Optical Air Mass and Clear-Sky Beam Irradiance

Relative optical air mass from the solar zenith angle by the Kasten-Young formula, corrected for site elevation, and a simple clear-sky direct-beam irradiance.

Method: Kasten–Young relative optical air mass; Meinel clear-sky beam model

Input parameters

Unit system: SI

Parameter	Value	Unit
Solar zenith angle	48.190	°
Site elevation	0	m

Calculated results

Parameter	Value	Unit
Air mass 1/cos θ_z (flat-earth)	1.5000	
Relative air mass (Kasten–Young)	1.4980	
Pressure ratio at the elevation	100.00	%
Pressure-corrected air mass	1.4980	
Clear-sky beam irradiance (Meinel)	846.39	W/m²

Notes for this case

• Kasten–Young (1989): AM = 1/[cos θ_z + 0.50572(96.07995° − θ_z)^−1.6364], accurate to the horizon; scaled by station pressure. Meinel's clear-sky beam I_b = 1,353 × 0.7^(AM^0.678) W/m² is a rough average clear atmosphere. AM 1.5 (θ_z ≈ 48.2°) is the standard test spectrum.

Formula and method

$$AM = \frac{1}{\cos\theta_z + 0.50572(96.07995^\circ - \theta_z)^{-1.6364}}, \quad I_b = 1353 \times 0.7^{AM^{0.678}}$$

Variables

θ_z	Solar zenith angle	rad
h	Site elevation	m
AM_{sec}	Air mass 1/cos θ_z (flat-earth)	-
AM	Relative air mass (Kasten–Young)	-
p/p_0	Pressure ratio at the elevation	-
AM_p	Pressure-corrected air mass	-
I_b	Clear-sky beam irradiance (Meinel)	W/m²

Method and standards

Air mass and clear-sky irradiance.

Assumptions and limits

- Standard atmosphere pressure; Meinel model is a coarse clear-sky estimate.

References

Kasten–Young relative optical air mass; Meinel clear-sky beam model

Report details

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Release checks	3 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/electrical/solar-pv/air-mass-kasten-young

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.