3600

Control Data® 3600 Computer System
SCOPE/Reference Manual

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SCOPE OPERATING SYSTEM 1

The SCOPE monitor system for the Control Data® 3600 computer facilitates job processing and simplifies programming and operating by providing:

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  - Assigns equipment
  - Initiates compilations and assemblies
  - Loads, links and initiates execution of subprograms
  - Allocates storage
  - Provides OVERLAY processing and accounting information
  - Communicates with Satellites ®
    for input/output tape handling
- Debugging Aids
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Monitor operations are specified in a job by control statements and programmer requests.

The resident section of SCOPE occupies the low numbered locations of bank zero. Resident includes the control routine (EXEC), input/output control (IOC), interrupt control (INC), equipment assignment (EQA), and the Satellite control program (SCP), if used. The loader is adjacent to resident in lower storage. System I/O drivers are loaded into the highest locations of the highest available bank. The system I/O drivers and SCOPE are protected by an internal interrupt system.

1.1 CONTROL STATEMENTS

SCOPE control statements have the following card format: a 7,9 punch in column 1; a statement name (beginning in column 2); and parameters, if required, separated by commas.

Control statements are free-field, but must be contained on a single 80-column card. No terminating character is needed.

1.2 REQUESTS

A request is written as a macro instruction and assembled into a calling sequence to a SCOPE routine. Requests may be written as calling sequences in assembly language programs.

The request name begins in column 10 and is terminated by a blank column. The address field may begin anywhere after the blank and before column 41. Unless noted otherwise, requests may contain any legal COMPASS expression in the address field. Further details on statement parameters are given in the COMPASS REFERENCE MANUAL.

1.3 JOBS

A job includes all operations indicated between JOB cards or between a JOB statement and an ENDSCOPE statement. Each job is terminated with an end-of-file mark. A job may consist of multiple assemblies, compilations, and executions.

A job stack consists of a group of jobs placed together for processing by the monitor control system. The stack begins with the first monitor statement and ends with an ENDSCOPE statement.

1.4 LOGICAL UNITS

In SCOPE control statements and requests, the logical unit designation allows reference to a piece of equipment within the logic of the program; it is

independent of the physical unit designation. The programmer designates input and output units with logical unit numbers 1 through 79. Mnemonics may be used in programmer requests. Logical units are divided into three classes:

PROGRAMMER UNITS (logical units 1-49)

These units are assigned throughout the job for reference by the program. When a tape is released at the end of the job, it may be unloaded and saved for the programmer, if specified; or made available for reuse in a later job.

SCRATCH UNITS (logical units 50-59)	Mnemonic
	S0,S1, . . . S9

Scratch units may be referenced at any time by the programmer, but they are released after each execution and may not be saved.

SYSTEM UNITS (logical units 60-80)

The system units assigned by the monitor system are used by SCOPE and the programmer and, with two exceptions, are released only at the end of the job stack. The load-and-go unit, available to compilers and assemblers, is released at run time; auxiliary libraries are released at the end of each job.

	Logical Number	Mnemonic
STANDARD INPUT	60	INP

The control cards for all SCOPE jobs are placed on this unit by the operator. Frequently, the programs and data to be processed are also on INP.

STANDARD OUTPUT	61	OUT

SCOPE control statements, diagnostics, dumps, and loader control cards are written in BCD mode on this unit. Program output may also be written on OUT.

STANDARD PUNCH OUTPUT	62	PUN

Program and SCOPE output for punching is recorded on this unit.

INPUT COMMENT	63	ICM

Comments from the operator to the monitor system are made on this unit. The programmer may also use ICM for input directions.

	Logical Number	Mnemonic
OUTPUT COMMENT	64	OCM

Statements from the monitor system to the operator are made on this unit. The programmer may also list information on this unit. ICM and OCM are usually assigned to the console typewriter.

ACCOUNTING INFORMATION	65	ACC

Job statements, date, time on and off, and elapsed job time are written on this unit for installation records.

SATELLITES	66-68	none

Satellite units are assigned by the operator to computers which communicate with the 3600. SCOPE contains a control program for handling Satellite input/output requests. Programmers cannot control or reference the Satellite units.

LOAD-AND-GO	69	LGO

Binary object programs transferred from the standard input unit or produced by compilation or assembly may be stored here prior to loading and executing. This unit may be saved by the programmer with an EQUIP statement. If saved, it will be released at the end of the job. If not saved, it will be released at the beginning of the run.

SCOPE LIBRARY	70	LIB

The SCOPE library contains the monitor system and all programs and subroutines which operate under SCOPE, such as, FORTRAN, COBOL, COMPASS, SORT, and ALGOL.

AUXILIARY LIBRARIES	71-79	none

Auxiliary libraries are used for library preparation and editing and additional system libraries.

SYSTEM SCRATCH RECORD	80	SCR

Monitor equipment tables, accounting data, and recovery dump information for each job are stored in the first record of this unit. If part of resident is destroyed by a running program, the system uses the information on this tape for recovery. The first scratch unit requested by a program is assigned to this unit. The programmer may never reference logical unit 80.

MINIMUM UNIT CONFIGURATION

The minimum configuration required by SCOPE includes:

INP	ACC (may be bypassed)
OUT	LIB
ICM	SCR
OCM	

Compilers and assemblers operating under SCOPE may require additional units.

EQUIPMENT ASSIGNMENT

SCOPE assumes that all programmer and scratch logical unit numbers refer to unique, high-density (556bpi), labeled, magnetic tapes read or written in binary mode; and that tapes are not saved at the end of a job. If programmer and scratch units meet this description, no special equipment declarations are needed.

The normal equipment assignments may be altered by:

EQUIP

- Equate a logical unit to a specific hardware type
- Equate different logical units to a single physical unit
- Declare a tape to be unlabeled

EQUIP or LABEL

- Indicate a desired tape label for a logical unit

MODE

- Indicate the recording mode of a tape unit

EQUIP or MODE

- Select a particular density for a tape unit
- Restrict the use of a unit

EQUIP or SAVE

- Indicate that a tape is to be saved at the end of the job

Blank labels are written on all tapes that are not saved; only blank labeled tapes may be assigned as output tapes.

SCOPE CONTROL STATEMENTS 2

Jobs and directives are submitted to SCOPE on the standard input unit. Jobs are executed in sequence from the standard input unit or as specified by the operator.

2.1 SEQUENCE STATEMENT

$^{7}_{9}$SEQUENCE,n

This statement assigns a job sequence number, n, which serves as identification for scheduling purposes. SCOPE does not check the order of the numbers.

The SEQUENCE statement immediately precedes a JOB statement on the standard input unit. When INP is magnetic tape, an end-of-file mark should precede each SEQUENCE statement (section 2.7).

When the SEQUENCE statement is encountered, SCOPE unloads saved tapes, and releases all other programmer units, scratch units, and the load-and-go unit. The current job is terminated and the new job initiated.

Example:

```
    <end-of-file>
7/9SEQUENCE,4
7/9JOB, . . .
    .
    .
    .
     end-of-file
7/9SEQUENCE,5
7/9JOB, . . .
```

In Satellite mode, SEQUENCE cards are recognized but are renumbered by the Satellite computer.

2.2 JOB STATEMENT

All programs submitted for processing under SCOPE start with a JOB card which signals the beginning of a job, provides accounting information for the installation, identifies the programmer, and sets a job processing time limit.

$^{7}_{9}$JOB,c,i,t

c the charge number; unlimited number of alphanumeric characters. SCOPE truncates to 8 characters in Satellite mode for Satellite accounting.

i the programmer identification. It may be any length and appears as given in the control card listing; it is truncated to 6 characters for operator identification or tape labels.

t the maximum time limit in minutes allowed for the entire job including operator functions. No job may exceed 2236 minutes; if a limit is not specified, the maximum is assumed.

The job is terminated if the c and i fields are not present. A single JOB card may be used for any number of independent programs; however, the time specified is the maximum allowed for the combined programs.

2.3 FILE STATEMENT

Binary records can be transferred from the standard input unit to another logical unit by the FILE statement.

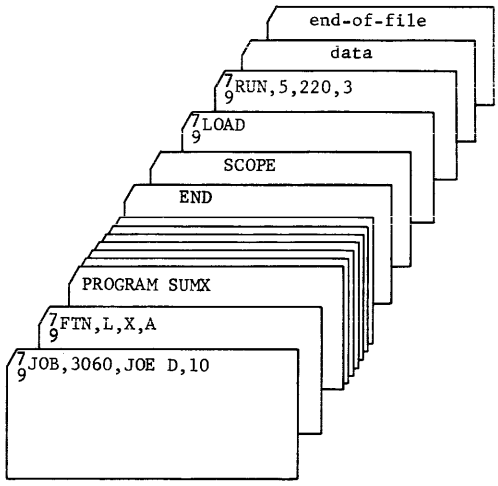
$^{7}_{9}$FILE,u

All records which follow the FILE statement up to a FILE END statement are transferred to logical unit u 1-59, or 69 (load-and-go). The records are written in odd (binary) parity.

$^{7}_{9}$FILE END

SCOPE writes an end-of-file mark and then backspaces over it when the FILE END statement is encountered. Any number of FILE - FILE END sequences may be directed to the same or a different logical unit. Any type of binary data may be transferred with a FILE statement except the SCOPE control statements: SEQUENCE, JOB, END REEL, END SCOPE. An attempt to transfer any of these statements will terminate the job.

In the sample deck shown for compiling and executing a FORTRAN program, JOB, FTN, LOAD, and RUN are SCOPE control statements. The FORTRAN program is composed of the statements PROGRAM through END. The SCOPE statement indicates the end of the deck to be compiled.



2.4 EQUIP STATEMENT

Normally, the EQUIP statement precedes the RUN card of the program or the entry point name statement. However, it may be entered on Input Comment Unit by the operator during a run. EQUIP statements are required to declare programmer or scratch units which are not unique, standard-density, labeled, magnetic tapes.

$7/9$EQUIP,u=d_1,d_2,d_3, . . . ,d_n

u logical unit number; 1-59,69,71-79 for INP;
1-65,69-79 for ICM

d declaration

There are six types of EQUIP declarations:

hardware	release
usage	equivalence
density	labels

The length of time that the EQUIP declaration remains in force depends upon the logical unit category. Declarations pertaining to scratch units are in effect for a single execution only. Programmer unit declarations carry over between executions of a job, unless changed by other EQUIP statements. System unit declarations remain until all jobs have been processed, unless specifically redefined.

Declarations may be combined in one EQUIP statement; however, there is no error checking. If they conflict, the last declaration in the list takes precedence.

HARDWARE DECLARATIONS

$^{7}_{9}$EQUIP,u=hhn

hh specifies the hardware type:

CR	card reader
PT	paper tape station
CP	card punch
DF	disk file
LP	on-line printer
DR	drum
TY	typewriter
TV	display
PL	plotter
MT	magnetic tape

n is the AET ordinal of the hardware type, (Appendix A). If n is absent, the next unassigned physical unit of the hardware type is assumed to be referenced.

When hh specifies a Satellite, SA, SB, SC, SD, SE, or SF, n is the octal ordinal for the unit connected to the specified Satellite. It must be specified.

After an EQUIP statement is processed, SCOPE types a message indicating which physical unit has been assigned. (Appendix C).

Examples:

$^{7}_{9}$EQUIP,10=CR

The first available card reader is assigned to unit 10.

$^{7}_{9}$EQUIP,12=CR2

Logical unit 12 will be the second card reader in the Available Equipment Table.

$^{7}_{9}$JOB,3215079,PETE,15

$^{7}_{9}$EQUIP, 10=CR2

$^{7}_{9}$EQUIP, 9=CP1

object program

$^{7}_{9}$RUN,7,300,7,1

<end-of-file>

$^{7}_{9}$EQUIP, 11=CR3

object program

$^{7}_{9}$RUN, 6,250

<end-of-file>

Logical unit 10 is the second card reader, logical unit 9 is the first card punch, and logical unit 11 is the third card reader in the AET.

USAGE DECLARATIONS

$^{7}_{9}$EQUIP,u=hh

hh		
	RW	read/write; all operations are allowed.
	BY	bypass; all references to this unit except MODE (usage) and STATUS are treated as no operation.
	RO	read only; output operations are rejected.
		Read-only units such as card readers need not be declared as such.

Usage declarations may be made for logical units 1-59, 65, 71-79.

$^{7}_{9}$EQUIP,11=RO Unit 11 is a read-only unit.

DENSITY DECLARATIONS

$^{7}_{9}$EQUIP,u=hh

hh		
	LO	low density magnetic tape (200bpi)
	HI	high density magnetic tape (556bpi)
	HY	hyper density magnetic tape (800bpi)

Density declarations are allowed for any acceptable logical unit not yet referenced.

$^{7}_{9}$EQUIP,12=HY

Density declarations may be followed by a magnetic tape ordinal, n.

$^{7}_{9}$EQUIP,5=HI05 processed as if the statement were:

$^{7}_{9}$EQUIP,5=MT05,HI

RELEASE DECLARATIONS

$^{7}_{9}$EQUIP,u=hh

hh SV — save tape at end of job. SCOPE unloads tape at end of job and directs a message to the operator. SCOPE writes blank labels on all tapes not saved and they become available for reuse. Only logical units 1-49, 69-79 may be saved.

PR — print

PU — punch

PP — print BCD records and punch binary records.

More than one release declaration may appear in an EQUIP statement, but only the last will be effective. SV, PR is the same as PR, SV. PU, PR is not the same as PP; only PR would be effective.

EQUIP STATEMENTS MAY ORIGINATE FROM:		LOGICAL UNITS	THESE EQUIP DECLARATIONS ARE LIMITED TO THE CHECKED UNITS					
			USAGE EQUIP, u = RW / BY / RO	LABEL EQUIP, u = ( )	RELEASE		EQUIVALENCE EQUIP, u=u'	
INP (60)	ICM (63)				EQUIP, u = SV	EQUIP, u = PR,PU,PP	u	u'
YES	YES	1-49	YES	YES	YES	YES	YES	YES
YES	YES	50-59	YES				YES	YES
	YES	60,63						YES
	YES	61,62,64						YES
	YES	65	YES					
		66-68						
YES	YES	69		YES	YES	YES		YES
	YES	70			YES			
YES	YES	71-79	YES	YES	YES		YES	YES
		80						
DECLARATIONS CONCERNING HARDWARE TYPE AND DENSITY MAY BE MADE FOR ANY ACCEPTABLE UNIT.				ANY ACCEPTABLE UNIT MAY BE DECLARED TO BE UNLABELED EQUIP, u=**			EQUIVALENCING OF SYSTEM UNITS IS LIMITED TO: 62=61, 65=61, 65=62	

Satellite mode:

PR,PU,PP cause the tape to be turned over to the Satellite for printing and/or punching. Unless SV is given, the tape is labeled with blanks and returned to the system. When SV is given, the tape is unloaded after being processed by the Satellite.

Non-Satellite mode:

PR,PU,PP cause the tape to be unloaded and an appropriate message typed to the operator.

$^{7}_{9}$EQUIP,2=SV,PR

In Satellite mode, logical unit 2 is printed by the Satellite, and unloaded.

In non-Satellite mode, a PRINT message is given to the operator on OCM and logical unit 2 is unloaded.

EQUIVALENCE DECLARATIONS

Master Logical Unit

$^{7}_{9}$EQUIP,u=u'

u' unit is made equivalent to u.

Unit u must be unassigned when the declaration is made, unless it is a system unit. Units 1-59, 71-79 (u) may be equated to units 1-64, 69, 71-79 (u'). System unit equivalencing is restricted to the following:

62 = 61

65 = 61

65 = 62

Two logical units are equivalent if they refer to the same physical unit. Any number of units may be equated to each other, but separate EQUIP statements must be used for each pair. Only one u' may be equated to one u per EQUIP card. The master logical unit is the last unit in the string of equivalences.

Examples:

$^{7}_{9}$EQUIP,30=61 Unit 30 is equated to standard output unit (61).

$^{7}_{9}$EQUIP,31=32	Unit 31 and 32 are the same physical unit
$^{7}_{9}$EQUIP,2=6 $^{7}_{9}$EQUIP,3=2	Unit 6 is the master logical unit

TAPE LABELS

The label provided by SCOPE or defined by an equipment declaration is written as the first record on a tape.

Word	BCD Parameters
1	nn-eerr,
2	
3	name
4	
5	
6	,iiiiii,
7	mm/dd/yy

nn	a logical unit number; or blank, if name is non-blank.
ee	an edition number 1 to 99 or blank.
rr	a reel number, 1 to 99.
name	32 alphanumeric characters. If blank, the unit number must be non-blank.
iiiiii	the programmer identification given on the JOB statement.
mm/dd/yy	the date the tape is written.

A standard label includes either a name or a logical unit number, but not both. (Library tapes are exceptions.) On the first write request, SCOPE writes the logical unit number nn as specified in the WRITE request, unless an EQUIP statement or LABEL request declares a different number or a label.

Declaration of edition and reel number is optional. Unless specified otherwise, SCOPE provides a blank edition number for output tapes and performs no check for input tapes. Unless the reel number is specified, SCOPE assumes that reel number 1 is the first reel and increments the number by one for each subsequent reel on the output tapes; for input tapes, the lowest numbered reel is read. Tape labels on library tapes are written in BCD mode. SCOPE supplies the identification and date for output tapes and ignores these fields on input tapes.

Example:

Write on logical unit 25 (high density magnetic tape) in binary mode, with standard labeling. Without an EQUIP statement or LABEL request, SCOPE searches for an available tape and writes a label containing:

logical unit number.	25
edition number	blank
reel number	1
name	blank
identification	from job card
date	entered by operator at beginning of SCOPE run

If a tape without a label is to be used, it must be declared as an unlabeled tape. If a name or a unit number different from that appearing in the request is to be read/written in a tape label, the name or number must be declared. All labels have either a name or a logical unit number in the label; library tape labels have both.

If the first request for a particular logical unit is a READ request and no label declaration has been given, SCOPE will search for a tape with the designated logical unit number in the label and read from it. If the correct label is not found, a message to the operator requests the tape. The operator may supply the tape or terminate the job.

If the first request is a WRITE request and no label declaration has been given, SCOPE will find a tape with a blank label, write the logical unit number in it, and execute the WRITE request.

UNLABELED TAPE DECLARATION

$^{7}_{9}$EQUIP,u=**

** unlabeled or non-standard labeled tape.

Any acceptable logical tape unit may be declared unlabeled. For unlabeled tapes, the operator makes a hardware declaration for the unit from information supplied by the programmer.

READ The programmer must inform the operator which physical reel should be mounted on which logical unit. The operator must give an EQUIP,u=hhn defining the specific physical tape unit on which the reel is mounted.

WRITE The operator must designate with EQUIP,u=hhn an unassigned tape unit with a blank reel of tape.

When unlabeled tapes are used, the first read command will read the first record on the tape. When tapes are labeled, the first read command reads the second record on the tape.

$^{7}_{9}$EQUIP,20=**,HI,SV

This statement makes it possible to read or write on an unlabeled, high density tape (556 bpi), unit 20. The SV (save) declaration causes SCOPE to unload the tape at the end of the job.

LABELED TAPE DECLARATIONS

$^{7}_{9}$EQUIP,u=(name,edition,reel)

Logical units 1-49, 69, 71-79 may be labeled.

Name may contain up to 32 alphanumeric characters, it may not be blank. Name begins with the first character after the left parenthesis and ends with the comma or right parenthesis.

Edition and reel number (1 to 99) are optional; but they should be used if two or more labels have the same name. If no reel number is specified, the lowest reel number is taken for input, output reel number is 1.

Examples:

$^{7}_{9}$EQUIP,25=(INVENTORY,1,1),LO,RO,SV

Logical unit 25 contains a tape labeled INVENTORY, edition 1, reel 1. It is a low density, read-only unit, which is to be unloaded at the end of the job.

$^{7}_{9}$EQUIP,10=(RUSSIAN-ENGLISH LEXICON, ,1)

Label a tape (logical unit 10) with RUSSIAN-ENGLISH LEXICON reel 1, the first operation on this tape must be a write.

LOGICAL UNIT NUMBER DECLARATIONS

$^{7}_{9}$EQUIP,u=(*nn,edition,reel)

Logical units 1-49, 69, 71-79 may be labeled.

nn is the 2-digit logical unit number contained in the logical unit field of the tape label (this is not the tape name) or to be written in the label. nn may be 1-79. If no tape with nn in its label is found when the first request for unit u is a READ request, SCOPE will ask the operator to supply the tape or terminate the job. If the first request for unit u is a WRITE request, the number nn will be written in the label.

Only u may be used in a request for that unit. If the programmer wishes to use a request with nn, he must first give EQUIP, u=nn.

```
7
9EQUIP,28=(*35,1,1)
```

The tape on logical unit 28 contains a 35 as the logical unit number in the tape label, although it is referenced as unit 28 in the program.

When writing, this statement may be used to label a tape referenced as unit 28 with the logical unit number 35.

EQUIP statements precede the program in which the logical unit is referenced. In the following example, FILE A, edition number 1, is the name of unit 20. CHANGE FILE is the name of unit 21. Unit 22 has the same name as unit 20, but it is the second edition. All units are to be saved.

```
7
9JOB,20,BETA 15

7
9EQUIP,10=CR

7
9EQUIP,11=CP

7
9EQUIP,20=(FILE A,1),SV,RO,LO

7
9EQUIP,21=(CHANGE FILE),RO,SV,LO

7
9EQUIP,22=(FILE A,2),SV,LO

7
9LOAD,49

7
9RUN,13,3000
```

Logical units 5 and 20 are high density (556 bpi) and to be saved. COSY input to the COMPASS assembly is on logical unit 5. COSY output is to be on logical unit 20.

```
7
9JOB 30,QWERTY,30

7
9EQUIP,5=(COSY TAPE,1,1),SV,HI

7
9EQUIP,20=(COSY TAPE,21,1),SV,HI
```

```
7
9COMPASS,Y=5,C=20,L,X
    IDENT
      .
      .
      .
    SCOPE
7
9EQUIP,25=(*40)
7
9EQUIP,26=**,HY
7
9LOAD
7
9RUN,28,1000
```

Logical unit 25 contains a tape with a label bearing the logical unit number 40; input/output requests within the program which reference 25 will reference this tape. (If 40 were referenced, a new unit would be assigned; both labels would contain the unit number 40.)

The hyper density (800 bpi) tape on unit 26 has a non-standard label. The physical unit must be specified by the operator via ICM.

2.5 LOADING, EXECUTING LIBRARY PROGRAMS

Library programs* are referenced by statements which name the entry point to a library program (FTN, COMPASS, ALGO, ALDAP, COBOL). The execution of this statement directs the referenced program to be loaded. Control is then given to the program and the necessary operation is performed. Upon return of control to SCOPE, the A register indicates whether errors were (non-zero) or were not (zero) detected during compilation or assembly.

7/9entry point name $p_1,p_2, \ldots ,p_m$

p_i are parameters interpreted by the library program.

Assembly options are indicated by free-field parameters separated by commas. Parameters may appear in any order. The parameters may be followed by =n, indicating a non-standard unit is to be used.

COMPASS

7/9COMPASS,assembly options

*Library programs should not be confused with SCOPE library subroutines which are called by symbolic reference in a subprogram.

Options	Meaning
I	BCD source language input
Y	COSY input
P	Punch relocatable binary object program deck
C	COSY output
X	Write relocatable binary object program output for a load-and-go option
L	List source language subprogram
B	Punch source subprograms from a COSY deck
R	Cross referenced symbol table listing

Specific information concerning the COMPASS card is in the 3600 COMPASS Reference Manual.

Examples:

$^{7}_{9}$COMPASS,P,X,L

Source input is on logical unit 60.

Binary deck is punched on logical unit 62.

Load-and-go tape is produced on logical unit 69.

Source language programs are listed on logical unit 61.

$^{7}_{9}$COMPASS,L=25,P=10

Source input is on logical unit 60.

Source language programs are listed on logical unit 61.

Binary output is punched on logical unit 10.

$^{7}_{9}$COMPASS,Y=1,L,C=2

BCD input is on logical unit 60.

COSY input is read from logical unit 1.

Source language programs are listed on logical unit 61.

COSY output is on logical unit 2.

FORTRAN

$^{7}_{9}$FTN,options

A terminal period is optional; the field may also be terminated by the end of the card.

Options	Meaning
L	List source language program
P	Punch relocatable binary deck
X	Write load-and-go tape
A	List assembly language program, COMPASS
I	BCD source language input
C	Punch a COSY output deck
B	BCD assembly output
*	Compile code for one bank

Specific information concerning the FTN card is in the 3600 FORTRAN Reference Manual.

Examples:

$^{7}_{9}$FTN,I=49,L,A

Source input is on logical unit 49.

Source and compiled program are listed on unit 61.

$^{7}_{9}$FTN,A,L,X

Source input is on logical unit 60.

Source and compiled program are listed on unit 61.

Binary object program is written on unit 69.

COBOL

$^{7}_{9}$COBOL,options

The parameter list may be terminated by a blank or a period.

Options	Meaning
Z	Suppress source program listing
X	Write object program on load-and-go
M	Print a data map
P	Punch relocatable binary object program
T	List trivial errors
L	List the object program
N	Number source code lines on source listing
S	Compile data division only

Specific information concerning the COBOL card is in the 3600 COBOL Reference Manual.

Examples:

$^{7}_{9}$COBOL,Z,X

suppress the source program listing and write object program on standard load-and-go unit.

$^{7}_{9}$COBOL,X

print source program listing on OUT and write the object program on standard load-and-go unit.

$^{7}_{9}$COBOL

treated as $^{7}_{9}$COBOL,X.

ALGOL

ALGOL 60 programs may be compiled in two modes. ALGO mode compiles and executes immediately. ALDAP compiles; execution may occur immediately or later.

$^{7}_{9}$ALGO

$^{7}_{9}$ALDAP,options

Options	Meaning
L	List source program
A	List assembly language program, COMPASS

1-49,62	P	Punch relocatable binary object program
1-59,69	E or X	Prepare load-and-go tape
1-49,6.	B	Punch BCD COMPASS cards
1-59,61	O	Assign a unit as translator overflow tape
1-59,60	I	BCD source language input

Specific information concerning the ALGO and ALDAP cards is in the 3600 ALGOL Programming Systems Bulletin.

Examples:

$^{7}_{9}$ALGO

The source program following the ALGO card on the standard input unit is compiled and executed.

$^{7}_{9}$ALDAP,L,P,X

Source input is on logical unit 60.

Binary cards are punched on logical unit 62.

Source program is listed on logical unit 61.

Load-and-go tape is prepared on logical unit 69.

SOURCE DECK STRUCTURE

The entry point name statement is followed by the source program to be assembled or compiled by the library program.

A FTN card may be followed by either FORTRAN or COMPASS source language subprograms to be compiled or assembled.

A COMPASS card is followed by COMPASS subprograms to be assembled.

A COBOL card is followed by a COBOL source program to be compiled.

An ALDAP card may be followed by an ALGOL source procedure to be compiled or compiled and executed or a COMPASS subprogram to be assembled. An ALGO card is followed by an ALGOL source procedure to be compiled and executed or a COMPASS subprogram to be assembled.

If more than one library program (compilers or assemblers) is used for processing the subprograms for a single program, the source decks are stacked consecutively.

When there are consecutive calls to the same library program with no intermediate runs, the library program is not reloaded. This is true even if the calls occur in different jobs.

For each source language subprogram, a binary object program will be produced and stored on the logical unit designated by one of the parameters on the entry point name card. After each binary program is written on a logical unit, the library program writes an end-of-file mark and backspaces over it. Therefore, after all binary subprograms are written on the unit, only one end-of-file mark will remain; and the unit will be positioned so that any subsequent compilations for that unit will write over it. Consequently, at the end of the last compilation, an end-of-file mark remains on the unit.

A SCOPE card is required to indicate the end of the source subprograms following a FORTRAN or COMPASS card; also to indicate the end of the source procedures following an ALDAP card. An EOP card is required to indicate the end of the program following an ALGO card. COBOL does not require a SCOPE card. The word SCOPE begins in column 10; since it is not a SCOPE control card, there is no 7,9 punch in column 1.

Examples:

```
1         10
7
9COMPASS,C,L,R
         IDENT ANDROCLES
            :
            :                          COMPASS subprogram
         END
         IDENT BRENDA
            :
            :                          COMPASS subprogram
         END
         SCOPE
```

```
1      7  10
7
9FTN,A,L,P
      PROGRAM ONE
            :
            :                          FORTRAN program
      END
         IDENT TWO
            :
            :                          COMPASS subprogram
         END
      SUBROUTINE TWO
            :
            :                          FORTRAN subroutine
      END
         SCOPE
```

```
1         10
7
9ALDAP,L,P,A
PROGRAM ARCO
            :                          ALGOL program
          'EOP'
            :                          ALGOL procedure
          'EOP'
          SCOPE
```

```
1         8
7
9COBOL,M,L,,P,T
       IDENTIFICATION DIVISION.
                 :                     COBOL program
       END PROGRAM.
```

```
1         10
7
9ALDAP,L,P,A
          IDENT FOR
            :                          COMPASS subprogram
          END
            :                          ALGOL procedure
          'EOP'
            :                          ALGOL procedure
          'EOP'
          IDENT TAG
            :                          COMPASS subprogram
          END
          SCOPE
```

SCOPE PARAMETERS

The SCOPE parameters, s_1 and s_2, in the entry point name statement are used to modify or debug the library program (not the program being compiled or assembled).

$^{7}_{9}$entry point name $(s_1,s_2),p_1,p_2, \ldots ,p_m$

s_1, s_2 C Octal Correction Cards for the library program are submitted on INP. The corrections apply only to the subprogram containing the specified entry point. The Octal Correction Cards are terminated by a single TRA card. The OCC and TRA card formats are given in 5.6.

If subprograms other than those with a main entry point are to be corrected, use the CORRECT Loader Control Card (5.5). Following the CORRECT card, are the OCC cards and 1 TRA card for each name on the CORRECT card.

D SNAP or TRACE statements for the library program are submitted on INP. The names on the SNAP and TRACE cards may be relative to any program name, entry point, or common block loaded during the loading of the specified entry point name (Chapter 4).

Note: The C and D designators may be interchanged, or either one may be absent.

Examples:

SNAP or TRACE statements only

7_9epname (D), p_1, p_2

TRACE and OCC

7_9epname (D,C), p_1, p_2

or

7_9epname (C,D), p_1, p_2

When the SCOPE parameters are used, the OCC and TRA cards follow the entry point statement. If both C and D are used, the Octal Correction Cards must precede SNAP and TRACE cards. A RUN statement (2.4) must be included to initiate execution. Source decks to be assembled or compiled follow the RUN statement.

Examples:

1	10
7_9COMPASS	(C),C,L,X
OCC	
OCC	See section 5.6
TRA	
7_9RUN,2,4000,5	
	COMPASS Subprograms
	SCOPE

```
1         10
7
9FTN (D),L,X
7
9SNAP,xxx
7
9SNAP,xxx
7
9TRACE,xxx
7
9RUN,5,1000,3
          FORTRAN Subprograms
          SCOPE
```

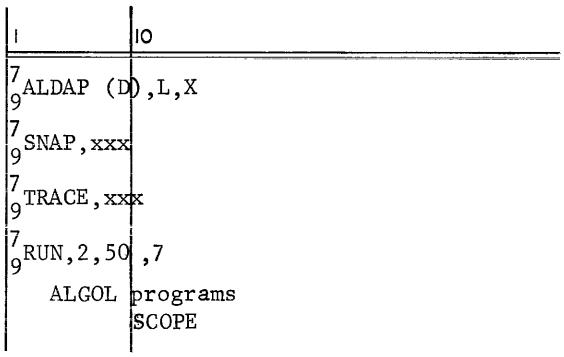
See chapter 4 for options

```
1         10
7
9COBOL (D,C), X,L
     OCC
     OCC
     TRA
7
9SNAP,xxx
7
9SNAP,xxx
7
9RUN,2,100,7
     COBOL program
```

```
1         10
7
9COMPASS (C,D),L,X
-
0
7CORRECT, COMPASSX, SIOPACK
9
      OCC's
      TRA
      OCC's
      TRA
7
9SNAP,xxx
7
9TRACE,xxx
7
9RUN,2,100,7
          IDENT
             .
             .
             .
```

corrections for COMPASSX

corrections for SIOPACK



2.6 AET STATEMENT

If conditions arise which alter the availability of the physical equipment, the Available Equipment Table (AET) entries in storage may be changed by the AET control statement. When changes are made by the AET statement, only the table in storage is altered; the original table recorded on LIB is not affected.

The operator or programmer may use the AET control statement to: (1) obtain a listing of the contents of the Available Equipment Table, (2) alter the status of a unit, and (3) establish or alter an entire table entry. In the following formats, e is the octal ordinal of the entry in the table.

To obtain a listing: $^{7}_{9}$AET, e, m

If e is blank, the entire table is referenced.

m is the unit on which the entry or table is to be written:

m = blank	the output comment unit
m = OUT	the listable output unit

To alter the status of a unit: $^{7}_{9}$AET, e, a

a is the availability of the unit:

a = DOWN	the unit is unavailable
a = UP	the unit is available

The operator uses DOWN to indicate the equipment is not operating. When the condition is corrected, the UP entry is made.

To alter an entire entry: $^{7}_{9}$AET, e, oooooooooooooooo

o's represent 16-octal digits which is the value replacing the previous value for entry e. See Appendix A for the format of the Available Equipment Table.

After changing a table entry, SCOPE writes the new entry on OCM (Appendix C).

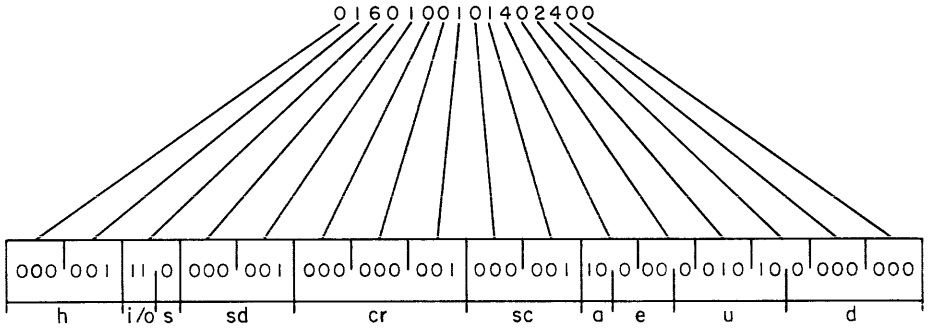
Examples:

$^{7}_{9}$AET, 5 The 5th entry of the table is printed on OCM.

$^{7}_{9}$AET, ,OUT SCOPE writes the entire table on OUT.

$^{7}_{9}$AET, 15, DOWN Operator notifies SCOPE that the 15th unit is down.

$^{7}_{9}$AET, 15, UP Unit represented in the 15th entry is again available.



h signifies magnetic tape

i/o indicates tape may be used for both input and output

s unit is accessible to SCOPE

sd identifies the driver ordinal for the unit

cr identifies the controller ordinal for the unit

sc Satellite control channel field

a unit is assigned to SCOPE

e Satellite equipment code field

u unit AET ordinal

d driver ordinal

to indicate that the unit is to be used for input only would require that i/o = 10 rather than 11. The statement:

```
7
9AET,12,0140100101402400
```

would make the necessary change in the AET.

2.7 END REEL STATEMENT

```
7
9END REEL
```

This statement terminates the current reel of the standard input unit and may appear between runs on the INP. It causes SCOPE to locate the next INP reel or, if a Satellite is defined, to accept the standard input unit from the Satellite. An end-of-tape also causes SCOPE to locate the next INP reel, and does not require the END REEL statement. It does not terminate a job; no job accounting occurs.

An end-of-file mark must precede an END REEL statement.

In Satellite mode, END REEL cards are recognized but not processed by the Satellite computer.

Examples:

```
7
9COMPASS,L,X
      .
      .
      .
   END
   SCOPE
--------------- physical end-of-tape mark
```

SCOPE will look for the next reel of the standard input unit and continue processing the COMPASS program.

```
7
9COMPASS,L,X
      .
      .
      .
   END
   SCOPE

<end-of-file>

7
9ENDREEL
```

SCOPE will look for the next reel of the standard input unit. If there are more COMPASS programs to be assembled in this job, the first control statement on the next reel of the standard input may be:

```
7
9COMPASS,X,L
```

2.8 LOADING OBJECT PROGRAMS

A description of the loader is in chapter 5. The LOADER request (3.4) allows the programmer additional control over loading operations.

STANDARD INPUT

A binary object program on the standard input unit is loaded into storage unless a preceding control statement specifies other processing. All binary program cards up to a SCOPE control statement or two transfer cards are loaded.

```
7
9JOB,1234-A,DDS,7
    binary object program
          .
          .
          .
```

OTHER UNITS

Relocatable binary subprograms can be loaded into storage from programmer and scratch units or the load-and-go unit by the LOAD statement.

```
7
9LOAD,u
```

u a logical unit number 1-49, or 69. When u is omitted, the standard load-and-go unit (69) is implied.

When the LOAD statement is encountered, SCOPE backspaces unit u one file and loads subprograms until an end-of-file, two transfer cards, or another control card is encountered. If the unit cannot be backspaced, SCOPE immediately loads the subprograms. SCOPE interprets a second transfer card as a loader terminator, but it is not required. If binary subprograms, transferred from the standard input unit and produced by compilation or assembly, are stored on the same logical unit during the job, only one end-of-file mark will be present and it will follow the last subprogram stored on the unit.

Binary subprograms may follow the LOAD statement if the loaded information was terminated by an end-of-file mark and not two consecutive transfer cards.

Examples:

```
7/9JOB,ACC77,AWS,12
7/9LOAD,36
7/9LOAD,37
      .
      .
      .
```

Binary subprograms are loaded from logical units 36 and 37. If there are two consecutive TRA cards, they must be the last records on unit 37.

```
7/9JOB,ACC77,ABC,5
7/9LOAD
    binary object subprogram
          .
          .
          .
```

2.9 EXECUTING OBJECT PROGRAMS

The RUN statement initiates program execution by transferring control to the object program in storage. This statement is required to execute all object programs. Library programs require a RUN statement only if SCOPE parameters are specified.

```
7/9RUN,t,p,r,m
```

t the execution time limit in minutes (maximum 2236 minutes). The entire job is terminated if the limit is exceeded. If t is blank, a constant time limit, determined by the installation, is supplied. If the run time limit is greater than the remaining job time limit, execution continues only until the job time is depleted. The run limit may not equal zero.

p the maximum number of print or write operations which may be requested on the standard output unit during the execution. This includes debugging dumps and any other output during execution. The entire job is terminated if the print limit is exceeded. If the print line limit is blank, a constant print limit, determined by each installation, is supplied. The print limit may not equal zero.

r the recovery indicator specifies an area to be dumped if the program does not proceed to normal completion. See Appendix D for recovery dump format.

r	dumped area, written on standard output unit
0 or blank	console
1	program and console
2	labeled common and console
3	program and labeled common and console
4	numbered common and console
5	program and numbered common and console
6	labeled and numbered common and console
7	console and all locations in all banks except those occupied by SCOPE

m the memory map indicator. If m is blank, storage allocations after loading will be listed on the standard output unit. No map is written if m is any other character. See Appendix C for format.

Example:

$^{7}_{9}$RUN,28,3000

Execution time limit is 28 minutes, and 3000 is the maximum number of print requests. The console dump, if the program is terminated, and the memory map are written on the standard output unit.

PROGRAM TERMINATION

The last executable statement in a program should return control to the operating system. This is accomplished through an EXIT request (3.4) or a jump to the named transfer. (An exit is accomplished by jumping to the transfer address specified by the entry point on an END card in a COMPASS subprogram.) Programs that terminate by returning control to the operating system, with no abnormal conditions existing, terminate normally. Programs terminated by any other method are terminated abnormally. Recovery dumps, if specified in the RUN statement, will be taken upon abnormal termination. The only way to get a dump on normal completion is to use SNAP or TRACE cards.

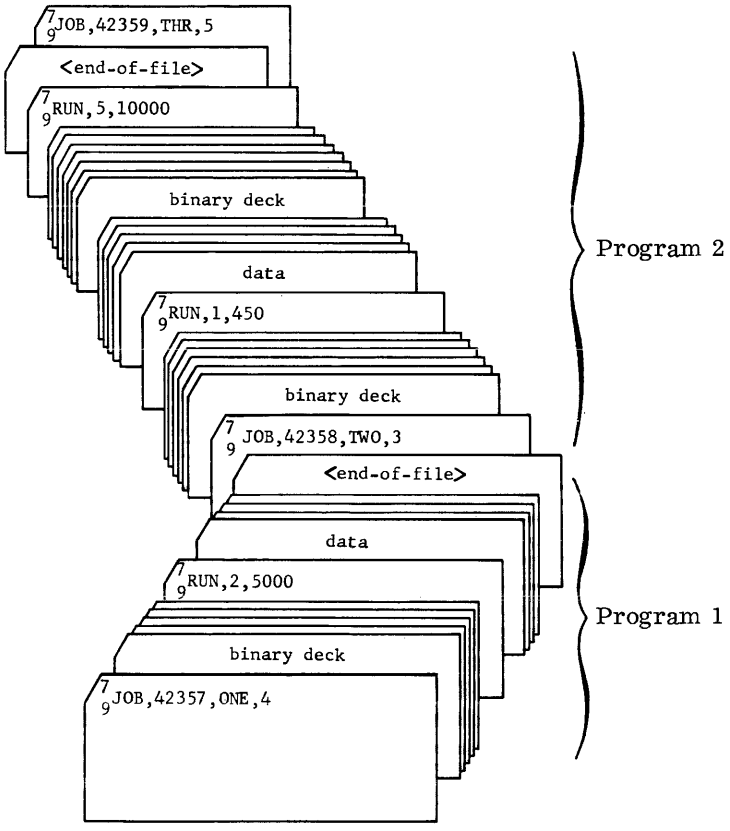
END-OF-FILE CARD

End-of-file indicators are required to separate jobs and are frequently used to separate runs within a single job. If a job or run is terminated abnormally, SCOPE skips to the next end-of-file on INP and reads the following statement.

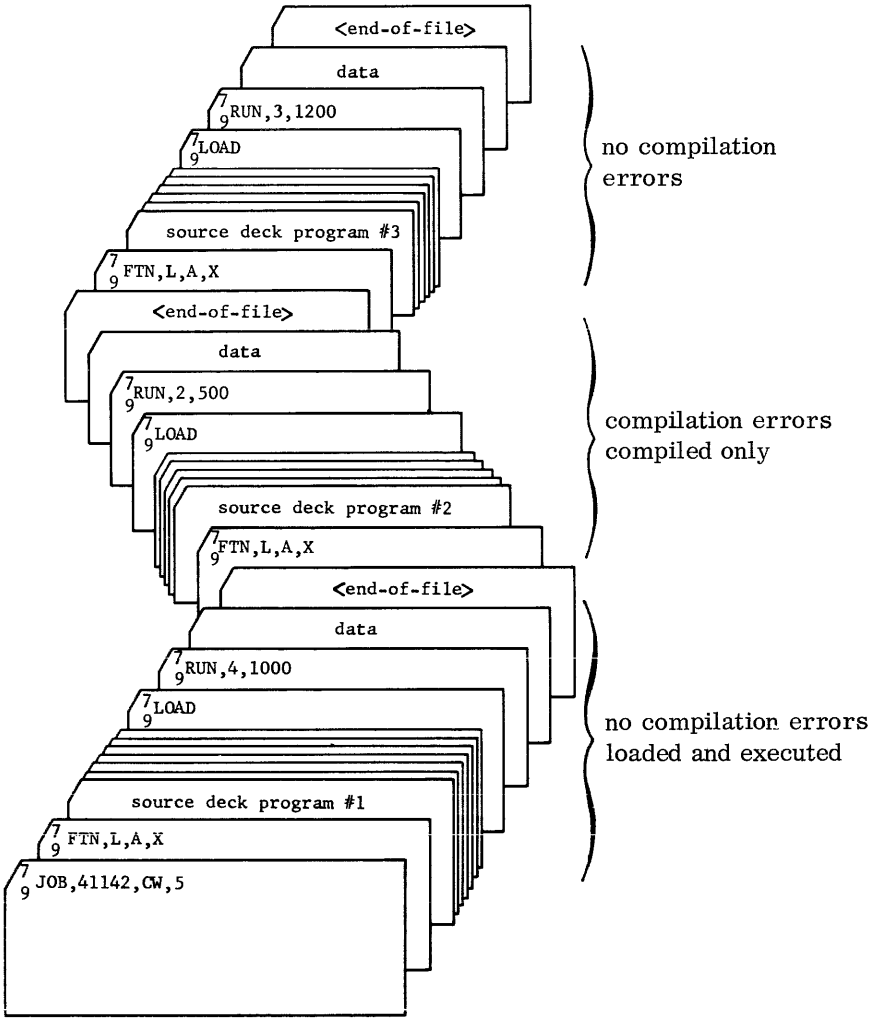
Runs should be separated by end-of-file indicators which must appear just prior to the time when control is returned to SCOPE from the running program. If program data follows the RUN card, the end-of-file comes after the data.

If fatal errors occur during assembly or compilation of a program, loading of the job is not attempted. Subsequent assemblies or compilations of programs in the job are processed, however, if the entry point name control statement is preceded by an end-of-file.

When a program is running under Satellite mode or using the on-line card reader, an end-of-file is produced by a card with a 7,8 punch in column 1. Other peripheral processing programs may require a different punch configuration to produce an end-of-file mark on tape.



If program 1 terminates abnormally, SCOPE skips to the beginning of the next job. If program 1 runs to completion, but all of the data is not processed, SCOPE attempts to read the next data card, prints a diagnostic and skips to the next job.



Since there are no errors in the first compilation, the object program is loaded and executed. Errors are encountered in the second compilation; after compilation is completed, SCOPE skips to the end-of-file mark and begins compiling the third program. After the third compilation, SCOPE skips to the next end-of-file mark. Had any of the runs terminated abnormally, SCOPE would have skipped to the beginning of the next job.

If subsequent compilations or assemblies are not to proceed when compiler errors occur, the runs should not be separated by end-of-file indicators.

2.10 ENDSCOPE STATEMENT

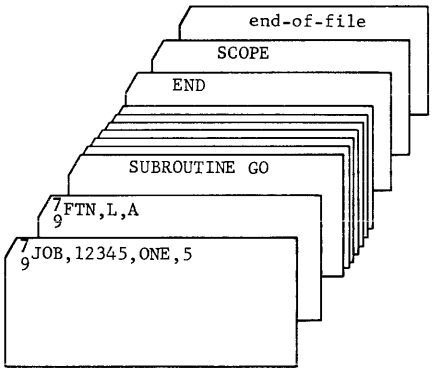
7/9ENDSCOPE

This statement signals SCOPE that the job stack is completed, and job accounting for the last job is recorded. ENDSCOPE appears on the standard input unit following the series of jobs to be processed. If INP consists of more than one reel, a physical end-of-tape causes SCOPE to transfer from a current reel to the next and ENDSCOPE appears on the last reel. The operator may enter this statement on the input comment unit to terminate processing prematurely.

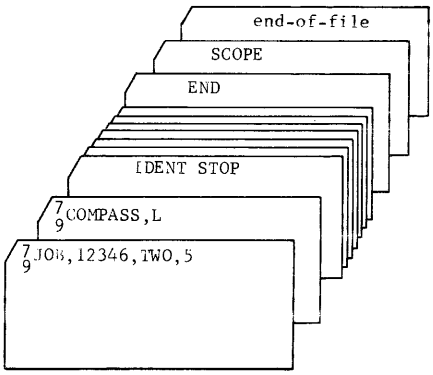
SCOPE releases INP, OUT, PUN, and ACC when ENDSCOPE is encountered. An end-of-file mark must precede an ENDSCOPE statement.

2.11 EXAMPLES OF DECK STRUCTURE

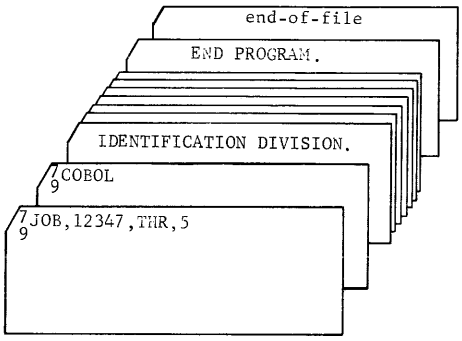
1) Compilation of a single FORTRAN subroutine.



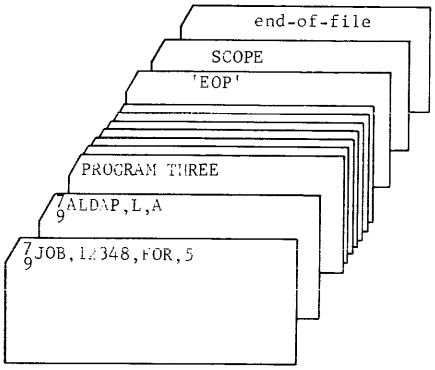
2) Compilation of a single COMPASS subroutine.



3) Compilation of a single COBOL program.

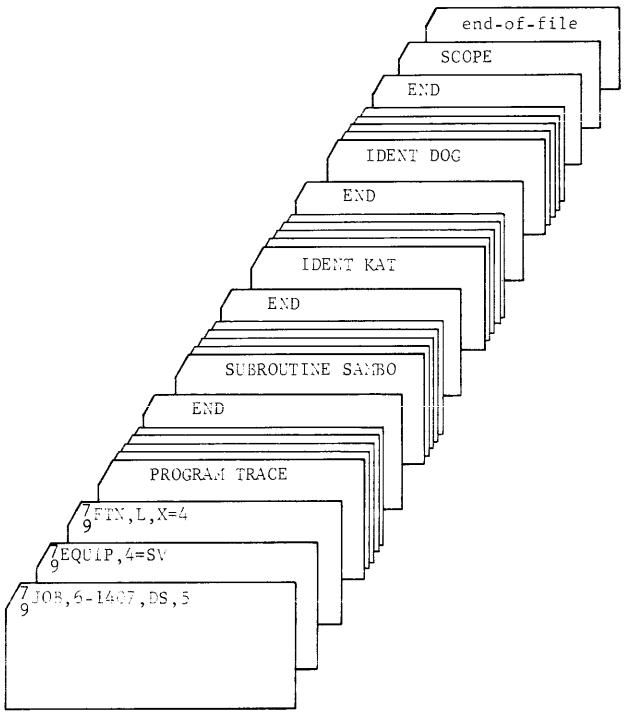


4) Compilation of a single ALGOL program.

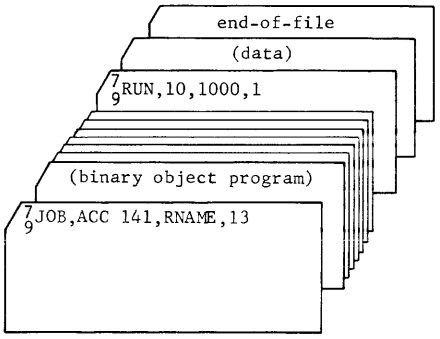


PROGRAM	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32	REMARKS
ALGOL	PROGRAM name	FIRST CARD OF SOURCE SUBPROGRAM(OPTIONAL)
	'EOP'	LAST CARD OF EACH SUBPROGRAM
	SCOPE	END OF COMPILE (ALDAP ONLY)
COBOL	IDENTIFICATION DIVISION.	FIRST CARD OF SOURCE PROGRAM
	END PROGRAM.	END OF PROGRAM AND COMPILE
COMPASS	IDENT name	FIRST CARD OF EACH SOURCE SUBPROGRAM
	END	LAST CARD OF EACH SOURCE SUBPROGRAM
	SCOPE	END OF ASSEMBLY
FORTRAN	PROGRAM name	FIRST CARD OF EACH SOURCE SUBPROGRAM
	SUBROUTINE name	
	FUNCTION name	
	END	LAST CARD OF EACH SOURCE SUBPROGRAM
	SCOPE	END OF COMPILE

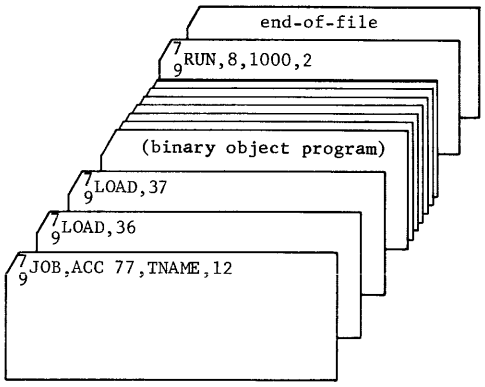
5) Compilation of a FORTRAN Program and several subprograms together with a COMPASS assembly. All binary object programs are placed on unit 4, which is saved.



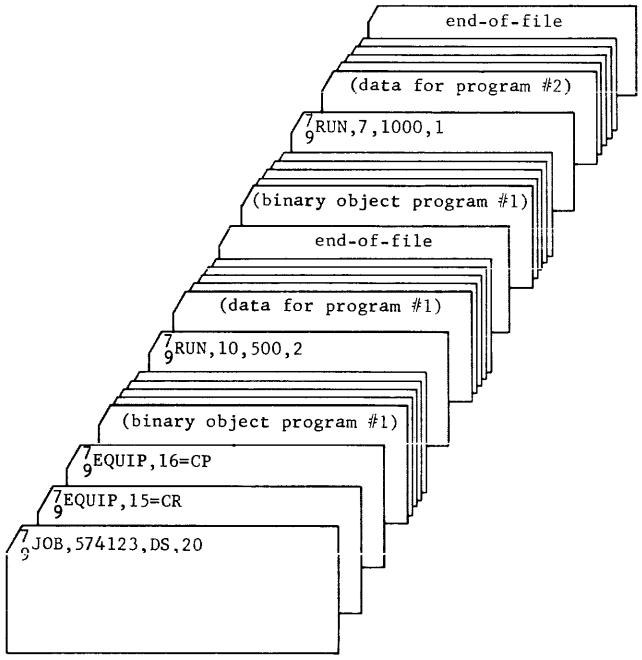
6) Execute directly from the standard input unit.



7) Load from two programmer units and INP.

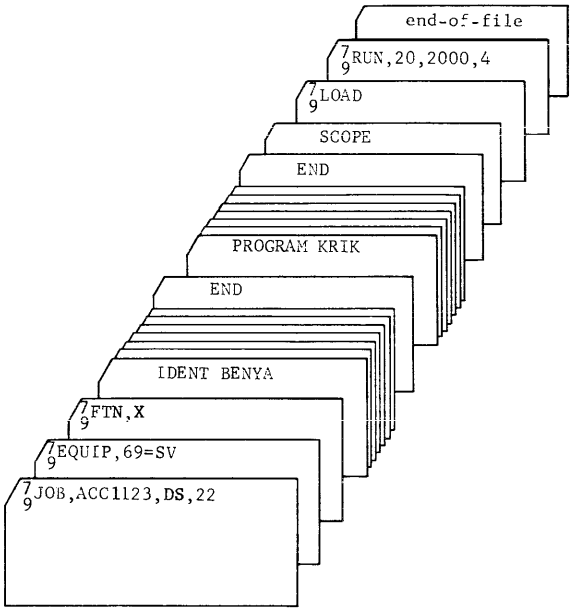


8) Sequential execution using EQUIP cards

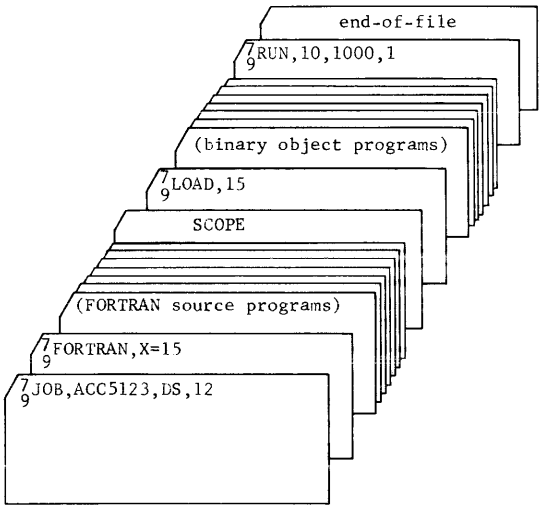


Changes made because of EQUIP statements remain in effect for the duration of the job or until changed by another EQUIP statement.

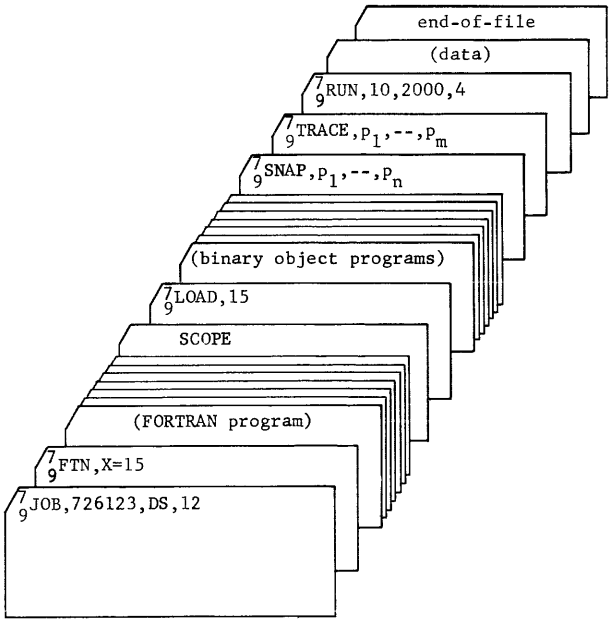
9) Assemble a COMPASS subprogram and FORTRAN subprogram on the load-and-go unit. Execute the program. Save the load-and-go tape.



10) Compile and load a FORTRAN program. Load a binary subprogram from INP. Execute.

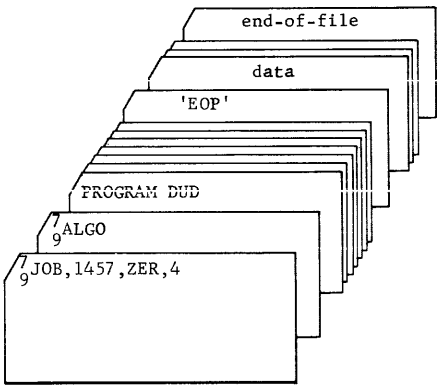


11) Include debugging aids.

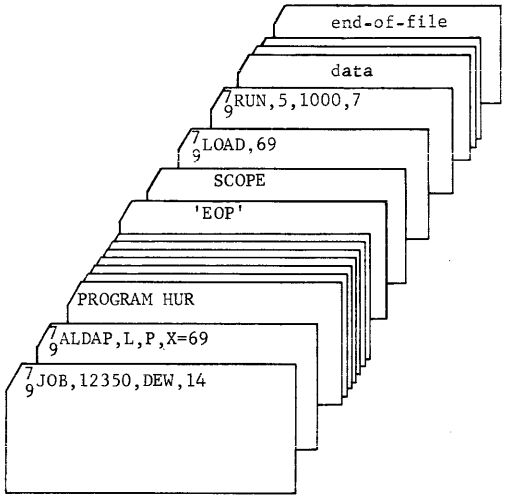


SNAP and TRACE cards precede the RUN card. (Refer to Chapter 4). The number of print requests includes SNAP or TRACE dumps.

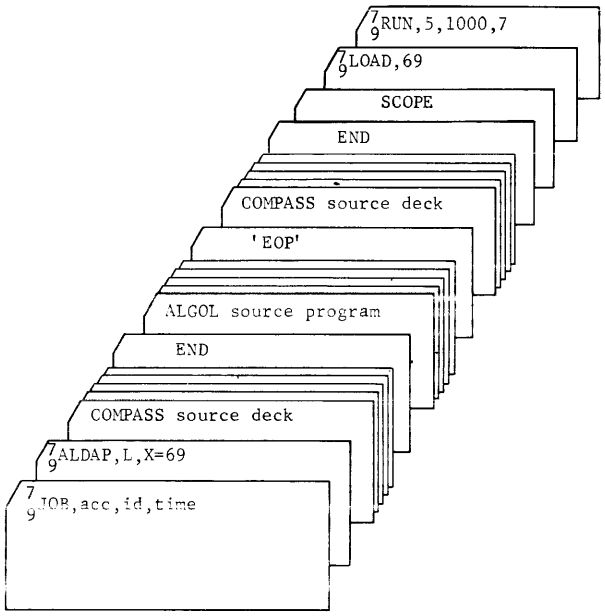
12) Compile and execute ALGOL program.



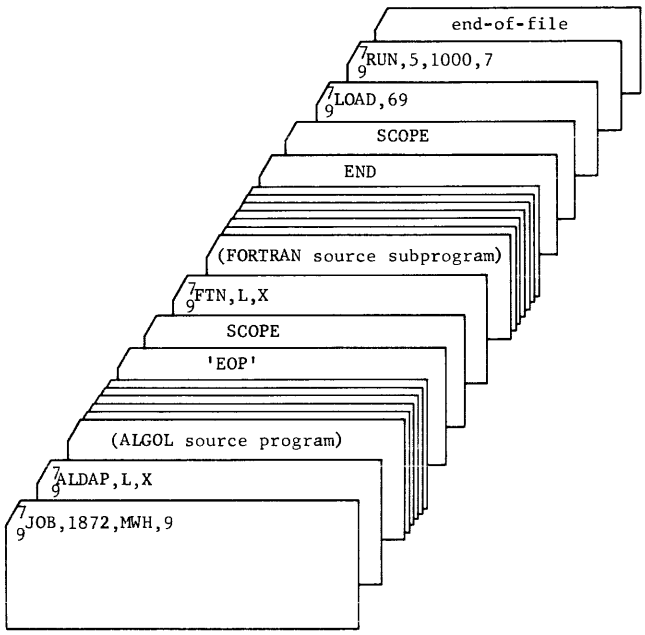
13) Compile and execute ALGOL program.



14) COMPASS subprograms in the form of subroutines may be assembled with an ALDAP compilation containing external declarations for the COMPASS subprograms. Neither a COMPASS nor FORTRAN subroutine may have a transfer card, since the ALGOL program always has a transfer card.



15) ALGOL programs may be compiled before or after FORTRAN programs for the same job. The basic operations for ALDAP, compile only, execute only and load-and-go are similar in format to those of other systems. A transfer address is generated by the ALDAP compiler and may not be provided by the programmer.



PROGRAMMER REQUESTS 3

Programmer requests are statements which can be included only in assembly language (COMPASS) programs. They specify operations for input/output control, internal interrupt, clock interrupt, and special requests. They may be written as system macros or in any fashion which generates a calling sequence to SCOPE as outlined in Appendix B.

3.1 INPUT/OUTPUT REQUESTS

SCOPE processes all input/output requests, including read/write, equipment status checks, and tape handling, and performs the following operations:

- Assigns logical unit numbers to physical units
- Selects an available channel
- Stacks a request if a channel is not available
- Responds to external interrupts
- Initiates input/output operations
- Locates a continuation tape when needed to complete an input/output operation or initiates one when end-of-tape is reached.

Parameters used in describing the requests are:

u — a logical unit number, 1-79, or a mnemonic for a system or scratch unit. (For mnemonics see 1.5).

cwa — the address of the I/O control word, or the first I/O control word in a chain. (See the 3600 REFERENCE MANUAL for control word format.)

ra — the reject address to which control is transferred if the unit is unavailable. A reject address must always be specified. If an asterisk, *, is given as the reject address, the request is repeated until the unit becomes available.

ia — the address of the programmer's interrupt subroutine to which control transfers when an interrupt condition is sensed; this term may be omitted. If an abnormal condition occurs, the tape is stopped at the end of the record.

The logical unit number and the program addresses may be modified by the contents of an index register. The base operand (m) and the index register

designator (b) are separated by a comma, and enclosed within parentheses (m,b). b may designate index registers, 1-6, or may specify indirect addressing, 7.

All addresses (control word, reject, interrupt) must be located within the same bank as the subprogram containing the READ/WRITE request. Any address may be defined as an external symbol; but the subprogram containing the associated entry point must be in the same bank (see BANK control statement).

Neither the reject nor control word address may be 0 or 77777_8; the interrupt address may not be 77777_8. If these addresses are used, the program will be terminated when they are detected by SCOPE.

BSPR over an end-of-file or read beyond end-of-file on logical unit 60 is illegal.

Input/output requests which SCOPE cannot handle will be rejected or the job will be terminated. The conditions causing job termination are listed with the diagnostic (Appendix C).

The conditions causing request rejection are:

Unit unavailable

Request must be stacked, but stack already contains 25 requests

Output requested on unit defined as read-only by EQUIP or MODE

Request for an impossible operation (i.e., READ printer)

READ/WRITE

READ } (u, cwa, ra, ia)
WRITE }

The programmer may direct the reading and writing of data with a READ/WRITE request. If a multi-reel operation has been indicated, the READ/WRITE request will initiate the search for the new reel and the release of the old reel.

The direction of read may be designated by a parameter in the MODE request.

Examples:

READ (IMP, CONTROLA, SAM, INTRPT)

Data is to be read from the standard input unit; the control word is at CONTROLA. If the request is rejected, control is to be transferred

The following table indicates the various units on which the requests are acceptable.

	Programmer Units 1-49	Scratch Units 50-59	Systems Units 60-80					
			INP 60 ICM 63	OUT 61 PUN 62 OCM 64 ACC 65	LGO 69	LIB 70	Auxiliary Library 71-79	Satellite 66-68 SCR 80
READ	X	X	X		X	X	X	
WRITE	X	X		X	X		X	
REOT	X	X			X		X	
WEOT	X	X			X		X	
BSPF	X	X					X	
BSPR	X	X	X	X	X	X	X	
REWIND	X	X				X	X	
SKIP	X	X	X				X	
ERASE	X	X	X	X	X	X	X	
MARKEF	X	X		X	X		X	
UNLOAD	X						X	
RELEASE	X	X			X		X	
MODE	X	X	X	X	X	X	X	
STATUS	X	X					X	
LABEL	X						X	
SAVE	X				X	X	X	

to SAM. When the read operation is completed (or an abnormal condition occurs), control transfers to the interrupt subroutine at location INTRPT.

WRITE (OUT, CONTROLB, *, INTRPTB)

A write operation is to be performed on the standard output unit. The control word is at CONTROLB, and the write request will be executed when OUT becomes available. When interrupt occurs, control transfers to INTRPTB.

REOT/WEOT

REOT }
WEOT } (u, cwa, ra, ia)

REOT and WEOT are tape movement controls which allow the programmer to read and write after the physical end-of-tape, before a continuation reel is assigned. If the request occurs before a physical end-of-tape, the reading or writing occurs and a logical end-of-tape condition is set. At the next READ or WRITE request, a continuation reel is established.

If a REOT or WEOT request falls between a LABEL and any other request, the job is terminated.

Example:

REOT (25, RDCWA, *)

Logical unit 25 is read. After reading is completed, a logical end-of-tape condition is set. Upon the next READ request for unit 25, a continuation reel will be assigned.

TAPE CONTROL REQUESTS

control name (u, ra, ia)

u is the logical unit number or a mnemonic. The reject address must always be specified; * indicates that the request is repeated until the unit becomes available. The interrupt address may be omitted.

Requests may be stacked.

Control names applicable to magnetic tape units are listed below:

BSPF	Backspace one file.
BSPR	Backspace one record

BSPR and BSPF clear a logical end-of-tape condition. The physical end-of-tape may remain set if the unit is not backspaced beyond the end-of-tape mark. BSPR at loadpoint causes the tape to be unloaded.

REWIND	Rewind to load point. REWIND moves the currently assigned physical unit to the load point.
SKIP	Skip to end-of-file or end-of-tape.
ERASE	Erase 6 inches of tape.
MARKEF	Mark end-of-file.

Examples:

```
REWIND  (20, RETURN, INT)

MARKEF  (S2, REJECT1, INT2)
```

UNLOAD

An UNLOAD request may be used to rewind and unload a physical unit (applicable to magnetic tape only).

```
UNLOAD  (u, ra, ia, c)
```

If the logical unit represents a multi-reel assignment, only the physical unit presently assigned will be affected by the UNLOAD request. A reject address must always be specified. * indicates that the request is to be repeated until the unit becomes available. The interrupt address may be omitted.

The release code, c, specifies the disposition of the physical unit after it has been unloaded:

0	unit is to be released
non-zero	unit is not to be released

RELEASE

This request releases the assignment of a logical unit and directs the disposition of the current physical unit.

```
RELEASE  (u, ra, c)
```

A reject address must always be specified. * indicates that the request is to be repeated until the unit becomes available.

The release code, c, specifies the disposition of the physical unit currently assigned to the logical unit:

0	dispose of physical unit according to previous directions.
non-zero	rewind the physical unit and release the assignment, but do not dispose of the tape.

MODE

A MODE request defines the usage of a tape unit or specifies density or recording mode for the unit. A MODE request can be honored only if the unit is available; if it is unavailable, control returns to the reject address.

MODE (u, ra, s, f, d, dr)

The reject address is the location to which control is transferred if the unit is unavailable or if invalid designators are specified. A logical unit designator and a reject address must always be present.

Usage, s, specifies an operating condition for the unit:

RW	(read and write) all legal requests will be performed.
BY	(bypass) all requests except STATUS will be treated as no operation until the end of the job or until another usage is specified.
RO	(read only) WRITE, WEOT, MARKEF, or ERASE requests will be rejected.

Format, f, is specified by BCD for even tape parity or BIN for odd tape parity.

Density, d, is specified:

HY	hyper density tape (800 bpi) or highest possible density
HI	high density tape (556 bpi)
LO	low density tape (200 bpi)

Direction, dr, of tape; if no direction is specified, normal is assumed.

RV	any READ or BSPR request for the unit is to be done in reverse mode of operation. Data is stored according to the control word address with no alteration.
ND	any READ or BSPR request for the unit is to be done in the normal direction.

MODE declarations are mutually exclusive; if more than one designator for usage, format, density, or direction is indicated in a single MODE request, the job is terminated; one of each may appear in a single MODE statement; all four are not required. Specifying density with the MODE request actually establishes the operating density for the unit.

Examples:

MODE (24, INSTR, RW, BIN, HY)

Logical unit 24 will perform all legal requests, with odd tape parity and hyper density. Reject address is INSTR.

MODE (25, REJECT, BY)

All requests except STATUS are treated as no operation.

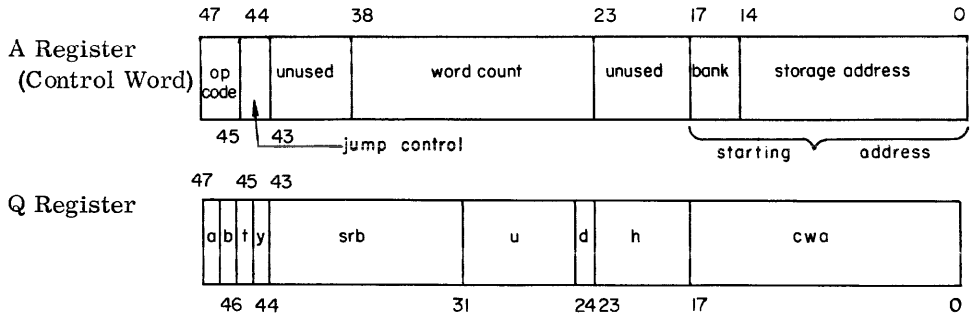
STATUS

The programmer may request the status of a logical unit at any time during operation.

STATUS (u, M)

M designates that the status of the master unit is required (see Equivalence Declarations Sec. 2.2)

The reply to the STATUS request is entered in the A and Q registers as follows: (The same information is contained in A and Q upon entering user's interrupt subroutines for input/output operations.)



a is the physical unit availability indicator
0, unit may accept request
1, unit in operation, or request is stacked

b is the physical unit busy indicator
0, not busy
1, busy

t is the magnetic tape indicator
0, unit is magnetic tape
1, unit is not magnetic tape

y is the bypass indicator
0, unit is not bypassed
1, unit is bypassed

srb are the status reply bits given at the last reference to the unit; srb depend upon hardware type.

u is a logical unit number assigned to this physical unit, or the number of the logical unit specified in the last I/O request for this physical unit.

Since a physical unit may be referenced alternately by several logical units, the logical unit appearing in the reply may not be identical to the one given in the STATUS request. If the physical unit is available, u will be the logical unit number of the request; if not, u is one of the equivalent logical units.

If master status is requested, u will contain the master logical unit number.

d and h depend on the value of t

if t = 0, d and h give reel number (1-99) of the magnetic tape

if t = 1, d is the driver indicator

d = 0, no driver for unit

d = 1, driver required for unit; h is the hardware type of physical unit.

cwa is the current or last content of the control word address register of the data channel governing the unit (displayed in A register). If the request is given during processing, the control word is taken from the communication module. It reflects the latest word count and storage address.

The ab indicators, when combined, have the following meaning:

ab = 00 unit may accept request

ab = 01 unit is available, but interrupt for previous I/O request has not been processed

ab = 10 an I/O request is stacked

ab = 11 unit is in operation

STATUS REPLY BITS

status reply bits (octal)	362X Magnetic Tape Controller	3655 Printer Controller	3659 Printer Controller	3641 Card Reader Controller	3649 Card Reader Controller	3644 Punch Controller	3682 Satellite Coupler	731 Console Typewriter
xxx1	ready	ready	ready	ready	ready	ready	flag 0	ready
xxx2	read/write control (and/or) busy		busy	busy	busy	busy	flag 1	busy
xxx4	write enable			binary card	binary card		flag 2	upper/lower case
xx1x	end-of-file		paper out	end-of-file	end-of-file card		flag 3	
xx2x	load point		last line on form	feed failure	stacker full or jam, or fail to feed		flag 4	
xx4x	end-of-tape**			stacker full	hopper empty		flag 5	end-of-line
x0xx	200 bpi density							
x1xx	556 bpi density			hopper empty	end-of-file switch	fail to feed	flag 6	
x2xx	800 bpi density		ready and busy	amplifier failure	ready not busy	ready and not busy	flag 7	
x4xx	lost data		end of operation	end of operation	end of operation	O. D.* computer running		
1xxx	longitudinal parity error		abnormal end of operation		abnormal end of operation	abnormal end of operation	O. D. read	
2xxx	vertical parity error				compare or pre-read error	compare error	O. D. write	parity error
4xxx	reserve reject	reserved for other control	reserved reject		reserve reject	reserve reject	O. D. parity error	

**The end-of-tape bit will be set when the physical end-of-tape has been sensed or when the logical end-of-tape has been defined in the program. Logical end-of-tape may be defined before or after the physical end-of-tape has been sensed. The logical end-of-tape is set if a REOT, WEOT, or LABEL request for a unit is given before physical end-of-tape.

*Other Division

If the unit is in operation (ab = 11), the reply describes the dynamic condition of the unit. For all other values of ab, the reply reflects the condition of the unit at the end of the last I/O operation.

If the unit is in operation (ab = 11) during an interrupt subroutine, the user should not wait for ab to change by repeating the STATUS request; since an interrupt on that unit cannot be processed (which may change ab) until control is returned to SCOPE. Any request but STATUS may be given to allow SCOPE to process interrupts.

When a logical unit has been bypassed, y is set to 1 and u is the logical unit to which the physical unit has most recently been assigned; the rest of the reply is zero.

If STATUS is given on an unassigned logical unit, A and Q are zero, except for the u field which contains either the called or the master logical unit.

Example:

The logical units are equated by EQUIP statements such that 2 is equivalent to 6, and 6 is the master unit,

STATUS (2)	gives the dynamic status of logical unit 2, with 2 in the u field of the Q register.
STATUS (2,M)	gives the dynamic status of logical unit 2, with 6 in the u field of the Q register. The status is identical in both examples, except for the u field.

LABEL

This statement provides identifying information for tape labels.

LABEL (u, addr, edition, reel)

logical unit	a decimal number.
addr	the address of the first of four computer words containing the name. The name may be 32 characters, alphabetic, numeric, or spaces; or it may be *nn, where nn is a logical unit number less than 50.
edition number	1-99. If not specified, blanks will be written as the edition number in the output label; or any edition number will be accepted on an input label.
reel number	1-99. If not specified, reel 1 is written on an output label; or the lowest numbered reel is read from an input label.

If a tape is not named, the logical unit number will be placed in the label. This number is either the master logical unit used in the program, or the number, less than 50 and preceded by an asterisk, specified in place of the name in the LABEL request. The number preceded by the *, may not be used as the logical unit number in programmer requests to refer to the tape.

When a LABEL request is given, a new reel of the unit is defined, and a logical end-of-tape condition is set on the current reel. If REOT or WEOT is then requested for the current reel before a READ or WRITE request, the program will be terminated.

Normally, a single LABEL request suffices for a unit throughout a run; it must precede the first I/O operation on the unit. When the first READ request is given, the specified input label must match the label on the input tape. SCOPE writes the complete label at the first WRITE request. Label information may be given in an EQUIP statement rather than in a LABEL request.

Example:

```
LABEL (15, =H*10bbbbb)
```

Logical unit 15 will contain a label with a logical unit number of 10. The spaces ,b. . .b, are required since =H defines a Hollerith literal of 8 characters. Logical unit number 15 must be used in subsequent programmer requests.

Since edition number and reel number are unspecified, the edition number will be blank and reel will be number 1 for output, or the lowest reel for input.

SAVE

The programmer may specify that a tape be saved at the completion of the job.

```
SAVE (u)
```

The SAVE request may be given at any point in the program as it does not inhibit reading and writing on the unit. At the end of the job, the current reel of the saved logical unit is unloaded and a message directs the operator to reserve the tape for the programmer. For a multi-reel saved logical unit, each reel is unloaded and saved as it is completed or released. Save may also be requested in an EQUIP statement.

Examples

SAVE (29)

SAVE (LGO)

3.2 STACKING OF REQUESTS

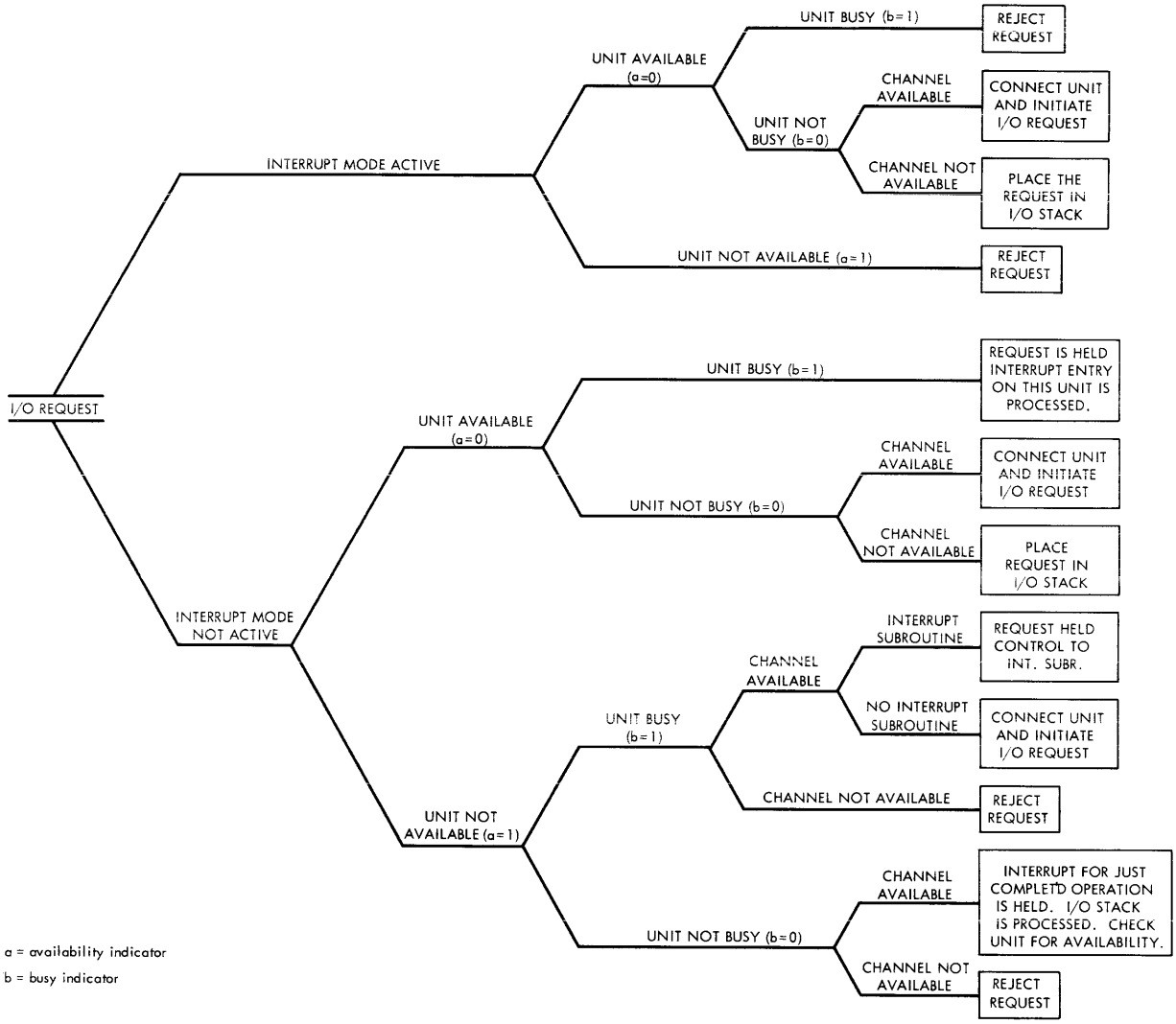
When an I/O request is given (see fig 3-1), SCOPE determines whether the request was given while the interrupt mode was active or it came from an interrupt subroutine (interrupt mode not active).

If the request was made while the interrupt mode was active, and SCOPE finds that the unit requested is not available, the request will be rejected. If the unit is available and not in operation, SCOPE will check to see if a channel is available to which the unit may be connected. If a channel is found, the unit will be connected and the request will be initiated. If no available channel can be found, the request will be placed in the I/O request stack. In either case, control will return to the calling routine via the normal return.

If the I/O request came from within an interrupt processing routine (interrupt mode not active), SCOPE will determine whether or not the unit is available. If the unit is available, but is busy (an interrupt on this unit is being held), the request will be held until the interrupt has been processed. If the unit is available and not busy, SCOPE determines whether or not a channel is available to connect to the unit. If a channel is available, it is connected and the request is initiated. If no channel is available, the request is added to the I/O stack. When SCOPE determines that the unit is not available, it checks to see if the unit is busy. If the unit is not busy (an I/O request on this unit is already in the stack), but no channel is available the request is rejected. If a channel is available the interrupt for the just completed operation is held and the stacked requests are processed. The I/O request is again routed through the unit and channel availability checks. If an operation is being performed on the requested unit (unit not available and busy) SCOPE checks the channel availability to see if the operation has been completed. If the channel is not available, the request will be rejected. If the channel is now available (operation has been completed), and an interrupt subroutine was not specified the channel will be connected and the request initiated. If an interrupt subroutine was specified, the current request is held while the interrupt is processed.

HELD REQUESTS AND INTERRUPTS

After an interrupt processing subroutine has been completed, SCOPE checks to see if any I/O requests or interrupts are being held. All held requests are


I/O REQUEST
INTERRUPT MODE ACTIVE
UNIT AVAILABLE (a=0)
UNIT BUSY (b=1)
REJECT REQUEST
UNIT NOT BUSY (b=0)
CHANNEL AVAILABLE
CONNECT UNIT AND INITIATE I/O REQUEST
CHANNEL NOT AVAILABLE
PLACE THE REQUEST IN I/O STACK
UNIT NOT AVAILABLE (a=1)
REJECT REQUEST
INTERRUPT MODE NOT ACTIVE
UNIT AVAILABLE (a=0)
UNIT BUSY (b=1)
REQUEST IS HELD INTERRUPT ENTRY ON THIS UNIT IS PROCESSED.
UNIT NOT BUSY (b=0)
CHANNEL AVAILABLE
CONNECT UNIT AND INITIATE I/O REQUEST
CHANNEL NOT AVAILABLE
PLACE REQUEST IN I/O STACK
UNIT NOT AVAILABLE (a=1)
UNIT BUSY (b=1)
CHANNEL AVAILABLE
INTERRUPT SUBROUTINE
REQUEST HELD CONTROL TO INT. SUBR.
NO INTERRUPT SUBROUTINE
CONNECT UNIT AND INITIATE I/O REQUEST
CHANNEL NOT AVAILABLE
REJECT REQUEST
UNIT NOT BUSY (b=0)
CHANNEL AVAILABLE
INTERRUPT FOR JUST COMPLETD OPERATION IS HELD. I/O STACK IS PROCESSED. CHECK UNIT FOR AVAILABILITY.
CHANNEL NOT AVAILABLE
REJECT REQUEST
a = availability indicator
b = busy indicator

processed (on a last-in-first-out basis) before each held interrupt. This is done so that the requests held during the execution of an interrupt subroutine may be honored before the next interrupt routine begins processing. When all of the held requests and held interrupts have been processed, SCOPE returns control to the main program.

3.3 EXTERNAL INTERRUPT CONTROL

If an interrupt address is specified, control will be transferred to that address at the end of the operation or upon abnormal condition interrupt. Before giving control to the interrupt address, SCOPE stores the A and Q registers and enters the control word in the A register and the unit status in the Q register (see STATUS 3.1). Control will be transferred to the interrupt address by a bank return jump. The programmer returns control from the interrupt processing routine to SCOPE by returning to the interrupt address. Upon regaining control, SCOPE processes any other interrupts, restores the A and Q registers, and returns to the running program.

Input/output operations may be requested from within interrupt subroutines. However, if a request is given in an interrupt subroutine, the end of operation interrupt for that request will not be processed until the interrupt subroutine has been completely processed.

3.4 INTERNAL INTERRUPT CONTROL

Four controls are available for handling internal interrupt features. SELECT indicates the type of interrupt and the location of a routine to be entered when that interrupt occurs. REMOVE releases the interrupt. An interrupt address may also be reassigned, by an indirect technique, to a previously selected location. BOUND sets storage area limits outside of which references are not to be made and the address to which control is transferred if the bounds are violated.

UNBOUND releases the last set of bounds and reimposes the bounds that were in effect before the last BOUND request.

Program address parameters in all internal interrupt requests may be modified by the contents of an index register by enclosing within parentheses the program address and the index register designator separated by a comma, (m,b). The program address, m, may be any legal COMPASS address field expression. If b is 1-6, the address will be m + (b). If b is 7, indirect addressing will be used.

All program address parameters must be located within the same bank as the subprogram containing the internal interrupt request.

SELECT/REMOVE

SELECT designates the specific interrupt; when the interrupt occurs, a jump is made to the interrupt address. If a previous SELECT request with the same interrupt had been made, its interrupt address will be saved in the current SELECT calling sequence. When the interrupt occurs, further interrupts are locked out and a bank return jump is made to the interrupt address. Control is transferred from the interrupt subroutine to the monitor by a jump to the interrupt address.

SELECT (interrupt, address)

Address — the location to which control is transferred when the interrupt is detected.

Interrupt

SHIFT	shift fault
DIVIDE	divide fault
EXOV	exponent overflow fault
EXUN	exponent underflow fault
OVER	fixed point overflow fault
ADDR	*non-existent address fault
M1604	1604 mode alert
TRACE	trace mode alert
INST	*illegal instruction fault
OPER	*operand parity fault
MANUAL	manual interrupt alert

REMOVE (interrupt)

REMOVE removes the specified interrupt and saves the interrupt address declared in the SELECT request for that interrupt. The interrupt address is saved in the current REMOVE calling sequence.

If there was no SELECT, REMOVE acts as a NOP.

SELECT (I, SELECT or REMOVE address)

I specifies an indirect selection of the interrupt address assigned before the specified SELECT or REMOVE.

SELECT or REMOVE address is the location at which a previous SELECT or REMOVE request was made.

*If these interrupts are not selected by the programmer, they will terminate the program.

SELECT indirect reselects an interrupt address designated by the SELECT or REMOVE instruction in effect prior to the instruction at the specified address. The indirectly selected interrupt address will be the address contained in the SELECT or REMOVE request, for the same interrupt, which was in effect prior to the request at the specified address.

I	IO
	IDENT STARTEST
	:
C1	SELECT (OVER, STX1)
	:
	RTJ SUB1
	:
	RTJ SUB2
	:
	END
	IDENT SUB1
	ENTRY SUB1
SUB1	
	:
A3	SELECT (OVER, OVX2)
	:
	RTJ SUB2
	:
	SELECT (I, A3)
	SLJ SUB1
	END
	IDENT SUB2
	ENTRY SUB2
SUB2	
	:
B1	SELECT (OVER, VYZ)
	:
	SELECT (I, B1)
	SLJ SUB2
	END

Indirect interrupt select is requested in subprograms SUB1 and SUB2 before control is returned to the calling subprograms. Therefore, in each of these routines, a new interrupt address is taken when the routine is entered and the previous interrupt address is reinstated before control is transferred back to the calling program. The indirect interrupt request in SUB1, for example, removes the SELECT at address A3, leaving in effect the last interrupt address (STX1) specified for OVER before that SELECT was given. The indirect interrupt request in SUB2 removes the SELECT at B1 leaving in effect the last interrupt address, OVX2. This indirect SELECT allows the programmer to reinstate the interrupt address in the calling program before he transfers back to it, without knowing which program he will be returning to.

BOUND/ UNBOUND

SCOPE is protected by upper and lower bounds. The upper bound is the highest location in the highest numbered bank available, excluding the system I/O drivers. The lower bound is the lowest numbered location in bank 0 excluding SCOPE and the loader, unless numbered common is assigned to the region usually occupied by the loader.

The BOUND request sets bounds outside of which any instruction reference will cause an interrupt. The first BOUND request executed in a program may set any BOUND range allowed by SCOPE. Subsequent BOUND requests must set bounds which lie within the previously set bounds. If any requested bounds overlay those previously set, the request is rejected and control is transferred to the reject address. If the bounds are accepted, the previous bounds are stored. The number of nested bounds is limited to 5.

BOUND (lower bound, upper bound, reject address, interrupt address)

lower bound upper bound	are addresses to which the memory bounds are set; bank terms may be included in these addresses. If they are omitted, ($) is assumed. The lower and upper bounds cannot be indexed because of bank terms. ($) name, indicates that the bank already associated with name will be used.
reject address	is the location to which control is transferred if the bounds list is full (5 requests) or if the requested bounds do not fall within those previously set.
interrupt address	is the location of the programmer's interrupt subroutine to which control is transferred when an interrupt condition occurs.

Example:

BOUND (((*) LIMIT1), LIMIT2, RA, IA)

The lower bound will be LIMIT1 in the bank containing the BOUND request. The upper bound will be LIMIT2 in the bank in which LIMIT2 is located. Note: ($) LIMIT2 is assumed.

UNBOUND

The UNBOUND request removes the bounds set by the last executed BOUND request and re-establishes the bounds previously set. UNBOUND cannot be used to remove the bounds set by SCOPE.

Example:

BOUND (((0) LOWEST), ((0) HIGHEST), RA, IA)

BOUND (((0) LOWER), ((0) UPPER), RA, IA)

UNBOUND

The first set of bounds are LOWEST and HIGHEST. The next set, LOWER and UPPER, lie within the first set of bounds. UNBOUND removes LOWER and UPPER and reinstates LOWEST and HIGHEST.

3.5 CLOCK INTERRUPT

Four controls handle clock interrupts. LIMIT imposes a time restriction. FREE releases the last time limit, and re-establishes the previous time limit. TIME returns the time remaining until the next time interrupt in the A register, and the time of day in the Q register. DATE returns the calendar date in the A register.

LIMIT

The LIMIT request sets a time limit after which control will be transferred to the interrupt address.

LIMIT (du, ra, ia)

du — the duration in seconds of the time limit; milliseconds may be appended by giving the parenthesized expression (seconds, milliseconds)

ra — the transfer location if the limit is not accepted.

ia — the location to which control is transferred when the limit is reached. The interrupt subroutine is entered by a bank return jump. The interrupt subroutine should return to the interrupt address.

The reject address and interrupt address may be modified by the contents of an index register. (See 3.1).

No more than five limits may be in effect at one time; each must fall within the time set by the last executed LIMIT request. If the new limit is larger than the previous, control will transfer to the reject address. When each new limit is accepted, the clock comparison register is reset and the previous limit is stored. Upon time interrupt, the limit which caused the interrupt is released before transferring control to the interrupt address.

Example:

```
LIMIT  ( (1000,500), RA1, IA1)
```

FREE

FREE

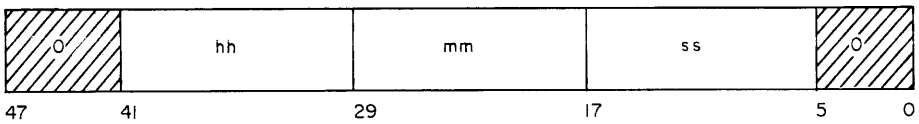
FREE releases the last time set by a LIMIT request (the smallest in the list of time limits) and re-establishes the next previous time set (the next smallest limit in the list). Limits set by SCOPE cannot be freed.

TIME

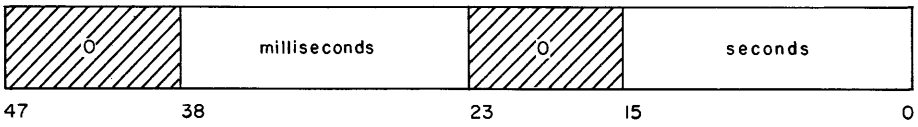
TIME

Upon receiving a TIME request, SCOPE enters the time of day into the Q register in BCD and the time remaining before the next time interrupt into the A register in binary.

The time of day is based upon a 24-hour clock (one minute before midnight is 235900) and is given in hours (hh), minutes (mm) and seconds (ss). This time is entered in the Q register in the format:



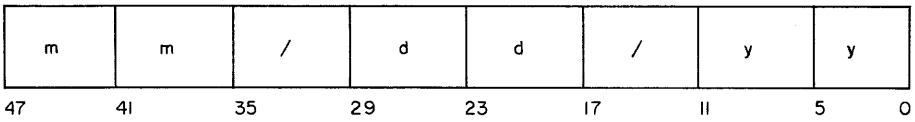
The time to the next interrupt is entered in the A register in the format:



DATE

DATE

When a DATE request is received, SCOPE enters month, day and year into the A register, in BCD, in the format:



3.6 SPECIAL REQUESTS

A running program may request SCOPE to position the library at a particular record or at the directory preceding it (LIBRARY). Requests are also available for calling the loader to load programs (LOADER), obtaining or setting memory limits (MEMORY), and for returning control to the monitor system (EXIT). An interrupt subroutine may modify the A and Q registers of the program at the time the interrupt occurred (HERESAQ).

LIBRARY

LIBRARY may be used to position the library tape.

LIBRARY (u, ra, record name address, record number)

u	the library logical unit number, 70.
ra	the location to which control is transferred if the specified record is not found.
record name address	the storage location of the first of four computer words containing the record name.
record number	a signed integer, 0 through 2^{24}.

Library unit, reject address, and record name address may be modified by the contents of an index register. (See 3.1)

The possibilities for the record number and location of record name in positioning the library are as follows:

Record Name Address	Record Number	SCOPE Positions Library at:
zero or blank	zero or blank	the next directory
non-zero	non-zero	record r of the series beginning with the named record
non-zero	zero or blank	the directory containing that record
zero or blank	non-zero	(see below)

LIBRARY may also specify the number of records which the user has moved the library tape. When the user has read or backspaced the library tape and intends to use either LIBRARY or LOADER requests later in the run, a LIBRARY request must be given indicating the current position of the library tape. The record name address will be blank or zero and the record number will be the signed number of records that the tape has been moved (+ forward, - backward).

Example:

```
LIBRARY  (70, REJECTA, CTABLE,1)
```

This request positions the library tape at the beginning of the record, CTABLE.

Assume that the user reads 2 records and then wants to find another table MATCHC. He must give:

```
LIBRARY  (70, REJECTB,  ,+2)

LIBRARY  (70, REJECTC,  MATCHC,1)
```

LOADER

LOADER

The loader request is used by a running program to call the loader. If the loader is not in storage, SCOPE will read it from the library into its customary position immediately following resident. Just prior to giving the request, the parameters (sec. 5.4) specifying what is to be loaded must be placed in the A and Q registers. SCOPE passes these parameters to the loader and retains control until that call to the loader is complete. Upon exit from the loader, the contents of A and Q are returned to the calling program for examination. The loader returns control to SCOPE through its entry point, and SCOPE returns control to the calling program.

If numbered common has been assigned to bank 0, the loader will overlay numbered common. SCOPE does not adjust the limits of available storage after loading the loader.

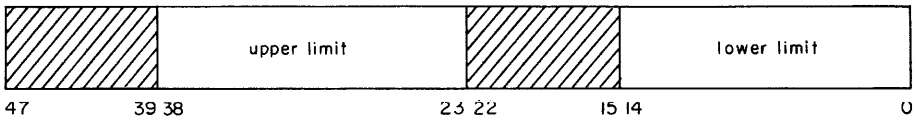
MEMORY

The limits of available storage may be obtained or changed by the MEMORY request.

MEMORY (bank designator, lower limit, upper limit)

bank designator	a number 0-7,*, or $symbol. * designates the bank containing this request $symbol designates the bank in which symbol is located
lower limit upper limit	absolute octal locations in the range 1-77777. These must not be prefixed with bank designators or suffixed with index designators.

If either limit in the programmer request is zero, the other limit is not changed. Limits larger than SCOPE bounds can not be set. If the lower limit requested lies in resident, it will be reset to the first location following resident. If the requested upper limit is greater than the upper bound of SCOPE, the job is terminated. When the limits have been changed by MEMORY, the new limits are returned in the A register. If no limits are supplied in the request or if both limits are zero, the current storage limits for the specified bank will be entered in the A register in the following binary format:



A non-existent bank is indicated when the A register is equal to zero.

EXIT

EXIT

The EXIT request returns control from a running program to SCOPE. This causes a normal termination of the program as long as there are no abnormal conditions. Control may also be returned to the monitor system by transferring to the running program transfer address which is preset with an EXIT request by SCOPE.

HERESAQ

HERESAQ

An interrupt subroutine may modify the A and Q registers at time of interrupt by the HERESAQ request. Just prior to giving the request, the new contents for A and Q are placed in the respective registers.

DEBUGGING AIDS 4

Selected areas of storage may be dumped each time a particular instruction is encountered (SNAP) or before execution of each jump instruction in a designated area (TRACE). Recovery dumps may be designated for abnormal termination and a memory map, giving a listing of absolute addresses assigned to the program by the loader, may be obtained.

SNAP and TRACE dumps consist of a console scoop and a storage dump. (See Appendix C). The A and Q registers are printed in the mode requested. The index registers, bounds registers and P register are printed in octal. The interrupt register, interrupt mask register and switches are printed in binary.

Each printed line contains an absolute octal address, an octal address relative to the name in the first word address (fwa), and four to ten computer words, depending upon the mode requested. One or more lines of identical words are omitted.

4.1 SNAP DUMP

Snap dumps are periodic dumps of specified areas. The programmer specifies the instruction address where the dump request is executed. He also specifies the frequency and the areas to be dumped. SCOPE replaces the instructions at the dump addresses with jumps to the SNAP routine. The SNAP routine dumps the specified areas onto the standard output unit, executes the instructions originally at the dump address, and returns control to the program.

More than one snap dump may be specified for an address and any number of addresses may produce snaps. After the last snap is produced, normal program operation resumes. The only restrictions on the number of snap dumps are the print request limit in the RUN statement and the amount of available storage remaining after the program is loaded.

$^{7}_{9}$SNAP,a,fwa,lwa,f,d_1,d_2,d_3,id

a the program address where the dump is initiated. The program address may be a program name or an entry point name plus or minus an octal displacement, p±n; p is an entry point or program name and n is an octal number. If a program name is used, the program address will be the first location in the program. If an entry

point name is used, the program address will be the entry point location. If the program and entry point names are identical, the program address will be the first location in the program. If a is blank, a snap is taken only if abnormal termination occurs.

fwa,lwa The first word address and the last word address of the area to be dumped may be:

1) A 6-digit absolute octal location; the left-most digit is the bank designator. If less than 6 digits are given, bank 0 is assumed.

2) $p_y \pm n_y$, a common block name, an entry point name, or a program name, p_y; plus an octal displacement, n_y, relative to the name. If a common block name is used, it is enclosed in slashes: /name/. If the block name is blank, two slashes are given: //.

3) $\pm n_x$, an octal displacement relative to the previously declared entry point, common block, or program name on this SNAP card.

4) blank (fwa and lwa), no area will be snapped; the console will be snapped if C is suffixed to the mode designator. Where fields are omitted commas must be placed, unless no non-blank fields follow.

If fwa equals lwa, a console scoop will be given.

f the format of the dump on the standard output unit is designated by:

0 or blank	octal dump
M	octal dump with mnemonic operation codes
I	fixed decimal dump, integer
S	floating decimal dump, single precision
D	floating decimal dump, double precision
B	BCD dump
C	is suffixed to the designator, if a snap of the console is to be included

d_1,d_2,d_3 control the start, stop, and frequency of the SNAP dump. A dump will be produced at the d_1 encounter of address $p \pm n$, and at every d_3 encounter thereafter until d_2 is reached. If these parameters are blank, a dump is produced at every encounter of the address. If d_3 is blank, a dump is produced at every encounter of the address between d_1 and d_2.

id is an optional identification for each dump on the standard output unit. It may be up to five alphanumeric characters.

The SNAP cards are placed immediately before the RUN card in the program deck.

Examples:

$^{7}_{9}$SNAP,ANNA,+5,+30,MC,1,100,5,JACK

The area of storage occupied by locations ANNA+5 through ANNA+30 will be dumped. A dump is produced the first time location ANNA is encountered, and every 5th time thereafter until the 100th time. JACK is printed with each dump as identification. An octal dump with mnemonics and a console scoop are produced.

$^{7}_{9}$SNAP,BETA,+0,+50

The snap is triggered by location BETA. The area of storage to be dumped is BETA through BETA+50. An octal dump will be produced every time BETA is encountered.

$^{7}_{9}$SNAP,BETA,/SAM/,+50,S,1,20,2,JM

The common storage area SAM through SAM+50 is dumped in floating decimal, single precision when BETA is encountered. A dump is produced the first encounter and every alternate encounter until the 20th. JM is the identification.

4.2 TRACE DUMPS

The TRACE statement produces a dump whenever jump instructions within a specified range of the program are executed. The dump will be written on the standard output unit in the same format as the snap dump.

$^{7}_{9}$TRACE,a_1,a_2,fwa,lwa,f,d_1,d_2,d_3,id

- a_1 is the first address of the trace area; may be an entry point or program name plus or minus an octal displacement (p±n).
- a_2 is the last address of the trace area; a_2 must be greater than a_1. a_2 may be one of the following:
  - $\pm n_x$ an octal displacement relative to the program entry point or program name, p.
  - $p_y \pm n_y$ an octal displacement relative to program entry point or program name, p_y.

Any number of ranges (a_1 to a_2) may be specified. The contents of the address a_1 may not be referenced or modified within the program nor may either a_1 or a_2 contain an input/output control word or a jump

instruction (RTJ or BRTJ class) which sets an address for return. When the last trace is produced, normal program operation resumes.

fwa is the first word address of the area to be dumped.

lwa is the last work address of the area to be dumped.

The parameters, fwa and lwa correspond to those of the SNAP statement.

f is the format of the dump on the standard output unit. The various designators are described following the SNAP statement.

d_1 specifies the number of times the area to be traced is passed through before a jump may produce the first dump. d_1 must be less than 4096.

d_2 specifies the last time through the trace area that a jump instruction will cause a dump. d_2 must be less than 4096.

d_3 specifies how often tracing occurs when passing through the trace area. d_3 must be less than 4096.

The area is traced at the d_1 encounter of a_1, and at every d_3 encounter thereafter until d_2 is reached. During tracing, the counter is not incremented until a_2 is encountered; jumps to a_1 in TRACE mode will not affect the count of the trace. If the parameters are blank, tracing is initiated at every encounter of a_1.

The specified area (fwa to lwa) is dumped before the jump instructions are executed. If the jump transfers control to a location outside of the tracing limits, trace output is halted. Upon returning within limits, trace output is resumed, beginning with the first jump instruction within the limits. If a jump instruction is located at a_1, it is traced; at a_2, it is not traced.

The TRACE cards are placed immediately before the RUN statement. If both SNAP and TRACE cards are used, their order is not significant, as long as they are the last cards before the RUN card.

Example:

$^{7}_{9}$TRACE,ALPHA,BETA,+5,+30,MC,1,100,5,JACK

Jump instructions in the range ALPHA - BETA will be traced. The locations BETA+5 through BETA+30 will be dumped whenever a jump instruction is executed. Tracing will begin with the first encounter of ALPHA and every fifth encounter until the 100th: BETA must be executed in order to increment this count. An octal dump with mnemonics and a console scoop will be given. JACK is written as identification on the standard output unit.

4.3 RECOVERY DUMP

On the RUN control statement (sec. 2.4) a recovery dump may be specified for abnormal termination of a program.

Recovery dumps are given in octal with mnemonics and have the following form:

Console scoop, if requested

Print lines containing an absolute octal address, an octal address relative to the beginning of the subprogram or common block, and the contents of four words. When a new subprogram or common block is encountered, its name is printed and the relative address reset to zero.

One or more lines of identical words are omitted.

Information on recovery dump diagnostics is in Appendix C.

4.4 MEMORY MAP

If a memory map is to be suppressed, this must be indicated in the RUN control statement (sec. 2.4). When debugging aids are used, a map is always given. The locations are given as six octal digits, the leftmost designating the bank. The memory map lists the absolute location of the following items:

subprograms

program extension areas

labeled common

numbered common

entry points

Information on memory map diagnostics is in Appendix C.

LOADER 5

The loader performs the following functions:

- Loads and links subprograms
- Detects errors and provides diagnostics
- Patches subprograms and labeled common
- Assigns program extension areas
- Selects banks

A program may be divided into several subprograms, each separately compiled or assembled. The loader links these subprograms to each other and to library subroutines by associating entry points with external symbols.

The central control routine of SCOPE transfers control to the loader for loading drivers and programs to be executed. When loading is completed, control returns to the calling program. All errors detected are written out as diagnostics on the standard output unit (Appendix C). The loader provides for patching subprograms and labeled common and assigns a program extension area if necessary.

5.1 LOADER OPERATIONS

As each subprogram is loaded into storage, the names and locations of all entry points are entered into a symbol table. External symbols are also stored in the symbol table and, as loading progresses, linked with their corresponding entry points. When the entire loading process is completed, either by two consecutive transfer cards or by a RUN statement, the loader searches the SCOPE library directories for subroutines corresponding to the names of all undefined external symbols. If any undefined symbol is not the name of a library subroutine, a loader diagnostic is written on the standard output unit and the job is terminated. If an undefined symbol is the name of a library subroutine, the loader loads the library subroutine into storage, records the transfer address, and returns control to the calling program. Unless the loader was called by the LOADER request, control returns to the next control statement on INP.

All programs loaded into storage for execution must have at least one transfer address. A transfer address is the entry point to which control will be transferred to begin execution. A transfer address is contained on a named TRA card.

The FORTRAN compiler compiles a single TRA card for each subprogram. A name is generated on the TRA card for each subprogram beginning with the PROGRAM statement. The COBOL compiler compiles a single TRA card for each paragraph. In COMPASS each END statement becomes a TRA card with the transfer address included if it was given in the END statement. Only one transfer card is needed for each subprogram. The ALDAP compiler compiles a single TRA card (without a transfer address) for each independently compiled procedure. A TRA card with a transfer address is always generated for each ALDAP compiled program. The name on the TRA card is the program name, if given, or a name generated by ALDAP.

If two transfer addresses are encountered in loading subprograms for execution, control transfers to the second address. The first address is placed in the A register, bits 41-24 (bits are numbered from right to left beginning with zero).

More than two transfer addresses will terminate a job, and a loader diagnostic will be written on the standard output.

The cards which the loader encounters while loading and processing subprograms and library subroutines are listed below. Details about the loader cards are in section 5.5.

IDC	Subprogram Identification Card
EPT	Entry Point Symbol Table
BCT	Block Common Table
RBD	Relocatable Binary Subprogram Deck
EXT	External Symbol Table
LAT	Linkage Address Table
BRT	Bank Relocation Table
OCC	Octal Correction Card
TRA	Transfer Card
LCC	Loader Control Card

LOADER NAMES

All loader names, including entry point names, external symbols, and subprogram names except common block names are 1-32 characters long. A name of 8 characters or less is contained in one word. If the name is greater than 8 characters but less than or equal to 32 characters, it is prefixed by 1-4, specifying the number of words comprising the name.

A name prefixed by a number is not identical to the same name not prefixed by a number.

Example:

1A ≠ A

2AAAAAAA	A	≠ AAAAAAAA
first word	2nd word	1 word

5.2 LOADER CONTROL CARDS

Loader control cards indicate subprograms to be overlayed, subprograms to be corrected, or the memory banks to which subprograms and common blocks are to be assigned. All loader control cards contain 11 (-), 0, 7, and 9 punches in card column 1. There are six types:

-0 7 9 BANK,(b_1), . . . ,$name_i$, . . . (b_2), . . . ,$name_k$, . . .

or

-0 7 9 BANK,(m),sym_1,sym_2, . . .

-0 7 9 CORRECT,$epname_1$,$epname_2$, . . .

-0 7 9 MAIN,u

-0 7 9 OVERLAY,u,o

-0 7 9 SEGMENT,u,n

} described in chapter 6.

BANK STATEMENT

There are two types of BANK statements.

The programmer may specify a particular bank for each subprogram and common block, or that particular subprograms and common blocks go into the same bank. This statement is placed before the subprograms to which it

pertains, if they are binary (object) subprograms; otherwise, it is placed immediately before the LOAD statement.

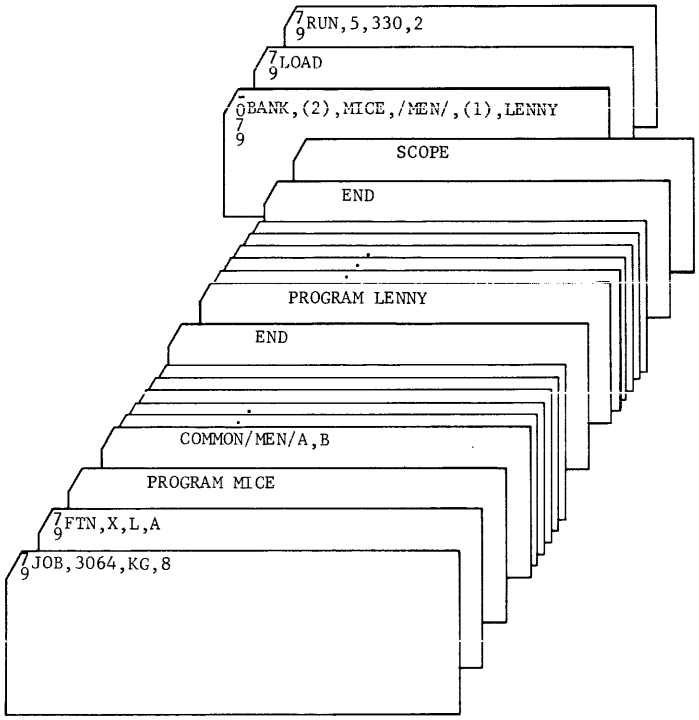
11
0
7
9BANK,(b_1), . . . ,$name_i$, . . . ,(b_2), . . . ,$name_k$, . . .

b a bank number (0-7), an entry point, or a common block name.

name an entry point, program, or common block name. A common block name is enclosed in slashes.

If b is an entry point or common block name, the names which follow it are allocated to the same bank as the entry point or common block name, and the loader places the subprograms in the bank having the largest amount of available storage, other than bank zero. If there are several entry points in a subprogram, only one of these need appear in the BANK statement.

Programs compiled or assembled by systems such as FORTRAN, COMPASS, ALGOL, must have provisions for bank relocation before they may appear in a BANK statement.



Two FORTRAN subprograms are to be compiled and written on the load-and-go unit. The BANK statement precedes the LOAD statement. Subprogram MICE and the common block MEN are to be placed in bank 2 and subprogram LENNY is to be placed in bank 1.

Various combinations of subprograms or common blocks may be forced into a particular bank.

11
0
7
9BANK,(m_1),sym_1,sym_2, . . . ,(m_2),sym_3,sym_4, . . .

m_i is a bank number, 0-7
sym_i may be the following designators:

SP.	= subprograms	on binary input unit
NC.	= numbered common	
LC.	= labeled common	
LSP.	= library subprograms	from library subroutines
LNC.	= library numbered common	
LLC.	= library labeled common	
APC.	= SP. + NC. + LC.	
ALC.	= LSP. + LNC. + LLC.	
ALL.	= APC. + ALC.	

The designated subprograms and common blocks will be allocated to the specified bank. These declarations apply only to subprograms or common blocks for which no previous bank declaration defining a unique bank has been given.

Examples:

0
7
9BANK, (0), APC., LSP.

The succeeding subprograms, labeled, and numbered common, read from the binary input unit and library subprograms will be stored in bank 0. Numbered and labeled common blocks from the library are dynamically assigned by the loader.

0
7
9BANK,(A),B

```
-
0
7
9BANK,(0),A


-
0
7
9BANK,(1),ALL.
```

Subprograms containing entry points A and B will be forced into bank 0 by the first two bank statements. The remaining subprograms and common blocks will be loaded into bank 1.

CORRECT STATEMENT

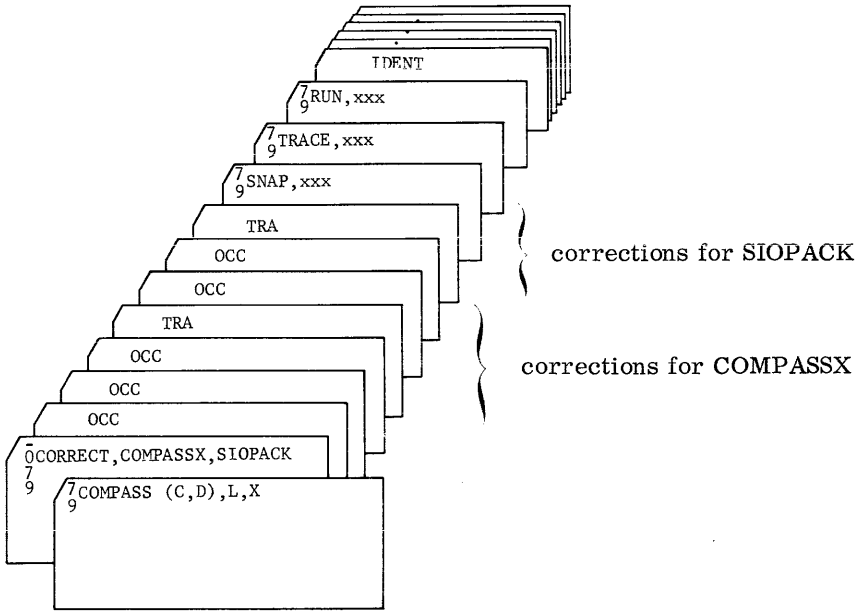
If library subprograms other than those specified on the entry point name statement are to be corrected, the CORRECT card is used.

```
11
 0
 7
 9CORRECT,epname1,epname2, . . .
```

epname$_i$ is an entry point name within the library subprogram to be corrected; names must occur in the order in which they appear on the library tape.

Octal correction cards containing the corrections to the subprogram must follow the CORRECT card. The corrections for each subprogram are terminated by a single TRA card. The octal corrections must appear in the same order as the subroutines on the library tape to which they apply.

SNAP and TRACE cards may follow the last TRA card. The corrected deck and/or SNAP and TRACE cards must be followed by a RUN card. In this example COMPASSX must appear on LIB before SIOPACK.

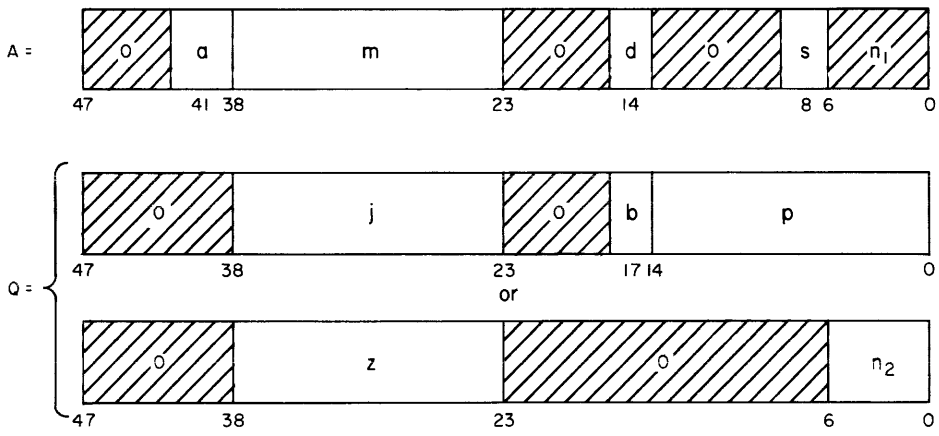


5.3 LOADER CALLS

When the LOADER request is made, the A and Q registers must contain certain parameters. Control is given to the loader only by EXEC upon a return jump. With certain parameters in the A and Q registers, the calling sequence is the following:

```
        RTJ     LOADER
+       return
```

The parameters supplied in A and Q are:



am — is an 18-bit address, or zero, specifying a location for preset entry points which have been defined by the calling program:

d — is a mapping parameter:

0 no map after loading
1 map after loading

s — specifies the kind of loading operation:

00 load library programs from n_1 (upper Q is used)

01 load program from n_2 (lower Q is used)

10 load library program from n_1, and octal corrections to it from INP (upper Q is used)

11 complete loading operation after interruption - (ignore remainder of A and Q)

n_1 — the logical unit number of the library unit (usually 70).

j — the number of names in the list starting at bp.

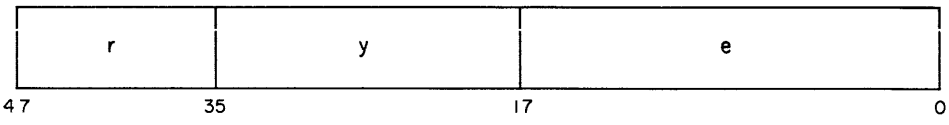
bp — an 18-bit address specifying the beginning of a list of library subroutine entry point names to be loaded from the library tape (n_1). A name may be in either form allowed for loader names (5.1).

z — the location, in bank zero, of the first binary card image of the program to be loaded. The rest of the cards are found on n_2. If z = 0, the first card is also found on n_2.

n_2 — designates the logical unit from which binary cards, or images of cards, one per record, are to be loaded.

The unused portions of A and Q must be zero.

The location defining the preset entry points contains:



r — a 12-bit value specifying the number of entry points which are preset into the entry point symbol table.

y — the first word address (18 bits) of the list of entry point names. The names must be in contiguous storage locations and may extend to 32 characters per name.

e — the first word address (18 bits) of the list of entry point addresses. This list must be contiguous words with one address occupying one word. Each address is contained in

the lower 18 bits of its word. The number of entry point addresses must equal the number of entry point names, each of which must equal r.

The four loading operations, keyed by the s parameter in the call to the loader, are as follows:

s = 00

Load from unit n_1 the library subroutines called by the entry point names at bp. The entry point symbol table is preset if am is not zero.

SCOPE uses this call for COMPASS, COBOL, FORTRAN, ALGO, ALDAP and those programs defined on an entry point name statement, unless SCOPE parameters are used.

When the loader returns control to its calling program, the lower address of the A register specifies the first location in bank zero of the address list. This list gives the relocated addresses of the entry point names found at bp in the lower 18 bits of consecutive words. Bit 47 of the A register is zero. Bit 46 of the A register specifies whether numbered common in bank zero has (1), or has not (0) overlayed the loader. The Q register contains the number of errors encountered in loading, right justified. If a transfer address was encountered during loading, it is placed in the lower address of A, and the location of the address list is placed in the upper address of A.

Any time numbered common overlays the loader, the loader must be reloaded (Sec. 3.4) before another loader operation can be executed.

s = 01

Load subprograms from unit n_2; when two consecutive TRA cards are encountered, load externally-referenced library subroutines from n_1. If z is non-zero, it gives the location of the first card image in bank zero. An entry point symbol table is preset if am is non-zero.

SCOPE uses this call to load from INP or a load-and-go unit.

No more than two TRA cards may specify transfer addresses. When the loader returns to its calling program, the lower address of the A register gives the relocated address of the last transfer address encountered. If there were two transfer addresses, the first is given in bits 41-24 of the A register. Bit 47 of the A register is zero. Bit 46 of the A register specifies whether numbered common in bank zero has (1), or has not (0) overlayed the loader. The Q register contains the number of errors noted during loading, right justified.

If an end-of-file is encountered on n_2, control is returned with a 1 in bit 47 of the A register and bits 14-0, zero. If a binary card with w = 0 is encountered, bit 47 is one, and bits 14-0 in A contain the location in bank zero of that card image. In both cases, library subroutines are not loaded before returning. Loading is completed by the s = 11 call; loading is continued by another s = 01 call.

s = 10

This is the same as the loading operation when s = 00, except that j must be 1 and OCC cards are accepted. After the named program from n_1 is loaded, OCC cards are loaded from INP until a TRA card is encountered. If a SCOPE control card is detected on INP, the loader returns with a 1 in bit 47 of the A register and bits 14-0 specify the location of the card image. Loading is completed by an s = 11 call.

SCOPE uses this call when loading programs defined by an entry point name statement with SCOPE parameters.

s = 11

Complete the loading operation after an end-of-file or SCOPE control card interruption. Only the s field in the A register is interpreted. If the previous operation was s = 01, library subroutines are loaded and return is made to the calling program.

If the previous operation was s = 10, processing of the octal corrections is completed, any remaining library subroutines are loaded, and return is made to the calling program.

5.4 PROGRAM ASSIGNMENT

During loading, the program is assigned to various portions of storage. Programs which are too large for available storage may be divided into sections and executed sequentially under OVERLAY control. (Chapter 6).

BANK ASSIGNMENT

If the programmer specifies a particular bank, SCOPE loads the subprogram or common block into that bank. If the programmer specifies that particular subprograms and common blocks go into the same bank, as each is encountered it will be assigned to the bank with the most available storage, excluding bank zero. If there is no bank declaration, SCOPE selects the bank, other than zero, having the amount of available storage into which the subprogram or common block fits most tightly. Bank zero is assigned only when the other banks cannot provide space. Banks may be specified with the BANK statement (Sec. 5.5).

STORAGE ALLOCATION

After each load operation, SCOPE records the consecutive storage locations which have not been assigned to a subprogram, common block, or monitor routine. These constitute available storage and the limits may be obtained or changed by a programmer request during execution (MEMORY request, 3.4). Storage in a bank extends from the lowest location, 00000_8, to the highest location, 77777_8.

SCOPE resides in lower memory of bank 0.

Object subprograms, labeled common, program extension areas, programmer I/O drivers, and library subroutines are loaded into the highest available locations in their assigned bank.

Numbered common is assigned storage beginning at the lower end of available storage in its assigned bank. Numbered common, if in bank zero, overlays the loader, beginning at the first loader location. If numbered common is not in bank 0, the loader remains in storage. The last numbered common block in each bank may vary in size from one declaration to the next.

The loader permits subprogram and labeled common modification by octal correction cards. Instructions which do not fit a corrected area in the program are loaded into a program extension area declared by the programmer and assigned by the loader. The program extension area is limited in size only by the amount of available storage in the bank into which the program and corrections are loaded.

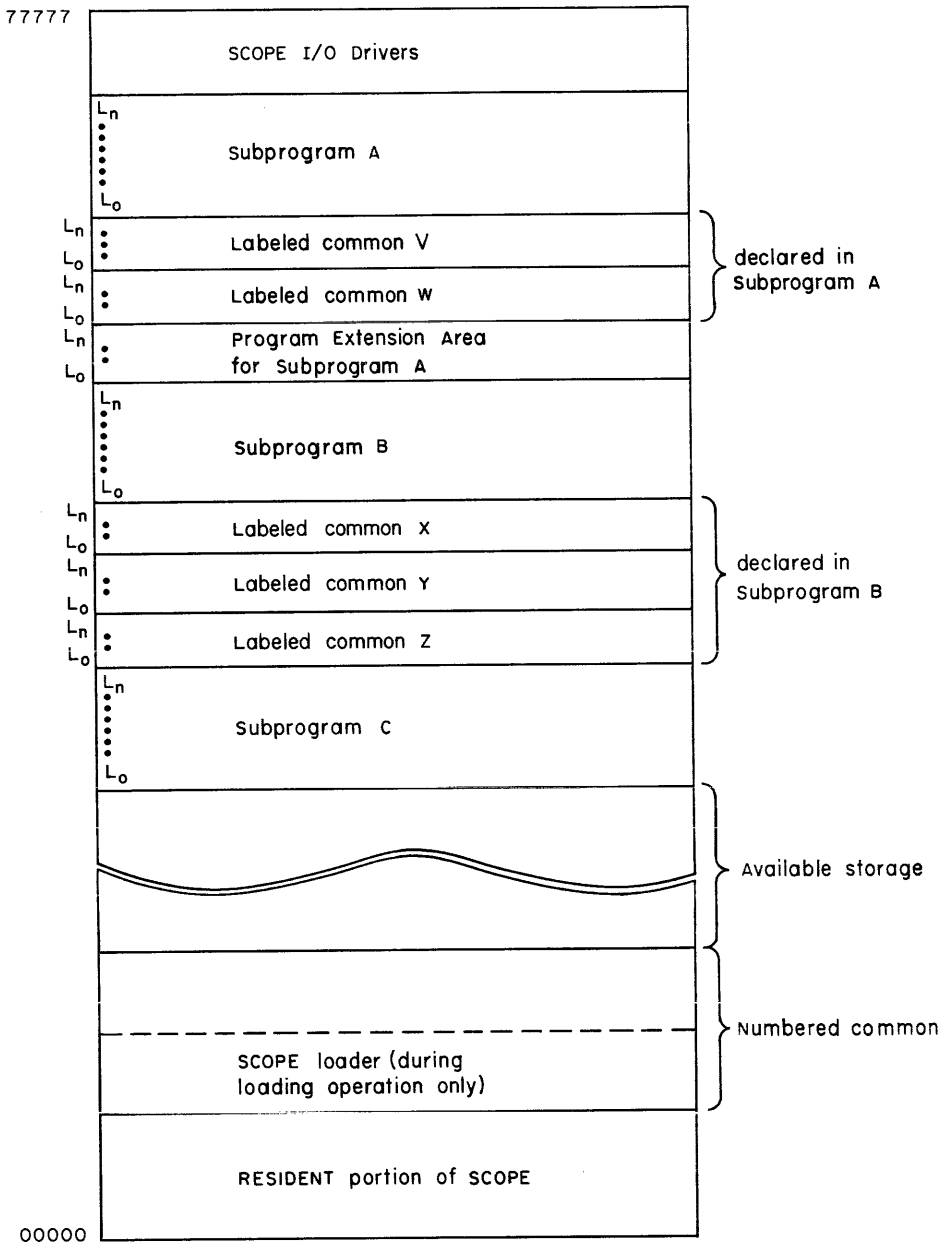
The locations occupied by a program after it is loaded can be obtained from the memory map, which includes a listing of the names and locations of all subprograms, labeled common, numbered common, program extension areas, and entry points in storage.

STORAGE DIAGRAM

The following diagram illustrates how an object program might be stored.

Assuming that there is only one bank of storage, the SCOPE I/O drivers are loaded into the highest numbered area while SCOPE and the loader occupy the lowest portion of storage. During execution SCOPE and the I/O drivers are bounds protected.

The first subprogram, A, is loaded into highest available storage followed by labeled common blocks V and W. The loader is assigned the next available locations as a program extension area; the size is determined by information on the octal correction cards. Next, subprogram B is loaded; then labeled common X, Y, Z, and subprogram C. The area for numbered common overlays the loader; numbered common can not be preset. Subprogram C may or may not have contained octal corrections; however, if octal corrections were present, no program extension area was defined.


77777
SCOPE I/O Drivers
Ln
Lo
Subprogram A
Labeled common V
Labeled common W
declared in Subprogram A
Program Extension Area for Subprogram A
Subprogram B
Labeled common X
Labeled common Y
Labeled common Z
declared in Subprogram B
Subprogram C
Available storage
Numbered common
SCOPE loader (during loading operation only)
RESIDENT portion of SCOPE
00000

5.5 CORRECTING SUBPROGRAMS

Octal correction cards can be included with an object program at load-time. Existing instructions and labeled common data may be altered; additional instructions and data may be loaded into a program extension area. Any section of a program may be corrected. This area, determined and assigned by the loader, is limited in size only by the amount of available storage in the bank into which the program and corrections are loaded.

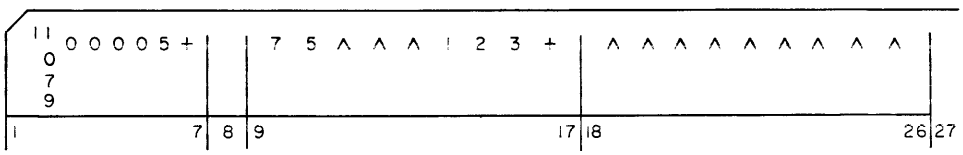
All octal correction cards contain a load address, the contents of one to four computer words, and relocation designators for the address portion of each instruction:

Column	Contents
1	punches in rows 11, 0, 7, and 9
2-6	relocatable load address, aaaaa, for the first correction field on the card
7	relocation factor for address aaaaa
8	blank
9-17	data field 1 - upper instruction or data word to be loaded at the address aaaaa
18-26	data field 2 - lower instruction or data word to be loaded at the address aaaaa
.	.
.	.
.	.
63-71	data field 7 - upper instruction or data word to be loaded at the address aaaaa + 3
72-80	data field 8 - lower instruction or data word to be loaded at the address aaaaa + 3

Octal correction cards are placed immediately before the TRA card of the binary subprogram to which they pertain.

Example:

To correct a single instruction in a subprogram:



In the fifth instruction of the subprogram, the upper instruction will be changed to an SLJ to relocatable 123 in the subprogram. The lower instruction will not be affected.

RELOCATION FACTORS

The relocation factor, which follows the load address in card column 7, may be any one of the following:

Factor	Relocation
E	Relative to the first location of the program extension area
+	Relative to the first location of the subprogram
1	Relative to the first location of the first declared common block
2	Relative to the first location of the second declared common block
.	. .
.	. .
.	. .
9	Relative to the first location of the ninth declared common block
0	Relative to the first location of the tenth declared common block

Only labeled common blocks may be corrected, data cannot be prestored in numbered common blocks. In selecting the correct factor for a common block, however, both numbered and labeled common blocks in the program must be counted in the order in which they are declared. Only the first ten blocks can be corrected.

Examples:

A FORTRAN program contains the following statement:

```
COMMON /1/A/B3/G,H/B4/F/6/Z/COG/P
```

To alter data in block B3, the relocation factor 2 would be used. To alter data in block COG, factor 5 would be used. Data cannot be prestored in the numbered common blocks.

A COMPASS program contains the following statements:

```
21        BLOCK 10
          COMMON AFLAGS(5), BFLAGS(5)

H30       BLOCK 200
          COMMON A(10, 10), B(10, 10)

26        BLOCK 3
          COMMON R1, R2, R3

RTABLE    BLOCK 100
          COMMON R(10, 10)
```

To alter data in block H30, the relocation factor 2 would be used. To alter data in block RTABLE, the relocation factor 4 would be used. Data cannot be prestored in blocks 21 and 26 because they are numbered common.

DATA FIELDS

The format of each data field, card columns 9-80, is:

nnnxxxxxi

Data fields 1-8 are loaded into sequential half-words in storage starting with address aaaaa (columns 2-6).

nnn — the upper 9 binary digits of an instruction or data word.

xxxxx — the address of an instruction, or lower 15 binary digits of a data word.

i — the relocation factor for the address, xxxxx. Any of the factors in the relocation list may be used with two additions:

Factor	Relocation
blank	no relocation
-	Relative to the complement of the first address of the subprogram.

Since program instructions may refer to both numbered and labeled common, the value of the relocation designator, i, must be determined by counting each declared common block -- both labeled and numbered -- up to the one to which the address refers.

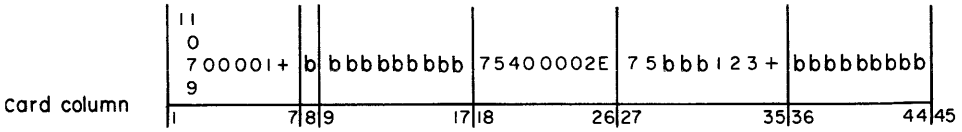
Blanks in the nnn and xxxxx fields are converted to zeros; if the entire field is blank, the related portion of storage is not altered.

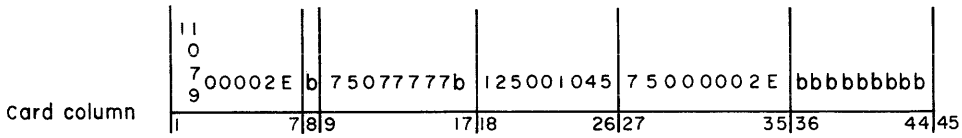
PROGRAM EXTENSION AREA

The size of the program extension area is defined by the largest reference to the area in the load address. Data field references are not taken into consideration when determining the size. If . . . . . 2E were the largest load address, the program extension area would consist of three words (0, 1, and 2).

The programmer must provide a jump to the program extension area from the program to execute the octal corrections. A return jump from the program extension area to the program must also be included.

Example of two cards in an octal correction deck.





In the subprogram:

at location 00001+ UI is unchanged because of the blanks

LI contains a return jump to the 3rd word (2E) of the program extension area

at location 00002+ UI contains an SLJ to relocatable 123 in the subprogram (blanks fill to zeros).

LI is unchanged, because it is blank.

In the program extension area:

at location 2E UI contains an SLJ **. The blank designator indicates no relocation.

LI contains a LDA with the contents of relocatable 104 of fifth declared common block.

at location 3E UI contains an SLJ to 2E, the third location of the program extension area, to exit back to the program.

LI is unchanged.

The program extension area is allocated 4 words, 0, 1, 2, and 3.

5.6 BINARY CARD FORMATS

SCOPE loader processes the subprograms and subroutines that are to be executed as a running program under SCOPE control. The loader assumes that the programs contain certain elements that enable it to relocate the coding and tie the subprograms and subroutines together. These elements are contained on binary cards, listed below. Generally, they are produced by COMPASS, FORTRAN, COBOL, and ALGOL; and are of no concern to the programmer. It is possible, however, to prepare all cards directly without using an assembler or compiler.

1.	Subprogram Identification Card	IDC
2.	Entry Point Symbol Table	EPT
3.	Block Common Table	BCT
4.	Relocatable Binary Subprogram Deck	RBD
5.	External Symbol Table	EXT
6.	Linkage Address Table	LAT
7.	Bank Relocation Table	BRT
8.	Octal Correction Cards	OCC
9.	Transfer Card	TRA
10.	Loader Control Cards	LCC

Card types 1 to 9 must occur in the order listed; only IDC and TRA are required in all subprograms. Type 10 occurs only between subprograms or ahead of the first subprogram in a series.

Unless identified as octal or coded decimal, information is assumed to be in binary on cards or in card format. In most cases more than one entry is contained on a card. With the exception of the octal correction card and the named TRA card, subprogram cards are punched in binary.

Each column on a card represents 12 bits of a 48-bit computer word. The correspondence between card positions and computer word bit positions for each group of four card columns is shown below.

	Corresponding Bit Position			
Row	Column 1	Column 2	Column 3	Column 4
12	47	35	23	11
11	46	34	22	10
0	45	33	21	9
1	44	32	20	8
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.
9	36	24	12	0

All SCOPE loader cards have a 7, 9 punch in column 1. On most loader cards the first four columns identify the type to provide a means of checking its contents.

Mnemonic	Row	Column	Corresponding Word Bits	Purpose
(none)	12	1	47	must = 0
w	11 to 3	1 to 1	46-42	card type or word count (RBD)
a	4 to 6	1 to 1	41-39	relocatable address (RBD)
	12 to 9	2 to 2	35-24	sequence number, or blank
b	7 9	1 1	38 and 36	indicates a binary card
i	8	1	37	indicates whether a checksum will be processed 1, checksum is ignored 0, checksum is compared
c	12 to 9	3 to 4	23-0	24-bit checksum

The remaining words (columns) depend upon the card type.

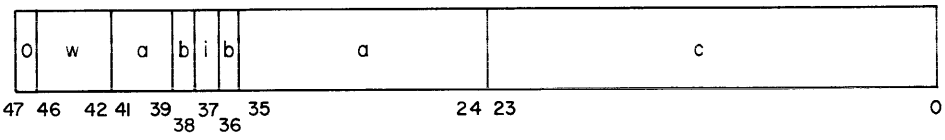
The checksum is formed by finding the 48-bit arithmetic sum of the 20 words on the card (columns 3 and 4 are set to 0 and left carries go into the low order bit). The high order 24 bits of the 48-bit sum are added to the low order 24 bits to form a 24-bit result. A left carry is generated if overflow into the 25th bit occurs. The 24-bit result is the checksum.

Card representation of first word:

	1	2	3	4
12	o	a	c	c
11	w	a	c	c
0	w	a	c	c
1	w	a	c	c
2	w	a	c	c
3	w	a	c	c
4	a	a	c	c
5	a	a	c	c
6	a	a	c	c
7	b	a	c	c
8	i	a	c	c
9	b	a	c	c

a address or sequence number
b binary card indication
c checksum
i ignore checksum bit
w word count

Bit structure of first computer word:



IDC CARD

The subprogram identification card names the subprogram which follows it and provides information about the subprogram to the loader.

Card Content:

Columns	Computer Word	Use
1-4	1	Card type
5-8	2	Subprogram identification
9-24	3-6	Subprogram name in BCD
25-80	7-20	Zero

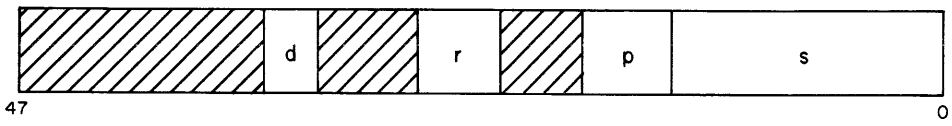
Word Content:

Word 1: $w = 31_8$

a zero

c checksum

Word 2:



d word number, 3-6, of the first word on the card which contains loadable data. Data begins in the (d+1)st word of all RBD cards.

r length, 2 to 8, of the relocation byte on the RBD cards.

p the number, 6 to 24, of relocation bytes per word on the RBD cards.

s length of the subprogram in binary; 0 to 77777_8.
s is 0 if only common blocks follow.

The unused portions of word 2 are zero.

Words 3-6: name of subprogram in BCD, in format specified for loader cards (Section 5.1).

EPT CARD

The Entry Point Symbol Table defines the names and relocatable addresses for the entry points in the subprogram.

Card Content:

Columns	Computer Word	Use
1-4	1	Card type
5-80	2-20	These columns contain entry point names, in BCD, and related addresses, in binary.

Word Content:

Word 1: $w = 32_8$

a sequence number in binary; all cards must be in sequence.

c checksum

Words 2-20:

Each entry point requires from 2 to 5 whole words: the name of the entry point occupies from 1 to 4 words (either form given for loader names, Section 5.1); and the relocatable address of the entry point in the subprogram occupies positions 14-0 of the last word. Each entry point definition immediately follows the preceding one; definitions continue from word 20 of one card to word 2 of the next card.

As many EPT cards as are necessary may be used to define the entry points of a subprogram; the cards must be in sequence.

BCT CARD

The Block Common Table defines the name and length of each common storage area declared in the subprogram.

Card Content:

Columns	Computer Word	Use
1-4	1	Card type
5-8	2	Zero
9-80	3-20	Common declarations

Word Content:

Word 1: $w = 33_8$

- a ascending sequence number in binary; all cards must be in sequence.
- c checksum.

Words 3, 5, 7, . . . 19: Names, in BCD code, of the blocks of common assigned. A name may not contain more than 8 characters; it may be numeric (for numbered common) or alphanumeric (for labeled common).

Words 4, 6, 8, . . . 20: Length of the common block named in the preceding word.

Common blocks are data storage areas which are shared by subprograms and library subroutines. Common may be labeled or numbered. For labeled common, the first character must be alphabetic. The 8-character name for a block of labeled common is assigned from high order to low order storage, following the subprogram in which it was first referenced. The 8-character name for a block of numbered common must begin with a numeric character.

Numbered common is always assigned to locations in lower storage following SCOPE. Numbered common may not be preset; it may be assigned to the area used by the SCOPE loader and overlays the loader when it is referenced.

Subprograms sharing a block of common must each identify common by the same name and block length. There is one exception: the last numbered common block in a storage bank may vary in length between subprograms.

Up to 126 blocks may be defined for one subprogram.

RBD CARD

The Relocatable Binary Subprogram Deck contains the instructions, constants, and data to be positioned. A relocation increment or decrement may be applied to the address portions of each word.

Card Content:

Columns	Computer Word	Use
1-4	1	Number of instruction words on the card, the first relocatable address and a checksum.
5-24	2-6	Relocation bits, in constant length bytes, which determine the kind of relocation and the address portions of each word. Up to 6 computer words are filled.
13-80	4-20	Instruction words to be loaded. As many computer words are used as are available.

Word Content:

Word 1: w = word count, 1 to 21_8

a initial load address for the words on the card

c checksum

b, i are as defined for all standard card types

The number of words reserved for the relocation bytes depends on the length of each byte (2-8 bits) which in turn depends on the number of common blocks to be used. The number of words may be determined from the following table:

No. of Common Blocks	Relocation Byte Length	Max. No. of Bytes/Word	Total Possible No. of Bytes	No. of Words for Relocation Bytes
0	2	24	35	2
1-2	3	16	33	3
3-6	4	12	33	3
7-14	5	9	31	4
15-30	6	8	31	4
31-62	7	6	29	5
63-126	8	6	29	5

An integral number of bytes is arranged in a word, left justified. The first byte in word 2 designates relocation for the load address. Subsequent bytes correspond to left, then right, address portions of the first instruction word, then the second, and so on. The value of the byte, excluding the leftmost bit, is used to locate an entry in a table of relocation factors during loading (RFTABLE). The leftmost bit of the byte specifies incrementing (0) or decrementing (1) the contents of the related portion of the instruction or the load address. The remaining bits give the ordinal of the proper word in the table. The first word of this table contains the relocation factor for fixed addresses and, therefore, contains zero. The second word contains the factor for addresses to be relocated relative to the subprogram; the third word for addresses to be relocated relative to the first declared common block on the BCD card; the fourth word for the second declared common block, and so on. If a byte points to an undeclared common block, an error diagnostic is printed.

If an address is to be decremented, the complement of the indicated relocation factor is used when relocating the address. The words not used by the relocation bytes are used for the relocatable instruction, constants, data, and so forth. These words always begin in the same column, for each subprogram, as though the maximum number of relocation bytes were needed.

A byte length, the word number of the last word containing relocation bytes, d, and the total number of bytes per word, p, are contained on the IDC card.

A byte value of 10 . . . 0 is illegal.

A byte value of 00 . . . 0 implies that the address is not to be modified.

A byte value of 0 . . . 01 or 10 . . . 01 implies a subprogram instruction.

A byte value of 0 . . . 010 or 10 . . . 010, refers to the first common block; 0 . . . 011 or 10 . . . 011, the second; 0 . . . 100 or 10 . . . 100, the third, and so on. The reference to the 126th common block would be 01111111 or 11111111.

The load address byte may not be 0 . . . 0, or 1x . . . . x.

EXT CARD

The External Symbol Table contains names of the symbols external to the subprogram. The names are entry points to other subprograms and library subroutines.

Card Content:

Columns	Computer Word	Use
1-4	1	Card type.
5-80	2-20	External symbol names in BCD.

Word Content:

Word 1: $w = 34_8$

a ascending sequence number in binary

c checksum

Words 2-3: External symbol names in BCD are arranged contiguously on a card and may be split between successive cards; a name may continue from word 20 of one card to word 2 of the next card. Loader name format is given in Section 5.5. As many EXT cards as are necessary may be used to define external symbols; the cards must be in sequence.

LAT CARD

The Linkage Address Table provides linkage for all references to external symbols. A minimum of one LAT word exists for every external symbol.

Card Content:

Columns	Computer Word	Use
1-4	1	Card type.
5-80	2-20	Relocatable addresses and related information for the external symbols referenced in the subprogram.

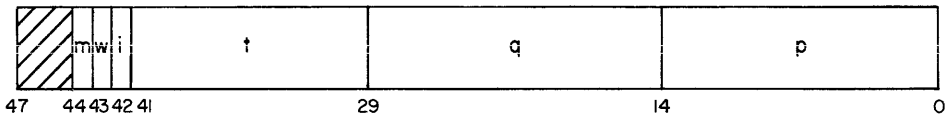
Word Content:

Word 1: $w = 35_8$

a ascending sequence number in binary

c checksum

Word 2-20: Each LAT entry, one word in length, points to a single string of references to one EXT symbol. The LAT entries for each EXT symbol are threaded through the table.



m relocation mode indicator for the external symbol.

1 normal (incremented) references

0 complementary (decremented) references

w upper/lower string indicator.

0 string starting at p refers to an external symbol in the upper portion of the word in the subprogram.

1 string starting at p refers to an external symbol in the lower portion of the word in the subprogram.

i 1

t ordinal of the next LAT entry related to the same external symbol or zero if no more LAT entries are needed.

q is the quantity added to the relocated address of the EXT symbol (q may be zero).

p relocatable address of the word in which the external symbol is used. It is the initial location in the subprogram of the string of references to an EXT + Q. This address gives the location of the next reference, and so on. The last address in the string contains 77777_8.

For each EXT symbol there will be at least one LAT entry. If the identical symbol appears in both the upper and lower positions of a word, there will be two LAT entries. There will be other LAT entries for each modification value, q, of the symbol. Finally, there will be separate entries for each q-valued portion of the symbol for either value of the relocation mode indicator, m. There may be many LAT entries for a single external symbol. For example, each of the following references will require two LAT entries if each is referenced from an upper and lower portion of a word. Eight entries would result from:

$$EXT + Q_1$$
$$EXT + Q_2$$
$$-EXT + Q_1$$
$$-EXT + Q_2$$

The EXT and LAT tables are arranged in parallel so that the ith LAT begins the series of references to the ith symbol. When more than one LAT entry exists for an EXT symbol, successive entries continue after all initial LAT entries. The related LAT entries are threaded together by the t designation in the entry.

If a symbol with unique values for m, w, and q appears only once in a subprogram, the address of the word using it is recorded in the p portion of the entry. If the same symbol with identical values of m, w, and q appears more than once in a subprogram, SCOPE assumes that all these references are strung together. The string is constructed so that the address portion of the word in which the particular version of the symbol is used is replaced by the location of the word in which the next reference occurs. The location of the following reference is placed in the preceding address portion, and so on. The last address portion is assumed to contain 77777_8. The location of the first word of the string is recorded in the p portion of the LAT entry. This method of stringing identical versions of the symbol allows SCOPE to replace the relocatable address by a particular relocated address for the symbol when it can be determined (defined as an entry point).

The designator, t, is used to locate the next LAT entry for a specific symbol regardless of the values of m, w, and q. The thread of LAT entries is terminated by t setting to zero. t is also zero if the symbol occurs only once.

If an extraneous EXT entry exists, (an EXT is listed but not referenced) the LAT entry will have the value: m = w = t = q = 0 and p = 77777_8.

If no LAT entry exists for an EXT entry, it is an error.

As many LAT cards as are necessary may be used, they must be in sequence and all but the last must contain 19 entries.

SOURCE SUBPROGRAM

LOC	UPPER ADDRESS	LOWER ADDRESS
aaaaa		SAM
bbbbb	SAM	-SAM-2
ccccc		SAM+2
ddddd		SAM+2
eeeee		ROGER+5
fffff		ROGER+5
ggggg		ROGER+6

OBJECT SUBPROGRAM

aaaaa		77777
bbbbb	77777	77777
ccccc		77777
ddddd		ccccc
eeeee		77777
fffff		eeeee
ggggg		77777

EXT ENTRIES

SAM
ROGER
ANDY

LAT ENTRIES

ORDINAL	m	w	t	q	p
0	1	1	3	0	aaaaa
1	1	1	5	5	fffff
2	0	0	0	0	77777
3	1	0	4	0	bbbbb
4	1	1	6	2	ddddd
5	1	1	0	6	ggggg
6	0	1	0	-2	bbbbb

BRT CARD

The Bank Relocation Table indicates locations within the subprogram where bank designators depend on the banks to which this or other subprograms or common blocks are assigned. As many BRT cards as necessary may be used; they must be in sequence.

Card Content:

Columns	Computer Word	Use
1-4	1	Card type.
5-80	2-20	Threaded list of BRT entries.

Word Content:

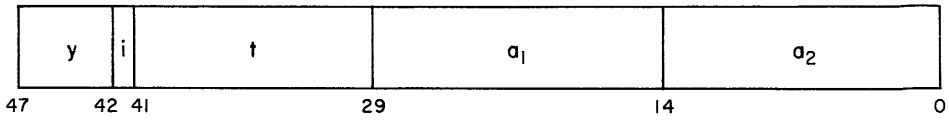
Word 1: $w = 36_8$

a sequence number in binary

c checksum

Words 2 - 20: The BRT table has three sections. The first section parallels the EXT table and each word contains the first two entries for that EXT symbol. If no bank designators depend on that symbol, there are no entries. The second section consists of a pointer to the beginning of the thread of entries for this subprogram and each common block it defines. Section three holds the rest of the BRT entries, two per word, pointed to from sections one and two.

Format of the words in sections one and three:



y specifies one of the five bank designator positions to be relocated within the word at a_1 and a_2.

The value of y may be one of the 30 possibilities, $1\text{-}36_8$:

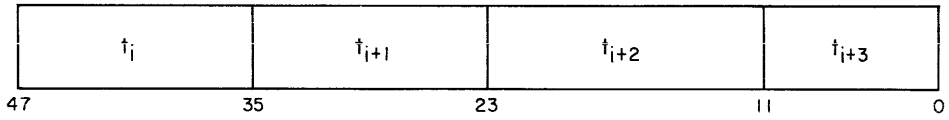
y = (code for a_1 designator) + 5 times (code for a_2 designator). If a_2 is not present, y is 1 to 5.

i 0

t designates the next BRT word (two entries) in this thread.

a_1 and a_2 are addresses in this subprogram in which a relocatable bank designator appears. If more than one designator in a word is relocatable, each has a BRT entry.

Section two parallels the RFTABLE with four entries per word:



t_i is the ordinal in section three, relative to the beginning of BRT, at which the first two BRT entries corresponding to the ith RFTABLE entry occur. t_1 points to the entries depending on the bank into which the subprogram is loaded. t_2 through t_{127} (or the last t field) point to the entries depending on the banks to which the corresponding common blocks are assigned. t_0, and any fields not pointing to a section three entry are zero. As many t fields are required as the number of declared common blocks.

TRA CARD

The Transfer Card signals the end of the subprogram deck or the entire program deck, and in some cases, the starting location of the program.

Card Content:

Columns	Computer Words	Use
1-4	1	Card type.
9-80	not applicable	Entry point name of the starting address of the program.

Word Content:

Word 1: w = 37_8

a 0

c checksum

Beginning in column 9, an entry point transfer name is punched in Hollerith. Up to 31 Hollerith characters may be used. When there is no transfer name, columns 9 through 80 must be blank.

Usually, only one subprogram or library subroutine encountered in a loading operation specifies a transfer name. Control is given to the address specified by that name when the program is run. However, a second transfer name may be specified in a later subprogram or library subroutine. When the program is run, control is given to the second address, the first address placed in the A register (bits 41-24).

LCC CARD

The Loader Control Cards indicate overlay subprograms and the banks to which subprograms and common blocks are to be assigned.

Card Content:

Columns	Computer Word	Use
1 w = 30_8	not applicable	Card type 11, 0, 7, 9.
2-80	not applicable	Hollerith characters representing loader control statements and parameters.

In the six types of LCC cards, columns 2 through 80 are free field; parameters are separated by commas, and blanks are ignored. All information must be contained on one card.

MAIN,u
OVERLAY,u,o } see chapter 6
SEGMENT,u,n

u decimal number, 0 to 50 or 69, specifying the unit on which the main program, overlay or segment is to be written.

o decimal number specifying the overlay number.

n decimal number specifying the segment number.

BANK,(b_1), . . . ,$name_i$, . . . ,(b_2), . . . ,$name_k$, . . .
BANK,(m),sym_1,sym_2, . . .
CORRECT,$epname_1$,$epname_2$, . . .

} see chapter 5

b bank designator, 0-7; the name of an entry point, enclosed in parentheses (entry point); or the name of a common block, enclosed in slashes and parentheses (/block/).

m bank designator, 0-7.

name entry point or common block name; a block name must be enclosed in slashes.

sym_i symbol to specify subprogram, numbered or labeled common, or library subroutines.

$epname_i$ entry point name in a library subroutine.

OCC CARD

The Octal Correction Cards provide facility to correct existing instructions in the subprogram and to add new instructions in a program extension area preceding the subprogram in storage.

Card Content:

Columns		Use
1	$w = 30_8$	Card type.
2-7		Relocatable load address for first correction field on card and relocation increment.
9-80		Corrections or additions.

Information on this card is punched in Hollerith characters to be loaded into sequential half words in storage. The card is divided into 9 fixed fields; the first consists of 6 characters; the remainder, 9 characters each. This card is described in Section 5.3.

PREPARATION OF OVERLAY TAPES 6

Overlay processing allows programs that exceed available storage to be divided into independent parts which may be called and executed as needed. A program may be divided into a main section and any number of overlays, each of which may contain any number of segments. Main, overlay, and segment may each contain subprograms. Only main, one overlay, and one segment may occupy storage at a given time.

In a program containing overlays, the loader control statements, MAIN, OVERLAY, and SEGMENT, precede the relocatable binary subprograms which comprise the respective sections. After a source program is assembled or compiled, overlay processing loads the relocatable binary subprograms into storage and writes each overlay or segment as a separate record in absolute binary on an overlay tape. This overlay tape is then called in sections for execution. The absolute records do not require the relocatable binary loader to perform the usual relocating and linking functions.

Initially, control is transferred to main which resides in storage continuously; it in turn calls the overlays when they are needed during program execution. Segments may be called either by main or an overlay. FORTRAN and COMPASS subroutines are available to call the overlays and segments during execution; these must be included in the source subprograms. Once an overlay tape is created, it may be executed subsequently with the SCOPE control statement, LOADMAIN.

An overlay tape is composed of absolute binary records, followed by two end of files. Each record, constituting a main subprogram, overlay, or segment, may be composed of many subprograms. A particular main, overlay, or segment may occupy any number of banks when in absolute form.

6.1 LOADER CONTROL STATEMENTS

The overlay tape is prepared by preceding each section of the program with a loader control statement specifying whether it is a main section, overlay or segment. A loader control statement (as opposed to a SCOPE control statement) is interpreted by the loader and contains an 11, 0, 7, 9 punch in card column 1. Each statement specifies the logical unit on which the resultant absolute binary program will be stored. The cards following a loader control statement may consist of binary subprograms, compiler language or assembly language subprograms; SCOPE control statements may be included if compilation and assembly is to be performed prior to creation

of the overlay tape. Each main, overlay or segment must contain one transfer address. Main may contain two transfer addresses.

MAIN

$\bar{0}$
7
9 MAIN,u

u is the logical unit number of the overlay tape, 1-49, on which the main section of the program is to be stored in absolute binary. u may not be omitted.

The MAIN control statement may precede the object subprograms which comprise the main section; it defines the main part and the logical unit number of the overlay tape on which it is to be stored.

When overlay tapes are being prepared, the main section remains in storage for immediate execution. After all sections of the program have been stored on tape, the main section may be executed.

The main subprograms must precede the first overlay; if the MAIN statement is omitted, an overlay tape is written containing just the overlays and segments. The overlay tape may be used for immediate execution whether it contains main or not; however, if the overlay tape does not contain main, it cannot be used in subsequent executions.

Portions of the main section may be assigned to several banks with the BANK statement.

OVERLAY

$\bar{0}$
7
9 OVERLAY,u,o

u is a logical unit number, 1-49, of the overlay tape on which the overlay section is to be written in absolute binary. u may not be omitted.

o is the decimal number identifying the overlay.

The OVERLAY control statement precedes the object subprograms which comprise the overlay; when it is encountered SCOPE creates an overlay section and writes this section in absolute binary on the overlay tape specified by the logical unit number.

The main section must include calling sequences to call each overlay into storage. The overlay may be assigned to several banks with the BANK statement.

SEGMENT

0
7
9 SEGMENT,u,n

u is the logical unit number, 1-49, of the overlay tape on which the segment is to be written in absolute binary. u may not be omitted.

n is the decimal number identifying the segment.

The SEGMENT control statement precedes the object subprograms which comprise the segment; when it is encountered SCOPE creates a section and writes it in absolute binary on the overlay tape specified by the logical unit number.

The main or overlay section must include calling sequences for each segment. The segment may be assigned to several banks with the BANK statement.

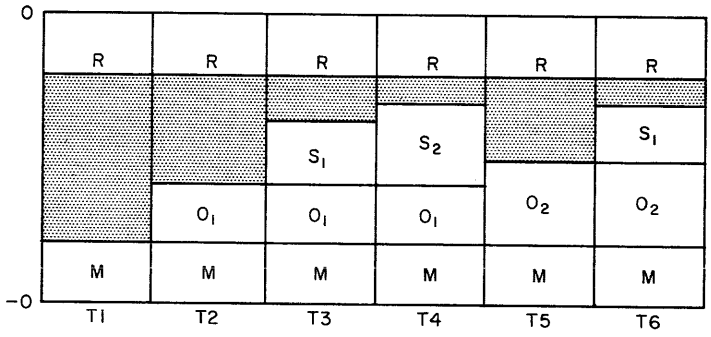
RULES

Rules for partitioning a program into overlays and segments:

1. Numbered and labeled common and all entry points declared in the main subprograms may be referenced by any overlay and any segment.
2. Numbered and labeled common and all entry points declared in an overlay may be referenced by that overlay and its associated segments, but not by the main subprograms, another overlay, or segments contained in another overlay.
3. Numbered and labeled common and all entry points declared in a segment may be referenced by that segment only.
4. The first overlay card must be preceded by a main program. If the main program is not declared with a MAIN card, it is not written on the overlay tape.
5. The overlay numbers must start with one and be consecutive for all overlays written.
6. The segment numbers, within an overlay, must be consecutive starting with one.
7. Only four overlay tapes may be written. No overlay tape may occupy more than one reel.
8. Each overlay and segment must have a single named transfer point.
9. All segments for a particular overlay must immediately follow that overlay on the tape.

STORAGE DIAGRAM

A diagram of storage during overlay processing and execution:



R = Resident
M = Main
O_i = Overlay
S_i = Segment
Tn = Time n

DECK STRUCTURE

Deck structure in the preparation of an overlay tape differs according to input. Relocatable binary subprograms, preceded on INP by the loader control statements, MAIN, OVERLAY, and SEGMENT, are loaded and then written on the overlay tape in absolute binary. Source language subprograms must be compiled/assembled onto a load-and-go tape before they can undergo overlay processing; the loader control statements MAIN, OVERLAY, SEGMENT, preceding each portion coded in source language, must be transferred to the load-and-go tape. The load-and-go tape then becomes input for the overlay tape. Relocatable binary subprograms and source language subprograms may be combined as input.

As the overlay tape is prepared, each section is assigned absolute locations in storage. As each loader control statement is read, it is written on OUT. The section following the loader control statement is loaded into storage and a MAP is written on OUT showing the absolute locations assigned to each main, overlay, and segment.

BANK ASSIGNMENT

Any subprogram within a main section, overlay, or segment may be assigned to a specific bank. In source language subprograms, a bank may be selected by the appropriate source language pseudo instruction.

If relocatable binary subprograms are the input for an overlay tape, they may be assigned to specific banks by the loader control statement:

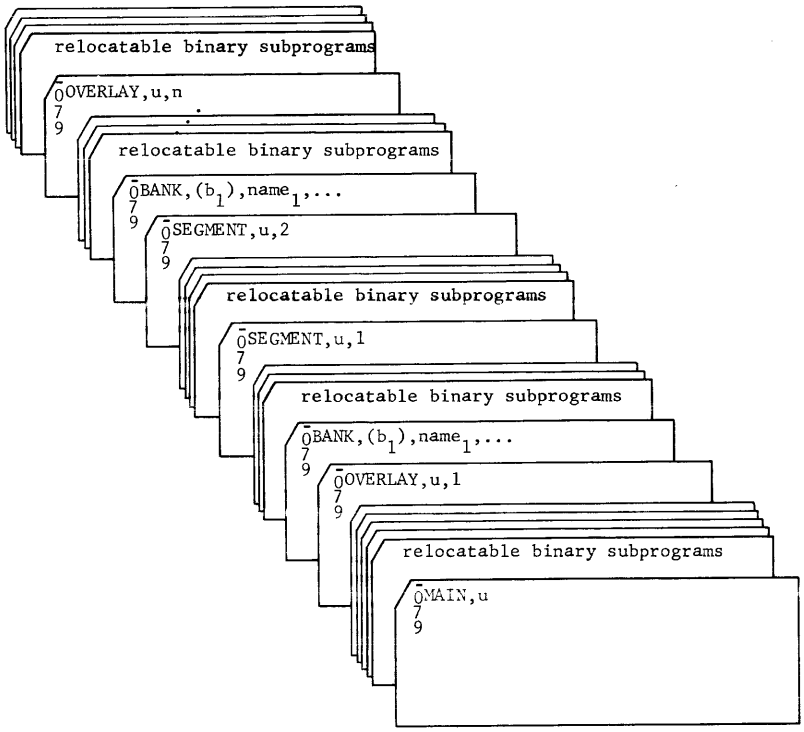
$$\begin{matrix}-\\0\\7\\9\end{matrix}\text{BANK,}(b_1)\text{,name}_1\text{, . . . , }(b_k)\text{,name}_1\text{, . . . ,name}_n$$

The BANK statements must precede the binary subprograms to which they pertain; however, BANK statements must follow the OVERLAY or SEGMENT statement to which they pertain. If the relocatable binary subprograms are contained on a load-and-go tape as the result of a compilation/assembly, the BANK statements may not precede the LOAD statement which loads the load-and-go tape for overlay processing.

If there are no BANK statements, normal bank assignment occurs.

BINARY SUBPROGRAMS ONLY

To create an overlay tape when the deck consists only of relocatable binary subprograms, each subprogram must be preceded by a control statement,MAIN, OVERLAY, or SEGMENT. If a subprogram is to be assigned to a specific bank, a BANK statement must be included before the binary subprogram and after the loader control card. The order in this example (MAIN, subprograms, OVERLAY, subprograms, . . .etcetera) must be followed in all overlay programs.



The overlay tape logical unit numbers may be the same or they may differ; however, segments must follow the overlay on the same overlay tape. If the information in the preceding example were on a tape unit other than INP, it could be loaded by a LOAD control statement and processed as though it were on INP. With the deck in the preceding example on INP, processing proceeds as follows:

1. Relocatable binary subprograms following the MAIN statement and up to the first OVERLAY statement are loaded into storage and linked by the loader. They are then written in absolute binary in a single record on the overlay tape, logical unit u. The first two words which identify it as the main record contain the absolute transfer address. The control statement, MAIN, is written on OUT followed by a MAP of the main section showing the assigned absolute locations. If the main section is not preceded by a MAIN statement, it is not written on the overlay tape, although it is retained in storage during overlay processing.

2. The binary subprograms following the first OVERLAY statement are loaded into an area beginning with the first location after the main area. They are written in absolute binary as a single record on the overlay tape, logical unit u. The first word of the record identifies it as an overlay with its overlay number (1 in the first case). The control statement, OVERLAY, is written on OUT followed by a MAP of the overlay section showing the assigned absolute locations. The BANK statement following the OVERLAY statement controls the assignment for subprograms contained in the first overlay.

3. The BANK statement following the second SEGMENT statement controls bank assignment for subprograms contained in segment 2 of overlay 1.

   Step two is repeated for each overlay and segment. In storage, the segment begins with the first location after its related overlay. During this process the main section remains in storage.

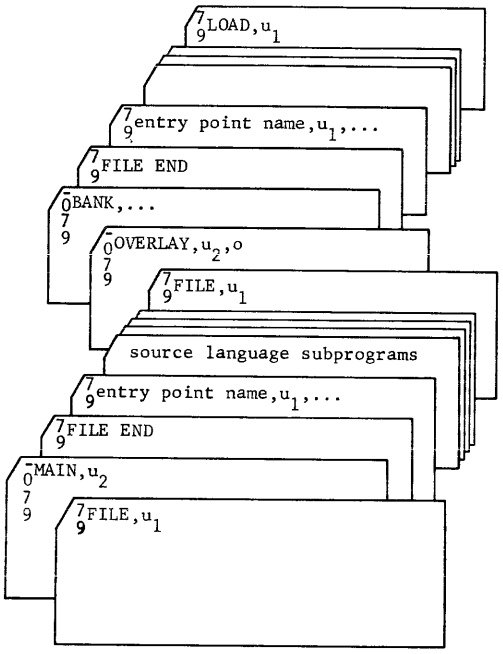
   All the overlays are loaded into the same area following main before they are written on the overlay tape. All segments are loaded into storage beginning at the same first location following the associated overlay before they are written on tape.

4. The end of overlay processing is signaled by a SCOPE control statement such as 7/9RUN, or two consecutive transfer cards.

SOURCE LANGUAGE SUBPROGRAMS

If source subprograms comprise the overlay deck, they must be compiled/assembled onto a load-and-go tape. Loading of the load-and-go tape for overlay processing is initiated by a LOAD statement. The loader control statements, MAIN, OVERLAY, and SEGMENT, must precede the subprograms on INP and

the load-and-go unit as usual; they are transferred to the load-and-go tape by FILE, FILE END control sequences. Bank assignment may be included in the source language subprograms; BANK statements may be transferred to the load-and-go tape by FILE, FILE END control sequences. $\overset{7}{9}$COMPASS and $\overset{7}{9}$FTN are entry point name statements; they must immediately precede the subprograms to be assembled or compiled. Entry point name statements must follow each FILE, FILE END sequence to return control to the compiler/assembler.



With this deck on INP, processing proceeds as follows:

1. The MAIN statement is transferred to the load-and-go unit, u_1.

2. The subprograms following the first FILE END statement will be processed by the named library program. The entry point name statement should specify that the binary object subprograms be stored on the load-and-go unit, u_1.

3. Steps 1 and 2 are repeated until the LOAD statement is encountered. At this time the load-and-go unit, u_1, contains the same deck structure as INP would have contained (Section 6.1) were only binary subprograms included in the deck, as follows:

   $\overset{-}{0}$
   $\overset{7}{9}$MAIN,u_2

   relocatable binary subprograms

$\bar{0}$
7
9OVERLAY,u_2,o

$\bar{0}$
7
9BANK, . . .

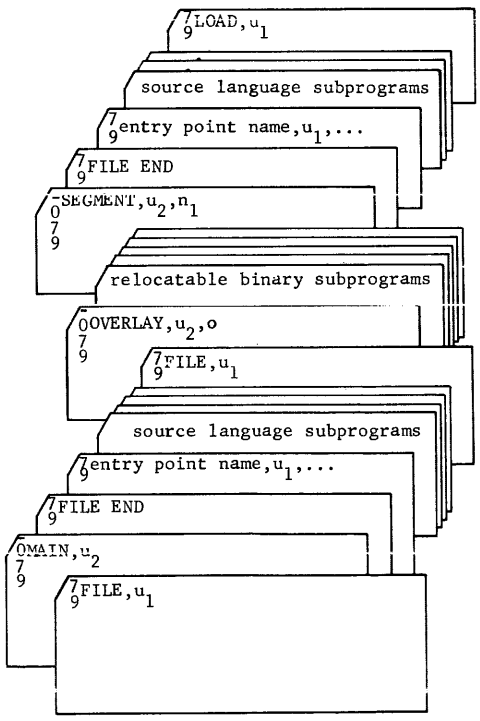
relocatable binary subprograms

.
.
.

4. When the LOAD statement is encountered, the load-and-go unit, u_1, is loaded, and processing is identical to the overlay processing for binary subprograms only. The overlay tape is on logical unit, u_2.

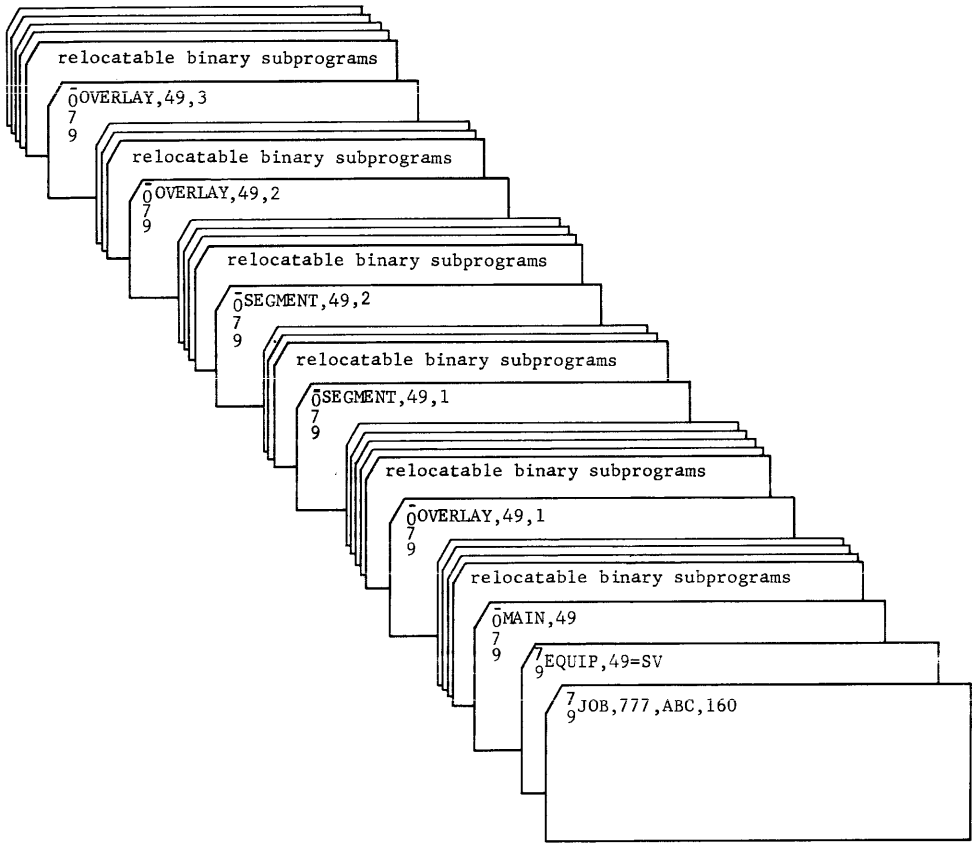
BINARY AND SOURCE SUBPROGRAMS MIXED

If relocatable binary subprograms are mixed with source language subprograms in an overlay deck, the binary subprograms must be transferred to the load-and-go unit by FILE, FILE END sequences. The order on the load-and-go unit must be the same as that on INP in the example (Section 6.1). Processing is similar to that for source language subprograms.



6.2 EXECUTING OVERLAY PROGRAMS

When an overlay tape is prepared, it may be saved with an EQUIP control statement for subsequent executions. If the overlay tape is to be prepared for subsequent executions only, no RUN control statement is required.



IMMEDIATE EXECUTION

When the overlay tape is prepared, the main section is retained in storage. To execute immediately, a RUN control statement (LOADMAIN is not used) must be placed at the end of the overlay deck or the LOAD statement on INP. When the RUN statement is encountered, the overlay tape is rewound and control goes to the transfer address in the main section. The main section then calls the overlays and segments from the overlay tape.

1)

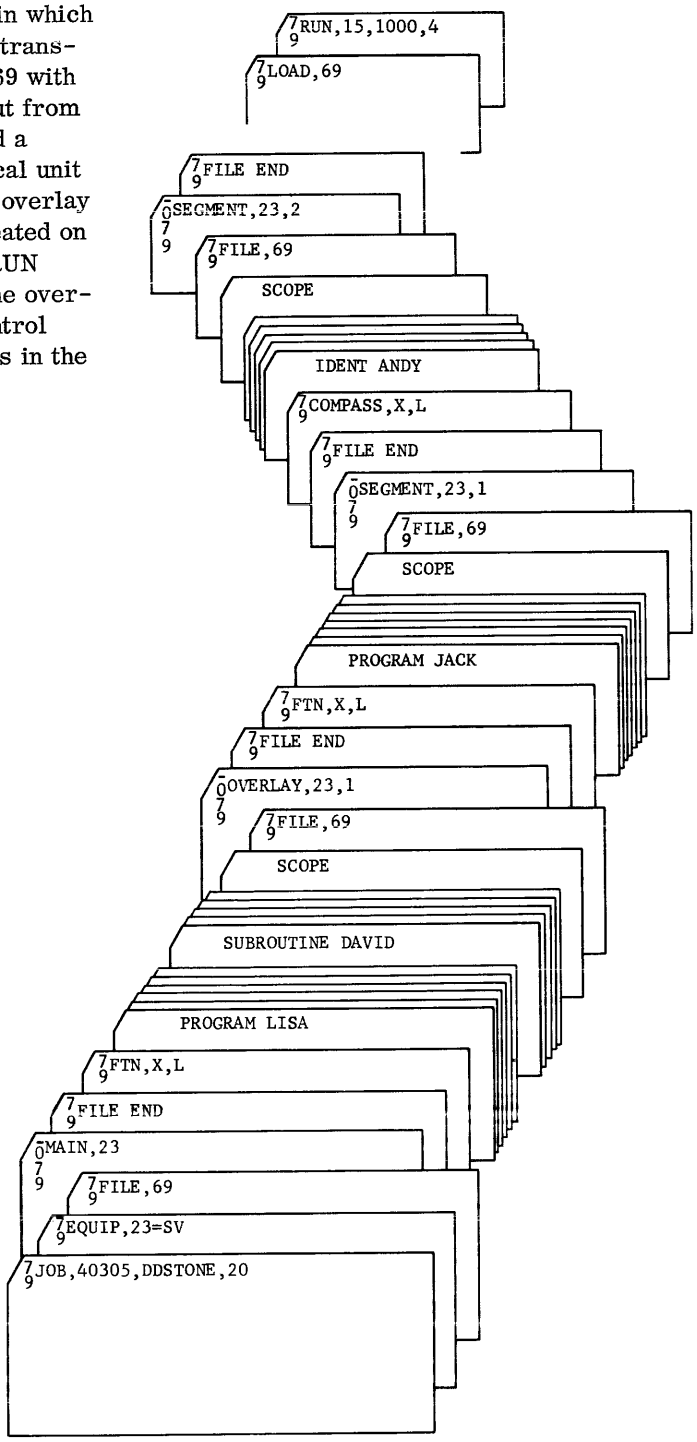
Main, overlay 2 and its segment are saved on unit 23.

Overlays 1 and 6 are saved on unit 42.

Overlay 3 and overlay 5 and its segments are saved on unit 10.

Overlay 4 is saved on unit 45.

2) This deck illustrates a job in which the overlay statements are transferred to load-and-go unit 69 with the relocatable binary output from FORTRAN compilations and a COMPASS assembly. Logical unit 69 is loaded to prepare the overlay tape; an overlay tape is created on logical unit 23. When the RUN statement is encountered the overlay tape is rewound and control goes to the transfer address in the main section.



PREPARED OVERLAY TAPE

Once an overlay tape has been prepared, the overlay program in absolute binary can be loaded and executed with the SCOPE control statement, LOADMAIN.

7/9LOADMAIN,u

LOADMAIN loads the main section from the overlay tape on logical unit u and transfers control to the transfer address in the main section. During execution the main section calls the overlays and segments from the overlay tape. LOADMAIN cannot be used unless the main section is included on the overlay tape. A RUN control statement is not required to execute overlays which are loaded by LOADMAIN.

Example:

7/9JOB,7777,ROG,50

7/9LOADMAIN,25

data to be read by program

.
.
.
.

Diagnostics written on OUT by LOADMAIN and their cause are:

DIAGNOSTIC	CAUSE
PARITY ERROR ON MAIN RECORD	A parity error was encountered on five successive readings of the main record.
ILL. L.U.N. SPECIFIED (LOAD-MAIN)	Logical unit number was less than 1 or greater than 49.
MAIN NOT ON L.U.	The main programs (O = 0, s = 0) could not be found on the specified logical unit.
MAIN PROG. OUT OF BOUNDS	Attempt was made to load the main program outside the bounds found in the bounds register at the time of entry.

6.3 LOADING OVERLAYS AND SEGMENTS

SCOPE provides a subroutine to load overlays and segments (LOVER). A call may be generated to LOVER in COMPASS subprograms. LOVER is linked to the main subprogram when the overlay tape is prepared. FORTRAN source programs may call OVERLAY and SEGMENT to load and execute overlays and segments.

During execution of an overlay program, the main subprogram always remains in storage. Only one overlay and one segment may occupy storage at one time. The main subprogram may call overlays and segments from the overlay tape; overlays may only call their associated segments.

RULES FOR LOADING

1. Overlays and segments will normally be designed to be entered via the bank return jump instruction when LOVER is used, and to exit via their entry point, but they may exit directly to the calling overlay or main program.
2. An overlay may be loaded only by a call from the main program.
3. A segment may be loaded only by a call from the associated overlay if the overlay is in storage, or from the main program. A segment belonging to an overlay not currently in storage cannot be loaded.
4. Overlays can be called from the overlay tape in any order. Segments within overlays can be called from the overlay tape in any order.

These rules apply to FORTRAN and COMPASS programs.

FORTRAN CALL

FORTRAN source language subprograms use the following call statement to load and execute overlays and segments. The overlay or segment call uses LOVER to load overlays and segments.

CALL { SEGMENT / OVERLAY } (o,s,u,d,p_1, . . . ,p_n)

SEGMENT	loads and executes a segment.
OVERLAY	loads and executes an overlay.
o	is the overlay number, specified for both segment and overlay.
s	is the segment number, blank if an overlay.
u	is the logical unit number.
d	is a dummy parameter which must be present if any actual parameters appear. The dummy parameter may be blank.
p_i	are actual parameters to be passed to the overlay or segment routine. No more than 59 may appear.

If o, s, u, or d is blank, the comma must appear; the order is fixed.

One subprogram in each overlay and segment must begin with the FORTRAN statement PROGRAM name. This statement may contain a maximum of 59 parameters:

PROGRAM name (p_1, . . . ,p_n)

name	is the transfer address for the overlay or segment.
p_1, . . . ,p_n	are formal parameters. The actual parameters, p_i, in the CALL must correspond to these formal parameters.

CALLING SEQUENCE

The following calling sequence is generated during compilation for the CALL statement:

```
      BRTJ   ($)  { SEGMENT / OVERLAY } , ,*
+     SLJ    *+m
      0n     DICT.
+     00     o
      00     s
```

```
+       00      u
        00      d
+       00      p1
        :       :
        :       :
        00      pn
```

$$m = \frac{n+1}{2} + 1$$

n is the number of parameters specified in the FORTRAN CALL statement (o . . . p_n).

The above calling sequence jumps to the OVERLAY or SEGMENT subroutine which passes the parameters, o, s, and u to LOVER. LOVER loads the segment or overlay and returns either a loading error code or the transfer address for the overlay or segment loaded.

If no errors occur during loading, the following call to the transfer address is generated by the SEGMENT or OVERLAY subroutine:

```
        BRTJ    ($)name,,*
+       SLJ     *+m
        0n      DICT.
+       00      p1
        :       :
        :       :
        00      pn
```

name is the transfer address for the loaded overlay or segment

$$m = \frac{n+1}{2} + 1$$

n is the number of actual parameters in the FORTRAN CALL statement, (p_1, . . . ,p_n).

p_1, . . . ,p_n are the actual parameters in the FORTRAN CALL statement.

Example:

CALL SEGMENT(3,2,25,,A,B,C)

The first FORTRAN card is: PROGRAM SUB2(X,Y,Z)

The transfer address in segment 2 of overlay 3 is SUB2.

The call to load the segment is:

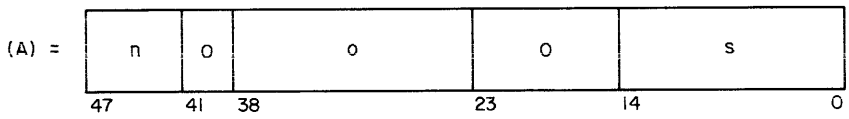
```
BRTJ    ($)SEGMENT, , *
SLJ     *+5
07      DICT.
00      =03
00      =02
00      =025
00      0
00      A
00      B
00      C
00      0
```

The call from SEGMENT to the transfer address SUB2 in segment 2 of overlay 3 is:

```
BRTJ    ($)SUB2, , *
SLJ     *+3
03      DICT.
00      A
00      B
00      C
00      0
```

ERRORS If errors occur during the loading of the overlays and segments, when using the FORTRAN CALL, the job is terminated. The A register will contain the contents of the parameters for the last LOVER call specified in the

CALL { OVERLAY / SEGMENT } statement.



n = Logical unit number
o = Overlay number
s = Segment number

The contents of the A register is written on OUT together with one of the following messages:

1. READ PARITY ERROR
2. LUN OUT OF RANGE
3. USE OF TOO MANY LUN
4. RECORD NOT ON THIS LUN
5. ILLEGAL SEQUENCE
6. OUT OF BOUNDS LOAD

COMPASS CALL

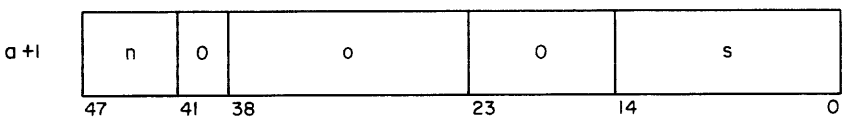
The LOVER subroutine, which keeps a record of the last overlay and segment loaded from each unit, must be in storage as a part of the main subprogram. LOVER must be declared an external symbol to the main program in order for the SCOPE loader to load LOVER from the library tape and link it to the main program at the time the overlay tape is prepared. LOVER is called during program execution when an overlay or segment record is to be loaded from the overlay tape. LOVER does not execute the overlay or segment; it only calls it.

During execution of the overlay program, any residual tape beyond the double end-of-file marking the end of the overlay tape may be put to other uses. Therefore, when LOVER is entered, the overlay tape must not be positioned at the end of recorded information.

CALLING SEQUENCE

The following calling sequence is included in a COMPASS subprogram to load an overlay or segment:

```
a     CALL LOVER
```




```
a+2   (return point)
```

n = Logical unit number of the overlay tape
o = Overlay number
s = Segment number, S = 0 for the overlay

If LOVER has loaded the overlay or segment correctly, the A register is set to zero; a bank return jump instruction to the transfer address of the overlay or segment is placed in the Q register; return is made to the return point. The transfer address is stored in the second word of the overlay or segment record on the overlay tape.

Example:

The following macro definition could be used to specify calls to LOVER:

```
LOADOV   MACRO   (N,V,S)
         BRTJ    ($)LOVER,0,$LOVER
         VFD     A6/N,O3/0,A15/V,O9/0,A15/S
         EXT     LOVER
         ENDM
```

To load overlay 2 from logical unit 10, the following macro call can be made:

```
         LOADOV  (10,2)
```

To load segment 2 of overlay 5 from logical unit 6, the following macro call can be made:

```
         LOADOV  (6,5,2)
```

ERRORS If errors are encountered while loading the overlay or segment, the A register contains one of the following error codes right justified.

Error Code	
1	A non-recoverable parity error was encountered when loading the overlay or segment record.
2	The specified logical unit number is not 1-49.
3	More than four logical units have been addressed in reading overlay and segment records.
4	The overlay or segment specified in the calling sequence was not on the specified logical unit.

5 The overlay or segment specified in the calling sequence was not consistent with the last overlay or segment loaded. (Either rule 3 or 4 in Section 6.3 has been violated.)

6 An attempt was made to load an overlay or segment out of bounds.

6.4 FORMAT OF OVERLAY TAPES

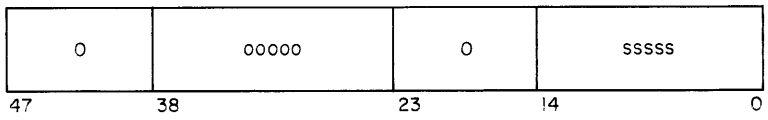
Each overlay tape is divided into files. The first file contains either one record, consisting of the main program, or no records. The second and remaining files are overlay files, the last of which is terminated with two end-of-file marks. Each file contains an overlay record, and records for associated segments. A single end-of-file mark precedes each overlay record. All the overlays and segments for one program must be on no more than four logical units, and no unit may occupy more than one reel.

The first record in each overlay file must be an overlay record and may be followed by segment records referenced by that overlay. The overlays on each overlay tape must be numbered in ascending order. Segments within an overlay file must be numbered and ordered consecutively. All segments of one overlay must be in one overlay file on one reel of one logical unit.

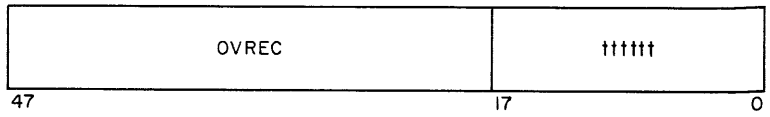
Loading information is contained in each overlay and segment record. The binary information in a record need not be all for one bank. A particular main, overlay, or segment may occupy any number of banks. In order to allow for the reloading of the various parts of a main, overlay or segment into the correct bank, the loader inserts 3600 control words in the record. The control word for loading a part of any overlay, segment or main program, n words in length, into a particular bank will be inserted within the record, immediately preceding the n words to be loaded. The n words will be followed by another control word for loading the next m words into another bank, and so on, until the last two words of the record are the control words, IOTR 0,0.

The first six words of each record contain identification parameters for that overlay or segment. These six words are in the following format:

word 1:

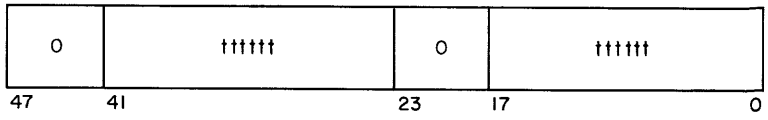


word 2: (A)



or

(B)



words 3-6:

0	fwa(7)	0	fwa(6)
0	fwa(5)	0	fwa(4)
0	fwa(3)	0	fwa(2)
0	fwa(1)	0	fwa(0)

47 38 23 14 0

ooooo is the overlay number
sssss is the segment number
OVREC is the BCD mnemonic
tttttt is an 18-bit transfer address
fwa(n) is the first word address of available storage in bank n at the time the record is written.

If the record is a main record, word 1 is zero. If there are two transfer addresses for the main record, word 2 type (B) is used. The first transfer address encountered by the loader occupies bits 41-24; the second transfer address occupies bits 17-0. If only one transfer address is encountered, it occupies bits 17-0, and is in the format for type (A) of word 2.

If bits 14-0 of word 1 are zero, the record is an overlay record.

All overlay and segment records contain the mnemonic OVREC in bits 47-18 of word 2.

Words 3-6 of each record contain 15-bit addresses in the upper and lower address portions of each word. Each address specifies the last word address+1 of any numbered common in a particular bank at the time the record was written. For a non-existent bank the address contains zero. The last word address+1 of numbered common is the same as the first word address of available storage for a bank.

A typical overlay record might be composed as follows:

000	00006	000	00003	word 1
OVREC			123456	word 2
000	00000	000	00000	
000	00000	000	00000	words 3-6
000	00100	000	00001	
000	01234	000	17654	
IOTW,C		(1)	10000,100	
100 words absolute binary subprogram				
IOTW,C		(2)	70000,300	
300 words absolute binary subprogram				
IOTW,C		(3)	60000,200	
200 words absolute binary subprogram				
IOTR		(0)	0,0	
IOTR		(0)	0,0	

This example is segment 3 of overlay number 6. The lower limits of available storage for this segment are: (0)17654, (1)01234, (2)00001, (3)00100. The record specifies loading 100_8 words into bank 1 beginning at address 10000, 300_8 words in bank 2 beginning at address 70000, and 200_8 words into bank 3 beginning at address 60000. The transfer address for this segment is 23456 in bank 1.

LIBRARY PREPARATION AND MAINTENANCE

7

PRELIB is the SCOPE routine which prepares and maintains library tapes. A library tape may include:

- Absolute binary programs
- Relocatable binary programs
- Binary data
- BCD data
- Subroutine directories
- User defined information
- End of file marks

New libraries may be created by extracting records from up to nine old libraries, and/or processing data in any one of five modes from one or more input units. The old libraries may be the standard SCOPE library (logical unit 70) or the auxiliary libraries (logical units 72-79). The input units may be the standard input unit (logical unit 60) or a programmer defined unit (logical units 1-49, or 62). The five modes for processing input records are absolute binary, relocatable binary, BCD data, binary data, or special.

Directories describe the relocatable binary records which follow them on the library tape. The loader uses the information contained in the directory to locate and load subroutines.

The first record of every library contains a table of contents and a label. The table of contents, which describes each record on the tape, is used by SCOPE to position the library tape and to locate directories. Although auxiliary libraries are referred to by logical unit numbers 72-79 during PRELIB processing, all library tapes contain logical unit number 70 in the label; however, the labels may contain different names and edition numbers.

The PRELIB routine may be used to:

List the table of contents of a library

Edit an existing library while inserting records from an input unit

Prepare a new library from the old SCOPE library, auxiliary libraries, and records from an input unit

PRELIB processing consists of two phases. In phase 1, control cards are read from the standard input unit and records are processed according to the mode specified. Those records that can be fully processed before reading another control card (absolute, relocatable, binary data, BCD data, special) are written on the scratch unit, S0, as soon as they have been processed. Directories, initiated by DIR control cards and terminated by END control cards, are prepared and stored internally. A table of contents is developed internally containing the name of each record and its mode.

When PRELIB encounters the FINISH control card, the run will be terminated if it was a LIST run. If it was EDIT, the rest of the tape is copied onto S0. If it is either an EDIT or PREPARE run, S0 is rewound and the table of contents of the new library is listed on OUT. If any errors are found during phase 1 processing, the run is terminated. If no errors occur, phase 2 is initiated. The new library tape will be created on logical unit 71, the label will contain logical unit 70 and the name for logical unit 71. The first record on S0 must be binary; the new table of contents plus the label is appended to the first record and written on the new library.

According to their order and mode in the table of contents in storage, records are copied from S0 onto 71, directories are copied from storage onto 71 and end-of-file marks are written on 71 where specified. If a record on S0 has been defined in phase 1 as repeated, when it is encountered on S0, it is copied into a repeat table in storage. If it is too long for storage it is written on S1. When the repeated record is called for in the table of contents, it is written onto logical unit 71. Upon completion of the new library tape, 71 is rewound and unloaded and control is returned to SCOPE. An end-of-file mark is not written at the end of the new library unless specified.

Only parity errors are possible during phase 2. When an unrecoverable parity error occurs, the message PARITY ERROR will be written on OUT after the table of contents listing; no further records will be written on 71.

7.1 INPUT/OUTPUT

All control cards to a PRELIB run are read from the standard input unit (60). Column 1 of PRELIB control cards must contain a 7,9 punch; the balance is free-field, except for imbedded blanks, which are significant. A control statement must be contained on one card and is terminated by a period or column 80. Comments, which may appear beyond the period, are ignored by PRELIB.

Input to PRELIB may be records from logical units 1-49, 60, and 62, from the SCOPE library (logical unit 70), and from auxiliary libraries (logical units 72-79).

Input records in absolute, relocatable, BCD data, binary data, and special form must be indicated by the control statements, ABS, REL, BCD, BIN,

special. The records may follow the control statements directly on logical unit 60. Records contained on a different logical unit (1-49, or 62), must be specified by a UNIT control statement. UNIT may specify 60; if no UNIT statement is used, 60 is assumed.

During a PRELIB run, the following information is written on the standard output unit:

all PRELIB control cards

the new table of contents

error messages

MAP of absolute and relative records

7.2 RECORD TYPES

The mode of transfer for records from logical units 1-49, 60, or 62 to the new library on logical unit 71 must be specified by a mode control statement. Other control statements define directories and end-of-file marks on the new library tape.

In the following statements, name is entered in the table of contents to identify the information following the control statement on the logical unit. It may be up to 31 characters in length. If no name is specified, the name of the first subprogram in the record is inserted in the table of contents; if no subprogram name exists, blanks are inserted. For relocatable binary records, the name from the IDC card is inserted in the directory which contains the record.

RELOCATABLE BINARY RECORDS

$^{7}_{9}$REL,name

REL specifies that the information on a logical unit is a single subroutine in relocatable binary card form and should be written as one record on the new library in a condensed relocatable form. REL may be used only within the range of a directory. A DIR control statement must precede the first REL control statement.

REL processes the single relocatable binary subroutine by placing the information from the IDC, EPT, BLT, and EXT cards in the subroutine directory tables. BRT, RBD, LAT, and TRA cards are read into storage in card image format. When one TRA card is processed, the entire record is written on S0; another control statement is read from the standard input unit.

ABSOLUTE BINARY RECORDS

$^{7}_{9}$ABS,name(location)

PRELIB links relocatable binary subprograms read from the standard input unit or another logical unit and writes them on S0 as one absolute binary record. An absolute binary record may originate at any absolute location specified in the location field (in octal). If the location is not specified, the absolute binary record originates at location zero.

ABS processes the relocatable binary subprograms by loading the RBD card images as though the first subprogram began at the specified absolute location and subsequent subprograms began where the preceding subprogram terminated. The subprograms are linked by associating external symbols with entry points within the program. When two consecutive TRA cards are encountered, the linked subprograms are written as one record on S0.

Examples:

$^{7}_{9}$ABS,BOOT

This record, BOOT, is originated at absolute location zero.

$^{7}_{9}$ABS,LDR(14000)

This record, LDR, is originated at absolute location 14000.

BINARY RECORDS

$^{7}_{9}$BIN,name

Binary information is transferred without alteration from the standard input unit or another logical unit to S0. It is written on S0 as a single binary record. The end of the data is indicated by a card with a word count of zero.

BCD RECORDS

$^{7}_{9}$BCD,name

BCD information is transferred without alteration from the standard input unit or another logical unit to S0. It is written on S0 as a single record. The end of the data is indicated by a blank card.

MACRO DEFINITIONS

$^{7}_{9}$MACRO

MACRO composes the system and library macro tables for COMPASS. Macro definitions in COMPASS language are read from the standard input unit or another logical unit. The first set of definitions is the system macro table and is terminated by ENDSYS* following the last ENDM. Immediately following the ENDSYS* card are the library macro definitions. The table is terminated by an ENDLIB*. If there are no library macro definitions, the ENDSYS* card need not appear.

When an ENDLIB* card is encountered, the entire table is written as one binary record on S0 and control is returned to PRELIB.

Example:

```
7/9MACRO
NAME1     MACRO     (p1,p2, . . . , pn)
            .
            .
            .
          ENDM
NAME2     MACRO     (p1,p2, . . . , pn)
            .
            .
            .
          ENDM
          ENDSYS*
NAME3     MACRO     (p1,p2, . . . , pn)
            .
            .
            .
          ENDM
          ENDLIB*
```

USER CONTROL CARD

The user may add special routines to PRELIB. The special control statement, 7 characters or less, must be added to the PRELIB list of control statements. Input/output will be handled by PRELIB if jumps are made to the proper routines with the correct parameters. If a special routine results in one or more records on 71, the names and modes of the records must be added to the table of contents.

DIRECTORIES

$^{7}_{9}$DIR,name

The DIR control statement indicates that a directory is to be inserted on the new library tape, 71. A directory of all subsequent relocatable subprograms is constructed in storage until an END, DIR, or FINISH control statement is encountered. Only relocatable binary subprograms may be contained in a directory.

The directory name and mode are entered in the table of contents. The directory is constructed in storage from tables or, during the processing of IDC, EPT, BLT, and EXT cards, in the relocatable binary subprograms. During phase 2 when a directory mode is encountered in the table of contents, the directory is written on the new library tape, logical unit 71.

$^{7}_{9}$END,name

This control statement terminates the relocatable binary subprograms to be included in the directory specified by the previous DIR control statement. END does not result in a record on the new library tape.

Example:

$^{7}_{9}$DIR,name

$^{7}_{9}$REL,name

relocatable binary subprogram

$^{7}_{9}$REL,name

relocatable binary subprogram

$^{7}_{9}$END,name

END-OF-FILE

$^{7}_{9}$EOF,name

EOF specifies that an end-of-file mark is to be written on the new library, logical unit 71. When the EOF control statement is read from the standard input unit, the name and mode are entered in the table of contents in storage. During phase 2 when an end-of-file mode is encountered in the table of contents, an end-of-file mark is written on the new library tape.

End-of-file marks placed before each directory, allow SCOPE to skip files to locate directories. If a loader precedes a directory, the end-of-file should precede the loader. End-of-file marks should not be used within the directory.

It is recommended that a library be terminated by two consecutive end-of-file marks.

7.3 CONTROL STATEMENTS

Control statements on the standard input unit may prepare a new library tape, edit an old library tape or list a library table of contents. Records can be repeated and different logical units may be specified to contain input records. PREPARE, EDIT, and LIST are mutually exclusive within a PRELIB job.

The parameter, libname-ee, in a control statement refers to the name in the label of a library tape. The tape edition number, ee (1 to 99), is optional. For the SCOPE system library tape, logical unit 70, the name is *. LIB is never used.

A libname beginning with an * means the current system library unit 70. Any characters immediately following the * and before the next comma or right parenthesis are ignored. PRELIB deletes leading blanks and fills in trailing blanks so that all names are 32 characters in length, imbedded blanks are counted.

The parameter, rec, in a control statement refers to an existing library record which is to be transferred to the new library. When rec is numeric, it specifies the ordinal of the record on the source library which is the same as in the source library table of contents. When rec is alphabetic, it specifies the name of a record listed in the table of contents of the source library.

A range of record identifiers may be specified as rec_j-rec_k.

PRELIB RUN

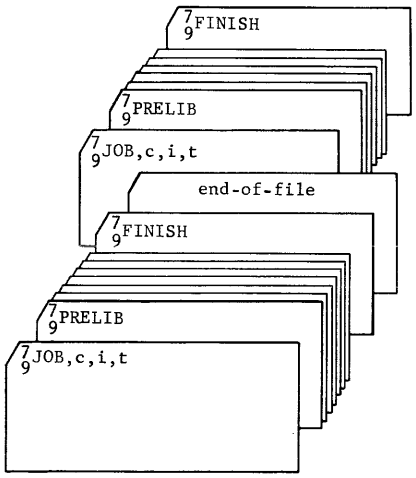
A PRELIB run may be PREPARE, EDIT or LIST; it begins with a PRELIB control statement and terminates with a FINISH control statement. There may be only one PRELIB run in a SCOPE job.

$^{7}_{9}$PRELIB

Calls the SCOPE library preparation routine into storage and transfers control to it.

$^{7}_{9}$FINISH

Returns control to SCOPE after processing is completed.



COMMENTS

A comment card is ignored by PRELIB and printed on the standard output unit.

7/9*. . .

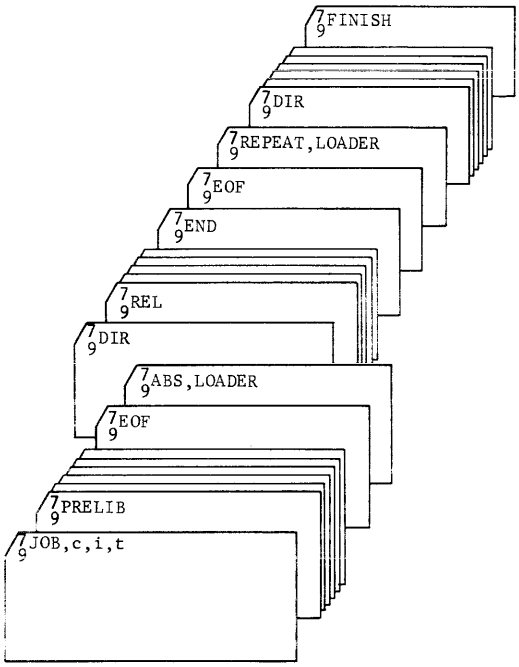
In a comment card, the first non-blank character must be *.

REPEATED RECORDS

The same record may be written in different positions on the new library by a REPEAT statement.

7/9REPEAT,name

name may be any record that has already been processed except an EOF or DIR. To repeat a REL record, it must appear in a completed directory. Two records with the same name may not be in the same directory.

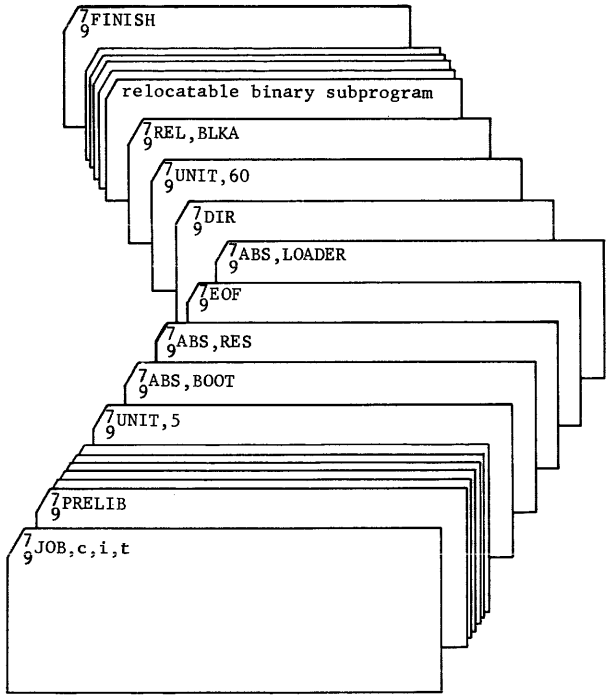


LOGICAL UNIT FOR INPUT RECORDS

A UNIT control statement specifies the logical unit, 1-49, 60, or 62, from which input records will be read until the next UNIT control statement is encountered on INP.

7/9UNIT,u

A control statement specifying mode, such as REL or ABS, is read from INP before the input record is read from the specified logical unit.



During processing, PRELIB encounters the UNIT,5 control statement.

1) The UNIT,5 control statement indicates that input records are on logical unit 5.

2) ABS,BOOT specifies that PRELIB is to read the next input record, BOOT, in relocatable binary from logical unit 5 until 2 consecutive TRA cards are encountered. BOOT is written on S0 in absolute binary.

3) ABS,RES specifies that RES is to be read from unit 5 and written on S0 in absolute binary.

4) An end-of-file is indicated in the table of contents in storage.

5) ABS,LOADER specifies that the LOADER is to be read from unit 5 and written on S0 in absolute binary.

6) A directory for the following relocatable binary subprograms will be built in storage.

7) UNIT,60 indicates that input records are on the standard input, logical unit 60.

8) REL,BLKA specifies that PRELIB is to read the next input record, BLKA, a relocatable binary subprogram, from the standard input unit until 1 TRA is encountered. BLKA is written on S0 in relocatable binary.

LISTING TABLE OF CONTENTS

The table of contents of the named library tape is written on the standard output unit. As many as 9 tapes may be listed in one run if one is *, the SCOPE system tape.

$^{7}_{9}$LIST(libname$_1$-ee,libname$_2$-ee, . . .)

PRELIB considers the parameters as logical units 72-79 from left to right in the statement. If a libname cannot be found, a message is typed on OUT. (Messages and Diagnostics, Appn C.) If more than one tape with the same name is specified, the edition numbers of all but the last in the list must be specified. If this is not done, assignments must be made on the typewriter.

Examples:

$^{7}_{9}$LIST(*,SASY1-8,BRT SCOPE,MACRO,SASY1)

PRELIB considers libnames to be logical unit numbers:

*	70
SASY1-8	72
BRT SCOPE	73
MACRO	74
SASY1	75

For logical unit number 75, PRELIB will choose the library named SASY1 which has not yet been assigned a logical unit number.

If there is no mounted tape with BRT SCOPE in the label (including the space) a message will be typed: 73 NEEDED

$^{7}_{9}$JOB,777,DDSTON,3

$^{7}_{9}$PRELIB

$^{7}_{9}$LIST(SASY1-1,SASY1-2,*)

$^{7}_{9}$FINISH

The table of contents for SASY1-1, SASY1-2, and the SCOPE system library are listed on the standard output unit.

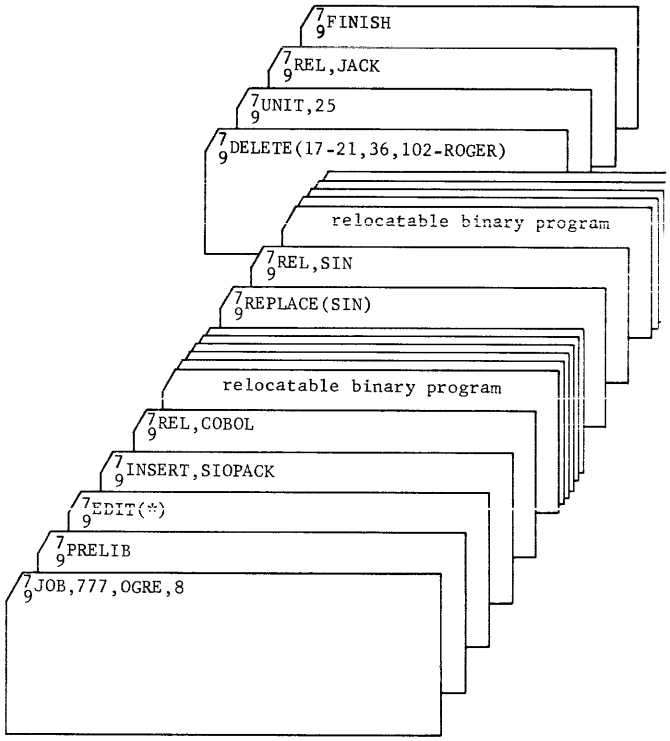
EDITING EXISTING LIBRARY

A single library tape is edited by deleting, replacing or inserting records. Auxiliary libraries may not be used.

EDIT is the first statement in the editing deck.

7/9 EDIT(libname-ee)

Edit Example



The source library tape is the SCOPE system library.

1) The source library is copied onto S0 up to and including SIOPACK and the tape is positioned at the beginning of the record following SIOPACK.

2) The relocatable program, COBOL, is copied from the standard input unit onto S0.

3) The source library is copied beginning with the record following SIOPACK, skipping SIN, and the tape is positioned at the beginning of the record following SIN.

4) The relocatable program, SIN, is copied from the standard input unit onto S0.

5) The source library is copied onto S0 beginning with the record following SIN through record 101, skipping records 17-21 and 36. Records 102 through ROGER are skipped and the source library is left at the beginning of the record following the one named ROGER (assuming that ROGER comes after 102).

6) The relocatable binary subprogram, JACK, is then copied from logical unit 25 onto S0.

7) FINISH indicates that the remainder of the source library is to be copied onto S0. The new table of contents is listed on the standard output unit. The new library is then copied from S0 and storage onto 71. Note that if a directory is within the range of records to be copied, that the directory is not copied, but that a completely new directory is built in storage and written on 71 at the location specified.

The name of the new library will be the same as the source library with the edition number incremented by one. An * is used if the SCOPE system library is to be edited.

All records on the source library, except those replaced or deleted, will be copied onto S0. Since the source library can move forward only, records must be declared in the order in which they appear on the source tape.

During editing, old directories are updated by PRELIB.

The FINISH control statement terminates the editing deck; after it is encountered, the rest of the source library is copied onto S0. The new table of contents is listed on OUT; then the new library is written.

Example:

$^{7}_{9}$EDIT(LIBRARY-5)

The tape to be edited is named LIBRARY, edition number 5. The new tape will be named LIBRARY, edition number 6.

DELETE specifies records, rec_i, on the source library which are not to be copied; all other records not to be deleted are copied.

$^{7}_{9}$DELETE(rec_1,rec_2,rec_3-rec_4, . . . ,rec_n)

DELETE may be followed by control statements to insert any number of records onto the new library to effect a REPLACE control statement.

Although an END control statement is not a record, it is indicated in the source table of contents. To delete it from the source table of contents, the record following it must be deleted.

Example:

$^{7}_{9}$DELETE(1-4,COMPASS,17-FTN,PRELIB)

$^{7}_{9}$REL,SIN

relocatable binary subprogram
.
.
.

While copying the source library on to S0:

1) Records 1-4 are skipped.

2) Records 5 to COMPASS minus 1 are copied onto S0.

3) COMPASS is deleted.

4) COMPASS plus 1 to record 16 are copied onto S0.

5) 17 to FTN are skipped.

6) FTN plus 1 to PRELIB minus 1 are copied onto S0.

7) PRELIB is skipped.

8) The source tape is positioned at the beginning of PRELIB plus 1.

9) Relocatable binary subprogram SIN is read from the standard input unit, processed, and written on S0.

INSERT causes all records up to and including a specified record to be copied onto S0. The source tape is positioned after the specified record. INSERT is followed by control statements to insert any number of records on the new library at that point.

$^{7}_{9}$INSERT,rec_i

If rec_i is 0, any input records following INSERT will be copied before any records are copied from the source library.

Example:

$^{7}_{9}$ABS,BOOT

relocatable binary program

$^{7}_{9}$INSERT,ALGOL

$^{7}_{9}$REL,SORT

relocatable binary subprogram

.
.
.

1) BOOT is written in absolute binary on S0.

2) The source library is copied onto S0 up to and including ALGOL and is positioned at the beginning of ALGOL plus 1.

3) The relocatable binary subprogram, SORT, is copied onto S0.

REPLACE copies records from the source library onto S0 skipping one or more specified records. The source library tape is positioned after the specified records. DELETE may be followed by control statements to insert any number of records on the new library at that point. There need not be a one-to-one correspondence between the number of records deleted and inserted.

$^{7}_{9}$REPLACE(rec$_i$)

Example:

$^{7}_{9}$REPLACE(A-14)

$^{7}_{9}$UNIT,7

$^{7}_{9}$REL,COMPASS

.
.
.

1) The source library is copied onto S0 skipping records A-14. The source library is positioned at the beginning of record 15.

2) The relocatable binary subprogram, COMPASS, is copied from logical unit 7 to S0.

NEW LIBRARY TAPE

A new library is prepared by extracting information from existing libraries, and including new records from a logical unit. When the FINISH statement is encountered, information is taken from S0 and storage, the new table of contents is written on OUT, and the new library is written on logical unit 71. During library preparation, records need not be declared in the order of appearance on the library tapes. If a record is requested that has been passed, the library tape will be rewound, then spaced forward to extract the requested record.

PREPARE instructs PRELIB to prepare a new library from the source libraries.

EXTRACT specifies the records on source library tapes which are to be transferred to the new tape. EXTRACT can only be used with a PREPARE statement.

$^{7}_{9}$EXTRACT,u(rec$_1$,rec$_2$, . . . rec$_n$)

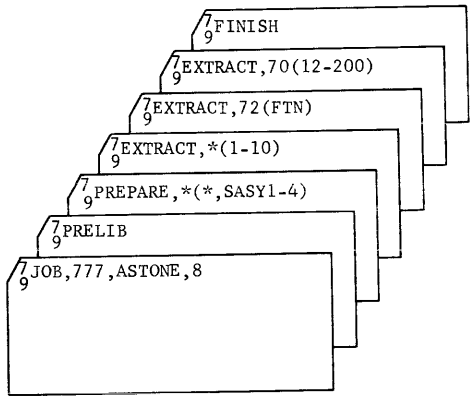
u is the logical unit number (*, 70, 72-79) or a source tape name specified in the PREPARE statement. Either * or 70 may be used for the current system library.

The records to be extracted from the specified library tape, rec_i, need not be specified in the order of appearance on the library tape, since the library tape can be rewound. If the same name appears in the table of contents twice, the first will be chosen.

Example:

7/9EXTRACT,*(1-5,4,19-FTN,12)

Records 1-5 are copied onto S0 from the system library; the library tape is rewound. Records 1-3 are skipped, record 4 is copied, records 5-18 are skipped, records 19-FTN are copied. The tape is rewound and records 1-11 are skipped then record 12 is copied. The library is positioned at the beginning of record 13 at this point. If FTN precedes record 19 on the tape, that tape will be rewound after copying 19, then skipped forward to copy FTN.

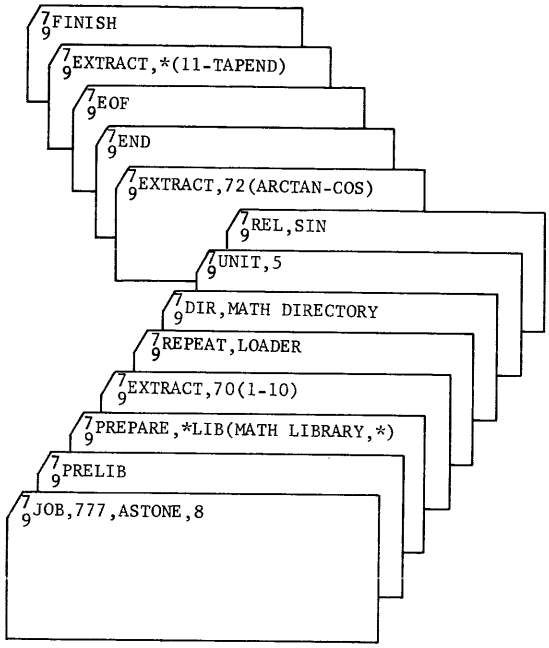


1) A new SCOPE system library is prepared from the current library and SASY1-4.

2) Records 1-10 are copied from * to S0.

3) FTN is copied from logical unit 72 to S0.

4) Records 12-200 are copied from logical unit 70 to S0.



1) A new SCOPE system library will be prepared from the current system library and the math library.

2) The first 10 records are copied from the current system library onto S0.

3) The loader must have already been encountered on the system library; indication will be made to repeat it.

4) A math directory will be built in storage to include the following relocatable binary records.

5) The relocatable binary input record, SIN, will be read from logical unit 5, processed, and written on S0.

6) ARCTAN-COS is copied onto S0 from the math library.

7) The math directory is terminated by the END control statement.

8) EOF is written in the new library table of contents.

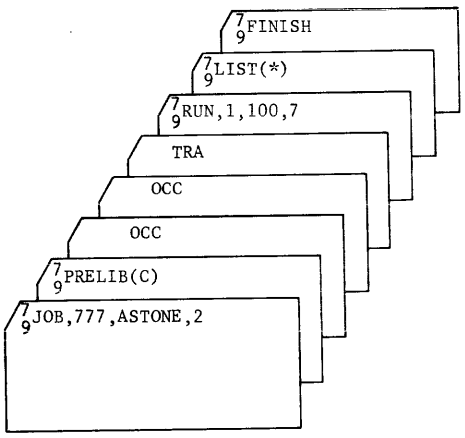
9) Records 11-TAPEND are copied from the current system library to S0. Naming the last EOF in a library provides a convenient way to read to the end of the library.

10) Library preparation is terminated with FINISH.

7.4 CHANGING PRELIB

The SCOPE parameters, s_1 and s_2, may be used to temporarily modify, snap, or trace PRELIB. The program extension area may not be used with octal corrections.

$^{7}_{9}$PRELIB(s_1,s_2)



7.5 TABLE OF CONTENTS

The library table of contents is in the first record on a library tape between the bootstrap routine and the tape label. Records are written in binary and numbered in the order in which they appear on the library.

Entries are in the order specified by the control statements used to prepare the library. An entry may or may not describe a record in the library. If it does, the mode, name, and record number are recorded. If the entry does not describe a record, such as END which is not a record on the library, mode and name are recorded. If the name is longer than one word, the first character gives the number of words in the name.

The table of contents of each new library is listed on the standard output unit during library preparation or editing. The LIST control statement may specify that the table of contents of an existing library is to be listed.

Following is a sample SCOPE system library, SASY1, as listed on the standard output unit.

70-0601,SASY1 04/22/64

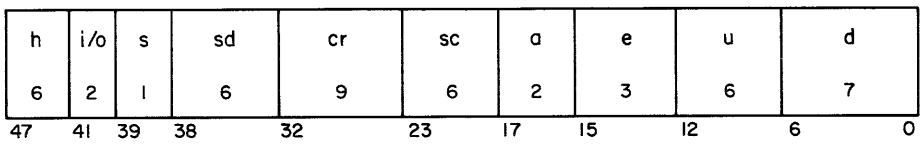
Record Number	Name	Mode
1	BOOT	ABS
2	RESIDENT	ABS
3		EOF
4		DIR
5	CARPU	REL
6	DR3649	REL
		END
7		EOF
8	LOADER	ABS
9		DIR
10	SIOPACK	REL
11	COMPASS	REL
12	COMPASSX	REL
13	FTN	REL
		END
14		EOF
15	LOADER	ABS
16		DIR
17	IOP	REL
.	.	.
.	.	.
.	.	.
.	.	.
.	.	.
87	DPOWER	REL
		END
88		EOF
89		DIR
90	DCP	REL
		END
91		EOF

Record Number	Name	Mode
92		DIR
93	STD	REL
94	PRELIB	REL
		END
95		EOF
96		EOF
97	TAPEND	EOF
	END OF LIBRARY TAPE	

APPENDIX SECTION

AVAILABLE EQUIPMENT TABLE A

This table is a record of the equipment at an installation. It may be altered temporarily in storage by the AET statement (Sec. 2.6). The format of each word in the table is as follows:



h (octal)	Hardware Type	Mnemonic
01	magnetic tape unit	MT
02-03	(reserved for tape-like equipment)	
04	card reader	CR
05	card punch	CP
06	line printer	LP
07	paper tape station	PT
10	typewriter	TY
11	disc file	DF
12	drum	DR
13	CRT display	TV
14	plotter	PL
15-17	---	
20	3682 Satellite	
21	equipment associated with Satellite 1 (SA)	defined within the Satellite system
22	equipment associated with Satellite 2 (SB)	
.	.	
.	.	
.	.	
26	equipment associated with Satellite 6 (SF)	
27-57	---	
60-77	reserved for installation use	

i/o input-output capability of the unit

01	output
10	input
11	input and output

s SCOPE accessibility bit

0	unit is accessible to SCOPE
1	unit is accessible only to Satellites.

sd is the ordinal of the unit driver.

cr is the ordinal (>0) of the unit controller.

sc Satellite-control-channel field used as follows:

If h = 21-26, sc = hardware type for the Satellite

If the equipment is capable of interrupting the 3600 asynchronously, sc = SCOPE channel connection and e = SCOPE equipment number

When a unit is connected, sc = channel connection. (sc = 40B initially)

a availability

00	unassigned, available
01	unassigned, down
10	assigned to SCOPE
11	assigned to Satellite

e equipment code of the unit for the Satellite.

u the unit code.

d the ordinal (d>0) of the driver name.

MACRO DEFINITIONS AND CALLING SEQUENCES

B

INTERNAL

```
CALL36      MACRO     (CC)
  +         63        CC*8
            03        SENTRY
            EXT       SENTRY
            ENDM
```

SCOPE call codes (CC) are as follows:

0	EXIT	16	SELECT
1	READ	17	REMOVE
2	WRITE	18	LIMIT
3	REOT	19	FREE
4	WEOT	20	TIME
5	BSPR	21	BOUND
6	BSPF	22	UNBOUND
7	REWIND	23	DATE
8	UNLOAD	24	LOADER
9	SKIP	25	LIBRARY
10	ERASE	26	MEMORY
11	MARKEF	27	HERESAQ
12	MODE	28	RELEASE
13	STATUS	29-63	Not Assigned
14	LABEL	64-4095	reserved for use of
15	SAVE		individual installation

```
IOF         MACRO     (L,C,R,I,CC)
            CALL36    (CC)
                      control word address (C)
                      logical unit number (L)
            STAR      ( (R),*-2)
                      interrupt address (I)
            ENDM

STAR        MACRO     (R,S)
            IFT,EQ    R,/*/,1
                      Call address (S)
            IFT,NE    R,/*/,1
                      Reject address (R)
            ENDM
```

```
Z       MACRO       (CC,I,X)
        VFD         A6/CC,A3/X,A15/I
        ENDM
```

INPUT/OUTPUT

READ, WRITE, REOT, WEOT

Definition

```
⟨READ⟩
⟨WRITE⟩   MACRO     (L,C,R,I)
⟨REOT⟩
⟨WEOT⟩

          IOF       ( (L),(C),(R),(I), ⟨1⟩ )
                                       ⟨2⟩
                                       ⟨3⟩
                                       ⟨4⟩
          ENDM
```

Calling Sequence

```
⟨READ⟩
⟨WRITE⟩   63        ⟨1⟩ *8
⟨REOT⟩              ⟨2⟩
⟨WEOT⟩              ⟨3⟩
                    ⟨4⟩
          03        SENTRY
          00        control word address
          00        logical unit number
          00        reject address
          00        interrupt address
```

NOTE: The names of these macros are used for illustrative purposes, and may be any acceptable alphanumeric identifier.

BSPR, BSPF, REWIND, SKIP, ERASE, AND MARKEF

```
name    MACRO       (L,R,I)
        IOF         ( (L),0,(R),(I),CC)
        ENDM
```

Calling Sequence

```
name    63          (CC)*8
        03          SENTRY
        00          0
        00          logical unit number
        00          reject address
        00          interrupt address
```

The following mnemonics may be used to reference scratch and system units:

Mnemonic	Logical Unit	Mnemonic	Logical Unit
S0	50		
S1	51	INP	60
S2	52	OUT	61
S3	53	PUN	62
S4	54	ICM	63
S5	55	OCM	64
S6	56	ACC	65
S7	57	LGO	69
S8	58	LIB	70
S9	59	SCR	80

UNLOAD

```
name    MACRO   (L,R,I,P)
        IOF     ( (L),(P),(R),(I),10B)
        ENDM
```

Calling Sequence

name		63	10B*8
		03	SENTRY
		pp	release parameter
		00	logical unit number
		00	reject address
		00	interrupt address
pp	=	0	logical unit assignment is to be released after the physical unit is unloaded.
	≠	0	logical unit assignment is not to be released after the physical unit is unloaded.

RELEASE

```
name    MACRO   (L,R,P)
        CALL36  (34B)
        IFT,EQ  P,0,1
        00      logical unit number
        IFT,NE  P,0,1
        40      logical unit number
        STAR    ( (R),*-1)
        ENDM
```

Calling Sequence

name		63	34B*8
		03	SENTRY
		p . . 0	logical unit number
		00	reject address
pp	=	0	dispose of the physical unit according to previous specifications.
	≠	0	rewind the physical unit and release the assignment, but do not dispose of the tape.

MODE

name	MACRO	(L,R,U,F,D,DR)
	CALL36	(14B)
	STAR	((R),*-1)
		logical unit number
	VFD	O23/0, A5/U, A5/F, A5/D, A5, DR
	ENDM	

Calling Sequence

name		63	14B*8
		03	SENTRY
		00	reject address
		00	logical unit number
		VFD	O23/0, A5/U, A5/F, A5/D, A5, DR
U (usage)	RW	24B	allow all legal operations
	BY	22B	bypass unit
	RO	21B	allow only input operations
F (format)	BCD	7	set BCD recording mode
	BIN	6	set binary recording mode
D (density)	HY	13B	800 bpi
	HI	12B	556 bpi
	LO	11B	200 bpi
	OP	10B	operator's option
DR (direction)	RV	30B	read reverse
	ND	31B	read normal

STATUS

STATUS	MACRO	(L,M)
	CALL36	(15B)
	IFT,NE	M,/M/,1

```
            00          0
  -         00          logical unit number
            ENDM
```

Calling Sequence

```
  name      63          13B*8
            03          SENTRY
            00          00
            00          logical unit number
```

LABEL

```
  LABEL     MACRO       (L,N,E,C)
            CALL36      (16B)
            00          location of name (N)
            00          logical unit number (L)
            00          edition number (E)
            00          reel number (C)
            ENDM
```

Calling Sequence

```
  name      63          16B*8
            03          SENTRY
            00          location of name
            00          logical unit number
            00          edition number
            00          reel number
```

SAVE

```
  SAVE      MACRO       (L)
            CALL36      (17B)
                        0
  -         00          logical unit number
            ENDM
```

Calling Sequence

```
  name      63          17B*8
            03          SENTRY
            00
            00          logical unit number
```

INTERRUPT

SELECT

```
name    MACRO     (F,I)
        CALL36    (20B)
        IFT,EQ    F,/I/,2
        10        **
        00        I
        IFT,NE    F,/I/,2
        00        **
        Z         (F,I)
        ENDM
```

Calling Sequence

```
name    63        20B*8
        03        SENTRY
        00        **
        F         interrupt address
```

F = 01 interrupt on shift fault
02 interrupt on divide fault
03 interrupt on exponent overflow fault
04 interrupt on exponent underflow fault
05 interrupt on arithmetic overflow fault
10 interrupt on storage reference fault
11 1604 mode alert
12 trace mode alert
14 interrupt on illegal instruction fault
15 interrupt on operand parity fault
16 manual interrupt alert

REMOVE

```
name    MACRO     (F)
        CALL36    (21B)
  -     VFD       A6/F, O18/0
        ENDM
```

Calling Sequence

```
name    63        21B*8
        03        SENTRY
        00        **
        F         00
```

LIMIT

```
name    MACRO     (D,R,I)
        CALL36    (22B)
        IOSR      time (D)
        00        reject address (R)
        00        interrupt address (I)
        ENDM
```

Calling Sequence

```
name    63        22B*8
        03        SENTRY
        IOSR      (seconds, milliseconds)
        00        reject address
        00        interrupt address
```

BOUND

```
name    MACRO     (LB,UB,R,I)
        CALL36    (25B)
        XMIT      LB,UB
        00        reject address
        00        interrupt address
        ENDM
```

Calling Sequence

```
name    63        25B*8
        03        SENTRY
        XMIT      lower bound, upper bound
        00        reject address
        00        interrupt address
```

UNBOUND, EXIT, FREE, TIME, DATE, HERESAQ

```
name    MACRO
        CALL36    (CC)
        ENDM
```

Calling Sequence

```
name    63        CC*8
        03        SENTRY
```

SPECIAL

LOADER

```
name    MACRO
        CALL36      (30B)
        ENDM
```

Calling Sequence

```
name    63          30B*8
        03          SENTRY
```

LIBRARY

```
name    MACRO       (L,R,NA,NU)
        CALL36      (31B)
        00          reject address (R)
        00          logical unit number (L)
        VFD         A24/record number (NU)
        00          record name address (NA)
        ENDM
```

Calling Sequence

```
name    63          31B*8
        03          SENTRY
        00          reject address
        00          interrupt address
        VFD         record number
        00          record name address
```

MEMORY

```
name    MACRO       (B,LL,UL)
        CALL36      (32B)
        VFD         O6/0, B3/B, A15/UL
        00          LL
        ENDM
```

Calling Sequence

```
name    63          32B*8
        03          SENTRY
        VFD         bank designator, upper limit
        00          lower limit
```

SCOPE MESSAGES AND DIAGNOSTICS

C

Messages are written to the operator on the operator comment medium (OCM), to the programmer on the standard output unit (OUT) and standard punch unit (PUN), and to the installation on the accounting unit (ACC). Messages do not require any corrective action.

Diagnostics are indications of error conditions which require corrective action. They are written on OCM or OUT, or both.

MESSAGES ON OUT

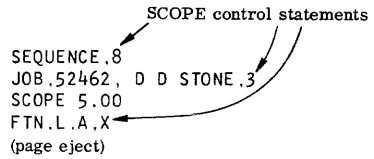
message	meaning
AET printouts	The AET table is printed according to the AET statement options.
BEGIN JOB AT hhmm - ss	The time is printed on OUT when no sequence statement is present.†
SCOPE c. xy	To separate the control statements from the run and identify the version of the system. c refers to a specific COSY tape. x is the field update number. y is the installation update number.
control cards except JOB, SEQUENCE, ENDSCOPE	SCOPE control cards are listed before being processed.
END JOB SEQUENCE xxxxxx DATE mm/dd/yy TIME hhmm - ss ELAPSED TIME xx HRS xx MIN xx SEC	Job termination message.††
end-of-file mark	Jobs on OUT are separated by an EOF record.
JOB card image	The JOB card is printed.

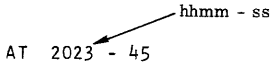
† hh = hours
mm = minutes
ss = seconds

†† mm = month
dd = day
yy = year

message	meaning
SEQUENCE card image with words 8, 9, and 10 preset to: AT hhmm - ss	The SEQUENCE statement and job initiation time are written.
1	A page eject record separating runs.

The following example illustrates the messages and information written to the programmer on OUT for a typical compilation and execution. According to the $^{7}_{9}$FTN, L, A, X card, the FORTRAN source program is listed, followed by the assembly language listing; next, a COMPASS program is assembled and listed. All SCOPE control statements, times, MAP, and program output are listed. A memory dump of the program, labeled and numbered common, and console scoop are forced because of an illegal jump out of bounds.





FORTRAN Source Program Listing

```
5.1                                                          PAGE NO.    1

            PROGRAM  A TEST RECOVERY OPTIONS
            TYPE INTEGER B, SUM
            COMMON/A/B(10)
            DATA (B=10,16.4,2,3.5.7,9,2,18)
            PRINT 12
      12     FORMAT (17H  SUM = BI + BI+1)
            DO 7 I=1,9,2
            SUM=B(I)+B(I+1)
            PRINT 10,SUM,B(I),B(I+1)
      10    FORMAT (315)
      7     CONTINUE
            CALL START
            END
  0       0       22002 <-- compiler diagnostic
(page eject)
```

```
                                        IDENT     TESTRECX
PROGRAM LENGTH              00055
ENTRY POINTS
                  TESTRECX  00007
BLOCK NAMES
                  A         00012
EXTERNAL SYMBOLS
                     ELD.
                  Q8QDICT.
                    START
                     STH.
                  Q8QENTRY
  00000  63  0  P00000   EXIT.    63        ($)*
         20  0  X77777             20        ($)Q8QDICT.
  00001  00  0   00000   DICT.    OCT       0000000000000000
         00  0   00000
  00002  63  2   56263             OCT       6325626351252367
         51  2   52367
  00000.                   A       BLOCK     10
  00000                            COMMON    B(10)
                  C00000           ORGR      B
  00000  00  0   00000             OCT       0000000000000012
         00  0   00012
  00001  00  0   00000             OCT       0000000000000020
         00  0   00020
  00002  00  0   00000             OCT       0000000000000004
         00  0   00004
  00003  00  0   00000             OCT       0000000000000002
         00  0   00002
  00004  00  0   00000             OCT       0000000000000003
         00  0   00003
  00005  00  0   00000             OCT       0000000000000005
         00  0   00005
  00006  00  0   00000             OCT       0000000000000007
         00  0   00007
  00007  00  0   00000             OCT       0000000000000011
         00  0   00011
  00010  00  0   00000             OCT       0000000000000002
         00  0   00002
  00011  00  0   00000             OCT       0000000000000022
         00  0   00022
                 P00003            ORGR      *
  00003                  FORMAT.   BSS       4
                                   ENTRY     TESTRECX
  00007  63  0   00000  TESTRECX  UBJP      ($)*,,*
         01  0  P00007
  00010  63  0  P00007  +          63        ($)*-1
         20  0  X00000             20        ($)Q8QDICT.
   .                 .                                 .
   .                 .                                 .
   .                 .                                 .
  00052  75  0  P00050             SLJ       BEGIN.
         00  0  P00001             00        DICT.
  00053  50  1   00000  ENDING.    ENI       0,1
         75  0  P00000             SLJ       EXIT.
                                   END       TESTRECX
        NULLS                     TESTRECX              .7
```

(page eject)

COMPASS Program

```
2/17F                                                          ED    00000    PAGE NO.     1
                                        IDENT     RECOV
      PROGRAM LENGTH          00004
      ENTRY POINTS
                    START     00000
      BLOCK NAMES
                              00031
                    7070      00012
                    LABELED   00012
                                        ENTRY     START
                                                  THIS PROGRAM ATTEMPS A JUMP OUTSIDE ITS AREA OF
                                                   MEMORY, PRODUCING A BOUNDS FAULT TERMINATION.
        00000                           BLOCK     0
        00000                           COMMON    C(5,5)
        00000           7070            BLOCK
        00000                           COMMON    A(10)
        00000           LABELED         BLOCK
        00000                           COMMON    B(10)
        00000   50  0   00000 START     NOP
                50  0   00000
        00001   50  1   00001 +         ENI       1,1
                50  2   00002           ENI       2,2
        00002   50  3   00003           ENI       3,3
                04  0   77777           ENQ       77777B
        00003   63  0   00000           63        0       }
                03  0   00076           03        62      } jump out of bounds
                                        END
              NULLS                       START          C          A          B
        (page eject)
```

LOAD ← SCOPE control statements
RUN,2.1000.7,, FOR STANDARD OUTPUT UNIT LISTINGS
(page eject)

MAP

```
PROGRAM NAMES
1 77722  TESTRECX  00055     1 77704  RECOV     00004     1 77577  Q8QENTRY  00073     1 77171  IOS.      00406
1 77006  Q8QERROR  00163     1 75632  IOP.      01154     1 75463  ALLOC.    00147     1 75404  STH.      00057
1 73746  IOH.      01436

PROGRAM EXTENS.
NONE

LABELED COMMON
1 77710  A         00012     1 77672  LABELED   00012

NUMBERED COMMON
1 00001            00031     1 00032  7070      00012

ENTRY POINTS
0 00062  SENTRY              1 77731  TESTRECX            1 75020  ELD.              1 77577  Q8QDICT.
1 77704  START              1 75410  STH.                1 77600  Q8QENTRY          1 77651  EXIT
1 75635  IOP.               1 77244  Q8QHIST.            1 77171  IOE.              1 77363  Q8QCHAIN
1 77211  IOS.               1 77503  IOR.                1 77006  Q8QERROR          1 75543  ALLOC.
1 75470  RETURN.            1 75602  ALLOCIN.            1 73746  IOH.

EXECUTION STARTED AT   2024 -17 ← a FORTRAN run time printout
(page eject)
```

Program Output

```
SUM = BI + BI+1
 26    10    16
  6     4     2
  8     3     5
 16     7     9
 20     2    18
(page eject)
```

Recovery Dump

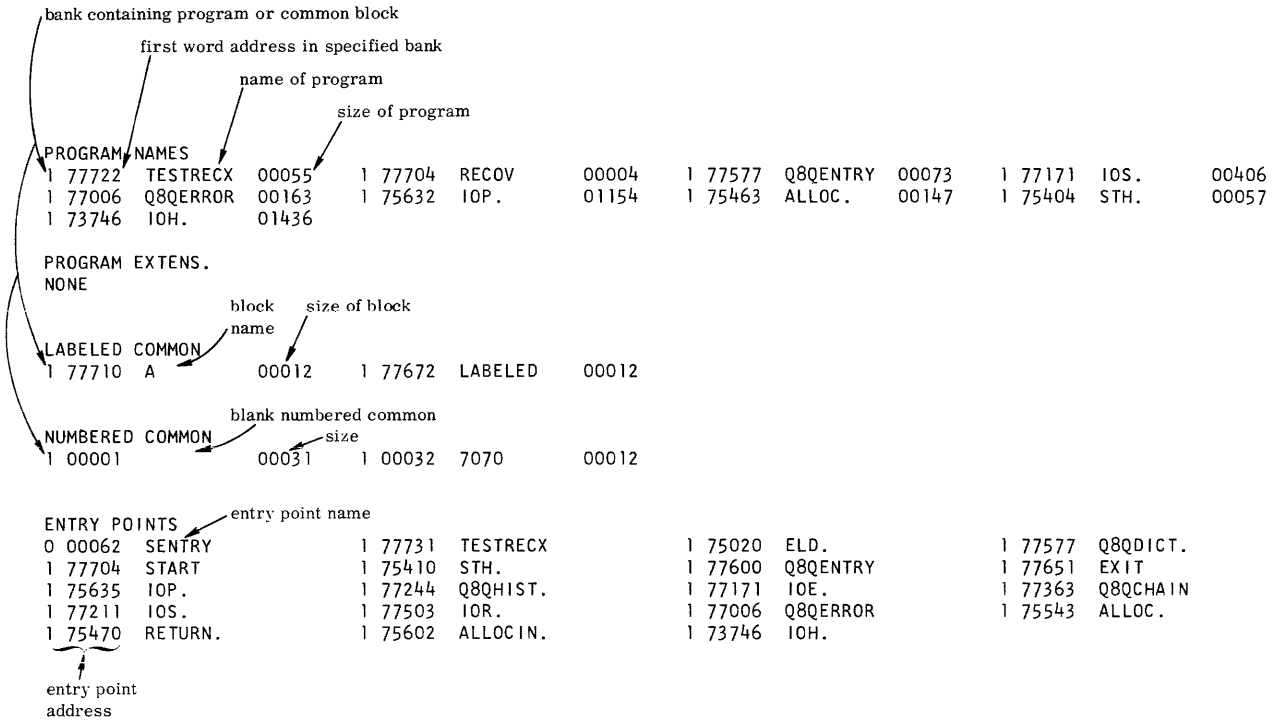
```
RECOVER        ILL. BOUNDS INT

(ZERO)=6300000101177707        SENTRY=6300000001000062        BOUNDS=0017777700014600

A = 0000000000000001   Q = 7777777777777777   D = 0000000000000000   IR = 0000000000000000   IM = 7777777777771600
  B1 = 00001   B2 = 00002   B3 = 00003   B4 = 64003   B5 = 00001   B6 = 00000   MS = 0000000000000014

100001       0   00000000 00000000   00000000 00000000   00000000 00000000   00000000 00000000   00000000 00000000
100006       5   00000000 00000000   00000000 00000000   00000000 00000000   00020640 00000006   00000000 00000000
100013      12   00000000 00000000   00000000 00000000   00000000 00000000   00000000 00000000   00000000 00000000
  **      **       **       **       **       **       **       **       **       **       **       **       **       **
100025      24   00000000 00000000   00000000 00000000   00000000 00000000   00000000 00000000   00000000 00000000
      7070
100032       0   00000000 00000000   00000000 00000000   00000000 00000000   00000000 00000000   00000000 00000000
100037       5   00000000 00000000   00000000 00000000   00000000 00000000   00000000 00000000   00000000 00000000
      IOH.
173746       0     UBJP 6300000101175430   RXT00741225 STA20075261   SAL61074210 SAL61074356   SAL61074430 RXT00740407
173752       4   SAU60074207 SIU56174255   SIL57274255 SIU56374256   SIL57474256 SIU56574257   SIL57674257 ENI50100010
173756      10   STQ21075257 ENI50000000     SBYT 6301170350574206     SBYT 6301170350574213   ENI50200021 ENI50500000
173762      14     SBYT 6302000150774210   RXT00740653 RXT00740343     SBYT 6301170350574177     SBYT 6300301750475262
173766      20   STA20075344 LDA12073746   STA20074261 INA11000001   STA20075031 INA11000001     SBYT 6300002250575162
  .                      .                       .                       .                       .
  .                      .                       .                       .                       .
  .                      .                       .                       .                       .
175376    1430   LDQ16715312 ROP00000000   SST40000000 ROP00000000   SAU60000000 ROP00000000   SAU60606060 SAU60606000
175402    1434   SAU60606060 SAU60604000   RSW00700000 ROP00000000
      STH.
175404       0     XMIT 6317540420177577     UBJP 6300000101177753   FSB31614660    62633033     XMIT 6317540420177577
175410       4     UBJP 6300000101177763     XMIT 6317541020177577     XMIT.6317541020175405     SBYT 6300001750775410
175414      10   ENQ04000000 ENI50000000     BRTJ 6300000003177211   SAL61075434 LDQ16075422     LBYT 6300302250375405
  .                      .                       .                       .                       .
  .                      .                       .                       .                       .
  .                      .                       .                       .                       .
175454      50   LDA12076156 AJP22075453   ALS05000017 ENI50000000   RAD70000442 SLJ75075447   ROP00076212 LIU52575457
175460      54   SIU56575466 ENA10000001   STA20076063 STA20076153   SLJ75075467 ENI50000000
      ALLOC.
175463       0   ENA10077777 ENI50000000   ENI50100075 ENI50200017   ENI50300000 ENI50464003   ENI50500002 ENI50600052
175467       4   LDQ16075602 RXT00740615     UBJP 6300000101176770     RTJ 7701440075475606     RGJP 6200000001075464
  .                      .                       .                       .                       .
  .                      .                       .                       .                       .
  .                      .                       .                       .                       .
175623     140     BRTJ 6307777003000062   ROP00214343 SBL46232163   SBL46516023 FAD30213145   SAU60234346 AJP22222551
175627     144   DVI25246060 SAU60606060   FAD30000004 ROP00175624      77700000 INF77000000
      IOP.
175632       0   ENI50100011 ENI50200047   ENI50300000 ENI50464003   ENI50500002 ENI50600052     UBJP 6300000101175436
175636       4      STA 7710440020076173   SIU56175632 SIL57275632   SIU56375633 SIL57475633   SIU56575634 SIL57675634
  .                      .                       .                       .                       .
  .                      .                       .                       .                       .
  .                      .                       .                       .                       .
177663      64   SBL46456062    63215163   DVI25246021    63606060   QRS02000204 SAU60400107   SAU60606060 SAU60606060
177667      70   ROP00000005 ROP00177662   ROP00000001 ROP00177671   ARS01606060 SAU60606060
      LABELED
177672       0   00000000 00000020   07400077 00000074   00000007 00000000   00000000 00007000   40000000 00000011
177677       5   10400000 00000074   77777777 00000000   60606060 00000000   00000100 00000074   77777777 77700350
      RECOV
177704       0     UBJP 6300000101177767   ENI50100001 ENI50200002   ENI50300003 ENQ04077777     BRTJ 6300000003000076
      A
177710       0   00000000 00000012   00000000 00000020   00000000 00000004   00000000 00000002   00000000 00000003
177715       5   00000000 00000005   00000000 00000007   00000000 00000011   00000000 00000002   00000000 00000022
      TESTRECX
177722       0     XMIT0631777222 177577     UBJP 6300000101177652     LBYT 6325626351252367     CONN 7401073060606264
177726       4   LDL44601360 AJP22316020   SAU60223120 ARS01346060     CONN 7403310534606060     BRTJ 6300000003000062
177732      10     XMIT 6317773120177577     XMIT 6317773120177723   SIU56177775 RTJ75477772   ENA10000075 ENQ04077743
177736      14     BRTJ 6300000103175410   SLJ75077741 ARS01077723   ROP00177725 ROP00000000     BRTJ 6300000103175020
177742      20   SLJ75077743 ROP00077723   ENA10000001 RXT00741225   STA20077776 ENI50000000   RXT00741225 LIL53177776
177746      24      LDA 7710440012177707   ADD14177710 RXT00741225   STA20077771 ENA10000075   ENQ04077763 ENI50000000
177752      30     BRTJ 6300000103175410   SLJ75077755 ARS01077723   ROP00177730 ROP00000000   LDA12077771    77700000
177756      34      LDA 7710440012177707      77700000 LDA12177710      77700000 ENI50000000     BRTJ 6300000103175020
177762      40   SLJ75077763 ROP00077723   ENA10000002 RXT00741225   RAD70077776 INA11077765   AJP22377745 ENI50000000
177766      44     BRTJ 6300000103177704   SLJ75077770 ROP00077723   SLJ75077775 ENI50000000   ROP00000000 ROP00000024
177772      50   SLJ7507735 ENI500000000     BRTJ 6300000103177600   SLJ75077772 ROP00077723   ENI50100017 SLJ75077722
177776      54   ROP0000000 ROP000000013
  END JOB SEQUENCE 8      DATE 02/20/64     TIME  2024 - 53  ELAPSED TIME 00 HRS  01 MIN  07 SEC
(page eject)
                                              hhmm - ss
```

MAP

MAP is obtained after the program is loaded. It is printed on OUT. Following is the map from the sample job. All information in the MAP is in octal.

Under program names, names declared in the subprograms are listed first, library subroutine names follow. Similarly, entry point names such as TESTRECX and RECOV in the subprograms precede library subroutine entry point names. The library subroutines Q8QENTRY, IOS., Q8QERROR, etcetera, are called by the FORTRAN object program.

MAP



RECOVERY DUMPS

Recovery dumps are taken for programs which do not terminate normally. The dump is written on OUT. There are 4 computer words per line in octal with mnemonics for program locations, and 5 computer words per line in octal for common. An octal console scoop is always taken.

A recovery diagnostic (see diagnostics on OUT) is written indicating the cause of the abnormal job termination.

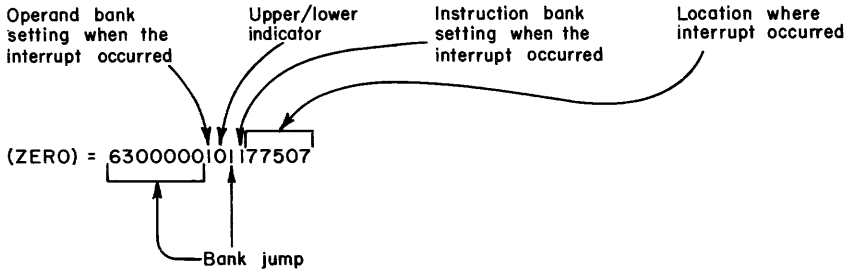
One or more identical lines are omitted and are indicated by a row of asterisks.

Mnemonics in the console scoop are:

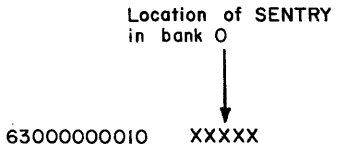
A	A register
Q	Q register
D	D register
IR	Interrupt register
IM	Interrupt mask register
B1-6	Index registers 1-6
MS	Miscellaneous mode selections register
BR	Bounds register

If the dump occurs with the interrupt system active, location zero contains an unconditional bank jump (63.0) to the location or location +1, where the interrupt occurred.

Example:



SENTRY will contain the following:

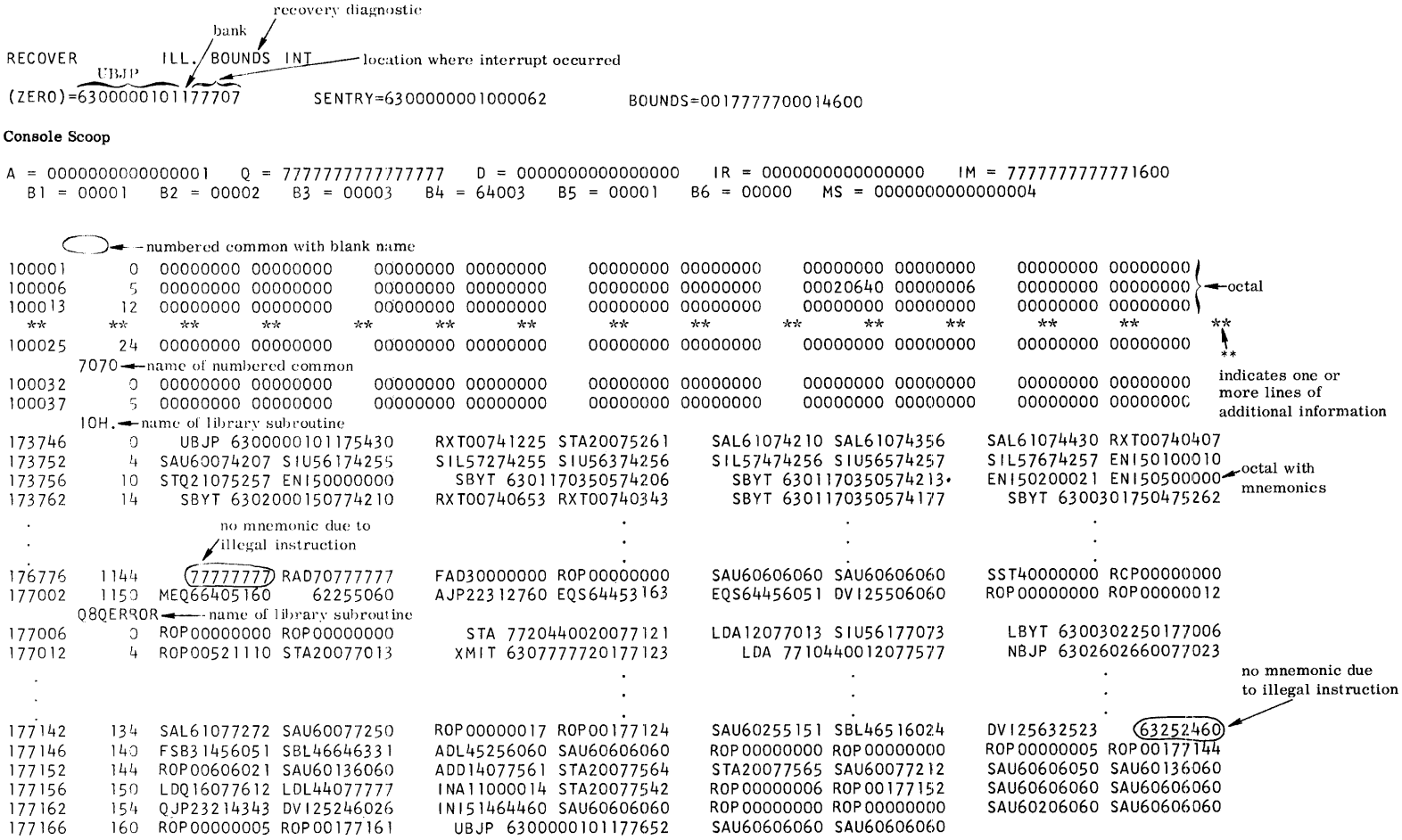


If the dump occurs during interrupt lockout mode, it is because of an I/O request causing abnormal termination and SENTRY contains an unconditional bank jump to the location +1 of the I/O request.

When autoload recovery is used, (ZERO) and SENTRY contain zero.

The recovery dump for the typical job is shown.

RECOVERY DUMP



```
        IOS.<------ name of library subroutine
177171      0  ROP00000000 ROP00000001      SAU 7710440060077171   ENA10000000 LLS07000052      DVF 7710000127077573
177175      4     DVF 7710000127077574    SBYT 6300001450777207   LDA12077171 ENQ04000075    BRTJ 6300001503175635
177201     10    BRTJ 6300000003177006  ROP00000000 ROP00000000   ROP00000000 ROP00177204  DVI25515146 INI51604623
  .                    .                          .                    .                        .
  .                    .                          .                    .                        .
  .                    .                          .                    .                        .
177571    400  SLJ75077552 EN150000000  ROP00000000 ROP00000000   ROP00000000 ROP00000012  ROP00000000 ROP00000100
177575    404  ROP00000000 ARS01000000  ROP00000000 RXT00777777
        Q8QENTRY<------ name of library subroutine
177577      0    XMIT 6317540420177577    UBJP 6300000101177774   RXT00741225 SLJ75077600  ENA10077600 SAL61077601
177603      4  LDQ16077644 LDA12077600  RXT00740341 ARS01000017   RXT00740565 LDA12100000  RXT00740341 STQ21100000
  .                    .                          .                    .                        .
  .                    .                          .                    .                        .
  .                    .                          .                    .                        .
177657     70  ROP00000005 ROP00177662  ROP00000001 ROP00177671   ARS01606060 SAU60606060
        LABELED<------ labeled common
177672      0  00000000 00000020   07400077 00000074    00000007 00000000    00000000 00007000   40000000 00000011 } <-- octal
177677      5  10400000 00000074   77777777 00000000    60606060 00000000    00000100 00000074   77777777 77700350 }
        RECOV<---------- COMPASS program
177704      0    UBJP 6300000101177767  EN150100001 EN150200002   EN150300003 ENQ04077777   BRTJ 6300000003000076 } instruction causes interrupt
        A<------ labeled common
177710      0  00000000 00000012   00000000 00000020   00000000 00000004    00000000 00000002   00000000 00000003 } <-- octal
177715      5  00000000 00000005   00000000 00000007   00000000 00000011    00000000 00000002   00000000 00000022 }
        TESTRECX<------ FORTRAN program
177722      0    XMIT 6317772220177577    UBJP 6300000101177652     LBYT 63256263512523 67     CONN 7401073060606264 }
177726      4  LDL44601360 AJP22316020  SAU60223120 ARS01346060     CONN 7403310534606060      BRTJ 6300000003000062 }
177732     10    XMIT 6317773120177577    XMIT 6317773120177723   SIU56177775 RTJ75477772    ENA10000075 ENQ04077743 }
177736     14    BRTJ 6300000103175410  SLJ75077741 ARS01077723   ROP00177725 ROP00000000      BRTJ 6300000103175020 }
177742     20  SLJ75077743 ROP00077723  ENA10000001 RXT00741225   STA20077776 EN150000000    RXT00741225 LIL53177776 } octal with
177746     24     LDA 7710440012177707  ADD14177710 RXT00741225   STA20077771 ENA10000075    ENQ04077763 EN150000000 } mnemonics
177752     30    BRTJ 6300000103175410  SLJ75077755 ARS01077723   ROP00177730 ROP00000000    LDA12077771    77700000 }
177756     34     LDA 7710440012177707     77700000 LDA12177710      77700000 EN150000000      BRTJ 6300000103175020 }
177762     40  SLJ75077763 ROP00077723  ENA10000002 RXT00741225   RAD70077776 INA11077765    AJP22377745 EN150000000 }
177766     44    BRTJ 6300000103177704  SLJ75077770 ROP00077723   SLJ75077775 EN150000000    ROP00000000 ROP00000024 }
177772     50  SLJ75077735 EN150000000    BRTJ 6300000103177600   SLJ75077772 ROP00077723    EN150100017 SLJ75077722 }
177776     54  ROP00000000 ROP00000013
 END JOB SEQUENCE 8      DATE 02/20/64    TIME  2031 - 51   ELAPSED TIME 00 HRS    01 MIN  07 SEC
```

absolute octal 18 bit address

octal address relative to the beginning of the subprogram or common block. When a new name is printed, the relative address is reset to 0.

word contents

SNAP AND TRACE

SNAP and TRACE dumps are in the same format. The dump consists of a console scoop and a memory dump written on OUT.

In the console scoop:

A and Q registers are printed in the requested mode.

Index registers and the D register are printed in octal.

Interrupt register, interrupt mask register and sense switches are printed in binary. Above the interrupt registers are bit positions for reference purposes.

In the memory dump, 4-10 computer words appear per line depending on the mode requested; asterisks in locations indicate that the information is identical to the preceding line.

The example shows the program and the SNAP dumps. Note the location of the SNAP card images; the first is printed after the LOAD card and the rest after the MAP.

When tracing is initiated, the following statement is written on OUT:

TRACING BEGIN AT 6 octal digit address - first word address of area to trace jumps $-a_1$

Before each dump in the SNAP format, the message is written:

P = address of jump instruction (P) = contents of P

```
SEQUENCE,9                                                    AT  2031 - 51
JOB,91001,LARSON,2
SCOPE 5.00
COMPASS,X,L
(page eject)


2/17F                                                  02/20/64      ED    0      PAGE NO.      1

                                                       IDENT     SNAPSSS
      PROGRAM LENGTH                    30011
      ENTRY POINTS
                          FIRST         30001
                          HELP          30006
      BLOCK NAMES
                          1234          00144
                                        ENTRY     FIRST,HELP
        00000                     1234  BLOCK     0
        00000                           COMMON    SPACE(100)
        00000                     ARY   BSS       30001B
        30001   50   0   00000  FIRST   NOP
                50   0   00000          NOP
        30002   50   1   00000  PG      ENI       0,1
                10   0   00000          ENA       0
        30003   20   1  P00000  STR     STA       ARY,1
                50   0   00000
        30004   54   1   30000          ISK       30000B,1
                75   0  P30003          SLJ       STR
        30005   10   0   77777          ENA       77777B
                50   0   00000
        30006   20   1  P00000  HELP    STA       ARY,1
                50   0   00000
        30007   54   1   30000          ISK       30000B,1
                75   0  P30006          SLJ       HELP
        30010   75   0  P30001          SLJ       FIRST
                50   0   00000
                                        END       FIRST
              NULLS                       SPACE             PG
        (page eject)


LOAD,69
SNAP,HELP,SNAPSSS,+550,0C,1,7,3,RESLT
(page eject)


MAP
(page eject)
```

```
SNAP,FIRST+1,FIRST,+7,M,1,2,1,PROG
SNAP,HELP,/1234/,+143,0,1,6,1,NCOMM
RUN,2,2000,1
```

PROG ← identification from SNAP card

```
        FIRST ← entry point (name in fwa)
177767      0    BRTJ 6300000003000062    BRTJ 6300005003077757    STA20147766  EN150000000    ISK54130000  SLJ75077771
177773      4  ENA10077777 EN150000000    BRTJ 6300012003077757    ISK54130000  SLJ75077774    SLJ75077767  EN150000000
```

NCOMM ← identification

```
        1234 ← common block name (name in fwa)
100001      0  50100000 10000000  63000001 01177771  00000000 00000000  00000000 00000000  00000000 00000000
100006      5  00000000 00000000  00000000 00000000  00000000 00000000  00020640 00000036  00000000 00000000
100013     12  00000000 00000000  00000000 00000000  00000000 00000000  00000000 00000000  00000000 00000000  ** ← locations are same (zeros)
  **       **    **       **       **       **       **       **       **       **       **       **
100102    101  00000000 00000000  00000000 00043222  00000000 00000000  00000000 00000000  00000000 00000000
100107    106  00000000 00000000  00000000 00000000  00000000 00000000  00000000 00000000  00020637 00000030  00000000 00000000
100114    113  00000000 00000000  00000000 00000000  00000000 00000000  00000000 00000000  00000000 00000000
100121    120  00000000 00000000  00000000 00000000  00000000 00000000  00000000 00000000  00000000 00000000  **
  **       **    **       **       **       **       **       **       **       **       **       **
100140    137  00000000 00000000  10000000 00065777  00000000 00000000  00000000 00000000  00000062 23464725
```

RESLT ← identification

Console Scoop

```
A = 7777777777777777    Q = 0000004400000001    D = 0000000000013773    BR = 0017777700014600

    B1  00000       B2   00000       B3  00000       B4  61533       B5  00001       B6  00000       SWITCHES  001000

bit position
              7654321098765432109876543210987654321098765432109876543210
IR = 00000000000000000000000000000000000000000000000000000000000000000000

bit position
              7654321098765432109876543210987654321098765432109876543210
IM = 11111111111111111111111111111111111111111111111111001110000000
```

SNAPSSS ← program name (name in fwa)

```
        SNAPSSS ← program name (name in fwa)
147766      0  00000000 00000000  00000000 00000000  00000000 00000000  00000000 00000000  00000000 00000000
  **       **    **       **       **       **       **       **       **       **       **       **       **
  ↑        ↑
absolute   octal address relative to name in fwa
octal
address
```

OCTAL CORRECTIONS AND LOADER CARDS

The following example contained an illegal instruction. OCC cards were used to correct the program and inserted into the binary deck. Note, the program extension area is included in the MAP.

All loader control cards (LCC) are written on OUT. These include BANK, MAIN, OVERLAY, and SEGMENT cards.

```
SEQUENCE,931                                                    AT  1409 - 45
JOB,52462,DDS,5
SCOPE 5.00
BANK,(1),HELP,/1234/
OCC IN PROGRAM USELESS  00003+ 75000000E
OCC IN PROGRAM USELESS  00000E 77200000 20000004+75000000+
(page eject)


PROGRAM NAMES
1 77771  USELESS     00006

PROGRAM EXTENS.
1 77767  USELESS     00002

LABELED COMMON
NONE

NUMBERED COMMON
1 00001  1234        00500

ENTRY POINTS
0 00062  SENTRY                  1 77771  HELP
RUN,4,1000,1
```

entry point in USELESS

common block in USELESS

} Octal corrector cards are inserted into a binary deck.

} Second octal correction is loaded in program extension area.

MESSAGES ON OCM

Message	Meaning	Action
AET printouts	AET table is printed according to AET statement options.	
ENTER DATE MDY	Initial autoload or computed time is later than midnight.	Enter date
JOB ABANDONED	Job is terminated because of control statement errors on INP.	
ssssss , iiiiii,	New job. The first 6 characters of sequence card and JOB identification are typed.	
PAUSE xxxxxx	A pause was requested before this job.	Any legal operator statement. A period means continue with next job.
RELEASED hh oo	hh oo is released.	
UNLOADED hh oo PRINT hh oo PUNCH hh oo PR/PU hh oo	Physical unit hh oo is unloaded. Tape is to be saved and has been unloaded.	
nn eerr, = hh oo †	Identifies a numbered unit.	
nn eerr, name of tape 32 characters = hh oo	Identifies a named unit.	
nn eerr, (TAPE IS UNLABELED) = hh oo	Identifies an unlabeled unit.	

SCOPE INITIATION TYPEOUT

ENTER DATE MDY

M month, D day, Y year, 2 digits each

† nn = logical unit number
ee = edition number appearing in label, or blank
rr = reel number
hh = hardware type mnemonic
oo = AET ordinal of unit, within hardware type

ENTER TIME HHMMSS. MARK BY JK1

HH hour, MM minute, SS second, 2 digits each

Operator types in time; when clock reaches selected second, operator presses jump key 1.

uu eerr, = hhoo

uu logical unit number

ee edition number

rr reel number

hh hardware type

oo AET ordinal within hardware type (octal)

SET STOP SWITCH x ON FOR SCR=hhoo

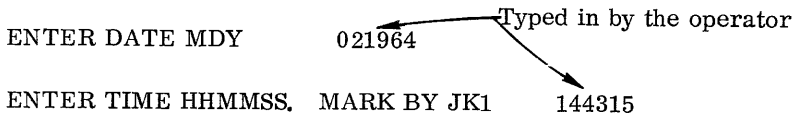
Operator sets requested stop switches.

ssssss , iiiiii, (Job identifier typeout)

Programmer I/O declarations (same format as for standard unit declarations)

Program output on OCM

Example:




```
70  0201, = MT20
65    01, = MT02
61    01, = MT03
      SET STOP SWITCH 1 ON FOR SCR   MT01

60    01, = MT07
 1      , DDSTON,
69    01, = MT04

 RELEASED MT04
01    02, (TAPE IS UNLABELED)                    =MT11
45    15, THIS LABEL IS 32 CHARACTERS LONG=MT07
 UNLOADED MT11
 UNLOADED MT07
```

AET LISTING

The AET listing on OCM or OUT can be obtained by entering the statement AET, , or AET, , OUT, on either OCM or INP.

Example:

```
AET 001     0261000400000200
AET 002     0271000400000400
AET 003     0271000400000600
AET 004     0271000400001000
AET 005     0261000400001200
AET 006     0261000400001400
AET 007     0261000400001600
AET 010     0261000400002000
AET 011     0271000400002200
AET 012     0261000400002400
AET 013     0261000400002600
AET 014     0261000400003000
AET 015     0261000400003200
AET 016     0261000400003400
AET 017     0261000400003600
AET 020     0271000400000000
AET 021     0541020000660203
AET 022     0541020000660403
AET 023     0731020000120002
AET 024     2063000000120001
```

MESSAGES ON ACC

Message	Meaning
END JOB SEQUENCE xxxxxx DATE mm/dd/yy TIME † hhmm - ss ELAPSED TIME xx HRS xx MIN xx SEC	Job termination message.
BEGIN JOB AT hhmm - ss	Time is printed on ACC when no sequence statement is present.†
JOB card image	The JOB card is printed.
SEQUENCE card image with words 8,9, and 10 preset to: AT hhmm - ss	The SEQUENCE statement card image and job initiation time are written.

† hh = hours
mm = minutes
ss = seconds

mm = month
dd = day
yy = year

MESSAGES ON PUN

Message	Meaning
end-of-file mark	Separator for punch tape at the end of the job in which unit 62 was used.
SEQUENCE, ssssss oo. . . o (80 character record)	Separator for punch tape at beginning of each job which requires unit 62. This record is binary.

DIAGNOSTICS ON OUT

Diagnostic	Condition	Action
CONTROL STATEMENT FORMAT ERROR	a) Illegal BCD character on a control card. b) Illegal equivalence declaration. c) Illegal logical unit number in the FILE LOAD or EQUIP card. d) Illegal parameter on RUN card.	Correct the illegal field.
CONTROL STATEMENT REJECTED	Statement out of sequence. Illegal character on an ENTRY POINT NAME card.	Check control cards for proper ordering.
ERRORS IN LOADING I/O DRIVERS	Loading errors detected when loading drivers.	Consult loader diagnostics and correct I/O driver routines on library tape.
ERRORS RETURNED - LOADING NOT ATTEMPTED	Compiler errors in the job before this loading operation was attempted. The LOAD statement precedes this message.	Correct compiler/assembler errors.
ERRORS IN LOADING OPERATION	Loader returned errors.	Consult loader diagnostics.
FILE I/O OR DATA ERROR	I/O error in FILE statement or illegal control statement within data to be filed.	Check data to be filed.
TIME LIMIT EXCEEDED	Time Limit exceeded while reading a control statement.	Extend specified time limit.

Diagnostic	Condition	Action
TAPE READ ERROR ON INP	1) Parity errors on control card read. (May be a BCD record.) 2) Parity errors on binary record when skipping.	Check if program read all of data.
TRA = 0	Transfer address after loading is zero. No transfer name provided on TRA card (generated by COMPASS END cards). Job is abandoned.	Provide a transfer name.

RECOVERY DUMP DIAGNOSTICS

Diagnostic	Condition
BAD SENTRY CALL	Entry to SENTRY through a jump during interrupt mode, not necessarily through a call
CWA ILLEGAL	Control word address is zero
EOF ON SYST UNIT	Attempt to backspace past end-of-file on systems unit or read past end-of-file on INP
EOT OP. - ILLEGAL	REOT/WEOT request used as first operation on unit
ILL. BOUNDS INT	Illegal bounds interrupt
ILLEGAL DENSITY	Specifying illegal density, e.g., hyper on 606
ILLEGAL INSTR.	Illegal instruction
ILLEG LABEL CALL	Illegal LABEL request, e.g., labeling a scratch tape; or edition number or reel number too large
ILL. MEM. MACRO	Illegal MEMORY request, e.g., setting limits in an illegal bank
ILLEG MODE CALL	Illegal MODE request, e.g., specifying contradictory modes within a call
ILL. USE OF UNIT	Illegal use of unit, e.g., a label macro reference to a unit which is not a tape
INTERNAL REJECT	Hardware problem, see 3600 Reference Manual, Appendix II

Diagnostic	Condition
INT. ADDR ILLEG	Interrupt address is 0 or -0
INT. ADDR. = 0	Interrupt address of a BOUND, SELECT, or LIMIT request is zero
INT. FEATURE BAD	Interrupt in SELECT request is illegal (0 or > 15)
L.U.N. ILLEGAL	Logical unit number illegal, negative, zero, or greater than 80
MACHINE OR SYSTEM ERROR FROM (5 digit address within SCOPE)	SCOPE equipment tables destroyed; machine or equipment malfunction
MEMORY REFERENCE	A reference has been made to a non-existent bank
NO WRITE ENABLE	Trying to write on a tape with no ring
OPERAND PARITY	Hardware problem, see 3600 Reference Manual, Appendix I
OPERATOR TERM.	Operator terminated job with an operator statement on OCM or recovery autoload
PRINT LIMIT	Print limit specified on RUN card exceeded
REJECT ADDR = 0	Reject address must be specified
TIMESUP	Time limit specified on JOB or RUN card exceeded

SNAP/TRACE DIAGNOSTICS

If an error occurs while processing SNAP or TRACE cards, the following message is written on OUT followed by the card image.

CARD yyy {SNAP / TRACE} ERROR AT COLUMN xxx mmmmmmmm

yyy	number of card
xxx	column being processed when error was detected
mmmmmmmm	diagnostic listed below

Diagnostic		Condition
BIG	NUM	Octal value more than 6 digits
BIG	PAR	Parameter greater than 4096
EXC	CARD	Insufficient information on SNAP or TRACE card

Diagnostic	Condition
FWA	FWA exceeds LWA
ILL MODE	Illegal character in mode field
ILL OCT	Illegal character in octal field
ILL PAR	Illegal character in parameter field (non-numeric)
ILL SLSH	Slash appears illegally
LOC MEM	Location references non-existent memory
LOC1 OCT	Initial location is absolute octal
LOC1 REL	Relative location with no preceding name
LOC2 OCT	LOC2 absolute octal
NO LOC2	No LOC2 on TRACE card
NO LWA	No LWA
NOT LOAD	Name not in loader tables
REL ERR	Relative address with no preceding name
LOC1 BIG	LOC1 greater than/equal to LOC2 on TRACE card

LOADER DIAGNOSTICS

All loader diagnostics are written on OUT in the following format:

LOADER ERROR P_1 P_2 P_3

When the loader detects an error in the loading operation, the diagnostic is written on OUT, and loading continues. For example, after writing the checksum error diagnostic on OUT, the card containing the error is processed as though the checksum was correct. The exceptions are the memory overflow errors and too many overlay tapes which cause the loading operation to be terminated. When errors are encountered during the loading operation, no library subroutines are loaded.

P_1 is the last subprogram name encountered by the loader; or if the errors are on the library tape, P_1 will be LIB TP, or blank. The values of P_2 and P_3 for each error are shown below.

P_2	P_3	Condition
BANK	Portion of BANK card containing format error.	BANK card format error.
CARD SEQ	Col. 1 and 2 of current card.	Card out of sequence, e.g., LAT card followed by EXT card.
CHKSUM	Col. 1 and 2 of current card.	Checksum error; Checksum on binary card does not agree with computed checksum.
COM LNG	Name of common block.	Common block length error. Labeled common blocks differ in length or multiple numbered common blocks in one bank vary in length.
CD TERM	Col. 1 and 2 of current card.	Previous card not terminated. On EPT or EXT, the second card for a continued name was not found.
EOT	Suppressed.	An end-of-tape has been encountered in writing an overlay tape.
FEW BRT	Suppressed.	Either the T portion of a BRT has made a reference past the end of the BRT table or the EXT entries exceed the BRT entries.
FEW LAT	Suppressed.	Either the T portion of an LAT has made a reference past the end of the LAT table or the EXT entries exceed the LAT entries.
ILL BYTE	Col. 1 and 2 of current card.	Illegal byte value in R field of RBD card; byte 10. . . 0, which is not used, was encountered.
ILL CHAR	Col. 1 thru 8 of OCC card.	A character which is not octal or blank appears in a correction, or an illegal relocation designator is used.
ILL PNCH	Col. 1 thru 8 of the OCC card.	An illegal punch configuration appears on an OCC.
LAT OV	LAT(T) .	The computed value of T, when entering an LAT into the permanent loader tables is greater than 4095.

P_2	P_3	Condition
LAT RNG	Address of attempted reference.	LAT range error; attempt to reference SCOPE in an LAT string.
LIB TP	Suppressed.	Library tape error. One of following conditions encountered on library tape: end-of-file card ≠ RBD, LAT, BRT, TRA parity error
LOAD ADD	Col. 1 and 2 of RBD card or col. 1 - 8 of OCC.	Illegal load address on RBD or OCC card. Byte for load address specified either a fixed or decremented address on RBD card. OCC load error may be one of following: Blank load address relocation designator specifies: decremented address fixed address numbered common
MD BANK	EPT name.	Multiply defined bank for EPT. Bank specified for EPT on BANK statement does not agree with bank assigned to entry point.
MD C BK	Name of common block.	Multiply defined common bank. Common block has been assigned to two or more banks by BANK statements or automatic assignment of the block followed by a BANK statement.
MD EPT	Entry point name.	Multiply defined entry point. Same entry point name defined at two addresses.
MD P.N.	Suppressed.	Multiply defined program name. Subprogram name encountered more than once.
MD TRA	Illegal transfer name.	Multiply defined transfer name. More than two TRA cards contain same name.
OVERLAY	Overlay number.	Current overlay card violates overlay rule.
OV MEM	Col. 1 and 2 of current card.	Memory overflow. Not enough memory available to assign block of common, subprogram, or program extension.

P_2	P_3	Condition
OVT MEM	Col. 1 and 2 of current card or col. 1 - 8 of OCC.	Memory overflow. Not enough memory available for loader tables.
PARAM	A register parameter for current loader call.	Parameter error. An illegal call to the loader. S=11 call after loader completed previous load request. S=10 or 00 call before loader completed previous load request. S=10 or 00 and QU = 0.
PARITY	Suppressed.	Non-recoverable parity error on loading unit or overlay tape.
SEC LIM	Col. 1 thru 8 of OCC card.	Current value of load address outside program section being corrected. (program section is the portion of the program referenced by a relocation designator of + or 1-9,0 on OCC).
SEGMENT	Overlay number followed by segment number.	Current segment card has violated a segment rule.
SEQ NO	Col. 1 and 2 of current card.	Sequence number on an EPT, BCT, EXT, LAT or BRT is out of sequence.
TAPE NO	Requested tape number.	Logical unit on LCC is out of range.
UN COM	Col. 1 and 2 of RBD card or col. 1-8 of OCC.	Undefined common reference. No common block declared for byte value on RBD card or relocation field on OCC card; or associated common block resulted in a COM LNG error.
UN EXT	External symbol.	Undefined external symbol. Reference to an external symbol not defined as entry point to any subprogram loaded or to any library subroutine.
UN TRA	Transfer name.	Undefined transfer name. Symbolic transfer name on one of the TRA cards was never defined as entry point to a subprogram.
126 BLK	Col. 1 and 2 of current card.	More than 126 common block names have been encountered in a subprogram.
5 TAPES	Suppressed.	More than 4 overlay tapes requested when preparing overlay tapes.

PRELIB ERROR DIAGNOSTICS

When PRELIB detects an error, the diagnostic is written on OUT and processing continues as though the error had not been encountered. Exceptions are memory and table overflow errors, ILLEGAL BCD, and ILLEGAL CONTROL CARD; these cause the job to be abandoned.

Message	Condition	Action
BLOCK LENGTHS UNEQUAL	Labeled common blocks of the same name in programs of an ABS record are not the same length.	Make labeled common blocks the same length.
CARD SEQUENCE ERROR	Card out of sequence.	Correct binary input.
CHECKSUM ERROR	Checksum on binary card does not agree with the computed checksum.	Correct punched checksum.
FEWER LATS THAN EXTS	Fewer LATS than EXTS within a subroutine.	
ILLEGAL BCD	Non-Hollerith character after column one on control card. Job abandoned.	Check for extra punches.
ILLEGAL BYTE VALUE	Illegal byte value in R field of RBD card; byte 10. . . 0, which is not used, was encountered.	Check RBD card and IDC which specifies byte length.
ILLEGAL CONTROL CARD	Control statement illegal, or name more than 31 characters, or name as first parameter (library name) on EXTRACT statement instead of number in tape designation field.	Check control cards.
ILLEGAL LOAD ADDRESS	Byte for load address specified a fixed or decremented address on RBD card.	Correct binary input.
MD BANK	Multiply defined bank on EPT or EXT card.	
MEMORY OVERFLOW FROM PROGRAM	ABS or REL subprogram too long. Job abandoned.	Subdivide program
MORE THAN 126 COMMON	More than 126 common blocks defined.	Reduce number of common blocks.

Message	Condition	Action
MULTIPLE TRANSFER NAMES	More than one named TRA card.	Replace extra named TRA cards with unnamed TRA.
MULTIPLY DEFINED EPT	Entry point name already defined.	Probably an extra subroutine in ABS record.
OVERFLOW FROM xxxxxxxx TABLES	Directory or loader tables too long. Job abandoned.	Reassemble PRELIB with expanded tables.
PARITY ERROR	Parity error in reading or writing a unit used by PRELIB.	Remake binary input, or change tape reels on 71 or 50.
PREVIOUS CARD UNFINISHED	Previous EPT or EXT card incomplete.	Correct binary input.
SEQUENCE NUMBER WRONG	EPT, EXT, BCT, or LAT card out of sequence.	Correct binary input.
SUBROUTINE NOT ON TAPE	Name or record number in DELETE, INSERT, REPLACE, or EXTRACT statement not on tape, or tape spaced beyond record.	Check source library tapes.
UNDEFINED COMMON BLOCK	Relocation byte on RBD card refers to undefined common block.	Correct binary input.
UNDEFINED EXTS	Undefined external symbols in an ABS record.	Probably a subroutine is missing.

DIAGNOSTICS ON OCM

Diagnostic	Condition	Action
BOUNDS REJECTED. AUTOLOAD	Perhaps a machine error.	Autoload to try again.
CANCELLED hh oo	Attempted release or unload cannot be accomplished on unit hh oo.	Mount a tape with blank label or unlabeled and give EQUIP statement in the form: EQUIP,uu=MToo.
CANNOT ASSIGN uu=hh oo	No unit containing a blank label is available for output. oo may be blank.	Mount tape with blank label. Type EQUIP, uu=hh oo; oo is unit on which tape was mounted.

Diagnostic	Condition	Action
CANNOT FIND REQUESTED JOB	A NEXT,C was issued; job containing sequence C cannot be located.	When type-in light comes on, respond with: Period to reprocess abandoned job, or NEXT for another job.
CONTROL STATEMENT FORMAT ERROR	Illegal BCD character on ICM or illegal equivalence declaration.	Correct illegal character declaration.
PRESS AUTOLOAD	Equipment tables have been destroyed.	Autoload.
SCR ORDINAL TOO LARGE FOR RECOVERY	No blank labeled tapes on bank zero. SCR was assigned to a tape on bank 1.	Press GO to continue, or restart with a blank label tape on a unit on bank 0.
SCOPE PARITY	Parity errors on reading RESIDENT or BOOT from system library tape.	Press GO to run with errors, or set A $\neq$ 0 to try three more reads.
STATEMENT UNINTELLIGIBLE	Illegal statement.	Check spelling, punctuation, etc., and retype statement.
nn BAD	Malfunction on tape nn or label parity error. Job abandoned.	Call Customer Engineers to check unit nn.
nn eerr, NEEDED nn eerr, name of tape NEEDED	Either, Tape with specified label is not mounted or not ready; or Multiple tapes with the specified label are available.	Mount or ready tape containing specified label. Type in: EQUIP,nn=hhoo; oo is unit containing needed tape.
nn eerr,(TAPE IS UNLABELED) NEEDED	Unlabeled tape specified in a control card on INP.	Type in: EQUIP,nn=hhoo; oo is unit containing needed tape.
TROUBLE ON hh oo	First reference to assigned unit impossible (EQUIP statement referenced non-existent unit).	Operator must reassign the unit.
PUT RING IN hh oo	Blank labeled tape with no write enable ring. Computer stops.	Operator must insert the ring and press GO.
60 ,NEEDED	System cannot locate standard input tape (logical unit 60).	Check physical tape drive containing INP for ready status. Also check that no other tapes are available to SCOPE with identical standard input label. Then, type: EQUIP,60=HIoo, oo is the unit on which INP is mounted.

AUTOLOAD RECOVERY

Autoload recovery may be used by an operator at any time to terminate a running program abnormally.

SCOPE reads the system scratch record indicated by the ordinal set in the stop switches. SCR contains enough information to produce the recovery requested on the RUN card. If the checksum is proper, the system is intact(I). Otherwise, the system is not intact(II) .

If the recovery dump is to be on equipment other than tape, manually interrupt SCOPE during the requests for tapes to be unloaded. When the TYPE-IN light comes on after unloading all programmer tapes, enter an EQUIP statement to define 61 as non-tape.

I. SYSTEM IS INTACT (SATELLITE MODE)

Diagnostics	Condition	Action
65=SA01	ACC is assigned to paper tape punch on the Satellite.	None
WHERE IS LAST 60 WHERE IS LAST 61 WHERE IS LAST 62	SCR has been found intact. The following messages are to locate the most recent reels of the standard units.	Type in: a 1 or 2-digit ordinal of tape assigned to requested logical unit at time of this recovery. This is obtained from the SCOPE initiation typeout: if 61 01, = MT03 is in initiation typeout, answer with 03 or 3. If requested unit was not assigned during this job or was assigned to a unit which is not magnetic tape, a space followed by a carriage return is sufficient.
UNLOAD TAPE NO.	All standard units have been assigned. Message releases all programmer and scratch tape units in use at autoload time.	Type in: a 1 or 2-digit ordinal of a tape to be saved. This message is repeated until there is a blank and a carriage return. All tapes, 1-59, assigned within this job should be unloaded.
WHICH JOB NEXT	Recovery dump taken. INP is positioned at point where last program ceased reading.	Follow with a job sequencing statement: NEXT ENDSCOPE REPEAT Repeat an AET statement given during this job. Reassign any non-tape equipment for standard units given during this job.

Example:

```
70 1101, = MT 20
61   01, = MT 03
 SET STOP SWITCH   1   ON FOR SCR = MT  01
60   03, = MT 12
 0004   ,LLSLEI,
01   01, = MT 15
71   01, = MT 16
UNLOADED  MT 16
60   04, = MT 14
 0005   ,DMKURN,
05   01,FTN COSY 4.00                  = MT 05
69   01, = MT 12
WAITING FOR INP
60   05, = MT 12
 0006   ,EFJONE,
60   06, = MT 14
 0007   ,GHJONE,
60   07, = MT 12
 0008   ,IJJONE,
60   08, = MT 14
 0009   ,KLJONE,
60   09, = MT 16
 0010   ,MNJONE,
07     , = CP 01
69   01, = MT 12
CANNOT ASSIGN 43 = MT  LOOK.                    Sequence job #10

43   01, = MT 12
CANNOT ASSIGN 25 = MT  LOOK.

25   01, = MT 05                                Point of AUTOLOAD recovery

65     , = SA 01

WHERE IS LAST 60

WHERE IS LAST 61

WHERE IS LAST 62

UNLOAD TAPE NO. 12

UNLOAD TAPE NO. 5

UNLOAD TAPE NO.

WHICH JOB NEXT  NEXT.                           Sequence job #10 was abandoned
                                                and job #11 was executed.
0011   ,OPJONE,
```

SYSTEM IS INTACT (NON-SATELLITE MODE)

Diagnostics	Condition	Action
WHERE IS LAST 60 WHERE IS LAST 61 WHERE IS LAST 62 WHERE IS LAST 65	SCR has been found intact. The following messages are to locate the most recent reels of the standard units.	Type in: a 1 or 2-digit ordinal of tape assigned to requested logical unit at time of this recovery. This is obtained from the SCOPE initiation typeout: if 61 01, = MT03 is in initiation typeout, answer with 03 or 3. If requested unit was not assigned during this job or was assigned to a unit which is not magnetic tape, a space followed by a carriage return is sufficient.
UNLOAD TAPE NO.	All standard units have been assigned. Message releases all programmer and scratch tape units in use at autoload time.	Type in: a 1 or 2-digit ordinal of a tape to be saved. This message is repeated until there is a blank and a carriage return. All tapes, 1-59, assigned within this job, should be unloaded.
WHICH JOB NEXT	Recovery dump has been taken. INP is positioned at the point where the last program ceased reading.	Follow with a job sequencing statement: NEXT ENDSCOPE REPEAT Repeat an AET statement given during this job. Reassign any non-tape equipment for standard units given during this job.

Example:

```
ENTER DATE MDY  070164

ENTER TIME HHMMSS.  MARK BY JK1  111500

70 1201, = MT 20
61   01, = MT 02
65   01, = MT 11
 SET STOP SWITCH   1   ON FOR SCR   MT = 01
60   01, = MT 14
 101     ,CDJONE,
 102     ,EFJONE,
 103     ,GHJONE,
 104     ,IJJONE,
 105     ,KLJONE,
 106     ,MNJONE,
07      , = CP 01
69   01, = MT 12
43   01, = MT 15
RELEASED  MT 12
25   01, = MT 12
WHERE IS LAST 60

WHERE IS LAST 61

WHERE IS LAST 62

WHERE IS LAST 65

UNLOAD TAPE NO. 12

UNLOADED MT 12
UNLOAD TAPE NO. 15

UNLOADED MT 15
UNLOAD TAPE NO.

WHICH JOB NEXT  REPEAT.

 106     ,MNJONE,
07      , = CP 01
69   01, = MT 04
43   01, = MT 16
RELEASED  MT 04
25   01, = MT 04
```

Normal printout during execution of an input reel.

Point of AUTOLOAD recovery

Sequence job 106 will be repeated

II. SYSTEM IS NOT INTACT (SATELLITE MODE)

Diagnostics	Condition	Action
65 = SA01	ACC is assigned to paper tape punch on the Satellite.	None
WHERE IS LAST 70 WHERE IS LAST 60 WHERE IS LAST 61 WHERE IS LAST 62	SCR was not found intact. The following messages are used to locate the standard assignments of tape units.	Type in: A 1 or 2-digit ordinal of tape assigned to requested logical unit at time of this recovery. If unit was not tape, not assigned or equivalenced, enter space, carriage return.
LEST OLD 60 BE FORGOTTEN	If the job in operation was part of a priority input, this message should be answered.	Type in: Space, carriage return if not a priority job. If priority, enter tape number of previous input tape whether or not it has been unloaded.
ENTER DATE MDY		Enter 6 digits, MMDDYY.
ENTER TIME HHMMSS. MARK BY JK1		Enter time and set jump key 1 to mark the second when clock should be read.
UNLOAD TAPE NO.	All standard units have been assigned. Message releases all programmer and scratch tape units in use at autoload time.	Type in: A 1 or 2-digit ordinal of tape to be saved. This message is repeated until there is a blank and a carriage return. All tapes, 1-59, assigned within this job should be unloaded.
WHICH JOB NEXT	Recovery dump has been taken. INP is positioned at the point where the last program ceased reading.	Redefine any non-tape standard units. Re-enter any AET statements previously given which should remain in effect. Follow with a job sequencing statement: NEXT, REPEAT, ENDSCOPE. Terminate input by period, carriage return, when all messages have been entered. Messages may be in any order.

Example:

```
65      , = SA 01
WHERE IS LAST 7020

WHERE IS LAST 60

WHERE IS LAST 613

WHERE IS LAST 62

LEST OLD 60 BE FORGOTTEN15

ENTER DATE MDY  070164

ENTER TIME HHMMSS.  MARK BY JK1  040000

UNLOAD TAPE NO. 5

UNLOAD TAPE NO. 14

UNLOAD TAPE NO.

WHICH JOB NEXT   NEXT.

 JOB ABANDONED
CANNOT ASSIGN 61 = MT  LOOK.

61 0101, = MT 05
 0015    ,GHJONE,
 0016    ,IJJONE,
 0017    ,KLJONE,
 0018    ,MNJONE,
07      , = CP 01
69   01, = MT 16
43   01, = MT 03
25   01, = MT 16NEXT.
```

SYSTEM IS NOT INTACT (NON-SATELLITE MODE)

Diagnostics	Condition	Action
WHERE IS LAST 70 WHERE IS LAST 60 WHERE IS LAST 61 WHERE IS LAST 62 WHERE IS LAST 65	SCR was not found intact. The following messages are used to locate the standard assignments of tape units.	Type in: A 1 or 2-digit ordinal of tape assigned to requested logical unit at time of this recovery. If unit was not tape, not assigned or equivalenced, enter space, carriage return.
ENTER DATE MDY		Enter 6 digits, MMDDYY.
ENTER TIME HHMMSS. MARK BY JK1		Enter time and set jump key 1 to mark the second when clock should be read.
UNLOAD TAPE NO.	All standard units have been assigned. Message releases all programmer and scratch tape units in use at autoload time.	Type in: A 1 or 2-digit ordinal of a tape to be saved. This message is repeated until there is a blank and a carriage return. All tapes, 1-59, assigned within this job should be unloaded.
WHICH JOB NEXT	Recovery dump has been taken. INP is positioned at point where last program ceased reading.	Redefine any non-tape standard units. Re-enter any AET statements previously given which should still remain in effect. Follow with a job sequencing statement: NEXT, REPEAT, ENDSCOPE. Terminate input by period, carriage return, when all messages have been entered. Messages may be in any order.

Example:

```
ENTER DATE MDY  070164

ENTER TIME HHMMSS.  MARK BY JK1  114500

70 1201, = MT 20
61   01, = MT 02
65   01, = MT 04
 SET STOP SWITCH   1   ON FOR SCR = MT  01
60   01, = MT 14
 101    ,CDJONE,
 102    ,EFJONE,
 103    ,GHJONE,
 104    ,IJJONE,
 105    ,KLJONE,
 106    ,MNJONE,
07     , = CP 01
69   01, = MT 11
43   01, = MT 12
RELEASED  MT 11
25   01, = MT 11

WHERE IS LAST 7020

WHERE IS LAST 6014

WHERE IS LAST 612

WHERE IS LAST 62

WHERE IS LAST 654

ENTER DATE MDY  070164

ENTER TIME HHMMSS.  MARK BY JK1  120300

UNLOAD TAPE NO. 12

UNLOADED  MT 12
UNLOAD TAPE NO. 11

UNLOADED  MT 11
UNLOAD TAPE NO.

WHICH JOB NEXT  NEXT,107

 JOB ABANDONED
 107    ,ABMILL,
 108    ,MNJONE,
 109    ,FINISH,
60   02, NEEDED
```

Normal printout during execution of an input reel.

Point of AUTOLOAD recovery

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