LIQUID FLOW C_V EQUATION

$$C_v = \frac{Q\sqrt{G}}{\sqrt{\Delta P}}$$

This equation applied to all liquids including cryogenic liquids.

LEGEND

- C_v - Flow coefficient
- Q - Flow in GPM
- ΔP - Differential Pressure (Difference between inlet and outlet pressure) in PSI.
- G - Specific Gravity (Taken from Properties of Liquids)

EXAMPLE

GIVEN: Flow - 20 GPM of Water
Inlet pressure - 100 PSIG
Outlet pressure - 95 PSIG

FIND THE C_v REQUIRED.

SOLUTION

Q = 20 GPM
Inlet pressure = 100 PSI
Outlet pressure = 95
ΔP = 5 PSI
Media = Water
Specific Gravity of Water = 1.0

$$C_V = \frac{Q\sqrt{G}}{\sqrt{\Delta P}} = \frac{20\sqrt{1.0}}{\sqrt{5}}$$

$$C_V = \frac{20 \times 1}{2.24} = 8.9$$

NOTE

1 GALLON OF WATER EQUALS 8.336 LBS.
1 LB. OF WATER EQUALS .1198 GALLONS

GAS FLOW C_v EQUATION
SUBSONIC FLOW

DEFINITION

Flow is subsonic when the ΔP (differential pressure) is less than 1/2 of the inlet pressure.

$$C_v = \frac{Q\sqrt{G}}{\sqrt{P_2 \Delta P}}$$

LEGEND

- C_v - Flow coefficient
- Q - Flow in SCFM
- ΔP - Differential Pressure (Difference between inlet and outlet pressure) in PSI.
- G - Specific gravity of Media (Taken from Properties of Gases)
- P_1 - Inlet pressure in PSIA (PSIG + 14.7)
- P_2 - Outlet pressure in PSIA (PSIG + 14.7)

EXAMPLE

GIVEN: Flow - 100 SCFM of N_2
Inlet Pressure - 100 PSIG
Outlet Pressure - 75 PSIG

FIND THE C_v REQUIRED.

SOLUTION

Q = 100 SCFM N_2
Inlet Pressure = 100 PSIG
P_1 = 100 PSIG + 14.7 = 114.7 PSIA
Outlet Pressure = 75 PSIG
P_2 = 75 PSIG + 14.7 = 89.7 PSIA
$\Delta P = P_1 - P_2$ = 114.7 PSIA - 89.7 PSIA
ΔP = 25 PSI
Media = N_2
Specific Gravity of N_2 = 0.067

$$C_v = \frac{Q\sqrt{G}}{\sqrt{P_2 \Delta P}}$$

$$C_v = \frac{100\sqrt{0.967}}{\sqrt{89.7 \times 25}}$$

$$C_v = \frac{100 \times 0.983}{\sqrt{2242}} = \frac{98.33}{47.4} \qquad C_v = 2.07$$

GAS FLOW C_v EQUATION
SONIC FLOW

DEFINITION

Flow is sonic when the ΔP (Differential Pressure) is equal to or greater than 1/2 of the inlet pressure.

$$C_v = \frac{Q\sqrt{G}}{P_1/2}$$

LEGEND

- C_v - Flow coefficient.
- Q - Flow in SCFM.
- ΔP - Differential Pressure (Difference between inlet and outlet pressure) in PSI.
- G - Specific Gravity of Media. (Taken from Properties of Gases)
- P_1 - Inlet Pressure in PSIA. (PSIG + 14.7)
- P_2 - Outlet Pressure in PSIA. (PSIG + 14.7)

EXAMPLE

GIVEN: Flow = 100 SCFM of N_2
Inlet Pressure = 100 PSIG
Outlet Pressure = 25 PSIG

FIND THE C_v REQUIRED.

SOLUTION

Q = 100 SCFM of N_2
Inlet Pressure = 100 PSIG
P_1 = 100 PSIG + 14.7 = 114.7 PSIA
Outlet Pressure = 25 PSIG
P_2 = 25 PSIG + 14.7 = 39.7 PSIA
$\Delta P = P_1 - P_2 = 114.7 - 39.7 = 75$ PSI
Media - N_2
Specific Gravity of N_2 = 0.967

$$C_v = \frac{Q\sqrt{G}}{P_1/2} = \frac{100\sqrt{0.967}}{114.7/2} = \frac{100 \times 0.9533}{57.35}$$

$C_v = 1.7$