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MACHINE-AIDED INDEXING

Paul H. Klingbiel

Directorate of Development

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13. ABSTRACT

Progress is reported at the 500,000-word level on the development of a partial syntactic analysis technique for indexing text. The overt error rate at this level is 3.1% (1012 overt errors in 32662 candidate index terms). New and revised indexing subroutines are provided. Computer speed is good. About one million words of text can be indexed in one hour of CPU time.

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PREFACE

This is the third annual report covering the development efforts in machine-aided indexing (MAI). The partial automation of indexing is part of a larger effort which includes the automation of bibliographic searching so that the casual on-line user can receive a reasonable response to a question expressed in natural language. Both indexing from text and the use of natural language for search and retrieval require the existence of a large natural language data base (NLDB). Machine-Aided Indexing, Machine-Aided Retrieval (MAR), and the Natural Language Data Base are all currently being developed and are at different points of completion.

The contents of this report indicate the status of MAI as of 30 June 1971. Current efforts are devoted to indexing enough text (three to four million words) so that the system may be used in an operational environment as rapidly as circumstances permit. We are attempting to hold the error rate down and maintain processing speed as the data base enlarges.

The NLDB is being constructed now using the index terms generated by MAI during the period covered by this report. We anticipate having an operational NLDB by 31 December 1971.

A contractual effort to automate the bibliographic search function has been completed, and a technical report [1] has been issued. Additional work under the general heading of machine-aided retrieval has begun in-house. Initial efforts are devoted to a study of the retrieval lexicon; this study includes a comparison with the MAI dictionary and standard thesauri. Technical reports will be issued as information on the results of these efforts becomes available.

An effort to convert the MAI programs to COBOL is progressing satisfactorily. The existence of a conversion program will make MAI exportable. Our own in-house efforts utilize programs written in assembly language on the UNIVAC 1108 operating under EXEC 8.

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THE MACHINE-AIDED INDEXING SYSTEM

Recognition Dictionary

The format of this dictionary has been retained through the indexing of 565,011 words of text. All entries for that corpus are single words. No hyphenated forms or alphanumeric combinations were carried. The nine word classes established previously were retained.

The statistics for the dictionary items assigned to each macro for the 565,011 words of text are as follows:

MACRO	WORDS	MACRO	WORDS
1	1998	9	end of field
2	1721	10	1
3	2578	11	comma
4	1	12	1
5	special symbols	13	hyphen
6	2566	14	13
7	9659	15	8
8	1		

The computer dictionary held only 8,888 words, i.e., macro 7 was not held. A concerted effort was made to reduce the macro 7 words (mostly of low frequency) to one of the other categories. Although that task was not completed when an additional 211 DD 1634 reports became available to us, the impact can be seen in the following statistics as of 621,124 words of text. (The 56,079 words of text from the 211 reports contributed only 333 new types.)

MACRO	WORDS	MACRO	WORDS
1	4288	9	end of field
2	1926	10	1
3	2725	11	comma
4	1	12	1
5	special symbols	13	hyphen test
6	2764	14	13
7	7152	15	11
8	1		

The million-word mark has been exceeded, but macro assignments are not yet complete. Preliminary statistics indicate about 25,000 unique words at that level. This is a startling contrast to the finding of Kucera and Francis, 2/who reported 50,406 unique

types at the same level. The difference cannot be explained on the basis that our vocabulary is drawn from a narrowly defined technological field while that of Kucera and Francis represents general English. The million-word data base, to be sure, is a technical English data base, but it is across the board in that it covers all of the disciplines listed in the COSATI Subject Category List.3/ Several million-word data bases are becoming available, and a report on some of their statistical features will be prepared.

Indexing Subroutines (Macros)

Unfortunately, errors appeared in the indexing routines given in the previous report. 4/ Macro 1, pages 11 and 12 of that report, was printed with a line missing. It is given in its correct form in its entirety immediately below. Macro 4, page 13 of the previous report, had two instructions reversed. This macro, too, will be repeated in its entirety. Macro 10 is for the word "or," not the word "on" as stated in the previous report.

MACRO 1

I. Clear RR.

II. Is TS empty? If

A. YES - Read in next word.

B. NO - Do contents of FR match FD?

1. YES - Write TS on IT; clear FR, TS, and read in next word.

2. NO - Does last character in FR match either P, X, Y, A, B, or +? If

a. YES - Drop last character in FR and last term in TS. Go to step II.

b. NO - Does FR contain a "P?" If

(1) YES - Does FR match any of the special "of" formats? If

(a) YES - Does TS match special tables? If

1. YES - Write contents of TS on IT; clear FR, TS, and read in next word.

2. NO - Do contents of FR before "P" match FD? If

a YES - Write TS before "of" on IT. Do contents of FR after "P" match FD? If

i YES - Write TS after "of" on IT; clear FR, TS, and read in next word.

ii NO - Clear FR, TS, and read in next word.

b NO - Do contents of FR after P match FD? If

i YES - Write TS after "of."

ii NO - Clear FR, TS, and read in next word.

(b) NO - Go to step IIB2b(1)(a)2.

(2) NO - Clear TS, FR, and read in next word.

MACRO 4
(and)

I. Is TS empty? If

A. YES - Clear RR and read in next word.

B. NO - Is last character in FR an "A?" If

1. YES - Does FR contain less than 4 characters? If

a. YES - Place + in FR, "and" in TS. Clear RR and read in next word.

b. NO - Delete last symbol in FR and last term in TS and go to macro 1.

2. NO - Go to macro 1.

The following macro is a replacement for macro 13 as given on page 11 of the previous report. Test shots with this macro have been very encouraging.

MACRO 13

I. Is TS empty? If

A. YES - Clear RR and read in next word.

B. NO - Store hyphen in TS - read in next word and go to step II.

II. Is word followed by a hyphen?

A. YES - Go to I B.

B. NO - Store an "A" in FR and term in TS. Read in next word.

Macro 16 is a trial balloon. Words assigned to this macro cannot occur initially. In all other respects they act like weak nouns.

MACRO 16

I. Is TS empty?

A. YES - Clear RR and go to macro 1.

B. NO - Store a "Z" in FR and term in TS and read in next word.

Format Dictionary

The 75 formats recognized by the format dictionary and the frequency of their occurrence in the 450,000-word data base are as follows:

Rank	Frequency	Format	Rank	Frequency	Format
1	9,518	ZZ	16	416	NZZ
2	7,283	N	17	411	NN
3	7,243	AZ	18	391	ZPN
4	2,355	ZZZ	19	368	ZPZZ
5	2,325	AZZ	20	317	ZNZ
6	1,886	NZ	21	265	A+AZ
7	1,391	AN	22	261	AAZZ
8	1,273	ZN	23	224	ZZN
9	820	ZPZ	24	164	ZAZZ
10	712	AAZ	25	148	AZAZ
11	535	ZAZ	26	115	AAN
12	510	AZZZ	27	112	AZZZZ
13	426	ANZ	28	109	ZAN
14	422	AZN	29	107	NAZ
15	420	ZZZZ	30	102	AZNZ

Rank	Frequency	Format	Rank	Frequency	Format
30	102	ZPAN		27	AA+AZ
31	98	BN		26	ZZZN
32	94	ZPNZ		26	NAN
33	84	ANZZ		19	ZZR
33	84	NPZ		18	AXAZ
34	81	A+ZZ		13	BR
35	74	ZZAZ		9	AZR
36	72	ANN		9	NNZZ
37	68	A+AZZ		8	AA+AZZ
38	66	ZZZZZ		7	ANZZZ
	64	ZR		6	ZNZN
	62	ZNZZ		6	AXAN
	59	AZAZZ		5	NAAZZ
	56	NZZZ		5	A+YZ
	53	AZZN		5	AA+AN
	52	ZZPZ		3	A+YZZ
	49	NZN		3	ARZ
	47	AR		3	AXAZZ
	45	A+AN		1	A+XAN
	45	ZZPN		1	A+XAZ
	41	ZNN		0	A+YN
	30	NNN		0	A+YAN
	28	ZAZZZ			

The first five formats by frequency rank identically to that found for the 115,094-word corpus. Additional formats will be added to the dictionary as explained on page 24. More study is needed, but the suspicion is growing that certain words are sufficiently context sensitive in terms of occurrence as word initial, medial, or final as to warrant setting up several new word classes. This, of course, would somewhat increase the number of recognized formats.

Natural Language Data Base

In an operational environment, all candidate index terms are to be screened against the NLDB. This screen has been constructed and was in keypunch at the time this report was prepared. No data on the NLDB will be available until the next reporting period.

The NLDB is intended not only to screen out all of the errors listed in appendix C, Errors of Commission, but also to screen out syntactically correct but useless terms for retrieval. Estimates of this category run as high as 16 to 20 percent of the total candidate index terms. If this estimate is validated, the MAI programs would be producing useful index and retrieval terms about 75 percent of the time.

An additional in-house effort is now underway to compare the vocabulary, both on an individual-word basis and on a retrieval index-term basis, of the language of the requester with the language of the report writer. As that material becomes available, insofar as it affects the MAI project (either in macro assignment, format occurrence, or presence in the NLDB), it will be reported as part of each annual MAI report. The material may very well be of sufficient interest to warrant separate publication.

Statistics

An interesting feature of text is the occurrence of long stretches of text, six words or more, unbroken by a throw-away word. Such sequences occurred in the initial 125,000-word base reported on previously, 4/ but were not discussed because many of them were attributable to deficient punctuation. The new data base is normal with respect to punctuation, and therefore the long stretches are an actual feature of the text.

A feeling is growing that stretches of text longer than four words are too specific for retrieval. This hunch will be checked against the stretches of text actually found in retrieval requests. Note that the present format dictionary contains the following five-word formats.

AZZZZ	ZAZZZ	AA+AN	A+YAN
A+AZZZ	AA+AZ	A+YZZ	AXAZZ
ZZZZZ	ANZZZ	A+AZZ	
AZAZZ	NAAZZ	A+XAN	

It also contains the six-word format, AA+AZZ. Unclassified examples of these formats are given in appendix A. Statistically, there were 385 stretches of five words and 8 stretches of six words recorded by the format dictionary and accepted as candidate index terms in the 4K data base. However, if mismatches are included, the statistics are as follows:

776 stretches of five words
120 stretches of six words
66 stretches of seven words
14 stretches of eight words
5 stretches of nine words
2 stretches of ten words

Of the 983 stretches of five words or more, only 267 involved either "and," "of," "or," or "other." Consequently, the majority of these long stretches consist of adjectives and nouns only. Unclassified examples of stretches up to and including six words have been given in appendixes A and B. Unclassified stretches longer than six words are given immediately below.

Seven Words

structural electrical magnetic and optical functions materials
doppler inertial and radio inertial error analysis
organic polymeric electronic and composite ceramic materials
potential lethal incapacitating or riot control agents

Army ABM defense system ground support facilities
small stationary and portable nuclear power plants
subsonic and supersonic reaction jet flow models
high and low cycle fatigue crack growth
single or multiple stationary or moving targets
attenuated western and eastern equine encephalitis vaccines
very high and very low frequency signals
lethal and incapacitating or riot control agents
CW yag single mode single frequency laser
very low power small size frequency synthesizer
man portable and mechanized flame weapon systems
portable and tower air traffic control radios
aerial fire support air craft propulsion system
aerial fire support air craft qualification program
utility tactical transport aircraft propulsion system planning
reusable lifting reentry heat shield panel simulations
depth technical and cost effectiveness trade offs
electrical, optical, magnetic and electro acoustic properties
offensive and defensive air force weapons systems
fast neutron elastic and inelastic cross sections
reliable data compaction and automatic image processing
homogeneous and heterogeneous free turbulent mixing flows
flame and shock tube chemical kinetic studies
prototype gas turbine engine oil base stocks
civilian pay and EDP equipment rental areas
tropospheric scatter and air ground radio links
integrated maneuvering and life support system contracts
symmetry metal oxide silicon random access memory
wind tunnel and free flight test techniques
neutron elastic and inelastic scattering cross sections
free flight weapon stores environmental test criteria
dynamic crew seat crash loads test program
pylon mounted variable geometry external fuel tank
low altitude proximity low altitude proximity delay
lightweight and heavy transportable communications equipment programs
variable deflection thruster fluidic flight control system
continuous oxygen carbon dioxide ion exchange system
reliable sewage sanitary waste treatment removable systems
portable direct reading automatic ultrasonic test system
high altitude military or commercial supersonic flight
high frequency bulk and surface wave applications
compact closed cycle light weight miniature refrigerators
new wire reinforced CB composites creep rupture
low and high energy electron diffraction studies
irradiated reactor structural and fuel cladding alloys
turbojet and other air breathing propulsion systems
radioactive waste disposal system distillate cooling system

Eight Words

low energy electron diffraction high energy electron diffraction
air defense small caliber fluid propellant weapon system
nuclear weapons effects research test nuclear effects simulators
skid mounted closed Brayton cycle power conversion system
exploratory model high powered pneumatic actuated water cannon
small gun rugged high rate reserve power sources
switch high power gallium aluminum arsenide injection lasers
depth technical and cost effectiveness trade off studies
extremely high frequency solid state delay lines amplifier
integrated airframe exhaust nozzle wind tunnel testing techniques

Nine Words

barge mounted and deep underground nuclear power plant studies
ablative structural and ablative nuclear hardened missile heat shield
liquid rocket propellant resistant long life value seat material
phase of head mounted high resolution acoustic lens sonar

Ten Words

computer science software theory pattern recognition techniques
numerical computer techniques

Some of these stretches are suspicious: for instance, the one example of a ten-word stretch. The context of the whole sentence reveals that a comma is missing after the first instance of "techniques." Consequently, there is really only a seven-word stretch. On the other hand, the last instance of the nine-word stretches is bonafide, though peculiar. The context is:

...complete exploratory development phase of head mounted high resolution acoustic lens sonar and prepare...

The only reason this is not an eleven-word stretch is because we have chosen to mark "development" a throw-away word. Consequently, the statistics made available through our indexing programs cannot be taken as indicating "true" linguistic entities. This is a problem. One wants to discover certain patterns of natural text both for the sake of (1) knowing what some of the textual patterning features are and (2) using the information, if possible, to optimize the total system. The MAI system is deviant in the sense that each word has only one part of speech while natural language allows lexical entities to function in a multiplicity of ways. Additionally, the part of speech assigned does not always conform to the traditional partitions: traditional grammar does not distinguish between stand-alone nouns and nouns requiring modification. Indeed, this feature is completely idiosyncratic so that

given another data base, different choices would be made without thereby changing the basic MAI logic. Finally, there is the choice of throw-away words, including "development," "design," etc. The absence of such nouns and adjectives obviously influences the frequency of occurrence of two-word, three-word, etc., adjective phrases. More will be said about this topic at the million-word level.

Incorrect Assignment

Appendix C lists examples of various kinds of errors of commission. Statistically, the following error pattern of commission pertains:

Error Type	Total	U	C	S	Percent of Total
1	512	315	150	47	50.59
2	167	114	43	10	16.50
3	84	46	31	7	8.30
4	18	10	4	4	1.78
5	25	18	7	-	2.47
6	138	93	37	8	13.64
7	13	9	3	1	1.28
8	14	13	1	-	1.38
9	25	17	6	2	2.47
10	3	2	1	-	0.30
11	2	2	-	-	0.20
12	11	9	-	2	1.09
13					
TOTALS	1012	648	283	81	100.00

This table lists a few more error types than presented in the previous report.[4] In addition, category 7, which had previously referred to a special symbol deleting problem, has been expanded to cover a punctuation problem involving commas. Instances are listed in appendix C. Error type 11 requires a new syntactic format for its correction; error type 12 is adverb-noun confusion; error type 13 resulted from a programing error (since corrected).

For comparative purposes, the percentage of error for each error type is listed for the 115,000- and the 450,000-word data bases.

Error Type	1K Base	4K Base	Change	Error Type	1K Base	4K Base	Change
1	15 36	50.59	+	8	1.12	1.28	+
2	1.50	-	-	9	29.21	1.38	-
3	20.97	16.50	-	10	1.12	2.47	+
4	17.23	8.30	-	11	-	0.30	
5	0.37	1.78	+	12	-	0.20	
6	5.24	2.47	-	13	-	1.09	
7	7.87	13.67	+				

Five error types show percentage decreases for the 4K vs the 1K data base. These are:

Error type

2 - Adjective-noun confusion.
3 - Noun-verb confusion.
(40% of these are words ending in "ing.")
4 - "And" logic (macro 4).
6 - Goofs.
(It is nice to see this category decrease.)
9 - Missing punctuation.
(This verifies our remarks that the 1K data base was unusually bad with regard to punctuation. The current percentage may very well represent an unreducible residue under normal proofreading practices.)

Eight error types show percentage increases, including three new error type categories. The categories showing increases are:

Error type

1 - A preceding or a following word is a throw-away word and the partial phrase identified coincidentally matches an acceptable format (this is the largest source of error). The problem will be discussed below.

5 - Style, such as adjective following noun.
7 - Special symbol problems including commas in very long phrases.
8 - Macro 8 logic (of).
10 - Adjective-verb confusion.
11 - New format required.
12 - Adverb-noun confusion.
13 - Programing error.

Error types 1 and 6 may remain high for some time. Initially, we had a working rule to the effect that a macro number would not be assigned to a word until we had at least five instances of the use of that word. This practice accounts for the inordinate number of macro 7 designations (page 1). Because several million-word bases are now becoming available and because the statistics of these bases appear to differ significantly from that of Kucera and Francis, 2/ we are now making decisions on all words. This policy will probably result in more type 1 and 6 errors, but it will give us a statistically clean file.

The following words, in alphabetical order, were responsible for the type 1 errors. The frequency of the word through 565,000 words of text is given, the macro number assigned at the time indexing took place, and the new macro assignments, if any. There has not been time

to review all of the words, and there is no implication that such review will necessarily result in a macro change. Some errors will be unavoidable. The number in parentheses to the left of some words indicates the number of times the word caused trouble. All other words caused trouble only once.

Freq	Old Macro	New Macro	Word
1041	1		advanced
28	1		advancing
168	1	6	agents
1317	1		analysis
541	1		application
231	1		approaches
2	7	2	Asian
24	6		attitude
16	1		augmentation
408	1		basic
17	1		bits
5	7		boring
6	1	16	bound
43	7	6	bridge
11	1		call
670	1		capability
1	7		chaplain
54	7		characterization
1	7	6	cleaner
20	7	1	competence
636	1		(3) concepts
33	1	6	conference
8	7	6	conferencing
73	1		content
2	7		contours
194	1		critical
157	7	6	delivery
1609	1		design
189	1		designs
3471	1		(4) development
206	1	16	(3) device
1	7		diffused
4	7		downward
1060	1		effort
1	7		ellipsometry
1	7	6	Eloden
16	7	2	equivalent
116	1		establishment
1000	1		evaluation
234	1		(2) experiments
105	1		extended
3	7	2	fabric
1	7	6	fibre
17	2	2	firings
1	7		Fishers
9	2		flat
12	7		flir
12	1		(3) focal
1	7		Fesnel
134	1		full
12	2	1	functioning
319	1		general
2	7		graded
1	7		Greenbrier
93	1		(2) groups
120	1		(7) higher
3	7	1	homework
1	7		Hopkinsons
168	1		improvements
12	7	1	indicating
2	7	2	instant
178	1		interest
508	1		investigations
126	1		IR
32	1		larger
15	7	1	latitude
3	7	1	leg
174	1	6	line
26	7	1	longer
26	1		manipulation
22	1	6	master
260	1		(2) measurements
119	1		measuring
75	1		medium
2	7		micropound
71	1		modeling
9	7		moderate
2	7	6	morbidity
3	7		navion
421	1		(1) one
232	1		operating
187	1		optimum
2	7	1	pads
71	1		papers
2	7	2	polylactic
4	7		powers

Freq	Old Macro	New Macro	Word
729	1	6	processing
2	7		profiler
15	7	2	Q
8	7	3	radiac
188	1		reference
36	1		referral
62	1		relationship
8	7		repetition
67	7	6	resistance
11	7	2	(2) rough
19	1	1	routine
23	1		schedules
90	1		scheduling
394	1		(4) service
367	1		services
64	1		(2) site
1	7	1	sizing
5	7		slant
2	7		slaved
176	1		source
341	1		special
2	7		spectrally
8	7		stand
1	7		siting
49	1		store
1215	1		study
1	7	3	subprojectile
2	7		swing
1	7		talk
977	1		task
826	1		(2) technology
8	1		transform
4	7		trouble
21	7	1	turn
447	1		two
307	1		type
208	1		(2) types
212	1		(2) unit
528	1		various
1	7	1	views
2	7		vuilleumier
1	7		Wankel
8	7		weighted

A high frequency term such as "advanced" is extremely tedious to recheck and its potential payoff is very small. The fact that the word was a throw-away word caused only a single error despite its high frequency of occurrence. A word like "Asian," on the other hand, has a high payoff. Although it occurred only twice, our failure to mark it caused an error.

From a slightly different point of view, words like "unit" (modular x-ray unit), "device" (coaxial dense plasma focus device), and "technology" (naval ship hydromechanic technology) pose a different problem. The word sequences, modular x-ray, coaxial dense plasma focus, and naval ship hydromechanic, are obviously incomplete. Yet, from a retrieval point of view, the addition of the missing last word does not generate a useful retrieval term. That is, words like "unit," "device," and "technology" appear to serve more as phrase "completers" than as useful retrieval concepts. Indeed, except for their role as phrase completers, these words in isolation are much too general for retrieval.

Finally, the problem comes to this. If these and similar phrases are held to be of no utility, then nothing need be done about words like "unit," "device," and "technology." If these phrases represent useful content, even if eventually transformed, for instance, from "naval ship hydromechanic technology" to "naval hydromechanics," the completer words must appear in the indexing output in order to work with grammatically complete phrases. In this event, context sensitive

rules may be required in order to limit the selection of these terms to just the "completer" context. At this point, no decision on the matter has been reached.

The words, "one" and "two," appear on the list as throw-away words. The word "three" has been marked as an adjective (macro 2). The other numbers, "four," "five," "six," "seven," "eight," "nine," and "ten," are all macro 1 words. I decided to investigate the contexts of these words to see if "three" is indeed unique or whether we had been inconsistent in our treatment of these number names. The relevant contexts of one, two, three and ten occur below (numbers in parentheses indicate the frequency of this combination).

a long term one
a manual one for
a pressing one
an explosive one
plus one (12)
weapons one
sub one
how does one construct
only one
into one
NSAP one (2)
one 2-d interior
one 10KW
one aircraft
one airman (2)
one AN/
one and
one another
one application
one area
one Army (2)
one arresting
one aspect
one at (1)
one author
one billion
one case
one cause
one complete
one compound (2)
one comprehensive
one consideration
one context (2)
one contractor
one country
one current and approved
one data reduction (2)
one day (4)
one degree
one descriptive
one design
one dimension
one due to
one ED model (2)
one effort
one employing
one existing
one exoskeletal
one fifth of
one file
one foot (2)
one for (2)
one frame
one full
one generation
one graduate
one half (3)
on the one hand (3)
one hemolytic
one Hugoniot curve
one hundred (6)
one innovation
one international
one is (3)
one jeep
one laboratory (2)
one large
one level
one library
one located
one major area (1)
one man (6)
one manufacturers (2)
one means of
one megawatt
one meter
one method
one mile (2)

one million (3)
one minute
one mirror
one made
one model
one module (2)
one mold set
one molecule
one month
one more
one municipal
one munition system
one new
one nucleon mass
one objective
one of (42)
one on (5)
one optimized
one or (15)
one part
one patient
one percent
one phase
one possible
one previously established
one private
one prototype (3)
one question
one result (2)
one routine
one runway
one satellite
one sector
one segment
one sensor
one set of
one shelter
one side
one source
one stop
one study (2)
one such (3)
one system (3)
one task (67)
one team (2)
one technical (2)
one tenth
one that can
one-third
one thousand (2)
one time (3)
one timer
one-time input (3)
one to (5)
one type
one unit
one university
one wave (2)
one way
one which
one will
one wire (3)
one with
one (1) (3)
one year (16)
phase one
that one has
that one may
number one priority (2)
the one following (2)
one under
only one
NSAP one which
VLAP one (2)

NSAP two (2)
the last two
the two will
two AD models
two additional (5)
two advanced
two AIM/4-D
two AIM/9-D
two analytical (2)
two and (2)
two approaches (2)
two areas (11)
two attack
two autodin
two band
two basic (3)
two bhangmeter
two books
two Boyles
two bridge (2)
two candidate
two carbon
two categories (3)
two cell
two centers
two Ch-47
two channel
two chemical
two chinese
two communities
two comparative
two compartment (2)

two competing (3)
two competitive (3)
two complete (2)
two component (3)
two components (2)
two compounds (4)
two comprehensive
two computer
two concept
two concepts
two conferences (2)
two contexts
two contractors
two contracts
two coordinated
two correlators
two-day conference
two degrees (2)
two designs
two development
two different
two dimensional (3)
two dimensions
two distinct
two documents
two double
two dual
two earlier (2)
two EATR's (2)
two efforts (4)
two electronics
two engineering (4)
two EST
two events (3)
two experimental (2)
two experiments
two exploitation
two explosions
two extensive (2)
two extreme
two fiberglass
two field
two files
two final
two fiscal
two flexibly
two flight
two fluids
two former (2)
two forms
two forthcoming
two full
two fully
two functions
two FY
two general (2)
two graphical
two groups
two high
two hours
two hundred (2)
two IBM
two ICM
two identical
two IEEE
two important
two inches
two increments
two insert (2)
two international
two ion
two issues
two jeep
two junior
two kinds
two languages
two levels
two lines
two liters
two load
two main (2)
two major (7)
two manufacturers
two marking
two methods (2)
two MFR (2)
two micropounds
two miles
two million
two minor
two models (2)
two modified
two more (2)
two new (11)
two NSF
two OAR
two of (10)
two ONR
two operational
two or (5)

two Orbach (2)
two ordnance
two organizations
two other
two panel
two papers (4)
two parts (2)
two performance
two persons
two phases (8)
two pilot
two place
two plug-in
two position (2)
two predecessor
two previous (2)
two previously
two primary
two principal
two problems (2)
two procured
two procurement (2)
two proposed
two prototype (3)
two purposes
two radar
two radomes
two reactive
two recently
two reports (2)
two rockets
two scheduled
two scientific
two second
two seismic
two selected (3)
two sentry
two separate
two series
two shelter
two signals
two significant
two SOR's
two sorts (2)
two sources
two stage (2)
two stages
two state
two station
two statistical
two-steo
two-step (2)
two steps
two strategies
two studies (2)
two study (2)
two subsystems
two symposia
two systems (4)
two task (3)
two tasks (12)
two technical (2)
two tests
two themis
two-thirds
two thousand (3)
two through
two to
two types (9)
two underway
two units (2)
two universities (2)
two unmodulated
two USSR
two variables (3)
two VC (2)
two very
two viewpoints
two volume
two-way
two weekly
two weeks (12)
two were
two wide
two will
two (2) (8)
two year (5)
two years (8)
two 2600
two 9MM
VLAP two (3)

the three
phase three
seventy three
three 130
three 500 (2)
three 40mm
three AD
three additional
three AFSC
three age
three AN/
three approaches
three arc seconds

three areas (12)
three basic
three broad
three candidate (2)
three candidates (2)
three civilian
three classes
three clusters (2)
three coatings
three commercial
three compartments
three competitive
three complete
three components
three concurrent
three contractor
three contracts
three countries (2)
three day
three depths
three designers
three developing
three different (5)
three differing
three dimensional (8)
three dimensions
three efforts (2)
three element
three events (2)
three exemplary
three experiments
three experimental
three factors (2)
three families
three flow (2)
three fold
three free
three fundamental
three FY's
three general (3)
three groups
three high
three hundred (2)
three inch
three interconnected
three interfacing
three interim
three international
three journals
three large
three levels (3)
three main
three major (2)
three membranes
three models
three monthly issues
three months
three more
three new (8)
three nuclear
three of (2)
three operational
three ordinary
three oscillograph
three other (2)
three papers
three parallel
three participating
three particular
three parts
three phases (2)
three phrases
three preliminary
three previously
three priority
three professional
three projects (2)
three pronged
three prototypes
three qualified
three quarters
three related (3)
three reports
three RF
three samples
three satellites (2)
three SDRS
three second (2)
three segments
three senior personnel
three services (5)
three sets
three sonar
three special
three stage
three standoffs
three state
three sub (2)
three subject
three subtasks (4)

three systems
three task
three tasks (8)
three teams
three technical (3)
three themis
three thousand (3)
three to
three types
three underground
three university
three US
three van (2)
three vehicles (2)
three volumes
three ways (2)
three (3) (2)
three year (2)
three years (9)
three, four and five

one year in ten (2)
ten active
ten amino
ten billion
ten dispensers
ten duty
ten environmental
ten individual
ten languages
ten MHCS's
ten micrometer
ten million
ten minutes
ten missile
ten of (3)
ten post (3)
ten research (2)
ten rocket
ten subunits
ten times
ten to
ten types
ten years

Despite the fact that one can immediately come up with contexts in which the number names would be useful, these contexts seem to be of very low frequency in text. The new hyphen macro will pick up any of these words, of course, when they occur in a hyphenated form such as "two-dimensional." Under normal circumstances, since all of the number names except "three" are throw-away words, none of the contexts listed for these terms appears as a candidate index term. My judgement is that we lose very little. About the only useful terms that appear with "three" involve the word, "dimensional." The other number names occur in contexts which are no more useful than the ones given here. Consequently, number names, with the exception of "three," appear to be throw-away words.

Finally, other circumstances which cause a type 1 error are the presence of an arabic number and certain abbreviations which are ambiguous and therefore are marked as a macro 1 at the moment. As an example of the number situation, consider the following contexts for the word "latitude:"

a parallel of latitude
30 degrees north
30 degrees south latitude
functions of latitude and altitude
a degree of latitude, not otherwise available

On this basis, if "latitude" were marked as macro 6, the only possible candidate index terms are those with numerals. Since we do not pick up numerals, we would get the incomplete "degrees north latitude" and "degrees south latitude." Actually, we have marked "latitude" as a macro 1, and I believe the above contexts clearly support that decision.

The problem of abbreviations can be illustrated by "IR," which may represent either "information retrieval" or "infrared," to mention only two possibilities. Macro assignments in these cases require a thorough study of context so that misleading index terms are not picked up (such terms would degrade retrieval performance).

Format Mismatches

As usual, a record was made of those strings of text which had no counterpart in the format dictionary. This record is used to determine whether significant stretches of text are being lost from a retrieval point of view. The nonmatching formats and their frequency of occurrence follow.

Mismatch Formats By Frequency

Rank	Frequency	Format	Rank	Frequency	Format
1	32,281	Z	22	20	NZNZ
2	906	B		20	ZBZ
3	657	BZ	23	19	AAAZZ
4	591	A	24	18	NZAZ
5	172	BZZ	25	17	AA+Z
6	88	A+		17	AZAZZZ
7	70	BAZ	26	16	AA+ZZ
8	63	A+Z		16	ANNZ
9	57	ZZNZ	27	15	AZNN
10	48	AAAZ		15	AZZNZ
11	46	AA		15	AA+
12	43	BNZ	28	14	AZZAZ
13	37	AAZN	29	13	ZZZAZ
14	34	AX		13	A+ZZZ
	34	BZZZ		13	ZB
15	31	ZAAZ		13	AB
	31	AZAN		13	ZAAZZ
16	28	AANZ		13	A+N
	28	ZANZ	30	12	AZZZZZ
	28	ZA		12	A+A
17	25	BAZZ		12	ZZAN
18	24	NAZZ	31	11	ZZZNZ
	24	AAZZZ		11	ZAZN
	24	ZZAZZ	32	10	NA
19	23	A+NZ		10	ZNNZ
20	22	ABZ		10	BZN
21	21	A+AAZ		10	ZA+ZZ

Rank	Frequency	Format
	10	AAZAZ
	10	NR
33	9	A+X
	9	A+ANZ
	9	AAZNZ
	9	ANAZ
	9	ZZZZZZ
	9	ANZN
	9	AZAAZ
	9	AAA
34	8	BANZ
	8	ZAZNZ
	8	AZNZZ
	8	A+ZAZ
	8	BAN
35	7	ZAZAZ
	7	AANN
	7	AZANZ
	7	A+BZ
	7	ZZNN
	7	BAZZZ
	7	AZAZN
	7	ZZA
	7	ZZA
36	6	ZNAZ
	6	NNAZ
	6	AZZAZZ
	6	NZZZZ
	6	BZZN
	6	AAZZZZ
	6	AA+ZN
37	5	A+B
	5	BA
	5	ZZAZZZ
	5	BNZZ
	5	ZZANZ
	5	AA+AAZ
	5	A+AAZZ
	5	NZZN
	5	AZZZN
	5	NAZZZ
	5	BZZZZ
38	4	ZAA
	4	NAZN
	4	AARZ
	4	ANNN
	4	NZAZZ
	4	AZZZAZ
	4	BNN

Rank	Frequency	Format
	4	A+NN
	4	ZBZZ
	4	ANAZZ
	4	ZAAZZZ
	4	ANNZZ
	4	ZAAN
	4	ABZZ
	4	AZZNN
39	3	ZAAZ
	3	AA+N
	3	ZA+AZZ
	3	AAR
	3	A+ZNZ
	3	BZAZZ
	3	BA+
	3	AAAAZZ
	3	ZAZZN
	3	A+AZAZ
	3	BAZN
	3	BAANZ
	3	AZAZAZ
	3	NNZZZ
	3	ANZZN
	3	BAZZZZ
40	2	BNNZ
	2	AZNZZZ
	2	AAX
	2	ZNAN
	2	NZR
	2	AA+BZ
	2	AAA+
	2	A+AAR
	2	AXZ''
	2	ZA+AN
	2	AANZZ
	2	NZZAZ
	2	NZNZZ
	2	AA+ZZZ
	2	ZANN
	2	AANZZZ
	2	ZA+
	2	NNNN
	2	AAZAAZ
	2!	BA+AZZ
	2	AZAAZZ
	2	AZZZNZ
	2	AAAZN
	2	ANA
	2	ZZZZNZ

Rank	Frequency	Format	Rank	Frequency	Format
	2	AABB		1	ZA+B
	2	ZZAZN		1	BZAAZ
	2	A+NZZ		1	A+YNZ
	2	AZBZ		1	BA+ZZ
41	1	BA+AZN		1	ZAZZAZ
	1	A+RZ		1	ZA+Z
	1	ZBAZZ		1	ABZZN
	1	ZBAZZZ		1	A+ZAN
	1	AA+YN		1	NA+NZ
	1	ZZBZZ		1	NAZZZZ
	1	NAZAZZ		1	ZAZAAZ
	1	ZNANZ		1	NBZ
	1	AANA		1	A+ZANZ
	1	ANR		1	ZABAZZ
	1	A+ZZNZ		1	NNZAZ
	1	ZAAZAN		1	AAANZZ
	1	BZZZN		1	AA+NNZ
	1	ZA+ZZZ		1	NZNNZ
	1	ANAAZN		1	NAAAAZ
	1	AZZAN		1	AAZZAZ
	1	AAZZNZ		1	ZNAAZ
	1	BZZZZZ		1	BZZNN
	1	ZNAZN		1	ZNBZN
	1	ZNNAZ		1	AAAZAN

Several interesting comparisons can be made with the statistics at the 100,000- and 400,000-word levels.

Rank	1K Frequency	Format
1	10,470	Z
2	197	A
3	171	R
4	152	B

94.6% of mismatches

Rank	4K Frequency	Format
1	32,281	Z
4	591	A
	0	R
2	906	B

93.0% mismatches

Rank	4K Frequency	Format
1	32,281	Z
2	906	B
3	657	BZ
4	591	A

94.8% of mismatches

The fact that R did not occur in isolation in the larger corpus is startling. The R class contains only 8 members. The frequency of occurrence of each in each corpus is given below:

Class R

Word	1K	4K	Word	1K	4K
current	187	273	parameters	46	103
government	75	40	patterns	34	214
Jersey	6	5	plastics	4	38
number	123	158	variables	37	41

Except for the word, plastics, the frequencies in the 3K corpus do not scale up as might be expected. The index routines counted 64 instances of ZR, 47 of AR, 19 of ZZR, 13 of BR, and 3 of ARZ: the legitimate formats which contain R. Ten mismatches occurred on NR, 4 on AARZ, 3 on AAR, 2 on NZR and A+AAR, and 1 on A+RZ and ANR. Unusual as it appears, it is just a chance occurrence that the R class never appeared in isolation in the 300,000-word corpus.

The overall mismatch statistics of the two corpora are quite similar. The first four format mismatches accounted for 94.6 percent of the mismatches in the first case and 94.8 percent in the second.

Formats which can be rejected immediately are also very similar in the two corpora. The first six formats in each corpus match rank exactly.

Format	1K	4K	Format	1K	4K
A+	42	88	AXA	1	
A+Z	20	63	ZYZ	1	
AA	16	46	A+XA	1	
AX	11	34	AAAAX	1	
ZA	4	28	ZB		13
AA+	3	15	AB		13
A+X	3	9	ZZA		7
AAA	2	9	BA		5
A+B	2	55	ZAA		4
AXZ	2	2	BA+		3
ZA+	2	2	AAB		2
A+R	11	13	AAX		2
A+A	1	12	AAA+		2

The first four mismatched formats by frequency, plus the other lower frequency mismatched formats of no utility for the 1K corpus, accounted for all but 4.5 percent of the mismatches. For the 4K corpus, the first three mismatched formats, plus those others of no utility listed just above, account for all but 5.9 percent of the mismatches. Unclassified instances of each of these formats is provided

in appendix B. A study of these mismatches has resulted in the following actions:

1) These formats have been added to the recognition dictionary on the basis that they appear to add significant retrieval terms which might otherwise be lost.

AAZN
ANNZ
AZNN
ZANZ
A+NZ → AZ
NZ
$A+Z_1Z_2Z_3 \rightarrow AZ_2Z_3$
$Z_1Z_2Z_3$

$ZA_1+A_2N \rightarrow ZA_1N$
ZA_2N

2) The macro designation has been changed for the following words:

Old Macro	New Macro		Old Macro	New Macro	
1	6	agents	1	6	line
7	2	Asian	7	1	longer
7	6	bridge	1	6	master
7	6	cleaner	1	6	modeling
7	1	competence	7	6	morbidity
1	6	conference	7	1	pads
7	6	conferencing	7	2	polylactic
7	6	delivery	7	2	Q
7	6	eloden	7	6	repetition
7	2	equivalent	7	6	resistance
7	2	fabric	7	2	rough
7	6	fibre	6	1	routine
2	1	functioning	7	1	sizing
7	2	graded	7	6	stand
7	1	homework	7	3	subprojectile
7	1	indicating	7	1	turn
7	2	instant	7	1	views
7	1	latitude	7	1	weighted
7	1	leg			

3) The following words have been assigned to macro 16. Their previous macro assignment is indicated.

Old Macro	
1	bound
1	device
3	growing
0	routing

Old Macro	
0	safeguards
0	savings
0	scene
0	scenes

There are many more words which require analysis. We will attempt to partially automate this procedure by making the MAI routines themselves an analytical aid. Specifically, we intend to modify the MAI program so that it will accept as an accession one line at a time, where line is defined to mean the word under analysis and either two or three words on each side, provided such words exist. This means that the phrases listed on pages 14-19 for "one," "two," "three," and "ten" will be indexed with arbitrary designations for the word under analysis.

For example, if the word "one" is designated macro 1, then that word does not appear in any context as an index term. If "one" is designated macro 2, then "one" will appear initially and medially but never finally; nor can "one" occur in isolation. If "one" is designated macro 3, "one" is picked up in all positions and in isolation. If "one" is designated macro 4, then "one" will be picked up only if preceded by an adjective - definitely a context-sensitive condition.

By using the MAI programs to index those words which appear to be giving trouble, we can organize and condense the large amount of data quickly and display it in a form which will allow the best decision to be made. Errors cannot be avoided. We are looking for the best solution in terms of error rate and processing cost.

PLANS FOR FY 72

1. The data base will be doubled as a minimum.

2. The investigation of "ing" words and other troublesome words will continue.

3. A context-free grammar version of the format dictionary, now in for test, will be used to check running time.

4. The NLDB will become an operational part of MAI as the final screen of candidate index terms.

5. A report will be issued emphasizing statistics at the 1,000,000-word level.

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APPENDIX A

CURRENT FORMAT MATCHES

AAN

Acute Respiratory Diseases
Dynamic Human Perception
Military Environmental Medicine

AAZ

Biological Neural Networks
Extremely High Altitudes
Naval Oceanographic Office

AAZZ

Coated Leading Edge Structures
Flexible Offensive Gun Systems
Oscillatory Lifting Surface Theory

AA+AN

Biological, Chemical and Physical Oceanography
- Biological Oceanography
- Chemical Oceanography
- Physical Oceanography

Unconventional, Electromagnetic and Inertial Sensors
- Unconventional Sensors
- Electromagnetic Sensors
- Inertial Sensors

Trained Military and Civilian Scientists
- Trained Scientists
- Military Scientists
- Civilian Scientists

AA+AZ

Biological, Radiological and Chemical Contaminants
- Biological Contaminants
- Radiological Contaminants
- Chemical Contaminants

Biological Chemical and Physical Test
- Biological Test
- Chemical Test
- Physical Test

Diurnal, Seasonal and Spatial Distribution
- Diurnal Distribution
- Seasonal Distribution
- Spatial Distribution

AN

Digital Tachometers
Global Navigation
Polar Molecules

ANN

Electrostatic Vacuum Gyros
High Purity Gallium
Reversible Zinc Electrodes

ANZ

Fixed Weapons Systems
Inertial Navigation Systems
Qualitative Construction Requirements

ANZZ

High Enthalpy Gas Flows
Lightweight Infantry Load Carrier
Small Arms Ground Fire

ANZZZ

Interactive Man Machine Problem Solving
Naval Ordnance Systems Command Requirements
Variable Geometry Fuel Tank Systems

AR

Atomic Parameters
Mach Number
Reinforced Plastics

ARZ

Atmospheric Number Density
Electric Current Sheets
Ionospheric Current Systems

AXAN

Hot or Cold Climates	Hot Climates Cold Climates
Hard or Soft Seafloors	Hard Seafloors Soft Seafloors
Single or Multiple Stresses	Single Stresses Multiple Stresses

AXAZ

Approximate or Exact Solution	Approximate Solution Exact Solution
Caseless or Encapsulated Systems	Caseless Systems Encapsulated Systems
Tactical or Strategic Intelligence	Tactical Intelligence Strategic Intelligence

AXAZZ	Electronic or Proximity Time Fuzes	Electronic Time Fuzes Proximity Time Fuzes
	External or Internal Flow Systems	External Flow Systems Internal Flow Systems
AZ	Biomechanical Forces Difference Analyses Firing Tables	
AZAZ	Closed Cycle Environmental System Electron Beam Ferroelectric Memories Gamma Ray Spectroscopic Techniques	
AZAZZ	High Efficiency Linear Power Amplifiers Low Altitude High Speed Flight Solid State Visual Display System	
AZN	Bipolar Power Transistors Thin Film Capacitors Variable Sweep Wings	
AZNZ	Thermal Fuel Cracking System Ultra Reliable Interphone System Variable Stability VTOL Aircraft	
AZR	Behavioral Science Variables Human Factors Variables Winterization System Parameters	
AZZ	Charged Particle Accelerator Laminar Boundary Layers Qualitative Flight Tests	
AZZN	Digital Time Division Multiplexer Noble Gas Ion Lasers Rechargeable Metal Air Batteries	

AZZZ

Aerial Fire Support System
Automatic Test Fixture Concept
X Ray Diffraction Techniques

AZZZZ

Close Air Support Gun System
Forward Area Radio Relay Equipment
Low Density Arc Jet Facility

A+AN

Acoustic and Electromagnetic Camouflage	Acoustic Camouflage Electromagnetic Camouflage
Analog and Digital Modulation	Analog Modulation Digital Modulation
Bacterial and Fungal Infections	Bacterial Infections Fungal Infections

A+AZ

Ballistic and Orbital Vehicles	Ballistic Vehicles Orbital Vehicles
Cardiovascular and Pulmonary Function	Cardiovascular Function Pulmonary Function
Gaussian and Exponential Functions	Gaussian Functions Exponential Functions

A+AZZ

Acoustic and Electromagnetic Wave Propagation	Acoustic Wave Propagation Electromagnetic Wave Propagation
Incendiary and Flame Fuel Formulations	Incendiary Fuel Formulations Flame Fuel Formulations
Mid and High Intensity Conflict	Mid Intensity Conflict High Intensity Conflict

A+AZZZ

Electronic and Photographic Signal Recording Media	
	Electronic Signal Recording Media
	Photographic Signal Recording Media
Seismic and Infrasonic Wave Propagation Phenomena	
	Seismic Wave Propagation Phenomena
	Infrasonic Wave Propagation Phenomena
Flame and Incendiary Weapon Effectiveness Methodology	
	Flame Weapon Effectiveness Methodology
	Incendiary Weapon Effectiveness Methodology

A+YZ

Acoustic and Other Theory	Acoustic Theory
Modular and Other Standard	Modular Standard
Structural and Other Applications	Structural Applications

A+YZZ

Ferromagnetic and Other Signal Processing	
	Ferromagnetic Signal Processing
Nuclear and Other Munition Devices	
	Nuclear Munition Devices
Spectral and Other Measurement Equipment	
	Spectral Measurement Equipment

A+ZZ

Physiological and Threshold Effects	
	Physiological Effects
	Threshold Effects
Magnetic and Velocity Fields	
	Magnetic Fields
	Velocity Fields
Wound and Burn Repair	
	Wound Repair
	Burn Repair

BN

Local Electroanesthesia
New Lubricants
Operational Hazards

BR

Complex Variables
New Jersey
Operational Parameters

NAAZZ

Barge Mounted Nuclear Power Plant
Scramjet Powered Long Range Missile

NZZZ

Man Machine System Performance
Nitrogen Cross Section Data
Weapons Cost Effectiveness Analyses

ZAN

Active Organic Depolarizers
Band Acoustic Transducer
Cable Mounted Sensors

ZAZ

Data Compaction System
Earth Moving Equipment
Field Cartographic Equipment

ZAZZ

Glass Reinforced Plastic Structures
Heat Actuated Refrigeration System
Integral Thermal Management Techniques

ZAZZZ

Laboratory Submerged Arc Weld Compositions
Potential Hard Rock Missile Sites
Target Activated Munition Effectiveness Methodology

ZN

Accelerator Physics
Ball Ammunition
Characteristic Emissions

ZNN

Explosive Ordnance Disposal
Prototype Arctic Windscreens
Tank Crew Clothing

ZNZ

Active Carbon Species
Body Armor Studies
Cloud Physics Data

ZNZN

Inlet Head Pressure Differentials
Model Dust Control Distributor

ZNZZ

Combat Crew Training Levels
Defense Ceramics Information Center
Image Isocon TV Camera

ZPAN		
	Area of Castable Rubber	Castable Rubber
	Production of Energetic Molecules	Energetic Molecules
	Conversion of Floating Cause Ways	Floating Cause Ways
ZPN		
	Angle of Arrival	(Retained in Full)
	Studies of Electro-Statics	Electrostatics
	Sets of Yarns	Yarns
ZPNZ		
	Theory of Drag Reduction	Drag Reduction
	Influence of Sand Waves	Sand Waves
	Prediction of Transpiration Temperature	Transpiration Temperature
ZPZ		
	Angle of Attack	
	Department of Defense	
	Equations of Motion	
ZPZZ		
	Function of Aerosol Environments	Aerosol Environments
	Studies of Electrode Behavior	Electrode Behavior
	Fabrication of Test Fixtures	Test Fixtures
ZR		
	Airplane Parameters	
	Circulation Patterns	
	Plasma Current	
ZZ		
	Energy Storage	
	Fire Control	
	Growth Requirements	
ZZAZ		
	Air Force Ballistic Missile	
	Field Chamber Comparative Studies	
	Oil Pollution Exploratory System	

ZZN

Control Surfaces Actuators
Hygroscopic Particle Feeding
Induction System Deposition

ZZPN

Laboratory Testing of Adhesive	Laboratory Testing Adhesive
Difficulty Level of Trainees	Difficulty Level Trainees
Microwave Spectra of Solids	Microwave Spectra Solids

ZZPZ

Assembly Performance of Assemblies	Assembly Performance
Machine Translation of Languages	Machine Translation
Time Effects of Radiation	Time Effects

ZZR

Engine Performance Parameters
Flow Field Patterns
Pulse Delay Parameters

ZZZ

Air Breathing Engines
Breathing Gas Systems
Gas Flow Tables

ZZZN

Aircraft Fuel Tank Sealants
Ion Exchange Bed Demineralizer
Reentry Plasma Sheaths

ZZZZ

Breech Launched Rocket Systems
Dry Lake Bed Surfaces
Jet Engine Compressor Blades

ZZZZZ

Combat Vehicle Fire Control Systems
Hypervelocity Re Entry Space Vehicles
Time Sharing Data Management System

APPENDIX B
FORMAT MISMATCHES

AAAAZZ

Integrated Ablative Radiative Thermal Protection Systems

AAAZ

Antipersonnel Flame Incendiary Studies
Bistatic HF Doppler System
Castable Elastomeric Potting Compound
Chemical Biological Radiological Materials
Coaxial Heterogeneous Mixing Configurations
Continuous Solar X Ray
Cryogenic Shipboard Electronic Systems
Electro Chromic Protective Material
Electrochemical Electromagnetic Mechanical Photoelectric
Free Turbulent Mixing Processes
Illuminated Far Infrared Photodetector
Manual Automatic Integrated Fire
Mid Infrared Spectroscopic Technique
Miniaturized Geodetic Geophysical Techniques
Multipurpose Respiratory Protective System
National Naval Medical Center
Nonflammable Nontoxic High Strength
Orthogonal Linear Phased Arrays
Packaged Airborne Electronic Equipment
Physical Chemical Electrical State
Physical Mathematical Defensive Models
Prepackaged Portable Nuclear Plant
Reinforced Oval Cylindrical Shells
Second Harmonic Cyclic Pitch
Small Flexible Digital Terminals
Tandem Van De Graaff
Three Dimensional Lifting Bodies
Timely Forward Looking Solutions
Tunable Opto Acoustic Filter
Ultra Sensitive Parametric Amplifiers
Ultra Tuned Electronic Circuits
Very High Protective Vehicle

AAAZN

Electronically Tuned Microelectronic Receiver Tuner
Linear Dielectric Tuning Filter Transducers
Slip Cast Fused Silica Radomes

AAAZZ

Empirical Turbulent Kinetic Energy Method
Extremely Low Acoustic Propagation Velocities
Far Infrared Atmospheric Transmission Experiment
High Powered Regenerative Fuel Cell
High Precision Inertial Guidance Theory
Lightweight Pressurized Portable Plastic Extinguishers
Mos Push Down List Memory
Powered Wheeled Military Transport Vehicles
Slip Cast Fused Silica Materials
Tandem Van De Graaff Accelerator
Three Dimensional Turbulent Boundary Layers
Three Dimensional Turbulent Boundary Layer

AANN

Facsimile Auxiliary PCM Multiplexer
Living Attenuated Typhus Vaccine
Simulated South Vietnam Airfields
Soluble Phenylated Quinoxoline Polymers

AANZ

Aerial Night Vision Applications
Airborne Magnetic Detection System
Audio Doppler Radar Mount
Automated Psychiatric Nursing Notes
Coherent Optical Radar Laboratory
Colored Illuminating Flares Signals
Combined Incendiary Fragmentation Effects
Compact Automatic EEG Analyzer
Controlled Airdrop Cargo System
Energetic High Nitrogen Compounds
Far Infrared Vision Systems
Flexible Integrated Intercommunications System
Heavy Single Flechette Cartridge
Lightweight Inertial Navigation System
Simulated Nuclear Blast Effects
Simulated Nuclear Weapons Effects
Simulated Nuclear Weapons Environment
Solid Chemical Oxygen Generators
Thermally Excited Nitrogen Dioxide

AANZZ

Automated Solar Flare Monitoring Systems

AANZZZ

Three Free Convection Fluid Circulation Cells
Valid Small Arms Requirements Data Base

AAR

Atmospheric Environmental Parameters
Cultural Demographic Variables
Global Geodetic Parameters
High Reynolds Number
Measurable Crystallographic Parameters
Solar Geophysical Parameters

AARZ

High Mach Number Flows
High Mach Number Inlet
High Reynolds Number Testing
Low Atomic Number Elements

AAZAZ

Ambient Polar Cap Upper Atmosphere
Controllable Variable Density Optical Filters
Defensive Multiple Surface Shaped Charges
Fast Long Wavelength Infrared Detectors
Powered Aerial Targets Exhaust Plumes
Short High Frequency Electromagnetic Pulses
Very High Frequency Electromagnetic Forces
Very Long Range Strategic Forecast

AAZAZZ

Coupled Ionospheric Magnetospheric Solar Wind Systems

AAZN

Automatic Electronic Antenna Coupler
Buoyant Cold Weather Clothing
Cast Foam Filled Seats
Ceramic Reinforced Plastic Laminates
Daily Northern Hemisphere Maps
Hardened Bipolar Power Transistors
High Cyclic Rate Weapons
Horizontal Airborne Transmitting Antennas
Ionized Turbulent Combustion Gases
Lightweight Cold Weather Clothing

Lightweight High Performance Cameras
Precise Faster Response Navigation
Radioactive Gaseous Waste Disposal
Redundant Hydraulic Servo Actuators
Shipboard Automatic Failure Detection
Soft X Ray Spectroscopy
Solar X Ray Flares
Supersonic Hypersonic Combustion Ramjets
Tactical Phased Array Radar
Toxic Chemical Agent Detection
Ultra Lightweight Reconnaissance Transceiver
Ultra Short Pulse Width
Very High Field Strengths
Very High Peak Spikes
Very Short Radio Wavelengths
Wideband High Power Modulators

AAZNZ

Extremely High Resolution Interferometer Spectrometer
Fourth Solar Radio Astronomy Installation
Lightweight Gyro Azimuth Surveying Instrument
Modular Chemical Agent Detection System
Nuclear Powered Energy Depot Systems

AAZZZ

Airborne Digital Computer Systems Program
Close Coupled Delta Wing Configurations
Empirical Human Performance Effectiveness Data
Extremely Hazardous Air Force Environments
HF Single Sideband Radio Set
Hypersonic Leading Edge Heating Problem
Infrared Celestial Background Radiance Data
Integrated Topographic System Data Bank
Low Molecular Weight Combustion Products
Magnetic Annular Shock Tube Experiment
Organic Rankine Cycle Engine Generator
Self Sealing Fuel Cell Material
Shipboard Upper Air Sounding System
Solar X Ray Emission Lines
Stimulated Rayleigh Wing Light Scattering
Tactical Facsimile Target Display System
Tactical Medical Treatment Facility System
Tactical Wide Band Security Equipment
Universal High Energy Particle Detector

AAZZZZ

Chronic Low Power Density Microwave Exposure
Lightweight Reinforced Plastic Composite Gun Tubes
Miniature Combined Dosimeter Dose Rate Equipment
Rugged High Power Crystalline Laser Materials
Self Powered Flight Deck Light Water

AA+AAZ

Anti Icing and De Icing Systems
Optical Proximity and Super Quick Plug
Organic Inorganic and Organo Metallic Compounds
Rotary Winged and Fixed Winged Aircraft

AA+BZ

Adverse Environmental and Operational Conditions
Psychological Social and Organizational Factors

AA+N

Aromatic Nitro and Nitroamines
Flame Incendiary and Smoke

AA+YN

Infrared Acoustic and Other Detection

AA+Z

Automatic Diagnostic and Inspection
Civilian Pay and Benefits
Perceptual Cognitive and Motor
Physical Statistical and Engineering
Portable Mobile and Base
Satisfactory Functioning and Operation
Scientific Technological and Material
Shallow Step and Extension
Solid Hybrid and Air
Topological Statistical and Sensitivity
Turbulent Mixing and Combustion

AA+ZN

Accelerated Wound and Fracture Healing
Atomic Molecular and Plasma Physics
Freeze Dried and Model Foods
Optical Acoustic and Radio Emissions
Visual Infrared and Millimeter Wavelengths

AA+ZZ

Automatic Diagnostic and Inspection System
Computational Environmental and Reliability Requirements
Dynamic Firings and Static Tests
Mathematical Scientific and Management Problems
Mechanical Thermal and Interface Phenomena
Military Educational and Training Problems
Nuclear Infrared and Microwave Detectors
Opto Electronic and Laser Materials
Positive Automatic and Reliable Identification
Strategic Tactical and Support Aircraft
Tactical Strategic and Reconnaissance Aircraft
Technical Financial and Planning Data
Technical Scientific and Program Management
Visual Infrared and Millimeter Wave

AA+ZZZ

Strategic Tactical and Air Lift Forces
Visual Infrared and Millimeter Wavelength Propagation

ABZ

Airborne Meteorological Data
Atmospheric Meteorological Data
Automatic Meteorological System
British Meteorological Office
Extreme Operational Environments
Increasingly Complex Input
Molecular Collision Dynamics
Naval Operational Areas
Negative Real Parts
Psychological Operational Requirements
Qualitative Quantitative Requirements
Simulated Operational Environments
Simulated Operational Environment
Technical Operational Programs
Three New Projects

ABZZ

Continuous Real Time Monitoring
Dynamic Real Time Information
Military Operational Support Systems
Partially Operational Army Research
Three New Work Units

ANAZ

Coated Tantalum Structural Elements
Low Inertia Arresting System
Low Terrain VHF Scattering
Mortar Ammunition Applied Research
Nonlinear Ordnance Dynamic Data
Phototropic Dye Nondestructive Inspection
Solar Flare X Rays

ANAZZ

Caseless Ammunition Automatic Test Fixture
Insulating Substrate Epitaxial Semiconductor Systems
Self Healing Cold Cathode Emitters
Transonic Buffet Dynamic Load Prediction

ANNN

Coated Titanium Carbon Bearings
Depleted Uranium Flechette Ammunition
Warm Fog Condensation Nuclei

ANNZ

Ablative Nose Cone Materials
Airborne MTI Radar Techniques
Auditory Passive Sonar Signals
Fine Dendrite Arm Spacing
Free Swimming Diver Conditions
High Purity Aluminum Oxide
Lightweight Interrogator Transponder System
Mechanized Infantry Battalion Force
Military Survival Food Packets
Simplified Speech Intelligibility Test
Variable Deflection Thruster System

ANNZZ

Monolithic UHF Silicon Broadband Amplifier
Photographic Radar Landmass Simulation Techniques
Simulated Fog Flare Light Conditions
Small Arms Ammunition Weapon Systems

ANR

Nuclear Fallout Parameters

ANZN

Chemical Ionization Mass Spectroscopy
Coupled Torsion Bending Computations
Digital Troposcatter Communications Modems
Discrete Silicon Power Transistors
Flat Trajectory Tank Cannons
High Acuity Photo Recon
Low Shrinkage Matrix Resins
Warm Fog Dissipation Hypotheses

ANZZN

Lightweight Magnesium Dry Cell Batteries
Magnetic Wire Shift Register Boram

AZAAZ

Controlled Contaminant Free Physiologic Atmosphere
High Speed Morse Telegraph Terminal
High Speed Rotating Electrical Machinery
High Strength Lightweight High Temperature
Integrated World Wide Topographic Concept
Internal Conversion Electron Spectroscopic Techniques
Low Energy Cosmic Gamma Rays
Mixed Radiation Absolute Calorimetric Dosimeter

AZAAZZ

Free Induction Nuclear Magnetic Resonance Flowmeter
Low Power Miniature Precision Frequency Synthesizer

AZAN

Charged Particle Absolute Gravimeter
High Altitude Nuclear Detonations
High Altitude Pilot Helmets
High Altitude Pulmonary Edema
High Energy Nuclear Physics
High Energy Thermal Stimulation
High Fatigue Resistant Joints
High Force Cool Propellants
High Temperature Elastomeric Polymers
High Temperature High Stress
High Temperature Ionized Gases
Long Wave Infrared Sensors
Low Energy Nuclear Physics
Low Temperature Catalytic Oxidation
Marine Corps Medical Evacuation
Military Aircraft Open Cockpits
Narrow Beam Optical Radar
Resonant Pulse Parametric Oscillator
Small Engine Internal Aerodynamics
Stabilizing Light Sensitive Polymers
Thin Film Amorphous Semiconductors
Thin Film Piezoelectric Semiconductors
Ultra Violet Airborne Transmissometer
Upper Atmosphere Chemical Physics
Wide Angle Null Steering
Wide Band Object Camouflage

AZANZ

High Altitude Scientific Balloon Flight
High Performance Naval Weapons Systems
High Strength Armored Crew Seat
Integrated Ground Airborne Avionics System
Limited Function Integrated Avionics System
Wide Band Secure Crypto Equipment

AZAZAZ

High Temperature Warning System Solid State
Thin Film Solid State Facsimile Recording

AZAZN

High Temperature Extreme Pressure Greases
High Temperature Long Life Bearings
Lighter Weight Inflatable Life Boats

AZAZZZ

Closed Loop Primary Flight Control Systems
Colloidal Core Nuclear Reactor Rocket Engine
Dental Panographic X Ray Scanner System
Heavy Class Military Vehicle Propulsion Systems
High Performance Low Light Level Television
High Speed High Altitude Transport Aircraft
Highest Performance Low Light Level Tube
Low Altitude High Speed Flight Regime
Low Level Gamma Ray Flux Measurement
Microminiature Microwave Acoustic Surface Wave Amplifiers
Small Reserve Fluoboric Acid Poser Supplies
Ultra Reliable VHF FM Radio System

AZBZ

Electron Spin Lattice Interactions
Marine Corps Operational Logistics

AZNN

Clear Air Radar Backscattering
High Altitude Balloon Instrumentation
High Strength Columbium Alloys
Pathogenic Micro Organism Aerosols
Rare Earth Cobalt Magnets
Rotary Wing Cockpit Instrumentation
Strategic Structures Vulnerability Hardening
X Band Microstrip Oscillator

AZNZZ

Mobile Ocean Basing System Studies
Mobile Ocean Basing Systems Studies
Radiative Transport Weapons Effects Calculations
Retinal Burn Flashblindness Prediction Model
Single Mode CW Power Output

AZNZZZ

High Power CW Laser Radiation Studies
Low Altitude EMP Sensor Recording Systems
Thin Film Thermocouple Room Temperature Detector

AZZAZ

Exploratory Model Maintenance Diagnostic Set
High Data Rate Secure Communications
High Pressure Impact Resistant Materials
High Sensitivity Field Warning System
Highest Peak Power Solid State
Lightweight Company Level Mortar System
Low Data Rate Global Communications
Low Dose Rate Gamma Exposure
Low Field Strength Electromagnetic Radiations
Solid State Devices Applied Research
Wide Band Gap Semiconducting Compounds
Wide Base Band Military Systems

AZZAZZ

High Performance Aircraft Thermal Control Systems
Solar Network Making Fixed Frequency Burst

AZZNN

Ceramic Metal Plastic Armor Composites
High Strength Beta Titanium Alloys
Three Candidate Meningococcal Meningitis Vaccines

AZZNZ

Automated Tissue Cell Culture Control
Controlled Air Drop Cargo Systems
Controlled Air Drop Cargo System
Elevated Temperature Radiation Embrittlement Sensitivity
High Performance Aircraft EMP Testing
Military Space Vehicle Tracking Facilities
Solid State Micro Electronics Sciences
Variable Speed Constant Torque Turbine

AZZZN

High Quantum Efficiency Injection Luminescence
High Resolution Pulse Compression Radar
Primary System Water System Purification

AZZZNZ

Airborne Surveillance Target Acquisition Radar Techniques

AZZZZZ

Anti Tank Assault Air Defense System
Digital Data Acquisition Processing Display System
High Data Rate Laser Communications Systems
High Power Density Missile Power Sources
High Power Light Weight Power Generators
High Speed Landing Gear Track Facility
Variable Output Gas Generator Test Program

A+AAR

Atomic and Molecular Optical Parameters
Strategic and Tactical Military Variables

A+AAZ

Aeroelastic and Thermoelastic Structural Loads
Antipersonnel and Anti Vehicular Mines
Closed and Partially Closed Atmospheres
Geophysical and Oceanographic Environmental Complexes
Heavy and Lightweight Transportable Equipment
Inner and Outer Solar Corona
Lethal and Incapacitating Chemical Agents
Linear and Digital Integrated Circuits
Linear and Nonlinear Mathematical Programming
Low and Extremely High Levels
Mathematical and Electrical Analog Models
Molecular and Atomic Spectroscopic Data
Monolithic and Mos Integrated Circuits
Normal and Abnormal Sensory System
Poisonous and Venomous Marine Animals
Subsonic and Supersonic Coaxial Streams
Tactical and Strategic Military Aircraft
Topographic and Military Geographic Support
Topographic and Military Geographic Information
Transportable and Ultra Transportable Equipment

A+AAZZ

Offensive and Defensive Chemical Systems Effectiveness
Rotary and Piston Combined Cycle Engine
Subsonic and Supersonic Slender Body Theory

A+ANZ

Armored and Anti Armor Systems
Cold and High Elevation Regions
Military and Indigenous New Media
Open and Closed Iron Sights
Organic and Inorganic Radome Structures
Tropical and High Elevation Regions

A+AZAZ

Low and High Pressure Firing Tests
Mid and Long Range Strategic Forecasts
Rigid and High Temperature Resistant Materials

A+BZ

Advisory and Direct Support
Climatic and Operational Environments
Environmental and Operational Conditions
International and Organizational Conflict
Strategic and Operational Guidance

A+NN

Diarrheal and Skin Diseases
Flame and Fragmentation Weapons
Regulatory and Stress Physiology
Utility and Cockpit Adaptability

A+NZ

Atmospheric and Radome Environment
Cellular and Organ Levels
Earthworking and Construction Equipment
Environmental and Endurance Testing
Gaseous and Particulate Materials
Mechanical and Oxidation Stability
Microbiological and Dosimetry Standards
Naval and Marcorps Teams
Photographic and Navigation Systems
Physical and Adhesive Properties
Positioning and Navigation System
Taylor and Helmholtz Effects
Warning and Detection Systems

A+NZZ

Maneuvering and Drag Compensation Functions

A+RZ

Industrial and Government Proposals

A+ZAN

Decontaminating and Dispensing Military Fuels

A+ZANZ

Automated and Computer Interfaced Microform Storage

A+ZAZ

Environmental and Shock Absorbing Properties
Natural and Disturbed Atmospheric Environments
Normal and Disturbed Ionospheric Conditions
Quiet and Disturbed Geophysical Conditions
Scientific and Management Advisory Committee
Single and Counter Rotating Propellers

A+ZNZ

Microbiological and Radiation Dosimetry Standards
Parasitic and Integral Armor Systems

A+ZZZ

Atmospheric and Background Light Conditions
Ballistic and Reentry Flight Vehicles
Biological and Liquid Metal Attack
Electron and Ion Beam Techniques
Normal and Emergency Flight Conditions
Rarefied and Radiation Gas Dynamics
Spectral and Time Signature Data
Tactical and Air Defense Missions
Technical and System Engineering Support
Thermal and Flight Load Environments
Thermodynamic and Transport Property Data

BAANZ

New Automated Captive Trajectory System

BAN

Direct Hydrocarbon Oxidation
New Electromagnetic Detection
New Organosilicon Lubricants
New Synthetic Chemicals

BANZ

Local National Labor Forces
New Flame Weapons Systems
New Freeze Drying Facilities
New Lightweight Armor Materials
New Miniature Oxygen Regulator

BAZ

Complex Biomedical Problems
Complex Military Equipment
Complex Military Systems
Local Military Commands
New Acoustic Media
New Adaptive Technique
New Ballistic Data
New Biological Assays
New Biological Information
New Calorimetric Technique
New Ceramic Compositions
New Ceramic Materials
New Chemical Compounds
New Clinical Tests
New Computational Models
New Computational Techniques
New Dielectric Materials
New Digital Circuitry
New Digital Techniques
New Dynamic Stabilization
New Electrical Performance
New Electronic Functions
New Electronic Systems
New Epitaxial Films
New High Quality
New High Temperature
New Incendiary Agent
New Inorganic Compounds
New Inorganic Materials
New Magnetic Material
New Mathematical Aids
New Mathematical Theory
New Metallic Materials
New Microelectronic Circuits
New Military Environment
New Military Selection
New Nuclear Systems
New Optical Components

BAZ

New Organic Structures
New Polymeric Materials
New Polyurethane Coating
New Precise Time
New Prime Systems
New Probabilistic Techniques
New Protective Equipment
New Stabilizing Additives
New Therapeutic Material
Operational Electromagnetic Compatibility
Operational Environmental Conditions
Operational Human Factors
Operational Hydraulic Oil
Operational Military Systems
Operational Tactical Settings
Quantitative Acoustic Reflection

BAZAN

New High Temperature Stable Macromolecules
New Wideband Log Periodic Antennas

BAZN

New High Speed Excavating
New Infrared Transmitting Glasses
New Mental Standards Airmen
New Aerodynamic Stabilization Techniques
New Dental Equipment System
New Dynamic Strength Requirements
New Hybrid Computer Techniques
New Lightweight Aircraft Structures
New Lightweight Wind Systems
New Mathematical Problem Areas
New Military Health Problems
New Military Systems Equipments
New Nondestructive Testing Techniques
New Physical Conditioning Program
New Remote Control Units
New Self Dispersing Shapes
New Solid State Devices
New Supersonic Combustion Chamber
Operational Mobile Reconnaissance Facility
Operational Programmable Shock Strut
Operational Topographic Data Bank

BAZZZ

New Continuous Tone Reproduction Materials
New Epoxy Dip Coating Systems
New High Pressure Gas Apparatus
New Parametric Surface Wave Amplifier
New Solid Film Bonding Techniques
New High Resolution Neutron Scattering Spectrometer
New High Resolution Phase Signature Radars
New Wide Temperature Range Base Stocks

BA+AZN

Local Respiratory and Gastrointestinal Tract Immunity

BA+AZZ

New Antipersonnel and Antimateriel Dispenser Munition
New Atomic and Molecular Frequency Sources

BA+ZZ

New Domestic and Foreign Science

BNN

Local Bird Population
New CB Decontamination
New England Storms
New Insect Vibration

BNNZ

New Intrusion Detection System

BNZ

Direct Blood Pressure
Expanded Armor Program
Lattice Vibration Spectra
Meteorological Balloon Systems
Meteorological Monograph Series
New Carborane Compounds
New Carborane Derivatives
New Career Orientation
New Construction Techniques
New Corrosion Inhibitors
New Dexsil Products
New Dust Palliatives
New Flutter Phenomena
New Flutter Prediction
New Instrumentation Techniques

BNZ

New Irritant Compounds
New Man Machine
New Modulation Scheme
New Mothproofing Agents
New Piping Systems
New Radar Components
New Radar Indicator
New Transducer Devices
New Vibration Simulators
New Vtol Aircraft
New Weapons Systems
Real Battlefield Environment

BNZZ

New Aluminum Landing Mats
New Oxygen Breathing Mask
New Quartz Crystal Technique
Operational Vtol Aircraft System
Random Vibration Measurement Data

BZ

Complex Area
Complex Environment
Complex Environments
Complex Performance
Complex Plane
Complex Position
Complex Problems
Complex Structures
Complex Substances
Complex System
Complex Systems
Complex Vibrations
Direct Ascent
Direct Communication
Direct Effect
Direct Effects
Direct Fire
Direct Impact
Direct Measurement
Direct Method
Direct Navy
Direct Observation
Direct Potential
Direct Power

BZ

Direct Ranging
Direct Research
Direct Response
Direct Sounding
Direct Support
Direct Transformation
Direct Value
Direct Voice
Expanded Activity
Expanded Contract
Lattice Damage
Lattice Deformation
Lattice Spacing
Lattice Vibrations
Local Density
Local Level
Local Purchase
Meteorological Conditions
Meteorological Data
Meteorological Elements
Meteorological Equipment
Meteorological Measurement
Meteorological Prediction
Meteorological Processes
Meteorological Rocket
Meteorological Simulator
Meteorological Structures
Meteorological Support
Meteorological Variations
New Additives
New Agent
New Agents
New Air
New Aircraft
New Algorithm
New Antenna
New Applications
New Area
New Areas
New Center
New Class
New Codes
New Combat
New Components
New Compounds
New Computer
New Concept

New Conditions
New Container
New Contracts
New Data
New Devices
New Directions
New Elements
New Engineering
New Environments
New Equipment
New Families
New Family
New Formulations
New Foundations
New Functions
New Gas
New Generator
New Ground
New Growth
New Gun
New Heater
New Imagery
New Information
New Installation
New Jet
New Laser
New Levels
New Logic
New Manuals
New Material
New Materials
New Metal
New Method
New Methodology
New Munitions
New Navy
New Neutron
New Observations
New Officers
New Operations
New Pad
New Personnel
New Phenomenology
New Plasma
New Potentials
New Problems
New Processing
New Program
New Programs
New Project

BZ

New Properties
New Proposals
New Propulsion
New Prototype
New Radars
New Reactions
New Regions
New Requirements
New Research
New Rotation
New Seat
New Sequence
New Shelter
New Ships
New Sources
New Species
New Specification
New Start
New Starters
New Statistics
New Strain
New Structure
New Structures
New Studies
New Substances
New System
New Systems
New Target
New Targets
New Technique
New Techniques
New Test
New Tests
New Theories
New Theory
New Tool
New Vehicle
New Work
New Zones
Operational Activities
Operational Aircraft
Operational Applications
Operational Areas
Operational Bases
Operational Command
Operational Commands
Operational Condition
Operational Control
Operational Data
Operational Deficiencies

Operational Doctrine
Operational Effectiveness
Operational Effects
Operational Efficiency
Operational Environments
Operational Equipment
Operational Error
Operational Factors
Operational Functions
Operational Impact
Operational Job
Operational Logging
Operational Missions
Operational Model
Operational Munition
Operational Performance
Operational Personnel
Operational Planning
Operational Problems
Operational Range
Operational Readiness
Operational Reliability
Operational Requirements
Operational Restrictions
Operational Selection
Operational Settings
Operational Speed
Operational Support
Operational System
Operational Test
Operational Testing
Operational Tests
Organizational Problems
Organizational Requirements
Organizational Set
Organizational Structure
Organizational Structures
Organizational Subsystems
Quantitative Calculations
Quantitative Data
Quantitative Description
Quantitative Effects
Quantitative Information
Quantitative Interactions
Quantitative Reliability
Quantitative Safety
Quantitative Solution
Quantitative Solutions
Quantitative Techniques
Random Excitation
Random Processes
Real Problems
Real Structures
Real Time

BZAAZ

Direct Fire Antitank Guided Missiles

BZAZZ

New Heat Resistant Explosive Compounds
New Interference Free Field Method
New Polymer Pyrotechnic Fuel Mixtures

BZN

Collision Transport Integrals
Direct Air Blast
Direct Fire Ammunition
New Antiradiation Chemicals
New Polymer Binders
New Transmission Seal
Real Time Computations

BZZ

Complex Aerospace Communications
Complex Computer Processing
Complex Computer Programs
Complex Data Bases
Complex Energy Interactions
Complex Flow Field
Complex Flow Fields
Complex Information Processing
Complex Problem Solving
Complex Threat Environments
Complex Training Problems
Direct Energy Conversion
Direct Exposure Tests
Direct Mode Operation
Direct Ranging Method
Local Command Resources
Local Heating Effect
Local Radiation Belts
Meteorological Data Requirements
Meteorological Information Criteria
Meteorological Rocket Concept
Meteorological Rocket Program
New Active Exchangers
New Aircraft Proposals
New Alloy Materials
New Amplification Techniques
New Communications Concept
New Computer Programs
New Computer System
New Control Techniques
New Data Cards

New Drug Applications
New Emplacement Holes
New Energy Absorption
New Engine Cycles
New Engineering Material
New Explosive Fillers
New Feeding Requirements
New Field Studies
New Fire Suppression
New Gun System
New Imaging Techniques
New Kill Criteria
New Laser Systems
New Materiel Requirements
New Measurement Techniques
New Membrane Materials
New Navy Contracts
New Nonmetallic Materials
New Performance Area
New Personnel Management
New Plastic Frame
New Power Sources
New Preservation Techniques
New Probe Measurement
New Problem Areas
New Project Area
New Propellant Systems
New Recoil Mechanisms
New Reconnaissance Equipment
New Reconnaissance Systems
New Research Program
New Safety Devices
New Sensor Information
New Sensor Systems
New Shock Tube
New Simulation Problems
New Storage Materials
New Systems Simulation
New Tank Materials
New Technique Areas
New Test Series
New Test Techniques
New Testing Techniques
New Transmission Techniques
New Transmitter Techniques
New Vehicle Control
New Wave Classification
New Weapon Configurations

BZZ

New Weapon System
New Weapon Systems
New York University
Operational Aerospace Systems
Operational Failure Data
Operational Flight Environments
Operational Interference Problems
Operational Performance Efficiency
Operational Personnel Tests
Operational Problem Areas
Operational Research Techniques
Operational Satellite Altitudes
Operational Satellite Systems
Operational System Efficiency
Operational Temperature Range
Operational Weather Forecasts
Organizational Field Equipment
Quantitative Performance Data
Quantitative Satellite Tests
Random Access Method
Random Gust Loads
Random Wave Studies
Real Air Force
Real Flight Loads
Real Gas Effects
Real Life Targets
Real Time Acquisition
Real Time Context
Real Time Data
Real Time Display
Real Time Identification
Real Time Prediction
Real Time Processing
Real Time Signal
Real World Conditions
Real World Environments

BZZN

New Metal Phosphinate Polymers
New Power Transmission Fluids
New Shed Light Sensors
New Ship Concept Hydromechanics
New Sounding System Sensors
Operational Air Force Satellites

BZZNN

New Pulse Code Modulation Multiplexer

BZZZ

Complex Energy Interaction Mechanisms
Direct Energy Conversion Processes
Direct Energy Conversion Techniques
Local Radio Distribution Systems
Meteorological Data Sounding System
Meteorological Observation System Studies
New Aerosol Field Samplers
New Air Force Systems
New Airframe Reliability Criteria
New Fire Control Systems
New Flight Load Survey
New Liquid Crystal Systems
New Liquid Crystalline Compounds
New Power Conversion Systems
New Power Supply Systems
New Signal Processing Technique
New Sounding System Area
New Weapon System Procurements
Operational Air Force Commands
Operational Earth Space Communications
Quantitative Static Ground Tests
Real Time Computer Control
Real Time Computer Processing
Real Time Information System
Real Time Prediction Radiation
Real Time Reconnaissance Displays

BZZZZ

New Satellite Velocity Mass Spectrometer
New Turbine Guide Vane Material
Real Time Data Processing Work

BZZZZZ

New Air Defense Computer Simulation Models

NAZAZZ

Fiberglass Reinforced Plastic Tail Rotor Assembly

NAZN

Arthropod Borne Virus Diseases
Man Sanitary Waste Disposal
Silicon Schottky Barrier Photodiodes

NAZZ

CIC Lighting Team Communications
Man Tactical Support Aircraft
Michigan International Data Archives
Passive High Flux Neutron
Princeton Dynamic Model Track
SI Schottky Barrier Detectors
Stress Acoustic Surface Wave
Texas Social Behavior Inventory
Thunderstorm Electrical Charge Distributions
UHF Unfurlable Satellite Antenna
VLF Elf Propagation Codes
VLF LF Reflection Coefficients

NAZZZ

Battalion Close Support Weapon System
Iron Double Focusing Beta Spectrometer
Vtol Low Speed Flight Dynamics

NA+NZ

Man Portable and Avionics Equipments

NBZ

Ardis Operational Subsystems

NNAZ

Artillery Weapons Applied Research
CW BW Defensive Operations
CW BW Medical Defense
Rain Erosion Resistant Materials

NNNN

Diver Helium Speech Unscrambler

NNZAZ

Barium Strontium Titanate Single Crystals

NNZZZ

Hydrogen Oxygen Fuel Cell Plant

NAN

Balloon Borne Sensors
Passive Human Monitor
Vacuum Resistant Lubricants

NAZ

Corrosion Preventive Compounds
Lightning Warning Set
Radar Doppler Shifts

NN

Oscillator Strengths
Payload Ejection
Silicon Carbide

NNN

Epidemic Typhus Rickettsia
Skin Friction Drag
Stress Corrosion Cracking

NNZ

Bond Dissociation Energies
Diver Speech Communications
Nucleation Condensation Processes

NNZZ

ASW Sonar Target Simulation
Fallout Debris Cloud Formation
Sand Dust Water Separator

NPZ

Calculus of Variations (Retained in Full)
Degradation of Rubber Degradation
Turbulence of Plasma Turbulence

NZ

Beach Jumper
CAI Techniques
Defoliation Activities

NZN

Eye Burn Hazards
Firepower Denial Neutralization
GAAS Laser Diodes

NZZ

Hafnium Base Alloy
Impurity Defect Interactions
Kansas State University

NR

Fallout Patterns
Grinding Parameters
Growing Number
History Variables
Moisture Parameters
Personality Variables
Seeding Patterns
Sleep Patterns
Speech Patterns

NZAZ

Additive Effects Microbial Growth
Aluminum Alloy Structural Shapes
Cannon Launched Guided Munition
Cannon Launched Guided Munitions
Drag Reduction Polymeric Additives
Elastomer Sheet Antifouling Coatings
GE Area Illuminating Rocket
Indium Antimonide Schottky Barriers
Terrain Avoidance Warning System
Titan Vehicle Electrostatic Environment

NZAZZ

Grid Wind Tunnel Computer Technique
Rotorcraft Flight Maneuvering Computer Program

NZNZ

Albacore Polymer Additive Program
Aquanaut Life History Questionnaire
Diving Failure Detection System
Fleets Shock Hardening Program
Magnesium Aluminate Spinel Display
Quartz Crystal Humidity Sensor
Sodium Chlorate Oxygen Generators
Terrain Vehicle Man System

NZNZZ

Aluminum Wood Elastomer Composite Inserts
Artillery Simulator Artillery Simulator Program

NZR

Blood Flow Patterns

NZZAZ

Artillery Fire Control Applied Research

NZZN

CW Operation Avalanche Oscillators
Titanium Alloy Airframe Joints

NZZZZ

Navigation Guidance Computer Memory Devices
Sediment Shear Wave Sound Speed

ZAAAZ

Environment Controlled Delayed Elastic Effects
Mode Linear Partial Differential Equation
Ultrasonic Electron Nuclear Double Resonance

ZAAN

Explosion Resistant Hydraulic Fluids
Fire Resistant Phenolic Foams
Weight Protective Flexible Shelters

ZAAZ

Active Stripline Phased Arrays
Aircraft Mechanical Hydraulic Subsystems
Aircraft Mechanical Hydraulic Equipment
Aircrew Environmental Protective Systems
Broadband Tuning High Power
Control Chronic Respiratory Disease
Disseminating Military Geographic Data
Exhibits Very Brittle Behavior
Heat Resistant Inorganic Materials
Radiation Hardened Electronic Devices
Radiation Resistant Rugged Reliable
Radiation Resistant Solar Cells
Reliable Fixed Tuned Circuits
Reliable Hydraulic Mechanical Equipment
Standard Finite Difference Techniques
Testing Modular Medical Units
Voice Excited Formant Tracker
Wind Tunnel Free Flight
Wind Tunnel Magnus Balance
World Wide Climatological Data
World Wide Environmental Requirements
World Wide Military Command
World Wide Military Operations
World Wide Precise Time

ZAAZZ

Control Nuclear Electromagnetic Blackout Phenomena
Exhibit Extremely Fast Diode Behavior
Flight Maneuvering Digital Computer Program
Prototype Centralized Automatic Test System
Radiation Resistant Solid State Materials
Rocket Borne Chemical Release Tests
Stol Utility Fixed Wing Airplane
World Wide Environmental Health Conditions

ZAAZZZ

Fleet Chemical Biological Warfare Defense Studies
Point Detonating Proximity Point Initiating Base
Prototype Self Luminous Vehicle Instrument Dials
Wind Tunnel Magnus Effect Test Models

ZABAZZ

Army Wide Operational Chemical Information System

ZANN

Determination Small Arms Weapons

ZANZ

Aircraft Arresting Hook Installation
Army Small Arms Program
Army Small Arms Requirements
Computer Interfaced Microform Storage
Disturbed Polar Ionosphere Studies
Instrument Pilot Instructors School
Level Warm Fog Model
Processing Red Blood Cells
Prototype Photochromic Goggle System
Rocket Borne VLF Receivers
Roll Bonded Titanium Panels
Transmission Electron Microscopy Studies
Voice Excited Vocoder Operations

ZAZAAZ

Frequency Modulated Phase Locked Digital Synthesizer

ZAZAZ

Army Long Range Technological Forecast
Forecasting Long Range Military Requirements
Forming Ceramic Metal Ceramic Structures
Glass Reinforced Plastic Structural Rod
Potential Deep Submergence Structural Material
Propellant Actuated Devices Applied Research

ZAZN

Army Marine Craft Modernization
Candidate Ablative Polymer Composites
Efficiency Schottky Barrier Diodes
Metal Bonded Diboride Composites
Potential Solid State Lasers
Ship Amphibious Field Medicine
Test Remote Terminal Query
Turbine Powered Pipeline Pumps

ZAZNZ

Air Mobile Aircraft Refueling System
Composite Ceramic Metal Armor Area
Prototype Buoyant Body Armor Assembly
Support Worldwide Army Construction Requirements
Watch Standing Monitoring Sonar Displays

ZAZZAZ

Vehicle Hydraulic System Maintenance Diagnostic Sets

ZA+AN

Army Offensive and Defensive Weapons
Tank Primary and Secondary Armament

ZA+AZZ

Arc Second and Automatic Position Read
Army Topographic and Geodetic Systems Requirements
Field Medical and Dental Treatment Facilities

ZA+Z

Soil Applied and Growth

ZA+ZZ

Contract Clinical and Laboratory Research
Fluid Dynamic and Control Systems
Hazard Warning and Target Acquisition
Injector Mixing and Ignition Systems
Motor Drive and Transport System
Processing Geodetic and Mapping Data
Radio Astronomical and Satellite Studies
Shot Window and Satellite Damage

ZA+ZZZ

Wind Tunnel and Range Test Facilities

ZBAZZ

Army Direct Aerial Fire Support

ZBAZZZ

Army Direct Aerial Fire Support Aircraft

ZBZ

Aircraft Operational Restrictions
Army Operational Requirements
Caliber Direct Fire
Combat Operational Environment
Disseminating Meteorological Data
Engine Operational Problems
Fleet Operational Conditions
Fleet Operational Forces
Logistics Organizational Structures
Research Meteorological Teams
Sea Operational Problems
Shed New Light
Spin Lattice Relaxation
Standard Meteorological Equipment
Support Operational Commands
System Operational Failures
System Operational Processes

ZBZZ

Spin Lattice Relaxation Time
Support Meteorological Field Studies
Support New Communication Equipment

ZNAN

Laser Scintillation Atmospheric Turbulence
Liquid Helium Nucleate Boiling

ZNAZ

Air Leakage Sealing Mechanisms
Aircrew Eye Protective Equipment
Flash Blindness Protective Devices
Ground Crew Technical Training
Helicopter Downwash Mixing Technique
Tank Cannon Applied Research

ZNAZN

FM CW High Resolution Radar

ZNBZN

Field Artillery Direct Support Cannon

ZNNZ

Class LST Marriage Gear
Composite CDS Quartz Resonators
Ground MTI Radar Techniques
Phase Synthesis Taper Techniques
Plasma Chromatography Detection System
Polymer Additive Drag Reduction
Shock Hardening Ordnance Equipment

ZZAN

Air Force Biomedical Scientists
Air Force Clinical Medicine
Air Force Nuclear Weapons
Light Weight Doppler Sensors
Materiel Support Southeast Asia
Polymer Solutions Inhibit Cavitation
Problem Studies Integrating Ammunition

ZZANZ

Army Engineer Nuclear Cratering Group
Army World Wide Overseas Problems
Flight Test Auxiliary Cooling System
Pulse Code Modulated Multiplexer Equipment

ZZAZN

Dual Hardness Kinetic Energy Ammunition
Millimeter Wave Solar Temperature Maps

ZZAZZ

Air Force Close Air Support
Air Force Electronic Systems Equipments
Air Force Global Weather Central
Air Force Human Resources Laboratory
Air Force Pilot Factors Program
Ball Screw Hydropneumatic Suspension System
Compound Semiconductor X Band Receiver
Gun Launched Guided Projectile Structures
Lead Sulfide Infrared Detector Materials
Model Field Medical Laboratory System

ZZAZZZ

Air Force Close Air Support Aircraft
Air Force Unmanned Radiation Satellite Program
Field Army Forward Area Air Defense

ZZBZZ

Aircraft Systems Operational Safety Requirements

ZZNN

Integral Rocket Battalion Ammunition

ZZNZ

Air Defense Guns Systems
Air Force Armament Laboratory
Air Force Vtol Aircraft
Air Force Weapons Laboratory
Air Force Weapons Systems
Air Pressure Casting Machine
Aircraft Impact Injury Prevention
Arsenal Laser Physics Research
Combat Vehicle Crew Sizes
Combat Vehicle Weapons Systems
Draft Army Artillery Program
Dual Beam Radar Returns
Fire Control Radar Systems
Flight Deck Eye Protection
Guide System Software Acquisition
Host Pathogen Biocide Interactions
Laboratory Animal Housing Modules
Land Combat Weapons Effectiveness
Laser Performance Decrement Studies
Light Water Carbon Dioxide
Novel Air Weapons Launching
Plan Cut Foliage Preservation
Radio Relay Retransmission Problems
Range Speed Payload Potential
Reentry Vehicle Vibration Predictions
Room Temperature Copper Cavities
Threat Level EMP Simulator
Time Division Multiplex Equipment
Traffic Ship Navigation Aids
Transport Aircraft Crew Utilization
Vapor Space Corrosion Inhibitors
Vehicle Performance Terrain Relations
Weapon Test Vulnerability Problem

APPENDIX C

AAN	1	forward deployed NATO	of forward deployed NATO general purpose forces with
AAZ	1	airborne moving target	to give airborne moving target indicating (MTI) radaring systems for
AAZ	1	exact lower confidence	an exact lower confidence bound for the
AAZ	1	extremely low power	an extremely low power module IF that
AAZ	1	international ionized gas	at the ninth international ionized gas conference
AAZ	1	modular x-ray	tests of modular x-ray unit
AAZ	1	portable long base	semi-portable long base line interferometry with
AAZ	1	single integrated engineering	A single integrated engineering development effort will be
AAZ	1	x civil engineering	53x civil engineering services by contract:
AAZZ	1	coaxial dense plasma focus	A coaxial dense plasma focus device is being assembled
ANZ	3	consumable rockets launched	the application of consumable rockets launched from ocean bouys
ANZ	3	tropical oceans lead	studies over tropical oceans lead to the conclusion
AZZ	3	transonic speeds lead	airflow at transonic speeds lead to airfoil sertims
AZZZ	3	high speed vehicle flying	particles collected by high speed vehicle flying through rain
A+ZZ	3	filling gaps	will be updated by replacing new data for old and filling gaps
NAZ	3	monitor cardiovascular response	developed instrumentation to monitor cardiovascular response to various
NAZ	3	monitor environmental factors	Monitor environmental factors affecting acoustic transmission
NAZ	3	stress incapacitating agents	field warning system which stress incapacitating agents and to
NAZ	3	stress inorganic materials	efforts will stress inorganic materials for
NN	3	soldiers wounded	the care of soldiers wounded on the battlefield
AAZ	4	classical x-ray	by classical, x-ray and microprobe method of
AAZ	4	fast compact reliable	through fast, compact, reliable and flexible processors
AAZ	4	marine integrated fire	(3) marine integrated fire and support;

AAZ	4	marine integrated personnel	(4) marine integrated personnel and logistic;
AAZ	4	parallel extremely reliable	highly parallel, extremely reliable, and flexible processors
AAZ	4	utility heavy lift	configured for utility, heavy lift, and surveillance missions
AAZ	4	variable single seat	merged into variable single seat and multi-crew configurations as the
AAZ	4	amphibious overseas	support of amphibious overseas and remote area operations
AN	4	combined airblast	and the other with combined airblast and direct induced effects
AN	4	mixed zirconium	Mixed zirconium and wiskering graphite fibers to
AZAZ	5	electronic ports applied research	electronic ports applied research and engineering (Title)
AZZ	5	truck transmission matching	effort on truck transmission matching including automatic transmission
ZAN	5	event nuclear weapons	in the event nuclear weapons are used on
ZAZ	5	training technical domain	in the education and training technical domain
ZR	5	guide current	maintain design guide current as the state-of-the-art advance
ZZ	5	targets visible	that effective engage targets visible to the
ZZ	5	test command	a result of test operations at test command DASA
ZZZ	5	effects micro wave radiation	; define effects micro wave radiation on central nervous systems,
ZZZ	5	problems problem areas	and will identify problems problem areas.
ZZZ	5	vehicle performance soil	refine vehicle performance-soil another vehicle performance-terrain relations
AAZ	6	the microbiological, nutritional, biochemical	the microbiological, nutritional, biochemical and chemical factors
ANZ	6	elastomeric sphere filled	and elastomeric sphere filled tire for increased
AZ	6	chemical biochemical	chemical, biochemical, physical and microbiological limitations

AZ	6	combined pitch	study of combined pitch and yaw oscillations
AZ	6	combined attitude	methods of providing combined attitude sensoring and missile control
AZ	6	combined sound	the problem of combined sound, high temperature environment simulation
AZ	6	combined work	the combined work has led to a
AZ	6	empirically aid	to empirically aid in developing alternate ...
AZ	6	increasingly active	They will become increasingly active in the
AZ	6	physiological biochemical	through physiological, biochemical and chemical pathological investigations
AAZ	7	manual automatic control	; manual/automatic control application
AAZ	7	seismic mineral phase	mineral properties (seismic, mineral phase, electrical) at
AAZ	7	slender high velocity	of a slender high velocity, oblique-angle, water-entry will be
AA+ZZ	7	solid gas	, solid/solid and solid/gas equilibria
AAZZ	7	mid high intensity warfare	airmobility in mid-high intensity warfare in Europe
AZ	7	ceramic metal	and ceramic metal combinations
AZ	7	least operation	and not least, operation in adverse
AZ	7	lightweight reliable	prototypes of lightweight, reliable, high performance cryogenic coolers.
AZ	7	sensitive quantum	to evolve sensitive quantum-electronic, parametation other low-noise receivers
AZAZ	7	technical domain atmospheric	in the technical domain-atmospheric environment
AZ	8	national bureau	The National Bureau of Standards
ZPZZ	8	art surveys	state-of-the-art surveys, designs data
ZPNZ	8	Arizona contract	University of Arizona contract F33615-70-C-1007 becomes
ZPNZ	8	Kentucky contract	The University of Kentucky contract will be considered for
ZPNZ	8	Korea army	by the Republic of Korea army.
ZPNZ	8	Tennessee space	at the University of Tennessee space institute,
ZPNZ	8	Virginia contract	University of Virginia contract F33615-69C-1048 becomes
ZPZZ	8	attack control	design of an angle-of-attack control for sounding rockets
ZPZZ	8	defense guidance	based on Department of Defense guidance concerning the
ZZ	8	error probable	, circle of error probable

NZN	9	demolition kit catering	of demolition kit catering XM180 and
NZN	9	detection techniques radar	In the development of catering detection techniques radar and aircraft data
NZZZ	9	terrain vehicle systems university	"Introduction of terrain-vehicle systems" University of Michigan press
ZN	9	computers magnetohydrodynamics	such as holography and computers magnetohydrodynamics and
ZN	9	method graphite	by this method graphite was converted to
ZN	9	temperature humidity	for measuring radiation, temperature humidity, density, composition
ZZ	9	addition work	In addition work will proceed on
ZZ	9	molecular energy	within the molecular energy can be redistributed
ZZ	9	projects research	under these sub-projects research will be
ZZZ	9	studies documentation studies	continue selected material handling studies documentation studies
AAZ	10	destroying classified material	methods of destroying classified material will
AAZ	10	incapacitating Naval personnel	present physiological hazards form incapacitating Naval personnel
AAZ	10	manipulate factual data	techniques to extract manipulate factual data from
AAZ	10	propagating electromagnetic waves	to study means of propagating electromagnetic waves through the
AN	10	inhibit learning	variables that facilitate or inhibit learning, to formulate
AN	10	mixing helium	one application of mixing helium and oxygen in
ANN	10	mounting turbulence sensors	techniques for mounting turbulence sensors on the
AZ	10	absorbing heat	this method of absorbing heat will be very effective
AZ	10	classified standard	that item by type classified standard A
AZ	10	generating signals	means of efficiently generating signals at micro wave,

AAZ	11	electro optical ultraviolet	(e.g., electro optical, ultraviolet, etc.)
AAZ	11	extremely high radio	objects with extremely high radio, x-ray, ultraviolet, or infrared flux...
AAZ	11	light weight long life	improved efficiency, small size, light weight long life, greater reliability
AAZ	11	looking infrared display	a morning belt downward looking infrared display for
AAZ	11	optical reflection luminescent	sights include optical reflection luminescent, open and closed iron sights.
AN	11	quadripartite NATO	such international groups as quadripartite, NATO, SEATO, MWDA, etc.
AZ	11	alpha beta	a need to detect, in real time, alpha beta, gamma neutron and x-ray radiation
AZ	11	electron neutron	(3) electron, neutron, x-ray and molecular beam diffraction
AZ	11	mixing ignition	in injection, mixing ignition and combustion in
AZ	11	multiple phase	A multiple phase, 30 month, advanced development program is....
BN	12	new carborane	of new carborane compounds
ZZ	13	magnet off	the field of a magnet off its axis has been
ZZ	13	skid off	an uncontrolled 90 degree skid off thepavement

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