Burner Air Throat Velocity and Pressure Drop

Combustion air velocity in a burner throat and the air-side pressure drop by the orifice equation, from air flow, temperature, pressure and throat diameter.

Method: Continuity and orifice equation Δp = (ṁ/(C_d A))²/(2ρ); dry-air molar mass (US Standard Atmosphere composition)

Input parameters

Unit system: SI

Parameter	Value	Unit
Air flow to the burner	30.000	t/h
Air temperature	250.00	°C
Air pressure (absolute)	104.00	kPa
Throat diameter	550.00	mm
Discharge coefficient 0.8 is a FireCAD starting value for a rounded throat; use the burner maker's figure. The pressure drop scales with 1/C_d².	0.80000	

Calculated results

Parameter	Value	Unit
Air density	0.69257	kg/m³
Throat velocity	50.646	m/s
Air-side pressure drop	141.52	mmWC

Notes for this case

- Hot air needs a larger throat for the same pressure drop; check at maximum and minimum firing.

Formula and method

$$\rho_a = \frac{p\,M_{da}}{R\,T_a}, \quad A = \frac{\pi d^2}{4}, \quad v = \frac{\dot{m}_a}{\rho_a A}, \quad \Delta p = \frac{1}{2\rho_a}\left(\frac{\dot{m}_a}{C_d A}\right)^2$$

Variables

$\dot{m}_a$	Air flow to the burner	kg/s
T_a	Air temperature	K
p	Air pressure (absolute)	Pa
d	Throat diameter	m
C_d	Discharge coefficient	-
ρ_a	Air density	kg/m³
A	throat area	m²
M_{da}	molar mass of dry air, 28.96	kg/kmol
R	universal gas constant	J/(kmol·K)
v	Throat velocity	m/s
Δp	Air-side pressure drop	Pa

Method and standards

Dry-air density by the ideal-gas law at the throat temperature and pressure, continuity for the velocity, and the orifice equation with a discharge coefficient for the pressure drop. The default C_d of 0.8 is a FireCAD starting value, not a published one; the drop scales with $1/C_d^2$, so use the burner maker's figure.

Assumptions and limits

- Incompressible flow.
- Dry air: combustion air humidity (1–2 % by mass) lowers the density slightly, so the velocity is a little higher than shown.

References

- Continuity and orifice equation $\Delta p = (\dot{m}/(C_d\,A))^2/(2\rho)$; dry-air molar mass (US Standard Atmosphere composition)

Report details

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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/boilers-power-plant/combustion/burner-air-throat-velocity

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.