Plume Rise and Effective Stack Height (Briggs)

Buoyancy flux of a hot stack plume, distance to final rise, Briggs final plume rise for neutral and unstable air, and the effective stack height.

Method: Briggs (1975) plume rise equations as used in US EPA dispersion models (de Nevers, Air Pollution Control Engineering, 2nd ed. (McGraw-Hill, 2000), ch. 6)

Input parameters

Unit system: SI

Parameter	Value	Unit
Physical stack height	60.000	m
Stack exit diameter	2.5000	m
Exit velocity	15.000	m/s
Exit gas temperature	150.00	°C
Ambient temperature	30.000	°C
Wind speed at stack top	4.0000	m/s

Calculated results

Parameter	Value	Unit
Buoyancy flux (m⁴/s³)	65.181	
Distance to final rise	632.70	m
Final plume rise	118.64	m
Effective stack height	178.64	m

Notes for this case

- Briggs buoyant rise for neutral and unstable air (classes A–D), with x_f = 49F^(5/8) (F < 55) or 119F^(2/5). Stable air (classes E–F) gives a lower rise that this does not compute.

Formula and method

$$F_b = g v_s d^2 \frac{T_s - T_a}{4 T_s}, \quad \Delta h = \frac{1.6 F_b^{1/3} x_f^{2/3}}{u}$$

Variables

h_s	Physical stack height	m
d	Stack exit diameter	m
v_s	Exit velocity	m/s
T_s	Exit gas temperature	K
T_a	Ambient temperature	K
u	Wind speed at stack top	m/s
F_b	Buoyancy flux (m⁴/s³)	-
x_f	Distance to final rise	m
Δh	Final plume rise	m
H	Effective stack height	m

Method and standards

Briggs buoyant rise.

Assumptions and limits

- Buoyancy-dominated plume; neutral or unstable air. Stable air gives a lower rise, not computed here.

- A temperature excess below the Briggs crossover ΔT_c (momentum-dominated plume) and stack-tip downwash (v_s < 1.5u) are flagged.

References

• Briggs (1975) plume rise equations as used in US EPA dispersion models (de Nevers, Air Pollution Control Engineering, 2nd ed. (McGraw-Hill, 2000), ch. 6)

Report details

Report reference	FCC-ZP8H-HHCM (the same inputs always give the same reference)
Generated	17 November 2026, 19:46 UTC
Calculator	Plume Rise and Effective Stack Height (Briggs)
Method last reviewed	13 November 2026
Software release	FireCAD Calc, release of 17 November 2026
Release checks	2 reference cases of this calculator, computed independently, are checked on every release

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

This calculator online

https://calc.firecad.com/environmental/air-pollution/briggs-plume-rise

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.