

NOMENCLATURE

<u>QUANTITY</u>	<u>SYMBOL</u>	<u>COHERENT SI UNIT</u>
Absorptivity (radiation)	α	—
Absorption Coefficient (radiation)	κ	m^{-1}
Activation Energy of a Reaction	ΔE	J/kg
Amount-of-Substance molar flow rate molar 'mass velocity' ($= \dot{N} / A_c$)	N \dot{N} \dot{n}	kmol kmol/s kmol/m ² s
Angle plane solid of contact	$\alpha, \beta, \gamma, \theta, \phi$ Ω, ω θ	rad sr rad
Area cross-sectional surface	A_c, S A, A_s	m^2 m^2
Coefficient of Volume Expansion	$\beta = (1/v) (\partial v / \partial T)_p$	K^{-1}
Compressibility Factor ($= p\bar{v} / \bar{R}T$)	Z	—
Complex Refractive Index	$m = n - ik$	—
Concentration mass ($= M/V$) molar ($= N/V$)	c_i, ρ_i $\bar{c}_i, \bar{\rho}_i$	kg/m^3 kmol/m^3
Coordinates Cartesian cylindrical spherical	x, y, z r, ϕ, z r, θ, ϕ	m, m, m m, rad, m m, rad, rad
Density mass ($= M/V$) molar ($= N/V$)	ρ $\bar{\rho}$	kg/m^3 kmol/m^3
Diffusion Coefficient	D	m^2/s
Diffusivity, Thermal ($= k/\rho c_p$)	α	m^2/s
Dryness Fraction (quality) of flow	x x^*	— —
Emissive Power (radiation)	E	W/m^2
Emissivity (radiation)	ϵ	—
Energy kinetic potential transfer per unit time (power)	E E_k E_p \dot{W}, \dot{Q}	J = Nm J = Nm J = Nm W = Nm/s = $\text{kg m}^2/\text{s}^3$
Enthalpy ($= U + pV$) specific, molar of reaction	H h, \bar{h} ΔH^0	J J/kg, J/kmol J
Entropy specific, molar	S s, \bar{s}	J/K J/kg K, J/kmol K
Equilibrium (dissociation) constant	K	—
Extinction coefficient	$\beta = \kappa + \sigma_s$	m^{-1}

Force weight (force of gravity)	F Mg	$N = \text{kg m/s}^2$ $N = \text{kg m/s}^2$
Fraction mass, of species i mole, of species i void of volume flow	x_i, y_i \bar{x}_i, \bar{y}_i ε ε^*	— — — —
Frequency circular	ν, f ω	$\text{Hz} = \text{s}^{-1}$ rad/s
Gas Constant molar (universal) specific, of species i	\bar{R} R_i	J/kmol K J/kg K
Gibbs Function (= $H - TS$) specific (= $h - Ts$) molar (= $\bar{h} - T\bar{s}$)	G g \bar{g}	J J/kg J/kmol
Gravitational Acceleration standard	g g_n	m/s^2 m/s^2
Heat quantity of rate (power) flux (\dot{Q}/A) rate per unit volume	Q \dot{Q}, q \dot{q}, q'' \dot{S}, \dot{q}'''	J W = J/s W/m ² W/m ³
Heat Capacity specific (constant ν or p) molar (constant ν or p) ratio c_p/c_ν	C c_ν, c_p \bar{c}_ν, \bar{c}_p γ	J/K J/kg K J/kmol K —
Heat Transfer Coefficient	h	W/m ² K
Helmholtz Function (= $U - TS$) specific (= $u - Ts$) molar (= $\bar{u} - T\bar{s}$)	F f \bar{f}	J J/kg J/kmol
Intensity (radiation)	I	W/m ² sr
Internal Energy specific, molar	U u, \bar{u}	J J/kg, J/kmol
Joule - Thomson Coefficient	$\mu_{JT} = (\partial T / \partial p)_h$	K/Pa = m ² K/N
Length width height diameter radius distance along path film thickness thickness	L W H D R s δ δ, Δ	m m m m m m m m
Mass flow rate velocity of flux (flowrate per unit area = \dot{M}/A_c)	M \dot{M} $\dot{m}, \rho u$	kg kg/s kg/m ² s
Mass Transfer Coefficient	h_m, k_m	m/s
Molar Mass	\bar{M}	kg/kmol

Mean Free Path	$\bar{\lambda}, l$	m
Optical Thickness	τ	—
Phase Function (radiation)	Φ	—
Pressure	p	Pa = N/ m ²
drop	Δp	Pa
partial	p_i	Pa
Reflectivity (radiation)	ρ	—
Scattering Albedo	$\omega = \sigma_s / (\sigma_s + \kappa)$	—
Scattering Coefficient (radiation)	σ_s	m ⁻¹
Shear Stress	τ	Pa = N/m ² = kg/m s ²
Stoichiometric Coefficient	ν	—
Surface Tension	σ	N/m = kg/s ²
Temperature absolute	T	K
Thermal Conductivity	k	W/mK
Time	t	s
Velocity	u	m/s
components in Cartesian coordinates x, y, z	u, v, w	m/s
View Factor (geometric or configuration factor)	F_{ij}	—
Viscosity dynamic (absolute)	μ	Pa s = N s/m ² = kg/m s
kinematic (= μ/ρ)	ν	m ² /s
Volume	V	m ³
flow rate	\dot{V}	m ³ /s
specific, molar	v, \bar{v}	m ³ /kg, m ³ /kmol
Work	W	J = Nm
rate (power)	\dot{W}	W = J/s = Nm/s
Wavelength	λ	m

SUBSCRIPTS AND SUPERSSCRIPTS

<u>QUANTITY</u>	<u>SYMBOL</u>
Bulk	b
Critical State	c
Fluid	f
Gas or Saturated Vapour	g
Liquid or Saturated Liquid	l
Change of Phase	
fusion	ls
sublimation	sg
evaporation	lg
Mass transfer quantity	m
Solid or Saturated Solid	s
Wall	w
Free-stream	∞
Inlet	in, 1
Outlet	out, 2
At Constant Value of Property	p, v, T , etc
Molar (per unit of amount-of-substance)	— (overbar)
Stagnation (subscript)	0

DIMENSIONLESS GROUPS*

<u>QUANTITY</u>	<u>SYMBOL</u>
Biot Number	$Bi = hL / k$
Bond Number	$Bo = g(\rho_l - \rho_v)L^2 / \sigma$
Dean Number	$(Re) (r_{in}/R_{coil})^{1/2}$ (r_{in} = tube inner radius; R_{coil} = coil mean radius)
Eckert Number	$Ec = u^2 / c_p \Delta T$
Euler Number	$Eu = \Delta p / (\frac{1}{2} \rho u^2)$
Fourier Number	$Fo = \alpha t / L^2$
Friction Factor	$f = \tau_w / (\frac{1}{2} \rho u^2)$
Froude Number	$Fr = u^2 / gl$
Galileo Number	$Ga = L^3 g / \nu^2$
Grashof Number	$Gr = \frac{\beta g L^3 \Delta T}{\nu^2}$
Graetz Number	$Gz = (Re)(Pr) D/L$
Knudsen Number ($\bar{\lambda}$ = mean free path)	$Kn = \bar{\lambda} / L$
Lewis Number	$Le = (Sc)/(Pr) = \alpha/D$
Mach Number	$M = u / u_{sound}$ $= u / (\gamma \bar{R} T / \bar{M})^{1/2}$ for perfect gas
Marangoni Number	$Ma = \frac{\partial \sigma}{\partial T} R \Delta T / (\alpha \mu)$
Nusselt Number	$Nu = hL/k_f$
Péclet Number	$Pe = (Re)(Pr)$
Prandtl Number	$Pr = \frac{\mu c_p}{k}$
Rayleigh Number	$Ra = (Gr)(Pr)$
Reynolds Number	$Re = uL / \nu = \rho u L / \mu = \dot{m} L / \mu$
Schmidt Number	$Sc = \nu/D = \mu/\rho D$
Sherwood Number	$Sh = h_m L/D$
Stanton Number	$St = (Nu)/(Re)(Pr) = h/\rho c_p u$
Stefan or Jakob Number	Ste or $Ja = c_p \Delta T / \Delta h$
Strouhal Number	$Sr = \nu L/u$
Weber Number	$We = u^2 \rho L / \sigma$

* The symbol L in the dimensionless groups stands for a generic length, and is defined according to the particular geometry being described; i.e., it may be diameter, hydraulic diameter, plate length, etc.

PHYSICAL CONSTANTS

<u>QUANTITY</u>	<u>SYMBOL</u>
Avogadro's Number	$N_A = 6.02214 \times 10^{26} \text{ kmol}^{-1}$
Boltzmann's Constant	$k = 1.38065 \times 10^{-23} \text{ J/K}$
Planck's Constant	$h = 6.62607 \times 10^{-34} \text{ Js}$
Stefan-Boltzmann Constant	$\sigma = 5.67040 \times 10^{-8} \text{ W/(m}^2\text{K}^4)$
Speed of Light in Vacuum	$c = 2.99792 \times 10^8 \text{ m/s}$
Universal Gas Constant	$\bar{R} = 8.31447 \times 10^3 \text{ J/kmol}\cdot\text{K}$