Effective Sky Temperature and Radiation Loss to the Sky

Effective clear-sky temperature by Berdahl and Martin from air and dew point temperatures, sky emissivity and the radiation loss of a surface facing the sky.

Input parameters

Unit system: SI

Parameter	Value	Unit
Air temperature	20.000	°C
Dew point temperature	10.000	°C
Hour from midnight	0	h
Surface temperature	30.000	°C
Surface long-wave emittance (glass 0.88)	88.000	%
Surface slope (0 = horizontal)	0	°

Calculated results

Parameter	Value	Unit
Effective sky temperature	2.9872	°C
Sky depression below air temperature	17.013	K
Sky emissivity	0.78730	
Net radiation to the sky per unit area	131.30	W/m²
Radiation coefficient to the sky	4.8606	W/(m²·K)

Notes for this case

- Clear sky. Clouds raise the sky temperature; Berdahl and Martin's data covered dew points from −20 to 30 °C.

Formula and method

$$T_{sky} = T_a \left[0.711 + 0.0056 T_{dp} + 0.000073 T_{dp}^2 + 0.013 \cos(15t)\right]^{1/4}$$

$$q = \varepsilon \sigma \frac{1 + \cos\beta}{2} (T^4 - T_{sky}^4)$$

Variables

T_a	Air temperature	K
T_{dp}	Dew point temperature	K
t	Hour from midnight	s
T_{surf}	Surface temperature	K
ε	Surface long-wave emittance (glass 0.88)	-
β	Surface slope (0 = horizontal)	rad
T_{sky}	Effective sky temperature	K
$T_a - T_{sky}$	Sky depression below air temperature	K
ε_{sky}	Sky emissivity	-
q_{rad}	Net radiation to the sky per unit area	W/m²
$h_{r,s}$	Radiation coefficient to the sky	W/(m²·K)

Method and standards

Berdahl and Martin (1984) clear-sky correlation; T in kelvin, T_dp in °C, t hours from midnight.

Assumptions and limits

- Clear skies only.

Report details

Report reference	FCC-CB6A-J5SP (the same inputs always give the same reference)
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Calculator	Effective Sky Temperature and Radiation Loss to the Sky
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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/environmental/solar-thermal/sky-temperature-radiative-cooling

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.