

A SHORT GUIDE TO TECHNICAL WRITING
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READ THIS MANUAL CAREFULLY BEFORE WRITING YOUR FIRST REPORT AND THEN KEEP IT FOR FUTURE REFERENCE..

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WRITING THE REPORT

1. *Voice*: In the past, it has been customary to write reports in passive voice in recognition of the fact that the writer's relationship to the material he/she is presenting is a purely objective one, a practice which is still adhered to in the preparation of material for the more conservative technical publications. But, nowadays, there is a growing trend to use active voice, at least occasionally, where it may be effective to do so, as in emphasizing an especially pertinent point or in avoiding the awkwardness of a weak passive. For example, "It was desired that the values be checked," may better be rendered as, "We were asked to check the values." The letter of transmittal, by preference, should be written in active voice because it may be the writer's only opportunity to speak as him/herself and not as an impersonal agent.

2. *English usage*: The *formal report* is to be written in conformance with the best standards of English usage, as practiced by writers of serious scientific works. The *informal report*, such as that on a field trip, may be written more casually and in active voice, though even here the dictates of good taste should be observed. Since the student is preparing to enter the professional world, he/she must begin writing at that level; for it will be his/her responsibility to compile the research studies, operational directives, and reference manuals upon which future scientific and technical progress will depend.

3. *Tense*: The procedural, narrative part of the report, including the calculations, should be written in *past tense*, because the writer is giving an account of what he/she *did* or *has done*. The present tense is to be used only for expounding theory and principles involved, for stating known fact, and for explaining figures and diagrams.

4. *Equations*: Each equation is to be placed on a line by itself. Equations that will be referred to in the text of the report should be numbered, with the numbers flush with the right margin. All statements relating to equations are to be treated as sentences and punctuated accordingly, although a period is not required after an equation when it is on a line by itself.

Example: The results are plotted in Figure 5. The data show good agreement with the straight line of slope 1/2. Thus, the order of the reaction, n , is

$$n = 1/2 \quad (10)$$

From Figure 5, a straight line, shown in Figure 6, is drawn. The slope of the straight line gives

$$\frac{\Delta E}{R} = 6.81 \times 10^3 \text{ (K)} \quad (11)$$

Therefore, the activation energy is

$$\Delta E = 3.55 \text{ (kcal/mole)} \quad (12)$$

5. *Literature cited*: See "Guidelines for Literature References"

FAULTS IN GENERAL WRITING

6. *Failure to construct a paragraph properly*. Some student writers hand in reports made up of paragraphs consisting of one to three sentences only, and others do not paragraph at all. Both of these groups of writers have failed to distinguish between the topics requiring elaboration and the supporting details. The best way out of the dilemma is to make a preliminary outline of the principal points and list below each point the details needed for amplification. The main topics then become the topic sentences; and the subtopics, the body of the paragraph. No set rule can be specified for length; there will often be some very short paragraphs and a few very long ones. However, the average paragraph in expository writing contains from one hundred to two hundred words, or from eight to sixteen typewritten lines.

7. *Failure to develop a paragraph logically*. Several devices exist for developing a logical paragraph sequence. Terms or ideas that seem to need explanation are followed by the necessary details. If the paragraph explains a process, stating the consecutive steps in the process is the only logical method of development. In paragraph development, one may proceed from the simple to the difficult, from the familiar to the unfamiliar, from the known to the unknown. In any event, do not include within the paragraph any detail not comprehensible on the basis of what has already been said.

8. *Monotonous repetition.* Nowhere does a poverty-stricken vocabulary betray itself more unpleasantly than in the close proximity of two or more similar words. Surely, with ingenuity, the writer can find a way around such expressions as the following:

"Then. . . Then. . . Then. . . Then," when describing a process. A preferable approach could be, "First. . . Secondly. . . etc.," or, "First. . . Next. . . Then. . . Finally."

<i>Poor</i>	<i>Better</i>
A voltage of 7500 volts	a potential of 7500 volts
gas dried in drying towers	moisture removed in drying towers
blown by blowers	forced along by blowers
fans that fan the gases	fans that propel the gases
pumped by pumps	forced out by pumps
cooled in the cooler	the heat was dispelled by the cooler

9. *Ambiguity.* This term signifies writing in such a way that a statement may have two or more meanings or be indistinct or obscure. Someone has called it "the dishonor badge of technical writing." It may result from the absence or misuse of some mark of punctuation, the lack of precision in terminology, or carelessness of expression. In any event, it forces the reader to think twice before he/she can arrive at the intended meaning.

Such lack of clarity may even lead to disaster. William Gilman, in *The Language of Science*, tells of what happened in the routine check-up of an airliner, during which it was necessary to remove an elevator assembly. To replace it correctly, both the reference manual and the catalog of parts were consulted; but their directions were ambiguous. There appeared to be two ways of replacing a certain idler part. The wrong way was chosen. The plane crashed at take-off, killing sixteen persons.

Everyone has experienced the ineptness of certain repairmen, not all of which may be due to ignorance but rather to ambiguous wording in their shop manuals. As the writer of such reference guides, where clarity should be of the essence, the student should make it a cardinal principle to avoid the double talk of ambiguity. It is usually upon rereading what he/she has written that he/she detects such lapses. He/She should, therefore, never be content with his/her first draft.

As the lever lifted the whole apparatus shook. ("As the lever lifted the whole apparatus. . .
 "or, "As the lever lifted, the whole apparatus shook?")
 After all the crystals settled to the bottom. . . ("After all the crystals. . ." or,
 "After all, the crystals settled. . .")
 In practice measurement of relative viscosity is done at various concentrations. ("In practice
 measurement. . ." or, "In practice, measurement. . . is done ?")
 Only at 85°C did the solution stick to the walls of the container, and *this* was not consistent.
 ("This" seems to refer to "container," when it was meant to refer to the entire preceding clause.
 "This" should, therefore, be followed by a word or term which summarizes that clause, as,
 "This *tendency* was not consistent.")

10. *Lack of precision in word choice.* Because engineering reports must convey precise and accurate information, the student should avoid the so-called "wastebasket" words, which are so comprehensive and yet so indefinite. In this category come such verbs as *get, use, find, do, put,* and, especially, *to be.*

"This work was *done* with the aid of several computers, but was *done* in the main by. . ."
 Why not *accomplished* or *executed*?
 "The bob was *put* into the water." Why not *dropped, lowered, immersed, let down, released*
into, allowed to fall, made to descend?
 "Solving the equation *gives.* . . ." Why not *results in, establishes a value of, yields the*
expression, reduces to?

The same objections hold true in regard to nouns, adjectives, and adverbs, as well as to the other parts of speech. Gilman mentions the case of the Army engineers who provided specifications for the St. Lawrence Seaway and labeled the soil as "compact to very compact." The contractors thought they could scoop it up in power shovels. Instead, they had to dynamite. Contending that the adjective should have been

"cemented," they demanded an extra \$7 million. The best aid for acquiring the range of possible meanings for each overworked word is Roget's *Thesaurus*, the dictionary being a close second.

11. *Misspelled words.* Bad spelling is one of the most inexcusable faults of which the writer can be guilty. Improperly spelled words are the first things that strike the eye. The reader immediately assumes that the botched spelling is a criterion of the writer's technical skill and that his/her work as an engineer will be no more reliable. Besides, the writer further convicts him/herself of having been too lazy, ignorant, or indifferent to consult the dictionary. If the word is too new to appear there, it may be found in some technical work. The following words are among those most commonly misspelled in chemical engineering reports, with "separate" the most frequent offender. Most word-processing programs have spell checkers, and failure to use them can result in a poor grade.

12. The authority for all spellings listed below is Webster's *Third New International Dictionary*.

absorb, absorption	dependence	occur, occurred
accommodate	desiccant	omit, omitted
achieve	elute, eluent <i>or</i> eluant	omission
ambience or ambiance,	empirical	personnel
ambient	equip, equipped	Poiseuille
analyze	equilibrium	proceed, procedure
aqueous	extension	propellant (preferred)
Avogadro	forty	<i>or</i> propellent
begin, beginning	fluctuate	pseudo
believe	fluorine	rarefy
Bernoulli	fluorescent	refer, referred
buoyant	gas, gases	recommend
canceled <i>or</i> cancelled	gauge or gage	Reynolds number (no')
changeable	labeled <i>or</i> labelled	rotameter
commit, committed	liquefy	separate
condensable or	maintenance	similar
condensible	movable <i>or</i> moveable	sizable <i>or</i> sizeable
consistent	negligible	transfer, transferred
control, controller	nickel	vertical
crystal, crystallize	ninety	versus
definitely	noticeable	yield

13. In the engineering world, there is a growing tendency to spell such words as those below with "-or" instead of "-er," the original ending. This newer spelling is used especially where the words designate a mechanical device, as: "The distributor needs new points." However, when the words are used in a nontechnical sense, the original spelling is more likely to be retained, as: "Better Brands, Inc., is the distributor of our products."

In present-day practice, certain words are still spelled exclusively with "-er" and others with "-or." Some may be spelled both ways:

<i>"-er" only</i>		<i>"-or" only</i>		<i>Both</i>
condenser	agitator	extractor		computer, -or
controller	calculator	integrator		connector, -or
digester	compressor	moderator		converter, -or
experimenter	detector	resistor		conveyer, -or
	evaporator			distributor, -or

14. Avoid simplified spelling in any form of serious writing. Do not use *enuf, lite, nite, tho, thot, thru,* etc.

PUNCTUATION ERRORS

15. Because of the importance of the hyphen, especially in scientific and technical writing, the discussion of this most misused of all marks of punctuation occupies the chief portion of this section of the manual. The importance of this small mark cannot be exaggerated. Its presence or absence can change a meaning completely. Was the tank recovered or re-covered? Is it a light gas unit or a light-gas unit? Static-

liquid-seal height or static-liquid seal height? The student must decide whether each adjective can modify the noun independently or whether two or more, as a one-word force, are needed. Consider "heat transfer data"; are they *heat* data or *transfer* data, or does it take both words as a unit to express the idea accurately? If so, hyphenate. In the expression "double pipe heat exchanger," is it a *pipe* exchanger or a *double* exchanger? Since neither makes sense, the two words joined must be necessary; therefore, use a hyphen.

As the student can see, inability to understand the function of the hyphen and its correct application is one of the factors which may defeat the very purpose of his/her research. The failure of our first \$16 million Venus rocket was due to the omission of one little hyphen from the computer data. It is, consequently, of utmost importance, for purposes of clarity and precision, that the writer familiarizes him/herself with the conventions of its use. Although the rules are highly fluid and in a constant state of flux, some well-established standards nevertheless exist, the rudiments of which are detailed below. Should a more complete list be desired, consult the rules on hyphenation in Webster's *New Collegiate Dictionary*.

16. First and foremost is the rule that, when two or more words modify another word as a *unit*, the hyphen must be used to show the compound relationship. In the examples below, chosen because they are among the most commonly used expressions in chemical engineering reports, observe that, without the hyphen, the precise meanings of the modified nouns would be seriously in doubt. The ordinary reader might not be able to detect the real meanings at all, and even the technician might be puzzled. The writer owes the reader the courtesy of making his/her meaning unmistakably clear, a properly placed hyphen being one way of doing so.

acetic-acid water system	gas-bubble column
bubble-cap tray	heat-exchange-product stream
bulk-air temperature	heat-transfer-film coefficient
chemical-process equipment	impact-velocity feed line
constant-head tank	liquid-temperature air-enthalpy plot
constant-pressure theory	logarithmic-mean temperature
continuous-stirred-tank reactor	mass-transfer packed-tower theory
constant-pressure enthalpy-	product-stream line
composition linear diagram	proportional-plus-integral-mode
dissolved-oxygen content	controller
dynamic-process-control analysis	reciprocal-film heat-transfer equation
enthalpy-difference driving force	scintillation-counter spectrometer
exit-line pressure	sensible-heat transfer
fluid-column height	steam-jacketed one-tube-pass heat
free-convection energy-	exchanger
transport coefficient	thermal-energy transfer
fluid-friction factor	time-drying-rate plots
laminar-velocity profile	tray-type column
low-energy bond	tube-flow viscometer
inside-pipe cross-sectional area	water-head pressure
liquid-gas interface	

17. In a series of hyphenated words having a common base, use suspended hyphens:

a two- or three-year study
 dextro- and levo-tartaric acid
 low-, medium-, and high-density polyethylenes
 T- and H-shaped rib design
 twenty-six or -seven days

18. Although there are exceptions, a one-word force is not hyphenated when it stands after the noun or in the predicate:

a built-in oscillator		an oscillator is built in
a T-shaped metal support	<i>but</i>	the support is T shaped
a day-old solution		a solution a day old

19. Do not hyphenate with -ly:

an imperfectly rounded Styrofoam ball

accurately held dimensions

20. If the preceding adjective is in the comparative or the superlative degree, no hyphen is used:
a high-priced unit *but* a higher priced unit
a small-size pipe the smallest size pipe

21. Prefixes are usually written solid with the word modified, except when an awkward doubling or trebling of letter occurs or when the word modified is a proper noun:

coexist	hydroelectric	millivolt
countercurrent	infrared	nontechnical
	<i>but</i>	
co-orbits	non-Newtonian	shell-like
inter-Allied	photo-optical	trans-Stilbene
intra-atomic	pre-exposure	

However, "coordinate" and "cooperate" need not be hyphenated.

22. Since a different meaning may be conveyed by writing a prefix solid with the word, a hyphen may have to be used

resort to other means		re-sort the particles
recover the effluent		re-cover the receptacle
recollect past errors	<i>but</i>	re-collect the filtrate
microin (correct)		micro-in. (better)
reform the methods		re-form the molecules
unionized labor		un-ionized atoms

23. Words compounded with ex- (former), self-, and quasi- are hyphenated.

ex-chairman	self-evident	quasi-scientific
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24. Various parts of speech are often compounded when no one word will accurately depict the idea. When used as the parts of speech designated below, they are hyphenated.

air-dry (v.)	heat-treat (v.)	stand-in (n. or adj.)
by-product (n.)	man-hour (n.)	start-up (n.)
down-drag (n.)	mix-up (n.)	straight-line (adj.)
follow-up (n.)	power-driven (adj.)	water-free (adj.)
foot-pound (n.)	right-hand (adj.)	well-founded (adj.)
half-hour (adj.)	short-circuit (v.)	well-known (adj.)

Example: The initial experiments require follow-up. *But*, we follow up our experiments with data analysis.

25. Through frequent use, certain compounds lose the hyphen and are written solid. Others drop the hyphen but are still written as two words. The dictionary is the criterion; but, if the words are too new to appear there, technical writings must be the guide.

acidproof	downdraft	nonnuclear	shakedown
airline or air line	downstream	overall	sheetmetal
airstream	downtime	oversized	shutdown
airtight	drawoff	overhead	standpipe
all right	fallout	output	steady state
blowdown (n.)	feedback	outweigh	stopwatch
blowout (n.)	flow rate	payoff (n.)	streamline
breakdown (n.)	free fall	payout (n.)	throughput
buildup	halfway	percent	turbojet
bypass	heat exchanger	phototype	twofold
byproduct	holdup	photosensitive	upend
checkup (n.)	input	pinpoint	upkeep
crosscut	intake	pipeline	upstroke
crossflow	layout (n.)	radioactive	voltmeter
cross section	lineup (n.)	setscrew	wave length

dew point
downcomer

makeup
nonstop

setup (n.)
set point

widespread
worthwhile

26. For clearer and smoother reading, it is often advisable to avoid excessive or awkward hyphenation by writing the expression in a different way. However, if the writer prefers the long compound modifier before the noun, the hyphens must be used.

"A four-foot-deep seven-by-five-foot tank" is better written "a tank four feet deep and seven by five feet wide."

"A 1000-barrel-per-day rate" or "a rate of 1000 barrels per day."

"Corrosion-, heat-, and cold-resistant material" or "material resistant to corrosion heat, and cold."

"Friction-factor-vs.-Reynolds-number plot" or "plot of the friction factor vs. the Reynolds number."

27. Some words which are normally nouns are occasionally used as adjectives. If an adjective of this nature is preceded by a numerical value, the two words must be joined by a hyphen. *Failure to observe this rule is a major cause of downgrading in English.*

a 300-mesh screen

a 3/4-ton truck

a 5-gal tank

two 42-ft lengths

a 100-kiloton-yield warhead

a 20-percent profit

a 9-ft-diam 3 1/2-ton cylinder

an 8-mm band

a 5-in-by-2-ft shaft

a 75-hp engine

28. Though not universally done, in most expressions involving a substance designated by number, it is preferable to hyphenate. The word preceding the numeral should be capitalized.

Amoco-200 oil

Dow-200 silicone

a Series-400 diaphragm

a Type-152 controller

29. All spelled-out compound numbers from twenty-one through ninety-nine must be hyphenated. (However, common usage is to write all numbers from 10 up as figures.)

thirty-one

forty-four

seventy-seven

30. In handwritten or typewritten papers, it is usually unnecessary to divide many words. An uneven right-hand margin is usually preferable to a multitude of split words. But, if word division is necessary, observe the following rules:

- a. All divisions should take place between syllables. If in doubt, consult the dictionary.
- b. Unless unavoidable, divide none but very long words at the end of a line.
- c. Avoid dividing a word in such a manner that the first part does not suggest the second.
- d. Never divide words of one syllable.
- e. Never divide a word so that a single letter is allowed to stand by itself.
- f. Avoid dividing proper names.

CAPITALIZATION

31. a. Capitalize all proper nouns such as, names of persons, places, companies, institutions, etc. and the adjectives derived therefrom.

b. Capitalize the first word of every sentence and also the first word of every direct quotation.

32. When writing such terms as "Reynolds number," "Fanning friction factor," "Newtonian fluid," etc., capitalize the name of the person associated with the concept but not the expression following.

Note: Although Webster's *Third New International Dictionary* sanctions the lack of capitalization of such terms, departmental policy favors adherence to the more conservative practice.

33. Capitalize such words as sophomore, quarter, chemical engineering, university, etc., only when referring to them as special entities. When used in a general sense, do not capitalize.

Here is a catalog for the *Fall Quarter*. (Special)

Credits will be given for *any quarter*. (General)
 The *Chemical Engineering Department* of the University of Utah. (Special)
 Good courses in *chemical engineering* are offered here. (General)

34. Capitalize north, east, south, and west only when these words refer to places, not when they refer to directions.

Western Phosphates, Inc., sells its products mostly in the Intermountain West. (Place)
 We traveled west to visit this plant. (Direction)

35. A trademarked name is capitalized unless it has become so common as to represent a class or a type. (Even so, some manufacturers insist upon capitalization.) Many such names are in a transitional stage, and it is difficult to know whether to capitalize or not. If the term is well established, the spelling will appear in the dictionary. If not, many of these terms can be found in the index of some standard scientific work or in a dictionary of technical terms. (The following examples are spelled as of 1967.)

Amberlite	Fiberglass	Pyrex
Bakelite	Greensand	Saran
butadiene-Natrium	Lucite	Silastic
Carbopol	Maxite	silicone
Celite	n-butyl-Neoprene-Cellosolve	Styrofoam
cellophane	nylon	Teflon
Dacron	orlon	Versene
dynel	Plexiglass	vinyl
Erichrome Black T	polaroid Land camera	

36. A device is frequently manufactured by several companies. When one of these devices is mentioned in a report, capitalize only the brand name, regardless of advertising copy or catalog listing.

Torrington needle bearings	a G-E X-ray spectrometer
a Bendix C-E computer	Bilt-Rite aluminum products

37. Do not capitalize the names of elements, chemicals, or their compounds. (Chemical symbols are obvious exceptions.) Names of elements followed by their atomic numbers should be hyphenated. If the elements are referred to by symbol only, the initial letter should be capitalized.

magnesium-12	Mg-12
uranium-238	U-238
chlorine-17	Cl-17

38. Numbered items should be capitalized when referred to in the text of the report. Write the numbers as figures, not as words.

Equation (7)	Group 2
Chapter 1	Project 3A
Reference 3	Particles 6-9
Table III	Run No. 4
p. 6	11.7-9 p. 2 and ff.
pp. 2-5	
1.4	

39. When listing items, observe consistency in lettering. Apart from the first word, which will ordinarily be capitalized, every succeeding word may begin with either a capital letter or a small one: but, whichever the choice, hold to it throughout.

<i>Table of Contents</i>	Write equations for:
2. The Atomic-Molecular Hypothesis	a. preparations for. . . .
3. Valence: The Periodic Law	b. reduction of. . . .
4. Atoms and Isotopes: Atomic Nuclei	c. action of oxygen
<i>Apparatus</i>	Water analysis
8. R. F. electrode	1. conversion of units

- 9. Embossing die
- 10. Mylar-coated film

- 2. specific heat of . . .
- 3. index of separation

THE COMMA

40. Unless the clauses are very short, a comma separates two or more independent clauses joined by the conjunctions *and*, *but*, *or*, and *nor*. This practice is especially the case if a change of subject takes place in the succeeding clause or clauses.

"The apparatus was completed and four runs were made." (Two short clauses; no separation needed.)

"The compressor operates at a pressure ratio of 3.4 to 1, *and* the gasifier turbine rotates at a full-power speed of 33,000 rpm. (Following long clauses, commas are necessary to let the reader know that one thought is ending and another beginning.)

41. If pauses are clearly indicated by the following expressions or similar ones, they should be set off by commas. If the expression introduces the sentence, the comma will precede; if interpolated within the sentence, a pair of commas must be used.

Therefore, a convenient quantity, *q*, is used. . . .(Introductory)

These values hold, generally speaking. (Concluding)

The apparatus, shown in Fig. 3, consists of. . . .(Interpolated)

The beads, as well as the bits of plastic, swirled. . . .(Pause)

He performed the experiment as well as he could. (No pause)

Teams 1 and 2, respectively, will report. . . .(Pause)

above all	first, second, etc.	in conclusion	next
accordingly	for example (e.g.)	indeed	nevertheless
and so on (etc.)	for instance	in effect	of course
apparently	furthermore	in general	on the other hand
as a rule	hence	in other words	respectively
besides	however	instead	that is (i.e.)
consequently	if necessary	in turn	therefore
finally	in addition	moreover	thus
conversely	in brief	namely	

42. If an explanatory phrase or clause breaks into a sentence at any point, it should be set off by a pair of commas.

It was realized that these loads, as applied in the laboratory on simulated test set-ups, did not necessarily. . . .

My major interest, you will note, has been the designing of. . . .

The subject of my thesis, required for the B.S. degree, is. . . .

43. Commas are used to set off a term explaining another term or expression. (If an "or" phrase is used for this purpose, commas are required.)

Two important properties, *the dielectric constant and the power factor*, determine how much heat. . . (Explanatory)

Calvin discovered that nucleic acid particles, *precursor components of living molecules*, are present in. . . . (Explanatory)

An insulated electrode, or "*cribbing*," isolates the. . . (Explanatory)

If arcing or *burning* occurs, holes may be. . . (Not explanatory)

44. If a clause can be removed from the sentence without impairing the meaning, it should be set off by commas. If it cannot be removed, no commas should be used.

The internal "feedback," *which caused oscillations and other difficulties*, has now been removed. (Removable)

The small electrical appliances *that come from Japan* are quieter than those made in the U.S. (Not removable)

45. The commas should be used to set off most introductory elements (words, phrases, clauses), especially if they are long. With very short ones, the comma is optional, though conservative usage seems to favor it.

By equating the weight rates of flow and by using the known calibration of the venturi, the calibration constant can be obtained. (Long introductory element)
Because of the method of construction, line EM can never cross the curve. (Long introductory element)

In 1963, 35 barrels were shipped. (Short introductory element, but ambiguous without the comma.)
In the 1920's(,) Flettner applied the idea of the Magnus effect to ship construction. (Comma optional)

46. In technical writing, the comma is placed before the concluding *and*, *or*, or *nor* in listed words so that the last two items will not be erroneously grouped. (In other writing, the last comma may not be dropped.)

The wires were colored red and white, blue and gold, orange and green, and yellow.
(The last comma to prevent the last color from being confused with the two preceding ones)
Polysaccharides are tasteless, amorphous, and insoluble substances.

47. The comma may or may not appear between consecutive adjectives directly preceding the noun they modify. To decide whether or not to use the comma, this useful though not infallible test may be applied. For instance, if one can say "a long *and* difficult experiment," then it may be written "a long, difficult experiment." On the other hand, since "and" cannot be inserted naturally between the two adjectives in "a multi-cylindered diesel engine," the comma is not appropriate.

A lengthy, unwieldy equation resulted.
A harsh, crusty, unusable substance appeared.
The column consisted of a four-inch double-wall Pyrex pipe.
A durable lacquer coating was applied.

48. The comma is used to set off absolute phrases (those in which the participial form of the verb ending in "-ing" is used).

The desired value *having* been obtained, the final result could then be calculated.
The trouble could not be located, the power source *having* been cut off.

49. If a word, phrase, or clause is out of its natural order, or inverted, it is usually set off by a comma, unless immediately preceding the predicate in an inverted sentence.

The alpha particles, upon hitting a nucleus, may emit. . . .
If, in the case of fully developed flow, the local shear stress decreases linearly with the radical distance, then. . . .
On p. 6 will be found the requisite data. (No comma because the inverted phrase precedes the verb.)

50. Use commas to set off geographical names, dates, addresses, and literary references. (Underscore or italicize text names but NOT the name of the author).

The statement is found in Brown's *English for Engineers*, Ch. 7, p. 63.
The Seneca Mfg. Co., Inc., is located at 751 West 8th So., Salt Lake City, Utah. They sent us a catalog May 6, 1967.

51. When incorporating catalog specifications into the text of a report, separate the various items by commas; otherwise, a too lengthy, unbroken series results.

A 1/2-hp, Class I, Group D, explosion-proof, 3-phase, 60-cycle, 220/440-volt electric motor.
A Leeds and Northrup, Series-60, current-adjusting-type controller.
A 24-in long, 4-in.i.d., Type-347 stainless pipe.

52. A word or phrase that follows a noun to explain or define it is called an appositive and should be set off by a pair of commas. However, if this expression cannot be omitted without impairing the meaning, no commas are used.

A Swedish scientist, *Jakob Berzelius*, coined the term "isomer."
(The name may be omitted without impairing the sentence.)
The scientist *Jakob Berzelius* coined the term "isomer."
(Here, the name cannot be omitted without impairing the sentence.)

53. Letter values and similar symbols used appositively should be set off by commas. Such expressions are preceded by the articles *a*, *an*, or *the*. Where the articles *do not* appear, no commas are used.

The controller gain, Kc, is expressed by. . . .
Controller gain Kc is expressed by. . . .
Where *the* subscript, s, stands for. . . .
Where subscript s stands for. . . .
Since *the* expression, 3-4, involves only. . . .
Since expression 3-4 involves only. . . .

54. Clauses introduced by *that* are "restrictive"; that is, they cannot be deleted from the sentence without impairing its meaning. Such clauses may be handled in three ways:

- a. It was found that for this particular composition the steam rate to the reboiler was
(No comma)
- b. It was found that for this particular composition, the steam rate to the reboiler was. . . .(Comma at end of clause)
- c. It was found that, for this particular composition, the steam rate to the reboiler was. . . . (A pair of commas enclosing the clause)

a. and b. are the more usual practices. Note that the comma *never* precedes "that."

55. Avoid the "that. . . .that" error. One "that" is unnecessary. Omit either the first or the last.

Observations show *that*, in a fluid flowing along a solid boundary, *that* there is zero velocity at the boundary.
It was found *that*, for this particular feed composition, *that* the steam rate to the reboiler was. . . .

SEMICOLON AND COLON

56. Two individual statements not joined by a conjunction but closely related in thought may be linked by a semicolon. Two independent statements joined by a conjunction but containing internal commas should be separated by a semicolon--a stronger punctuation mark than a comma--so that the two main clauses will be distinct.

The data of this report are concerned with periodical literature of interest to welders; they are discussed as to authority, usefulness, and scope.

A dangling modifier, a misplaced comma, a misspelled word, a wrong word choice are for the most part superficial errors; but these are the things that created first impressions.

57. A semicolon is placed *before* a word that introduces a listing at the end of a sentence. A comma is placed *after* the word. Such introductory words are:

namely	viz. (to wit)	as
for example (e.g.)	for instance	that is (i.e.)

The air-gaging circuit must meet these requirements; *namely*, gaging range of 0.001 in., gaging time of 0.2 sec. max., and gaging cycle of 0.36 sec.

58. When such words as *hence*, *however*, *moreover*, *therefore*, etc., begin a clause, they are followed by a comma. When used internally, they are preceded by a semicolon.

Seven runs were made in glycerine. However, further experimentation was required.
Proofread your report before handing it in; *otherwise*, a lower grade in English may result.
Definite air-fuel ratios are necessary for different conditions of speed and load; *therefore*, it is quite important that for testing purposes the air-fuel ratio be determined quickly and accurately.

Note: Nowadays, the practice is to place such introductory words as *therefore*, etc., elsewhere in the clause in order to avoid excessive punctuation. Read the clauses above as:

. . .before handing it in; a lower grade in English may *otherwise* result.
. . .conditions of speed and load; it is *therefore* quite important that. . . .

59. When any one of the elements in a series contains a comma, all members of the series should be separated by semicolons.

The main lines of the new chemistry are: first, the creation of a basic concept of the way atoms are joined into molecules, called the electronic theory of the chemical bond; second, the practical proliferations of this theory into more complex chemical structures; and, finally, the increasing merger of chemical research with physics and biology.

60. The colon introduces a summing up, an illustration, a formal quotation, or an enumeration for which the previous words in the sentence have prepared the reader. It usually stands for *namely*. Do not confuse the colon (:) with the semicolon (;).

The amount of heat developed is due to two important properties: the dielectric constant and the power factor.

Other engineering features of Firebird III include:

2. cruise control,
3. an auxiliary 10-hp engine,
4. a unique frame design,
5. an air-oil suspension system.

61. The dash is used to set off material that is loosely connected with the thought of a sentence. It is also used to mark a sudden change in the construction of a sentence, before a summarizing sentence, and also to set off appositional material at the end of a sentence, or long appositional material, especially series, within the sentence. It is typed as two hyphens with no space before or after.

Alcohols of all three classes--primary, secondary, and tertiary--can be synthesized by. . . .

If he/she is writing for people outside his/her own organization, he/she pays another penalty--loss of readership.

62. The use of quotation marks to set off quoted material is well observed in engineering reports. However, their use in regard to unusual names or terms is not so well understood. When such expressions appear in a report, they should be placed in quotes the first time they are mentioned but not thereafter.

To "scram" the apparatus is to ram in the safety rods. The operators failed to scram it on time with the result. . . .

63. a. Use an apostrophe to indicate possession. If the name of the possessor is singular, place the apostrophe before the "s"; if plural, after the "s."

Kepler's theory	the Burnses' home
Bank's works	the Darwins' estate
an hour's time	two hours' time
a dollar's worth	ten cents' worth

b. If the apostrophe creates awkwardness, use an "of" phrase instead: rather than "the nucleus's ability," say, "the ability of the nucleus." In fact, with the exception of personal names, an "of" phrase is preferable in scientific writing.

PERIOD

64. The period should be used at the close of each complete statement and also after every nontechnical abbreviation. If the sentence ends in an abbreviation requiring a period, one period suffices for both. The experiment requires a period of 20 hrs.

NUMBERS

65. Do not begin a sentence with a figure. Either write it as a word or recast the sentence.

Not, "200 barrels were delivered."

But, "Two hundred barrels were delivered."

"A total of 200 barrels was delivered."

66. The general rule for ordinary writing, as in the early part of a report, is to spell out numbers under 10 but to write all others as figures.

two wires

nine feet

18 electrodes

20 tons

67. Arabic numerals are used for percentages, decimals, dates, and numbers followed by abbreviations.

6 percent

3.6 units

June 10, 1967

8 kg

68. Decimal fractions are preferably written with a zero preceding the decimal point, as: 0.50, 0.765.

69. a. If two numbers modify an item, one number (usually the first) is spelled out.

two 2 x 4's

two 15-sec runs

eight 5-gal cans

b. But, if the second number is the shorter, it may be spelled out instead.

300 four-inch strips

45 three-inch slots

70. In tabulations, two spaces or a spaced hyphen separate such numbers.

15 3" pipes

150 2 x 4's

5 - 3/8" boards

71. Use a slash (/) in writing fractions attached to whole numbers, leaving a space between the number and its fraction.

2 1/2

4 3/8

12 2/3

72. Isolated fractions in the text should be spelled out unless they are long and complicated.

The formula called for *one third* of the amount.

Only *18/25* of the mixture was used.

73. Do not write one part of a small fraction as a figure and the other as a word. They should appear as:

half-inch pipe

1/2-inch pipe

1/2-in. pipe

ENUMERATIONS

74. Numbers and letters used in enumerating in-text items should be *enclosed in parentheses* and the items themselves *followed by commas*.

The buildup room is used for preparing the parts to be tested. It includes such equipment as: (1) down-draft spray booth, (2) special spray equipment for coating a test part with lacquer, and (3) storage area for test equipment.

75. However, if commas or other marks of punctuation already occur within the items enumerated, the individual items are separated by *semicolons*.

Gyros are classified into two categories: (1) *captive*, or having one degree of freedom; and (2) *free*, or having two degrees of freedom.

76. In enumerating a formal list of items, one of the following methods should be used: 1., 1), or a). In most cases, Arabic numerals are preferred. (Note that periods are always aligned.)

- | | |
|---|-----------------|
| 9. Extremely high-resolution radar | I. Introductory |
| 10. Advanced electronic countermeasures | II. Summary |
| 11. Improved IFF | III. Theory |

ABBREVIATIONS

77. The Period should be omitted after technical abbreviations. Use an abbreviation only when its meaning is unambiguous.

78. Periods must be used after nontechnical abbreviations; such as:

vs.	i.e.	dept.
p.m.	etc.	mfg.
op. cit.	pp.	cf.

79. Terms denoting units of measurement should be abbreviated only when preceded by the amounts indicated in numerals. Do not mix.

sixteen inches *or* 16 in. twenty minutes *or* 20 min.

80. The same abbreviation is used for both singular and plural.

bbl, barrel or barrels *gpm*, gallon or gallons per minute

81. In the descriptive or more general parts of a report, avoid such signs as (%) for *percent*, (/) for *or*, (#) for *number*, (") for *inches*, and (¢) for *cents*. Use (+) and (-) with figures only.

82. Do not use the symbol (%) unless preceded by a figure. *Percentage*, not percent, is the correct word when no figure is given.

Six *percent* of the solution failed to evaporate.
The *percentage* of the solution which failed to evaporate was 6%.

GRAMMATICAL AND MISCELLANEOUS ERRORS

83. Avoid the use of *this*, *that*, or *which* referring to unexpressed words, vague ideas, or the whole of the preceding statement as antecedents. In scientific writing, the exact reference of each of the above pronouns should be rigidly checked; otherwise, a lack of precision, with consequent misunderstanding, may result. When such pronouns are used, they should be followed by a summarizing word or term.

There is no discontinuity in the plot where the flow changes from laminar to turbulent.
This is due to the geometry of the system. (Rather, *This lack* of discontinuity is due to. . . .)
The fluid was passed through the bed from a 30-ft hose. *This* provided sufficient pressure to.
(Rather, *This procedure* provided sufficient pressure to. . . .)

Because of the difficulty of arriving at a satisfactory summarizing term, a list of suggested ones follows:

factor	line of action	method	phrase
action	tendency	step	problem
manipulation	proceeding	finding	goal
course	procedure	fact	phenomenon
treatment	practice	trend	objective

84. Subject and verb must agree in number; a singular subject requires a singular verb; and a plural subject, a plural verb. (In this connection, remember that the letter "s" indicates the plural of most *nouns* but the third-person singular of *verbs*, as: one equations (s.), two equations (pl.); *but*, the law states (s.), the laws states (pl.).

85. A compound subject is plural and takes a plural verb.

The temperature differential, the area, and the heat-transfer coefficient of each effect *determine* the rate of vaporization. (Since the sentence contains a three-part, or combined, subject, the verb must be plural.)

86. Do not be confused by a "delayed" subject, or a subject which comes after the verb.

Off the tops of the distillation columns *come* the light hydrocarbons. (Even though "hydrocarbons" follows the verb, it is nevertheless the subject of the sentence; and the verb should therefore be plural.)

87. Do not let yourself be confused by a plural noun that intervenes between a verb and its singular subject.

A knowledge of the stress and strain characteristics of materials *is* important to the engineer. (The word "knowledge" is the subject of the verb, not "materials," the word which stands closest to the verb.)

88. In scientific writing, certain Latin and Greek words still retain their original plural, regardless of informal or conversational use. Be especially on guard with respect to the Latin plural *data*. Use *these* and *those*, not *this*, with the plurals listed.

<i>Singular</i>	<i>Plural</i>	<i>Singular</i>	<i>Plural</i>
axis	axes	nucleus	nuclei
basis	bases	phenomenon	phenomena
criterion	criteria	quantum	quanta
<i>datum</i>	<i>data</i>	radius	radii
hypothesis	hypotheses	stratum	strata
medium	media		

These data assure the validity of the findings. (Pl.)

Many *data* were taken. (Pl.)

The *datum* point was set at three degrees. (S.)

The packing *medium* was raschig rings. (S.)

The porous *media* were glass beads and aluminum particles. (Pl.)

89. When referring to an industrial company or organization, use the singular verb and pronoun.

The company *has* sent out *its* catalog.

Johns-Manville *manufactures* roofing.

General Motors, *which* invites us. . . .

90. Do not place so many words between the pronoun and its antecedent that the meaning will be unclear. The word in question should be repeated, or the sentence should be rearranged.

The solution to the problem is still uncertain, but *it* looks as if *it* could be accomplished by investing *its* underlying causes. (Upon analysis, it may be seen that the first "it" is general; the second "it" refers to "solution"; and the third "it" refers to "problem." The sentence must then be rewritten in some such way as: "The solution to the problem is still uncertain, but the difficulty could apparently be solved by investigating its underlying causes.")

91. Do not use the impersonal pronoun "one" when referring to yourself as the observer. "One" denotes *anybody*, whereas *you alone* are reporting the reactions occurring during your experiment. Therefore, say "I" or "we."

Not, "One saw the solution turn blue, " but "I" (we) saw. . . ."

92. *Myself, himself, itself*, etc., should be used to reflect or intensify nouns or pronouns that are already expressed in the sentence. In the absence of such expressions, the ordinary pronouns--*I, me, him*, or the like--should be used.

I saw the error *myself*. (Correct, because "myself" reflects "I.")
Newton *himself* formulated the laws of gravitation. (Correct, because "himself" intensifies Newton.)
Jay Hansen and *myself* comprised the team. (Incorrect, because there is no pronoun for "myself" to reflect. The sentence should therefore read, "Jay Hansen and *I* . . .")
The project was assigned to Jay and *myself*. (Incorrect, because there is no pronoun for "myself" to reflect. The sentence should then read, "The project was assigned to Jay and *me*."

93. Avoid the omission of necessary words from a comparison such as *that of, those of, any, etc.* The temperature is the same as the ambient air. (The temperature cannot be the same as the air. The sentence should read, ". . .as *that of* the ambient air.") The opportunities in engineering are greater than teaching. ("Opportunities" cannot be greater than "teaching." The sentence should read, ". . .greater than *those of* teaching.")

94. Do not omit *a, an, the, of, to, at*, and the like when the nouns following each denote different things. The omission of one of these words may lead to ambiguity.

A large pump and magnet (One unit of apparatus or two?)
The tube and rod (One article or two?)
The relative velocity of the particle and air (Both or one?)

95. Do not omit words needed for complete formulation of the logic.

Experiments *can and are* the best way to ascertain the truth. (Should read, ". . .*can be* and are. . . .")
We moved the cutter closer or farther from the wheel. (Should read, ". . .*closer to* or farther from. . . .")

96. "So," as a co-ordinating conjunction meaning "therefore," is not common in formal writing. It should be avoided as a loose, indefinite connective.

These linkages hold the molecules close together and cause friction when the molecules move; and so, when the molecules rotate. . . (Should read, "and, *therefore*, or *as a result*,. . . .")

97. In formal writing, do not use "so" as a conjunction of purpose. It must be accompanied by "that."

An insulated electrode isolates the high-voltage output from the rest of the press so a voltage gradient can be developed. (Should read, ". . .*so that*. . . .")

98. *Such that* is commonly wrongly used for *so that, in such a way that, or in such a manner that*.

The apparatus was arranged *such that* one potentiometer fed voltage to an electric analog computer. (Should read, ". . .*was arranged so that, or in such a way that*,. . . .")

99. To notify the reader that two or more elements in a sentence are of equal rank, the writer uses a device called parallelism. Since the only way to express such equality is by means of grammatical structure, the coordinate expressions must be identical in form--noun for noun, phrase for phrase, clause for clause, etc.

Two great theories are the theory of relativity and *the one called the quantum theory*. (The two parts of the compound subjective complement are unlike in construction. The second part should therefore read, ". . .and the quantum theory.")

The engineer is given a set of geometrical dimensions, *a certain kind of material is supplied*, and *he is told the exact quantity specified*. (Since all terms of a series should be of a coordinate structure, the last two terms, in order to agree with the first term, should read, ". . .*a certain kind of material, and the exact quantity specified*."

100. When stating temperature and other values, be sure to include all the words necessary, as is shown below:

A resolving time of *between* 75 and 300 sec.

Values accurate *to within* ten degrees.

The temperatures rose *to from between* 70 and 80 degrees to *between* about 120 and 135 degrees. (However, the proximity of so many prepositions is awkward. Such sentences are better written as, "The temperature rose first from 70 to 80 degrees and then from 120 to 135 degrees." Or, "The range of temperature was *from between* 70 and 80 degrees *to between* 120 and 135 degrees.")

101. In technical writing, use only those words accepted on the level of present-day written English. Avoid those marked in the dictionary as colloquial or slang. "Speech may be relatively vague and loose, but writing should be firm and exact."--A. O. Guthrie. Do not use:

"good" for "valid," "accurate," "excellent"
"lab" for "laboratory"
"fix" for "repair"
"in good shape" for "in good condition"
"the reason is because" for "the reason is that"
"most all of" for "almost all"
"rig" for "apparatus"
"plus" for "together with"
"around 300 degrees" for "about" or "approximately"
"to try and distill" for "to try to distill"
"checked into" for "investigated"

102. Avoid the use of the preposition *with* in place of an absolute phrase.

The two most common types are orifice meters and pitot-tube meters, *with* venturi meters also a popular type. (Better, ". . . venturi meters also *being* a popular type.")

103. Use *should* rather than *would* to express expectation.

This restriction on the use of the equipment *should* make it possible to build up the basic analog in one panel.

104. Use the correct verb tense to indicate time different from that of other verbs in the same sentence.

Not, "The machine *was started* where it *was* set, "*but*, ". . . where it *had been set*"; the "setting" antedated the "starting."

Not, "The tank *being* drained, it *was* ready for the influx of brine," *but* "The tank *having been* drained, . . ." since the tank had to have been drained before the solution could be poured in.

105. Guard against the use of an active infinitive or participle when the passive character of the principal verb calls for consistency in the use of verbal modifiers.

The oxygen is pumped to cylinders after *evaporating* it by *passing* it through a heat exchanger. (The two underlined words are active participles, but the dominant verb "is pumped" is in passive voice. To be consistent, these verbals should therefore read, ". . . after its *having been evaporated* and *passed* through a heat exchanger.")

The acetylene gas is sent to the alumina-filled drying tower *to remove* the water. ("Is sent," the main verb, is passive; "to remove" is an active infinitive which should be changed to read, "for the removal of water," or, "for the water to be removed.")

106. Verbals ending in -ing and used as adjectives must either "hang to," or modify, some definite word in the sentence or else some unexpressed but implied word. If they do not, the verbal is called a *dangling participle*, or a "dangler." This error is most likely to happen when the writer is using passive voice, the reason for which is shown below:

Using this equation, we obtained excellent results. (In this sentence, the verb "obtained" is in active voice, and "using" modifies "we.")

Using this equation, excellent results were obtained. (In this sentence, the verb "obtained" is now shifted to passive voice. Since "we" no longer appears as the subject, "using" now becomes a dangler because it no longer modifies anything.)

To avoid the error of the dangling participle, such devices as the following are used:

An adverbial modifier, "By the use of this equation," may be substituted.

An adverbial clause, "When (since, because) this equation was used," may be utilized.

An absolute, or independent, expression may be substituted; such as, "This equation having been used, excellent results were obtained."

In the examples appearing below, no word is present for the verbal to modify; and, technically, they therefore become dangles. However, certain unexpressed words may be understood; and the sentences, though poor, are allowed to stand.

Applying Equation (5), a curve is drawn. . (By *our* applying Equation (5), a curve is drawn. . . .)

If a fire got started, these cylinders would melt, *releasing* the acetylene. (. *thereby* releasing the acetylene.)

The real objection to the dangler is aimed at awkward constructions, which should be changed to make them grammatically acceptable.

Being in too great a hurry, the apparatus required an extra amount of time to be set up. ("Being" appears to modify "apparatus," a ridiculous construction, and must therefore be rewritten in some such way as, "Because the team was in too great a hurry. . .")

Nine hundred gallons of solution are in the tank, *lasting* about ten days. (Since "lasting" has nothing to modify, the expression should be rewritten; perhaps as, "an *amount* which will last about ten days.")

This step would tend to greater natural diffusion of the dye, causing the radius to increase with thickness. ("Causing" modifies no one word in the sentence; and the expression should therefore be rewritten as, ". . .thereby causing the radius to increase with thickness.")

107. The infinitive is a verb preceded by the preposition "to," as, *to study*, *to neglect*, etc. "Splitting an infinitive" is to place an adverbial modifier between "to" and its verb, a practice still regarded by more conservative authorities as contrary to the best usage. To avoid the error, the writer should place the adverb either *before* or *after* the infinitive. He/She should, however, choose the position which is most natural and the one which most precisely conveys his/her meaning. Sometimes a split infinitive is better than the more grammatically correct form, which may be awkward, stilted, or ambiguous. Occasionally, a sentence may have to be recast because no one of the three arrangements is satisfactory.

Allow the model *to rotate slowly*, *to slowly rotate*, or *slowly to rotate*.
(No. 1 is best, No. 2 is split, No. 3 is awkward.)

They promise *to vigorously pursue* the study, *vigorously to pursue* the study, *to pursue* the study *vigorously*. (No. 3 is best.)

A discrepancy so small as *to be scarcely* worthy of consideration, as *to scarcely be* worthy of consideration, as *scarcely to be* worthy of consideration. (No. 1 is best.)

The infinitive has three other forms. Examples: *to be written*, *to have written*, and *to have been written*. The same rules apply to these as to the simple infinitives shown above. However, the student should concern himself with *to be* and *to have* only, because it is only in these parts of the compounds that the split can occur.

Not, to instantly be written, but, to be instantly written.

Not, to actually have been written, but, to have actually been written.

108. *As* is a badly overworked word. Do not substitute it for the stronger words, *since* or *because*.

As used correctly:

As a result, we made serious errors.
Our data were not as reliable as we had hoped.
It looks as if we must try again.

Therefore, do *not* say:

"As time was up, we could not finish," *but*, "Since time was up"
"Our report is incomplete, as we lacked sufficient data," *but* "because we lacked. . . ."

WORD USAGE

109. *Affect*, to influence. "Heat *affects* the surface film."
Effect, v., to bring about, "A radical change *was effected*."

n., "The Magnus *effect* will be studied."

110. *Between*, used with *two* things only. *Not*, "The air is then compressed in four stages, with water-cooling between each stage," *but* "between stages."

Among, used with *more than two*. *Not*, "A choice was made *between* three kinds of metals," *but* "from *among* three kinds. . . ."

111. *Compare with*, to liken relative values. "Compare the caloric values of coke and gas with those of coal."

Compare to, to represent as similar. "Compare an atom to the solar system."

112. *Comprise*, contains, comprehends, or includes. "The text *comprises* all known phases of heat transfer."

Compose, made up of constituted of. "The mixture is *composed* of sand and gravel."

113. *Farther* implies a greater distance in space. "The outside wheel travels *farther* than the inside wheel." "Mars is *farther* from the sun than the planet Earth."

Further implies something additional--in space, time, degree, quantity, etc. "*Further* experimentation with this equipment is useless." "Read no *further*."

114. *Few* refers to number. "*Few* data were presented."

Less has reference to quantity or degree. "*Less* speed will make for greater accuracy."

115. *In* denotes situation or position. "The drain is located *in* the center."

Into implies motion from outside to inside. "The particles were dropped *into* the tank." "The needle was inserted *into* the sphere." (The verb "to place," however, takes the preposition *in*.)

116. *Its*, possessive of *it*. "The valve was placed in *its* seat."

It's, contraction of *it is*. "*It's* difficult to do."

117. *Leaving* cannot be used preceding a noun. When describing outward flow, one may say the "exiting" or "departing" gas but *not* "the leaving gas." However, one may say the "gas leaving."

118. *May* indicates possibility: "Some day the chemists *may* invent ways of concentration the traces of metals now found in seawater."

Can signifies ability: "Magnesium *can* be extracted from seawater."

119. *Only*. To achieve a greater degree of accuracy and clarity, place the word "only" as close as possible to the word modified.

Not, "The temperature of the feed rose *only* to 43°C," *but* "to 43°C *only*."

Not, "Since it *only* allowed measurement of flow rates over a small range," *but*, ". . . over a small range *only*."

120. *Principal*, adj., main, chief. "One of the *principal* faults in scientific writing is ambiguity."

Principle, n., a fundamental truth. "All those devices are based on the same scientific *principle*--that of the lever."

121. *Therefore*, hence, for that reason, accordingly. "The particles were then knocked off the pan to the bottom of the container. It was *therefore* (for that reason) unnecessary to remove the pan each time."

Thus, in this manner. "The regenerator rotates first through the hot exhaust gases and then through the relatively cool compressor-discharge air. *Thus* (in this manner), heat is carried from the exhaust gas to the compressed air."

Therefor, for that, for it. "Since copper was lacking, brass was substituted *therefor* (for it)."

122. *Whereas*, implying opposition or contrast to that which precedes. "Curves A and B show the pressure rise, *whereas* (on the contrary) Curve C shows the rate of pressure decay."

While, at the same time as. "The drop in brake force occurred *while* (at the same time as) the wheel speed was reaching zero."

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