

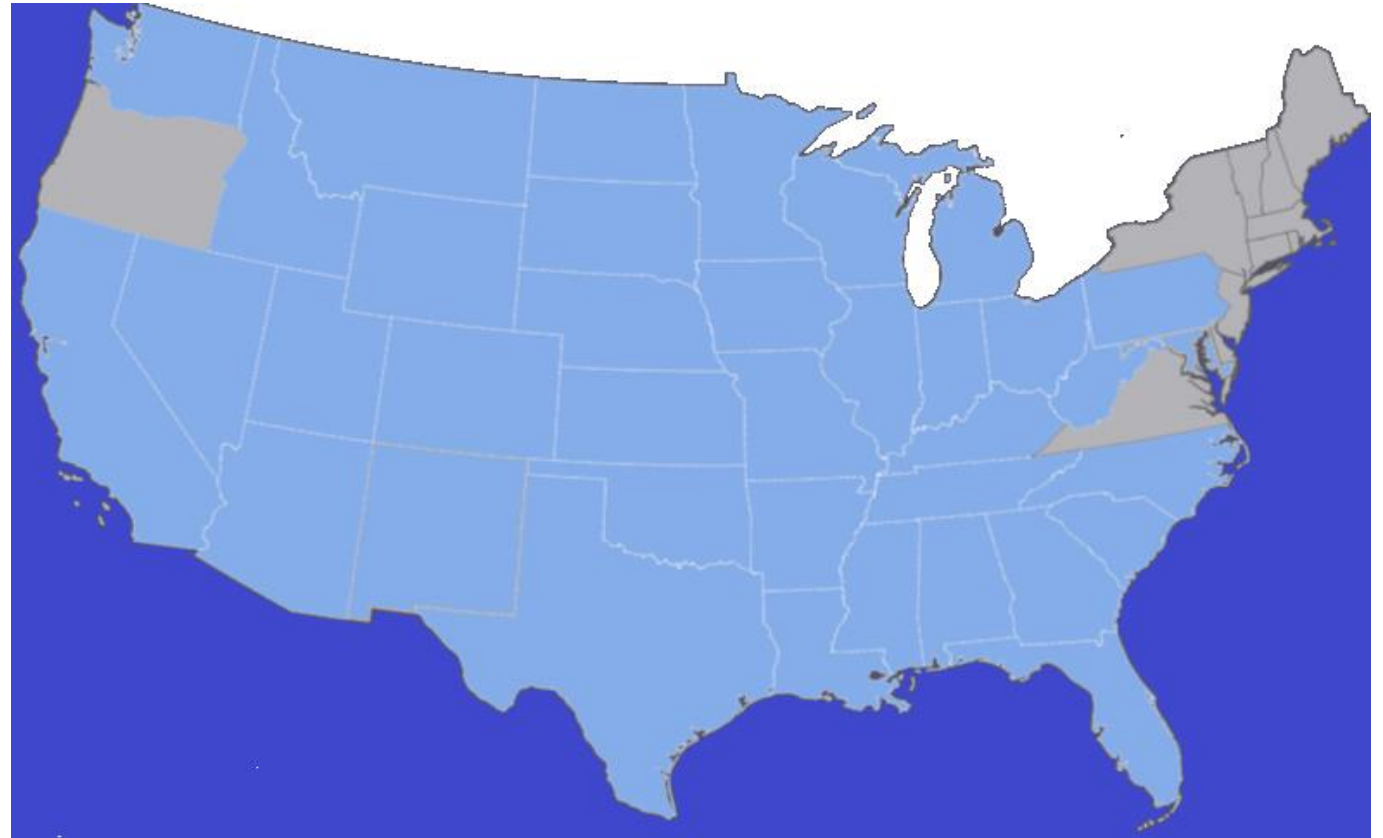


# GENERAL HVAC FOR APEC

By Benjamin P. Boyt PE & Richard Sanders  
Principal Engineer Boyt Engineering  
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# Boyt Engineering

- Based in Marion, Illinois but our business is more dispersed
- Professionally Licensed in over 30 states
- Holds an International Professional Engineering Listing of Record





# General

- Energy Conservation Trends
  - ERVs being required
  - Lighting Controls being required
  - Low flow plumbing being required
  - Overall more efficient equipment required
  - This has an effect on the overall costs nullifying many old rules of thumb



# Overview HVAC

- HVAC

- Codes & Standards

- <http://bcapcodes.org/code-status/commercial/>

- Heating and Cooling Equipment

- Ductwork

- Other Systems



# Overview HVAC

- Tonnage Rule of Thumb
  - Don't
  - It varies by region, building use, windows, etc.
  - New equipment types have made many of the older rules of thumb of little value



# HVAC Codes & Standards

- ASHRAE Codes
- Specific Highly Important Codes
  - ASHRAE 55 Thermal Environmental Conditions for Human Occupancy
  - ASHRAE 62.1 Ventilation for Acceptable Indoor Air Quality
  - ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings
- Energy Codes
- SMACNA Standards
- ACGIH Industrial Ventilation Recommended Practices



# HVAC Heating & Cooling Equipment



- Split Systems
- Packaged Units
- VAV, VVT Systems
- WSHP Water Source Heat Pump
- VRF Variable Refrigerant Flow
- OOAS Occupant Outside Air System or (DOAS Dedicated Outside Air System)
- Plant Systems
- Radiant

# HVAC Heating & Cooling Equipment

## Split Systems

- System may be residential or commercial style
- Two Components one Inside the Building and one Outside the Building
- Different Sections such as:
  - Fuel Source Heat
  - Electrical Strip Heat
  - Hot Water Heat
  - DX Heat and Cool or only one





# HVAC Heating & Cooling Equipment Packaged Units

- System may be residential or commercial style
- One Component
- Roof Mount Requires:
  - Coordination of Weight & Curb
  - Seismic Vibration with Structural
  - Know Seismic Zone
- Different Sections such as:
  - Fuel Source Heat
  - Electrical Strip Heat
  - Hot Water Heat
  - DX Heat and Cool or only one
  - Chilled Water Cooling



# HVAC Heating & Cooling Equipment

## VAV & VVT

- Boxes downstream of a main unit
- Require controls to the boxes and communication with the main unit
- Boxes may have the following components
  - Volume Dampers
  - Electric Reheat Coils
  - Hot Water Coils
  - Chilled Water Coils
  - Hot & Chilled Water Coils

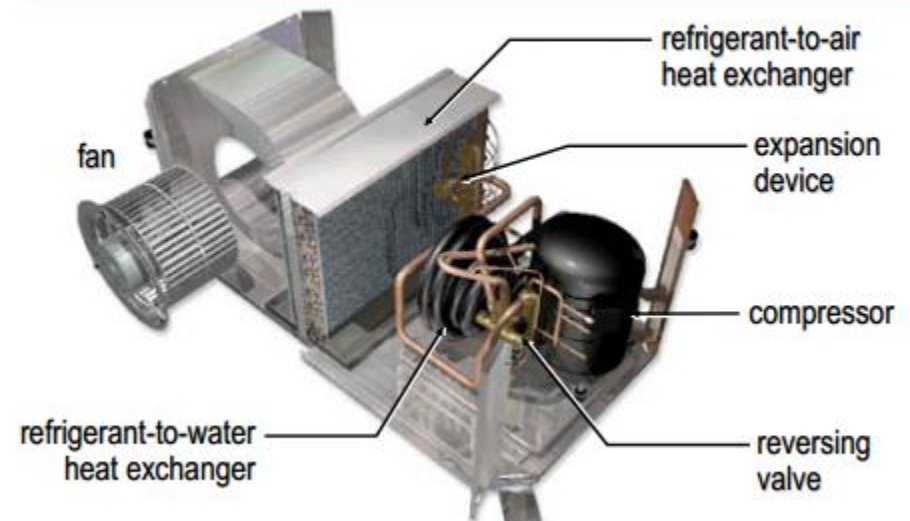


# HVAC Heating & Cooling Equipment

## Water Source Heat Pumps WSHP

- Heat Pumps that work off of a hydronic loop
- Take water and use it as the medium to exchange heat
- Usually not capable of much outside air

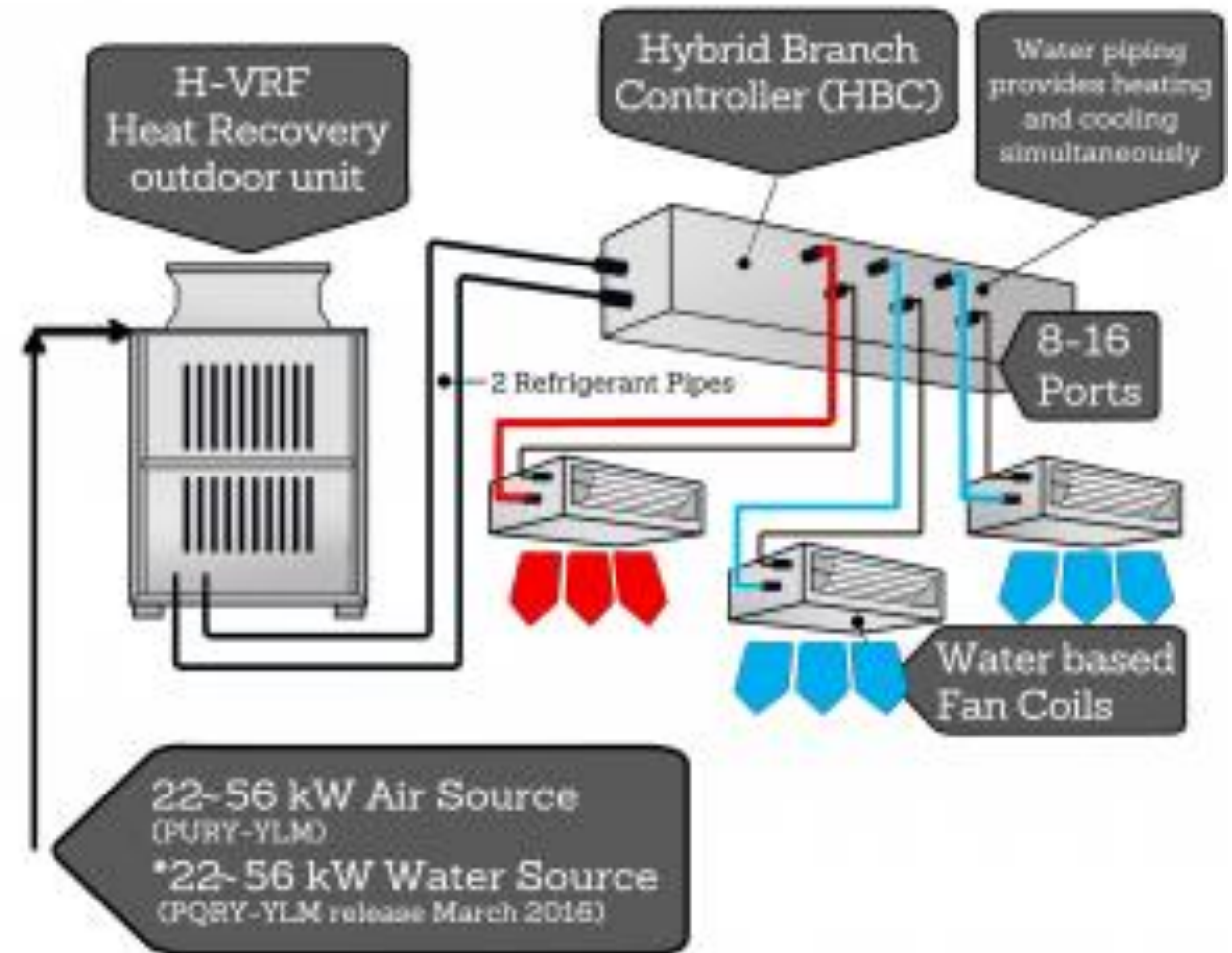
### Water-Source Heat Pump



# HVAC Heating & Cooling Equipment

## Variable Refrigerant Flow VRF

- Outdoor Unit connected to multiple Indoor Units
- Work off of a refrigerant loop
- ASHRAE 15 Safety Standard for Refrigeration Systems
- Highly efficient as heat extracted from one space may be released in another
- Usually not capable of much raw outside air



# HVAC Heating & Cooling Equipment

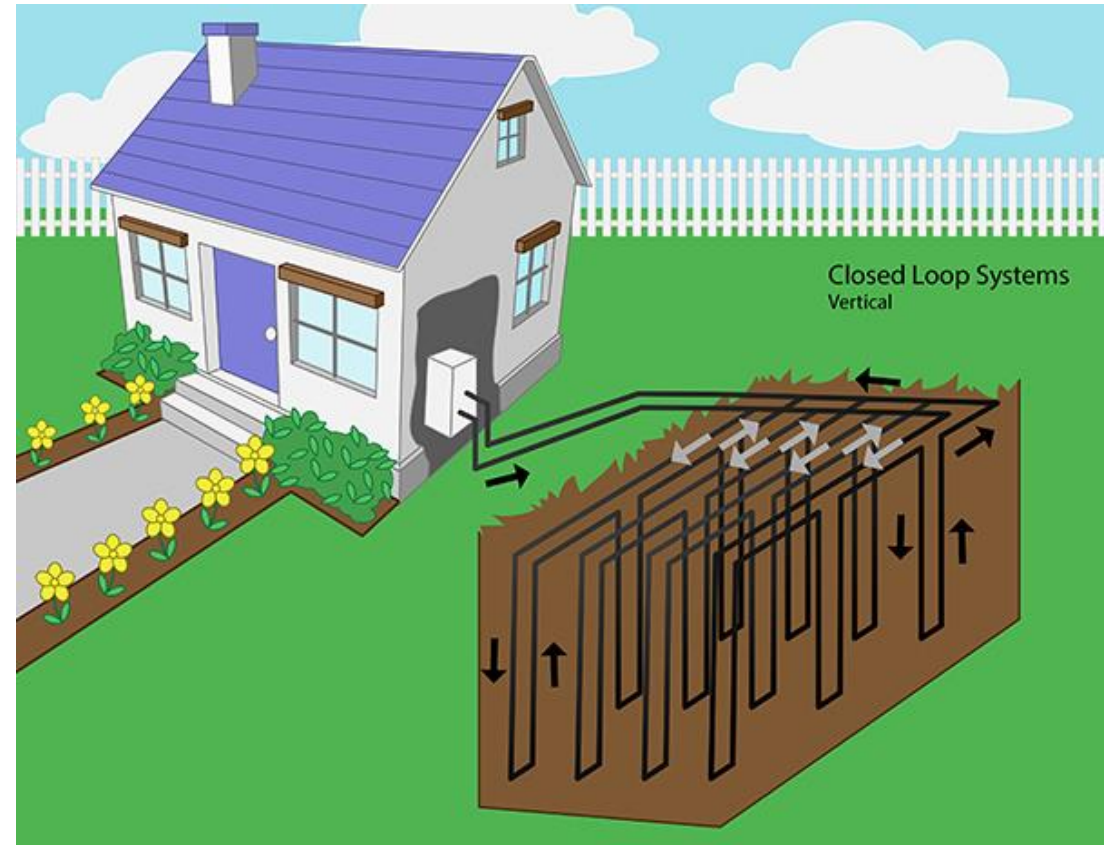
## OOAS Occupant Outside Air System (DOAS)

- Typically a Packaged Unit Capable of Treating Large Amounts of Outside Air, up to 100%
- Meant to supplement another unit inside a building that is efficient but not capable of high outside air loads
- Typically includes energy recovery



# HVAC Heating & Cooling Equipment Plant Systems

- Hot Water Boilers
  - Non Condensing (atmospheric)
  - Condensing
- Steam Boilers
- Chillers
  - Fluid Cooler / Cooling Tower
- Geothermal Well Fields



# HVAC Heating & Cooling Equipment Plant Systems



# HVAC Heating & Cooling Equipment

## Radiant

- High Bay Radiant
- In/Under Slab Radiant
- Radiant Ceiling Panels
  
- OTHER:
  - Baseboard
  - Cove
  - Unit Heaters





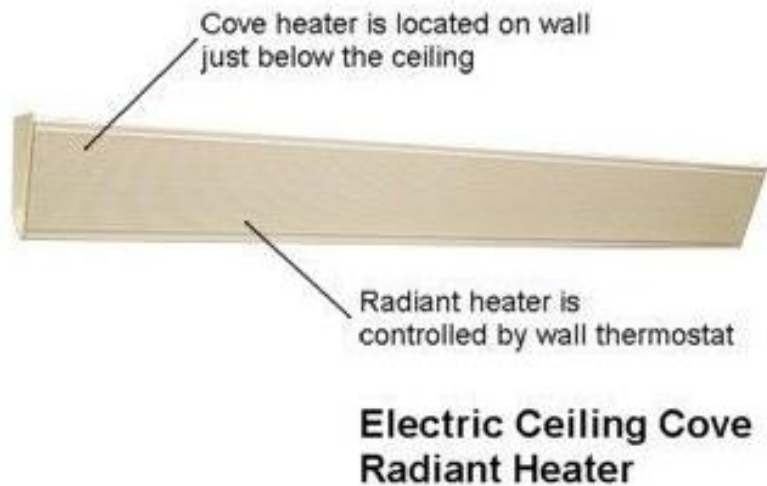
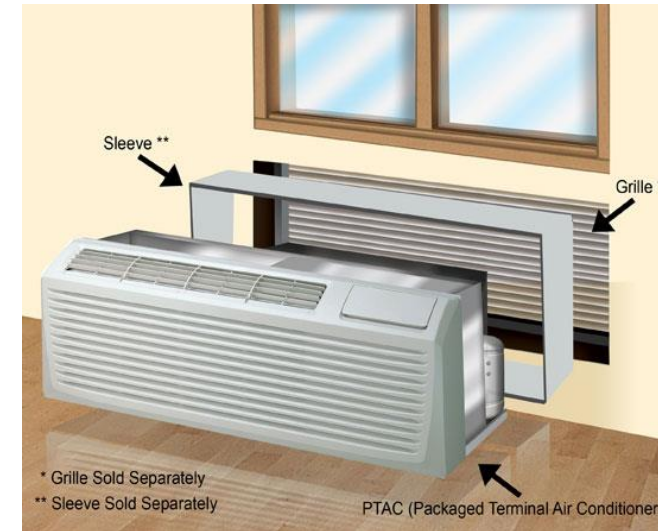
# HVAC Heating & Cooling Equipment

## Radiant



# HVAC Heating & Cooling Equipment

## Other





# HVAC Ductwork

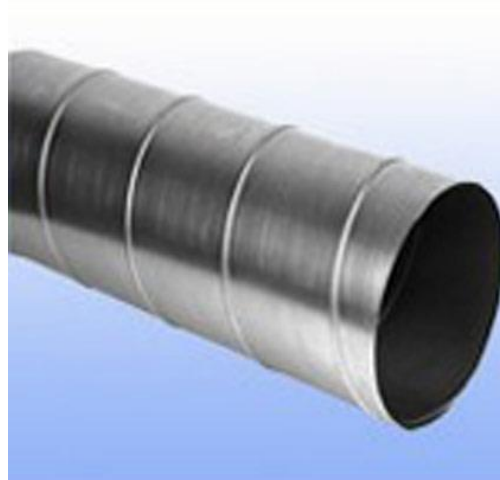
- Different Materials
  - Galvanized
  - Aluminum
  - Stainless
  - Ductsock
  - Duct Board (Not Recommended by Boyt Engineering)
  - Exotic
- Different Configurations
  - Rectangular
  - Round
  - Oval
- Insulation
  - Internal (Not Recommended by Boyt Engineering)
  - External



# HVAC Ductwork



Rectangular



Round

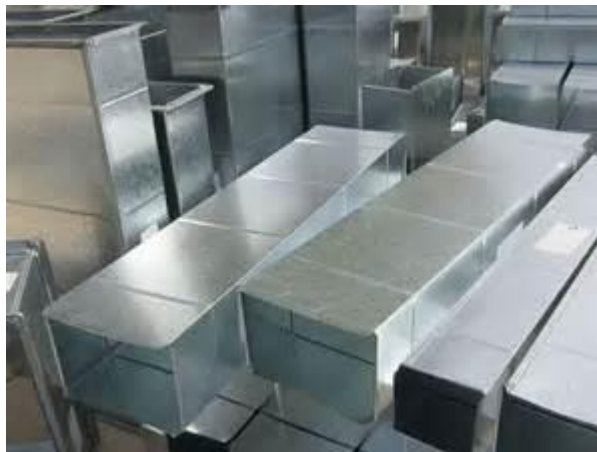


Oval

# HVAC Ductwork



Galvanized



Aluminum



Stainless Steel



# HVAC Other Systems

- Vehicle Exhaust
- Wood Shop Exhaust
- Kitchen Hoods & MAU (Makeup Air Units)
- High Volume Low Velocity Fans
- Underfloor Cooling
- DHU Dehumidification Units
- General Exhaust
- Laboratory Exhaust



# HVAC Other Systems

## Vehicle Exhaust

- May be in slab or overhead
- Connect to Engine Exhaust to remove harmful fumes from a work environment
- Typical in commercial repair shops



# HVAC Other Systems

## Wood Shop Exhaust

- Large Cyclone with bagger
- Intend for source capture for woodworking
- May have their own recirculation system





# HVAC Other Systems

## Kitchen Hoods & MAU

- Commercial Kitchens have hoods with exhaust and makeup air
- Typically will have a fire suppression system such as ansul



# HVAC Other Systems

## HVLV

- High Volume Low Velocity Fans
- Used in Industrial areas for circulation
- Works best in very tall structures
- Air flow to increase comfort especially in uncooled spaces



# HVAC Other Systems

## Underfloor Cooling

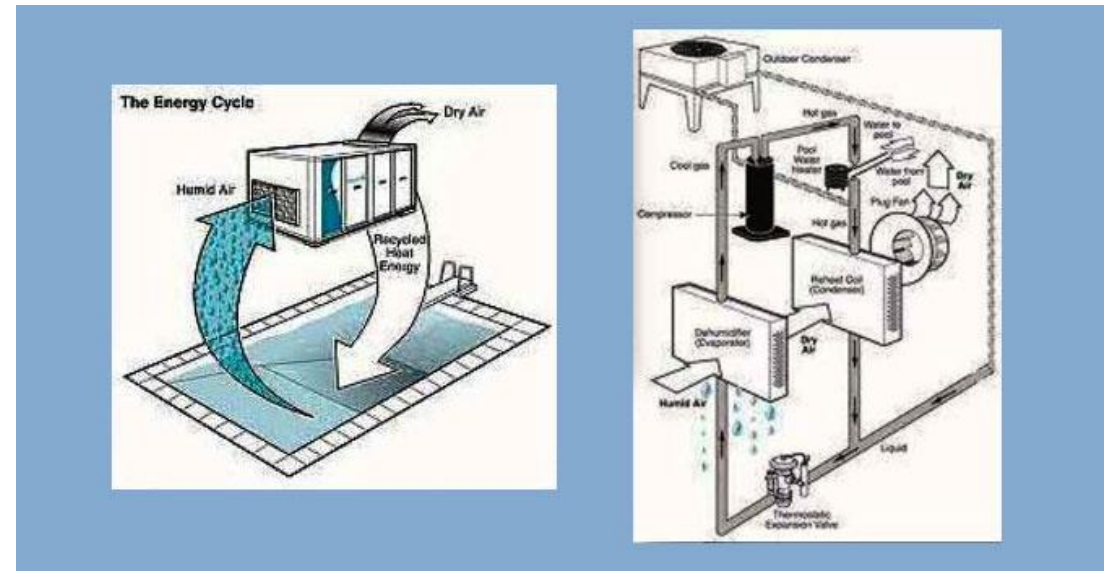
- Typically used for Data Centers
- Circulation allows for cooling to pass through the Data Center to keep equipment cool



# HVAC Other Systems

## DHU

- Dehumidification Units
- Typically for pools and Aquatic environments
- Coils will be specially treated for high chemical concentrations and to remove humidity from the air
- May have heat rejection off of the coils to heat pool water



# HVAC Other Systems

## General Exhaust

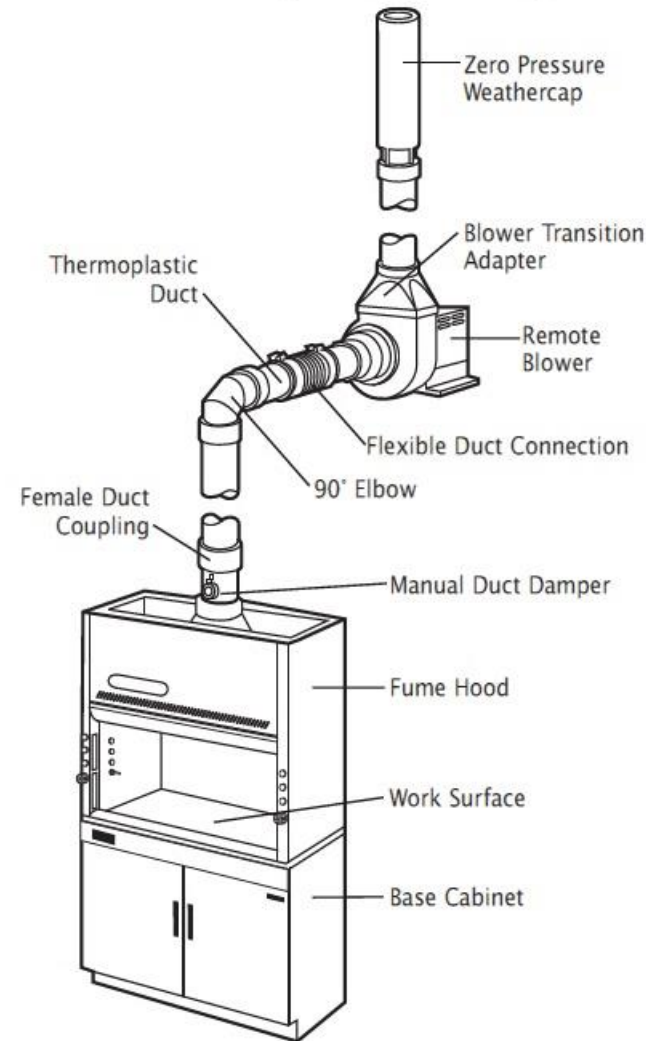
- Exhaust is Required in areas such as Restrooms in general at 75 CFM per WC or Urinal
- Exhaust Fans come in numerous types
  - Wall Mount
  - Inline
  - Roof Mount



# HVAC Other Systems

## Lab Exhaust

- Laboratory Exhaust has different requirements as the air may not be designated as clean
- It may require filtering prior to exhausting
- It may have to be rejected into a plume high into the atmosphere





# Recap HVAC

- HVAC
  - Codes & Standards
  - Heating and Cooling Equipment
  - Ductwork
  - Other Systems