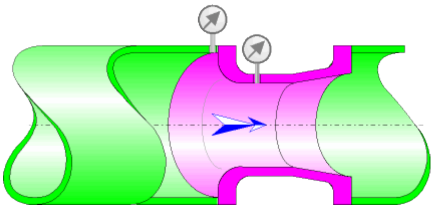
Venturi nozzle
(ISO 5167-3:2003)



Model description:

This model of component determines the fluid flow through a Venturi nozzle flowmeter, according to the international standard "ISO-5167-3:2003".

Model formulation:

Diameter ratio:

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

Orifice cross-sectional area (m²):

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

Pipe cross-sectional area (m²):

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

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:

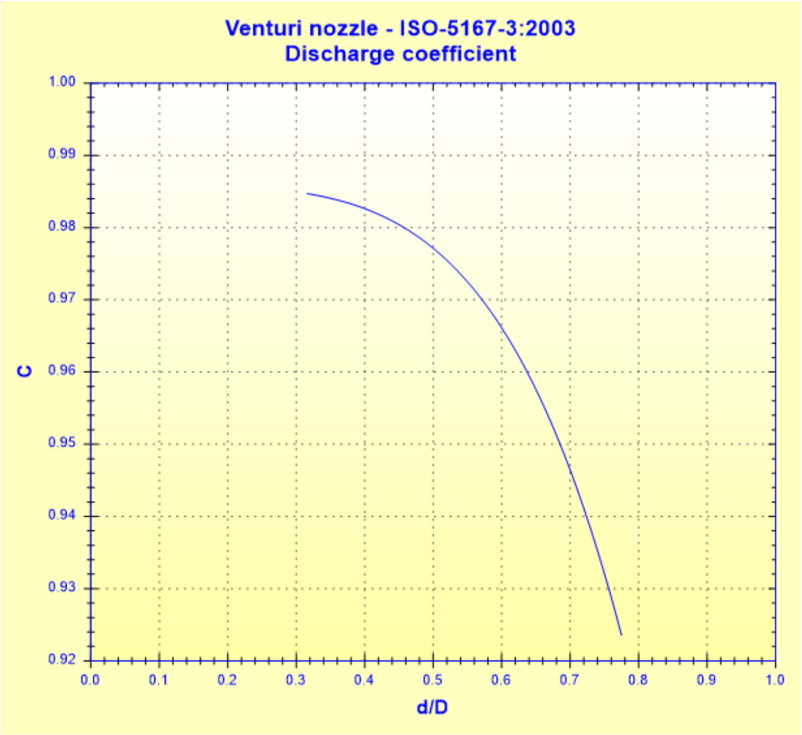
$$\mathrm{Re}_d = \frac{v \cdot d}{\nu}$$

Reynolds number referred to internal pipe diameter:

$$Re_D = \frac{V \cdot D}{\nu}$$

Discharge coefficient:

$$C = 0.9858 - 0.196 \cdot \beta^{4.5}$$ ([2] § 5.3.4.2)



Expansibility factor:

$$\varepsilon = 1$$ ([1] §3.3.6) for incompressible fluid (liquid)

Mass flow rate (kg/s):

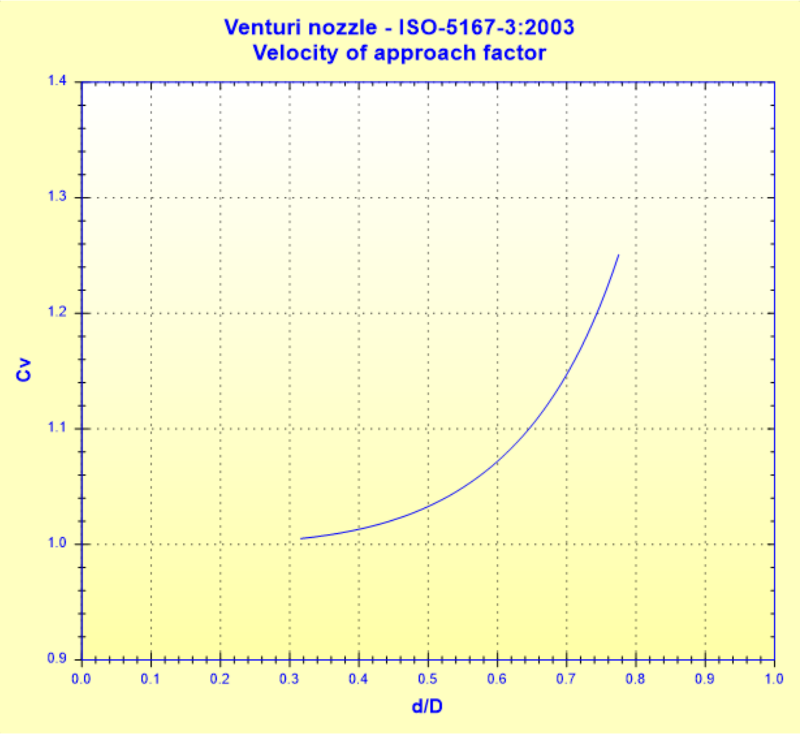
$$q_m = \frac{C}{\sqrt{1-\beta^4}} \cdot \varepsilon \cdot \frac{\pi}{4} \cdot d^2 \cdot \sqrt{2 \cdot \Delta p \cdot \rho}$$ ([1] §5.1 eq. 1 and [2] §4 eq. 1)

Volume flow rate (m^3/s):

$$q_v = \frac{q_m}{\rho}$$ ([1] §5.1 eq. 3 and [2] §4 eq. 2)

Velocity of approach factor:

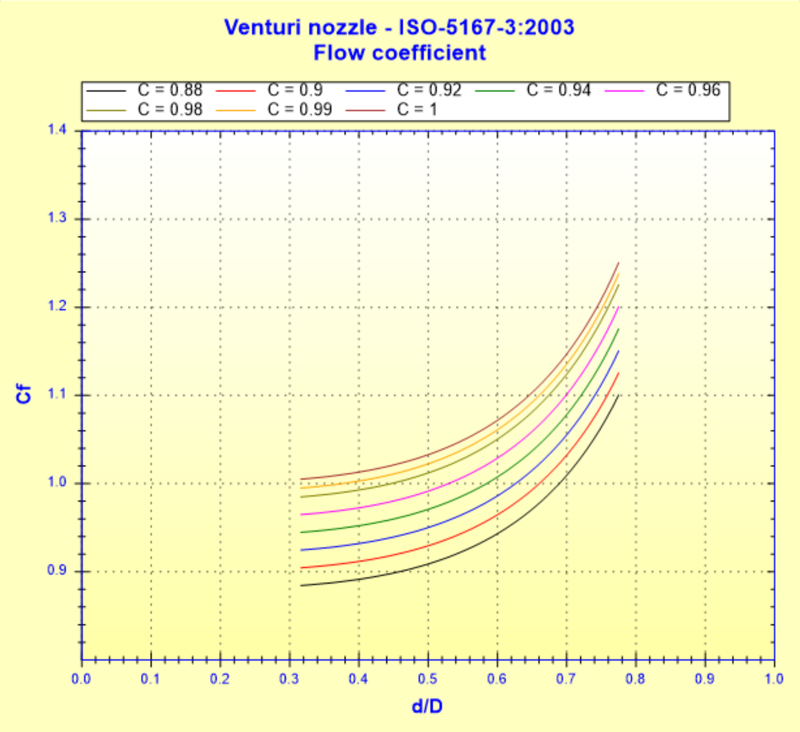
$$C_v = \frac{1}{\sqrt{1-\beta^4}}$$ ([1] §3.3.4)



Flow coefficient:

$$C_f = C \cdot \frac{1}{\sqrt{1-\beta^4}}$$

([1] §3.3.5)



Net pressure loss (Pa):

The net pressure loss is not formulated in the reference document [2]

Measured head loss (m):

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

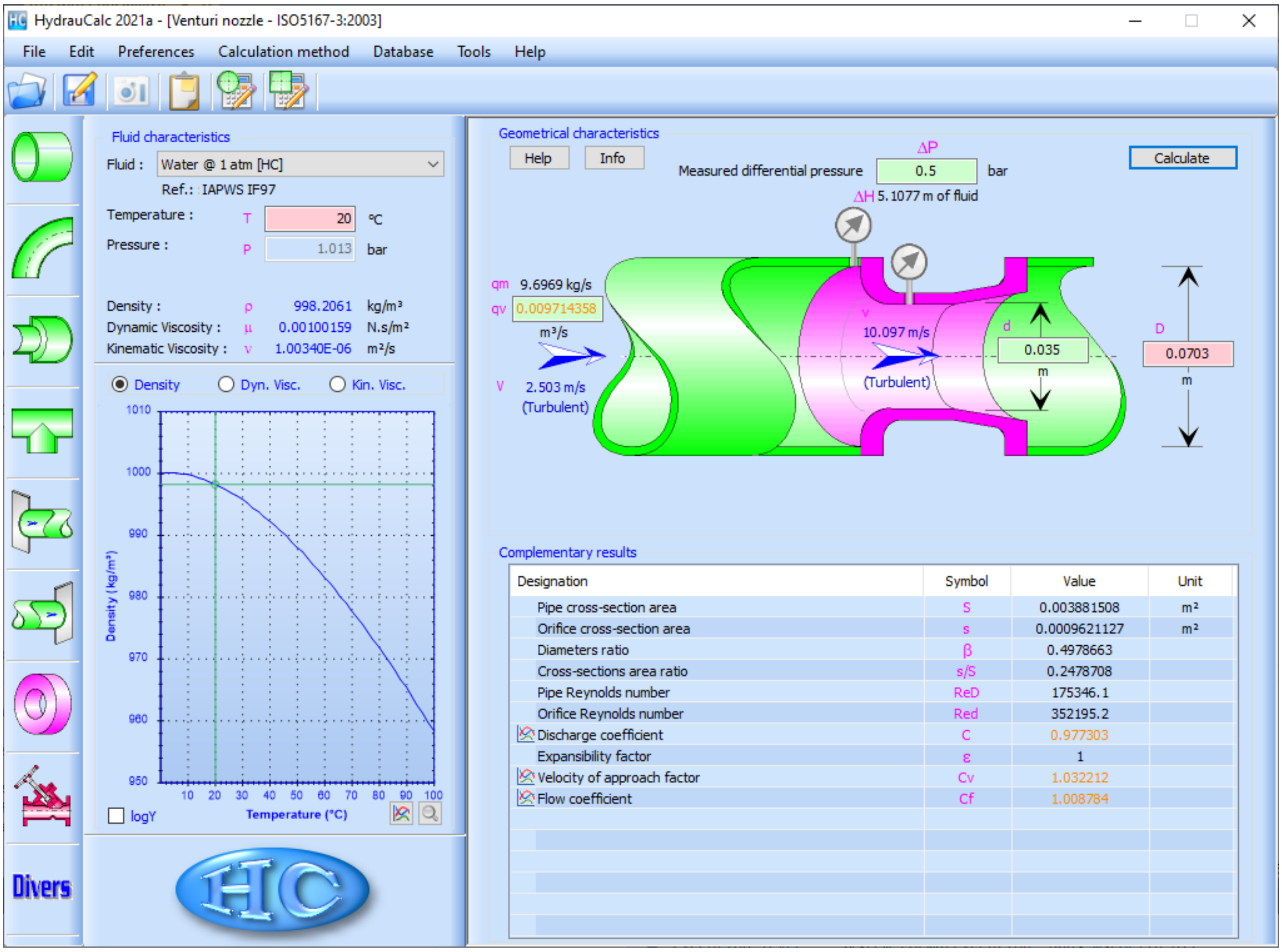
Symbols, Definitions, SI Units:

d	Orifice diameter (m)
D	Internal pipe diameter (m)
β	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 ()
ε	Expansibility factor ()
q_m	Mass flow rate (kg/s)
C_v	Velocity of approach factor ()
C_f	Flow coefficient ()
ΔP	Measured pressure loss (Pa)
ΔH	Measured head loss of fluid (m)
ρ	Fluid density (kg/m^3)
ν	Fluid kinematic viscosity (m^2/s)
g	Gravitational acceleration (m/s^2)

Limit of use ([2] §5.3.4.1) :

- 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 5167-1:2003 - Measurement of fluid flow by means of pressure differential devices inserted in circular-cross section conduits running full
Part 1: General principles and requirements

[2] ISO 5167-3:2003 - Measurement of fluid flow by means of pressure differential devices inserted in circular-cross section conduits running full
Part 3: Nozzles and Venturi nozzles