Individual g-const

$$R_{ch4} := 518 \frac{J}{kg \cdot K}$$

$$D := 1.9mm$$

$$\Delta p := 1kPa$$

Noz. coef.

$$\alpha_{noz} := 0.5$$

Density

$$\rho := 0.656 \frac{kg}{m^3}$$

Isentropic exp.

$$\kappa := 1.317$$

$$T_1 := 290K$$

$$p_2 := 1atm$$

$$p_1 := p_2 + \Delta p$$

Dynamic viscosity

$$\mu := 1 \cdot 10^{-5} \frac{kg}{\frac{m}{s}}$$

Kinematic viscosity

$$\nu := 1 \cdot 65^{-5} \frac{m^2}{s}$$

Burner tube geometry

$$D_2 := \frac{13mm}{2}$$

$$A_2 := \pi \left(\frac{D_2}{2}\right)^2 = 33.183\,mm^2$$

Specific vol.

$$v_1 := \frac{R_{ch4} \cdot T_1}{p_1} = 1.468 \frac{m^3}{kg}$$

Ideal speed

$$c_{2s} := \sqrt{2 \cdot \frac{\kappa \cdot 2}{\kappa - 1} \cdot p_1 \cdot v_1 \cdot \left[1 - \left(\frac{p_2}{p_1}\right)^{\frac{\kappa - 1}{\kappa}}\right]}$$

$$\boxed{c_{2s} = 76.774 \frac{m}{s}}$$

Real speed

$$\boxed{c_2 := c_{2s} \cdot \alpha_{noz} = 38.387 \frac{m}{s}}$$

Calculation based on measured flow rate

Flow rate (air) x √(1/Relative Density (NG))

$$V_{air} := \begin{pmatrix} 5.33 \\ 5.25 \\ 4.25 \end{pmatrix} \frac{l}{min}$$

$$RD_{ng} := 0.656$$

$$V_{ng} := V_{air} \cdot \sqrt{\frac{1}{RD_{ng}}}$$

$$V_{ng} = \begin{pmatrix} 0.395 \\ 0.389 \\ 0.315 \end{pmatrix} \cdot \frac{m^3}{hr} \qquad V_{ng} = \begin{pmatrix} 6.581 \\ 6.482 \\ 5.247 \end{pmatrix} \cdot \frac{l}{min}$$

Alt. veloc. calc.

$$A := \pi \cdot \left(\frac{D}{2}\right)^2 = 2.835 \cdot mm^2$$

$$v := \frac{V_{ng}}{A} = \begin{pmatrix} 38.684 \\ 38.103 \\ 30.845 \end{pmatrix} \frac{m}{s}$$

$$Massflowrate := V_{ng} \cdot \rho = \begin{pmatrix} 0.259018 \\ 0.255131 \\ 0.206534 \end{pmatrix} \cdot \frac{kg}{hr}$$

Reynolds number

$$Re := \frac{V_{ng} \cdot D_2}{\nu \cdot A_2} = \begin{pmatrix} 24928008.505 \\ 24553854.531 \\ 19876929.858 \end{pmatrix}$$