

# Plumbing

# Mechanical Systems

Materials and systems that bring buildings to life

Piping

Plumbing fixtures and equipment

Heating equipment

Refrigeration equipment

Air distribution

HVAC instrumentation and controls

# Piping

Major part of building infrastructure

Building services

Domestic water, sanitary, waste, vent

Storm drainage

Heating and cooling, refrigerant

Process piping

Air, gasses, water, waste

Fire protection

# Piping

Most common material: steel

Welded in larger sizes

Screwed in smaller sizes

Mechanical joints also an option

# Piping

Not all materials are compatible with steel

Some refrigerants, corrosive or acidic fluids

Corrosion reactions with moisture may  
contaminate product

Exposed piping where exterior corrosion a  
problem: galvanized steel

# Piping

Stainless steel often used in corrosive environments

- More expensive than steel

- Not compatible with all corrosive fluids

# Piping

Copper used for:

- Plumbing supply

- Many refrigerants

Dielectric unions required to interface with steel system

# Piping

Waste piping often run in cast iron for noise control

[reference.findtarget.com/search/cast%20iron/](https://reference.findtarget.com/search/cast%20iron/)



# Piping

PVC and other plastics or composites are used for residential sprinkler and plumbing piping, or in cases where the fluid being moved is incompatible with metal pipe.

# Fire Protection Piping

Automatic fire protection (sprinkler) systems to protect people and equipment

Commercial sprinkler piping steel

Residential sprinkler piping plastic.

# Fire Protection Piping

Sprinkler heads. normally open in a deluge system

Open individually based on reaching a temperature of 160°F

- Glass bulb that breaks

- Fusible link that melts to open the head.

# Piping and Valve Identification

ASME Standard A13.1-2007 has pipe and label colors for process fluids

Painted

Stenciled or pre-fabricated markers

Valves tagged and referenced to valve schedule

# Valves

Typically steel, stainless steel or bronze  
Plastic and PVC valves available for  
corrosive environments

Valves perform three functions:

- Isolate flow

- Control flow quantity

- Direct flow

# Valves

## Isolation valves:

Ball

Gate

Butterfly

Check

Swing

Spring-loaded

# Valves

## Ball valves

- Positive shut-off

- Smooth operation

- Most expensive, especially in larger sizes

# Valves

## Gate valve

- System isolation

- Least expensive

- May not provide positive shutoff after long periods due to build-up of material in seat



# Valves

## Butterfly

Both shut-off and throttling service

Positive shutoff against high pressure may not be possible

Tight shutoff valves very expensive

# Valves

## Check valves

Prevent reverse flow in system, especially during periods of shutdown

Swing check

Spring-loaded check

# Valves

## Flow control valves

Globe valves

Angle valves

Needle valves

Butterfly valves

# Valves

## Globe valves

- Precise flow control

- High pressure drop

- Flow-to-close:

  - Fluid pressure helps close valve for tight shutoff

- Flow-to-open

  - Flow pressure assists in quick-opening

# Valves

## Angle valve

Combination of globe valve and elbow

Frequently used on radiators

# Valves

## Needle valve

Flow control on very small lines

Similar performance to gate valves

# Valves

## Control valves

Three-way diverting valves

3-way mixing valves

# Insulation

Reasons to insulate pipe:

Temperature control

Safety

Condensation

Sound control



# Insulation

## Fiberglass

- Low cost

- Jacketed with heavy paper or aluminized plastic coating

- Foil-lined for vapor barrier

- Common covers include canvas, thin plastic or thin sheet metal

# Insulation

## Asbestos

Present in older installations

Safe when intact, but friable asbestos presents respiratory hazards

Abatement must be done by professionals

# Insulation

Flexible elastomeric material

Expanded, closed-cell, cross-linked rubber type compound

Both thermal insulation and vapor barrier

Common on refrigerant piping

No high temperatures

# Insulation

Fiberglass and flexible elastomeric insulation also used for equipment insulation

# Identification

Identification part of 15015, Basic Mechanical Materials and Methods

Labeling required both safety and maintenance

ASME standard specifies standard colors

Valve schedule required to locate all valves

# Pumps

Move fluids within systems

Two classifications:

Positive displacement

Move fixed quantity of fluid relatively independent of upstream or downstream pressure

Kinetic or centrifugal

Convert mechanical energy into hydraulic energy by means of centrifugal action

# Pumps

## Positive displacement

- Highly viscous liquids

- Liquids containing abrasives

- Moves constant fluid volume independent of downstream pressure

  - Rotary lobe and vane pumps

  - Peristaltic pumps

  - Reciprocating pumps

# Pumps

Rotary lobe pumps successively compress fluid as lobes rotate

Vane pumps have offset center, spring-loaded vanes



# Pumps

## Peristaltic pump

Fluid contained within thin plastic tubing

Rollers or lobes compress tubing, moving the fluid along

Maintains 100% isolation of fluid from machinery

# Pumps

## Reciprocating pump

Similar to reciprocating compressor

Used in hydraulic systems

Can create very high output pressures

# Pumps

## Kinetic pumps

Use centrifugal action to convert mechanical energy into hydraulic energy

Centrifugal pumps:

Low-head, high flow

Regenerative turbine pumps:

High head increases at low flow rates

# Pumps

## Centrifugal Pumps

Circulating pumps in domestic water systems

Distribution pumps in larger HVAC systems

Circulating pumps for HVAC coils and heating loops

# Pumps

## Horizontal split case

- Straight-through piping configuration

- Motor attached to side of pump, so footprint larger than some other configurations

- Mechanical seals or stuffing boxes required

# Pumps

## Vertical split case

Suction line either at right angle to discharge  
or both suction and discharge on top of pump

No lower bearing or shaft seal

Reduced floor space requirements

# Pumps

## Vertical In-line

- No lower bearing or shaft seal

- Motor mounted vertically above pump

- Minimizes floor space

- Available in both very large and very small sizes

# Pumps

## Regenerative turbine

High head increases

Lower flow requirements

Can handle volatile fluids with low flash points  
(vaporizes at low temperatures)



# Plumbing Fixtures

Typically selected by the architect and plumbed by the mechanical

Two classes of equipment

Residential

Commercial

# Plumbing Fixtures

## Water closet

### Toilet

Most residential units have tank with float valve

# Plumbing Fixtures

Water closet

Toilet

Commercial units have flushometer valves

Fixed quantity of high pressure water for flushing

# Plumbing Fixtures

## Urinal

Flushing device and drain for flushing away urine

Only handle liquids, so design simple than water closet

Single and multi-user designs common

# Plumbing Fixtures

## Lavatories and sinks

Variety of designs for residential and commercial applications

# Plumbing Fixtures and Equipment

## Bathtubs and showers

Common in residences

Also present in sports training or other commercial facilities

# Plumbing Fixtures

## Drinking fountains and water coolers

Drinking fountains provide tap water

Water coolers have self-contained refrigeration systems to provide cool water for drinking

# Plumbing Equipment

## Safety showers and eye wash stations

Provide water deluge to decontaminate from chemical contamination

Provide water flush to remove chemicals from eyes



# Plumbing Equipment

## Water heaters

- Tanks with heating elements

  - Natural gas

  - Electric

- Tankless heaters

<http://blogs.dailyrecord.com/domestitech/2009/04/14/the-water-heater-of-my-worry-free-dreams/>

# Plumbing Equipment

## Backflow preventers

Isolate incoming water stream from downstream system

Required to protect potable water from process water

Required for residential connection of dishwashers, etc.