• **VALVES:** A valve is a device to control the flow of liquid.

**Valve.**—A valve is a closure device in which the closure member remains fixed axially with respect to the fluid way and is either rotated or moved longitudinally to control the flow of water.
SELECTION OF VALVES

The control function
- Isolation valve
- Regulation valve
- Non Return valve
- Relief valve
- Safety valve
- Special valve

The fluid being transported
- Erosion caused by particles in suspension
- Viscosity of the fluid
- Corrosion caused by the fluid itself
- Temperature and pressure

The friction Loss:
TYPES OF VALVES

- Cocks
- Plug Valves
- Screw down stop valves
- Wedge gate sluice valves
- Parallel slide valves
- Diaphragm valve
- Butterfly valve
- Swing check valves
- Lift check valves
- Spring type safety valve
- Pilot operated safety valve
- Ball float valves
- Pressure reducing valves
Isolating valves

Gate valve

Plug valve

Ball
Regulating valve

Globe valve

Angle valve
Non return valve
Other special valves used in Hydro station

- Butterfly valve
- Spherical valve
- Annular sluice valve
- Directional control valve
Butterfly valves

- Used in low pr lines - low maintenance - low noise
Spherical valves are applied mostly as shut off valves in front of high head water turbines.
ANNULAR SLUICE VALVE
Basic elements of valves
## Selection material for valves

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>TEMP</th>
<th>PRESSURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cast Iron &amp; Bronze</td>
<td>220 Deg</td>
<td>10 to 13 ksc</td>
</tr>
<tr>
<td>Carbon steel Forging</td>
<td>426</td>
<td>17 ksc</td>
</tr>
<tr>
<td>Alloy steel (Alloying Elements Mo, v, Ni, Cr)</td>
<td>Super Critical temp</td>
<td>Super Critical Pressure</td>
</tr>
<tr>
<td>Stainless Steel</td>
<td></td>
<td>For Chemicals</td>
</tr>
</tbody>
</table>
## Valve seat and Disc Material

<table>
<thead>
<tr>
<th></th>
<th>VALVE BODY</th>
<th>YOKE, BONNET AND COVER</th>
<th>DISC/WEDGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 425 deg C</td>
<td>Carbon steel material</td>
<td>Forged steel</td>
<td>Carbon steel with seat hard facing to 13% Cr or Stellite</td>
</tr>
<tr>
<td>Above 425 deg C</td>
<td>Low alloy steel with Cr. Mo. used</td>
<td>Alloy steel with Cr. Mo contents</td>
<td>Low alloy steel with Cr. Mo. And hard facing of stellite</td>
</tr>
<tr>
<td><strong>Valve seat and Disc Material</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>STEM</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Up to 425 deg C</td>
<td>13% Cr or Stellite</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Above 425 deg C</td>
<td>Creep resisting steel</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gland group</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gland packing</td>
<td>Knitted asbestos yarn with solid lubricants like Graphite’s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gland cover Bolt and Nut</td>
<td>Carbon steel Normally</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Maintenance of Gate valve

• Running maintenance or on load maintenance

• Leakage through
  Flange joint- Tighten the bolts & Nuts.
  Bonnet joint- Tighten the bolts & Nuts.
  Gland - Open the valve fully for back seating and tighten the gland bolts or change the glands.

• Difficulty in Opening and Closing
• Exercising the valve
<table>
<thead>
<tr>
<th>DEFECT</th>
<th>CAUSES</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seat Passing</td>
<td>1. Damage to body and Wedge. 2. Incorrect Operation.</td>
<td>Machining and Lapping</td>
</tr>
<tr>
<td>Leakage Through Body/Bonnet Joint</td>
<td>1. Insufficient Bolt tightening. 2. Damaged gasket. 3. Damage to the Sealing surface of body and yoke.</td>
<td>Tighten uniformly Replace the Gasket Machining</td>
</tr>
<tr>
<td>Operational Difficulty</td>
<td>1. Insufficient lubrication. 2. Over tightening of Gland packing. 3. Incorrect Packing. 4. Stem Bend.</td>
<td></td>
</tr>
<tr>
<td>Leakage through Gland Packing</td>
<td>1. Insufficient Gland pressure. 2. Insufficient Packing Rings</td>
<td></td>
</tr>
</tbody>
</table>
1. Machining – will be necessary if the disc or seat badly damaged
2. Lapping – is an operation of bringing surfaces to high degree of smoothness- adopted for slight pitting or scars.
3. Check the run out of spindle should not exceed 0.025mm

Reconditioning methods
Butterfly Valve maintenance

Butterfly Valve

1. Leaf
2. Seal
3. Adjustable Seal
4. Vent Valves
5. Bypass Line
6. Guard Valve
7. Service Valve with Manual or Power-Driven Operator
8. Rubber Inserts
9. Adjusting Screw
10. Locking Bolt
11. O-Rings
12. Oil Pipe
13. Cylinder
14. Piston
15. Crank (Valve Closed)
16. Drain
17. Stem

FLOW
OPEN
FLOW

Seal Adjustment Arrangement
DEFECTS IN BUTTERFLY VALVE

• BEARING FAILURE IN TRUNION
• TRUNION SEAL LEAK
• VALVE DISC SEAT EROSION
BUTTER FLY VALVE TRUNION

- Stainless outer ring
- Bronze inner ring
- Seals
- Clamp ring
- Rubber seal
- STAINLESS SEAT
DEFECTS IN SPHERICAL VALVE

- EROSION OF MOVING AND FIXED SEAT IN SPHERICAL VALVE
- TRUNION SEAL FAILURE
- OPERATING CYLINDER LEAK
- HIGH PRESSURE WATER LINE PUNCTURE
- BYPASS VALVE LEAK
Maintenance of spherical valve

- Pressure line
- Fixed Seat
- Plug
- Movable seat
Maintenance of spherical valve
Valves are the devices which will control:

- Flow
- Pressure
- Direction
Isolating valve - A valve intended for use only in the closed or fully open position.

Regulating valve - A valve intended for use in any position between closed and fully open.

Control valve - A power-operated device which changes the fluid flowrate in a process control system.
LINEAR Valve Features

- TORTUOUS FLOW PATH
- LOW RECOVERY
- CAN THROTTLE SMALL FLOW RATES
- OFFERS VARIETY OF SPECIAL TRIM DESIGNS
- SUITED TO HIGH-PRESSURE APPLICATIONS
- USUALLY FLANGED OR THREADED SEPARABLE BONNET
Rotary Valve Features

STREAMLINED FLOW PATH
HIGH RECOVERY
MORE CAPACITY
LESS PACKING WEAR
CAN HANDLE SLURRY AND ABRASIVES
FLANGELESS
INTEGRAL BONNET
HIGH RANGEABILITY
• **Linear movement valves** - The obturator moves in a straight line. Included in this category are gate valves, globe valves, diaphragm valves and pinch valves. These valves are covered in greater depth within this tutorial.

**Isolation Valves - Rotary Movement.**
Rotary movement valves - The obturator rotates about an axis at right angles to the direction of flow. Ball valves and butterfly valves are the two most important rotary valves associated with steam applications and are covered in greater depth in Tutorial
TYPES
QUARTER TURN VALVES
BALL, PLUG, BUTTERFLY
MULTI TURN VALVES
GLOBE, GATE
Self actuated
SWING CHECK, WAFTERCHECK, LIFT CHECK
MULTI TURN VALVES

ADVANTAGES
GRADUAL OPENING,
REDUCES HAMMER EFFECT

DISADVANTAGES
REQUIRES MORE TIME TO OPERATE

QUARTER TURN

ADVANTAGES
FASTER OPERATION

DISADVANTAGES
DOWNSTREAM IS PRONE FOR HAMMER EFFECT
Primary Selection parameters

Nature of media
Temperature
Pressure
Flow
valve body material such as bronze, iron, steel, stainless steel and plastic. The valve body may be produced with one material and the trim, may or may not be made of the same material.
Valve trim is exposed to flow media and may be made of a different material than the valve body. The trim is normally more corrosion resistant than the valve body, so that corrosion is less likely to occur at the valve seating area.
The valve is actually stated by the NPS of the valve end connection. You should know that NPS is the abbreviation for Nominal Pipe Size. It refers to the named size of the pipe. The NPS of the valve end connections must always match the NPS of the line in which it is to be installed.
Ductile iron valves can be used in applications that experience vibration and shock. Ductile iron absorbs shock and also has good corrosion resistance.
No size limitations for iron valves, these valves have temperature limits. Cast iron has a temperature limit of approximately 450 F. and ductile iron has a limit of 650F.
Valves are also made of steel and stainless steel. Steel valves can be separated into two categories based on how the valve is made. Forged steel and/or cast steel. Forged steel is formed from heated slugs, which are forged into the valve shape by huge forging hammers and presses. Cast steel is melted in a furnace and then poured into molds in a foundry.
Forged steel valves are used when higher pressures and temperatures are involved and the line size is generally under 2-1/2”. Other factors could also favor the selection of forged steel, such as system requirements for socket-weld piping and compatibility of media.
The gate valve is a general service valve used primarily for on-off. The valve is closed by a flat face, vertical disc, or gate that slides down through the valve to block the flow.
Material
Gun Metal
Cast Iron
Cast Steel
Stainless Steel
Alloy Steel
Connection End
Screwed
Flanged
Usage
Water
Chemicals
steam
Sizes
3/8" to 12"
CHECK VALVE
The check valve is designed to prevent backflow. Fluid flow in the desired direction opens the valve, while backflow forces the valve closed.
Material
Gun Metal
Cast Iron
Cast Steel
Stainless Steel
Alloy Steel
Connection End
Screwed
Flanged
Usage
Water
Chemicals
Sizes
3/8" to 12"
BALL VALVE
The ball valve uses a rotating ball with a hole through it that allows straight-through flow in the open position and shuts off flow when the ball is rotated 90 degrees to block the flow passage.
Material
Gun Metal
Cast Iron
Cast Steel
Stainless Steel
Alloy Steel
Polypropylene
End Connection

Screwed
Flanged
Socket Weld
Usage
Water
Chemicals
Steam
Sizes
¼" to 6"
GLOBE VALVE

The globe valve effects closure by a plug with a flat or convex bottom lowered onto a matching horizontal seat located in the center of the valve. Raising the plug opens the valve, allowing Service media flow.
Connection End
Screwed
Flanged
Usage
Water
Chemicals
Steam
Sizes
3/8" to 12"
Material
Cast Iron
Cast Steel
Stainless Steel
Alloy steel
BUTTERFLY VALVES

The butterfly valve controls flow by using a circular disc with its pivot axis at right angles to the direction of flow in the pipe.
Actuators

A manual actuator employs levers, gears to facilitate movement; automatic actuator has an external power source to provide the force to operate a valve. Power actuators are a necessity on valves in pipelines located in remote areas.
a
Anticlockwise
Air is supplied forcing the pistons away from each other (towards the ends), rotating the drive pinion anticlockwise.

b
Clockwise
Air failure (loss of pressure) allows compressed springs to force pistons towards each other (toward centre), rotating the drive pinion clockwise and exhausting the air.
Connection End

Wafer

Flanged

Usage

Water

Chemicals

Sizes

$\frac{1}{2}''$ to 12''
Installation
Pipe Flange Connections

Incorrect installation!
Pipe flanges are misaligned.
Butterfly disc edge will hit pipe flange
Resulting in valve damage and leakage.

Correct Installation
Pipe flanges are aligned and centered.
ADVANTAGES

Functional design
Smaller space requirement
Excellent flow characteristics
High grade safety
FEATURES

Replaceable / Bonded seat.
Square coupling between stem/disc.
Self lubricating bearings.
Machined disc to reduce the operating torque.
Easy disassembling
RANGE

PRESSURE RATING: PN10/PN16

SIZE RANGE: 40mm - 600mm

OPERATION: HAND LEVER, WORM GEAR, ACTUATOR
M O C

BODY
DISC
SEAL
SHAFT
CASTIRON
DUCTILE
IRON/S.S
E.P.D.M/Nitrile
AISI 410
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Control Valve Classification

- Linear Motion
  - Globe
    - Diaphragm
      - Pinch or Clamp
        - Gate
    - Angle
    - 3-Way
  - Single Seated
  - Double Seated
  - Split Bodied

- Rotary Motion
  - Eccentric Plug
    - Swing-Through
    - Lined
    - Eccentric
  - Butterfly
  - Ball
    - Segmented
    - Full
    - V-Notch
LINEAR Valve Features

TORTUOUS FLOW PATH
LOW RECOVERY
CAN THROTTLE SMALL FLOW RATES
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Cast Steel
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Alloy Steel
Connection End

Screwed

Flanged

Usage

Water

Chemicals

steam

Sizes

3/8" to 12"
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HORIZONTAL LIFT CHECK

SWING CHECK
Material
Gun Metal
Cast Iron
Cast Steel
Stainless Steel
Alloy Steel
Connection End
Screwed
Flanged
Usage
Water
Chemicals
Sizes
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Cast Steel
Stainless Steel
Alloy Steel
Polypropylene
End Connection

Screwed
Flanged
Socket Weld
Usage
Water
Chemicals
Steam
Sizes
$\frac{1}{4}''$ to 6''
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Wafer
Flanged
Usage
Water
Chemicals
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