

HVACR

Comfort

Equipment required to control:

Temperature

Moisture

Air movement

Indoor air quality

May have separate boilers, pumps, etc.

Heat Generating

Heat generating equipment

Boilers

Coal

Natural gas

Oil

Propane

Electricity

Steam or hot water

http://www.southernboilers.in/F13535/steam_boilerssmoke_tube_boilers.html

Furnaces

Furnaces

Heat source and fan in the same cabinet

Burning fuel in heat exchanger warms air passed across it for delivery to space

Typical fuels used are natural gas, propane and oil

Refrigeration

Refrigeration equipment

Low and medium temperatures provided for food storage

High temperature provided for air conditioning

Home units use refrigerant directly in coil

Refrigeration

Refrigeration equipment

Water chillers produce cold water for distribution

Condenser may be air-cooled or tied to cooling tower

Heat Exchangers

Coils are air-liquid heat exchangers

Shell and tube are liquid-liquid or steam-liquid

HVACR

Heat pumps

- Use refrigerant for heat transfer

- Normal air conditioning during summer

- Draw heat from colder outside air in winter

- Need supplemental heat when very cold

- Defrost cycle required in winter to remove ice build-up from outside coil

Air Handling Units

Combine equipment to bring in outside air with central filtration, fans, heating and cooling coils, humidifiers, etc.

Connected to ductwork to distribute conditioned air to the space

HVACR

Air distribution

Ductwork

Fans

Air cleaning devices (primarily filters)

Terminal units

Ductwork

Ductwork provides the path for conditioned air

Galvanized steel most common

Resistant to atmospheric corrosion

Holds up well to repeated bending

Metal Ductwork

Other metal ductwork materials:

Stainless steel – corrosive and high temperature environments

Aluminum – corrosion-resistant, lighter than galvanized, cannot be used at high temperatures

Copper – high corrosion resistance, very costly – used as architectural metal

Ductwork

Other metal ductwork materials:

Lead – high corrosion-resistance, used in acid baths and x-ray booths

Zinc – corrosion-resistant, very brittle compared to galvanized

Plastics, including PVC, CPVC, FRP and others – used in certain chemical environments

Plastic Ductwork

PVC and CPVC may require special fire protection due to smoke generation hazards

Used when no other alternatives available

Duct Board

A rigid fiberglass panel combining duct and insulation in one product

Lower cost

Becoming more common in homes

Ductwork Sealing

Ductwork should be sealed

Leakage affects both fan performance and the ability to meet heating and cooling loads

United McGill estimates 10-15% duct leakage is common, resulting in increased fan energy consumption of 33-52% (United McGill Corp.'s Engineering Report No. 145, Duct Leakage and System Performance)

Fans

Fans

Devices used to move air to and from spaces

Also circulates air within the space

Two major classifications

- Centrifugal

- Axial

Centrifugal Fans

Centrifugal fans pull air along the shaft and discharge it radially away from the shaft

Classified based on their blade shape

- Forward-curved

- Backward-inclined

- Backward-inclined with airfoil blades

Forward Curved Fans

Forward-curved fans

Move high volumes of air at low static pressures

Low blade speed

Lowest initial cost of all centrifugal fans

Lowest efficiency of all centrifugal fans

Backward Inclined Fans

Backward-inclined fans

Fan wheel blades inclined away from flow

Operate over wide pressure range

High blade speed

Higher initial cost

Higher efficiency

Backward Inclined Airfoil Fan

Backward-inclined airfoil fan:

- Backward-inclined blades with airfoil shape

- Wide pressure range

- High blade speed

- Highest initial cost

- Highest efficiency

Axial Fans

Pull air along the shaft and discharge it in the same direction

Divided into three classes:

Propeller

Tubeaxial

Vaneaxial

Propeller Axial Fans

Propeller axial fans:

Move high volumes of air at very low static pressures

Low pressure

Not suitable for most HVAC system applications

May be ring-mounted or hung free (ceiling fan)

Tubeaxial Fans

Tubeaxial fan

- Propellers mounted in tubular enclosure

- Large air volumes

- Low static pressure

- Relatively compact, straight-through design may eliminate elbows

Vaneaxial Fan

Vaneaxial fan

Tubeaxial fan with flow straightening vanes

Vanes in front of or behind blades

More efficient

More costly

Filters

Air cleaning devices (filters)

Primarily mechanical air filters and electronic air cleaners

Most filters made of fibrous media

Varying efficiencies

Air Devices

Air terminal units and devices

Dampers

- Isolation

- Control

- Balancing

- Fire and smoke

Mixing and variable air volume boxes

Diffusers, registers and grilles

Isolation Dampers

Isolation dampers

Used to block flow when not required (such as block outside air when the air handling unit is off or the space is unoccupied)

Isolation butterflies

Parallel flow dampers

Control Dampers

Control dampers

Modulate airflow to meet space requirements

Opposed-blade

Butterfly

Balancing Dampers

Balancing dampers

Used to add resistance to system and match airflow to system design

Fire and Smoke Dampers

Fire and smoke dampers

Prevent passage of fire, smoke, or both where ductwork penetrates fire or smoke walls

Mixing Boxes

Mixing and variable air volume boxes

Dampers and controls

Control airflow amount based on heat/cool
or

Mix two airstreams to provide space with
specific temperature air

Diffusers, Registers, Grilles

Diffusers, registers and grilles

Diffusers – ceiling-mounted

Registers – supply air, wall or floor-mounted

Grilles – return air, ceiling, wall or floor mounted

Diffusers

Diffusers

Ceiling-mounted

Commercial structures

May be adjustable

Registers and Grilles

Registers and Grilles

Usually wall or floor mounted

Registers are adjustable, used for supply air

Grilles are non-adjustable, used for return air

Controls

HVAC Instrumentation and Controls

All systems require controls

Residential systems use thermostats

Commercial systems use built-up control systems

Most control systems today are digital (DDC)

Digital Controls

Direct digital controls (DDC)

Microprocessor-based

Provide remote communication and troubleshooting capabilities

Front-end Building Automation System (BAS) used for interface

Testing

Testing, Adjusting and Balancing

Critical step in commissioning process

Test to document existing conditions

Adjust to match contract requirements

Balance to provide acceptable space conditions in accordance with system design requirements

System balance best performed by independent contractor (AABC)