Typefaces for Symbols in Scientific Manuscripts

Most word processing software now in use at NIST is capable of producing lightface (that is, regular) or boldface letters of the Latin or Greek alphabets in both roman (upright) and italic (sloping) types. The understandability of typed and typeset scientific and technical publications is facilitated if symbols are in the correct typeface. The following rules are taken from International Organization for Standardization (ISO) International Standard ISO 31-0:1992 to ISO 31-13:1992.

The typeface in which a symbol appears helps to define what the symbol represents. For example, irrespective of the typeface used in the surrounding text, "A" would be typed or typeset in

— italic type for the *scalar quantity* area: A;

— roman type for the *unit* ampere: A;

— italic boldface for the *vector quantity* vector potential: $\boldsymbol{A}$.

More specifically, the three major categories of symbols found in scientific and technical publications should be typed or typeset in either italic or roman type, as follows:

— symbols for *quantities* and *variables*: italic;

— symbols for *units*: roman;

— symbols for *descriptive terms*: roman.

These rules imply that a subscript or superscript on a quantity symbol is in roman type if it is descriptive (for example, if it is a number or represents the name of a person or a particle); but it is in italic type if it represents a quantity, or is a variable such as x in E_x or an index such as i in $\Sigma_i\, x_i$ that represents a number. An index that represents a number is also called a "running number." The following four sections give examples of the proper typefaces for these three major categories.

Quantities and variables — italic

Symbols for quantities are italic, as are symbols for functions in general, for example, $f(x)$:

t = 3 s	t time, s second	T = 22 K	T temperature, K kelvin
r = 11 cm	r radius, cm centimeter	λ = 633 nm	λ wavelength, nm nanometer

Constants are usually physical quantities and thus their symbols are italic; however, in general, symbols used as subscripts and superscripts are roman if descriptive:

N_{A}	Avogadro constant, A Avogadro	R	molar gas constant
θ_{D}	Debye temperature, D Debye	Z	atomic number
e	elementary charge	m_{e}	m mass, e electron

Running numbers and symbols for variables in mathematical equations are italic, as are symbols for parameters such as a and b that may be considered constant in a given context:

$$y = \sum_{i=1}^{m} x_i z_i \qquad\qquad x^2 = ay^2 + bz^2$$

Symbols for vectors are boldface italic, symbols for tensors are sans-serif bold italic, and symbols for matrices are boldface italic:

$\boldsymbol{A}\cdot\boldsymbol{B} = \boldsymbol{C}$ (vectors) $\qquad$ $\mathbf{\mathsf{T}}$ (tensors) $\qquad$ $\boldsymbol{A} = \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix}$ (matrices)

Symbols used as subscripts and superscripts are italic if they represent quantities or variables:

c_p p pressure $\qquad$ q_m m mass $\qquad$ σ_Ω Ω solid angle $\qquad$ ω_z z z coordinate

Units — roman

The symbols for units and SI prefixes are roman:

m	meter	g	gram	L	liter
cm	centimeter	μg	microgram	mL	milliliter

(over)

Descriptive terms — roman

Symbols representing purely descriptive terms (for example, the chemical elements) are roman, as are symbols representing mathematical constants that never change (for example, π) and symbols representing explicitly defined functions or well defined operators (for example, $\Gamma(x)$ or div):

Chemical elements:

Ar argon B boron C carbon

Mathematical constants, functions, and operators:

e	base of natural logarithms	Σx_i	Σ	sum of	$\ln x$	$\log_e$	natural logarithm of
$\exp x$	exp exponential of	$\sin x$	sin	sine of	$\lg x$	$\log_{10}$	common (decimal) logarithm of
$\mathrm{d}x/\mathrm{d}t$	d 1st derivative of	$\log_a x$	$\log_a$	logarithm to the base a of	$\mathrm{lb}\, x$	$\log_2$	binary logarithm of

Symbols used as subscripts and superscripts are roman if descriptive:

$\varepsilon_0^{(\mathrm{ir})}$ ir irrational E_k k kinetic

V_m^l m molar, l liquid phase μ_B B Bohr

Sample equations showing correct type

$$F = \frac{q_1\, q_2}{4\pi\, \varepsilon_0\, r^2} \qquad F = ma \qquad pV = nRT$$

$$\varphi_\mathrm{B} = x_\mathrm{B} V^*_{\mathrm{m,B}} / \Sigma x_\mathrm{A} V^*_{\mathrm{m,A}} \qquad E_\mathrm{a} = RT^2\, \mathrm{d}(\ln k)/\mathrm{d}T \qquad c_1 = \lambda^{-5}/[\exp(c_2/\lambda T) - 1]$$

$$E = mc^2 \qquad \tilde{p}_\mathrm{B} = \lambda_\mathrm{B} \lim_{p \to 0} (x_\mathrm{B}\, p / \lambda_\mathrm{B}) \qquad \frac{\boldsymbol{F}}{Q} = -\,\mathbf{grad}\; V$$

Greek alphabet in roman and italic type

The following table shows the proper form, in both roman and italic type, of the upper-case and lower-case letters of the Greek alphabet.

Greek alphabet in roman and italic type

alpha	A	α	A	α
beta	B	β	B	β
gamma	Γ	γ	Γ	γ
delta	Δ	δ	Δ	δ
epsilon	E	ε, ϵ	E	ε, ϵ
zeta	Z	ζ	Z	ζ
eta	H	η	H	η
theta	Θ, Θ[a]	θ, ϑ[b]	Θ, Θ[a]	θ, ϑ[b]
iota	I	ι	I	ι
kappa	K	κ, $\varkappa$[b]	K	κ, $\varkappa$[b]
lambda	Λ	λ	Λ	λ
mu	M	μ	M	μ
nu	N	ν	N	ν
xi	Ξ	ξ	Ξ	ξ
omicron	O	o	O	o
pi	Π	π, ϖ	Π	π, ϖ
rho	P	ρ, [b]	P	ρ, [b]
sigma	Σ	σ	Σ	σ
tau	T	τ	T	τ
upsilon	Υ	υ	Υ	υ
phi	Φ	φ, ϕ	Φ	φ, ϕ
chi	X	χ	X	χ
psi	Ψ	ψ	Ψ	ψ
omega	Ω	ω	Ω	ω

[a] The International Organization for Standardization (ISO) gives only the first of these two letters (see ISO International Standard ISO 31-0:1992).

[b] ISO gives these two letters in the reverse order (see ISO International Standard ISO 31-0:1992).