Control Valve Sizing Formula for Gas and Vapour Service

A. Subcritical Flow $\Delta P < 0.5\, C_1^2 P_1$	B. Critical Flow $\Delta P \geq 0.5\, C_1^2 P_1$
Volumetric Flow	
$C_V = \frac{Q}{295}\sqrt{\frac{GT}{\Delta P(P_1+P_2)}}$	$C_V = \frac{Q\sqrt{GT}}{257\ C_1 P_1}$
Flow by Weight	
$C_V = \frac{47.2W}{\sqrt{\Delta P\,(P_1+P_2)\,G_1}}$	$C_V = \frac{54.5W}{C_1 P_1\sqrt{G_1}}$
For Saturated Steam	
$C_V = \frac{72.4W}{\sqrt{\Delta P\,(P_1+P_2)}}$	$C_V = \frac{83.7W}{C_1 P_1}$
For Superheated Steam	
$C_V = \frac{72.4(1+0.00126T_{sh})W}{\sqrt{\Delta P\,(P_1+P_2)}}$	$C_V = \frac{83.7(1+0.00126T_{sh})W}{C_1 P_1}$

Where:

C_V = Valve flow coefficient

C_1 = Critical flow factor

G_1 = Gas specific gravity (air = 1.0)

G = Specific gravity @ flowing temperature

$$= G \times \frac{288}{T}$$

P_1 = Upstream pressure, bars absolute

P_2 = Downstream pressure, bars absolute

ΔP = Actual pressure drop $P_1 - P_2$, bars

Q = Gas flow rate at 15°C and 1013 millibars abs. m^3/h

T = Flowing temperature °K (273 + °C)

T_{sh} = Steam superheat, °C

W = Flow rate, 1000 kg per hour