
ABBREVIATIONS, SIGNS, AND SYMBOLS

ABBREVIATIONS SAVE SPACE and prevent the distraction of needlessly repeated words or phrases. The space saved is usually so small, however, that the use of abbreviations is determined largely by custom, convenience to the reader, and the appearance of the printed page.

In general, few abbreviations should be used in the text of a Survey report, although many may be used in tables and footnotes. The text should be understandable by nonspecialists, and abbreviations should be used without definition only if they are widely understood (for example, such common bibliographic abbreviations as “fig.,” “pl.,” “p.,” and “no.,” and other nonbibliographic abbreviations such as “a.m.,” “p.m.,” “A.D.,” and “B.C.”).

Uncommon abbreviations must be defined the first time they are used in the main text. The standard Survey format is to enclose the abbreviated form in parentheses immediately following the spelled out form—for example, U.S. Geological Survey (USGS). Follow the same procedure in the abstract if a term is used several times there, and because the abstract must be able to stand alone, repeat the procedure in the main text the first time the abbreviation is used there.

Common sense can help decide when abbreviations are appropriate. Terms used only a few times should not be abbreviated, and abbreviations that might inconvenience the reader should not be used. In general, abbreviations are suitable for often-repeated names of organizations, conferences, congresses, and programs—for example, IGCP, for International Geological Correlation Programme; AGI, for American Geological Institute; also, for widely used instruments or processes—for example, SEM for scanning-electron microscope. Abbreviations are inappropriate for geographic names or geologic terms in Survey reports, no matter how many times such names or terms are used in a paper. Do not, for example, use AB for Appalachian Basin, SAF for San Andreas Fault, or MVTD for Mississippi Valley-type deposits.

Abbreviations are used freely in tables, partly because of tight space limitations. Abbreviations used in tables are defined in bracketed headnotes.

In general, abbreviations for scientific terms and for terms of measurement are not followed by periods; however, a period should be used with the abbreviation for “inch(es)” if the abbreviation might be con-

fused with the preposition “in.” A better procedure is to just spell out the word “inch(es).”

NAMES OF COUNTRIES AND OTHER POLITICAL SUBDIVISIONS

“U.S.” is used when “United States” precedes the word “Government” or the name of a Government organization: U.S. Government, U.S. Congress, U.S. Department of the Interior, U.S. Geological Survey. No spaces are left between the letters and periods of “U.S.,” but a space precedes the name that follows. In titles, “United States” should be written out whether it is a noun or an adjective. In the text, “United States” should be written out when used as a noun and abbreviated when used as an adjective—for example, “mineral deposits of the United States,” *but* “U.S. mineral deposits.”

Names of foreign countries, except that of the U.S.S.R. (or SSSR), are not abbreviated, nor are the names of their political subdivisions. “United States” is written out when used in association with the names of other countries, except the U.S.S.R.; thus, British, French, and United States Governments; United States-British talks; *but* U.S.-U.S.S.R. meeting.

STATES AND POSSESSIONS OF THE UNITED STATES

Names of States of the United States (except Alaska, Hawaii, Idaho, Iowa, Maine, Ohio, and Utah), also the District of Columbia, Puerto Rico, and the Virgin Islands, are abbreviated when they immediately follow a capitalized geographic term; they are spelled out after a lowercased word: Chicago, Ill.; Montgomery County, Md.; Stone Mountain, Ga.; Arlington National Cemetery, Va.; Redstone Arsenal, Ala.; *but* St. Lawrence County magnetite district, New York; Tacoma area, Washington. The names of other insular possessions, trust territories, and such places as Long Island and Staten Island are not abbreviated. Customary abbreviations are used for States in reports; Postal Service abbreviations are used only in “ZIP code” mailing addresses.

<i>States and possessions</i>	<i>Customary abbreviations</i>	<i>Postal Service abbreviations</i>	<i>States and possessions</i>	<i>Customary abbreviations</i>	<i>Postal Service abbreviations</i>	<i>States and possessions</i>	<i>Customary abbreviations</i>	<i>Postal Service abbreviations</i>
Alabama	Ala.	AL	Maryland	Md.	MD	Rhode Island	R.I.	RI
Alaska	Alaska	AK	Massachusetts	Mass.	MA	South Carolina	S.C.	SC
Arizona	Ariz.	AZ	Michigan	Mich.	MI	South Dakota	S. Dak.	SD
Arkansas	Ark.	AR	Minnesota	Minn.	MN	Tennessee	Tenn.	TN
California	Calif.	CA	Mississippi	Miss.	MS	Texas	Tex.	TX
Colorado	Colo.	CO	Missouri	Mo.	MO	Utah	Utah	UT
Connecticut	Conn.	CT	Montana	Mont.	MT	Vermont	Vt.	VT
Delaware	Del.	DE	Nebraska	Nebr.	NE	Virginia	Va.	VA
Florida	Fla.	FL	Nevada	Nev.	NV	Washington	Wash.	WA
Georgia	Ga.	GA	New Hampshire	N.H.	NH	West Virginia	W. Va.	WV
Hawaii	Hawaii	HI	New Jersey	N.J.	NJ	Wisconsin	Wis.	WI
Idaho	Idaho	ID	New Mexico	N. Mex.	NM	Wyoming	Wyo.	WY
Illinois	Ill.	IL	New York	N.Y.	NY			
Indiana	Ind.	IN	North Carolina	N.C.	NC	District of Columbia	D.C.	DC
Iowa	Iowa	IA	North Dakota	N. Dak.	ND	Guam	Guam	GU
Kansas	Kans.	KS	Ohio	Ohio	OH	Puerto Rico	P.R.	PR
Kentucky	Ky.	KY	Oklahoma	Okla.	OK	Virgin Islands	V.I.	VI
Louisiana	La.	LA	Oregon	Oreg.	OR			
Maine	Maine	ME	Pennsylvania	Pa.	PA			

ACCENTS AND DIACRITICAL MARKS

In Survey publications accents and diacritical marks are used chiefly in the spelling of foreign words. Take care to use them correctly:

- ˆ acute (Orléans)
- ° bolle (Ålesund)
- ˘ cedilla (français)
- ˆ circumflex (côte)
- ¨ dieresis or umlaut (Nürnberg)
- ˘ grave (Asmères)
- ˇ hacek (Přibyl)
- ˘ inverted cedilla (Dąbrowa)
- macron (Kyūshū)
- / slash (Rømros)
- ’ soft sign (Arkhangel’sk)
- superior dot (szarżysko Kamienna)
- ˜ tilde (cañon)

ADDRESSES

The words “street,” “avenue,” “building,” and similar address terms following a name or number are abbreviated in footnotes, tables, leaderwork, and lists, but as parts of names, they are spelled out, even in parentheses, footnotes, tables, and leaderwork: “2912 14th St.,” *but* “14th Street Bridge.” The words “county,” “fort,” “mount,” “point,” and “port” are not abbreviated. “Saint (St.)” and “Sainte (Ste.)” should be abbreviated.

CHEMICAL ELEMENTS, NAMES, AND SYMBOLS

Chemical names, rather than symbols, should generally be used in text, as discussed in “Chemical

Terminology.” Names and symbols are given in table 2.

DATES

Names of months followed by the day, or by the day and year, are usually abbreviated in tables, locality lists, and in parentheses. May, June, and July are always spelled out. Preferred forms for other months are as follows:

	Jan.	Apr.	Oct.
	Feb.	Aug.	Nov.
	Mar.	Sept.	Dec.

In narrow columns of tables, the names of months may be abbreviated even if they stand alone. Otherwise, the form used in Survey reports is “January 1, 1985.”

GEOCHRONOLOGIC DATING

Article 13 of the North American Stratigraphic Code (North American Commission on Stratigraphic Nomenclature, 1983), quoted in part below, should be followed for the preferred abbreviations used in geochronologic dating.

The “present” refers to 1950 AD [sic], and such qualifiers as “ago” or “before the present” are omitted after the value because measurement of the duration from the present to the past is implicit in the designation. In contrast, the duration of a remote interval of geologic time, as a number of years, should not be expressed by the same symbols. Abbreviations for numbers of years, without reference to the present, are informal (e.g., y or yr for years; my, m.y., or m.yr. for millions of years; and so forth, as preference dictates). For example, boundaries of the Late Cretaceous Epoch currently are calibrated at 63 Ma and 96 Ma, but the interval of time represented by this epoch is 33 m.y.

Table 2. Chemical symbols

[The names and symbols listed below are approved by the International Union of Pure and Applied Chemistry. From the U.S. GPO Style Manual, 1984, p. 157]

Element	Sym- bol	Atomic num- ber ¹	Atomic weight	Element	Sym- bol	Atomic num- ber ¹	Atomic weight
Actinium	Ac	89	227.0278	Molybdenum.....	Mo	42	95.94
Aluminium	Al	13	26.98154	Neodymium	Nd	60	144.24
Americium	Am	95	(243)	Neon.....	Ne	10	20.179
Antimony	Sb	51	121.75	Neptunium.....	Np	93	237.0482
(Stibium).							
Argon	Ar	18	39.948	Nickel	Ni	28	58.69
Arsenic	As	33	74.9216	Niobium.....	Nb	41	92.9064
Astatine.....	At	85	(210)	Nitrogen	N	7	14.0067
Barium.....	Ba	56	137.33	Nobelium.....	No	102	(259)
Berkelium.....	Bk	97	(247)	Osmium	Os	76	190.2
Beryllium.....	Be	4	9.01218	Oxygen.....	O	8	15.9994
Bismuth.....	Bi	83	208.9804	Palladium.....	Pd	46	106.42
Boron	B	5	10.81	Phosphorus	P	15	30.97376
Bromine.....	Br	35	79.904	Platinum	Pt	78	195.08
Cadmium.....	Cd	48	112.41	Plutonium.....	Pu	94	(244)
Caesium.....	Cs	55	132.9054	Polonium.....	Po	84	(209)
Calcium	Ca	20	40.08	Potassium	K	19	39.0983
				(Kalium).			
Californium	Cf	98	(251)	Praseodymium ...	Pr	59	140.9077
Carbon	C	6	12.011	Promethium	Pm	61	(145)
Cerium.....	Ce	58	140.12	Protactinium	Pa	91	231.0359
Chlorine.....	Cl	17	35.453	Radium	Ra	88	226.0254
Chromium.....	Cr	24	51.996	Radon.....	Rn	86	(222)
Cobalt.....	Co	27	58.9332	Rhenium.....	Re	75	186.207
Copper.....	Cu	29	63.546	Rhodium.....	Rh	45	102.9055
Curium.....	Cm	96	(247)	Rubidium	Rb	37	85.4678
Dysprosium.....	Dy	66	162.50	Ruthenium.....	Ru	44	101.07
Einsteinium	Es	99	(252)	Samarium	Sm	62	150.36
Erbium.....	Er	68	167.26	Scandium.....	Sc	21	44.9559
Europium	Eu	63	151.96	Selenium	Se	34	78.96
Fermium.....	Fm	100	(257)	Silicon	Si	14	28.0855
Fluorine.....	F	9	18.998403	Silver.....	Ag	47	107.8682
Francium.....	Fr	87	(223)	Sodium	Na	11	22.98977
				(Natrium).			
Gadolinium	Gd	64	157.25	Strontium.....	Sr	38	87.62
Gallium	Ga	31	69.72	Sulfur.....	S	16	32.06
Germanium	Ge	32	72.59	Tantalum	Ta	73	180.9479
Gold.....	Au	79	196.9665	Technetium.....	Tc	43	(98)
Hafnium.....	Hf	72	178.49	Tellurium.....	Te	52	127.60
Helium.....	He	2	4.00260	Terbium.....	Tb	65	158.9254
Holmium	Ho	67	164.9304	Thallium	Tl	81	204.383
Hydrogen.....	H	1	1.00794	Thorium	Th	90	232.0381
Indium.....	In	49	114.82	Thulium.....	Tm	69	168.9342
Iodine.....	I	53	126.9045	Tin.....	Sn	50	118.69
Iridium	Ir	77	192.22	Titanium	Ti	22	47.88
Iron.....	Fe	26	55.847	Tungsten	W	74	183.85
				(Wolfram).			
Krypton	Kr	36	83.80	(Unnilhexium)....	(Unh)	106	(263)
Lanthanum	La	57	138.9055	(Unnilpentium) ...	(Unp)	105	(262)
Lawrencium.....	Lr	103	(260)	(Unnilquadium)....	(Unq)	104	(261)
Lead	Pb	82	207.2	Uranium.....	U	92	238.0289
Lithium	Li	3	6.941	Vanadium	V	23	50.9415
Lutetium	Lu	71	174.967	Xenon.....	Xe	54	131.29
Magnesium	Mg	12	24.305	Ytterbium	Yb	70	173.04
Manganese.....	Mn	25	54.9380	Yttrium	Y	39	88.9059
Mendelveium.....	Md	101	(258)	Zinc	Zn	30	65.38
Mercury.....	Hg	80	200.59	Zirconium.....	Zr	40	91.22

¹The atomic weights of many elements are not invariant but depend on the origin and treatment of the material. The values of atomic weight given here apply to elements as they exist naturally on Earth and to certain artificial elements. Values in parentheses are used for radioactive elements whose atomic weights cannot be quoted precisely without knowledge of the origin of the elements. The value given is the atomic mass number of the isotope of that element of longest known half life.

For dating use the following:

ka for kilo-annum (10^3 years)
Ma for mega-annum (10^6 years)
Ga for giga-annum (10^9 years)

Note that ka and kilo are not capitalized (by international convention).

LAND

In describing land divisions subdivided by section, township, and range, use the following forms (omit periods after abbreviated compass directions that immediately precede and close up on figures):

SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 4, T. 12 S., R. 15 E., of the Boise Meridian
lot 6, NE $\frac{1}{4}$ sec. 4, T. 6 N., R. 1 W.
N $\frac{1}{2}$ sec. 20, T. 7 N., R. 2 W., Sixth Principal Meridian
Tps. 9, 10, 11, and 12 S., Rs. 12 and 13 W.
T. 2 S., Rs. 8, 9, and 10 E., sec. 26
T. 3 S., R. 1 E., sec. 34, W $\frac{1}{2}$ E $\frac{1}{2}$, W $\frac{1}{2}$, and W $\frac{1}{2}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 32 (with or without a township number)

If fractions are spelled out in land descriptions, "half" and "quarter" are used (not "one-half" or "one-quarter"): "south half of T. 47 N., R. 64 E." Avoid breaking a group such as NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 4 at the end of a line. If a break is unavoidable, make it after the fraction and use no hyphen.

LATITUDE AND LONGITUDE

The words "latitude" and "longitude" followed by figures are abbreviated (no periods after "lat" and "long"), and the figures are closed up: lat 52°33'05"N., long 13°21'10"E. Avoid breaking latitude and longitude figures at the end of a line. If a break is unavoidable, use a hyphen.

MEASUREMENTS

Terms denoting units of measurement should be abbreviated only when preceded by an amount indicated in numerals. Thus, write "3 m high," "6 cm thick," *but* "several meters long," "a few kilometers north."

Over a stratigraphic figure column, use "Meters," "(m)," "Feet," "(feet)," "Ft In," or "(ft in)," depending on the content of the column, whether the term stands by itself or follows another term such as

"Thickness," and depending on the amount of space available.

MINERALS

Mineral names are not ordinarily abbreviated in narrative text, but abbreviations may be appropriate on certain maps, in tables, or as symbols, subscripts, or superscripts. Symbols for common minerals are given in table 3.

NAMES AND TITLES

In the names of business firms, the abbreviated forms "Bros.," "Co.," "Corp.," "Inc.," "Ltd.," and "&" should be used if the full legal title need not be preserved. "Company" and "Corporation" are not abbreviated in names of Federal Government units. "Association" and "Manufacturing" are not abbreviated.

Names of railroads should not be abbreviated except in parentheses, footnotes, tables, and leaderwork. Use the correct form "Railroad" or "Railway" ("RR." and "Ry."), depending on the usage of the individual company.

In other than formal usage, a civil, military, or naval title preceding a name is abbreviated if followed by a given name or initials: "Col. H.M. Smith furnished data on the wells"; *but* "Colonel Smith furnished * * *." The titles "Senator" and "Representative" are not abbreviated.

NUMBER

The abbreviation "no." (lowercase "n") is used for serial numbers and in citing "v." and "no." of a publication: "Journal of Paleontology, v. 10, no. 3." In identifying specimens, wells, drill holes, and the like, however, "number" or "No." is generally superfluous and can be omitted: "specimen 4297," "Government well 6W," "Drill hole 5" *but* "Of all the specimens examined, No. 4297 most clearly illustrated * * *." Do not use the symbol #. Uppercase "N" is used in formal names and in numbered coal beds.

PERCENT

The word "percent" should be spelled out in text. In tables, the abbreviation "pct" or the symbol "%" may be used if other terms of measurement are also abbreviated. The symbol "%", however, is not as easily read in small type. "Percent" should be used with numerals: "20 percent." It is preferred to "percentage" for table headings. "Percentage"

Table 3. Mineral symbols

[Kretz, 1983; courtesy of the Mineralogical Society of America]

Acm	acmite	Elb	elbaite	Ntr	natrolite
Act	actinolite	En	enstatite (ortho)	Ne	nepheline
Agt	aggrine-augite	Ep	epidote	Nrb	norbergite
Ak	åkermanite	Fst	fassaite	Nsn	noosean
Ab	albite	Fa	fayalite	Ol	olivine
Aln	allanite	Fac	ferroactinolite	Omp	omphacite
Alm	almandine	Fed	ferroedenite	Oam	orthoamphibole
Anl	analcime	Fs	ferrosilite (ortho)	Or	orthoclase
Ant	anatase	Fts	ferrotschermakite	Opx	orthopyroxene
And	andalusite	Fl	fluorite	Pg	paragonite
Adr	andradite	Fo	forsterite	Prg	argasite
Anh	anhydrite	Gn	galena	Pct	pectolite
Ank	ankerite	Grt	garnet	Pn	pentlandite
Ann	annite	Ged	gedrite	Per	periclase
An	anorthite	Gh	gehlenite	Prv	perovskite
Atg	atgortite	Gbs	gibbsite	Phl	phlogopite
Ath	anthophyllite	Glt	glaucosite	Pgt	pigeonite
Ap	apatite	Gln	glaucophane	Pl	plagioclase
Apo	apophyllite	Gt	goethite	Prh	prehnite
Arg	aragonite	Gr	graphite	Pen	protoenstatite
Arf	arfvedsonite	Grs	grossular	Pmp	pumpellyite
Apy	arsenopyrite	Gru	grunerite	Py	pyrite
Aug	augite	Gp	gypsum	Prp	pyrope
Ax	axinite	Hl	halite	Prl	pyrophyllite
Brt	barite	Hs	hastingsite	Po	pyrrhotite
Brl	beryl	Hyn	hauyne	Qtz	quartz
Bt	biotite	Hd	hedenbergite	Rbk	riebeckite
Bhm	boehmite	Hem	hematite	Rds	rhodochrosite
Bn	bornite	Hc	hercynite	Rdn	rhodonite
Brk	brookite	Hul	heulandite	Rt	rutile
Brc	brucite	Hbl	hornblende	Sa	sanidine
Bst	bustamite	Hu	humite	Spr	sapphirine
Cam	Ca clin amphibole	Ill	illite	Scp	scapolite
Cpx	Ca clinopyroxene	Ilm	ilmenite	Srl	schorl
Cal	calcite	Jd	jadeite	Srp	serpentine
Ccn	cancrinite	Jh	johannsenite	Sd	siderite
Crn	carnegieite	Krs	kaersutite	Sil	sillimanite
Cst	cassiterite	Kls	kalsilite	Sdl	sodalite
Cls	celestite	Kln	kaolinite	Sps	spessartine
Cbz	chabazite	Ktp	kataphorite	Sp	sphalerite
Cc	chalcocite	Kfs	K feldspar	Spl	spinel
Ccp	chalcopyrite	Krn	kornrupine	Spd	spodumene
Chl	chlorite	Ky	kyanite	St	staurolite
Cld	chloritoid	Lmt	laumontite	Stb	stilbite
Chn	chondrodite	Lws	lawsonite	Stp	stilpnomelane
Chr	chromite	Lpd	lepidolite	Str	strontianite
Ccl	chrysocolla	Lct	leucite	Tlc	talc
Ctl	chrysotile	Lm	limonite	Tms	thomsonite
Cen	clinoenstatite	Lz	lizardite	Ttn	titanite
Cfs	clinoferrosilite	Lo	loellingite	Toz	topaz
Chu	clinohumite	Mgh	maghemite	Tur	tourmaline
Czo	clinozoisite	Mkt	magnesiokatophorite	Tr	tremolite
Crd	cordierite	Mrb	magnesioriebeckite	Trd	tridymite
Crn	corundum	Mgs	magnesite	Tro	troilite
Cv	covellite	Mag	magnetite	Ts	tschermakite
Crs	crystalite	Mrg	margarite	Usp	ulvöspinel
Cum	cummingtonite	Mel	melilite	Vrm	vermiculite
Dsp	diaspore	Mc	microcline	Ves	vesuvianite
Dg	digenite	Mo	molybdenite	Wth	witherite
Di	diopside	Mnz	monazite	Wo	wollastonite
Dol	dolomite	Mtc	monticellite	Wus	wüstite
Drv	dravite	Mnt	montmorillonite	Zrn	zircon
Eck	eckermannite	Mul	mullite	Zo	zoisite
Ed	edenite	Ms	muscovite		

(synonymous with “proportion”) may be used in such phrases as “a small percentage” when proportion is meant. When proportion is not meant, an expression such as “a small part” should be used. “Percentage” may be used with numerals in a phrase such as “5 percentage points.”

ROCKS

The names of rocks are never abbreviated in narrative text, but abbreviations may be appropriate on certain maps or tables; uniformity in such usage is desirable. Unusual abbreviations must be defined to

avoid misunderstandings. Common abbreviations are given on page 55.

TEMPERATURE

Temperature is expressed in figures. Following the practice of the American Society for Testing and Materials "Standard for Metric Practice," STA recommends no space before or after the degree sign (100°C, 212°F).

TERMS OF DIRECTION

Terms of direction are spelled out in text: "Kanosh is 58 km northwest of Koosharem; both are north of Kanab." In expressions of dip and strike, the terms of direction are abbreviated, and the degree mark is set without space against the figures:

A dip of 10° SE. (or 10° S. 35° E.)
 The strike is N. 55° E. (or N. 45°-70° E.)
 N. 55°30'25" E.
but "the dip is southeast."

Abbreviated terms of direction are followed by a period:

N., S., NW., SE., NNW., ESE.

COMMON WORD ABBREVIATIONS

The following abbreviations are commonly used in parenthetical phrases, brackets, footnotes, sidenotes, synonymies, tables, and leaderwork:

abstract(s), abs.	hydrologic(al), hydrol.
annual, ann.	illustration(s), illus.
appendix, app.	investigation(s), inv.
approximate(ly), approx.	locality, loc.
article(s), art., arts.	miscellaneous, misc.
association, assoc.	Mount, Mt.
biologic(al), biol.	page(s), p.
bulletin, bull.	part(s), pt., pts.
chapter, chap.	plate(s), pl., pls.
chemical, chem.	publication(s), pub., pubs.
communication(s), commun.	report(s), rept., repts.
edition, editor(s), ed., eds.	science(s), sci.
figure(s), fig., figs.	section(s), sec., secs.
formation(s), fm., fms.	series, ser.
geographic(al), geog.	stratigraphic(al), strat.
geologic(al), geol.	topographic(al), topog.
geophysical, geophys.	volume, v.
hydrographic, hydrog.	zoologic(al), zool.

SCIENTIFIC AND ENGINEERING TERMS

Table 4 lists abbreviations, signs, and symbols for scientific and engineering terms likely to be used in Survey reports. Cite meanings in text or appendix. The exact form and style of some symbols may vary with different printers.

Table 4. Abbreviations, signs, and symbols for scientific and engineering terms

[Adapted from lists in STA5 and STA6. For further treatment of abbreviations, see U.S. GPO Style Manual, 1984, chap. 9. For abbreviations on maps, see p. 55; for minerals and normative minerals, see p. 108; for chemical elements, see p. 106]

absolute	abs
absolute value	
absorbance	A
absorptivity	a
absorptivity, molar	ε
acceleration, angular	α
acceleration, linear	a
acre-foot (feet)	acre-ft
activity, chemical (absolute)	λ
activity, chemical (relative)	a
activity coefficient	γ
affinis	aff.
alternating current	ac or ⚡ or ⚡
alternating-current (unit modifier)	a-c
altitude	alt
ampere	A
analytical variability	ξ _a
angle	∠
angle between	^
angle between a ₀ and b ₀ in the unit cell	γ
angle between a ₀ and c ₀ in the unit cell	β
angle between b ₀ and c ₀ in the unit cell	α
angle between the two optic axes of a biaxial mineral	2V
angstrom	Å
angular frequency	ω
angular velocity	ω
anhydrous	anhyd
antilogarithm	antilog
approaches	→
approximate (tion of)	approx
approximately (nearly) equal to	≈
aqueous	aq
are (land area)	a
area	A or S
astronomical unit (in English)	au
asymptotically equal to	≈
atmosphere	atm
atomic mass	m _a or m

Table 4. Abbreviations, signs, and symbols for scientific and engineering terms—Continued

atomic mass of species X	$m(X)$ or m_x
atomic number	at. no or Z
atomic number of species X	$Z(X)$ or Z_x
atomic weight	at wt or M
atomic weight of species X	$M(X)$ or M_x
automatic data processing	ADP
average	avg
average (indicated by bar or vinculum over symbol or by angular parentheses)	— or $\langle \rangle$
Avogadro's number	N or N_A
avoirdupois	avdp
azimuth	az or α
barn (area)	b
barometer	bar.
barrel	bbl
barrel per day	bbl/d
base of natural logarithms	e
baud	Bd
Baumé (used with degree symbol)	°Bé
becquerel	Bq
before present (dates before 1950, in thousands of years)	B.P.
bench mark (in illustrations)	BM
bench mark (in text)	B.M.
Bernoulli number	B
Bessel function (first kind, zero order)	$J_0(x)$
Bessel function, hyperbolic (first kind, zero order)	$I_0(x)$
bias	δ
billion gallons per day	Ggal/d
billion years	b.y.
binary coded decimal	BCD
biochemical oxygen demand	BOD
bit, byte	b
Bohr magneton	μ_B
boiling point	bp
Boltzmann constant	k
Boltzmann function	H
bottom-withdrawal tube	BW-tube
braces	{ }
brackets	[]
Bragg angle, glancing angle (2θ is twice the glancing angle in X-ray diffraction)	θ
breadth (width)	b or B
Brinell hardness number	Bhn
British thermal unit	Btu
bushel	bu
byte	B
calculated	calc
calorie	cal
candela	cd
candela-hour	c·h

Table 4. Abbreviations, signs, and symbols for scientific and engineering terms—Continued

capacitance	C
carat	kt
Cartesian coordinates	x, y, z
cathode ray	CR
cathode-ray tube	CRT
Celsius (used with degree symbol)	°C
centimeter	cm
centimeter-gram-second (system)	CGS
centimeter-gram-second (unit)	cgs
central processing unit	CPU
chemical oxygen demand	COD
chemical potential	μ
chi-square statistic	χ^2
circa (about)	ca.
circle	○
circular (shape)	cir
citrate-extractable heavy metal	cxHM
coefficient	coef
cold-extractable copper	cxCu
collection(s) (abbreviation used only with numbers)	colln(s).
cologarithm	colog
compressibility	κ
concentrate	conc
concentrated	concd
concentration	concn or c
conductance	G
conductivity	γ
confer (to be compared to)	cf.
confidence limit, lower, for the population mean	μ_L
confidence limit, upper, for the population mean	μ_U
constant	const
constant as defined in text	K
continued (abbreviation used only in some tables)	con.
Coordinated Universal Time	UTC
corner	cor.
correlation coefficient	ρ or r
coscant	csc
coscant, hyperbolic	csch
cosine	cos
cosine, hyperbolic	cosh
cotangent	cot
cotangent, hyperbolic	coth
coulomb	C
counts per minute	c/min
critical	crit
Cross, Iddings, Pirsson, and Washington	CIPW
cross section of atoms and nuclei	σ
crystallographic axes	a, b, c
cubic centimeter	cm ³

Table 4. Abbreviations, signs, and symbols for scientific and engineering terms—Continued

cumulative frequency	c.f.
curie	Ci
cutting point in a hypothesis test	Ω
cycle (radio)	c
cycles per minute	c/min
cycles per second	c/s
cylinder	cyl
darcy, darcies	D
day	d
debye unit	D
decay constant	λ
decay constant based on alpha emission	λ_a
decay constant based on negative beta emission ...	λ_{β^-}
decay constant based on orbital electron capture	λ_e or λ_{EC}
decay constant based on positron emission	λ_{β^+}
decay constant based on spontaneous fission	λ_{SF}
decibel	dB
degree	°
degree Celsius	°C
degree Fahrenheit	°F
degree Rankine	°R
degree réamur	°R
degrees of freedom	d.f.
delta (finite change, incremental variations, difference)	Δ or δ
density (mass)	ρ
density (relative)	<i>d</i>
depth	<i>h</i>
deuterium	D or ² H
deuteron	d
diameter	diam, <i>D</i> , or <i>d</i>
dielectric constant (permittivity)	ϵ
dielectric flux	Ψ
differential, partial	∂
differential thermoanalysis	dta
differential, total	d or <i>d</i>
dilute	dil
direct current	dc or →
direction of extraordinary ray	E
direction of flow	→
direction of ordinary ray	O
discharge; total water discharge; rate of discharge; recharge	Q
disintegrations per minute	d/min
disintegrations per second	d/s
disk operating system	DOS
dissociation constant	K
dissociation constant, negative logarithm of; -log K	pK
dissolved oxygen	DO
dissolved solids	DS
distilled	dist

Table 4. Abbreviations, signs, and symbols for scientific and engineering terms—Continued

ditto (the same)	do.
divided by	÷
dozen	doz
dram	dr
dropping mercury electrode	dme
dry basis	DB
dyne	dyn
efficiency	eff
electric current	<i>I</i>
electric-current density	<i>J</i> , <i>j</i>
electric-field strength	<i>E</i>
electric potential	<i>V</i>
electromagnetic unit	emu
electromotive force	emf or <i>E'</i>
electron	e or <i>e</i>
electron mass	<i>m_e</i>
electron-spin resonance	esr
electronvolt	eV
electrostatic flux	Ψ
electrostatic unit	esu
elementary charge	<i>e</i>
elevation	elev
emendatio (emended)	emend.
end point	EP
energy	<i>E</i>
energy (kinetic)	<i>E_k</i>
energy (potential)	<i>E_v</i>
enthalpy	<i>H</i>
entropy	<i>S</i>
entropy (standard state of)	<i>S</i> [°]
ephemeris time	ET
equal to	=
nearly equal to	≈
not equal to	≠
equation(s)	eq (s)
equilibrium constant	<i>K</i>
equivalent	equiv.
equivalent conductivity	\wedge
equivalent uranium	eU
equivalent weight	equiv. wt.
error function	erf
error function (complement to)	erfc
Euler number	<i>E</i>
ex grupo	ex gr.
exchange	↕
exchangeable-potassium-percentage	EPP
exchangeable-sodium-percentage	ESP
excited hydrogen atom	H*
exponential of	exp, <i>e</i>
factorial product	!
Fahrenheit (used with degree symbol)	°F
farad	F
Faraday's constant (the faraday)	<i>F</i>

Table 4. Abbreviations, signs, and symbols for scientific and engineering terms—Continued

foot, feet	ft
footcandle	fc
footlambert	fL
foot (feet) per second cubed	ft/s ³
foot-pound	ft·lb
foot-pound-second (system)	FPS
force	<i>F</i>
force (moment of)	<i>M</i>
formality	<i>f</i>
freezing point	fp
frequency	<i>f</i> or <i>ν</i>
frequency (spectroscopy)	<i>ν</i>
friction, coefficient of	μ or <i>f</i>
Froude number	<i>F</i>
<i>F</i> -statistic for equality of variances	<i>F</i>
fugacity	<i>f</i>
function of <i>x</i>	<i>f</i> (<i>x</i>)
fusion point	fnp
gallon	gal
gallons per minute	gal/min
gamma function	Γ
gas, as in H ₂ O (g)	(g)
gas constant	<i>R</i>
gas liquid partition chromatography	glpc
gauss	<i>G</i>
Geiger-Müller (unit modifier)	G-M
Gibbs free energy, Gibbs function	<i>G</i>
Gibbs free energy (standard state)	<i>G</i> [°]
gradient	∇
grain	gr
gram	g
gravitational acceleration, acceleration of free fall, local acceleration due to gravity	<i>g</i>
gravitational constant	<i>G</i>
gray (unit of measure for absorbed dose)	Gy
greater than	>
much greater than	>>
not greater than	≧
greater than or equal to	≧ or ≡
Greenwich mean astronomical time	G.m.a.t.
Greenwich mean time	G.m.t.
gross	gr
gross weight	gr. wt.
half-life	<i>T</i> _{1/2}
half-life reduced	<i>fT</i> _{1/2}
haversine	hav
head, total	<i>H</i>
heat capacity	<i>C</i>
heat capacity at constant pressure	<i>C</i> _P
heat capacity at constant volume	<i>C</i> _V
hectare	ha
height	<i>h</i>
Helmholtz free energy	<i>A</i>

Table 4. Abbreviations, signs, and symbols for scientific and engineering terms—Continued

henry, henries	H
hertz	Hz
high-pressure (unit modifier)	h-p
high-pressure metal vapor	HPMV
horsepower	hp
hour	h
hydrogen-ion concentration, negative log ₁₀ of	pH
hyperbolic functions, inverse, prefix to be added to abbreviation (for example, arcosh)	ar
hypothesis (alternative)	<i>H</i> ₁
hypothesis (null)	<i>H</i> ₀
identical with	≡
not identical with	≠
imaginary square root of -1	<i>i</i> or <i>j</i>
inch (period may be used if abbreviation might be confused with the preposition "in")	in
inch-pound	in·lb
indeterminate	indet.
index of refraction	<i>n</i>
indices of refraction for biaxial crystals	<i>n</i> _x , <i>n</i> _y , and <i>n</i> _z or α , β , and γ
indices of refraction for uniaxial crystals	<i>n</i> _O and <i>n</i> _E or ω and ϵ
inductance (mutual)	<i>M</i>
inductance (self)	<i>L</i>
infinity	∞
infrared	ir
inside diameter	id
integral	\int
integral, closed (circuital or contour)	\oint
intensity of X-rays reflected from crystallographic planes	<i>I</i>
intermediate-pressure (unit modifier)	i-p
intersection or logical product	\cap
ionization constant	<i>K</i> or <i>K</i> _i
irrigation-water classification: <i>C</i> denotes conductivity (electrical); <i>S</i> denotes sodium-adsorption ratio (SAR); numbers denote respective numerical quality classes	<i>C</i> 2- <i>S</i> 3
Jackson turbidity unit	Jtu
joule	J
joule per kelvin	J/K
Joule-Thomson coefficient	μ
kelvin (degree symbol not used)	K
kilobyte	K
kilohm	k Ω
kilowatthour	kWh
K-meson	K
knot	kn
lambert	L
langley	ly
Laplacian operator	∇^2
latitude (abbreviation used only with figures)	lat

Table 4. Abbreviations, signs, and symbols for scientific and engineering terms—Continued

length	l
less than	$<$
much less than	$<<$
not less than	\nless
less than or equal to	\leq or \leq
limit of $f(x)$	$\lim f(x)$
linear alkylsulfonate	LAS
liquefied petroleum gas	LPG
liquid	liq
liquid oxygen	lox
liter	L
locality, localities (abbreviation used only with numbers)	loc (s).
logarithm (common)	log
logarithm (natural)	\log_e or \ln
logical product or intersection	\cap
logical sum or union	\cup
longitude (abbreviation used only with figures; omit period when "long" is used with "lat"; use period if abbreviation may be confused with the adjective "long")	long
longitudinal velocity; P -wave velocity	v_P
low frequency	LF
low-pressure (unit modifier)	l-p
lumen	lm
luminous flux	Φ
lux	lx
magnetic-field strength or intensity	H
magnetic flux	Φ
magnetic induction	B
Manning's roughness (resistance) coefficient	n
mass	m
mean sea level	m.s.l.
mass number	A
mass number of species X	$A(X)$ or A_x
matrix; for example $\ a_{ij}\ $ or (a_{ij}) or A	$\ $ $\ $ or $()$ or A
matrix, cofactor of element	$a_{ij}A_{ij}$
matrix, conjugate	A'
matrix, determinant of; for example $ a_{ij} $	$ $
matrix, identity	I
matrix, inverse	A^{-1}
matrix, transpose	A^T
maximum	max
maxwell	Mx
mean (statistical)	μ or m
mean life	τ
mean of a linear combination q	μ_q
mean of the lognormal distribution	α
mean of the negative binomial distribution	θ
mean of sample means	$\mu_{\bar{x}}$
mean of the variance of sample means	$\mu_{s_{\bar{x}}^2}$

Table 4. Abbreviations, signs, and symbols for scientific and engineering terms—Continued

mean sea level	m.s.l.
mean square error	M.S.E.
megabyte	Mb
megohm	M Ω
melting point	mp
member of (used with a set and its elements)	ϵ
meta (in organic compounds)	m
meter	m
metric ton	t
microGal	μG
micron	μ
mile	mi
miles per hour	mi/h or mph
Miller indices	hkl
millimeter of mercury	mmHg
million	M
million gallons per day	Mgal/d
million years	m.y.
minimum	min
minus	-
minus or plus	\mp
minute	min
minute; prime; foot	'
mixture melting point	mmp
Modified Mercalli	MM
molality, molal (concentration)	m
molar concentration of substance B	c_B
molar mass of substance B	M_B
molarity, molar (concentration)	M
mole	mol
molecular concentration	C
molecular weight	mol wt
month	mo
motorship	MS
multiplied by	\times or \cdot
multiplying factor for the geometric mean of lognormally distributed observations	ψ_n
multiplying factor for the variance of lognormally distributed observations	ϕ_n
multispectral scanner	MSS
muon	μ
nabla; del; differential vector operator	∇
natural variability	ξ_n
nautical mile	nmi
neutrino	ν
neutron	n
new genus	n. gen.
new series	new ser.
new species	n. sp.
new variety	n. var.
newton	N
newton meter	N·m
Newtonian gravitational constant	G

Table 4. Abbreviations, signs, and symbols for scientific and engineering terms—Continued

no data	n.d.
no record, not reported	n.r.
nomen nudum	nom. nud.
normality, normal (concentration)	N
not available; not applicable	NA.
not determined	n.d.
nucleon number	A
number of observations in a population	N
number of observations (sample size)	n
number of samples	k
observation	w
observed frequency of observations	O
oersted	Oe
ohm	Ω
ohm centimeter	Ω -cm
ohm meter	Ω -m
optical directions in a crystal; also rays of light in these directions and pleochroic colors in these directions	X, Y, Z
ortho (in organic compounds)	o
ounce	oz
outside diameter	od
oven-dry basis	ODB
oxidation-reduction potential	Eh
para (in organic compounds)	p
parsec	pc
part(s)	pt(s).
part(s) per billion	ppb
part(s) per million	ppm
part(s) per thousand	ppt or $\%_{\infty}$
partial pressure of oxygen or carbon dioxide	P_{O_2} , P_{CO_2} , or $P(O_2)$, $P(CO_2)$
particle-size diameter	ϕ
partition function	Z
pascal	Pa
pascal second	Pa·s
peck	pk
percentage risk of type I error	α
percentage risk of type II error	β
period	T
phase	ph
phenyl	Ph
phot	ph
photon	γ
pint	pt
pi (mathematical constant)	π
pion	π
Planck constant	h
plus	+
plus or minus	\pm
poise	P
Poisson ratio	ν or μ
pooled sample variance	s_p^2

Table 4. Abbreviations, signs, and symbols for scientific and engineering terms—Continued

population coefficient of variation and of skewness	γ
population mean	μ
population standard deviation	σ
population variance	σ^2
posterior distribution of a parameter θ	$D_1(\theta)$
potassium-adsorption ratio	PAR
potential difference	V or U
pound (mass)	lb
pound avoirdupois	lb avdp
pound-force	lbf
pound-force per square inch	lbf/in ²
power	P
precipitate	ppt or \downarrow
preparation variability	ξ_p
pressure	P or p
primary wave	P -wave
prior distribution of a parameter θ	$D_o(\theta)$
probability of the event A	$P(A)$
product of a series	Π
proportion	: :
proportion of successes in a binomial population	θ
protium	^1H
proton	p
quantity of electric charge or electricity; quantity of heat; quantity of light	Q
quart	qt
rad	rd
radian	rad
radiance	B
radiant emissivity	J
radiant energy	Q
radiant energy density	u
radiant exposure	H
radiant flux	Φ
radiant intensity	I
radical	$\sqrt{\quad}$
radio detection and ranging	radar
radio frequency	RF
radius	r or R
random fluctuation of "experimental error"	e
random access memory	RAM
Range(s) (legal land division)	R(s).
rankine (used with degree symbol)	$^{\circ}\text{R}$
ratio; is to (when solidus is used, the word "ratio" should follow; for example, Cu/Ni ratio)	: or /
reactance	X
read-only memory	ROM
réaumur (used with degree symbol)	$^{\circ}\text{R}$
refractive index at 20°C, sodium (D) line	n_D^{20}
relative cumulative frequency	r.c.f.
repeating decimal; bar covers part that is to be repeated	$1.\overline{14}$

Table 4. Abbreviations, signs, and symbols for scientific and engineering terms—Continued

resistance	<i>R</i>
resistivity	ρ
return beam vidicon	RBV
reversible reaction	\rightleftharpoons
revolutions per minute	r/min or rpm
revolutions per second	r/s or rps
Reynolds number	<i>R</i>
roentgen (used with degree symbol)	$^{\circ}\text{R}$
roentgen equivalent, man or mammal	rem
roentgen equivalent, physical	rep
root	$\sqrt{\quad}$
root mean square	rms
rubidium acid phthalate	RAP
Rydberg constant	<i>R</i> or <i>R_y</i>
Rydberg constant for infinite mass	<i>R_∞</i>
salinity (parts per thousand)	‰
sample coefficient of variation	<i>C</i>
sample mean	\bar{w}
sample standard deviation	<i>s</i>
sample variance	<i>s</i> ²
sampling variability	ξ_s
saturated calomel electrode	sce
secant	sec
secant, hyperbolic	sech
second (time)	<i>s</i>
second; double prime; inch	"
second-foot	s-ft
secondary wave	<i>S</i> -wave
section(s) (subdivision of Township and Range) ...	sec(s).
sensu lato	s.l.
sensu stricto	s.s.
shear velocity; <i>S</i> -wave velocity	<i>v_s</i>
siemens	<i>S</i>
sine	sin
sine, hyperbolic	sinh
sine of the amplitude (an elliptic function)	sn
skewness of frequency distribution	sk
sodium, line in spectrum of	<i>D</i>
sodium-adsorption ratio	SAR
solid, as in AgCl(s)	(s)
solid angle	ω
solidus (also called virgule, slash)	/
soluble	sol
solution	soln
sound navigation and ranging	sonar
spacing of Bragg planes in a crystal	<i>d</i>
species (singular)	sp.
(plural)	spp.
specific gravity	sp gr
specific heat	sp ht
specific heat capacity	<i>c</i>
specific volume	sp vol

Table 4. Abbreviations, signs, and symbols for scientific and engineering terms—Continued

square	sq
square centimeter	cm ²
square root	$\sqrt{\quad}$
standard	std
standard deviation	σ
standard error of laboratory means	<i>s_x</i>
standard mean ocean water	SMOW
standard state	$^{\circ}$
standard state Gibbs free energy	<i>G</i> ^o
standard temperature and pressure	STP
standardized normal distribution	s.n.d.
station(s) (abbreviation used only with numbers)	sta(s).
steradian (solid angle)	sr
stokes	St
strain, normal or linear	ϵ
strain, shear	γ
stress, normal	σ
stress, shear	τ
subgenus	subgen.
subset of; is contained in	\subset
subspecies	subsp.
"Suggestions to Authors"	STA
sum	Σ
sum of squares	SS
sum of squares of the replication totals	<i>T_r</i> ²
sum of squares of the treatment totals	<i>T_t</i> ²
sum total of observations in a sample	<i>T</i>
surface tension	γ or σ
tangent	tan
tangent, hyperbolic	tanh
temperature	temp
temperature, in degrees Celsius	<i>t</i>
temperature, in kelvins; absolute temperature; thermodynamic temperature	<i>T</i>
tesla	<i>T</i>
theoretical frequency of observations	<i>T</i>
thermogravimetric analysis	tga
thickness	<i>t</i> or <i>d</i>
thin-layer chromatography	tlc
thousand	k
thus	sic
time	<i>t</i>
ton, metric (tonne)	<i>t</i>
total (grand) of observations squared	<i>G</i> ²
Townships(s) (legal land division)	<i>T.</i> , <i>Tps.</i>
trace	tr.
trace of a matrix (math)	tr
transformed observation	<i>u</i>
transmittance	<i>T</i>
triangle	Δ

Table 4. Abbreviations, signs, and symbols for scientific and engineering terms—Continued

trigonometric functions, inverse circular, prefix to be added to abbreviation (for example, arccos)	arc
tritium	T or ^3H
tritium unit	TU
triton	t
true mean	t.m.
ultraviolet	uv
undetermined	undet.
unified atomic mass unit	u
union or logical sum	U
unit-cell edges	a_0 , b_0 , and c_0
United States (abbreviation used as adjective only)	U.S.
United States Geological Survey	USGS
U.S. Government Printing Office	GPO
United States National Museum (abbreviation used before locality or collection number)	USNM
universal time	u.t.
Universal Time, Coordinated	UTC
Universal Transverse Mercator	UTM
vacuum	vac
vapor pressure	vp
variance, statistic to estimate the variance of lognormally distributed observations	V^2
variance of quantity q	σ_q^2
variance of lognormal distribution	β^2
variance of negative binomial distribution	k
variation operator	δ
variations; varies as	\propto
variety	var.
velocity	v or u

Table 4. Abbreviations, signs, and symbols for scientific and engineering terms—Continued

velocity of light (in vacuo)	c
velocity, P -wave	v_P
velocity, S -wave	v_S
versed sine	vers
versus (standard usage)	vs.
vertical angle elevation bench mark	VABM
vinculum (above letter; for example, \bar{w})	—
viscosity, dynamic	η
viscosity, kinematic	ν
volt	V
voltampere	VA
volume, chemical and physical use	V
volume strain, bulk strain	θ
watt	W
watthour	Wh
wavelength	λ
wavenumber	σ or ν
weber	Wb
weight	wt
weight per volume	w/v
weight per weight	w/w
yard	yd
year	yr
yields	\rightarrow
Young's modulus of elasticity	E

Prefixes and abbreviations for multiples and submultiples, SI units

exa (10^{18})	E
peta (10^{15})	P
tera (10^{12})	T
giga (10^9)	G
mega (10^6)	M
kilo (10^3)	k
hecto (10^2)	h
deka (10)	da
deci (10^{-1})	d
centi (10^{-2})	c
milli (10^{-3})	m
micro (10^{-6})	μ
nano (10^{-9})	n
pico (10^{-12})	p
femto (10^{-15})	f
atto (10^{-18})	a