MASKED SEARCH PROGRAM

TECHNICAL DOCUMENTARY REPORT NO. ESD-TDR-64-629

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JANUARY 1965

G. S. Stoller

Prepared for
DIRECTORATE OF COMPUTERS
ELECTRONIC SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
L. G. Hanscom Field, Bedford, Massachusetts

Project 508.0
Prepared by
THE MITRE CORPORATION
Bedford, Massachusetts
Contract AF(628)2390
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ABSTRACT

The Masked Search Program is a static trace and can be used for debugging or modifying a 7090 program. This report describes the program and how it is used in most cases. Additional information is provided to cover unusual occurrences during the program run.

REVIEW AND APPROVAL

This technical documentary report has been reviewed and is approved.

JOHN F. EGAN
Project Officer
 Sections II through VI of this document describe the Masked Search Program and how it is used for most cases. Sections VII through XII provide additional information to cover an unusual occurrence during the running of the program. Sections VII through XII are also useful for changing the program for a non-M90 run or for running the program with a different monitor system. For example, any tape unit can be chosen as the input tape and any other tape unit may be designated as the output tape. The input tape can be prepared by a peripheral card-to-tape unit and the output tape can be listed on a peripheral tape-to-printer unit.
SECTION II

PURPOSE OF PROGRAM

By means of specification cards (described in Section IV), the user specifies a mask and a search area (block of storage) to the program. In accordance with the specification request, the program prints out a list of the locations in the search area that satisfy the conditions set up by the specification cards.

For instance, an address mask may be used to find all locations that have anything to do with a particular entry point to a subroutine; i.e., from which locations is this subroutine entered? After obtaining a list of the locations having this entry point as their address, a listing of the data being searched would normally tell where in the search area this subroutine is being entered.

Another example involves finding how certain storage locations are used; i.e., what is stored there and when is it read?* By means of an op-code mask, one can find all locations that contain instructions which change memory, i.e., all "store" instructions and RDS.

* This routine is a tool that was used to change a large system program (the META assembler) which was the working program.
SECTION III

DIRECTIONS FOR USE OF MASKED SEARCH PROGRAM

The Masked Search Program uses a relocatable column-binary deck. This deck should be preceded by a "relocate origin" card when it is being loaded. This card will have a 7-9 punch in column 1. The origin at which the Masked Search Program is to be loaded into the memory will be specified in the address field of what is usually the checksum word (the bottom three rows of column 5 and all of column 6).

The Masked Search Program can be loaded using the M90 load card. Along with the Masked Search Program, one should load the data that is to be searched.

After the loading is completed, control is given to the Masked Search Program. The program expects to find the specification cards on the community input (COMIN) tape. The specification cards should be BCD cards stored one-per-record (in BCD records) on the COMIN tape. If redundancy or EOF is encountered while attempting to read a specification card, the program aborts.

All output is written on the community output (COMOUT) tape for offline printing.

The deck for a sample run using the Masked Search Program could be arranged as follows:

III JOB

III LOAD 2COMIN

binary deck of program to be searched
"relocate origin" card
binary deck of Masked Search Program

III 1401 DATA, 1
input specification cards for the search

III ENDJOB

It is assumed that the program to be search contains exactly one transfer card. The number of transfer cards in that program determines the coefficient of "COMIN" on the M90 LOAD card.

The Masked Search Program occupies $224_{10}$ ($340_8$) locations of which the last $24_{10}$ ($30_8$) are buffer locations. For this reason it is restricted to be loaded with a new origin between $6_8$ and $70470_8$. 
SECTION IV

FORMAT OF (INPUT) SPECIFICATION CARDS

The first two columns of a specification card contain characters which tell the program what function to perform. Six functions are provided and can be called for by using the characters EQ, RL, RA, BD, MK, HO.

Following the characters which request a function are two fields each containing an octal integer (possibly signed). Both fields are required on the RL, RA, and BD cards. Only the first field is required on the EQ and MK cards. No fields are required on the HO card. The terms "argument 1" and "argument 2" shall refer to the contents of the first and second fields of a specification card (respectively).

Each of these two fields begins at a fixed length and a fixed column. The first field begins at column 6 and extends through column 18. The second field begins at column 24 and extends through column 36. Thus each field occupies 13 columns. In each field, the low-order 12 columns are interpreted as though each contained an octal digit. That is, only the three low-order bits of the six-bit character code are used when interpreting these columns. Hence, a blank column is equivalent to a column with a 6 punched in it. The first column of each field (columns 6 and 24) is examined for a minus sign. If this column contains a minus sign, then the corresponding argument is made negative through an SSM instruction. If this column does not contain a minus sign, the corresponding argument is unchanged.

Beyond the required columns, all punches are ignored. Hence comments may be inserted on all specification cards after column 37.
The EQ card (equals) causes the program to investigate the search area for words which are identical to argument 1 of the EQ card when looked at through the mask. The locations of these words are printed out (offline).

The RL card (range, logical) is used for a range search on logical quantities (i.e., unsigned numbers from 0 to $2^{36} - 1$). Here the sign bits of the arguments are considered as numerical bits. The program examines the search area for words which, considered as logical quantities, lie between (logical) argument 1 and (logical) argument 2 inclusive, when all of these quantities are looked at through the mask. The locations of these words are printed out (offline).

The RA card (range algebraic) causes the same processing as an RL card except that here the comparisons are algebraic (i.e., signed).

The BD card sets boundaries for the search area. Argument 1 is the first-word location and argument 2 is one more than the last-word location. These two arguments are not masked. A search area consisting of more than $77776_8$ locations should not be used. The addresses set by a BD card are initialized to the values that they would contain if a BD card having $0_8$ as argument 1 and $77776_8$ as argument 2 had been read in.

Argument 1 of the MK card (mask) is a mask which will be used on all subsequent searches until overridden by another MK card. Obviously this argument is not masked by the present mask. An initial mask of "all ones" is assumed.

The HO card (whoa) terminates the reading of specification cards. Its fields are ignored. A normal return to the monitor results after this card is read.
SECTION V

FORMAT OF COMMENT CARDS

A card that has been read into the computer by this program is considered a comment card only if column 2 is blank. Column 1 is then assumed to contain a carriage-control character for the printer. (Use a blank in column 1 if you wish to single space when printing this card; i.e., print on the line now available and then space up once.)
SECTION VI

OUTPUT FORMAT

All input cards (specification cards and comments cards) will be printed out (offline). The card will be printed basically as it is punched; i.e., characters in adjoining columns will be printed in adjoining print positions. The only exceptions to this rule are columns 1 and 2 which will be offset to the left.

Program-generated data will be printed out immediately after the specification card that caused it. If a specification card's conditions are not met anywhere in the search area, the line following the one on which the specification card was printed will be blank.
SECTION VII
ERROR RETURNS TO MONITOR

There are two conditions that cause a return to the error-entry point of the monitor. One of these is a format error on an input card; i.e., column 2 is not blank and none of the acceptable identifying characters, namely EQ, RL, RA, BD, MK, HO, have been found in columns 1 and 2. An EOF redundancy encountered while attempting to read a specification card (from COMIN) is the other error condition.

When an error occurs, the program either drops into or transfers to an expansion of the macro BAH. This macro expansion consists of the following two instructions:

\[ \text{STL LCTN} \]
\[ \text{TRA ERRPRT} \]

The address portion of the symbolic location LCTN, which is at nominal location 305, shows the actual location at which the error was made known. From this, the nominal location at which the error was made known may be computed. The comment appearing on the BAH card that is found near this nominal location in the attached listing will identify the error.

In the dump that is given, all of memory and all of the central processor's registers will be shown exactly as they were at the time that the error was made known, except for the accumulator and the MQ. (Memory locations LCTN and ERRPRT+2 may also be changed, but this is expected, and the previous contents of these registers are not needed for any debugging.)
SECTION VIII

ADDITIONAL NOTES ON (INPUT) SPECIFICATION CARDS

For both range searches (RL and RA), if argument 1 is identical to argument 2 when both are looked at through the mask, the program goes to the EQ routine. This is indicated in the printout on the line printed out immediately after the line on which the specification card was printed. In this situation, the line will always be printed out; a blank line will be printed if no program-generated data is available. If some program-generated data is to be printed out, then this line will be indented 12 print positions over its usual indentation. (Program-generated data is usually indented six print positions. The first digit of program-generated data to be printed on a line usually occupies print position 8.)

Optimization (of time-expenditure) in a range search may be possible if one has some knowledge of the data to be search. The first comparison against an argument will be made against argument 1, and if this comparison shows that the word cannot lie between argument 1 and argument 2 (when all are masked) no comparison against argument 2 is made. There is no "size" or "magnitude" ordering inherent in the arguments. (The program compares them to find out which is the greater of the two arguments.) That is, argument 1 can be less than, equal to, or greater than argument 2 when both are looked at through the mask. This allows the search to be optimized, as in the following two cases. If one is looking for all memory references to a block of storage which is near the end of his program, then he should choose the first-word location of that block as argument 1 and the last-word location of that block as argument 2. However, if this block lies near the beginning
of his program, then he should choose the last-word location of that block as argument 1 and the first-word location of that block as argument 2. Naturally, an address mask is used.
SECTION IX

ADDITIONAL NOTES ON OUTPUT FORMAT

A comment card is printed out which looks nearly the way it did when it was read in. Column 1 of the card was used as a carriage-control character. The character that appeared in column 3 is printed in print position 9, column 4 is printed in print position 10, and so on for the other columns, ending with column 80 being printed in print position 86.

A specification card is printed in a similar fashion. First, a carriage-control character is inserted in the line to cause the printer to space up two lines before printing the specification card. Columns 1 and 2 of the specification card are printed in print positions 3 and 4, respectively, column 3 is printed in print position 9, column 4 is printed in print position 10 and so on, ending with column 80 being printed in print position 86.

If there is an error in the format of an input card, this card is not printed out and the program goes to its error exit. Hence, the last input card printed is the one that appeared just before the card that is in error.

The buffer size for program-generated output is 22 words. The first word is a word of blanks. At most, 21 words of program-generated output are printed per line. In fact, a full line of program-generated data for EQ, RL, and RA output will normally contain 21 locations. An abnormal case occurs when an RL or RA specification card is read in, and arguments 1 and 2 are identical when looked at through the mask. In this case, the first line of program-generated output is indented 12 print positions if there is any program-generated data to be printed out. If no program-generated data exists for this specification card after the search is completed, a blank line is printed out.
SECTION X

DESCRIPTION OF SYMBOLIC DECK

The symbolic deck is sprinkled with comments to aid anyone who sees a need to change it. The notation "C(PLACE)" is to be read "the contents of location PLACE," and "CA(PLACE)" is to be read "the contents of the address field of location 'PLACE.'" The notations "GR(TH1, TH2)," "EQ(TH1, TH2)," "LS(TH1, TH2)" are almost self-explanatory; a full description of these functions can be found in supplement 1 to the META manual (MITRE TM-77 #2, S1).

The symbolic deck is set up to punch a relocatable column-binary deck with nominal origin $\theta$.

This program is dependent upon the regular monitor (i.e., the monitor that is left in main memory after an M90 LOAD card) for its I/O. All parts of this program that are in any way dependent upon the monitor are grouped together near the beginning of the program. (They are contained between card numbers 15 and 50 of the Appendix.)
SECTION XI

DESCRIPTION OF BINARY DECK

The binary deck is a column-binary relocatable deck with nominal origin 6.

Exactly $224_{10} (340_8)$ locations are required by the Masked Search Program for instructions, constants, and buffers. Only the first $200_{10} (310_8)$ locations are loaded. In the last $24_{10}$ locations arguments 1 and 2 are stored, input is read into, and output is written from.

Those parts of the program which are dependent on the monitor occupy nominal locations $1_8$ through $23_8$. 
SECTION XII

BLOCK DIAGRAM AND LISTING

All tricks, except for the obvious ones, have been avoided in coding this program. Tricks have been used at symbolic locations EXIT1 and ADRES1 (nominal locations 17 and 236 respectively). The tricks are documented in the comments appearing on these cards and on the following REM cards. Several other tricks could have been used, but they cause undue hardship in recoding parts of this program and do not give a big enough reduction in the size of the program to warrant their use.

Several locations have two symbolic names (e.g., PRINTI and PRINTO for 78, REDIN and BUFFER for 3128), while others, which are not referenced, are assigned symbolic names. The extravagance of assigning two symbolic names to a nominal location allows us to identify somewhat the reason for the reference to that nominal location. For example, a TSX PRINTI, 4 means "go to the closed subroutines that prints out an input card," while a TSX PRINTO, 4 means "go to the closed subroutine that prints out a line of program generated data." These two subroutines are identical although they could be different. Since they are performing different functions (although identically) they are given different symbolic names.

The symbolic locations that are not referenced have been named to show a special property which is explained by the comments accompanying the word.

All I/O performed by the Masked Search Program is by tapes.

G. S. Stoller

15
START
CLRBUF
CLEAR THE I/O BUFFER.

EJECT
RESTORE THE PAGE.
ROUTINES ENTIRELY INDEPENDENT OF M9C.

CHECK FOR TYPE OF SPECIFICATION CARD.

THE PRESENT CARD IS A COMMENT CARD. COLUMN 1 CONTAINS A CARRIAGE CONTROL CHARACTER FOR THE OUTPUT LISTING.

THE PRESENT CARD IS A SPECIFICATION CARD.

THE PRESENT CARD IS NOT A SPECIFICATION CARD.

THE PRESENT CARD IS A SPECIFICATION CARD.

ERROR IN FORMAT OF INPUT CARD.

EOF OR REDUNDANCY FROM COMIN.

POSITION TYPE SPECIFICATION CHARACTERS FOR PRINTING.

STORE ARGUMENT 1.

BRING IN BLANKS AND THE CARRIAGE CONTROL CHARACTER.
TRANSFER TABLE. THIS IS TIED TO THE TYPES TABLE.

1. (LOGICAL

LOOK FOR RANGE

2. (ALGEBRAIC)

ENTRY POINT TO EQ ROUTINE WHEN A

RANGE-SEARCH ROUTINE FINDS THAT BOTH ARGUMENTS

ARE IDENTICAL WHEN LOOKED AT THROUGH THE MASK.

CA(1) = -1 INITIALLY. THIS ADDRESS WILL

BE SET BY BD SPECIFICATION CARDS.

REM

0125 074CC 2 00025

EO AXT EBSIZE,2

0126 124

RGEQ SYN *

ENTRY POINT TO EQ ROUTINE WHEN A

REM

0126 124

INDEX

-1,1

REM

0126 124

SETE CAL -2,1

REM

0126 124

ERAS

REM

0126 124

ERAS

ENTRY POINT TO ERA ROUTINE WHEN A

REM

0126 124

ERAS

ENTRY POINT TO ERA ROUTINE WHEN A

REM

0126 124
146 0 56000 0 00277 RA LDQ ALGMP IC(ALGMP) = (CAS ++).
147 -0 50000 G 0030C CAL XCHALG IC(XCHALG) = (XCA).
       REM DROP THROUGH TO R ROUTINE.

* LOOK FOR RANGE.

150 0 602C0 G 00203 R SLW XCH
151 -0 620C0 G 00165 SLQ COMP R
152 -0 620C0 G 00204 SLQ COMP A1
153 -0 620C0 G 00213 SLQ COMP A2
154 -0 500C0 G 00307 RG CAL MASK TO ENTRY POINT OF RANGE-SEARCH ROUTINE WE
       REM HAVE ONLY ONE POSSIBLE RANGE-SEARCH.

155 0 320C0 G 00311 ANS KEY+1
156 -0 320C0 G 00310 ANA KEY
157 0 602C0 G 00310 SLW KEY
160 -0 130C0 G 00007 XCL
161 0 522C0 G 00203 XEC XCH
162 G 7740G 2 00025 AXT RBSIZE, 2
163 6 534GC 1 0124 LXA INEX, 1
164 -0 774GC 4 00000 AXC 0, 4
165 0 3400C G 00311 COMPR CAS KEY+1 THE OPERATION TO BE PERFORMED HERE IS
       REM EITHER CAS OR LAS. THIS OPERATION IS SET
       REM BY RL AND RA SPECIFICATION CARDS.

166 1 77777 4 00170 TXI **2, 4, -1
167 1 77776 2 00174 TXI RSAEQ, 2, (RBSIZE - 2) - RBSIZE
       REM EQ(C(KEY), C(KEY+1)) = 1.
       REM DROP THROUGH IF LS(C(KEY), C(KEY+1)) = 1.

170 -0 50000 G 00311 CAL ADRESS, 4
171 0 621C0 G 00207 STA COMP A1+3
172 0 771C0 G 00022 ARS 1R
173 0 621C0 G 00214 STA COMP A2+1
174 -0 522C0 G 00272 CAL ADRESS, 1, 4
175 0 621C0 G 00205 STA COMP A2+1
176 0 771C0 G 00027 ARS 1B
177 0 621C0 G 00216 STA COMP A2+3
200 -0 50000 1 77777 SCTR CAL -1, 1 CA(*) = -1 INITIALLY. THIS ADDRESS WILL
       REM BE SET BY BD SPECIFICATION CARDS.

201 -0 320C0 G 00307 ANA MASK
202 -0 130C0 G 00000 XCL
203 0 131C0 G 00000 XCH XCA
       REM THE OPERATION TO BE PERFORMED HERE IS
       REM EITHER XCA OR XCL. THIS OPERATION IS SET
       REM BY RL AND RA SPECIFICATION CARDS.

204 0 3400C G 00310 CCMP A1 CAS KEY THE OPERATION TO BE PERFORMED HERE IS
       REM EITHER CAS OR LAS. THIS OPERATION IS SET
       REM BY RL AND RA SPECIFICATION CARDS.

205 2 000C1 1 00000 TIX **, 1, 1
206 2 000C1 1 0021 TIX FOUND, 1, 1
207 2 000C1 1 00000 TIX **, 1, 1
210 3 002A4 2 00021 TXH RDCLEY, 2, RBSIZE - 1
211 0 0740C G 00007 TSX PRINT0, 4
212 0 0200C G 00021 TRA RDELAY
213 0 3400C G 00311 CCMP A2 CAS KEY+1 THE OPERATION TO BE PERFORMED HERE IS
       REM EITHER CAS OR LAS. THIS OPERATION IS SET
       REM BY RL AND RA SPECIFICATION CARDS.
<table>
<thead>
<tr>
<th>Line</th>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>214</td>
<td>020006</td>
<td>TRA **</td>
</tr>
<tr>
<td>215</td>
<td>020017</td>
<td>TRA FOUNDR</td>
</tr>
<tr>
<td>216</td>
<td>020000</td>
<td>TRA **</td>
</tr>
<tr>
<td>217</td>
<td>207425</td>
<td>FOUNDR TSX 2TO8.4</td>
</tr>
<tr>
<td>220</td>
<td>000012</td>
<td>TXI SETR,2,1</td>
</tr>
<tr>
<td>221</td>
<td>000007</td>
<td>TXI PRINTU,4</td>
</tr>
<tr>
<td>222</td>
<td>000200</td>
<td>TXI SETR,2,RBSIZE-1</td>
</tr>
<tr>
<td>223</td>
<td>000003</td>
<td>PROCESS THE FIELDS ON A SPECIFICATION CARD.</td>
</tr>
<tr>
<td>224</td>
<td>000003</td>
<td>SUBROUTINES.</td>
</tr>
<tr>
<td>225</td>
<td>000003</td>
<td>TO PRODUCE THE FIELDS ON A SPECIFICATION CARD.</td>
</tr>
<tr>
<td>226</td>
<td>000003</td>
<td>PROCESS THE FIELDS ON A SPECIFICATION CARD.</td>
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<td>262</td>
<td>000003</td>
<td>PROCESS THE FIELDS ON A SPECIFICATION CARD.</td>
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<tr>
<td>263</td>
<td>000025</td>
<td>TYPE1 BCD 1,0000GEO</td>
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<td>264</td>
<td>000051</td>
<td>BCD 1,0000GRL</td>
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<tr>
<td>265</td>
<td>000051</td>
<td>BCD 1,0000GUR</td>
</tr>
</tbody>
</table>

**Note:** The above code appears to be a part of a computer program or a programming reference, specifically related to processing fields on a specification card. The codes and operations described seem to be part of a subroutine or process for handling data on a specification card. The presence of characters such as TRA, FOUNDR, and LGR indicate specific operations or codes within this subroutine.
THE FOLLOWING SYMBOLS APPEAR TO BE CORRECT

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$2TOP=</td>
<td>165/00C245</td>
</tr>
<tr>
<td>$SEC=</td>
<td>83/0000123</td>
</tr>
<tr>
<td>$SRG=</td>
<td>108/00C154</td>
</tr>
<tr>
<td>$KEY=</td>
<td>200/00C0310</td>
</tr>
<tr>
<td>$MASK=</td>
<td>199/00C307</td>
</tr>
<tr>
<td>$SIGN=</td>
<td>159/00C237</td>
</tr>
<tr>
<td>$EXIT=</td>
<td>15/00C0017</td>
</tr>
<tr>
<td>$PZRC=</td>
<td>16/00C012</td>
</tr>
<tr>
<td>$PRLTG=</td>
<td>179/00C263</td>
</tr>
<tr>
<td>$PINTC=</td>
<td>7/00C007</td>
</tr>
<tr>
<td>$XCHGL=</td>
<td>130/00C276</td>
</tr>
</tbody>
</table>

TABLE OF ADDRESSES USED BY THE R ROUTINE.

<table>
<thead>
<tr>
<th>Address</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0246</td>
<td>1,000GBD</td>
</tr>
<tr>
<td>0247</td>
<td>0248</td>
</tr>
<tr>
<td>0250</td>
<td>0251</td>
</tr>
<tr>
<td>0255</td>
<td>0256</td>
</tr>
<tr>
<td>0260</td>
<td>0261</td>
</tr>
<tr>
<td>0265</td>
<td>0266</td>
</tr>
<tr>
<td>0270</td>
<td>0271</td>
</tr>
<tr>
<td>0275</td>
<td>0276</td>
</tr>
</tbody>
</table>

THE FOLLOWING SYMBOILS APPEAR TO BE CORRECT

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$2TOP=</td>
<td>165/00C245</td>
</tr>
<tr>
<td>$SEC=</td>
<td>83/0000123</td>
</tr>
<tr>
<td>$SRG=</td>
<td>108/00C154</td>
</tr>
<tr>
<td>$KEY=</td>
<td>200/00C0310</td>
</tr>
<tr>
<td>$MASK=</td>
<td>199/00C307</td>
</tr>
<tr>
<td>$SIGN=</td>
<td>159/00C237</td>
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<td>7/00C007</td>
</tr>
<tr>
<td>$XCHGL=</td>
<td>130/00C276</td>
</tr>
</tbody>
</table>
THE FOLLOWING SYMBOLS FROM THE COMPOOL WERE USED BY THE PROGRAM

$9EMTS = 32426/G77252  $9PRCS = 32422/G77246  $9REDS = 32427/G77253

THE FOLLOWING MACROS HAVE BEEN DEFINED BY THE PROGRAM

END OF META ASSEMBLIES.
The Masked Search Program is a static trace and can be used for debugging or modifying a 7090 program. This report describes the program and how it is used in most cases. Additional information is provided to cover unusual occurrences during the program run.
## INSTRUCTIONS

1. **ORIGINATING ACTIVITY:** Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization (corporate author) issuing the report.

2a. **REPORT SECURITY CLASSIFICATION:** Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.

2b. **GROUP:** Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

3. **REPORT TITLE:** Enter the complete report title in all capital letters. Titles in all cases should be unclassified. If a meaningful title cannot be selected without classification, show title classification in all capitals immediately following the title.

4. **DESCRIPTION NOTES:** If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.

5. **AUTHOR(S):** Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.

6. **REPORT DATE:** Enter the date of the report as day, month, year; or month, year. If more than one date appears on the report, use date of publication.

7a. **TOTAL NUMBER OF PAGES:** The total page count should follow normal pagination procedures, i.e., enter the number of pages containing information.

7b. **NUMBER OF REFERENCES:** Enter the total number of references cited in the report.

8a. **CONTRACT OR GRANT NUMBER:** If appropriate, enter the applicable number of the contract or grant under which the report was written.

8b, 8c, & 8d. **PROJECT NUMBER:** Enter the appropriate military department identification, such as project number, subproject number, system numbers, task number, etc.

9a. **ORIGINATOR's REPORT NUMBER(S):** Enter the official report number by which the document will be identified and controlled by the originating activity. This number must be unique to this report.

9b. **OTHER REPORT NUMBER(S):** If the report has been assigned any other report numbers (either by the originator or by the sponsor), also enter this number(s).

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   2. "Foreign announcement and dissemination of this report by DDC is not authorized."
   3. "U. S. Government agencies may obtain copies of this report directly from DDC. Other qualified DDC users shall request through"
   4. "U. S. military agencies may obtain copies of this report directly from DDC. Other qualified users shall request through"
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11. **SUPPLEMENTARY NOTES:** Use for additional explanatory notes.

12. **SPONSORING MILITARY ACTIVITY:** Enter the name of the departmental project office or laboratory sponsoring (paying for) the research and development. Include address.

13. **ABSTRACT:** Enter an abstract giving a brief and factual summary of the document indicative of the report, even though it may also appear elsewhere in the body of the technical report. If additional space is required, a continuation sheet shall be attached.

   It is highly desirable that the abstract of classified reports be unclassified. Each paragraph of the abstract shall end with an indication of the military security classification of the information in the paragraph, represented as (T5), (S), (C), or (U).

   There is no limitation on the length of the abstract. However, the suggested length is from 150 to 225 words.

14. **KEY WORDS:** Key words are technically meaningful terms or short phrases that characterize a report and may be used as index entries for cataloging the report. Key words must be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location, may be used as key words but will be followed by an indication of technical context. The assignment of links, roles, and weights is optional.