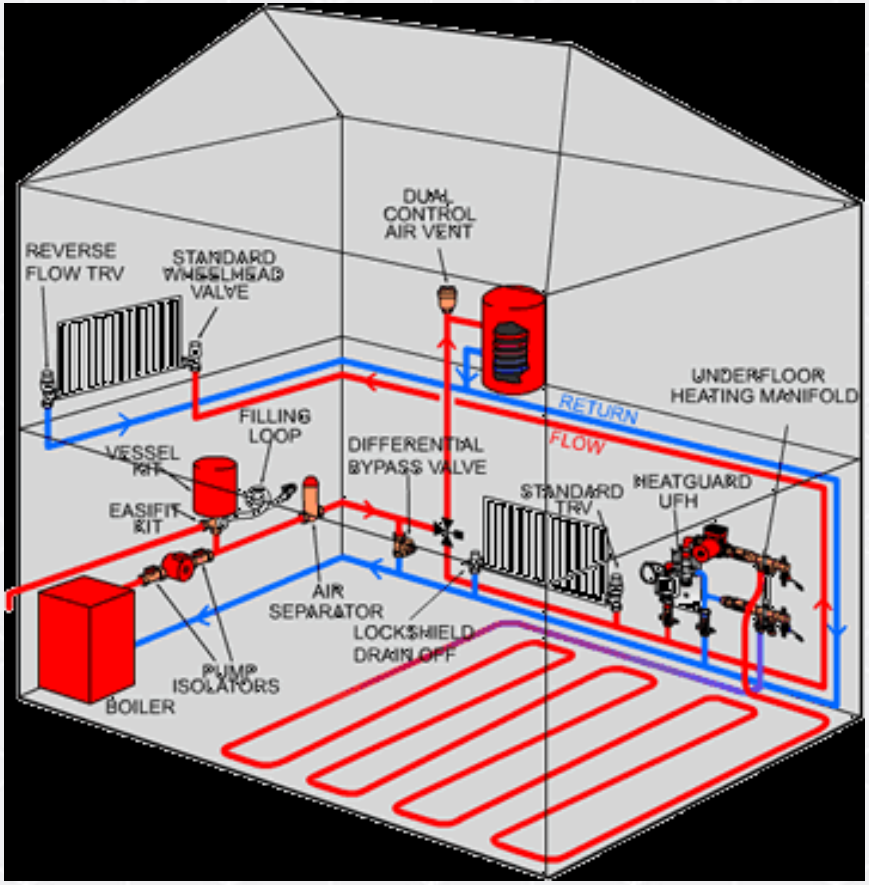


Image: seattleplumber.com

- Circulates a liquid through pipes to fin tube convectors, radiators, or tubing buried in a floor system:
  - Is less noisy
  - Provides more balanced heat
  - Can't use high efficacy filters
  - Necessitates a second system for cooling

Hydronic System Distribution

- Four heat distribution methods:
  - Fin tube distribution
  - Radiator distribution
  - Radiant floor distribution
  - Hydro-air distribution

Radiant Floor Heat Layout

Image: thisoldhouse.com

VENTILATION SYSTEMS

Ventilation

- Mechanical ventilation systems circulate fresh air using ducts and fans, rather than relying on airflow through holes or cracks in a home's walls, roof, or floors
  - You don’t know where uncontrolled ventilation draws air from
  - Exhaust fans often do not provide rated / code ventilation post installation – air flow should be tested
- ASHRAE 62.2
  - Establishes ventilation and indoor air quality (IAQ) rates in residential buildings(Low rise)
  - Provides criteria for exhaust fans & spot ventilation
  - Minimum Standard!
- “Build it Tight and Ventilate Right!”

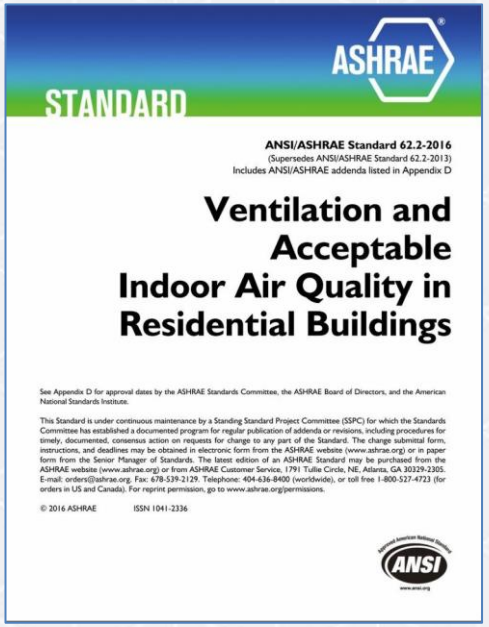


Image:ashrae.org

Ventilation Rate in CFM
(0.01 x total square foot area of house) + [7.5 x (number of bedrooms +1)]

Ventilation and Air Sealing

- Both natural and mechanical ventilation provide fresh air that can dilute and remove indoor pollutant levels
- Per the IMC/IRC, mechanical ventilation is required when homes are <5 ACH 50
  - Need to do a blower door test to determine leakage rate
  - **Liability concerns when not performed**
- A blower door test measures a building's existing air leakage
- Can not design a code compliant system without knowing air leakage

Courtesy of AC Tool Supply, Inc.

Ventilation and Air Sealing

- Blower door test result can be in CFM.
- Converting to ACH determines building's need for mechanical ventilation (≤5 ACH50)

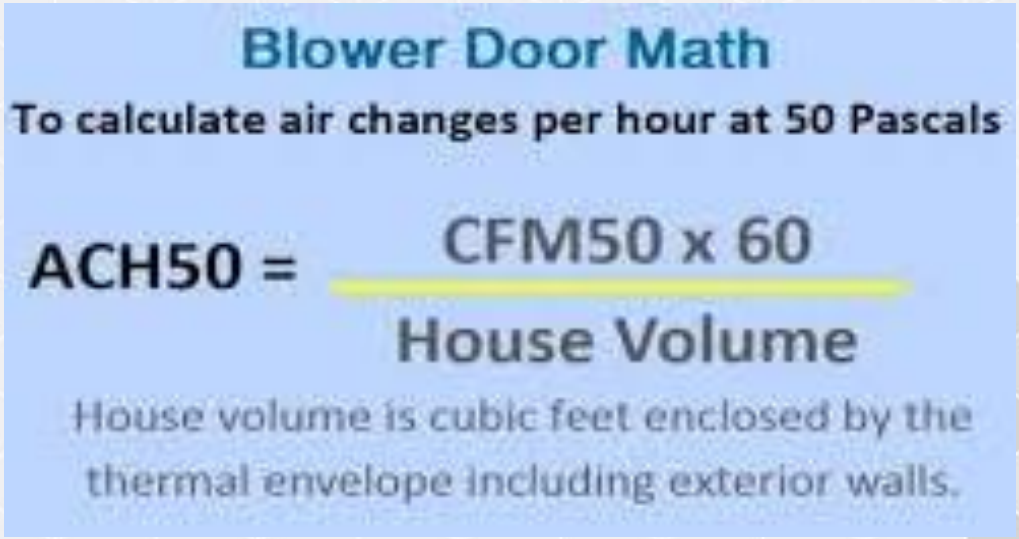
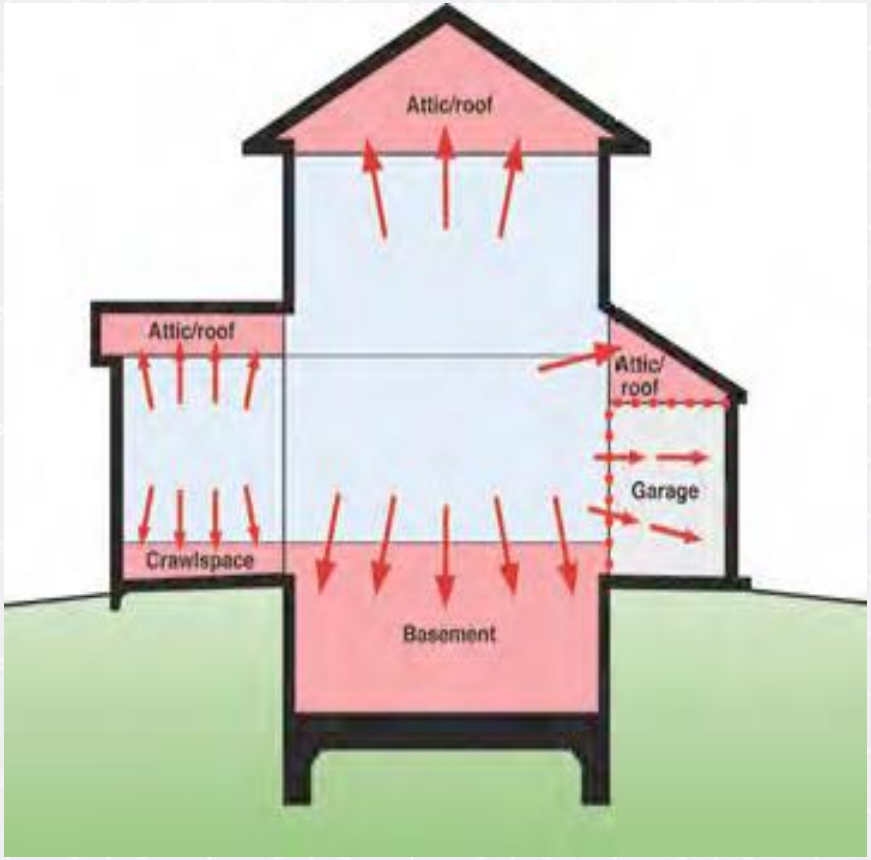


Image: deq.mt.gov

Ventilation – Pressure Differential



Expansion of Conditioned Space

- HVAC systems, temperature, wind, and stack effect all cause pressure differentials between inside and outside
- HVAC systems pressurize the home and conditioned space boundaries moving towards exterior surfaces of building
- Garage isolated from house by air barrier/pressure boundary
- Garage ventilated and conditioned independently of rest of conditioned spaces

Ventilation

- Tips and cautions:
  - Natural ventilation may be inadequate or excessive if the indoor environment's driving forces are inadequate.
  - Ventilating air from an unknown source can have a higher level of pollutant than the indoor air (e.g., moisture, pollen, smoke)
    - Balanced whole house ventilation solves this problem
- The priority is to control ventilation:
  - Spot ventilation systems (supply-only and exhaust-only)
  - Balanced ventilation systems (heat recovery and energy recovery ventilators)

Image: healmyheart.ca

Considering HVAC Design and Loads

- Today's homes risk health problems from inadequate ventilation
- New construction materials and techniques result in tighter homes
  - Sometimes <1 ACH50
- In some jurisdictions blower door tests are not required so builders are unaware of the need for ventilation
- Average from NE Residential Baseline Study is a new home air leakage of 2.8 ACH50
- More chemicals and products are used in and around a house
  - Concentration levels can be 2 to 100 times higher than outside.

Image: conditionedairsolutions.com

Balanced Ventilation

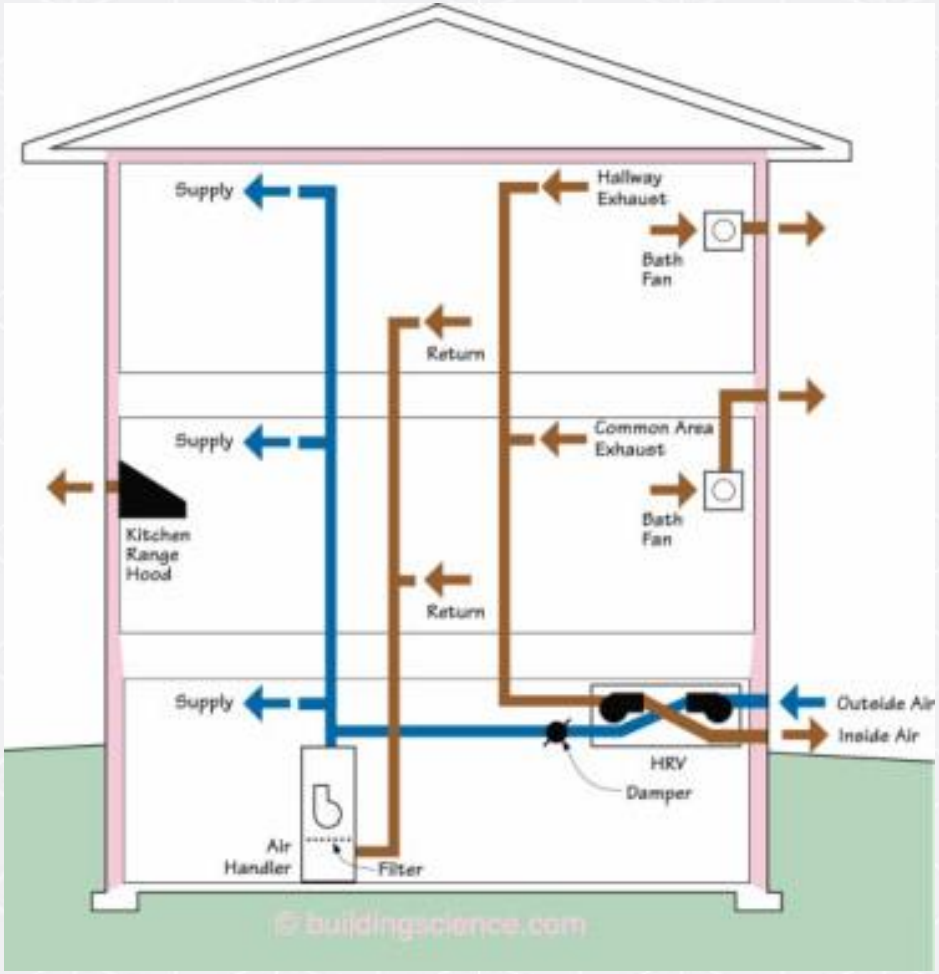


Image: buildingscience.com

- Blows air into and out of the house
- ERV/HRV makes this cost effective by reclaiming energy from exhaust and supply airflows (60%-80%!)
- Balances exhaust and supply flows
- Maintains the Minimum Ventilation Guidelines automatically with proper set-up

Balanced Ventilation - HRV

A heat recovery ventilator (HRV) uses a heat exchanger to condition incoming fresh air:

- It consists of a cube-shaped transfer unit made from special conductive materials.
- Airflows pass through different sides of the cube (but are not mixed).
- Conditioned exhaust air raises or lowers the incoming fresh air temperature.
- Air passes through an HVAC air handler or directly to rooms.

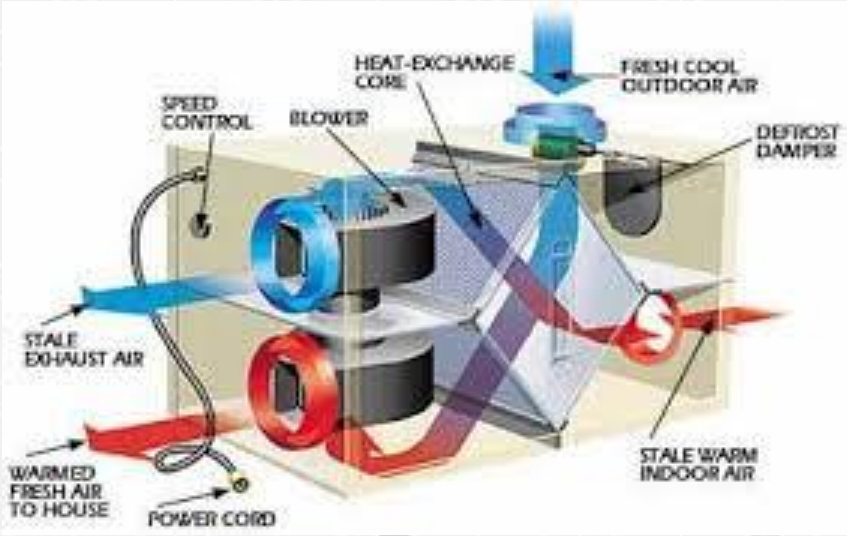


Image: popularmechanics.com

Balanced Ventilation - ERV

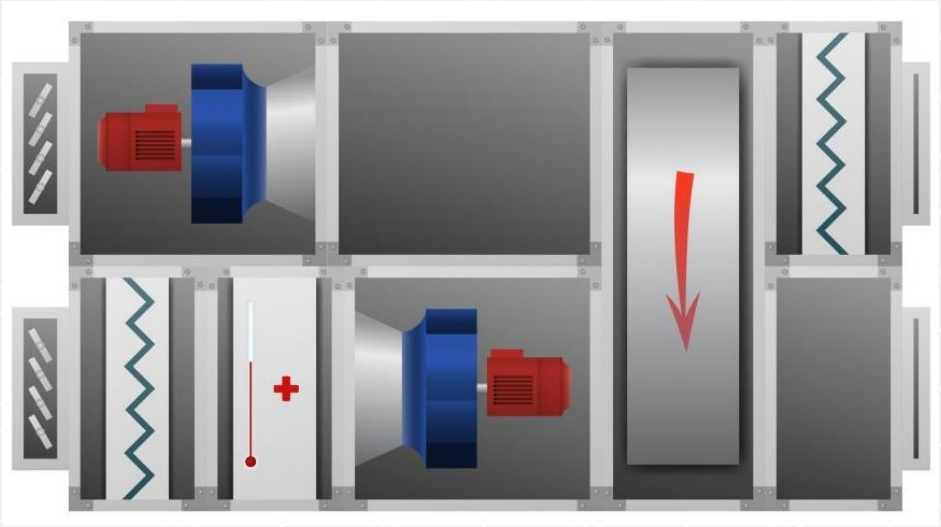


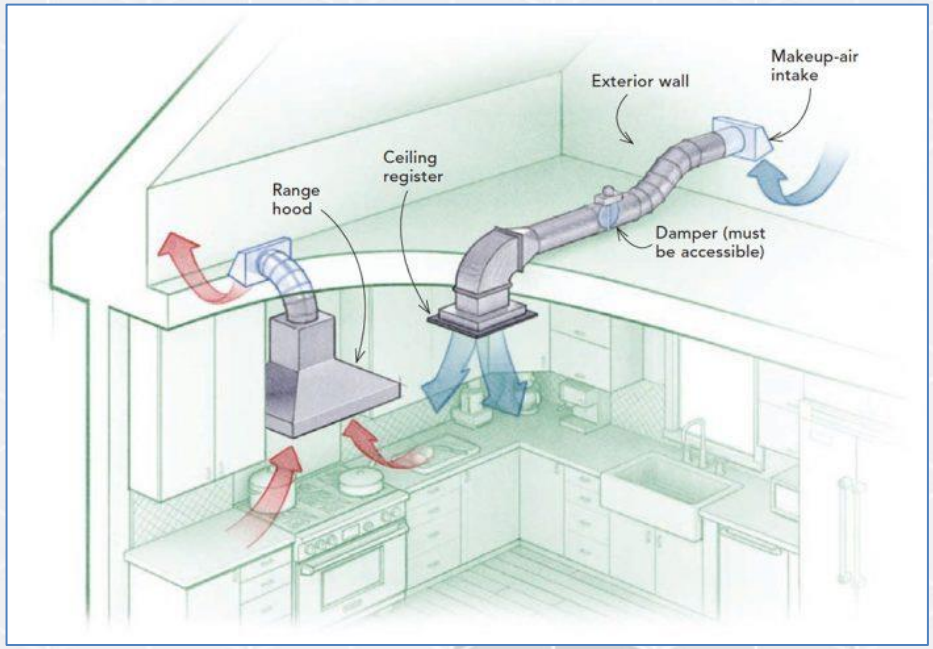
Image: totalcomfortma.com

An energy recovery ventilator (ERV) exchanges heat and moisture between the two air streams:

- It transfers moisture by a desiccant wheel.
- It allows the exchange of moisture to control humidity.
- It preconditions the incoming flow with return air ducts before it exits.
- It passes air through an HVAC air handler or directly to rooms.

Spot Ventilation (Supply-only and Exhaust-only)

- Supply spot ventilation:
  - Whole house
  - Makeup air or combustion air for appliances
- Exhaust spot ventilation:
  - Bathroom exhaust fan
  - Range hood vent
  - Ducted garage fan
  - Central vacuum
- Fans or portals with humidity-sensitive nylon strips



Images: greenbuildingadvisor.com

Air Filters

- Use filters to remove pollutants from the indoor air
  - They are characterized by the size of particle they remove
  - Type and size of filter should properly fit equipment
  - The higher the MERV rating, the finer the particulate filtered
  - Determining the best filter relies on understanding which substance(s) needs to be removed
  - System must be designed to accommodate the static pressure created by filter

Types of Furnace Filters

FLAT-PANEL FIBERGLASS	PLEATED MEDIA	HEPA (High Efficiency Particulate Air)	WASHABLE/ REUSABLE
MERV RATING*			
• 1 to 4 typical	• 5 to 13 typical • 14 to 16 high efficiency	• 17 to 20 typical	• 1 to 4 typical
PROS			
• Inexpensive • Reinforced	• Pleats increase filter efficiency • Resists airflow less than HEPA	• Catches up to 99.97% of all particles • Recognized by EPA and OSHA	• Last longer than disposable filters • Durably designed
CONS			
• Protects HVAC components more than it cleans air	• Cheaper than HEPA, but less efficient with very fine particles	• Too big for most residential systems • Retrofitting for HEPA is costly	• Require cleaning and maintenance • May harbor germs if not fully dry

Image: angieslist.com

Air Filters: MERV

Image: unitedfilter.com

- An air filter's minimum efficiency reporting value (MERV) rating measures how effectively the filter stops dust and other contaminants from passing through the filter and into the air stream
- Higher MERV value provides greater filtration but also increases pressure drop across filter
- MERV ratings should be determined during HVAC design

Air Filters: HEPA

- A HEPA filter works by forcing air through a fine mesh that traps harmful particles such as pollen, pet dander, dust mites, and tobacco smoke
- Not MERV rated but generally considered MERV 17-20
- HEPA filters:
  - Are 95 percent efficient
  - Are 99.97 percent effective:
    - Filter particles down to < one micron
  - Alter the particles' airflow stream lines
  - Vary in pressure drop characteristics
  - Are effective against bacteria and some viruses

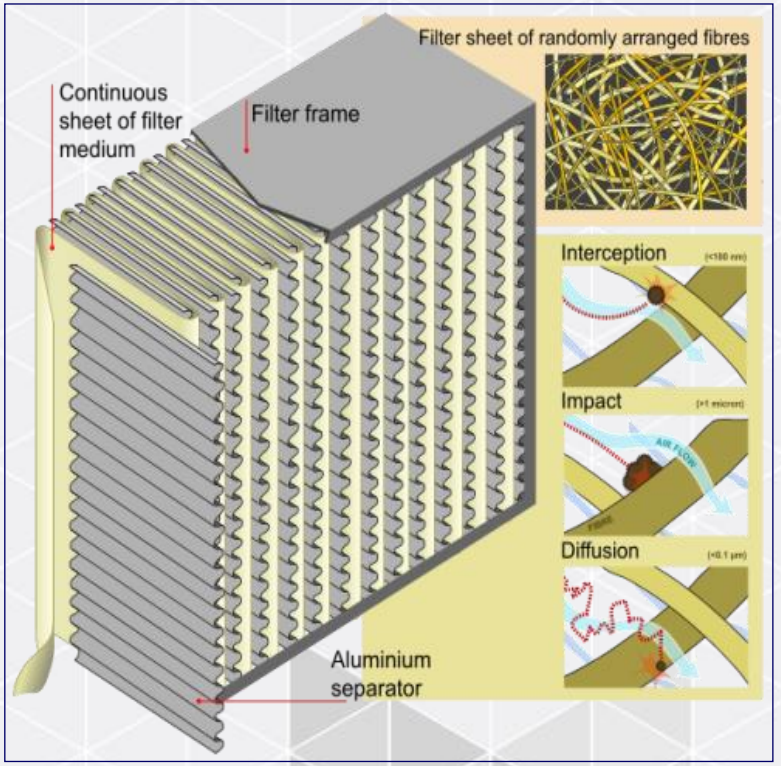


Image: Wikipedia.com

Construction and Filtration

- Construction activities generate a **lot** of dust
- Solutions:
  - Protect HVAC ducts during construction
  - Provide covers at the supplies and returns
  - Vacuum the ducts prior to occupancy
  - Seal the door between the garage and the home tightly
    - Should be done regardless to prevent infiltration of auto exhaust and other pollutants

Image: toulmincabinetry.com

E-Mail from Remodel Client 2013:

*"Also, wanted to share that this month was officially lower for electricity at the new (5000 sq ft) house than the old (2200 sq ft) house. The old house used **1013kWh** last month in 31 days **vs. 634 kWh** used in 29 days at the new house. Add on the 264kWh that the solar panels generated and it was almost 3 times less usage with twice the square footage."*

Key Takeaways

- Right Sizing
  - Air sealing is critical
  - Manual J calculations
- System Selection / Efficiency
  - Heat pumps are far more efficient than other systems
  - Cold climate heat pumps
- Ventilation
  - Whole house ventilation is required by model code
    - Average house is now built tight enough to need it
    - Balanced ventilation is best practice

Questions?

- Submit a question in the chat or unmute yourself to ask a question

Review Questions – Session 5

What are 2 of the accepted criteria and methods for designing an HVAC system?

A: Manual K and J

B. Manual J and S

C. Manual S and Q

D. Manual B and A

Review Questions – Session 5

Which is a better Air Filter?

A. Merv 11

B. Merv 6

C. Merv 20

D. Merv 13 +5

Review Questions – Session 5

Oversized HVAC Systems:

A. Make sure you wont backdraft a furnace flue

B. Eliminate phone calls about cold spots upstairs

C. Create more comfort, quicker

D. Draw more moisture into the conditioned space

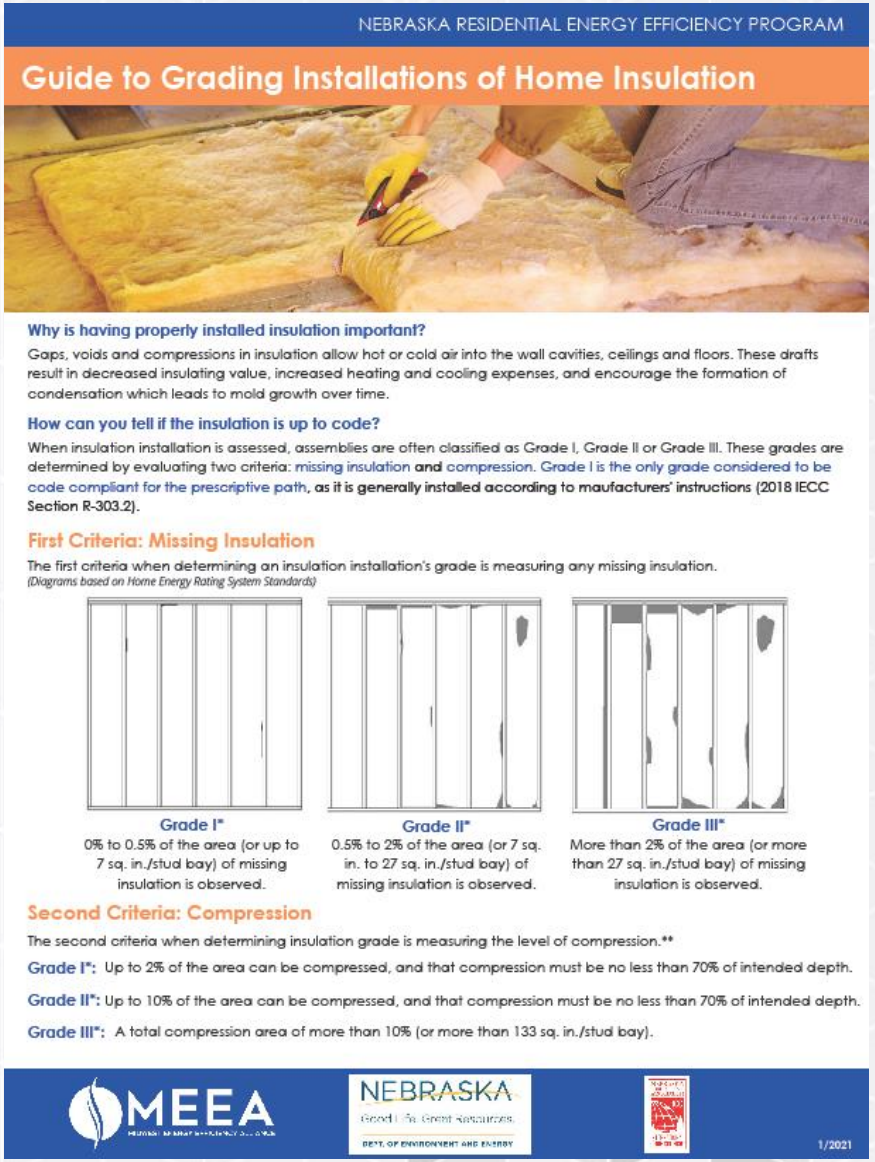
Review Questions – Session 5

With a forced air distribution system, the return air should:

A. Be vented directly back to the unit, shortest path possible.
B. Not have sealed ducts to draw pollutants in to filters
C. Have the same flow as supply air
D. Have slightly less flow than supply air

Resources

- Handouts on specific topics
  - Insulation installation
  - **HVAC Right Sizing**
  - Others coming soon
- Made to share with Trades/Subs, etc.
- Visit: https://www.mwalliance.org/metropolitan-community-college-energy-code-course



NEBRASKA RESIDENTIAL ENERGY EFFICIENCY PROGRAM

Guide to Grading Installations of Home Insulation

Why is having properly installed insulation important?

Gaps, voids and compressions in insulation allow hot or cold air into the wall cavities, ceilings and floors. These drafts result in decreased insulating value, increased heating and cooling expenses, and encourage the formation of condensation which leads to mold growth over time.

How can you tell if the insulation is up to code?

When insulation installation is assessed, assemblies are often classified as Grade I, Grade II or Grade III. These grades are determined by evaluating two criteria: missing insulation **and** compression. Grade I is the only grade considered to be code compliant for the prescriptive path, **as it is generally installed according to maufacturers' instructions** (2018 IECC Section R-303.2).

First Criteria: Missing Insulation

The first criteria when determining an insulation installation's grade is measuring any missing insulation.
(Diagrams based on Home Energy Rating System Standards)

Grade I*
0% to 0.5% of the area (or up to 7 sq. in./stud bay) of missing insulation is observed.

Grade II*
0.5% to 2% of the area (or 7 sq. in. to 27 sq. in./stud bay) of missing insulation is observed.

Grade III*
More than 2% of the area (or more than 27 sq. in./stud bay) of missing insulation is observed.

Second Criteria: Compression

The second criteria when determining insulation grade is measuring the level of compression.**

Grade I*: Up to 2% of the area can be compressed, and that compression must be no less than 70% of intended depth.

Grade II*: Up to 10% of the area can be compressed, and that compression must be no less than 70% of intended depth.

Grade III*: A total compression area of more than 10% (or more than 133 sq. in./stud bay).

MEEA NEBRASKA 1/2021

Continuing Education Credits

- Participants of this session are eligible for continuing education credits from the International Code Council

- Course ID: **27250**
- CEUs: **0.20**

- If you would like a certificate of completion for this session, email Nicole at nwestfall@mwalliance.org

Next Week

- March 2, 2021, 6:30-8:30pm
- Topic: Best Practices and Non-Code Standards
- Contact Matt with Questions: matt@verda-solutions.com

Matt Belcher

matt@verda-solutions.com

314-749-4189

SEE YOU NEXT WEEK!