Journal of Heat Transfer

Editorial

At the National Heat Transfer Conference in Albuquerque on August 16, 1999, the Editorial Board of the *Journal of Heat Transfer* considered and unanimously adopted a common symbol list for papers submitted to the Journal. At a meeting later that day, the Editors of 20 journals in the field of heat transfer unanimously adopted the same list, and will be publicizing its use to authors that submit manuscripts to their respective journals.

This action came after almost two years of consideration and revision of the list.

Authors submitting papers to the *Journal of Heat Transfer* should now use the symbols and definitions in the list, which is published in this issue of the Journal and is posted on the JHT web page. *When these symbols are used, they need not be included in the Nomenclature section of the paper.* Only those symbols not included in the common list need be placed in the Nomenclature of a particular paper. Because of the broad range of heat transfer topics covered in the Journal, the Common List cannot cover all quantities, and the exceptions should be covered as before in the individual Nomenclature definitions.

The Editors hope that the adoption of the Common List will make it easier for future readers of heat transfer literature to interpret paper content because of the common symbols and definitions used across the major journals. For the *Journal of Heat Transfer* in particular, eliminating the duplication of definitions used in the many papers in a single Journal issue allows the limited page count available for the Journal to be put to better use.

We do expect a certain amount of controversy, because every author has particular preferences for nomenclature and symbols. We hope that in the long term, the symbols in the Common List will be adopted across the field, and will provide a basis for more uniform and clear communication in the heat transfer community.

John R. Howell
Technical Editor

NOMENCLATURE

QUANTITY	SYMBOL	COHERENT SI UNIT
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 $kmol/m^2s$
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	$\beta = (1/\upsilon)(\partial\upsilon/\partial T)_p$	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=kg m^2/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 = kg m/s^2 N = 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	Hz = 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 v or p) molar (constant v or p) ratio c_p/c_v	C c_v, c_p $\bar{c}_v$, $\bar{c}_p$ γ	J/K J/kg K J/kmol K —
Heat Transfer Coefficient	h	W/m^2K
Helmholtz Function (= U - TS) specific (= u - $T s$) molar (= $\bar{u} - T\bar{s}$)	 F f $\bar{f}$	 J J/kg J/kmol
Intensity (radiation)	I	W/m^2sr
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 $\dot{M}$ $\dot{m}$, ρu	kg kg/s kg/m^2s
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 drop partial	p Δp p_i	Pa = N/ m^2 Pa 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 components in Cartesian coordinates x, y, z	u u, v, w	m/s m/s
View Factor (geometric or configuration factor)	F_{ij}	—
Viscosity dynamic (absolute) kinematic (=μ/ρ)	 μ ν	 Pa s=N s/m^2 = kg/m s m^2/s
Volume flow rate specific,molar	V $\dot{V}$ $v, \bar{v}$	m^3 m^3/s m^3/kg, m^3/kmol
Work rate (power)	W $\dot{W}$	J = Nm W = J/s=Nm/s
Wavelength	λ	m

SUBSCRIPTS AND SUPERSCRIPTS

QUANTITY	SYMBOL
Bulk	b
Critical State	c
Fluid	f
Gas or Saturated Vapour	g
Liquid or Saturated Liquid	l
Change of Phase fusion sublimation evaporation	 ls sg 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*

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

* 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

QUANTITY	SYMBOL
Avogadro's Number	$N_A = 6.0225\times10^{26}$ kmol^{-1}
Boltzmann's Constant	$k = 1.38066 \times 10^{-23}$ J/K
Planck's Constant	$h = 6.62608 \times 10^{-34}$ Js
Stefan-Boltzmann Constant	$\sigma = 5.67051\times10^{-8}$ W/(m^{2}K^4)
Speed of Light in Vacuum	$c = 2.99792 \times 10^8$ m/s
Universal Gas Constant	$\bar{R} = 8.31441\times10^3$ J/kmol·K