

◆ Nitrogen sulfide has been taken out of the examples. Cf. comment at 2.16.

2.23.—If the electronegative constituent is polyatomic it should be designated by the termination -ate.

In certain exceptional cases the terminations -ide and -ite are used—see 3.22.

2.24.—In inorganic compounds it is generally possible in a polyatomic group to indicate a *characteristic atom* (as in  $\text{ClO}^-$ ) or a *central atom* (as in  $\text{ICl}_4^-$ ). Such a polyatomic group is designated a *complex*, and the atoms, radicals, or molecules bound to the characteristic or central atom are termed *ligands*.

In this case the name of a negatively charged complex should be formed from the name of the characteristic or central element (as indicated in 1.12) modified to end in -ate.

Anionic ligands are indicated by the termination -o. Further details concerning the designation of ligands, the definition of "central atom," etc., appear in Section 7.

Although the terms sulfate, phosphate, etc., were originally the names of the anions of particular oxo acids, the names sulfate, phosphate, etc., should now designate quite generally a negative group containing sulfur or phosphorus, respectively, as the central atom, irrespective of its oxidation state (the designation of the oxidation state is discussed in later rules) and the number and nature of the ligands. The complex is indicated by brackets [ ], but this is not always necessary.

Examples:

$\text{Na}_2[\text{SO}_4]$	sodium tetraoxosulfate
$\text{Na}_2[\text{SO}_3]$	sodium trioxosulfate
$\text{Na}_2[\text{S}_2\text{O}_3]$	sodium trioxothiosulfate
$\text{Na}_2[\text{SO}_2\text{F}]$	sodium trioxofluorosulfate
$\text{Na}_3[\text{PO}_4]$	sodium tetraoxophosphate
$\text{Na}_3[\text{PS}_4]$	sodium tetrathiophosphate
$\text{Na}_6[\text{PCl}_6]$	sodium hexachlorophosphate
$\text{K}[\text{PO}_2\text{F}_2]$	potassium dioxodifluorophosphate
$\text{K}[\text{POCl}_2(\text{NH})]$	potassium oxodichloroimido-phosphate

In many cases these names may be abbreviated, e.g., sodium sulfate, sodium thiosulfate (see 2.26), and in other cases trivial names may be used (cf. 2.3, 3.224, and Section 5). It should be pointed out, however, that the principle is quite generally applicable, to compounds containing organic ligands also, and its use is recommended in all cases where trivial names do not exist.

The coordination principle applied in this rule may also be applied to complexes which are positive or neutral (cf. 3.1 and Section 7). However, neutral complexes which are as a rule considered as binary compounds are given names according to 2.22, 2.16. Thus,  $\text{SO}_3$ , sulfur trioxide, not trioxosulfur.

◆ In the examples it would seem that full coordination-type names should be given, e.g., either sodium tetraoxosulfate (VI) or disodium tetraoxosulfate. Cf. 7.32 and comment at 7.312.

2.25.—Indication of the Proportions of the Constituents.

2.251.—The *stoichiometric proportions* may be denoted by means of Greek numerical prefixes

(mono, di, tri, tetra, penta, hexa, hepta, octa, ennea, deca, hendeca, and dodeca) preceding without hyphen the names of the elements to which they refer. It may be necessary in some languages to supplement these numerals with hemi ( $1/2$ ) and the Latin sesqui ( $3/2$ ).

The prefix mono may generally be omitted. Beyond 12, Greek prefixes are replaced by Arabic numerals (with or without hyphen according to the custom of the language), because they are more readily understood.

This system is applicable to all types of compounds and is especially suitable for binary compounds of the nonmetals.

When it is required to indicate the number of entire groups of atoms, particularly when the name includes a numerical prefix with a different significance, the multiplicative numerals (Latin bis, Greek tris, tetrakis, etc.) are used and the whole group to which they refer may be placed in parentheses if necessary.

Examples:

$\text{N}_2\text{O}$	dinitrogen oxide
$\text{NO}_2$	nitrogen dioxide
$\text{N}_2\text{O}_4$	dinitrogen tetraoxide
$\text{N}_2\text{S}_5$	dinitrogen pentasulfide
$\text{S}_2\text{Cl}_2$	disulfur dichloride
$\text{Fe}_3\text{O}_4$	triiron tetraoxide
$\text{U}_3\text{O}_8$	triuranium octaoxide
$\text{MnO}_2$	manganese dioxide
$\text{Ca}_3[\text{PO}_4]_2$	tricalcium diorthophosphate
$\text{Ca}[\text{PCl}_6]_2$	calcium bis(hexachlorophosphate)

In indexes it may be convenient to italicize a numerical prefix at the beginning of the name and connect it to the rest of the name with a hyphen, but this is not desirable in text, e.g., *tri-Uranium octa-oxide*.

Since the degree of polymerization of many substances varies with temperature, state of aggregation, etc., the name to be used should normally be based upon the simplest possible formula of the substance except when it is required specifically to draw attention to the degree of polymerization.

Example: The name nitrogen dioxide may be used for the equilibrium mixture of  $\text{NO}_2$  and  $\text{N}_2\text{O}_4$ . Dinitrogen tetraoxide means specifically  $\text{N}_2\text{O}_4$ .

◆ In accordance with the organic nomenclature rules and well-established practice, it is recommended that "or Latin" be inserted between "Greek" and "numerical prefixes" in the first sentence and that "nona" replace "ennea," and "undeca" replace "hendeca."

Extreme caution is advised in the omission of numerical prefixes, including mono (cf. second set of examples in 5.23), because of the frequent use of names such as chloroplatinate (cf. 2.26 and the last sentence in 5.24).

2.252.—The proportions of the constituents also may be indicated indirectly by *Stock's system*, that is, by Roman numerals representing the oxidation number or stoichiometric valence of the element, placed in parentheses immediately following the name. For zero the Arabic 0 will be used. When used in conjunction with symbols the Roman numeral may be placed above and to the right.

The Stock notation can be applied to both cations and anions, but preferably should *not* be applied to compounds between nonmetals.

In employing the Stock notation, use of the Latin

names of the elements (or Latin roots) is considered advantageous.

Examples:

FeCl <sub>2</sub>	iron(II) chloride or ferrum(II) chloride
FeCl <sub>3</sub>	iron(III) chloride or ferrum(III) chloride
MnO <sub>2</sub>	manganese(IV) oxide
BaO <sub>2</sub>	barium(II) peroxide
Pb <sup>II</sup> <sub>2</sub> Pb <sup>IV</sup> O <sub>4</sub>	dilead(II) lead(IV) oxide or trilead tetraoxide
K <sub>4</sub> [Ni(CN) <sub>4</sub> ]	potassium tetracyanonickelate(0)
K <sub>4</sub> [Fe(CN) <sub>6</sub> ]	potassium hexacyanoferrate(II)
Na <sub>2</sub> [Fe(CO) <sub>4</sub> ]	sodium tetracarbonylferrate(-II)

◆ While the committees favor the extended use of the Stock notation, they suggest that in some cases the system of Ewens and Bassett (designation of the aggregate charge of a complex ion by an Arabic numeral in parentheses following the name, similar to the use as superior notations with formulas) is advantageous and should be allowed as an alternate (*cf.* 3.17 and comment at 7.323). Mixed use of the two systems, while not desirable in any one context, does not affect indexing and should not lead to confusion. See comment at 1.12.

2.253.—The following systems are in use but are not recommended:

2.2531.—The system of indicating valence by means of the suffixes *-ous* and *-ic* added to the root of the name of the cation may be retained for elements exhibiting not more than two valences.

2.2532.—“*Functional*” nomenclature (such as “nitric anhydride” for N<sub>2</sub>O<sub>5</sub>) is not recommended apart from the name *acid* to designate the acid function (Section 5).

◆ Apparently there is no objection to acid anhydride as a class name (*cf.* 5.32). Other functional derivatives of acids are named as such in the Rules (5.3).

2.26.—In systematic names it is not always necessary to indicate stoichiometric proportions. In many instances it is permissible to omit the numbers of atoms, oxidation numbers, *etc.*, when they are not required in the particular circumstances. For instance, these indications are not generally necessary with elements of essentially constant valence.

Examples:

sodium sulfate	instead of sodium tetraoxosulfate
aluminum sulfate	instead of aluminum(III) sulfate
potassium chloroplatinate(IV)	instead of potassium hexachloroplatinate(IV)
potassium cyanoferrate(III)	instead of potassium hexacyanoferrate(III)
phosphorus pentaoxide	instead of diphosphorus pentaoxide

### 2.3. Trivial Names

Certain well-established trivial names for oxo acids (Section 5) and for hydrogen compounds (water, ammonia, hydrazine) are still acceptable. For some other hydrogen compounds these names are approved

B <sub>2</sub> H <sub>6</sub>	diborane	Si <sub>2</sub> H <sub>6</sub>	disilane, <i>etc.</i>
SiH <sub>4</sub>	silane	P <sub>2</sub> H <sub>4</sub>	diphosphine
PH <sub>3</sub>	phosphine	As <sub>2</sub> H <sub>4</sub>	diarsine
AsH <sub>3</sub>	arsine	SbH <sub>3</sub>	stibine

In some languages names of the type “Chlorwasserstoff” are in use and may be retained if national nomenclature committees so wish.

Purely trivial names, free from false scientific implications, such as soda, Chile saltpeter, quicklime, are harmless in industrial and popular literature; but old incorrect scientific names such as sulfate of magnesia, Natronhydrat, sodium muriate, carbonate of lime, should be avoided under all circumstances, and they should be eliminated from technical and patent literature.

◆ For BH<sub>3</sub> (omitted in the Rules) borane rather than the previously used borine has been recommended by the Advisory Committee on the Nomenclature of Organic Boron Compounds of the ACS in a report not yet published.

Because soda is an ambiguous term, it is suggested that it be replaced by soda ash.

## 3. NAMES FOR IONS AND RADICALS

### 3.1. Cations

3.11.—Monatomic cations should be named like the corresponding element, without change or suffix, except as provided by 2.2531.

Examples: Cu <sup>+</sup>	the copper(I) ion
Cu <sup>2+</sup>	the copper(II) ion
I <sup>+</sup>	the iodine cation

◆ For I<sup>+</sup>, iodide(I) cation is more consistent with recommended practice. *Cf.* 3.21.

3.12.—The preceding principle should apply also to polyatomic cations corresponding to radicals for which special names are given in 3.32, *i.e.*, these names should be used without change or suffix.

Examples: NO <sup>+</sup>	the nitrosyl cation
NO <sub>2</sub> <sup>+</sup>	the nityl cation

◆ Polyatomic here and in 3.13, 3.14, 3.223, 3.32, and 5.2 seems to be limited to more than one *kind* of atom, and hence heteroatomic would be a more precise term. It is agreed that nityl and not nitronium should be used in all cases (*cf.* 3.151).

3.13.—Polyatomic cations formed from monatomic cations by the addition of other ions or neutral atoms or molecules (ligands) will be regarded as complex and will be named according to the rules given in Section 7.

Examples:

[Al(H <sub>2</sub> O) <sub>6</sub> ] <sup>3+</sup>	the hexaquoaluminum ion
[CoCl(NH <sub>3</sub> ) <sub>6</sub> ] <sup>2+</sup>	the chloropentamminecobalt ion

For some important polyatomic cations which fall in this section, radical names given in 3.32 may be used alternatively, *e.g.*, for UO<sub>2</sub><sup>2+</sup> the name uranyl(VI) ion in place of dioxouranium(VI) ion.

3.14.—Names for polyatomic cations derived by addition of protons to monatomic anions are formed by adding the ending *-onium* to the root of the name of the anion element.

Examples: phosphonium, arsonium, stibonium, oxonium, sulfonium, selenonium, telluronium, and iodonium ions.

Organic ions derived by substitution in these parent cations should be named as such, whether the parent itself is a known compound or not: for example (CH<sub>3</sub>)<sub>4</sub>Sb<sup>+</sup>, the tetramethylstibonium ion.

The ion H<sub>3</sub>O<sup>+</sup>, which is in fact the monohydrated proton, is to be known as the oxonium ion when it is believed to have this constitution, as for example in H<sub>2</sub>O<sup>+</sup>ClO<sub>4</sub><sup>-</sup>, oxonium perchlorate. The widely