

Term	Text	Drawings
economizer	ECN	ECN
effective horsepower	EHP	EHP
efficiency	EFF	EFF
electromotive force	EMF	EMF
equivalent direct radiation	EDR	EDR
evaporator	EVAP	EVAP
(-ing, -ed, -or)	EXP VLV	EXP VLV
expansion valve		
face-to-face	F to F	F to F
factor of safety	F/S	F/S
feet per minute	FPM	FPM
feet per second	FPS	FPS
foot	FT	FT
foot pound	FT LB	FT LB
foot-pound-second (system)	FPS	FPS
freezing point	FP	FP
gage or gauge	GA	GA
gallon	GAL	GAL
gallons per hour	GPH	GPH
gallons per minute	GPM	GPM
gallons per second	GPS	GPS
grain	SP	SP
gram-calorie	GCAL	GCAL
higher heating value	HHV	HHV
horsepower	HP	HP
horsepower-hour	HPHR	HPHR
hour	HR	HR
inch	IN	IN
inch-pound	IN-LB	IN-LB
indicated horsepower	IHP	IHP
indicated horsepower-hour	IHPHR	IHPHR
inside diameter	ID	ID
iron-pipe size	IPS	IPS
kilocalorie	KCAL	KCAL
kilogram	KG	KG
kilowatt	KW	KW
kilowatt hour	KWH	KWH
linear feet	Lin ft	Lin ft
liquid	LIQ	LIQ
logarithm (natural)	LOG	LOG
logarithm (to base 10)	LOG ₁₀	LOG ₁₀
lower heating value	LHV	LHV
maintenance	MAINT	MAINT
male and female	M&F	M&F
mass	MASS	MASS
maximum	MAX	MAX
mean effective	MEP	MEP
melting point	MP	MP
meter	M	M
meters per second	MPS	MPS
micron	UMU	UMU
miles per hour	MPH	MPH
millinches	MI	MI
millimeter	MM	MM
minute	MIN	MIN
minimum	MIN	MIN
molecular weight	MOL WT	MOL WT
mol	MOL	MOL
National Electrical Code	NEC	NEC
number	NO	NO
ounce	OZ	OZ
outside diameter	OD	OD
parts per million	PPM	PPM
pound	LB	LB
pounds per square foot	PSF	PSF
pounds per square foot absolute	PSFA	PSFA
pounds per square foot gage	PSFG	PSFG
pounds per square inch	PSI	PSI

Term	Text	Drawings
pounds per square inch absolute	PSIA	PSIA
pounds per square inch gage	PSIG	PSIG
pneumatic	PNEU	PNEU
pressure	PRESS	PRESS
pressure reducing valve	PRV	PRV
quart	QT	QT
receiver	REC	REC
recirculate(d)	RECIRC	RECIRC
relative humidity	RH	RH
required	REQD	REQD
revolution	REV	REV
revolutions per minute	RPM	RPM
revolutions per second	RPS	RPS
Saybolt seconds Furol (oil viscosity)	SSF	SSF
Saybolt seconds	SSU	SSU
Universal (oil viscosity)	SSU	SSU
second	SEC	SEC
shaft horsepower	SHP	SHP
specification	SPEC	SPEC
specific gravity	SP GR	SP GR
specific heat	SP HT	SP HT
square	SQ	SQ
square foot	SQ FT	SQ FT
square inch	SQ IN	SQ IN
standard	STD	STD
suction	SUCT	SUCT
temperature	TEMP	TEMP
thermostat	THERMO	THERMO
thousand	M	M
ton	spell out	spell out
thousand cubic feet	Mcf	MCF
ton of refrigeration	TR	TR
United States Gage	USG	USG
United States Standard	USS	USS
vacuum	VAC	VAC
valve	V	V
vapor proof	VAP PRF	VAP PRF
velocity	VEL	VEL
viscosity	VISC	VISC
volume	VOL	VOL
watt	W	W
watt-hour	WHR	WHR
wet-bulb temperature	WBT	WBT
year	YR	YR

LETTER SYMBOLS*

1. *Letter Symbol.* A letter symbol is a single character, such as *t* for temperature, with subscript or superscript if required, such as *t* for temperature of saturated liquid, used to designate a physical magnitude in mathematical equations and expressions. Two or more symbols together always represent a product.

Letter symbols are to be distinguished from abbreviations, mathematical signs and operators, graphical symbols and chemical symbols.

2. *The Same Symbols* should be used for the same physical magnitude regardless of the units employed and regardless of special values occurring for different states, points, parts, times, etc. Units or special values may be distinguished when necessary by subscripts, superscripts, or by upper- and lower-

* Letter Symbols for Mechanics of Solid Bodies, Z10.3-1943, and Letter Symbols for Heat and Thermodynamics, Y10.2-1958 (American Standards Association).
* Refrigeration Nomenclature for Text and Drawings (Proposed American Standard B33, Part C) (Published in Refrigeration Engineering, September 1951, p. 576).

Abbreviations and Symbols

case letters when both are specifically included as symbols in a standard list. The units used should be indicated when necessary. Sometimes different symbols are used for the components of a vector.

3. *Subscript.* A subscript preferably should be a single character. It is commonly employed to indicate constancy of a particular physical magnitude, such as pressure or temperature, when there are other variables. A multiple subscript, sometimes divided by a comma, refers to more than one state, point, part, time, etc. A subscript should not be attached to a subscript.

4. *Superscript.* A symbol with a superscript, such as a prime (') or a second (''), should be enclosed in parentheses, braces, or brackets before affixing an exponent—e.g., (*D*)'. A complicated exponent (or any other expression frequently repeated) may be replaced by a single symbol selected to represent it. Reference marks should not be attached to symbols.

5. *Unlisted Magnitudes.* To symbolize a special value of a listed magnitude, see Item 4. The symbol chosen by an author for a physical magnitude not appearing in any standard list should be one that does not already have a different meaning in the field of the text.

6. When standard symbols in related fields are needed, reference to ASA standards is recommended:

Letter Symbols for Heat and Thermodynamics, ASA Y10.2-1958

Letter Symbols for Hydraulics, ASA Y10.2-1958

Letter Symbols for Chemical Engineering, ASA Y10.12-1955

Letter Symbols for Mechanics of Solid Bodies, ASA Z10.3-1943

Letter Symbols for Physics, ASA Z10.6-1948

Additional symbols and variations in the standard symbols found necessary in the individual chapters will be found in lists at the end of Chapters 2, 3, 4, 6, and 27.

LETTER SYMBOLS

Symbol	Description of item	Typical units
<i>a</i>	air space thermal conductance	Btu per (hr)(sq ft)(F)
<i>a</i>	acceleration, linear	ft per (sec)(sec)
<i>A</i>	area	sq ft
<i>b</i>	breadth or width	ft
<i>B</i>	barometric pressure	psia or in. Hg
<i>c</i>	specific heat	Btu per (lb)(F)
<i>c_p</i>	specific heat at constant pressure	Btu per (lb)(F)
<i>c_v</i>	specific heat at constant volume	Btu per (lb)(F)
<i>C</i>	coefficient of performance	
<i>C</i>	coefficient	
<i>C</i>	thermal conductance, surface to surface	Btu per (hr)(sq ft)(F)
<i>d</i>	profile indicating differential	ft
<i>D</i>	diameter	ft
<i>e</i>	base of natural logarithms	
<i>E</i>	energy	Btu, Btu per lb, ft-lb
<i>E_i</i>	internal energy	Btu, Btu per lb, ft-lb
<i>E_k</i>	kinetic energy	Btu, Btu per lb, ft-lb
<i>E_p</i>	potential energy	Btu, Btu per lb, ft-lb
<i>E</i>	electrical potential	volts
<i>f</i>	heat transfer coefficient through film	
<i>f</i>	film conductance	Btu per (hr)(sq ft)(F)
<i>f_D</i>	friction factor, D'Arcy-Weisbach formula	
<i>f_r</i>	friction factor, Fanning formulation	
<i>F</i>	force	lb
<i>F_A</i>	configuration factor in radiant heat transfer	
<i>F_R</i>	emissivity factor in radiant heat transfer	
<i>g</i>	gravitational acceleration	ft per (sec)(sec)
<i>h</i>	specific enthalpy	Btu per lb
<i>h_a</i>	hydraulic head	ft
<i>h</i>	heat transfer coefficient	Btu per (hr)(sq ft)(F)
<i>h_d</i>	specific enthalpy of dry air	Btu per lb dry air
<i>h_c</i>	convection heat transfer coefficient	Btu per (hr)(sq ft)(F)

Symbol	Description of item	Typical units
<i>h_f</i>	specific enthalpy of saturated liquid	Btu per lb
<i>h_{fg}</i>	specific enthalpy of evaporation	Btu per lb
<i>h_g</i>	specific enthalpy of dry saturated vapor	Btu per lb
<i>h_s</i>	specific enthalpy of saturated solid	Btu per lb
<i>h_r</i>	radiation heat transfer coefficient	Btu per (hr)(sq ft)(F)
<i>h_a</i>	enthalpy of saturated air based on dry air weight	Btu per lb dry air
<i>h_{av}</i>	enthalpy of air-vapor mixture, based on wet-bulb temperature	Btu per lb dry air
<i>h</i>	signa "heat content," enthalpy of mixture minus enthalpy of liquid at basic saturation temperature, based on dry weight	Btu per lb dry air
<i>H</i>	total enthalpy	Btu
<i>I</i>	electric current	amperes
<i>J</i>	mechanical equivalent of heat	ft-lb per Btu
<i>k</i>	thermal conductivity	Btu per (hr)(sq ft)(F per ft) or (F per in)
<i>k</i>	ratio of specific heats <i>c_p/c_v</i> (use of <i>γ</i> , gamma, is preferred)	
<i>K</i>	proportionality constant	
<i>L</i>	length	ft
<i>L</i>	hydraulic radius, flow cross section divided by wetted perimeter	ft
<i>M</i>	mass	lb
<i>n</i>	exponent of polytropic expansion or compression	
<i>N</i>	rate of rotation	rpm
<i>N</i>	number in general	
<i>N_{Gr} or Gr</i>	Graetz number = $\frac{D_p \rho v \Delta T}{k}$	
<i>N_{Gr} or Gr</i>	Graetz number = $\frac{m c_p \Delta T}{k L}$	
<i>N_{Re} or Nu</i>	Nusselt number = $\frac{h D}{k}$	
<i>N_{Fr} or Fr</i>	Froude number = $\frac{v^2}{g D}$	
<i>N_{Re} or Re</i>	Reynolds number = $\frac{D v \rho}{\mu}$	
<i>p</i> or <i>P</i>	pressure, gage or absolute	psia, in. Hg, lb per sq ft
<i>p_a</i>	partial pressure of dry air	psia or in. Hg
<i>p_w</i>	partial pressure of water vapor	psia or in. Hg
<i>p_s</i>	saturation pressure of pure water vapor	psia or in. Hg
<i>P</i>	power	hp, ft-lb per sec, watts
<i>q</i>	heat transfer	Btu per hr, Btu per lb
<i>q_v</i>	volumetric flow rate	cu ft per sec or cfm
<i>q_L</i>	latent heat transfer rate	Btu per hr
<i>q_s</i>	sensible heat transfer rate	Btu per hr
<i>Q</i>	heat transfer, total	Btu
<i>Q_L</i>	latent heat transfer	Btu
<i>Q_s</i>	sensible heat transfer	Btu
<i>r</i>	radius	ft
<i>R</i>	gas constant	(ft-lb) per (lb)(R)
<i>R</i>	thermal resistance	(hr)(sq ft)(F) per Btu
<i>R</i>	absolute temperature unit	degrees Rankine
<i>s</i>	specific entropy (often with subscripts <i>f</i> , <i>g</i> , or <i>s</i> as with enthalpy)	Btu per (lb)(R)
<i>S</i>	entropy	Btu per R
<i>t</i>	temperature (usually with a defining subscript)	F
<i>T</i>	absolute temperature	R
<i>ΔT_m</i>	logarithmic mean temperature difference	F
<i>u</i>	internal energy (often with subscripts <i>f</i> , <i>g</i> , or <i>s</i> as with enthalpy)	Btu per lb
<i>U</i>	internal energy, total	Btu
<i>U</i>	overall heat transfer coefficient	Btu per (hr)(sq ft)(F)
<i>v</i>	specific volume	cu ft per lb
<i>v_h</i>	humid volume	cu ft per lb dry air
<i>V</i>	volume, total	cu ft
<i>V</i>	linear velocity	ft per sec
<i>W</i>	humidity ratio of moist air, weight of water vapor per unit weight of dry air	lb per lb dry air
<i>W</i>	weight	lb
<i>W</i>	work	ft-lb, Btu