Report Writing for Engineers

<u>Preface</u>

Nearly every project, development, or study calls for concluding paperwork; some sort of a report. There have been many reminders and cartoons saying that "the job is not finished until the paperwork is done".   But often there is reluctance on the part of those involved to pursue the task of preparing a report.   This course explains why some of the reluctance appears, suggests a technology-based approach to writing, provides ideas and concepts that assist writers in creating and presenting material, and illustrates key methods in accomplishing the objectives of a report.

This orientation, then, can assist engineers with:

– Personally preparing a report and improving writing techniques.
– Directing the preparation of a report written by others.
– Mentoring engineers and other technologists in the improvement of writing skills.

This course is not a detailed lesson in English usage.   It is rather a set of guidelines and recommendations that are intended to assist engineers in the creation of written reports by reviewing fundamentals and by describing an engineering approach to writing.

Loering M. Johnson, P.E.(Ret.)

I. DEFINITIONS

The following definitions of key terms used in the text provide the sense of the terms as they are used in this course.

Abbreviation – a shortened form of a word or phrase.

Acronym – A pronounceable word formed from the initial letters of a compound term, e.g. RAdio Detection And Ranging – RADAR.

Contraction – A word with one or more letters missing and replaced by an apostrophe.

Datum (plural, Data) – something given or admitted upon which an inference is based.

Diagramming – A shorthand representation of the relationship of the parts of a sentence to one another.

Grammar – The manner of writing or speaking with reference to grammatical rules.

Idiom – An accepted phase that violates usual grammatical construction, e.g. "getting up in years."

Initialism – A group of characters formed to represent the initial letters or words in a compound

term, but not forming a pronounceable word, e.g. E2L - English as Second Language.

Paragraph – A group of related statements (sentences) that a writer regards as a unit in the development of a topic.

Report – A written presentation of selected, coordinated, and discussed facts and data for information, recommendation, and reference.

Sentence – A group of words so related as to convey a completed thought with the force of asserting something or of asking, commanding, or wishing and marked at the close by a period, question mark, or exclamation mark.

Syntax – Sentence structure; the due arrangement of word forms to show their mutual arrangement in a sentence.

Verbal – Associated with words (does not specify whether written or oral).

II. INTRODUCTION

A. **The need for reports**

Communication, frequently in terms of a report, about the status of a task, project, or study is an important part of the performance on a project.   Large or lengthy activities may require interim reports.   Major needs of these reports are to –

   1. Document what was done or is being done for record purposes or for informing those who need to know.   This documentation may include facts and data from laboratory or field research, investigation, observation, or inspection.

   2. Establish bases for future activities.   The accomplishment of activity reported may be a step in a larger or continuing effort and future work needs to have the information about the current status in order to properly proceed.   Or the reported results may need to be independently verified and details of the work need to be presented in order for verification to be accomplished.   Or perhaps more funding is required and needs to be explained and justified.

   3. Confirm compliance with contractual or legal requirements that are involved.

B. **The Effort of Writing**

Writing is work.   If it is regarded as a disagreeable task, it becomes harder. Many of those in scientific disciplines have acquired a distaste for English as it is normally taught. After editing, and assisting with, the writing of technologists for nearly 60 years, this writer feels that the major problems are neither with the grammar (language writing and speaking) nor with the scientifically-oriented students, but rather with the way that the English grammar is presented.

As it is normally taught, English principles and usage do not involve the application of mathematical rigor or the structured effects of formula. The variability and variety in grammatical application may

not seem nearly as satisfying as the more ordered approaches of physics, chemistry, and engineering courses.   Is there a way to relate grammatical construction to the scientific method?   This writer believes that there is.

III. AN ENGINEERING APPROACH TO WRITING

It would be helpful to regard English usage, in this case the preparation of a written report, as being analogous to the development of a mechanical, electrical, or chemical product or the building of a bridge or other structure.   There are requirements to be met, materials to be selected, components to be fabricated, assembly and testing to be done, and finishing touches to be applied.   These analogies can be extended to whatever field the writer is in, even such fields as biological systems, art, and music.   With this analogous approach, writing can take on an entirely different aspect and a technical writer may be able to create a better product.

By looking at the letters of the alphabet as basic material (ore, elements, chemicals, yarn, etc.), the analogies can be started.   These basic materials can be assembled to form words which could be considered similar to refined or processed materials such as bars, sheets, wire, substrates, or other uniform substances.   Fortunately for writers, much of this basic and refining work has already been done.   The letters of the alphabet have been established and accepted. Thousands of words have been developed and are available in ready references (dictionaries) which are the "parts bins" for writers.

A writer must select words to assemble into sentences just as processed materials might be fabricated to form useable parts.   Consider that words have characteristics that are analogous; strength, hardness, durability, resistance, inductance, capacitance, and so on.   Will each word perform its necessary function adequately?   Are the words properly related so that they work together suitably?   Is a combination of words sufficient to enable a sentence (which may be considered analogous to a component) to perform its required action, the presentation of a thought, suitably?   Are there more words than are necessary? Just as one would avoid using materials that are inadequate for a hardware product, proper words should be selected for a report. In a similar way, using too few or too many parts or words would not be good design practice.

Sentences in turn are grouped into paragraphs which might be regarded as sub-assemblies which are capable of performing a function.   Here a similar evaluation can be made.   Do the sentences relate properly to one another?   Do they enable the assembly to perform the desired function; to have the desired effect?   In the chosen arrangement, do the sentences perform efficiently and effectively?   Would another arrangement be more effective?

Paragraphs are assembled into chapters or sections which might be considered assemblies or major parts of a final product.   Just as with a structure, a bulldozer, or a transformer each part from the initial material to the final protective coating has a function to perform and has requirements to meet in order that the final product can perform suitably in its intended capacity.

By viewing a report in this manner, a technologist may discover a more satisfying approach to writing.   With this kind of an approach, some of the technical tools can be applied.   Do the words

selected have suitable properties for the tasks they are to perform?   Do they properly match the other words to which they will be joined?   Can their properties introduce undesirable consequences (be misinterpreted)?   Are they necessary or superfluous?

In a similar way, sentences and paragraphs can be examined (tested) to see if they are suitable and will perform the tasks for which they have been selected. To evaluate the writing, one can even use basic Value Engineering tools such as –

    - how well will this report, as planned, accomplish the desired goal?
    - how much time (and cost) will this approach take to write?
    - how else could this information be presented in writing?
    - would this rewrite be preferable? More readable?   More effective?
    - how much time (and cost) would be involved in a rewrite?

With a view of writing as a design problem/challenge, some of the techniques used in English classes come into better focus.   Sentence diagramming (see Figure 1), which to many students oriented in technology seemed to be a waste of time, can be regarded as analogous to mechanical assembly diagrams (Figure 2), circuit diagrams (Figure 3), formula, or even sheets of music. These mechanical and electrical diagrams or formula are vital in their respective technologies in showing the proper relation and location of parts of the system such as components, sub-assemblies or musical notes.   In the same manner, a sentence diagram can show the proper relation of words in a sentence to help construct the most effective presentation of a thought.

An Example of a Sentence Diagram

Whenever the black squirrel jumped, the grey fox gazed suspiciously.
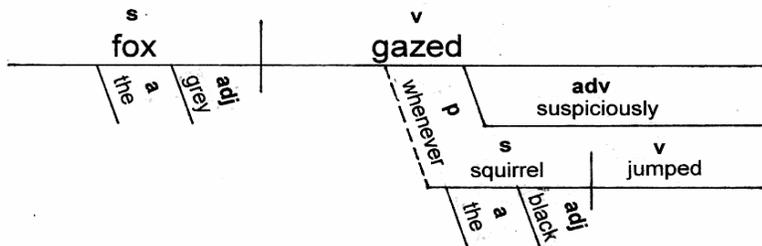
where **s** = subject   **adv** = adverb   **p** = preposition
v = verb   **adj** = adjective   **a** = article

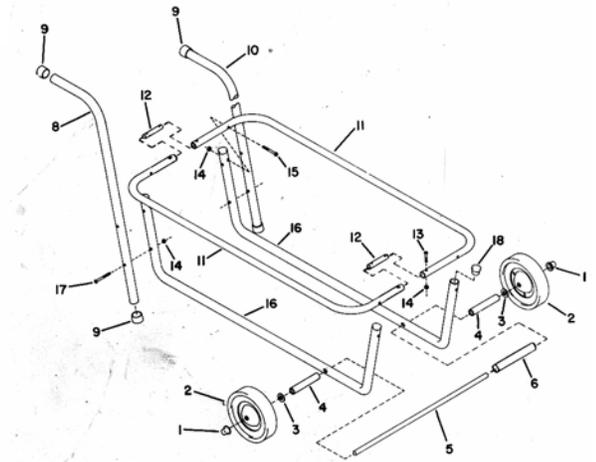**Figure 1**   **Figure 2**

In producing hardware, it is necessary to procure basic material at a cost and to work this material, also at a cost, to produce a component. In writing, the basic material, the alphabet, has been developed and is available to a writer at no cost.   In like manner, the alphabetical letters have been combined into words which express concepts or meanings. Lists of developed words have been prepared (dictionaries) and are also available at no cost (except for the cost of a dictionary). A writer, then, is fortunate in having basic material and components readily available

When viewed as the selection, processing, and assembly of basic materials into components, assemblies, and products, writing can be exciting.   Techniques used in hardware production, such as timelines, flow diagrams, control diagrams, can be applied and be helpful.   Selection of words can be an interesting procedure.   Words and sentences have some of the characteristics of hardware.   They may have strength, flexibility, hardness, or energy. They may connect items, effect a power output (stimulate), act as a conduit to channel the flow of effort (ideas), add decorative effects, evoke beauty, or induce a direction of thought.   They may be considered to have mass, resilience, inertia, and capacitance.   Looking at them this way may help in word selection to assure that, in combination, they will perform the desired function.   And, as in a hardware product, the final evaluation is whether the written report will accomplish the desired result.   A challenge for a writer is to prepare a report in such a way that a reader might be led to think "This is interesting – I hadn't thought of it [this matter] this way!"
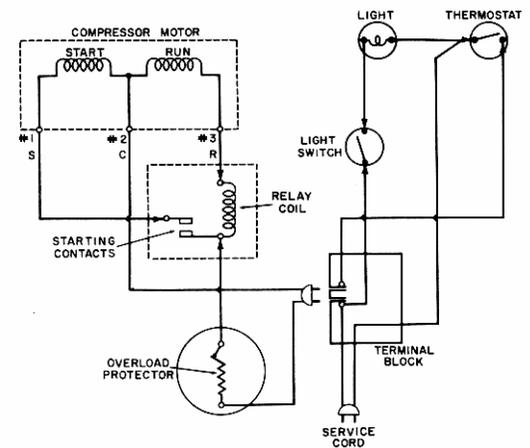
Figure 3

IV. THE WRITING PROCESS

A. **Design of Verbal Messages**

Reports can be considered as products. Products are designed to perform functions.   Whether they are buildings, cell phones, or space explorers, they are designed with an end in mind.   In a similar manner, reports should be designed to perform intended functions. The required function of a report may be to •
- summarize the work on a completed project
- describe the accomplishments and status of an ongoing project
- demonstrate compliance with applicable requirements, regulations, or laws
- satisfy an inquiry
- archive information for historical record or for future use
- present information for others to use

Considering preparation of a report as a design effort, a writer's task is to select words, construct sentences, and assemble paragraphs to convey information in a way to accomplish the report function. Acceptance and value of a hardware product depend upon its users. In a similar way, acceptance and value of a report depend upon its readers.   In order to satisfy readers, there are some basic rules to be observed.

B. **Rules for Report Writing**

RULE number 1

Write for the reader(s).

This is very important! Writers should develop an ability to try to anticipate •
- who will be the readers/users of the report
- what degree of familiarity do these readers/user have with the content of the report
- what is it that these readers/users would like to know or need to be informed of
- what languages are primary for the readers/users.   This is especially important in world-wide commerce, e.g. a report on compliance with a European Union Directive.

RULE number 2

Write to Be Readable.

One of the most frequent complaints by those who receive reports and must use them is that the reports are poorly written, are difficult to read, and do not do what they are intended to accomplish.   Robert Louis Stevenson is credited with saying "Don't write merely to be understood.   Write so that you cannot possibly be misunderstood."   How does one write in this way?

Engineering is largely a discipline of problem solving.   If the problem can be defined as the requirement to communicate a certain message to specified reader(s) in an appropriate way, the problem should be solvable. Coordination of these three elements, however, is essential. And with the increase in world-wide communication, suitable application of these elements has become more difficult. Some years ago the Economist reported that the English language was the standard for global communication:

"Electronic communications have affected, and will continue to affect, language in three ways.   First they change the way the language is used.   Secondly they have created a need for global language – and English will fill that slot. Third they will influence the future of other languages which people (perhaps perversely) continue to speak."

As many reports may have to be translated into other languages, there is a constraint on report writers to use proper grammar so that translators following the rules of English will be able to produce translations that are readable, convey the intended message clearly, and cannot be misunderstood.

RULE number 3

Avoid Reader Stress.

The object of writing reports is to have the intended reader(s) read and understand the reports (and possibly act on them as well).   What if they don't read them?   Obviously, if the reports are not read and understood there may be serious consequences.   If reading a report is a stressful experience, a reader might give up.

The amount of communications that one has to deal with has increased and continues to increase while the time readers have available has not increased.   This places a constraint upon report writers to be considerate of readers' time.   Reading time and associated stress may be increased if a report •
- is too long
- uses a style that is boring
- is difficult to follow and understand
- uses unfamiliar and unexplained terms
- is not what the reader wants to know

Each of these reasons induces stress in readers.   They may have to reread, to look up the meanings of words, or stop and think about the intention of the message.   Each of these actions interrupts reading flow, adds time to the reading process, and builds reader stress.

RULE number 4

Use Appropriate Style.

Report style refers to the report's appearance, its format, the arrangement of content, and the manner of writing.   The chosen style must fit the subject matter, the reader(s) and the writer. One of the report's requirements may be that it will be archived for future reference. The writer must ensure that the report style, format, and arrangement used are such that it can be accessed and read at a future time. The circumstances in which a report is written may dictate its format and arrangement of content.   An organization may have specified styles for reports to be prepared by its members.   Reports prepared for publication usually must observe the style rules of the publication.

Within these general guidelines, it is up to a writer to design reports to be appealing to the intended readers, effective in presentation of the data involved, and efficient and attractive in communication.

RULE number 5

Evaluate and Correct

Just as any hardware or software product needs to be examined and tested before release, a report needs to be reviewed, evaluated, and corrected.   Quality Assurance applies to reports as well as to hardware or services.

A report writer may be tempted to skip, or perform cursory, evaluation of a document. This can lead to dissatisfaction with the report by the recipient and could lead to undesirable conclusions on the reported topic. A thorough review, evaluation, and correction if necessary needs to be performed.

C. **Kinds of Reports**

A report is a communication of information. As such a report can take any one of many forms depending upon what information is being transmitted and to whom it is intended. What are the particular attributes that make a communication a report? A report is based upon facts that have been discovered or developed, is structured to serve a certain purpose, and is directed to particular users. Because of this orientation, reports can be considered competitive; which reports will be accepted or get attention, which reports will be selected to accomplish the intended purpose. Part of the challenge for the writer, then, is to produce a product (report) that is more attractive, more readable, and more effective in presentation than the competition.

Reports may be categorized by their content. They may be oriented to financial, technical, status, scientific, administrative, or general information issues. In form, reports can be brief and included in a letter. Or the reports can be more extensive and include material required to present and substantiate the points to be communicated. In any case, the type and style of a report should be selected to be most informative to the intended readers and effective in presentation. In this respect it is important that a report writer understand his or her position with respect to the report recipients.

The bases of reports are facts. It is these facts that are to be communicated. This communication must show the importance of the data and, where appropriate, interpret the data to show their relevance and their part in establishing the status or in leading to the conclusions presented. A report, then, must be designed to present the facts obtained in a way that will satisfy the intended function.

Facts, however, may be based upon conclusions from the means by which they were obtained. Note; the word 'fact' comes from a Latin root meaning 'a making'. In this light, it is apparent that facts may be 'created things' which may be supplemented, altered, or even invalidated by other events. Report writers should be aware of the possibilities for change and word the reports accordingly. Just as hardware products evolve and change based upon new developments, reports may also. A report is based upon a set of facts that exist (are accepted) at a particular time.

D. **Planning**

As with any product, a report's preparation should be planned and scheduled. The graphic engineering tools of timelines, flow diagrams, and control diagrams can be very helpful here. A timeline is important in assuring that appropriate time is allotted for the various activities. This timing is especially important if information has to be obtained from other parties or if clearance or approvals have to be secured. Whatever time is available should be divided up so that each activity has a reasonable percentage of the time available.

Flow diagrams can show how parts of a report come together, when decisions need to be made, how changes can be arranged, and what reviews need to be made. Control diagrams could be used to show networks of interaction among parties involved in report preparation and evaluation.

E. **Selection of Material for the Report Structure**

1. Items needed – Words

Most of the basic items needed, the letters of the alphabet and words, have already been developed. In the Engineering Approach To Writing (Section III above), it was suggested that the letters of the alphabet be considered like raw materials and that words be considered like the refined materials like bars, plastic, wire, etc.

While there are probably more than a million documented words in the English language, many of this number are technical or other special category words. A substantial number are also obsolete or archaic. A convenient way to group words is by time-dependent types. These types are •
- current – the large body of words involved in present use
- obsolete – once current, but no longer in use
- archaic – disappearing from use; used occasionally or under certain circumstances
- new – newly-coined words or new meanings for old words

Of the current body of words available, an individual writer may have recognition of 20,000 to 50,000 words, but use only 5,000 to 10,000 in normal information interchange.

A serious consideration in word availability is the increased use of short forms; abbreviations, acronyms, initialisms, and other, newly-developed short forms that use letters and numerals. These latter short forms are becoming increasingly popular in cell phone interchanges, Blog messages, and Text messages. These short forms need to be used with care.

English has developed with inputs from many languages and with global interchange will probably continue to grow in this manner. Cambridge don Peter Stevens predicted a time when;
"English will be taught mostly by nonnative speakers of the language to [other] nonnative speakers in order to communicate with nonnative speakers." The language "Will change and it is not clear what the consequences will be."

Words, then, need to be considered carefully to assure that they have the features necessary to produce the effect desired by the writer and to avoid misinterpretation when translated into another language.

a. Word quality

Word quality is an important characteristic, but one that may vary with the reader. Quality is used here in the sense of whether words will increase or decrease readability. In this sense, words may be •

- specific in that they refer to something definite or particular
- concrete in that they are perceptible to the senses
- abstract in that they name qualities, conditions, actions, or summaries of facts
- trite if they are words or word combinations that are overused
- euphemisms if they are pale or comfortable expressions for something specific
- unfamiliar which can include "big", archaic, and new words. Big words here refer to pompous words or words seldom used in common information exchange.
- colorless
- lively

b. Word meanings

A word means what it represents to the writer and to the reader(s); what in their understanding it refers to. What it refers to is called the referent; this is the property that gives a word its meaning.   Here it is easy to see one chance for misinterpretation.   If a writer and reader do not have the same referent, there is a good chance for misunderstanding. The danger of not having the same referent illustrates the importance of Rule for Report Writing no. 1 in having a writer understand and appreciate a reader's position.

This meaning characteristic of words allows them to be categorized in the following way:
- concrete words – words whose referent is customarily an object; e.g. chair, people, painting.   These words have definite core meaning or have a generally understood core meaning.
- relative words – words which have a definite core meaning only because people generally agree in the way that they are used, e.g. warm, thick, tall.
- abstract words – words which do not have a specific referent, but have meaning in the way that they are used, e.g. cost, far, citizenship.

Words may also have a connotation; that is, they may have a characteristic of inference. Their meanings may be affected by the circumstances in which they are used and the particular context in which they appear, e.g. slender, thin, skinny.
Writers need to be especially careful with words that are relative, abstract, or have connotations to ensure that they will not be misunderstood.

c. Word functions (in a sentence)

Consider that a writers parts supply includes bins containing words; nouns, pronouns, verbs, adjectives, adverbs, conjunctions, articles, and prepositions.   Some of these words are further characterized with subgroups.   Table 1 presents kinds of words and their basic characteristics.   This Table describes the types and function or use of nouns, pronouns, adjectives, adverbs and conjunctions.   Prepositions and interjections don't have types, but their function/use is indicated.

Verbs, however, need special treatment.   Formally a verb is a word that expresses or relates to a condition or action.   In verbal manipulation, verbs are one of the most versatile words at a writer's command.   They might be considered like sports figures that are capable of playing many positions on the team.   This versatility makes it important that one understand the features of verbs.

Table 1

Words -- the Processed Material for Verbal Communication

word	type	function or use
noun		a word used to indicate that which is spoken about
	common	refer to a member of a class of things (tree, chair, auto)
	proper	refer to names of people and places
	collective	refer to groups (army, team, committee)
	concrete	refer to items that are perceived by the senses (paper, water, pain)
	abstract	refer to ideas or qualities (relativity, stength, wisdom)
pronoun		a word that substitutes for a noun
	personal	refer to the speaker, the person spoken to, or the person spoken about
	relative	relate an adjective clause to its antecedent
	interrogative	ask a question, e.g. who, what, when
	demonstrative	refer to the person, thing, or quality spoken of
	reflexive	to obtain personal pronouns combined with "self", e.g. himself
	indefinite	for words that function as pronouns with implied antecedents, e.g.anyone
verb		a word that expresses or relates to a condition or an action
	mood	indicative, subjunctive, imperative
	voice	active, passive
	tense	present, past, future, present perfect, past perfect, future perfect
	forms	infinitive, gerund, participle
adjective		a word that modifies (describes, limits, explains) a noun or pronoun
	predicate	as a adjective that completes the thought of a linking verb, e.g. I feel good
adverb		a word that modifies a verb
	conjunctive	as adverbs that connect clauses and modify their meaning
preposition		a word that links a noun or pronoun to some other word in a sentence
conjunction		a word that joins words, phrases, or clauses in a sentence
	coordinating	connect words, phrases,or clauses of equal rank
	subordinating	connect subordinate clauses with independent clauses
	correlative	as coordinating conjunctions used in pairs, e.g. both…and, either…or
interjection		a word that expresses strong emotion; an exclamation

Table 2 shows that verbs have characteristics of mood, voice, object association, tense, and other applications.

Table 2

Verbs

feature	type	function or use
mood		the form of the verb showing the way in which the verb is thought of
	indicative	used in asking questions, making statements
	subjunctive	used in expressing wishes or regrets
	imperative	used in giving commands
voice		the verb form which shows whether the subject acts or is acted upon
	active	used where the subject is the doer of the action
	passive	used where the subject is the receiver of the action
have objects		a direct object is a noun, pronoun, or clause that names the person, thing,or quality affected by the action of the verb
	transitive	does not have a direct object
	intransitive	has a direct object
tense		the verb form which indicates the time of the action or condition
	present	used for present action or condition
	past	used for action or condition that occurred in a definite past time
	future	used for action or condition that will happen in the future
	present perfect	action or condition started in the past; is completed or continuing
	past perfect	action or condition that started and was completed in the past
	future perfect	action or condition to be completed at a future time
other		other applications of verbs
	infinitives	verb form; introduced by "to"; used as a noun, adjective or adverb
	gerunds	verb form with a suffix "ing" used as a noun
	participles	gerund form used as an adjective
linking		has little or no meaning on its own; links subject with predicate adjective or noun

In many cases, there are pairs or groups of words that a writer finds troublesome; perhaps because their use has been incorrect or their meaning is not clear.   Table 3 is a list of a few of the troublesome words.   Writers would do well to make their own lists of the particular words that trouble them to help them avoid using these words incorrectly in a report.

Table 3
Troublesome Words

word	function, meaning, use
accept	receive or approve
except	leave out, omit, bar
assure	give confidence to
ensure	make certain
insure	financially indemnify
beside	next to
besides	in addition to
can	means "able to"
may	indicates permission or possibility
capacity	in technical usage, usually maximum capability
rating	in technical usage, a designated performance level
claim	demand as being due
assert	maintain
complement	number or amount that makes the whole; allotment
compliment	relates to politeness and praise
continual	repeatedly, with interruptions
continuous	repeatedly, without interruptions
in	indicates location
into	directs where to go
its	possessive pronoun; no apostrophe
it's	contraction - insert apostrophe in place of missing "i" and space
less	refers to the amount
fewer	refers to the number
many	use with countable quantities
much	use with mass or bulk quantities
most	superlative degree or better part of
almost	nearly
practical	sensible (regarding persons) or efficacious (regarding things)
practicable	can be done
principle	general truth or fixed rule
principal	most important or chief
verbal	in words; spoken or written
oral	spoken

d. Word selection

The challenge for a writer is to assemble these parts (words) into a well-performing operating product (report).   Dictionaries are the parts bins.   Dictionaries may contain many obsolete or archaic words; they are included to be of use to readers of ancient or older documents.   An innovative writer might find a new use for some of these old words and, with appropriate explanation, return them to current use.   An unusual word might be just right for the message being conveyed; use the word, but explain it and do not overdo it (do it too many times).

Word selection needs to be done carefully. Each word should perform a function, i.e. present an immediate concept, action, or idea to the reader. Normally a writer should try to not use more words that necessary.   However, additional words may be desirable in some cases to provide emphasis or increase memory retention (think of redundancy or backup in hardware design).   Ronald J. Nelson's caution applies here:

"Every word in a sentence should add to the sentence; if it doesn't, it automatically detracts from the sentence."

Sometimes a writer is constrained by local rules or practices.   This writer once worked in a laboratory in which the director mandated that "data" was to be used in the singular sense. Although referring to "datas" as plural was uncomfortable, the director's instruction was followed.   The Rule of "Writing for the Reader" is primary.

2. Creating sentences (components)

a, General

A sentence is a group of words expressing a complete thought. One might think of a sentence as being analogous to a component which has been fabricated from the processed materials – words. In order to express a thought, a sentence must have certain parts.   The basic parts are subjects (which name persons, places or things spoken of) and predicates (which make statements, ask questions, or give commands).   Subjects and predicates may have modifiers which change the meaning (alter the performance) of the words (materials) to which they refer. In addition, predicates may have additional words, called completers, which are necessary to complete the intended thought.

Sentences are made up of clauses and phrases.   A simple sentence has only an independent clause.   A compound sentence has two or more clauses of like rank. A complex sentence has a principal clause and one or more subordinate clauses.   Sentences that are compound-complex can also be constructed.   Sentence order can be inverted, active and passive verbs can be used, and appositives can be added.

Examples of sentence types are shown in Table 4.

Table 4

Sentences

type	example
simple	The U. S. Military tested the feasibility of cross-country travel by automobile in 1919.
compound	The military staged a trip by a group of their vehicles and they selected a route from New York City to Seattle, Washington.
complex	As a young lieutenant, Dwight Eisenhower participated in this trip.
compound-complex	While there were passable local roads in some places, cross-country roads at that time were poor to non-existent and travel was difficult.
use of appositives	Eisenhower, a future President, learned the importance of road availability to national security.
active voice	In 1954, President Eisenhower proposed a highway reconstuction program that resulted in the building of an interstate road system.
passive voice	Roads in a particular state were constructed in accordance with a schedule that was established by that state.
inverted order	Use of these interstate roads to land and launch planes in the event of a national emergency was an interesting provision of the interstate road program.

b. Sentence Construction

Sentence construction is very important. It is here that the initial creation of intellectual property takes place.   Words (the basic, refined material) are selected out of the group available to everyone and are assembled and arranged into sequences which the writer expects to be attractive, explanatory, and convincing.   Here also the initial care needs to be taken to ensure that the Rules of Report Writing (previously presented) are being followed. This assembly and arrangement process is where the sentence type, style, length, and clarity are selected. These selections will determine the readability of the document.

For the process of sentence construction, it is essential to know the elements that make up sentences.   These elements are:

- Adjective clause – a clause which modifies a noun or pronoun; it is connected to the word modified by a relative pronoun (who, which, what, that) or a subordinate conjunction (after, although, as, as if, …).

- Adverb clause – a clause which modifies a verb, an adjective, or an adverb.
- Antecedent – a word or statement to which a pronoun or a pronominal adjective refers. This word or statement may stand before or after the pronoun.
- Appositive – words appearing after a noun or other expression that modify it by repeating its meaning.   The added words or expression can be close – no commas, or loose – set off by commas; whichever enhances readability and clarity.
- Clause – part of a compound or complex sentence that ordinarily has a subject and a finite verb. A conjunction or an implied connector (such as a semicolon) relates the clause to the rest of the sentence.
- Direct object – a substantive in the predicate that names the receiver or product of the action.
- Indirect object – a noun or pronoun that tells for whom something was done.
- Modifier – a word or expression that changes or adds to the meaning of the word to which it is related.
- Participle – a form of a verb that is used as an adjective.
- Phrase – a group of related words which function as a unit in a clause or sentence, but which does not have a subject or predicate.
- Predicate – the verb and its dependent words that complete the meaning of the subject of a subordinate or independent clause.
- Predicate nominative – a substantive in the predicate that explains or renames the subject.
- Prepositional phrase – a preposition, its object and sometimes modifiers.
- Subject – that sentence part that names the person, place, thing, or quality spoken of.
- Substantive – a noun, a pronoun, or a word group used like a noun

c. Language

Use of plain language in sentences is becoming increasingly important.   The European Union has emphasized the use of plain language in certain standards for consumer contracts.   EC Council Directive 9/13 requires unfair terms to be removed and states;

"In the case of contracts where all or certain terms offered to the customer are in writing, these terms must always be drafted in plain, intelligible language. Where there is doubt about the meaning of a term, the interpretation most favorable to the customer shall prevail."

Plain English may be described as that verbal expression which knowledgeable readers have a good chance of understanding at first reading, in the same sense as the writer meant it to be understood, and without misunderstanding.   Just as product liability issues make it important that a hardware product is not used improperly, it is important that reports be written so that they are not misunderstood.

Short, simple sentences with active verbs seem to comply best with the plain language requirement. However, a succession of short, simple sentences tends to be boring which leads to reader stress and therefore is not compliant with Rule for Report Writing no. 3.   A writer should construct the types of sentences to express the intended thoughts most effectively.   These types should vary to make more comfortable reading while at the same time have a logical relation and flow to be effective in informing, illustrating, or convincing.

d. Guidelines for Sentence Construction

The selection and arrangement of words into sentences is primary in avoiding duplication of someone else's writing. The selection and arrangement is also key in achieving better readability and in reducing the number of words.   Creating a report with an average sentence length of 10 to 20 words is a good guideline.   (There is one famous example of a sentence that continued for 13 pages!)   Other suggestions to improve sentence structure are •

- Each part of a sentence should subordinate to one principal idea or thought.
- A thought that can be expressed in one unified sentence should not be separated into several short sentences.
- Parts of a sentence should be worded so that the thought expressed is coherent.
- Compound sentences consisting of statements strung together with *and, but* or *so* should be avoided.
- A participle should be put close to the word it modifies. Dangling participles should be avoided.
- A modifier should also be placed close to the words it modifies.
- Usually, *and* and *but* are used to connect like grammatical elements.
- A relative clause should not be joined to its principal clause or to a phrase by *and, but,* or *or.*
- Correlative conjunctions should be put just before the words or expressions they connect.
- To connect clauses, use the conjunction that accurately expresses the relationship between the clauses.   (*And* indicates a plus relation; *but* indicates a minus relation.)
- Avoid the use of a pronoun if there can be any doubt about its antecedent.
- For interesting and lively sentences use simple, suggestive, vigorous, picture-making words.
- Begin a sentence with an important word; end with an emphatic word.
- Place the principal thought of a complex sentence in the principal clause.
- Use complex sentences to avoid excessive use of conjunctions.
- Use appositive to save words.
- Build sentences with compound predicates.
- Parallel the parts of a sentence where possible.
- Use a question, command, or exclamation occasionally.
- Use mostly active verbs, but passive verbs can provide a softer, subordinate tone if such is desired and appropriate.
- Vary the sentence type, length, and structure.

3. Building Paragraphs

It was proposed that sentences are somewhat like components; they express thoughts as components perform functions.   Paragraphs are groups of sentences.   Related sentences are grouped together as components are connected to form assemblies. As with an assembly, a paragraph acts as a unit in a report; presenting a group of related sentences to explain a fact, describe an occurrence, recommend a direction, or other coordinated action.

Paragraphs have to work together, too. The next paragraph that is constructed may treat a different part of the picture that is being presented. It is important that there be transitions between paragraphs to help a reader proceed smoothly through the text. The last statement of a paragraph should present some kind of a summary or highlight of the paragraphs thought. The opening sentence on the following paragraph should provide a clue of how the thought to be presented in this paragraph is related to the previous one.

Paragraphs are usually indicated by an indentation of the first line and by a blank line at the end. Paragraph lengths vary. For writing that is to be read quickly, paragraphs are usually short; for more involved reading, paragraphs may be longer. It is up to the writer to adjust paragraph length for adequate expression of thoughts to be presented as well as for good readability and comprehension.

Two paragraphs are especially important. The first paragraph must provide a lead into the subject; explaining perhaps the reason that the material to follow is presented and the importance of the subject to the reader. The last paragraph should give concluding statements that will finalize the perspective of the matter presented.

4. Other arrangements

Short reports may do with just the sentences and paragraphs that were created. Longer reports may need sections or chapters with headings to indicate the subject matter presented. It is up to the writer to determine the appropriate arrangement based upon the amount of information to be presented, the readability of the report, and its effectiveness.

Information presented in a report may need to be supported by diagrams, mathematical proofs, or details. Inclusion of detail may be essential, but too much detail in the body of the report may interfere with readability. Consider putting the supporting data in appendices at the end of the report (referenced as appropriate in the body of text) so as not to disrupt a reader's flow of thought.

F. **Writing Style**

1. General

While a report is the presentation of facts, the data and conclusions alone will not make the report effective. The writer's style or manner of writing will be instrumental in establishing the effectiveness of the report. The writing, then, must satisfy practical requirements of:
- facilitating rapid reading
- avoiding reader stress
- precisely conveying the intended meaning
- avoiding unnecessary exaggerations and enthusiasms
- being effective and impersonal in tone
- having necessary clarity for future reference

The style of writing involves the selection of words, creation of sentences and paragraphs, and report layout. A writer should select a style which is best suited to the report's reader(s); one which most suitably complies with the Rules for Report Writing.

2. Typeface

With most reports now being prepared with the aid of word processing or desktop publishing programs, there are many font options available to a writer. Type sizes from 9-point (a point is 1/72 inch; 0.353 mm) to 12-point for the main text are most suitable. The X-height (height of lower case letters in proportion to capitals) is important in the selection of a font as is the choice of serifs or sans (no) serifs. In making a selection, a writer should also check the appearance of **bold** and *italic* to see that these forms are suitable if they will be used. Some fonts may also be able to compress or expand text; these options should be used judiciously, not overdone.

3. Whitespace

An important option available to a writer is the use of whitespace. In a document, margins that limit column width to 9 to 12 words per line to promote easy readability are recommended. Also to avoid tiring readers, there should be a comfortable leading (pronounced "ledding") which is the space between lines. Fonts with larger X-height proportions need greater leading than those with smaller X-height proportions. A writer needs to consider and select options that will achieve a layout that is pleasing to the eye, effective in presenting points, convenient for access and transmission, as well as being conservative of paper.

4. Report Structure

A report of some length may include the following items:
1. A Title Page which includes the report title, name of the recipient, name of the author, and date of issue.
2. A Table of Contents.
3. An Executive Summary.
4. Appendices for details, diagrams, pictures, reference data, and other supportive material. If a substantial number of short forms (abbreviations, acronyms, initialisms) are used in the document, there should be an appendix listing these forms.
5. An Index to assist a reader in rapid information retrieval.

5. Grammar

Grammar is essentially the body of rules and conventions by which words are grouped in a way that is meaningful to other people. A comprehensive study of English would encounter types of grammar such as; descriptive, comparative, historical, and prescriptive or normative. For most report writing by technologists, a branch of the descriptive grammar that leans to plain, easily-understood English is the most useful. Principal guidelines of good grammar will serve in most cases, but a writer should always look for new and improved ways of expression.

In hardware production, a designer has to be aware of material properties such as strength, corrosion resistance, thermal sensitivity, and galvanic action. As coatings or buffers might enable the connection of incompatible hardware items, modifiers might allow the use of unlikely words together.

If unfamiliar words are being used, it would be very helpful to the reader to have these words explained to show what the writer intended. A brief explanation enclosed in parentheses immediately after the unfamiliar word is a convenient, and readable, way to do this.   In a similar manner, short forms (abbreviations, acronyms, and initialisms) should be explained when they are first used.   If a sizeable number of short forms are being used in a report, a list of them should be included; perhaps in an appendix.

Idioms, euphemisms, and colorless words should be avoided unless the writer has determined that, in a particular report, they would be appropriate and would make a positive contribution to the document.

6. Punctuation

Punctuation is an important part of the writing, but unfortunately frequently receives little attention.   Punctuation is intended primarily to enable a reader to get the writer's sense of the material. In this respect, too much punctuation is as bad as too little.   A writer may regard punctuation as traffic signs for a traveler on the reports pathways. The symbols/signs, by their shape and location, tell a reader/traveler of stops, pauses (cautions), intersecting statements/paths, breaks in thought (road construction), emphasis, possession, and added statements (information signs).

Using the traffic analogy, it is apparent that if traffic signs are not placed properly (or are not the correct signs) traffic can easily be snarled. And too few signs may lead to accidents or delays while too many signs may slow traffic unnecessarily.   In a similar manner, incorrect punctuation can lead to confusion and misunderstanding; too much or too little can lead to delay and stress.   An example is the placement of commas in lists; e.g. apples, carrots, beans, and squash.   While there is some support for not putting a comma before the "and", this writer feels that it is important to show that beans & squash are separate items by putting a comma after "beans."   Each writer needs to consider who the reader of the particular writing is and how this reader might interpret the punctuation.

Although there are about 30 punctuation marks in English, some of them are not used much. Table 5 lists the 14 most frequently used marks, identifies their use, and includes guidelines on when and how to use them.

Punctuation should receive thought and attention in the writing process and should be included on the check list for final test and evaluation.

Table 5

Punctuation

name	mark	use	application
Apostrophe	'	show possession, missing letter(s)	enter after words to indicate possession or insert in words to represent missing letters
Braces	{ }	surround or group data, formulas	indicate related items of text, numbers or formulas
Brackets	[ ]	surround inserted statements	show that the surrounded text has been inserted as an aside for explanation or clarification
Comma	,	separators; pauses	separate compound sentence clauses, complex sentence or subordinate phrases, items in lists
Colon	:	introduce lists; effect contrast	indicate beginning of lists; effect contrast by introducing a partial stop in reading
Dash/em	–	indicate asides; add emphasis	separate asides from text to add emphasis to them; effect a break in the text
Ellipsis	. . .	missing material show suspense	indicate missing or omitted material; add suspense by indicating an extended stop in reading
Exclamation mark	!	indicate surprise, shock, dismay	indicate surprise, excitement, importance, shock, or dismay
Hyphen	-	link words or parts of words	link words that may be broken by the end of a line or created, compound words
Parentheses	( )	surround subordinate statements	separate a portion of text that is relatively unimport-ant to the main thought of the sentence
Period	.	full stop; end of sentence	at the end of a sentence to indicate a full stop in reading
Question mark	?	indicates question or query	indicate to the reader a question or query that may require thought or action
Quotation marks	" "	indicate opening and closing direct speech	surround direct speech to define the words of others; indicate special attention
Semicolon	;	divide related clauses, phrases	indicate a partial stop -- the stop is less than that of a period, but more than that of a comma

G. **Doing the Writing**

1. Starting

Just as with the design of a hardware item or the development of a software program, starting a report is sometimes difficult. For reports it is useful to employ some of the same aids that are used with project management.   Organization charts can show responsibility, flow diagrams can be used to show how data are obtained and merged, timelines can show a schedule to be observed, control diagrams can show detailed interactions. Whatever a writer is familiar and comfortable with should be used to begin the writing process.   A helpful aid is a check list; a list of the requirements to be met, of the facts that are be assembled and discussed, of the blocks of thought to be developed, and of the visual aids to be prepared.   For a short report, a mental list may suffice; for a more comprehensive report a written list may be better.   A prepared check list will also be of value in final test and evaluation to assure that all of the intended things have been completed.

As a report develops, ensure that it is made effective by •
- emphasizing findings and conclusions
- avoiding exaggerations and opinions unless they are appropriate
- interpreting tables and charts; adding explanations and meanings
- explaining captions, titles, and unfamiliar terms where necessary
- providing for future reference by including information on background, conditions, circumstances that may be meaningful when trying to understand the report at a future time

2. Writer's Block

Almost every writer will encounter a time when thoughts don't seem to flow – when creativity seem to have ebbed. What is a writer to do?   A suggested way to proceed is to look over the outline, flow diagram, or other controlling guide. Usually one of the topics listed will spark a trend of thought that can be developed.   By pursuing this topic, other thoughts and ideas may start to flow and the writer can go on to the development of other areas as well.

3. Merging Text

Flow diagrams also enable another useful technique.   A writer can develop blocks of thought on differing subjects and identify these blocks with symbols on a flow diagram. With key blocks about the various aspects to be addressed completed, the diagram shows how they fit together; how they are to be merged, and can show where approvals (decisions) need to be made.   Once merged the blocks can be smoothed for overall report consistency.   Word processing programs have facilitated these techniques a great deal.

4. Intellectual Property

A report that is created is the intellectual property of the writer although legal ownership may be by the writer's employer or by those who have contracted for the report. In a similar

sense, writings by other writers are their property. If material written by others, in their exact words, is to be used in a document due credit should be given to the original authors by a proper citation and identification of the used material, e.g. by quotation marks, inset paragraphs, or italics.   The many words that have been developed are used again and again, but once assembled in a certain way become the intellectual property of the writer. Other writers may, with proper citation and credit, repeat those particular combinations of words. MATERIAL DEVELOPED BY OTHER WRITERS SHOULD NOT BE COPIED WITHOUT GIVING CREDIT TO THEIR AUTHORS. The number of permutations and combinations available with 5,000 to 10,000 words affords ample opportunity for a writer to express thoughts in the writer's own way

H. Testing, evaluation, correction

1. Need for evaluation

A piece of writing is seldom satisfactory in its initial draft form. Writing needs to be reviewed and checked – perhaps corrected or modified. As with a hardware or software product, it is always possible to continue to modify and improve one's writing.   However, the constraints of time and cost direct a writer to follow the time-honored principles (advice from Clarence (Kelly) Johnson in Passion for Excellence) of •
- do the best possible job
- in the simplest way
- at the cheapest cost
- in the quickest time

2. Evaluation aids

If the writing has been prepared with a word processor, there are usually options that enable the work to be evaluated in terms of readability and reading level.   These characteristics may include average words per sentence and average syllables per work. Spell checking is usually available.   A word of caution here; the grammar must be checked as well to ensure that the correct words are used.   Otherwise the spell checker will simply confirm that an incorrect word that has been used is spelled correctly.

3. Reviewing

Grammar may be checked by rereading to see that; suitable words are used, nouns are not used for verbs or adjectives, parts of sentences are paralleled where possible and indefinite references are avoided.   If a check list was prepared and used in the writing process, this list also provides a good way to ensure that all topics have been addressed, that the writing responds to the reader's needs and interests, and that reader stress is avoided.

An independent review by an associate is a good way to check the writing and its readability.   Some word processing programs facilitate this type of review by enabling reviewers to enter their comments in different colors; comments that, when resolved, do not appear in the final copy.

V. Summary

In summary, then, it is recommended that a report writer view the task of report preparation as a design challenge. Can words be chosen, sentences developed, and paragraphs assembled that will satisfy the reader(s), arouse interest, and prompt a positive response to the report?

When a report has been prepared, the writer may feel that it could have been done differently. That it could have been is certainly possible.   The combination and application of words into expression and descriptions is constantly changing.   Writers are finding new ways to express thoughts, to explain facts,   To say that there are no new ways to express thoughts is akin to the statement by Charles H. Duell, director of the U. S. Patent Office, in 1889 -- "Everything that can be invented has been invented."

The information in this course has been presented for guidance.   It is recommended that writers prepare their own lists of words, styles, sentences, techniques, and aids for their writing.   With a set of these personal tools, writing can become easier – and maybe even fun! And a writer should always value critiques and constructive comments.