Valve Pressure Loss & Flow

- The valve coefficient, Cv, is a number which represents the capability of a valve (or any flow component) to flow a fluid. The larger the Cv, the larger the flow at a given pressure differential. Cv is the number of U.S. gallons per minute that will pass through a valve with press drop of 1 psi. For example, a Cv of 150 would then equate to 150 gpm of water at 60° F with a differential pressure of one psi.

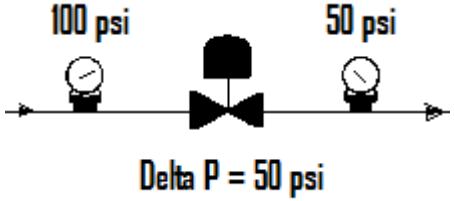
- Cv is determined by counting the number of gallons that pass through the valve with 1 psi applied pressure between the valve inlet the outlet at 0 psi. Cv is a mathematical constant. For a pressure drop other than 1 psi, a value can be calculated.

- Cv factors typically apply to full open/full closed valves, e.g., solenoid valves, ball valves, etc. Valves held open without aid of pressure.

- Cv does not apply to modulating or regulating valves, spring loaded check valves, etc., that incorporate a control spring or opposing gas charge or bellows since more than 1 psi is required just to start positioning the valve mechanism.

Differential Pressure

- Differential, Delta, Δ, refers to the pressure drop across a flow component – valve, screen, etc. Delta is the 'change' in something; in this case a change, or drop, in pressure. To determine the ΔP across a valve, simply subtract the outlet pressure (P2) from the inlet pressure(P1).
- The equation is P1-P2 = DP



Pressure Drop and Back Pressure

- Pressure drop across a valve is highly influenced by the area, shape, path and roughness of the valve.
- Resistance to flow creates backpressure. Perforations, screens, tubing, valves, chokes and regulators all contribute to both backpressure and pressure loss. In production, vertical flow creates back pressure.
- In either downhole flow or surface flow, it is important to identify the backpressure potential.
- In a surface piping system, valve performance can be adversely affected if their maximum pressure or differential pressure ratings are exceeded.
- Pressure drop is created by flow rate. The higher the flow rate through a restriction, the greater the pressure drop.

Calculating Cv

- How do the GPM, Cv factor, and work together to size a valve? - At least two of these elements are necessary to properly specify a valve. One sizing formula:
  - Where G = Specific Gravity of the Fluid

$$GPM = C_V\sqrt{\frac{\Delta P}{G}} \qquad C_V = \frac{GPM}{\sqrt{\frac{\Delta P}{G}}} \qquad \Delta P = \left[\frac{GPM}{C_V}\right]^2 G$$

Pressure Regulator vs. Back Pressure Regulator

- A backpressure regulator is a normally closed valve installed at the END of a flow system to provide provide pressure in order to draw fluid off the system.
- A pressure regulator is a normally open valve and is installed upstream of pressure sensitive equipment to regulate or reduce undesirable pressure.

Solenoid Valves

- Solenoid valves are commonly electronically activated to open to a certain point and usually default to a desired position, referred to as fail-safe, upon loss of power.

Valve Material Choice

- Material compatibility requires knowledge of type, concentration, temperature flow rate and abreasive or corrosive nature of fluids being handled and choice of compatible valve components (body and seals) at the extremes of the ranges of conditions.

Valve Diameter

- Don’t assume a 4” valve will handle the flow in a 4” line – the flow path is the critical factor and shape of the flow passage in the valve can be a problem. Look at the pressure through the valve – if the valve creates a pressure drop, a slightly larger valve may be needed.
- There is no industry-wide standard pressures for valve sizes; no two manufacturers design a 4" valve the same way, and different designs have different pressure considerations.
- Outlet pressure, for example, may be critical to spring loaded or gas charged valves.
- Valve Design Factors:
  - Rate and erosion compatability,
  - Minimum and maximum inlet pressures,
  - Minimum and maximum differential pressure,
  - Outlet or backpressures,
  - Temperature range,
  - Speed of closure and potential for water hammer,

Velocity Limits

- Generally accepted safe velocity for a thermoplastic piping system is 5 feet per second.
- In steel piping systems, flow limits of depend on density of the fluid, corrosiveness of the fluid, solids (content, size, density, velocity and angularity) and whether the flow is a single phase fluid.

Electrically Operated Valves

- Incorrect actuator voltages and electrical enclosure types creates problems and risk.
- Incorrect voltage on a solenoid valve or a valve actuated by an electric motor, can cause poor operation and the actuator or coil may overheat, and could cause a fire.
- NEMA ratings on electrically actuated valves are designed to provide for safety.

Chemical Metering Pumps

- Works where metering valves from a manifold are inefficient.
- Metering valves open and close to admit chemical from a manifold – often hooked to a programmable logic controller (PLC) that is affected by surges in flow from unsteady state production. Ends up over-treating and creating problems.