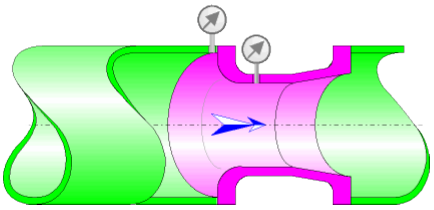
# Venturi nozzle
# (ISO 5167-1:1991)



**Model description:**

This model of component determines the fluid flow through a Venturi nozzle flowmeter, according to the international standard “ISO-5167-1:1991”.

**Model formulation:**

---

Diameter ratio:

$$\beta = \frac{d}{D}$$

---

Orifice cross-sectional area ($m^2$):

$$s = \pi \cdot \frac{d^2}{4}$$

---

Pipe cross-sectional area ($m^2$):

$$S = \pi \cdot \frac{D^2}{4}$$

---

Mean velocity in orifice (m/s):

$$v = \frac{q_v}{s}$$

---

Mean velocity in pipe (m/s):

$$V = \frac{q_v}{S}$$

---

Reynolds number referred to orifice diameter:

$$\mathrm{Re}_d = \frac{v \cdot d}{\nu}$$

---

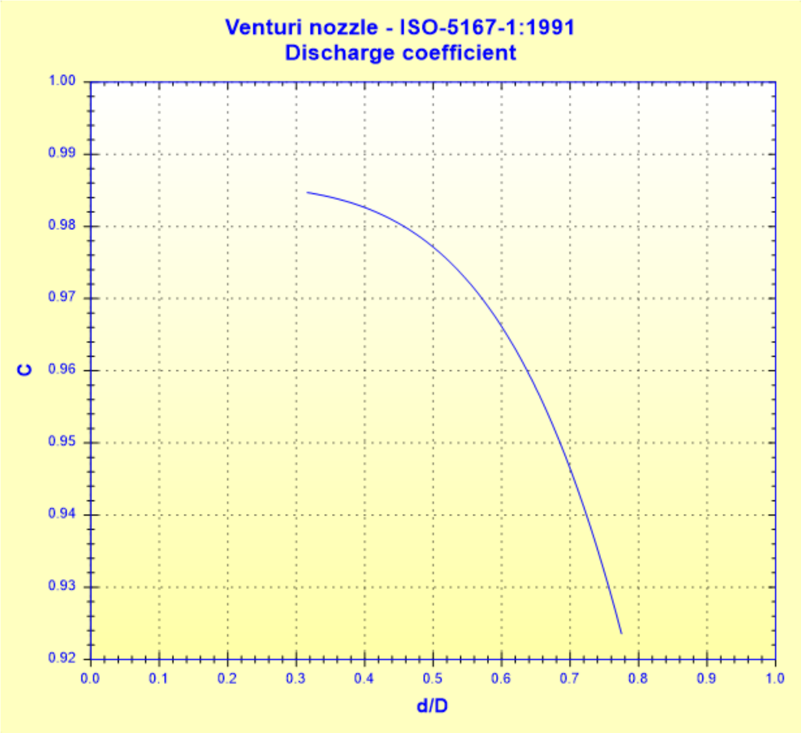
Reynolds number referred to internal pipe diameter:

$$\mathrm{Re}_D = \frac{V \cdot D}{\nu}$$

Discharge coefficient:

$$C = 0.9858 - 0.196 \cdot \beta^{4.5}$$

([1] §10.2.4.2)




Expansibility factor:

$$\varepsilon = 1$$

([1] §3.3.5) for incompressible fluid (liquid)

Mass flow rate (kg/s):

$$q_m = \frac{C}{\sqrt{1-\beta^4}} \cdot \varepsilon \cdot \frac{\pi}{4} \cdot d^2 \cdot \sqrt{2 \cdot \Delta p \cdot \rho}$$

([1] §5.1 eq. 1)

Volume flow rate ($m^3/s$):

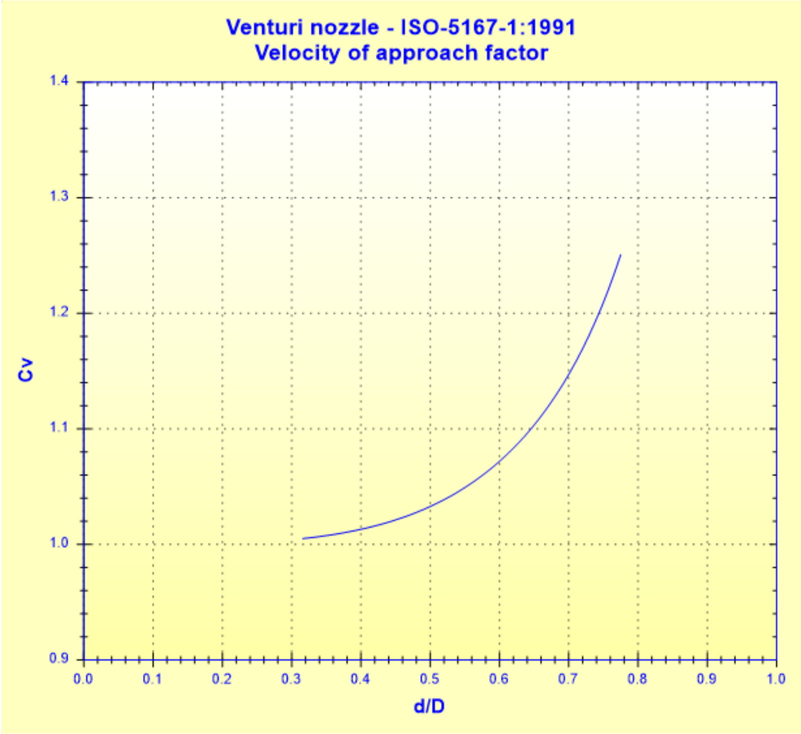
$$q_v = \frac{q_m}{\rho}$$

([1] §5.1 eq. 3)

Velocity of approach factor:

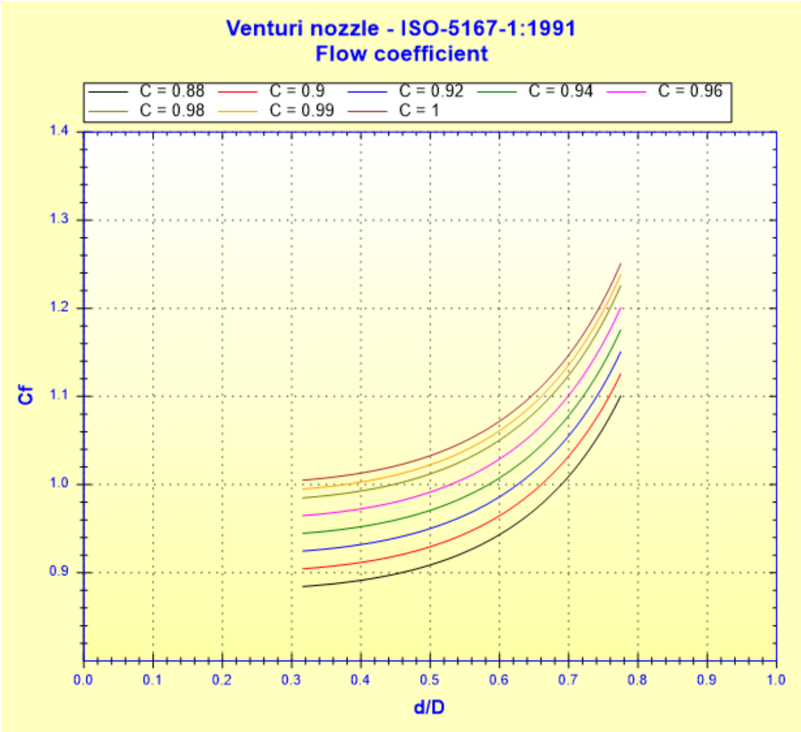
$$C_v = \frac{1}{\sqrt{1-\beta^4}}$$

([1] §3.3.4)




Flow coefficient:

$$\boxed{C_f = C \cdot \frac{1}{\sqrt{1-\beta^4}}}$$ ([1] §3.3.4)




Net pressure loss (Pa):

The net pressure loss is not formulated in the reference document [1]

Measured head loss (m):

$$\boxed{\Delta H = \frac{\Delta P}{\rho \cdot g}}$$

**Symbols, Definitions, SI Units:**

| | |
|---|---|
| d | Orifice diameter (m) |
| D | Internal pipe diameter (m) |
| $\beta$ | Diameter ratio () |
| s | Orifice cross-sectional area ($m^2$) |
| S | Pipe cross-sectional area ($m^2$) |
| $q_v$ | Volume flow rate ($m^3/s$) |
| v | Mean velocity in orifice (m/s) |
| V | Mean velocity in pipe (m/s) |
| $Re_d$ | Reynolds number referred to orifice () |
| $Re_D$ | Reynolds number referred to pipe () |
| C | Discharge coefficient () |
| $\varepsilon$ | Expansibility factor () |
| $q_m$ | Mass flow rate (kg/s) |
| $C_v$ | Velocity of approach factor () |
| $C_f$ | Flow coefficient () |
| $\Delta P$ | Measured pressure loss (Pa) |
| $\Delta H$ | Measured head loss of fluid (m) |
| | |
| $\rho$ | Fluid density ($kg/m^3$) |
| $\nu$ | Fluid kinematic viscosity ($m^2/s$) |
| g | Gravitational acceleration ($m/s^2$) |

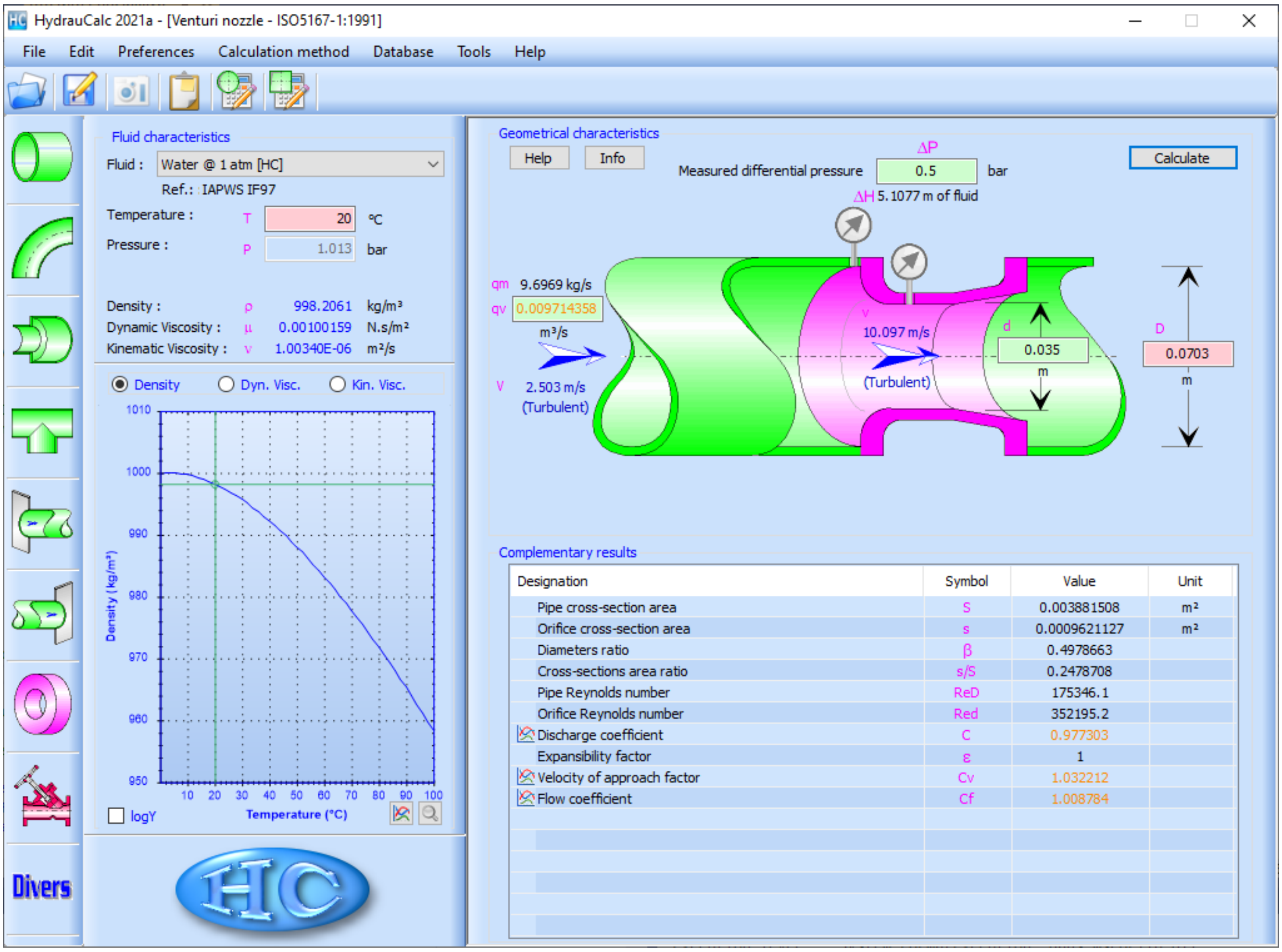
---

**Limit of use** ([1] §10.2.4.1):

- 65 mm $\leq$ D $\leq$ 500 mm
- d $\geq$ 50 mm
- $0.316 \leq \beta \leq 0.775$
- $1.5 \cdot 10^5 \leq Re_D \leq 2 \cdot 10^6$

---

**Example of application:**




## References:


[1] ISO 5167-1:1991 - Measurement of fluid flow by means of pressure differential devices