

Velocity Calculation

The basic formula is as follows:

$$V = K \times C \times \sqrt{\Delta P} \times \frac{\sqrt{T_{stack} + 273}}{\sqrt{M \times P}}$$

where

- V = stack gas velocity (m/s)
- K = pitot tube velocity constant (34.97)
- C = velocity pressure coefficient (for S-type pitot=0.84) (dimensionless)
- $\sqrt{\Delta P}$ = square root of differential pressure of stack gas (mmH₂O)
- T_{stack} = stack temperature (°C)
- M = molecular weight of stack gas, wet basis (g/g mole)
- P = absolute stack gas pressure (mm.Hg)

K

K is the velocity constant for pitot tubes and is set to 34.97.

C

C is the velocity pressure coefficient and for S type pitot tubes is around 0.84. This parameter should be adjusted for the individual pitot tubes used in the specific application.

Molecular Weight

M is the molecular weight of the stack gas on a wet basis in g/g mole. To calculate this value the component of the stack gas must be known. In general the main components are CO₂, O₂ and N₂ plus water. The dry weight is calculated by:

$$M_{dry} = 44 \frac{\%CO_2}{100} + 32 \frac{\%O_2}{100} + 28 \frac{\%CO}{100} + 28 \frac{\%N_2}{100}$$

When

- M_{dry} = dry molecular weight of stack gas (g/g mole)
- %CO₂ = percentage CO₂ in gas stream
- %O₂ = percentage O₂ in gas stream
- %CO = percentage CO in gas stream
- %N₂ = percentage N₂ in gas stream
- 44 = molecular weight of carbon dioxide (g/g mole)
- 32 = molecular weight of oxygen (g/g mole)
- 28 = molecular weight of carbon monoxide and nitrogen (g/g mole)

This can then be converted to a wet basis by:

$$M_{wet} = M_{dry}(1 - B_{wo}) + 18(B_{wo})$$

When

- M_{wet} = wet molecular weight of stack gas (g/g mole)
- M_{dry} = dry molecular weight of stack gas (g/g mole)
- B_{wo} = proportional of water vapor in the gas stream by volume
- 18 = molecular weight of water in (g/g mole)