

CHIEF OF NAVAL TECHNICAL TRAINING

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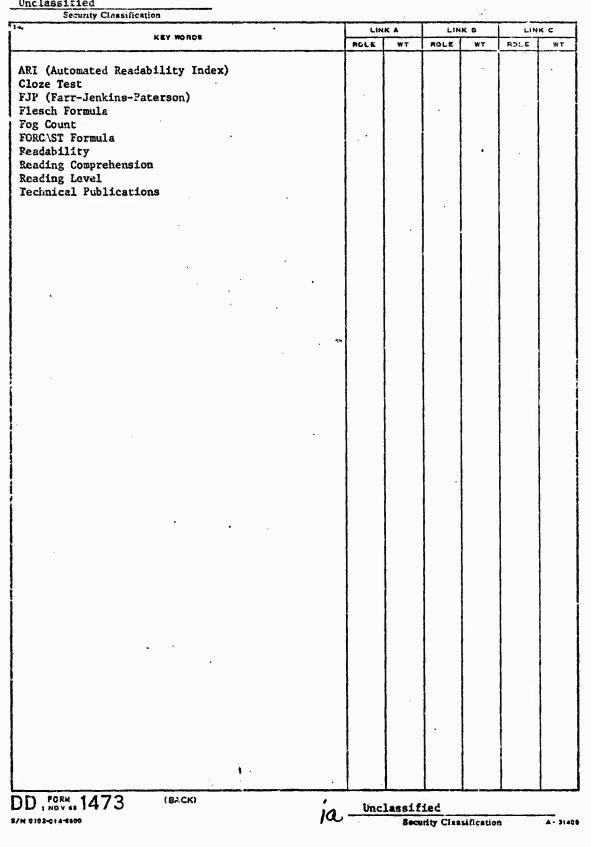
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Research Branch Report 8-75

DERIVATION OF NEW READABILITY FORMULAS (Automated Readability Index, Fog Count: and Flesch Reading Ease Formula) FOR NAVY ENLISTED PERSONNEL

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Three readability formulas were recalculated to be more suitable for Navy use. The three formulas are the Automated Readability Index (ARI), Fog Count, and Flesch Reading Ease Formula. They were derived from test results of 531 Navy enlisted personnel enrolled in four technical training schools at two Navy bases: Laval Air Station at Memphis, and Great Lakes Navy Training Center. Personnel were tested for their reading comprehension level according to the comprehension section of the Gates-McGinitie reading test. At the same time, they were tested for their comprehension of 18 passages taken from Rate Training Manuals. The average General Classification Test Score of the sample (54.7) is very close to the average GCT of the entire population of Navy enlisted personnel (54.3) indicating that the results should generalize to the entire population of Navy enlisted personnel. Scores on the reading test and training material passages allowed the calculation of the grade level of the passages. This scaled reading grade level is based on Navy personnel reading Navy training material and comprehending it. Thus, the three recalculated formulas (derived using multiple regression techniques) are specifically for Navy use. Furthermore, the formulas are directly interchangeable because they were all calculated using the same data base. That is, the ARI can be used when new material is being written, as the new material is usually typed anyway. The Flesch Formula is preferable when the Automated Flesch Count machine is available and existing material is being graded for reading difficulty. The Fog Count can be used when no equipment is available to aid the count. A simplified equation was calculated for both the ARI and Flesch Formula. Their use gives almost exactly the same result

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as the more complex formulas, and because they are easier to use, they should be preferable. Actually, there is only an error of about .1 grade level in using the simplified formulas and this is trivial.

A number of recent studies have suggested that readability formulas for military use should contain only a word difficulty measure, such as average word length or average syllables per word. Results of the present study indicate that a sentence difficulty measure adds accuracy in predicting how difficult a piece of Navy training material is to comprehend. Thus, the recommended formulas also contain a measure of sentence difficulty (average sentence length).

The use of these readability formulas should help the understanding of Navy training material when this material must be read by enlisted personnel. Currently, such material is written at a level weil above the reading ability level of the personnel that must read it. Estimates of the average reading ability level of Navy enlisted personnel range between the ninth and tenth grades. Readability level of the material should be kept at the reading ability level of the personnel using it.

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INTRODUCTION

The ability of military personnel to understand narrative technical material has for many years been a problem. Studies conducted by all three military services have verified that the material that must be comprehended to do the job is written at a level of difficulty well above the reading ability of the man reading the material (Kincaid, 1967; Smith & Kincaid, 1970; Klare, 1963; Caylor, Sticht, Fox & Ford, 1972; Carver, 1973a, Duffy & Nugent, 1974). The effects of faulty communication are well known and disastrous. One recent Air Force study (Johnson, Relova & Stafford, 1972) has traced many costly errors to the reading difficulty level of the instruction: in manuals to be followed. The more difficult the material, the more mistakes were made.

There are two basic ways to improve comprehension of written material by Navy personnel. The first is to improve the reading ability of the man using the material either by remedial instruction or by selecting men who have high reading ability. Remedial instruction requires a great deal of effort for significant gains in reading ability to be achieved. Selecting personnel with high reading abilities is getting progressively more difficult both because the average high school graduate is not reading as well as ten years ago and because of the new all-volunteer concept in the military services. Carver (1973b) estimates that the average reading ability of Navy enlisted personnel is about the ninth grade. Pinning (1974) estimated this reading ability to be 10.0 and projected that it would fall to 9.0 by the 1979-1982 time frame. Duffy and Nugent (1974) measured the reading ability

ol 3,565 June, 1974, enlistees at San Diego. The mean reading ability according to the Gates-McGinitie Reading Test, Form D (for grades 4-6) was 9.8.

The other basic method of dealing with the problem is by making the material easier to read. One way of doing this is by using readability formulas. Readability formulas have been used as a method of estimating reading according to a grade level measure. The Army and Air Force have used these to good advantage in making technical material easier to read. Kincaid, Yasutake and Geiselhart (1967) and Smith and Kincaid (1970) validated one readability formula, the Automated Readability Index (ARI) for use with Air Force technical material. Air Force enlisted personnel found technical material written at the eighth grade level of difficulty according to the ARI easier to understand. This validation was used as the basis for requiring that all narrative sections of the C-5A Technical Orders be written at no more than the tenth grade level of difficulty according to the ARI.

Most readability formulas have been derived and validated on the general population. The Flesch Reading Ease Formula, the most widely validated and used of all readability formulas, has never been validated for use by military personnel. Caylor, <u>et al.</u>, (1972) states that existing readability formulas have validity coefficients of about .70 for predicting the performance of school children on reading comprehension tests. Thus, they account for about 50 percent of the variability and this figure is probably lower with Navy enlistees reading and comprehending Navy training material. Prior to this study, we simply did not know how appropriate this readability formula or a number of others may be for Navy reading material with its characteristic

style, format, and heavy use of technical words. It appears likely that the repeating of technical words in Navy technical material would tend to inflate the computed readability level beyond the actual difficulty experienced by the technician or technical training student reading the material.

A unique approach to the problem of deriving readability formulas specifically for military populations was undertaken by HumRRO (Caylor et al., 1972), who developed the FORCAST formula for the Army. This formula was derived from the testing of Army enlisted personnel. It does not offer the advantages of easy automation because it is based on a count of one-syllable words in a passage which is done most easily by hand. However, the criterion measure approach used in the study can be used to recalculate existing readability formulas. In the study, a sample of training material was selected representing essential job reading material. Then a 395 subject sample of enlisted personnel was tested with a standardized reading test to assess the grade level of reading ability of each subject. The particular reading test used was the USAFI Reading Achievement Test III, Form A, Abbreviated Edition (a special printing of the Metropolitan Achievement Test, Advanced Battery). These same subjects were tested for their understanding of the selected reading passages using the cloze procedure. Every fifth word was left out and the subject's task was to fill it in. A passage was assigned a particular grade level in the case in which 50 percent of the subjects reading at that particular grade level scored 35 percent or better on the Cloze test. Once the passages were graded, the multiple regression technique was used to derive a new readability formula specifically for Army use.

Readability researchers using multiple choice items have employed a criterion of 75 percent correct to indicate that a passage has been comprehended .(e.g., Flesch, 1948), Rankin, and Culhane (1969) have shown that a score on a cloze test of 35 - 40 percent is comparable to a score of 75 percent on multiple choice questions. Since the cloze test is objectively prepared while the multiple choice items are at least partly subjectively chosen, the cloze method offers a real advantage.

The purpose of the present research project is to modify three readability formulas to correspond with Navy needs. Each is potentially useful in grading the reading difficulty of Navy nerrative materials under varying conditions. Using the criterion approach developed by Caylor, et al., (1972), the ARI, Fog Count and Flesch Reading Ease Formulas can be modified by recalculating new regression formulas. As a result, the three formulas will grade a given Navy narrative passage nearly the same and can be used interchangeably. This is an important result because the three formulas have varying degrees of usefulness in varying situations. For example, the ARI can be used when draft material is being typed or computer processed. Klare, Rowe, St. John, and Stolurow (1969) also have developed computer programs for calculating the Flesch Reading Ease Formula and the Fog Count. The dount of syllables, used in both of these formulas, is accursta to within one percent. The ARI is calculated using a modified typewriter and a typed copy is produced as the formula factors are gathered. The Flesch Reading Ease Score and Fog Count can be calculated without special equipment. While the Flesch Reading Ease score has been more widely used, it takes longer to take the counts, if done manually, than the Fog Count according to Thomas, Hartley,

and Kincaid (in press). However, Kincaid and McDaniel (1974) have developed a new machine automating the Flesch count. This machine cuts the time to take Flesch counts almost in half as compared with the manual taking of the count (McDaniel, 1974). Also the accuracy of the Automated Flesch Count es inferred from reliability is better than the manual method according to this study. The taking of both Flesch and Fog Counts does not require any special skills, such as proficiency in typing as is required to use the ARI. Also the Fog Count does not require any special equipment which means the man in the field can calculate the readability of existing material in the field situation using it. The formula for the Flesch Count is quite complex and is best calculated either using a calculator or by using conversion charts. The Flesch Reading Ease formula has associated with it a test-retest reliability of .79 according to one study (Thomas, et al. in press). This same study indicates test-retest reliabilities for the ARI and Fog Count to be much higher, .99 and .96 respectively. Certainly the difficulty of calculating the Flesch Formula is a significant contributing factor. Thus, there is a need to simplify the Flesch Formula for Navy use.

METHOD

Subjects

The sample consisted of 569 subjects from four schools at two Navy bases. Thirty-eight subjects were eliminated from the sample because of failure to follow instructions, illness, or because no GCT score was available leaving 531. Great Lakes Naval Training Center provided the following subjects: 191 BE/E students, 78 of which were in a remedial class, and 78 GM students from "A" and "C" schools. The Naval Air Station, Memphis, provided the following subjects: 242 ADJ students, and 246 AVA students. The subjects were predominantly rew enlistees with less than six months in the Navy. Most were recent high school graduates. A small number of marines and several women were included in the sample. Testing was conducted in September and October 1974.

Subjects were chosen to be representative of the Navy enlisted population. The most important matching variable was GCT score. Pinning, (1974) reported the mean GCT of the Navy enlisted population to be 54.3 as of 1973. Standard deviation of the test is supposed to be 10. The average GCT of the sample used in the present study was 54.7, with a standard deviation of 8.03. Thus, the match was very close and the sample is representative of the population of Navy enlisted personnel. The mean ARI score for the sample was 52.8 with a standard deviation of 8.16.

Test Materials and Procedures

Eighteen passages of material totaling 3,067 words were used. Mean passage length was 170 words. Passages were selected from Rate Training

Manuals deemed by specialists engaged in the writing of these manuals to be representative. Manuals were chosen to represent ratings characterized by a full range of GCT scores. Also a number of manuals were chosen that deal with basic military requirements. However, no manuals dealing with electronics were chosen because for the most part, these manuals were classified.

Twenty-three passages were originally chosen from the manuals and pretested on a class of 30 students enrolled in an advanced undergraduate psychology class at Georgia Southern College. Every fifth word of each passage was deleted and a line of standard length was inserted for the subject to write his answer. On the basis of this pretesting, five passages were eliminated as being either too easy or too difficult. A number of others were shortened so that they could be completed faster.

Table 1 contains a list of the 18 passages, the manual from which they were selected, and their readability passages according to three standard formulas. Note that the average difficulty of the passages is about the twelfth grade. Appendix A contains the 18 passages and indicates which words were deleted for the cloze test.

Two forms of the Gates-McGinitie Reading Test were used to assess reading ability: Form E (intended for grade levels 7-9) and Form F (intended for grade levels 10-12). Subjects with GCT scores of 55 and above were administered the more difficult test and those with GCT scores below 55 were administered the easier test. Only the comprehension section of the test was given because this section directly measured the pertinent variable: comprehension of narrative material. The raw score on the test was converted to a grade level by interpolating from tables in the "Technical Supplement" to the reading tests.

TABLE 1

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GRADE LEVEL OF DIFFICULTY OF 18 TEST PASSAGES CALCULATED WITH OLD FORMULAS

Passage Number	Name of Manual (Title of Passage)	NAVTRA No.	ARI	Fog Count	Flesch
1	Hull Maintenance Tech 3 + 2 (Temporary Repairs)	10573	10.6	12.4	8-9
2	Hull Maintenance Tech 3 + 2 (Preheating for Welding)	10573	20.3	15 .9	16-⊦
3	Ship's Serviceman 1 + C (Distribution and Ownership)	10287E	13.3	12.9	13-16
4	Ship's Servicemen's Handbook (Washing)	10292-A	8.8	7.8	8-9
5	Petty Officer 3 + 2 (Personal Appearance of Petty Officers)	10056-C	9.5	8.0	8-9
6	Journalist 1 + C (Communiques)	10295-A	12.4	12.7	13-16
7	Aerographer's Mate 1 + C (Wind Velocity and Fog)	10362-A	12.7	13.1	13-16
8	Aerographer's Mate 1 + C (General Circulation of Air Currents)	10362-A	16.4	1 7.9	13-16
9	Fireman (Operating the Globe Valve)	10520-D	9.7	10.4	7
10	Aerographer's Mate 3 + 2 (Sea Wave Observations)	10363-D	13.1	14.4	13-16
11	Petty Officer 3 + 2 (Obtaining Water)	10056-C	7.8	7.0	8-9
12	Seaman (Rope Construction-Fiber Rope)	10120-F	16.7	16.0	10-12
13	Machinery Repairman 3 + 2 (Truing and Dressing the Wheel)	10530-D	13.4	12.5	10-12

TABLE 1 (Continued)

Passage Number	Name of Manual (Title of Passage)	NAVTRA No.	ARI	Fog Count	Flesch
14	Machinery Repairman 1 + C (Cleaning Metals for Spray Metalizing)	10531-C	12.0	13.7	13-16
15	Petty Officer 3 & 2 (Role of the Navyman)	10056-C	9.7	11.6	8-9
16	Military Requirements for POl & C (Operational Orders & Plans)	10057-C	13.5	14.0	16+
17	Basic Military Requirements (When to Salute)	10054-D	10.4	10.4	10-12
18	Basic Military Requirements (Uniforms of the Day)	10054-D	10.9	7.2	11.7
,		<u>x</u> =	12.3	12.1	11.7

GRADE LEVEL OF DIFFICULTY OF 18 TEST PASSAGES CALCULATED WITH OLD FORMULAS

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Each subject received nine of the eighteen passages, the particular nine passages being assigned according to a Latin Square design.

Testing of subjects was done in groups, either in the classroom in in larger rooms with combined classes and took two hours. The reading test was administered first and this required 25 minutes. Each subject then proceeded to the cloze passages. In almost all cases, subjects had an opportunity to finish all nine cloze passages. Cloze tests were scored according to a strict criterion, that is, only minor misspellings were allowed. Otherwise the word was scored as being wrong. Table ⁹ contains the scaled reading grade level for each of the eighteen test passages. These grade levels were calculated in the same way employed by Caylor, <u>et al.</u>, (1972). That is, 50 percent of subjects with a reading ability at a particular grade level had to score 35 percent or better on the cloze test. Note the range of scaled reading grade levels to be 5.5 to 16.3. This wide range results from the wide range of reading ability scores according to the two forms of the Gates-McGinitie Reading Test: from grade levels 6 to 16. It appears likely that the use of only the comprehension sections of the tests resulted in higher estimates of reading ability than would have resulted from the use of the entire test. However, comprehension rather than vocabulary and speed versus accuracy (the other two sections of the test) reflects most what this study addresses: that is, improving comprehension by Navy enlisted personnel of technical and training material read on the job.

A multiple regression statistical procedure was applied with scaled reading grade level for each of the passages serving as the criterion measure and the various formula factors serving as predictor variables. In the case of the three formulas to be recalculated, there was both a word difficulty factor and a sentence difficulty factor. The sentence difficulty factor for each of the ARI, Fog and Flesch Formulas is sentence length. The word difficulty factor for one fog and Flesch Formulas is a syllable count. For the ARI, average strokes per word is the word difficulty measure.

Multiple cost resion techniques could not be applied to recalculate the Fog Count because the formula is not in the proper format. However, it can be noted that the original tog dont heads to overestimate grade level of difficulty.

RESULTS

Passage Number	Scaled RGL	ARI	Fog Count	Flesch Formula
1	6.9	8.5 (8.5)*	10.9	9.7 (9.7)*
2	16.1	18.3 (18.3)	14.4	16.7 (16.9)
3	16.0	12.4 (12.4)	11.4	12.7 (12.8)
4	10.9	7.9 (7.8)	7.3	8.2 (8.3)
5	7.0	8.6 (8.4)	7.5	7.1 (7.1)
6	16.0	11.3 (11.3)	11.2	12.3 (12.4)
7	12.0	11.3 (11.4)	11.6	11.7 (11.8)
8	16.3	14.7 (14.9)	16.4	14.7 (14.9)
9	7.8	8.0 (7.9)	8.9	8.0 (8.0)
10	8.9	11.9 (11.6)	12.9	11.7 (11.8)
11	9.0	7.0 (6.7)	6.5	8.1 (7.8)
12	16.1	12.6 (12.8)	13.5	11.8 (11.9)
13	8.9	11.5 (11.6)	11.0	10.0 (10.1
14	10.8	10.6 (10.6)	12.2	12.5 (12.7
15	5.5	7.7 (7.6)	10.1	8.4 (8.5)
16	11.8	12.7 (12.8)	12.5	13.8 (14.0)
17	5.8	10.2 (10.1)	9.9	9.3 (9.4)
18	9.8	10.6 (10.5)	6.7	6.6 (6.7)
5	č 10.9	10.9 (10.9)	10.8	10.7 (10.8

GRADE LEVEL OF DIFFICULTY OF 18 TEST PASSAGES CALCULATED WITH NEW FORMULAS, AND SCALED READING GRADE LEVEL OF TEST PASSAGES

TABLE 2

*Note: Grade levels in parentheses are calculated with simplified formulas.

The mean grade level of difficulty of the eighteen passages is 12.1 as seen in Table 1. The mean scaled reading grade level of these passages is 10.9. The recalculated Fog Count takes this overestimation into account. The recalculated Flesch and ARI formulas derived from multiple regression procedures, and the recalculated Fog Count are shown in Table 3. The original Fog Count tended to overestimate the scaled grade level of difficulty of the passages by about 1.5 grade levels. The new recalculated Fog Count takes this into account by containing a correspondingly larger subtracted constant.

Table 2 also shows the grade levels of each passage calculated with the new formulas. Note that all of the new formulas predict a grade level for the test passages which is about one to one and one-half grade levels below that of the original formulas. This can be seen by comparing Tables 1 and 2.

Table 4 contains the intercorrelations of the three original formulas derived from the eighteen test passages. It also contains correlations of the three recalculated formulas derived from the eighteen test passages. Note that these intercorrelations are generally higher in the case of the recalculated formulas. The correlation between the recalculated Flesch and ARI formulas, which were calculated according to multiple correlation techniques, is considerably higher than the correlation obtained by using the old formulas (.87 versus -.74). This negative correlation between the old formulas results because the original Flesch Reading Ease Formula uses a Reading Ease score which is inversely proportional to grade level.

Two other formulas were recalculated as a part of this study. These were the Farr-Jenkins-Paterson (FJP) adaptation of the original Flesch Reading Ease Formula (Farr, Jenkins, & Paterson, 1951) and the FORCAST Formula

TABLE	2
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EXISTING AND RECALCULATED READABILITY FORMULAS FOR THE ARI, FOG COUNT, AND FLESCH FORMULAS

Automated Readability Index

Old: $GL^* = 0.50$ (words/sentence) + 4.71 (strckes/word) - 21.43 New: GL = 0.37 (words/sentence) + 5.84 (strokes/word) - 26.01 Simplified: GL = .4 (words/sentence) + 6 (strokes/word) - 27.4

Fog Count

New:

$$GL = \frac{easy words + 3 (hard words)}{(sentences)} - 3$$

Flesch Reading Ease Formula

Old: RE*** = 206.835 - 1.015 (words/sentence) - .836 (syllables/100 words)
New: GL = .39 (words/sentence) + 11.8 (syllables/word) - 15.59
Simplified: GL = .4 (words/sentence) + 12 (syllables/word) - 16

*GL is grade level.

**Average Fog Count equals (easy words + 3 hard words) / sentences; easy words are 1 and 2 syllable words and hard words are words having more than 2 syllables.

***RE is Reading Ease; grade level is determined from a conversion table.

INTERCORRELATIONS	BETWEEN THE	E GRADE LEVELS	S PREDICTED B	Y RECALCULATED
ARI, FOG CO	UNT, AND FLE	ESCH FORMULAS	FOR 18 TEST	PASSAGES

Formula	Fog	Flesch
ARI	.80 (.83)*	.87 (74)
Fog		.90 (71)

* Correlation coefficients in parentheses are for the original formulas.

TABLE 4

(Caylor, et al., 1972). The original and recalculated formulas are shown in Table 5. One interesting result was noted as a result of the multiple regression derivation of the FJP formula. A formula was derived for the word factor alone (which is percent of one syllable words). This formula, which is shown in Table 5, is directly comparable to the FORCAST Formula. This previous study demonstrated that the addition of a word difficulty factor added very little to the ability of the formula to predict comprehension. This was not the case of the present study as the addition to the FJP formula of the sentence difficulty factor (average sentence length) added considerably to the multiple R (which was increased) from .646 to .749. Thus the coefficient of determination, which indicates the degree of shared variance between the predicted grade level and comprehension of the test passages, was increased from 41.6 percent to 57.6 percent. This 16 percent increase makes the use of the sentence difficulty factor very useful. Coefficients of determination (which is the square of the multiple R) were also calculated in the derivation of the ARI. For the formu's containing only the word difficulty factor (strokes/word) it was 30.9 percent but when the sentence difficulty factor was added. It increased to 54.4 percent.

TABLE 5

EXISTING AND RECALCULATED FORMULAS FOR THE FJP AND FORCAST FORMULAS

Farr-Jen	kins-P	aterson Adaptation of Flesch Formula
01d:	RE *	= 1.599 (% 1 syllable words) - 1.015 (words/sentence) - 31.517
New:	GL**	=307 (% 1 syllable words) + .387 (words/sentence) + 22.05
FORCAST		
01 d:	GL	= 20.4311 (1 syllable words in 150 word sample)
New:	GL	= 25.3124 (1 syllable words in 150 word sample)

"The state to be and the state

The second second

*RE is Reading Ease; grade level is determined from a conversion table. **GL is grade level.

DISCUSSION AND CONCLUSIONS

The main results of this study are the recalculated ARI, Fog and Flesch Formulas which are shown in Table 3. The recalculated ARI formula has a slightly lower weighting for the word length factor (.37 versus .50). The word difficulty factor (strokes/word) is weighted slightly heavier in the recalculated formula (5.84 versus 4.71). The subtracted constant in the recalculated formula results in an estimate of grade level of difficulty over a grade lower than the original formula. This is consistent with the prediction that Navy personnel familiar with the vocabulary of Navy training documents should understand this material better than other types of narrative material. Other factors, such as content and familiar patterns of wording probably also contributed to this increased understanding.

The recalculated Fog Count is very similar to the original Fog Count. However, there is only one form of the new formula while there are two forms of the original formula, depending on whether the predicted grade level of difficulty is above or below the tenth grade level of difficulty. The new formula has only one form regardless of predicted grade level of difficulty. This makes it simpler to use. The use of a subtracted constant of three in the new formula (rather than 2 or 0 in the old formulas) results in a lowered estimate of readability. The new Fog Count was not calculated according to multiple regression procedures because it is not in the proper format. The new formula was changed simply to reflect a lowered grade level of reading difficulty of a little more than one grade level. However, it correlates very well with the recalculated ARL and Flesch Formulas (above .8 in both cases).

This indicates that the recalculated Fog Count measures much the same thing as the recalculated ARI and Flesch Formulas.

The recalculated Flesch Formula has a different format than the original Flesch Reading Ease Formula. The original formula predicts "Reading Ease" which must be converted to grade level by means of a conversion table. An examination of this conversion table (Flesch, 1948) shows a linear relationship between Reading Ease and grade level between grade levels 8 and 16. A slightly different slope exists for grade levels for the seventh grade and below but this is of limited concern because most Navy narrative reading material is above the seventh grade level of reading difficulty. The new Flesch Formula shown is a linear equation that directly predicts grade level. This eliminates a step which saves time and the possibility of error involved in an additional step.

Simplified ARI and Flesch Formulas which can be used in place of the recalculated formulas are also shown in Table 3. They are much simpler to use, particularly if the calculation of the equation is done by hand rather than with a calculating machine. Even if a calculating machine is available, however, a simple formula is preferable to a complex one. Thomas, Hartley and Kincaid (in press) reported results concerning reliabilities associated with the ARI, Fog Count and Flesch Formulas. A good deal of reliability was lost in the calculation of the original Flesch Reading Ease Score. This is a difficult equation as all of the constants are carried out to three decimal places. The recalculated Flesch and ARI Formulas contain constants that are carried out to only two decimal places which is an improvement because the additional decimal place would result in virtually no increase in accuracy. The simplified

ARI and Flesch Formulas have either one or no decimal places in the constants which makes them still easier to use. While this results in about .1 grade level of error (as compared with the use of the recalculated formula) this can be an acceptable level of error in many circumstances. Actually, readability formulas are only accurate to within one grade level, so energot of .1 grade level is trivial. The new Fog Count is even easier to use and can be calculated entirely by hand.

Two recent readability formulas developed for military use, the RIDE (Carver, 1974a) and FORCAST (Caylor, et al., 1972) Formulas use only a word difficulty factor in the equations. Neither contains a set $e^{\text{aten}}e^{e}$ difficulty factor. This has certain advantages particularly when such for mulas are used in the rewriting of existing material. It is fairly simp leto simply cut sentences in two if a formula contains sentence length as a factor. The word length factor is much more difficult to mechanically manipulate as Caylor, et al., (1972) points out. Adding a sentence difficulty factor to the FORCAST Formula added almost nothing to the prediction of compreh ension. This finding is in marked contrast to the results of the present study as is mentioned earlier in this report. The addition of the sentence dif ficulty factor in the present study added substantially to the ability of the equation to predict comprehension. Table 5 shows the FORCAST formula and the equation derived from the data of the present study which is equivalent. An equation was derived based solely on the word difficulty factor of strokes/word of the ARI, but the full ARI equation containing a sentence difficulty factor gives a better prediction of comprehension, also. This formula is as follows:

GL = 6.2 (strokes/word) - 20.68

The formula is provided for information only; its use is not recommended.

To be best understood, reading material should be written at a level of difficulty appropriate to the reading ability of those reading it. The formulas derived in this study, if properly applied, should make Navy material easier to understand.

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Appendix A

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Eighteen Test Passages Taken From

Rate Training Manuals

Passage 1

TEMPORARY REPAIRS

Temporary repairs are usually <u>made</u> by securing some type <u>of</u> patch over the damaged <u>section</u> of pipe. The material <u>used</u> for the patch depends <u>upon</u> the type of piping <u>that</u> is being repaired. A good general rule to go by is to make the <u>temporary</u> patch from the same <u>type</u> of material that is <u>used</u> for the flange gaskets <u>in</u> the system. Back up the patch with a piece <u>of</u> sheet metal, and secure the sheet metal to the <u>pipe</u> with bolted metal clamps <u>or</u> similar devices. A sealing <u>compound</u> may be applied between the patch and the pipe <u>to</u> help seal the patched <u>area</u>. For low pressure salt <u>water</u> piping, a satisfactory patch <u>can</u> be made from red <u>lead</u> putty wrapped with canvas <u>and</u> served with marlin or <u>friction</u> tape.

Small holes in <u>some</u> piping may be temporarily <u>repaired</u> by drilling and threading and inserting a screw.

Passage 2

PREHEATING FOR WELDING

Preheating involves raising the <u>temperature</u> of the base metal or a section of the <u>base</u> metal above the ambient <u>temperature</u> before welding. Preheat temperatures <u>may</u> vary from as low as room temperature (70° F) when <u>welding</u> outdoors in winter to <u>as</u> high as 600° and 1200° F when welding highly hardenable <u>steels</u> and ductile cast iron respectively.

Preheating is a very <u>effective</u> means of reducing weld <u>metal</u> and base metal cracking. <u>Preheating</u> may improve weldability generally <u>but</u> has two major beneficial <u>effects</u> when it retards the cooling <u>rates</u> in the weld metal <u>and</u> heat-affected base metal, <u>and</u> reduces the magnitude of <u>shrinkage</u> stresses. However, when welding <u>quenched</u> or age-hardened materials, the <u>effects</u> of preheating can be <u>detrimental</u> unless controlled within allowable limits.

Passage 3

DISTRIBUTION AND OWNERSHIP

The defense supply centers <u>control</u> the wholesale distribution of <u>stock</u> among the four services. <u>Wholesale</u> stock is material owned by the integrated manager. Retail <u>stock</u> is material owned by <u>the military services</u>. Use is <u>made</u> of the facilities, regardless <u>of</u> military department ownership, that <u>are</u> best suited to meet the requirements of the services and the area served. These <u>facilities</u> are operated with administrative <u>support</u> furnished by the service <u>that</u> owns the facility. When a center is the principal <u>user</u> of the facility, however, <u>and</u> has management jurisdiction, the <u>center</u> provides the administrative support to the other tenants.

All stocks, both operating and reserves, <u>under</u> the control of a <u>defense</u> supply center are owned by the center and financed by a separate fund, the Defense Stock Fund.

Passage 4

WASHING

To conserve fresh water <u>supplies</u> it may be necessary <u>on</u> occasions that you use <u>sea</u> water for washing. When <u>this</u> is necessary, use Type <u>II</u> Detergent. Two formulas are <u>presented</u> which have been tested <u>for</u> effective salt water washing.

Even though you must use sea water for washing, use fresh water for the last two rinses.

Generally, you will not wash woolen clothing in the ship's laundry. Men should be instructed not to put their blues into the laundry because of the danger of their accidentally getting in with cottons and being ruined. You may find it necessary, however, to wash blankets or other woolens. If so, proceed as prescribed by the recommended formula.

<u>Water</u> at tap temperature will <u>not</u> damage wool fibers. Hold <u>mechanical</u> agitation to a minimum to prevent shrinkage. This is why you should stop the <u>machine</u> when filling and draining <u>water</u>, and run it at <u>low</u> speed and for short periods.

Passage 5

PERSONAL APPEARANCE OF PETTY OFFICERS

The uniform worn is <u>the</u> uniform of the day with SP brassard, web belt, <u>nightstick</u>, and whistle. Do not <u>swing</u>, twirl, or play with <u>the</u> nightstick. Keep it attached <u>to</u> your belt, ready for <u>quick</u> release. Sidearms are worn <u>only</u> under special circumstances.

Members of the shore patrol are expected to maintain the highest standards of personal appearance and <u>military</u> bearing. You must always be in a correct, clean, and neat uniform; have your <u>hair</u> neatly trimmed; be freshly <u>shaven</u>; and have shoes shined and hat squared. Servicemen are <u>quick</u> to notice and criticize faults in the uniform and <u>behavior</u> of the shore patrol.

Passage 6

COMMUNIQUES

The communique is a <u>special</u> form of an official <u>news</u> release giving a straight forward account of daily combat <u>operations</u>.

As a command's official <u>battle</u> report to the public, <u>its</u> preparation requires maximum care <u>and</u> attention to ensure quality <u>and</u> accuracy. Adequate time must <u>be</u> allotted to draft and <u>coordinate</u> the release.

The communique covers the broad tactical and operational picture with little emphasis on isolated engagements. If an action deserves special attention, it calls for a separate release. While a release of this type does not attempt to go into detail, it should contain enough data to give newsman a well rounded

account of the whole battle area. <u>Correspondents</u> see only a small <u>section</u> of the day's fighting and depend heavily on the <u>communique</u> and news briefing to round out their stories.

Passage 7

WIND VELOCITY IS A FACTOR IN FOG FORMATION

Wind velocity is an <u>important</u> consideration in the formation of fog and/ or low <u>ceiling</u> clouds. The horizontal motion of the air next to the earth's surface produces friction <u>which</u>, in turn, causes the <u>air</u> near the ground to <u>tumble</u>, setting up eddy currents. The size of the eddy <u>currents</u> vary with the wind <u>epeed</u> and the roughness of the terrain. Lower wind currents <u>produce</u> more shallow eddies, and <u>etronger</u> wind currents produce eddies <u>up</u> to several hundred feet <u>and</u> higher.

When the temperature and devpoint are close at the surface and eddy currents are 100 feet or more in vertical thickness, adiabatic cooling in the upper eide of the eddy could give the additional cooling needed to bring about suturation. Any additional cooling would place the air in a temporary supersaturated state. The extra moisture will then cordense out of the air, producing a low ceiling cloud. Adiabatic heating on the downward side of the eddy will usually dissolve the cloud particles. If all cloud particles dissolve before reaching the ground, the horizontal visibility should be good. However, if many particles reach the ground before evaporation, the horizontal visibility will be restricted by a moderate fog condition.

Passage 8

GENERAL CIRCULATION OF AIR CURRENTS

Hemispheric differences, in general, <u>decrease</u> with increasing altitude. All <u>the</u> jet streams of the <u>Northern</u> Hemisphere have their southern analogues. Southern jets are more <u>intense</u> on the average with <u>smaller</u> amplitudes, reflecting the greater <u>sonal</u> indices (over double in <u>magnitude</u>) of this hemisphere. The <u>stratospheric</u> cyclone of the polar <u>night</u> transorms into the anticyclone <u>of</u> the polar day in <u>both</u> hemispheres, but the "explosive <u>warming</u>" prior to the onset of the polar day has not yet been observed over the Antartic.

Blocks are comparatively <u>rare</u> and occur southeast of <u>continents</u> in late winter and <u>early</u> spring, and drift slowly <u>eastward</u>, again emphasizing the <u>importance</u> of middle latitude continents <u>on</u> features of the general <u>circulation</u>.

There is some doubt as to whether counterparts of the Aleutian and Icelandic lows <u>exist</u> in the mean circulation of the Southern Hemisphere. If they do, they are located in the Ross and Weddell <u>Sea</u> areas, on the edge of Antarctica, and are most sharply <u>sharply</u> defined at about 700 <u>millibars</u>. Navy meteorologists with experience in those areas indicate that <u>many</u> lows undergoing cyclolysis move into these regions but <u>disappear</u> rapidly at low levels, <u>retaining</u> their identity as cold lows aloft for longer periods.

Passage 9

OPERATING THE GLOBE VALVE

The valve should never <u>be</u> jammed in the open <u>position</u>. After a valve has <u>been</u> fully opened, the handwheel <u>should</u> be turned toward the <u>closed</u> position one-half turn. Unless <u>this</u> is done, the handwheel <u>is</u> likely to freeze in <u>the</u> open position, and it <u>will</u> be difficult to close <u>the</u> valve. Many valves have <u>been</u> damaged in this manner. <u>Another</u> reason for not leaving <u>globe</u> valves fully open is <u>that</u> it is sometimes difficult to tell if a valve <u>is</u> open or closed. If a valve is jammed in <u>the</u> open position, the stem <u>may</u> be damaged or broken by someone who thinks that <u>the</u> valve is closed, and <u>tries</u> to force it open. Valves that are exceptions to <u>the</u> above rule are called <u>back</u> seating valves. Sometimes the <u>operation</u> of a back seating <u>valve</u> will require that it <u>be</u> fully opened. Whenever this <u>is</u> so, special instructions to <u>that</u> effect will be given. <u>These</u> are designed so <u>that</u> when fully open, the <u>pressure</u> being controlled cannot reach <u>the</u> valve stem packing, therefore <u>eliminating</u> possible leakage past the <u>packing</u>.

Passage 10

SEA WAVE OBSERVATIONS

Accurate sea condition observations <u>are</u> necessary if the forecaster <u>is</u> to be expected to provide accurate sea condition forecasts for operational use.

When a <u>breeze</u> comes up, the sea <u>surface</u> will instantaneously become covered with tiny ripples which form <u>more</u> or less regular arcs <u>of</u> long radius. They increase <u>rapidly</u> in height until they <u>attain</u> a maximum steepness where <u>the</u> pointed crests take on <u>a</u> smooth glassy appearance, indicating small breaking processes. As the <u>wind</u> continues to blow over <u>the</u> sea, it drags over <u>the</u> surface producing increasingly larger <u>waves</u>. The wind acts in <u>a</u> manner similar to <u>a</u> paddle rhythmically stroking the <u>water</u>. There is, however, one <u>difference</u>. The wind is constantly <u>making</u> small changes in direction <u>and</u> speed. The result is <u>that</u> the wind is acting like many different paddles stroking <u>the</u> sea in different directions and at different speeds. This <u>produces</u> many different wave trains <u>in</u> the sea, all with <u>different</u> directions, all with different <u>periods</u>, and all at the <u>same</u> given point in the <u>ocean</u>.

If all the different wave trains generated are considered to be sine waves with <u>different</u> heights, directions, and periods, <u>the</u> sum of the heights <u>of</u> the sine waves at <u>a</u> given instant is the <u>mechanism</u> that produces the irregular <u>appearance</u> of the sea. The <u>various</u> waves which comprise the <u>sea</u> surface are commonly referred to as either sea waves <u>or</u> swell waves.

Passage 11

OBTAINING WATER

Before describing chemical means <u>of</u> obtaining water, let's first <u>discuss</u> some natural sources of <u>fresh</u> water, of which rain is the most common.

Never <u>discard</u> any article that will <u>hold</u> water. When it rains, <u>every</u> container that can possibly <u>hold</u> water will be invaluable. <u>To assist you in</u> filling <u>the</u> containers, a raincatcher tube is attached to the lifeboar <u>panopy</u>. Even in a light <u>rain</u>, some water will drain from the canopy down through the tube. After filling all <u>available</u> containers, stow them carefully <u>so</u> as not to lose <u>any</u> water. Cover all open <u>containers</u> to retard evaporation, and <u>use</u> those containers first. During the rain drink all you can hold.

In polar areas, <u>fresh</u> water can be obtained <u>from</u> old sea ice. This <u>ice</u> is bluish, splinters easily, <u>and</u> is nearly free from <u>salt</u>. New ice is milky <u>in</u> color, hard, and salty. <u>Fresh</u> water may also be <u>obtained</u> from icebergs, but use caution. As the berg's underwater <u>portion</u> melts, it gets topheavy <u>and</u> can capsize without warning.

Passage 12

ROPE CONSTRUCTION - FIBER ROPE

Any rope that is <u>not</u> wire is fiber rope. Except in a few instances where it is put to <u>certain</u> special uses, fiber rope <u>is</u> never called anything but <u>line</u> aboard ship. For example, <u>there</u> are fiber manropes on <u>gangways</u>; foot ropes on hammocks (and formerly on the yards <u>of</u> sailing ships); bolt ropes <u>on</u> sails and other canvas; <u>ridge</u> ropes on awnings (but <u>they</u> are usually of wire); <u>dip</u> ropes for passing some <u>object</u> under, outside of, or <u>around</u> another; and bull ropes for heavy heaving without benefit <u>of</u> a purchase (tackle).

Some small craft have fiber wheelropes <u>running</u> from wheel to rudder, <u>although</u> these, again, are more <u>likely</u> to be of wire. There are other exceptions as <u>well</u>, but all the exceptions <u>merely</u> go to prove the <u>strict</u> general rule that aboard <u>ship</u> a line is never <u>called</u> a rope.

In the <u>manufacture</u> of line, the fibers <u>of</u> various plants are twisted <u>together</u> in one direction to <u>form</u> yarns; the yarns are <u>twisted</u> together in the opposite <u>direction</u> to form strands; then <u>the</u> strands are twisted together <u>in</u> the opposite direction to <u>form</u> the line. In the <u>days</u> when ships swung to <u>fiber</u> anchor cables, three or four lines were twisted together, again in the opposite direction, to form the cable.

29

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Fassage 13

TRUENC AND DRESSING THE WHEEL

Grinding wheels, like other <u>cutting</u> tools, require frequent reconditioning of cutting surfaces to perform efficiently. Dressing is the term <u>used</u> to describe the process of clearing the periphery of <u>grinding</u> wheels. This cleaning breaks <u>away</u> dull abrasive grains and <u>smooths</u> the surface so that there are no grooves. Truing is the term used to <u>describe</u> the removal of material from the cutting face of the wheel so that the <u>resultant</u> surface runs absolutely true to some other surface such as the <u>trinding</u> wheel shaft.

If grinding wheels get out of balance because of out of roundness, dressing the wheel will usually remedy the condition. A grinding wheel can get out of balance by being <u>left</u> sitting with part of the wheel immersed in the <u>coolant</u>; if this happens, the <u>wheel</u> should be removed and <u>dried</u> out by baking. If the wheel gets out of <u>balance axially</u>, it probably will not affect the efficiency of <u>the</u> wheel on bench and <u>pedestal</u> grinders. This unbalance may <u>be</u> remedied simply by removing the wheel and cleaning the <u>shaft</u> spindle and spindle hole <u>in</u> the wheel and the <u>flanges</u>.

Passage 14

CLEANING METALS FOR SPRAY METALIZING

In order to ensure a good bond between the <u>sprayed</u> coating and the base <u>material</u> to which it is <u>applied</u>, the areas to be <u>metalized</u> and the adjacent areas <u>must</u> be free from such <u>spreaminants</u> as oil, grease, water, <u>paint</u>, and other foreign matter. To theroughly clean these surfaces, <u>a</u> suitable chemical solvent (or <u>heat</u>) and wire bousting (or <u>sandblasting</u>) may be used. If the surface to be metalized is of a bound as material, it must be heated sufficiently to drive out any oil or other part attacks. Generally, a <u>temperature</u> of 400 to 500° F is satisfactory. (Far sine surfaces, <u>a</u> chemical cleaning may be <u>necessary</u> before heating.) Carbon formed by the heating operation may be removed from the surface by sandblasting. The first cleaning <u>is</u> accomplished by applying the chemical cleaning solvent to the surface with a clean brush.

Passage 15

NOLE OF THE NAVYMAN

You may well be <u>workering</u> where you fit in the picture. True, you may be only one small cog <u>in the lase</u> wheel of the Navy, but everyone <u>is</u> important. If enough cogs break down, the theat won't <u>turn</u>. If enough men fail to perform their duties properly, <u>the ship</u> may be endangered. <u>Our</u> Navy is great because the personnel in it make it so.

As a <u>sailor</u>, you represent the Navy to the people at home; <u>in</u> foreign countries you also represent the United States government. <u>People</u> form their opinion of the Navy on your appearance and action, so wear your <u>uniform</u> with pride and <u>conduct</u> <u>powcself</u> in a magner that will reflect credit on you and on the Navy. When overseas, you must be especially careful of your conduct. If foreigners visited your home town and treated the people as though they were inferior, got drunk in public, damaged property, or just made a general nuisance of themselves, you would naturally be resentful and have a poor opinion of them. The people of other countries are no different. Remember, when you are overseas you are the foreigner. Many of their customs will be unfamiliar and may seem strange to you, but they are their customs and you must abide by them, and by local laws.

Passage 16

OPERATION ORDERS AND PLANS

An operation order is <u>intended</u> for a specific, relatively <u>short</u> operation. An operation plan <u>is</u> designed for operations extending <u>over a large geographic</u> area <u>and</u> usually covering a considerable <u>period</u> of time. A plan <u>also</u> is used to cover <u>contingency</u>, for example, an attack <u>on a particular area</u>. It <u>is</u> prepared well in advance <u>and</u> specifies when it will <u>become</u> effective (on signal, time). For our purpose we discuss the operation order.

An operation order is composed of the heading, body, and ending, plus such annexes and appendices as the originator deems necessary.

The <u>heading</u> shows the title of <u>the</u> issuing headquarters, name of <u>the</u> flagship or headquarters ashore, <u>geographical</u> location (or latitude and <u>longi-</u> <u>tude</u>) of the originator, security <u>classification</u> of the order, copy <u>number</u>, and date-time group. In <u>the</u> absence of any other instruction, the date-time group <u>is</u> the effective time.

The body of an operation order <u>consists</u> of a description of the task organization, five numbered <u>paragraphs</u>, and instructions for acknowledging.

Passage 17

WHEN TO SALUTE

Juniors always salute first, and hold the salute until it is returned or acknowledged by the officer saluted. Persons not covered do not salute, except to avoid embarassment or misunderstanding.

Aboard ship you need not salute officers after the first daily meeting, except that the following officers must be <u>saluted</u> on every meeting: the <u>commanding</u> officer, officers senior to him, visiting officers, officers making inspections, and any officer you are being addressed by or eddressing.

There are several things you should keep in mind <u>about</u> saluting. If possible, always use your right hand. If your right hand is injured or occupied, then you may use your left hand, unless you are in civilian clothes.

Accompany your salute with a <u>cheerful</u> respectful greeting; for example: "Good morning, Sir," "Good afternoon, <u>Commander</u>," "Good evening, Chaplain."

Always <u>salute</u> from the position of <u>attention</u>. If walking, you need <u>not</u> stop, but hold yourself <u>erect</u> and square. If on <u>the</u> double, slow to a <u>walk</u> when saluting.

Look directly into the officer's eyes as you salute.

If you are <u>carrying</u> something in both hands, <u>and</u> cannot render the hand <u>salute</u>, take the position of <u>attention</u>, look at the officer <u>as</u> though you were saluting and greet him.

Remove a pipe, cigar or cigarette from your mouth before saluting.

Salute an officer even if he is uncovered or his hands are occupied. He will acknowledge your salute by saying: "Good morning," "Good afternoon," or something similar.

Fassage 18

UNIFORMS OF THE DAY

Basically, four uniforms may be prescribed: service dress, full dress, tropical, and working. A white hat, black shoes and socks, and, as appropriate, black or white web belts are worn.

The service dress blue <u>uniform</u> ("dress bl.es") consists of <u>dress</u> blue jumper, blue trousers, <u>the</u> neckerchief, and ribbons. Service <u>dress</u> whites are white trousers, white undress jumper, neckerchief and <u>ribbons</u>.

Full dress is the <u>same</u> as service dress except <u>that</u> medals, rather than ribbons are worn.

There are three <u>tropical</u> uniforms: white long, white, <u>and khaki</u>. Tropical white long (<u>the</u> one usually prescribed) consists <u>of</u> white trousers, and white <u>short</u> sleeve shirt. Ribbons usually <u>are</u> prescribed. Tropical white substitutes <u>white</u> shorts and knee length <u>white</u> socks for the white <u>trousers</u> and black socks. Tropical <u>khaki</u> consists of khaki shorts <u>with</u> black shoes and socks and an undershirt. (An undershirt <u>is</u> worn with all uniforms). Appendix B

Instructions for Calculating Readability Using the Recalculated ARI, Fog Count, and Flesch Formulas

Instruction for Recalculated Automated Readability Index (ARI)

The Automated Readability Index (ARI) is a method for determining the difficulty of written material. The ARI utilized three measures that are recorded on a counter as you type. The three measures are the number of strokes, the number of words, and the number of sentences. Only minor changes from standard typewriting are necessary. The following instructions will aid you in arriving at the ARI.

i. Typing Instructions

1. When you have completed typing you must end with three measures:

- A. THE NUMBER OF STROKES
- B. THE NUMBER OF WORDS
- C. THE NUMBER OF SENTENCES
- 2. <u>Getting the number of strokes</u> is a simple task since every time you use a key a stroke is registered on the counter. Letters, symbols, and punctuation marks are included in the count of strokes. The spelling of a word is immaterial as long as it contains the proper number of letters.

- 3. <u>Counting the words</u> is done by counting the number of times the space bar is used. A few simple changes in typing are required for this.
 - A. DO NOT DOUBLE SPACE AFTER A SENTENCE.
 - B. DO NOT INDENT NEW PARAGRAPHS.
 - C. ALWAYS SPACE AFTER THE LAST WORD ON A LINE.
 - REMEMBER: THE RESULTS MUST BE ACCURATE. DON'T BE AFRAID TO START OVER IF SOMETHING GOES WRONG. IF YOU START OVER, RESET THE COUNTER OR YOUR FINAL MEASURES WILL NOT BE ACCURATE.
- 4. <u>Counting the sentences</u> is done by pressing the right hand key on the top row (=). "DON'T USE THIS KEY FOR ANY OTHER PURPOSE. When you have reached the end of a sentence, punctuate it according to the material being typed; then type =.

II. Computation Instructions

- 1. On the Tabulation Sheet record the number of strokes, the number of words, and the number of sentences as shown on the countsr. Subtract the number of sentences from the number of strokes to get proper stroke count.
- 2. Obtain the Average Sentence Length. Divide the number of words by the number of sentences: (words) (sentences)

Do computations to 2 decimal places.

REMEMBER: YOUR TASK IS TO OBTAIN COUNTS AND ONLY THE COUNTING IS IMPORTANT.

- 3. Obtain the Average Word Length. Divide the number of strokes by the number of words: (strokes) (words)
- 4. Compute the Grade Level (GL) according to the following equation:

GL = 0.37 (Average Sentence Length) + 5.84 (Average Word Length) -26.01

5. If you want you may use instead a slightly less accurate but simpler equation:

and the second second

Star Barth

GL = 0.4 (Average Sentence Length) + 6 (Average Word Length) - 27.4

Instructions for Recalculated Fog Count

The Fog Count is a means of determining the difficulty of written material. Two measures must be recorded: (1) the number of easy words; and (2) the number of hard words (polysyllables). An easy word can be pronounced in one or two sounds, for example, "like" "riding." Hard words have more than two sounds. "Difficulty" and "hospital" are two examples of hard words. The following instructions will aid you in arriving at a Fog Count.

I. HOW TO MAKE A FOG COUNT

1. Count the number of sentences.

Treat any complete statement or thought as a sentence. In some contexts one word can be a sentence, as here:

"Where's Tom?" "Flying."

Don't rely on a period to tell you where a sentence ends. When taking a Fog Count, you may consider a semicolon as a period because it indicates the end of a complete thought; thus, the sentence that you are reading now may be counted as two sentences.

- 2. Count the number of easy words (1 and 2 syllables) and give them a value of 1.
- 3. Count the number of hard words (more than 2 syllables) and give them a value of 3.

IMPORTANT: Mark the value (1 or 3) you assign a word above it. REMEMBER: Every word must have a value.

Study the following example:

1 1 1 1 1 3 1 1 1 1 1 To be usable for this purpose, a war plan must define quantitatively 1 1 1 1 3 · 1 1 1 1 1 3 1 the major wartime tasks, in terms of forces deployed, rates of operation. 1 3 1 3 1 $1 \ 1 \ 1$ 1 1 1 1 1 and rates of attrition and replacement, so that we may derive from it 1 1 3 1 1 1 · 1 1 1 1 the required levels of support activities, such as training, supply, 3 3 1 maintenance, procurement, and transportation.

4. Add the 1's and the 3's. This is the Total Fog Count.

So in the example above:

number of 1's = 41number of 3's = 10 (10 X 3 = 30) Tctal Fog Count = 41 + 30 = 71

5. Find the Average Fog Count.

Divide the Total Fog Count (#4) by the number of sentences.

6. Convert to a Grade Level (GL)

A. Subtract 3 from the Average Fog Count.

B. Divide this by 2 to obtain the Grade Level.

7. The equation for calculating the Grade Level is as follows:

GL = <u>Easy Words + 3 (Hard Words)</u> - 3 <u>Sentences</u>

II. PROBLEMS IN MAKING A FOG COUNT

Names of persons. A proper name is only given the value of 1. Common titles (such as Mr., Miss, General) are considered part of the proper name and are not given a value. That is, the common title and the proper name are combined and receive a value of 1. Uncommon titles are considered apart from the proper name and receive a value of 3. Note the following examples:

1 Dave B. Lucas

Miss 2 th Smith

General Eisenhower

Commissar Harry M. Raines

Numbers. The Fog Count treats all numbers, regardless of size, as
 easy words. Therefore, all numbers receive a value of 1. Dollars,
 cent, and percent symbols are considered part of the number with
 which they are written. Study the following examples:

1 :

 $\frac{1}{547}$ $\frac{1}{\$9.50}$

eighty-eight

1 38%

3. <u>Abbreviations</u>. Nany abbreviations have gained wide use and acceptance among people. Such common abbreviations usually stand for an easy word and receive a value of 1. Some examples: YMCA, USAF.

Instructions for Recalculated Flesch Formula

The Flesch Reading Ease formula is a method of determining the difficulty of written material. The Flesch Reading Ease formula uses two measures: (1) average number of words in a sentence; and (2) the number of syllables per word. The following instructions will aid you in arriving at a Flesch Reading Ease Score.

1. Count the number of words.

Count as a word any numbers, letters, symbols, groups of letters surrounded by white spaces. Hyphenated words and contractions count as one word. For example, each of the following count as one word:

couldn't F.O.B. i.e. 32,008 second-grade

2. Count the number of sentences.

Count as sentences each unit of thought that can be considered grammatically independent of another sentence or clause. A period, question mark, exclamation point, semi-colon, and colon usually denote independent clauses. Sentence fragments and incomplete sentences are counted as a sentence. Study the following examples:

"Where did he go?" "Home." (count as 2 sentences)

The equipment is old because: a. It was issued several years ago. b. It needs constant repair. c. We have no spare parts for it. (count as 3 sentences)

But the following sentence counts as 1 because the words after the colon are not complete sentences.

Three ships met at the appointed hour: Cario, Scott Fitzgerald, and the William James.

3. Count the number of syllables.

Count syllables the way you pronounce the word: for example,

"row"	l syllable
"maintain"	2 syllables
"dictionary"	4 syllables

With symbols and figures the syllables are known by the way they are normally pronounced, for example,

¢ (cent)	l syllable
R.F.D.	3 syllables
1918 (nineteen eighteen)	4 syllables

If there is any doubt about syllables, consult a dictionary.

4. Find the Average Sentence Length.

Divide the number of words by the number of sentences: (words) (sentences)

5. Find the Average Number of Syllables per word.

Divide the number of syllables by the number of words.

syllables words

6. Compute the formula.

Combine the Average Sentence Length and the Average Number of Syllables per Word into the following equation:

The equation for calculating the Grade Level is as follows:

GL = .39 (Average Sentence Length) + 11.8 (Syllables/Word) - 15.59

7. If you want, you may use a slightly less accurate but simpler equation.

GL = 0.4 (Average Sentence Length) + 12 (Syllables/Word) - 16