



ESDU TECHNICAL MEMORANDUM

Air and ground temperature

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AIR AND GROUND TEMPERATURE

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AIR AND GROUND TEMPERATURE

1. Notation and Definitions

1.1 Notation

Symbol	Meaning	SI Units
A	bond albedo	—
B	Beta distribution (see Reference 7)	—
C_P	specific heat of air at constant pressure	$\text{Jkg}^{-1} \text{K}^{-1}$
E	rate of evaporation from surface	$\text{kgm}^{-2}\text{s}^{-1}$
E_F	energy fraction of total energy balance	—
H	sensible heat flux	Wm^{-2}
L_x	output from light meter	Lumenm^{-2}
p	atmospheric pressure	Pa
$\text{Pr}[\]$	probability of event in []	—
r	aerodynamic resistance to heat transport	sm^{-1}
R	gas constant for air	$\text{Jkg}^{-1} \text{K}^{-1}$
$(R_L)_I$	incoming long -wave radiation	W m^{-2}
$(R_L)_O$	outgoing long -wave radiation	Wm^{-2}
R_N	net radiation flux	Wm^{-2}
$(R_N)_{MAX}$	approximate mean value for solar radiation reaching outer atmosphere	Wm^{-2}
$(R_S)_I$	incoming short -wave radiation	Wm^{-2}
T_A	air temperature	K
T_G	(runway) surface temperature	K
α	surface albedo	—
ΔT	difference between ground temperature and air temperature, that is, $T_G - T_A$	K
ϵ_A	emissivity of air	—
ϵ_S	emissivity of surface	—
η	luminous efficacy	—

λ	latent heat of evaporation of water	Jkg^{-1}
σ	Stefan-Boltzmann constant	$\text{Wm}^{-2} \text{K}^{-4}$
ξ	soil heat-fraction of net radiation	–

Refer to Section 1.2 for the values of constant terms defined in this section.

1.2 Values of constant terms

The values of the constant terms defined in Section 1.1 are listed in Table 1.1.

TABLE 1.1 Values of constant terms

Term	Value	Unit
A	$0.306^{\dagger}$	–
C_P	1005	$\text{Jkg}^{-1}\text{K}^{-1}$
R	287.1	$\text{Jkg}^{-1}\text{K}^{-1}$
$(R_N)_{MAX}$	1370	Wm^{-2}
ϵ_A	1	–
ϵ_S	0	–
λ	2.45×10^6	Jkg^{-1}
σ	5.767×10^{-8}	$\text{Wm}^{-2}\text{K}^{-4}$
ξ	0	–

[†] For Earth.

1.3 Definitions

Albedo is the reflectivity of a surface in the *short-wave* region of the spectrum.

Bond albedo is the fraction of power in the total electromagnetic incident on an astronomical body that is scattered back into space.

Emissivity is the measure of an object's ability to emit infrared energy. Emitted energy indicates the temperature of the object. **Emissivity** can have a value from 0 (shiny mirror) to 1.0 (blackbody). Most organic, painted, or oxidized surfaces have **emissivity** values close to 0.95.

Latent heat is related to changes in phase between solids, liquids, and gases.

Luminous efficacy is a measure of how well a light source produces *visible* light.

Luminous efficiency is the ratio of luminous efficacy of a source and the maximum possible luminous efficacy.