Nomenclature

Symbol	Quantity	Symbol
a	Acceleration	m/s^2
a	Specific Helmholtz function, $u-Ts$,	kJ/kg
A	Area	m^2
A	Helmholtz function, $U-TS$,	kJ
AF	Air-fuel ratio	
c	Speed of sound	m/s
c	Specific heat	kJ/kg·K
c_p	Constant pressure specific heat	kJ/kg·K
c_v	Constant volume specific heat	kJ/kg·K
COP	Coefficient of performance	
COP_{HP}	Coefficient of performance of a heat pump	
COP_{R}	Coefficient of performance of a refrigerator	
d, D	Diameter	m
e	Specific total energy	kJ/kg
E	Total energy	kJ
EER	Energy efficiency rating	
F	Force	N
FA	Fuel-air ratio	
g	Gravitational acceleration,	m/s^2
g	Specific Gibbs function, $h-Ts$	kJ/kg
G	Total Gibbs function, $H-TS$	kJ
h	Convection heat transfer coefficient	W/m^2·°C
h	Specific enthalpy, $u+Pv$	kJ/kg
H	Total enthalpy, $U+PV$	kJ
h_c	Enthalpy of combustion	kJ/kmol fuel
h_f	Enthalpy of formation	kJ/kmol
h_R	Enthalpy of reaction	kJ/kmol
HHV	Higher heating value	kJ/kg fuel
i	Specific irreversibility	kJ/kg
I	Total reversibility	kJ
I	Electric current	A
k	Specific heat ratio, c_p/c_v	
k_s	Spring constant	
k_t	Thermal conductivity	
K_p	Equilibrium constant	
ke	Specific kinetic energy, $V^2/2$	kJ/kg
KE	Total energy, $mV^2/2$	kJ
LHV	Lower heating value	kJ/kg fuel
m	Mass	kg
$\dot{m}$	Mass flow	kg/s
M	Molar mass	kg/kmol
Ma	Mach number	
MEP	Mean effective pressure	kPa
mf	Mass fraction	
n	Polytropic exponent	
N	Number of moles	kmol
P	Pressure	kPa
P_{cr}	Critical pressure	kPa
P_i	Partial pressure	kPa

P_m	Mixture pressure	kPa
P_r	Relative pressure	
P_R	Reduced pressure	
P_v	Vapor pressure	kPa
P_0	Surroundings pressure	kPa
pe	Specific potential energy, gz	kJ/kg
PE	Total potential energy, mgz	kJ
q	Heat transfer per unit mass	kJ/kg
Q	Total heat transfer	kJ
$\dot{Q}$	Heat transfer rate	kW
Q_H	Heat transfer with high-temperature body	kJ
Q_L	Heat transfer with low-temperature body	kJ
r	Compression ratio	
R	Gas constant	kJ/kg·K
r_c	Cutoff ratio	
r_p	Pressure ratio	
R_u	Universal gas constant	kJ/kmol·K
s	Specific entropy	kJ/kg·K
S	Total entropy	kJ/K
s_{gen}	Specific entropy generation	kJ/kg·K
S_{gen}	Total entropy generation	kJ/K
SG	Specific weight or relative density	
t	time	s
T	Temperature	°C or K
T	Torque	N·m
T_{cr}	Critical temperature	K
T_{db}	Dry-bulb temperature	K
T_f	Bulk fluid temperature	K
T_H	Temperature of high-temperature body	K
T_L	Temperature of low-temperature body	K
T_R	Reduced temperature	
T_{wb}	Wet-bulb temperature	°C
T_0	Surroundings temperature	°C or K
u	Specific internal energy	kJ/kg
U	Total energy	kJ
v	Specific volume	m^3/kg
v_{cr}	Critical specific volume	m^3/kg
v_R	Pseudoreduced specific volume	
V	Total volume	m^3
$\dot{V}$	Volume flow rate	m^3/s
V	Voltage	V
V	Velocity	m/s
V_{avg}	Average velocity	
w	Work per unit mass	kJ/kg
W	Total work	kJ
$\dot{W}$	Power	kW
W_{in}	Work input	kJ

W_{out}	Work output	kJ
W_{rev}	Reversible work	kJ
x	Quality	
x	Specific exergy	kJ/kg
x_{dest}	Specific exergy destruction	kJ/kg
X_{dest}	Total exergy destruction	kJ
$\dot{X}_{dest}$	Rate of Total exergy destruction	kW
y	Mole fraction	
z	Elevation	m
Z	Compressibility factor	
Z_h	Enthalphy departure factor	
Z_s	Entropy departure factor	

Greek letters

α	Absorbtivity	
α	Isothermal compressibility	1/kPa
β	Volume expansivity	1/K
Δ	Finite change in quantity	
ε	Emissivity; effectiveness	
η_{th}	Thermal efficiency	
θ	Total energy of a flowing fluid	kJ/kg
μ_{JT}	Joule-Tomson coefficient	K/kPA
μ	Chemical potential	kJ/kg
ν	Stoichiometric coefficient	
ρ	Density	kg/m^3
σ	Stefan-Boltzmann constant	
σ_n	Normal stress	N/m^2
σ_s	Surface tension	N/m
ϕ	Relative humidity	
ϕ	Specific closed system exergy	kJ/kg
Φ	Total closed system exergy	kJ
ω	Specific or absolute humidity	kg H_2O / kg dry air

Subscripts

a	Air
abs	Absolute
act	Actual
atm	Atmospheric
avg	Average
c	Combustion; cross section
cr	Critical point
CV	Control volume
e	Exit conditions
f	Saturated liquid
fg	Difference in property between saturated liquid and saturated vapor
g	Saturated vapor
gen	Generation
H	High temperature (as in T_H and Q_H)
i	inlet conditions
i	ith component
L	Low temperature (as in T_L and Q_L)
m	Mixture
r	Relative
R	Reduced
rev	Reversible
s	Isentropic
sat	Saturated
surr	Surroundings
sys	System
v	Water vapor
0	Dead state
1	Initital or inlet state
2	Final or exit state

Superscripts

· (over dot)	Quantity per unit time
-(over bar)	Quantity per unit mole
°(circle)	Standard reference state
*(asterisk)	Quantity at 1 atm pressure

Some Physical Constants

Universal gas constant	$R_u = 8.81447$ kJ/kmol·K
Standard acceleration of gravity	$g = 9.80665$
Standard atmospheric pressure	$1\ \text{atm} = 101.325\ \text{kPa}$
Stefan-Boltzmann constant	$\sigma = 5.6704 \times 10^{-8}$ W/m²·K⁴
Boltzmann's constant	$k = 1.380650$ J/K
Speed of light in vacuum	$c_0 = 2.9979 \times 10^8$ m/s
Speed of sound in dry air at 0°C and 1 atm	$c = 2.9979 \times 10^8$
Heat of fusion of water at 1 atm	$h_{if} = 337.7$ kJ/kg
Enthalpy of vaporization of water at 1 atm	$h_{fg} = 2265.5$ kJ/kg