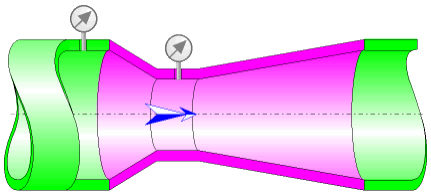
# Classical Venturi tube with a machined convergent section (ISO 5167-4:2003)



**Model description:**

This model of component determines the fluid flow through a classical Venturi tube with a machined convergent section, according to the international standard "ISO-5167-4:2003".

**Model formulation:**

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Diameter ratio:

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

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

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

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

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

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Mean velocity in orifice (m/s):

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

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Mean velocity in pipe (m/s):

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

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Reynolds number referred to orifice diameter:

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

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Reynolds number referred to internal pipe diameter:

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

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Discharge coefficient:

$$C = 0.995$$ ([2] §5.5.3)

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Expansibility factor:

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

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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)

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

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

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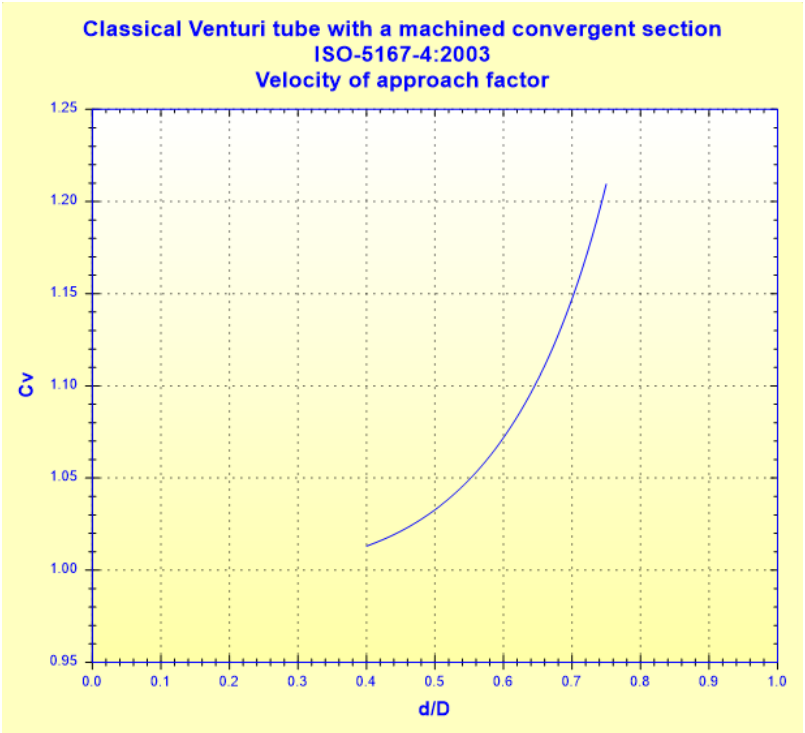
Velocity of approach factor:

$$C_v = \frac{1}{\sqrt{1-\beta^4}}$$ ([1] §3.3.5)

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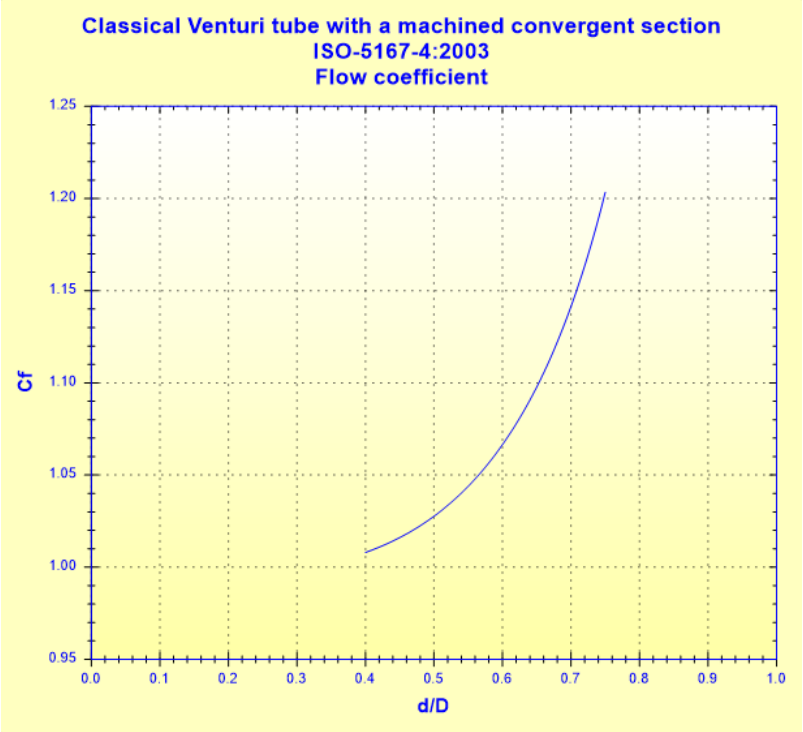
Flow coefficient:

$$C_f = C \cdot \frac{1}{\sqrt{1-\beta^4}}$$ ([1] §3.3.5)

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Net pressure loss:

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

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Measured head loss (m):

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

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**Symbols, Definitions, SI Units:**

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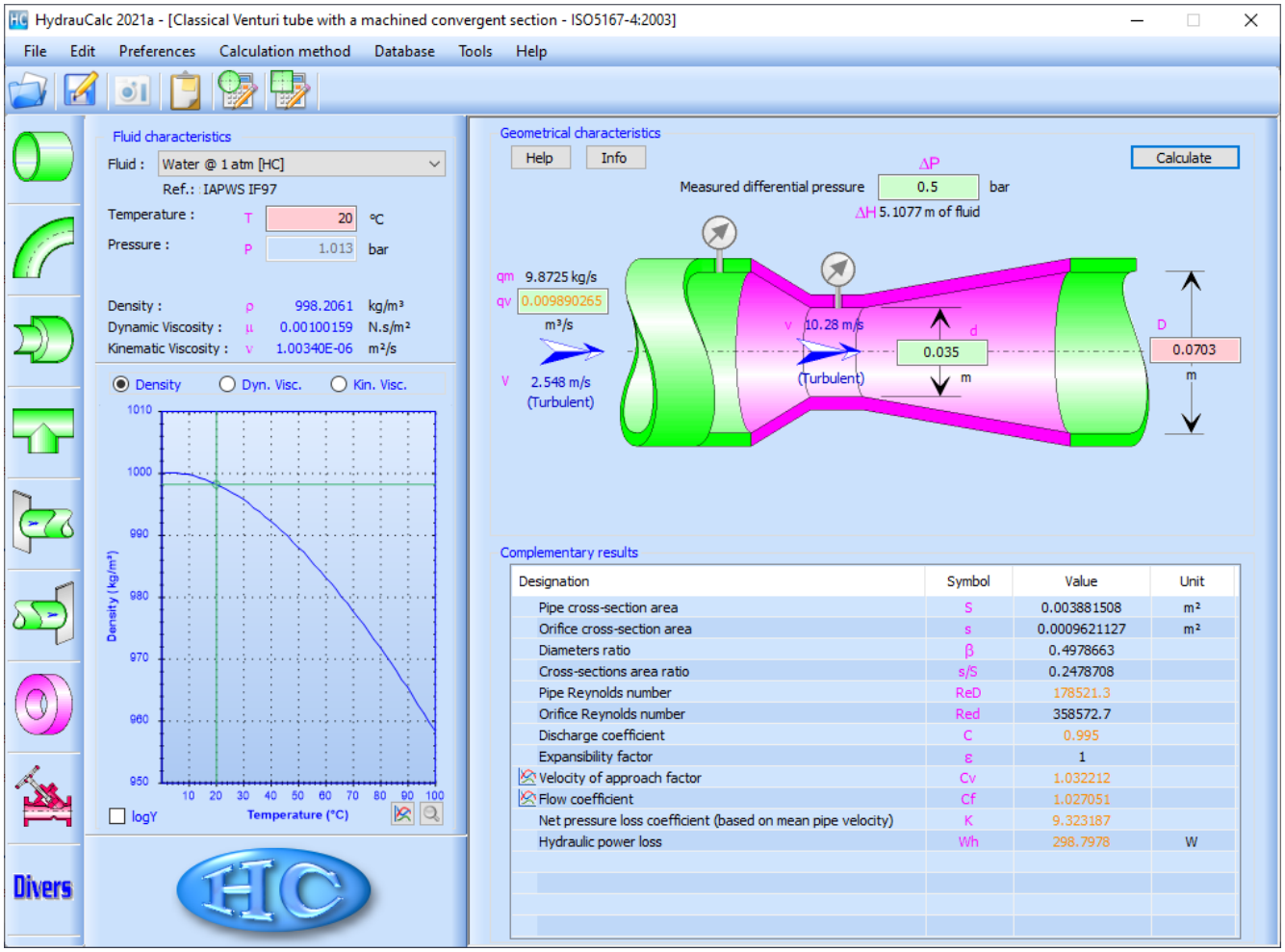
|---|---|
| d | Orifice diameter (m) |
| D | Internal pipe diameter (m) |
| β | Diameter ratio () |
| s | Orifice cross-sectional area ($m^2$) |
| S | Pipe cross-sectional area ($m^2$) |
| $q_v$ | Volume flow rate ($m^3/s$) |
| v | Mean velocity in orifice (m/s) |
| V | Mean velocity in pipe (m/s) |
| $Re_d$ | 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] §5.5.3):

- $50\ mm \leq D \leq 250\ mm$
- $0,4 \leq \beta \leq 0,75$
- $2 \cdot 10^5 \leq Re_D \leq 1 \cdot 10^6$

**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 5167-4:2003 - Measurement of fluid flow by means of pressure differential devices inserted in circular-cross section conduits running full
Part 4: Venturi tubes