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Systems

IBM Virtual Machine Facility/370: CMS User's Guide

Release 3 PLC 1

Contains general information and examples for using the Conversational Monitor System (CMS) component of IBM Virtual Machine Facility/370 (VM/370).

This publication is written for applications programmers and nontechnical personnel who want to learn how to use CMS to create and modify data files (including VSAM data sets) and programs , and to compile, test, and debug OS or DOS programs under CMS.

The CMS Editor and EXEC facilities are described with usage information and examples.

Prerequisite Publications

IBM Virtual Machine Facility/370: Terminal User's Guide, Order No. GC20-1810
IBM Virtual Machine Facility/370: Introduction, Order No. GC20-1800

IBM

First Edition (February 1976)

This edition corresponds to Release 3 PLC 1 (Program Level Change) of IBM Virtual Machine Facility/370, and to all subsequent releases unless otherwise indicated in new editions or Technical Newsletters.

Changes are periodically made to the specifications herein; before using this publication in connection with the operation of IBM systems, consult the latest IBM System/370 Bibliography, Order No. GC20-0001, for the editions that are applicable and current.

Requests for copies of IBM publications should be made to your IBM representative or to the IBM branch office serving your locality.

A form for readers' comments is provided at the back of this publication. If the form has been removed, comments may be addressed to IBM Corporation, VM/370 Publications, 24 New England Executive Park, Burlington, Massachusetts 01803. Comments become the property of IBM.

Preface

This publication is intended for the general CMS user. It contains information describing the interactive facilities of CMS, and includes examples showing you how to use CMS.

"Part 1. Understanding CMS" contains sections that describe, in general terms, the CMS facilities and the CMS and CP commands that you can use to control your virtual machine. If you are an experienced programmer who has used interactive terminal systems before, you may be able to refer directly to VM/370: CMS Command and Macro Reference publication to find specific details about CMS commands that are summarized in this part. Otherwise, you may need to refer to later sections of this publication to gain a broader background in using CMS.

The topics discussed in Part 1 are:

- What It Means to Have a CMS Virtual Machine
- VM/370-CMS Environments and Mode Switching
- What You Can Do With VM/370-CMS Commands
- The CMS File System
- The CMS Editor
- Introduction to the EXEC Processor
- Using Real Printers, Punches, Readers, and Tapes

"Part 2. Program Development Using CMS" is primarily for applications programmers who want to use CMS to develop and test OS and DOS programs under CMS. The topics discussed in Part 2 are:

- Developing OS Programs Under CMS
- Developing DOS Programs Under CMS
- Using Access Method Services and VSAM Under CMS and CMS/DOS
- How VM/370 Can Help You Debug Your Programs
- Using the CMS Batch Facility
- Programming in the CMS Environment

"Part 3. Learning to Use EXEC" gives detailed information on creating EXEC procedures to use with CMS. The topics discussed in Part 3 are:

- Building EXEC Procedures
- Using EXECs with CMS Commands
- Refining Your EXEC Procedures
- Writing Edit Macros

"Appendix A: Summary of CMS Commands" lists the commands available in the CMS command environment.

"Appendix B: Summary of CP Commands" lists the CP command privilege classes and summarizes the commands available in the CP command environment.

"Appendix C: Considerations for 3270 Display Terminal Users" discusses aspects of VM/370 and CMS that are different or unique when you use a 3270 display terminal.

"Appendix B: Sample Terminal Sessions" shows sample terminal sessions for:

- Using the CMS Editor and CMS file system commands
- Using line-number editing with the CMS Editor
- Creating, assembling, and executing an OS program in CMS
- Creating, assembling, and executing a DOS program in CMS/DOS
- Using Access Method Services in CMS

Terminology

Some of the following terms are used, for convenience, throughout this publication:

- The term "CMS/DOS" refers to the functions of CMS that become available when you issue the command

  ```
  set dos on
  ```

  CMS/DOS is a part of the normal CMS system, and is not a separate system. Users who do not use CMS/DOS are sometimes referred to as OS users, since they use the OS simulation functions of CMS.

- The term "CMS files" refers exclusively to files that are in the 800-byte block format used by CMS file system commands. VSAM and OS data sets and DOS files are not compatible with the CMS file format, and cannot be manipulated using CMS file system commands.

- The terms "disk" and "virtual disk" are used interchangeably to indicate disks that are in your CMS virtual machine configuration. Where necessary, a distinction is made between CMS-formatted disks and disks in OS or DOS format.

- "3270" refers to both the IBM 3275 Display Station, Model 2 and the IBM 3277 Display Station, Model 2.
- "3330" refers to the IBM 3330 Disk Storage Models 1, 2, and 11, the IBM 3333 Disk Storage and Control Models 1 and 11, and the IBM 3350 Direct Acsess Storage in 3330 compatibility mode.
- "2305" refers to the IBM 2305 Fixed Head Storage, Models 1 and 2.
- "3340" refers to the IBM 3340 Direct Access Storage Facility and the IBM 3344 Direct Access Storage.
- "3350" refers to the IBM 3350 Direct Access Storage device when used in native mode.
- Any information pertaining to the IBM 2741 terminal also applies to the IBM 3767 terminal, unless otherwise noted.

Note: Information on the IBM 3344 and 3350 Direct Access Storage Devices is for planning purposes only until the availability of the products.

For a glossary of VM/370 terms, see the IBM Virtual Machine Facility/370: Glossary and Master Index, Order No. GC20-1813.

Prerequisite Publications

If this is the first time you have used a computer terminal, you should consult the VM/370: Terminal User's Guide, Order No. GC20-1810, for information on using your terminal.

If your terminal is a 3767 Communications Terminal, then IBM 3767 Operator's Guide, Order No. GA18-2000, is a prerequisite.

The IBM Virtual Machine Facility/370: Introduction, Order No. GC20-1800, contains an overview of the VM/370 system and its components, and lists the programs and products that are supported in CMS.

Corequisite Publications

IBM Virtual Machine Facility/370: CMS Command and Macro Reference, Order No. GC20-1818, publication is a companion to this user's guide. It contains complete format descriptions of the CMS commands, EDIT subcommands, EXEC control statements, built-in functions, and special variables, DEBUG subcommands, and CMS assembler language macros that are discussed or used in examples in this book.

IBM Virtual Machine Facility/370: System Messages, Order No. GC20-1808, contains the responses, error messages, and return codes issued by the CMS commands, and EDIT and DEBUG subcommands referenced in this publication, as well as a complete list of the error messages issued by the EXEC processor.

To use CMS, you should be familiar with the control program (CP) component of VM/370. The CP commands available to general users are described in IBM Virtual Machine Facility/370: CP Command Reference for General Users, Order No. GC20-1820. If you are using CMS to develop programs to run under other operating systems, see IBM Virtual Machine Facility/370: Operating Systems in a Virtual Machine, Order No. GC20-1821.

Related VM/370 Publications

Additional descriptions of various CMS functions and commands which are normally used by system support personnel are described in

IBM Virtual Machine Facility/370:

System Programmer's Guide, Order No. GC20-1807

Operator's Guide, Order No. GC20-1806

Planning and System Generation Guide, Order No. GC20-1801

Interactive Problem Control System (IPCS) User' Guide Order No. GC20-1823

Environmental Recording, Editing, and Printing (EREP) Program, Order No. GC29-8300.

There are two publications available as ready reference material when you use VM/370 and CMS. They are IBM Virtual Machine Facility/370:

Quick Guide for Users, Order No. GX20-1926

Command Reference Summary, Order No. GX20-1961.

If you are going to use the Remote Spooling Communications Subsystem, see the IBM Virtual Machine Facility/370: Remote Spooling Communications Subsystem (RSCS) User's Guide, Order No. GC20-1816.

Assembler language programmers may find information about the VM/370 assembler in OS/VS, DOS/VS, and VM/370 Assembler Language, Order No. GC33-4010, and OS/VS and VM/370 Assembler Programmer's Guide, Order No. GC33-4021.

Related Publications for VSAM and Access Method Services Users

CMS support of Access Method Services is based on DOS/VS Access Method Services. The control statements that you can use are described in DOS/VS Access Method Services User's Guide, Order No. GC33-5382. Error messages produced by the Access Method Services program, and return codes and reason codes are listed in DOS/VS Messages, Order No. GC33-5379.

For a detailed description of DOS/VS VSAM macros and macro parameters, refer to the DOS/VS Supervisor and I/O Macros, Order No. GC33-5373. For information on OS/VS VSAM macros, refer to OS/VS Virtual Storage Access Method (VSAM) Programmer's Guide, Order No. GC26-3818.

Related Publications for CMS/DOS Users

The CMS ESERV command invokes the DOS/VS ESERV program, and uses, as input, the control statements that you would use in DOS/VS. These control statements are described in Guide to the DOS/VS Assembler, Order No. GC33-4024.

Linkage editor control statements, used when invoking the DOS/VS linkage editor under CMS/DOS, are described in DOS/VS System Control Statements, Order No. GC33-5376.

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Part 1. Understanding CMS

Learning how to use CMS is not an end in itself: you have a specific task or tasks to do, and you need to use the computer to perform them. CMS has been designed to make these tasks easier, but if you are unfamiliar with CMS, then the tasks may seem more difficult. The information contained in Part 1 of the user's guide is organized to help you make the acquaintance of CMS quickly, so that it enhances, rather than impedes, the performance of your tasks.

"Section 1. What It Means To Have a CMS Virtual Machine" introduces you to VM/370 and its conversational component, CMS. It should help you to get a picture of how you, at a terminal, use and interact with the system.

During a terminal session, commands and requests that you enter are processed by different parts of the system. How and when you can communicate with these different programs, is described in "Section 2. VM/370 Environments and Mode Switching."

There are almost two hundred commands and subcommands comprising the VM/370 language. There are some that you may never need to use; there are others that you will use over and over again. "Section 3. What You Can Do With VM/370-CMS Commands" contains a sampling of commands in various functional areas, to give you a general idea of the kinds of things you can do, and the commands available to help you do them.

Almost every CMS command that you enter results in some kind of activity with a direct access storage device (DASD), known in CMS simply as a disk, or minidisk. Data and programs are stored on disks in what are called "files." "Section 4. The CMS File System" introduces you to the creation and handling of CMS files.

"Section 5. The CMS Editor" contains all the basic information you need to create and write a disk file directly from your terminal, or to correct or modify an existing CMS file.

Just as important as the CMS Editor is another CMS facility, called the EXEC processor or interpreter. Using EXEC files, you can execute many commands and programs by entering a single command line from your terminal, or you can write your own CMS commands. "Section 6. Introduction to the EXEC Processor" presents a survey of the basic characteristics and functions of EXEC.

"Section 7. Using Real Printers, Punches, Readers, and Tapes" discusses how to use punched cards and tapes in CMS, and how to use your virtual printer and punch to get real output.

Section 1. What It Means To Have a CMS Virtual Machine

Virtual Machine Facility/370 (VM/370) is a system control program that controls "virtual machines." A virtual machine is the functional equivalent of a real computer, but where the computer has lights, buttons, and switches on the real console to control it, you control your virtual machine from your terminal, using a command language of active verbs and nouns. There are actually three command languages, CP, CMS, and RSCS.

The command languages correspond roughly to the three components of VM/370: the Control Program (CP), the Conversational Monitor System (CMS), the Remote Spooling Communications Subsystem (RSCS), and the Interactive Problem Control System (IPCS). CP controls the resources of the real machine; that is, the physical machine in your computer room; it also manages the communications among virtual machines, and between a virtual machine and the real system. CMS is the conversational operating system designed specifically to run under CP; it can simulate many of the functions of the OS and DOS operating systems, so that you can run many OS and DOS programs in a conversational environment. RSCS is a subsystem designed to supervise transmission of files across a teleprocessing network controlled by CP. IPCS provides system programmers and installation support personnel with problem reporting and analysis functions. Its commands execute in the CMS command environment.

Although this publication is concerned primarily with using CMS, it also contains examples of CP commands that you, as a CMS user, should be familiar with.

How You Communicate with VM/370

When you are running your virtual machine under VM/370, each command, or request for work, that you enter on your terminal is processed as it is entered; usually, you enter one command at a time and commands are processed in the order that you enter them.

You can enter CP commands from either the CP or CMS environment; but you cannot enter CMS commands while in the CP environment. The concept of "environments" in VM/370 is discussed in "Section 2. VM/370 Environments and Mode Switching."

After you have typed or keyed in the line you wish to enter, you press the Return or Enter key on the keyboard. When you press this key, the line you have entered is passed to the command environment you want to have process it. If you press this key without entering any data, you have entered a "null line." Null lines sometimes have special meanings in VM/370.

If you make a mistake entering a line, VM/370 tells you what your mistake was, and you must re-enter the entire command line. The examples in this publication assume that the command lines are correctly entered.

You can enter commands using any combination of uppercase and lowercase characters; VM/370 translates your input to uppercase. Examples in this publication show all user-entered input lines in lowercase characters and system responses in uppercase characters.

The CP Command Language

You use CP commands to communicate with the control program. CP commands control the devices attached to your virtual machine and their characteristics.

For example, if you want to allocate additional disk space for a work area or if you want to increase the virtual address space assigned to your virtual machine, use the CP command DEFINE. CP takes care of the space allocation for you, and then allows your virtual machine to use it.

Or, if for example, you are receiving printed output at your terminal and do not want to be interrupted by messages from other VM/370 users, you can use the CP command SET MSG OFF to refuse messages, since it is CP that handles communication among virtual machines.

Using CP commands, you can also send messages to the VM/370 system operator and to other users, modify the configuration of devices in your virtual machine, and use the virtual machine input/output devices. CP commands are available to all virtual machines using VM/370. You can invoke these commands when you are in the virtual machine environment using CMS (or some other operating system) in your virtual machine.

The CP commands and command privilege classes are listed in "Appendix B: Summary of CP Commands" and are discussed in detail in the VM/370: CP Command Reference for General Users and VM/370: Operating Systems in a Virtual Machine. However, since many CP commands are used in conjunction with CMS commands, some of the CP commands you will use most frequently are discussed in this publication, in the context of their usefulness for a CMS application. To aid you in distinguishing between CMS commands and CP commands, all CP commands used in examples in this publication are prefaced with "CP".

The CMS Command Language

The CMS command language allows you to create, modify, and debug problem, or application programs and, in general, to manipulate data files.

Many OS language processors can be executed under CMS: the assembler, VS BASIC, OS FORTRAN IV, OS COBOL, and OS PL/I Optimizing and Checkout Compilers. In addition, the DOS/VS COBOL and DOS/VS PL/I Program Products are supported. You can find a comprehensive list of language processors that can be executed under CMS and relevant publications in the VM/370: Introduction. CMS executes the assembler and the compilers when you invoke them with CMS commands. The ASSEMBLE command is used to present examples in this publication; the supported compiler commands are described in the appropriate DOS and OS Program Product documentation.

The EDIT command invokes the CMS Editor so that you can create and modify files. The EXEC facilities allow you to execute procedures consisting of CP and CMS commands; they also provide the conditional execution capability of a macro language. The DEBUG command gives you several program debugging subcommands.

Other CMS commands allow you to read cards from a virtual card reader, punch cards to a virtual card punch, and print records on a virtual printer. Many commands are provided to help you manipulate your virtual disks and files.

Since you can invoke CP commands from within the CMS virtual machine environment, the CP and CMS command languages are, for practical purposes, a single, integrated command language for CMS users.

GETTING COMMANDS INTO THE SYSTEM

Before you can use CP and CMS, you should know (1) how to operate your terminal and (2) your userid (user identification) and password.

The Terminal: Your Virtual Console

There are many types of terminals you can use as a VM/370 virtual console. Before you can conveniently use any of the commands and facilities described in this publication, you have to familiarize yourself with the terminal you are using. Generally, you can find information about the type of terminal you are using and how to use it with VM/370 in the VM/370: Terminal User's Guide. If your terminal is a 3767, you also need the IBM 3767 Operator's Guide.

In this publication, examples and usage notes assume that you are using a typewriter-style terminal (such as a 2741). If you are using a display terminal (such as a 3270), consult "Appendix C: Considerations for 3270 Display Terminal Users" for a discussion of special techniques that you can use to communicate with VM/370.

Your Userid and Password: Keys into the System

Your userid is a symbol that identifies your virtual machine to VM/370 and allows you to gain access to the VM/370 system. Your password is a symbol that functions as a protective device ensuring that only those authorized to use your virtual machine can log on. The userid and password are usually defined by the system programmer for your installation.

Contacting VM/370

To establish contact with VM/370, you switch the terminal device on and VM/370 responds with some form of the message

```
vm/370 online
```

to let you know that VM/370 is running and that you can use it. If you do not receive the "vm/370 online" message, see the VM/370: Terminal User's Guide for specific directions. You can now press the Attention key (or equivalent) on your terminal and issue the LOGON command to identify yourself to the system:

```
cp logon smith
```

where SMITH represents a userid. The LOGON command is entered by pressing the Return (or Enter) key. If VM/370 accepts your userid, it responds by asking you for your password:

```
ENTER PASSWORD:
```

You then enter your password, which may be hidden, depending on your terminal.

LOADING CMS IN THE VIRTUAL MACHINE: THE IPL COMMAND

You load CMS in your virtual machine using the IPL command:

```
cp ipl cms
```

where "cms" is assumed to be the saved system name for your installation's CMS. You could also load CMS by referring to it using its virtual device address, such as 190:

```
cp ipl 190
```

VM/370 responds by displaying a message such as:

```
CMS VERSION v.3 - 02/28/76  12:02
```

to indicate that the IPL command executed successfully and that CMS is loaded into your virtual machine.

Your userid may be set up for an automatic IPL, so that you receive this message, indicating that you are in the CMS command environment, without having to issue the IPL command.

Now you can enter a null line to begin your virtual machine operation.

Note: If this is the first time you are using a new virtual disk assigned to you, you receive the message

```
DMSACC112S DISK'A(191)' DEVICE ERROR
```

and you must "format" the disk, that is, prepare it for use with CMS files. See "Formatting Virtual Disks" below.

Logical Line Editing Symbols

To aid you in entering command or data lines from your terminal, VM/370 provides a set of logical line editing symbols, which you can use to correct mistakes as you enter lines. Each symbol has been assigned a default character value. These normally are:

Symbol	Character
Logical character delete	@
Logical line end	#
Logical line delete	¢
Logical escape	"

Logical Character Delete

The logical character delete symbol (@) allows you to delete one or more of the previous characters entered. The @ deletes one character per @ entered, including the ¢ and # logical editing characters. For example:

```
ABC#@@ results in AB
ABC@D results in ABD
¢@DEF results in DEF
ABC@@@ deletes the entire string
```

Logical Line End

The logical line end symbol (#) allows you to key in more than one command on the same line, and thus minimizes the amount of time you have to wait between entering commands. You type the # at the end of each logical command line, and follow it with the next logical command line. VM/370 stacks the commands and executes them in sequence. For example, the entry

```
query blip#query rdymsg#query search
```

is executed in the same way as the entries:

```
query blip
query rdymsg
query search
```

The logical line end symbol also has special significance for the #CP function. Beginning any physical line with #CP indicates that you are entering a command that is to be processed by CP immediately. If you have set a character other than # as your logical line end symbol, you should use that character instead of a #.

Logical Line Delete

The logical line delete symbol (¢) (or [for Teletype[1] Model 33/35 terminals) deletes the entire previous physical line, or the last logical line back to (and including) the previous logical line end (#). You can use it to cancel a line containing many or serious errors. If a # immediately precedes the ¢ sign, only the # sign is deleted, since the # indicates the beginning of a new line, and the ¢ cancels the current line. For example:

- Logical Line Delete:

  ```
  ABC#DEF¢ deletes the #DEF and results in ABC
  ABC#¢ results in ABC
  ABC#DEF¢#GHI results in ABC#GHI
  ABC#DEF¢GHI results in ABCGHI
  ```

- Physical Line Delete:

  ```
  ABC¢ deletes the whole line
  ```

Note that when you cancel a line by using the ¢ logical line delete symbol, you do not need to press a carriage return; you can continue entering data on the same line.

---

[1]Trademark of the Teletype Corporation, Skokie, Illinois.

Logical Escape

The logical escape symbol (") causes VM/370 to consider the next character entered to be a data character, even if it is normally one of the logical line editing symbols (@, ¢, ", or #). For example:

```
ABC"¢D results in ABC¢D
""ABC"" results in "ABC"
```

If you enter a single logical escape symbol (") as the last character on a line, or on a line by itself, it is ignored.

Defining Logical Line Editing Symbols

The logical line editing symbols are defined for each virtual machine during VM/370 system generation. If your terminal's keyboard lacks any of these special characters, your installation can define other special characters for logical line editing. You can find out what logical line editing symbols are in effect for your virtual machine by entering the command

```
cp query terminal
```

The response might be something like:

```
LINEND # , LINEDEL ¢ , CHARDEL @ , ESCAPE "
LINESIZE 130, MASK OFF, APL OFF, ATTN OFF, MODE VM
```

You can use the CP TERMINAL command to change the logical line editing characters for your virtual machine. For example, if you enter:

```
cp terminal linend /
```

Then, the line:

```
input # line / input / #
```

would be interpreted:

```
input # line
 input
 #
```

The terminal characteristics listed in the response to the CP QUERY TERMINAL command are all controlled by operands of the CP TERMINAL command.

HOW VM/370 RESPONDS TO YOUR COMMANDS

CP and CMS respond differently to different types of requests. All CMS command responses (and all responses to CP commands that are entered from the CMS environment) are followed by the CMS Ready message. The form of the Ready message can vary, since it can be changed using the SET command. The long form of the Ready message is:

```
R; T=7.36/19.89 09:26:11
```

If you have issued the command

```
set rdymsg smsg
```

the Ready message looks like:

```
R;
```

When you enter a command line incorrectly, you receive an error message, describing the error. The Ready message contains a return code from the command, for example

```
R(00028);
```

indicates that the return code from the command was 28.

Some Sample CP and CMS Command Responses

If you enter a CP or CMS command that requests information about your virtual machine, the response should be the information requested. For example, if you issue the command

```
cp display g
```

CP responds by showing you the contents of your virtual machine's general registers, for example:

```
GPR  0 = 00000003 00003340 000007A0 00000003
GPR  4 = 00000848 C4404040 00000040 00002DF0
GPR  8 = 00000008 000132F8 00002BA0 00002230
GPR 12 = 00003238 FFFFFFFD 50013386 00000000
```

Similarly, if you issue the CMS command

```
listfile * assemble c
```

you might receive the following information:

```
JUNK     ASSEMBLE  C1
MYPROG   ASSEMBLE  C1
```

If you enter a CP command to alter your virtual machine configuration or the status of your spool files, CP responds by telling you that the task is accomplished. The response to

```
cp purge reader all
```

might be

```
0004 FILES PURGED
```

Some CP commands, those that alter some of the characteristics of your virtual machine, give you no response at all. If you enter

```
cp spool e class x hold
```

you receive no response from CP.

Certain CMS commands may issue prompting messages, to request you to enter more information. The SORT command, which sorts CMS disk files, is an example. If you enter:

```
sort in file a1 out file a1
```

you are prompted with the message:

```
DMSSRT604R ENTER SORT FIELDS:
```

and you can then specify which fields you wish the input records to be sorted on.

Getting Acquainted with CMS

If you have just logged on for the first time, and you want to try a few CMS commands, enter:

```
query disk a
```

The response should tell you that you have an A-disk at virtual address 191; it also provides information such as how much room there is on the disk and how much of it is used. Again, if you receive an error message that indicates the disk may not be formatted, see "Formatting Virtual Disks."

Your A-disk is the disk you use most often in CMS, to contain your CMS files. Files are collections of data, and may have many purposes. For this exercise, the data is meaningless. Enter

```
edit junk file
```

You should receive the response

```
NEW FILE:
EDIT:
```

which indicates that this file does not already exist on your A-disk. Enter:

```
input
```

You should receive the response:

```
INPUT:
```

and you can start to create the file, that is, write input records that are eventually going to be written onto your A-disk. Enter 5 or 6 data lines, such as

```
hickory dickory dock
the mouse ran up the clock
the clock struck one
and down he run
dickory hickory dock
```

Now, enter a null line (one with no data). You should receive the message

```
EDIT:
```

Enter

```
file
```

You should see the message

```
R; T=0.01/0.02 19:31:29
```

You have just written a CMS file onto your A-disk. If you enter:

```
type junk file a
```

you should see the following:

```
HICKORY DICKORY DOCK
THE MOUSE RAN UP THE CLOCK
THE CLOCK STRUCK ONE
AND DOWN HE RUN
DICKORY HICKORY DOCK
```

The CMS command, TYPE, requested a display of the disk file JUNK FILE, on your A-disk.

To erase the file, enter

```
erase junk file
```

Now, if you re-enter the TYPE command, you should receive the message

```
FILE NOT FOUND
```

Most CMS commands create or reference disk files, and are as easy to use as the commands shown above. Your CMS disks are among the most important features in your VM/370 virtual machine.

Virtual Disks and How They Are Defined

Under VM/370, a real direct access storage device (DASD) unit, or disk pack, can be divided into many small areas, called minidisks. Minidisks (also called virtual disks because they are not equivalent to an entire real disk) are defined in the VM/370 directory, as extents on real disks. For CMS applications, you never have to be concerned with the extents on your minidisks; when you use CMS-formatted minidisks, they are, for practical purposes, functionally the same as real disks. Minidisks can also be formatted for use with OS or DOS data sets or VSAM files.

You can have both permanent and temporary disks attached to your machine during a terminal session. Permanent disks are defined in the VM/370 directory entry for your virtual machine. Temporary disks are those you define for your own virtual machine using the CP DEFINE command, or those attached to your virtual machine by the system operator.

PERMANENT VIRTUAL DISKS

The VM/370 directory entry for your userid defines your permanent virtual disks. Each disk has associated with it an access mode specifying whether you can read and write on the disk or only read from it (its read/write status). Virtual disk entries in the VM/370 directory may look like the following:

```
MDISK  190  2314  000  050  CMS190  R
MDISK  191  3330  010  005  BDISKE  W
MDISK  194  3330  010  020  CMS001  W
MDISK  198  3330  050  010  CMS192  W
MDISK  19E  3330  010  050  CMS19E  R
```

The first two fields describe the device, minidisk in this example, and the virtual address of the device. Virtual addresses (shown above as 190, 191, and so on), are the names by which you and VM/370 identify the disk. Each device in your virtual machine has an address which may or may not correspond to the actual location of the device on the VM/370 system.

The third field specifies the device type of your virtual disk. The fourth and fifth fields specify the starting real cylinder at which your virtual disk logically begins and the number of cylinders allocated to your virtual disk, respectively. The sixth field is the label of the real disk on which the virtual disk is defined and the seventh field is a letter specifying the read/write mode of the disk; "R" indicates that the disk is a read-only disk, and "W" indicates that you have read/write privileges. The MDISK control statement of the Directory Service Program is described in the VM/370: Operator's Guide.

DEFINING TEMPORARY VIRTUAL DISKS

Using the CP DEFINE command, you can attach a temporary disk to your virtual machine for the duration of a terminal session. The following command allocates a 10-cylinder temporary disk from a 3330 device and assigns it a virtual address of 291:

```
cp define t3330 as 291 cyl 10
```

When you define a minidisk, you can choose any valid address that is not already assigned to a device in your virtual machine. Valid addresses for minidisks range from 001 through 5FF, for a virtual machine in basic control mode.

FORMATTING VIRTUAL DISKS

Before you can use any new virtual disk, you must format it. This applies to new disks that have been assigned to you and to temporary disks that you have allocated with the CP DEFINE command. When you issue the FORMAT command you must use the virtual address you have defined for the disk and assign a CMS mode letter, for example:

```
format 291 c
```

CMS then prompts you with the following message:

```
DMSFOR603R FORMAT WILL  ERASE ALL FILES  ON DISK 'C(291)'.  DO YOU
           WISH TO CONTINUE? (YES|NO):
```

You respond:

```
yes
```

CMS then asks you to assign a label for the disk, which may be anything you choose. Labels can have a maximum of 6 characters. When the

```
DMSFOR605R ENTER DISK LABEL:
```

message is issued, you respond by supplying a disk label. For example, if this is a temporary disk, you might enter

```
scrtch
```

CMS then erases all the files on that disk, if any existed, and formats the disk for your use. When you enter the label, CMS responds by telling you:

```
FORMATTING DISK 'C'

'10' CYLINDERS FORMATTED ON 'C(291)'.

R; T=0.15/1.60  11:26:03
```

The FORMAT command should only be used to format CMS disks, that is, disks you are going to use to contain CMS files. If you want to format disks for OS, DOS, or VSAM applications, the disks should be formatted using the IBCDASDI program.

Sharing Virtual Disks: Linking

Since only one user can own a virtual disk, and there are many occasions that require users to share data or programs, VM/370 allows you to share virtual disks, on either a permanent or temporary basis, by "linking."

Permanent links can be established for you in your VM/370 directory entry. These disks are then a part of your virtual machine configuration every time you log on.

You can also have another user's disk temporarily added to your configuration by using the CP LINK command. For example, if you have a program that uses data that resides on a disk identified in userid DATA's configuration as a 194, and you know that the password assigned to this disk is GO, you could issue the command

```
cp link to data 194 as 198 r pass= go
```

DATA's 194 disk is then added to your virtual machine configuration at virtual address 198.

The "R" in the command line indicates the access mode; in this case, it tells CP that you wish only to read files from this disk. VM/370 will not allow you to write on it. If you try to issue this command when someone is logged on to the userid DATA, you will not be able to establish the link. If you want to link to DATA in any event, you can reissue the LINK command using the access mode RR:

```
cp link data 194 198 rr go
```

The keywords TO, AS, and PASS= are optional; you do not have to specify them.

You can also use the CP LINK command to link to your own disks. For example, if you log on and discover that another user has access to one of your disks, you may be given read-only access, even if it is a read/write disk. You can request the other user to detach your disk from his virtual machine, and after he has done so, you can establish the link:

```
cp link * 191 191
```

When you link to your own disks, you can specify the userid as * and you do not need to specify the access mode or a password.

You can find more information about the CP LINK command and CP access modes in VM/370: CP Command Reference for General Users.

Identifying Your Disk to CMS: Accessing

LINK and DEFINE are CP commands: they tell CP to add DASD devices to your virtual machine configuration. CMS must also know about these disks, and you must use the ACCESS command to establish a filemode letter for them:

```
access 194 b
```

CMS uses filemode letters to manage your files during a terminal session. By using the ACCESS command you can control:

- Whether you can write on a disk or only read from it (its read/write status).
- The library search order for programs executing in your virtual machine.
- Which disks are to contain the new files that you create.

If you want to know which disks you currently have access to, issue the command

```
query search
```

you might see the following display:

```
PER191  191  A    R/W
DAT194  198  B    R/O
CMS190  190  S    R/O
CMS19E  19E  Y    R/O
```

The first column indicates the label on the disk (assigned when the disk is formatted), and the second column shows the virtual address assigned to it.

The third column contains the filemode letter. Valid filemode letters are A, B, C, D, E, F, G, S, Y, and Z.

The fourth column indicates the read/write status of the disk. The 190 and 19E disks in this example are read-only disks that contain the CMS nucleus and disk-resident commands for the CMS system.

For the most part you will probably use your 191 disk, that is, your A-disk.

RELEASING VIRTUAL DISKS

When you no longer need a disk during a terminal session, or if you want to assign a currently active filemode letter to another disk, use the CMS command RELEASE:

```
release c
```

Then, you can issue the ACCESS command to assign the filemode letter C to another disk.

When you no longer need disks in your virtual machine configuration, use the CP command DETACH to disconnect them from your virtual machine:

```
cp detach 194
cp detach 291
```

If you are going to release and detach the disk at the same time, you can use the DET option of the RELEASE command:

```
release 194 (det
```

For more information on controlling disks in CMS, see "Section 4. The CMS File System."

Section 2. VM/370 Environments and Mode Switching

When you are using VM/370, your virtual machine can be in one of two possible "environments": the CP, or control program environment, or the virtual machine environment, which may be CMS. The CMS environment has several subenvironments, sometimes called "modes." Each environment or subenvironment accepts particular commands or subcommands, and each environment has its own entry and exit paths, responses and error messages. If you have a good understanding of how the VM/370 environments are related, you can learn to change environments quickly and use your virtual machine efficiently.

This section introduces the CP and CMS environments that you use and describes:

- Entry and exit paths
- Command subsets that are valid as input

Figure 1, at the end of this section, summarizes the VM/370 command environments and lists the commands and terminal paths that allow you to go from one environment to another.

With the exception of input mode in the edit environment, you can always determine which environment your virtual machine is in by pressing the Return or Enter key on a null line. The responses you receive, and the environments they indicate, are:

Response	Environment
CP	CP
CMS	CMS
CMS (DOS ON)	CMS/DOS
EDIT:	Edit
CMS SUBSET	CMS Subset
DEBUG	Debug

The CP Environment

When you log on to VM/370, your virtual machine is in the CP environment. In this environment, you can enter any CP command that is valid for your privilege class. This publication assumes that you are a general, or class G, user. You can find information about the commands that you can use in the VM/370: CP Command Reference for General Users.

Only CP commands are valid terminal input in the CP environment. You can, however, preface a CP command line with the characters "CP" or "#CP", followed by one or more blanks, although it is not necessary. These functions are described under "The CMS Environment."

You can enter CP commands from other VM/370 environments. There may be times during your terminal session when you want to enter the CP environment to issue one or more CP commands. You can do this from any other environment by doing either of two things:

1. Issue the command

   ```
   #cp
   ```

2. Use your terminal's Attention key (or equivalent). On a 2741 terminal, you must normally press the Attention key twice, quickly, to enter the CP environment.

The following message indicates that your virtual machine is in the CP environment:

```
CP
```

After entering whatever CP commands you need to use, you return your virtual machine to the environment or mode that it came from by using the CP command

```
cp begin
```

which, literally, begins execution of your virtual machine.

The CMS Environment

You enter the CMS environment from CP by issuing the IPL command, which loads CMS into your virtual storage area. If you are planning to use CMS for your entire terminal session, you should not have to IPL again unless a program failure forces you into the CP environment.

When you issue the IPL command, you can specify either the named system CMS at your installation or you can load CMS by specifying the virtual address of the disk on which the CMS system resides. For example,

```
cp ipl cms

  -- or --

cp ipl 190
```

When your virtual machine is in the CMS environment, you can issue any CMS command and any of the CP commands that are valid for your user privilege class. You can also execute many of your own OS or DOS programs; the ways you can execute programs are discussed in "Section 8. Developing OS Programs Under CMS" and "Section 9. Developing DOS Programs Under CMS."

You can enter CP commands from CMS in any of the following ways:

- Using the implied CP function of CMS (See Note.)
- With the CP command
- With the #CP function

Note: For the most part, you may enter any CP command directly from the CMS environment. This implied CP function is controlled by an operand of the CMS SET command, IMPCP. You can determine whether the implied CP function is in effect for your virtual machine by entering the command

```
query impcp
```

If the response is

```
IMPCP      = OFF
```

you can change it, by entering

```
set impcp on
```

When the implied CP function is set off, you must use either the CP command or the #CP function to enter CP commands from the CMS environment. CP commands that you execute in EXEC procedures must always be prefaced by the CP command, regardless of the implied CP setting. An example of using the CP command is:

```
cp close punch
```

When you issue CP commands from the CMS environment either implicitly or with the CP command, you receive, in addition to the CP response (if any), the CMS Ready message. If you use the #CP function, discussed next, you do not receive the Ready message.

You can preface any CP command line with the characters "#CP", followed by one or more blanks. When you enter a CP command this way, the command is processed by CP immediately; it is as if your virtual machine were actually in the CP environment.

EDIT, INPUT, AND CMS SUBSET

The CMS Editor is a VM/370 facility that allows you to create and modify data files that reside on CMS disks. The editor environment, more commonly called the edit environment, is entered when you issue the CMS command EDIT, specifying the identification of a data file you want to create or modify.

```
edit myfile assemble
```

is an example of how you would enter the edit environment to either create a file called MYFILE ASSEMBLE or to make changes to a disk file that already exists under that name.

When you enter the edit environment your virtual machine is automatically in edit mode, where you can only issue EDIT subcommands or CP commands prefaced by "#CP." EDIT subcommands tell the editor what you wish to do with the data you have accessed. After you enter the EDIT subcommand

```
input
```

data lines that you enter are considered input to the file. To return to edit mode, you must enter a null line.

If you issue the EDIT subcommand

```
cms
```

the editor responds

```
CMS SUBSET
```

and your virtual machine is in CMS subset mode, where you can issue any valid CMS subset command, that is, a CMS command that is allowed in CMS subset mode. These include:

```
ACCESS          LISTFILE        RT
CP              PRINT           SET
DISK            PUNCH           STATE
ERASE           QUERY           STATEW
EXEC            READCARD        TYPE
HT
```

You can also issue CP commands. To return to edit mode, you use the special CMS subset command, RETURN. If you enter the Immediate command HX, your editing session is terminated abnormally and your virtual machine is returned to the CMS environment.

When you are finished with an edit session, you return to the CMS environment by issuing the FILE subcommand, which indicates that all modifications or data insertions that you have made should be written onto a CMS disk, or by issuing the subcommand QUIT, which tells the editor not to save any modifications or insertions made since the last time the file was written.

More detailed information about EDIT subcommands and how to use the CMS Editor is contained in this publication in "Section 5. The CMS Editor" and in the VM/370: CMS Command and Macro Reference.

DEBUG

CMS DEBUG is a special CMS facility that provides subcommands to help you debug programs at your terminal. Your virtual machine enters the debug environment when you issue the CMS command

```
debug
```

You may want to enter this command after you have loaded a program into storage and before you begin executing it. At this time you can set "breakpoints," or address stops, where you wish to halt your program's execution so that you can examine and change the contents of general registers and storage areas. When these breakpoints are encountered, your virtual machine is placed in the debug environment. You can also enter the debug environment by issuing the CP EXTERNAL command, which causes an external interrupt to your virtual machine.

Valid DEBUG subcommands that you can enter in this environment are:

BREAK	GO	RETURN
CAW	GPR	SET
CSW	HX	STORE
DEFINE	ORIGIN	X
DUMP	PSW	

You can also use the #CP function in the debug environment to enter CP commands.

You leave the debug environment in any of the following ways:

- If the program you are running completes execution, you are returned to the CMS environment.
- If your virtual machine entered the debug environment after a breakpoint was encountered, it returns to CMS when you issue the DEBUG subcommand

  ```
  hx
  ```

  To continue the execution of your program, you use the DEBUG subcommand

  ```
  go
  ```

- If your virtual machine is in the debug environment and is not executing a program, the DEBUG subcommand

  ```
  return
  ```

  returns it to the CMS environment.

CMS/DOS

If you are a DOS/VS user, the CMS/DOS environment provides you with all the CMS interactive functions and facilities, as well as special CMS/DOS commands which simulate DOS functions. The CMS/DOS environment becomes active when you issue the command

```
set dos on
```

When your virtual machine is in the CMS/DOS environment you can issue any command line that would be valid in the CMS environment, including the facilities of EDIT, DEBUG, and EXEC, but excluding CMS commands or program modules that load and/or execute programs that use OS macros or functions.

The following commands are provided in CMS/DOS to test and develop DOS programs, and to provide access to DOS/VS libraries:

ASSGN	DSERV	OPTION
DLBL	ESERV	PSERV
DOSLIB	FETCH	RSERV
DOSLKED	FCOBOL	SSERV
DOSPLI	LISTIO	

Your virtual machine leaves the CMS/DOS environment when you issue the command

```
set dos off
```

If you reload CMS (with an IPL command) during a terminal session, you must also reissue the SET DOS ON command.

Interrupting Program Execution

When you are executing a program under CMS or executing a CMS command, your virtual machine is not available for you to enter commands. There are, however, ways in which you can interrupt a program and halt its execution, either temporarily, in which case you can resume its execution, or permanently, in which case your virtual machine returns to the CMS environment. In both cases, you interrupt execution by creating an "attention interrupt," which may take two forms:

- An attention interrupt to your virtual machine operating system
- An attention interrupt to the control program

These situations result in what are known as virtual machine (VM) or control program (CP) "reads" being presented to your virtual console. On a typewriter terminal, the keyboard unlocks when a read occurs.

Whether you have to press the Attention key once or twice depends on the terminal mode setting in effect for your virtual machine. This setting is controlled by the CP TERMINAL command:

```
cp terminal mode vm
```

The setting VM is the default for virtual machines; you do not need to specify it. The VM setting indicates that one depression of the Attention key sends an interrupt to your virtual machine, and that two depressions results in an interrupt to the control program (CP).

The CP setting for terminal mode, which is the default for the system operator, indicates that one depression of the Attention key results in an interrupt to the control program (CP). If you are using your virtual machine to run an operating system other than CMS, you might wish to use this setting, also. Issue the command:

```
cp terminal mode cp
```

VIRTUAL MACHINE INTERRUPTS

While a command or program is executing, if you press the Attention key once on a 2741 (or the Enter key on a 3270), you have created a virtual machine interrupt. The program halts execution, your terminal will accept an input line, and you may:

- Terminate the execution of the program, by issuing an Immediate command to halt execution:

  ```
  hx
  ```

  The HX command causes the program to abnormally terminate (abend).

- Enter a CMS command. The command is stacked in a console buffer and is processed by CMS when your program is finished executing and the next virtual machine read occurs. For example:

  ```
  print abc listing
  ```

  After you enter this line, the program resumes execution.

- If the program is directing output to your terminal and you wish only to halt the terminal display, use the Immediate command:

  ```
  ht
  ```

  The program resumes execution. You can, if you want, cause another interrupt and request that typing be resumed by entering the RT (resume typing) command:

  ```
  rt
  ```

- Enter a null line; your program continues execution. The null line is stacked in the console stack and read by CMS as a stacked command line.

HX, HT, and RT are three of the CMS Immediate commands. They are "immediate" because they are executed as soon as they are entered. Unlike other commands, they are not stacked in the console buffer. You can only enter an Immediate command following an attention interrupt.

CONTROL PROGRAM INTERRUPTS

You can interrupt a program and enter the CP environment directly by pressing the Attention key twice quickly, on a 2741, or pressing the PA1 key on a 3270. Then, you can enter any CP command. To resume the program's execution, issue the CP command:

```
cp begin
```

If your terminal is operating with the terminal mode set to CP, pressing the Attention key once places your virtual machine in the CP environment.

ADDRESS STOPS AND BREAKPOINTS

A program may also be interrupted by an instruction address stop, which you specifically set by the CP command ADSTOP. For example, if you issue the command

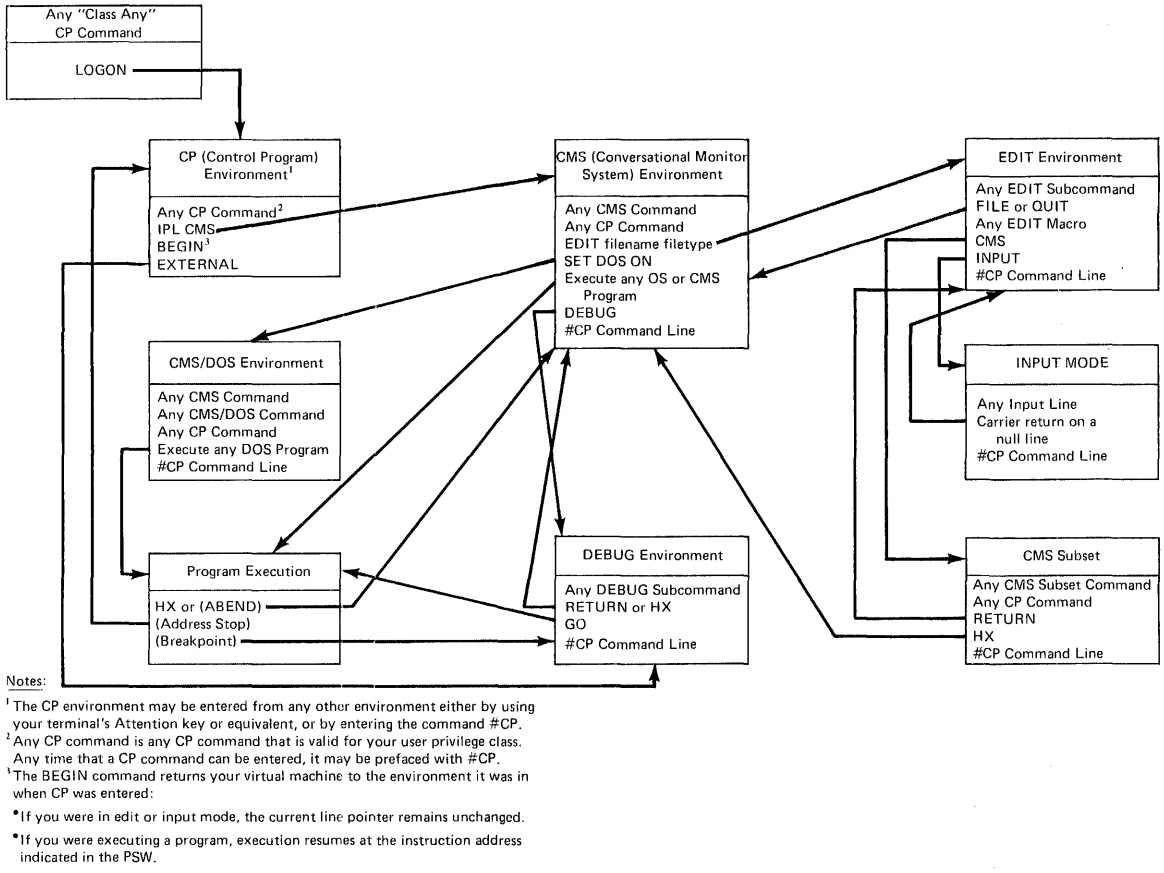
```
cp adstop 201ea
```

An address stop is set at virtual storage location X'201EA'. When your program reaches this address during its execution, it is interrupted and your virtual machine is placed in the CP environment, where you can issue any CP command, including another ADSTOP command, before resuming your program's execution with the CP command BEGIN.

Breakpoints, similar to address stops, are set using the DEBUG subcommand BREAK, which you issue in the debug environment before executing a program. For example, if you issue:

```
break 1 201ae
```

Your program's execution is interrupted at this address and your virtual machine is placed in the debug environment. You can then enter any DEBUG subcommand. To resume program execution, use the DEBUG subcommand GO. If you want to halt execution of the program entirely, use the DEBUG subcommand HX, which returns your virtual machine to the CMS environment. You can find more information about setting address stops and breakpoints in "Section 11. How VM/370 Can Help You Debug Your Programs."



Notes:

[1] The CP environment may be entered from any other environment either by using your terminal's Attention key or equivalent, or by entering the command #CP.

[2] Any CP command is any CP command that is valid for your user privilege class. Any time that a CP command can be entered, it may be prefaced with #CP.

[3] The BEGIN command returns your virtual machine to the environment it was in when CP was entered:

- If you were in edit or input mode, the current line pointer remains unchanged.
- If you were executing a program, execution resumes at the instruction address indicated in the PSW.

Figure 1. VM/370 Environments and Mode Switching

Section 3. What You Can Do With VM/370-CMS Commands

This section provides an overview of the CMS and CP command languages, and describes the various commands within functional areas, with examples. The commands are not presented in their entirety, nor is a complete selection of commands represented.

When you finish reading this section you should have an understanding for the kinds of commands available to you, so that when you need to perform a particular task using CMS you may have an idea of whether it can be done, and know what command to reference for details. For complete lists of the CP and CMS commands available in the VM/370 system, see "Appendix A: Summary of CMS Commands" and "Appendix B: Summary of CP Commands."

Command Defaults

Many of the characteristics of your CMS virtual machine are already established when you log on, but there are commands available so you can change them. In the case of many CMS commands, there are implied values for operands, so that when you enter a command line without certain operands, values are assumed for them. In both of these instances, the values set or implied are considered default values. As you learn CP and CMS commands, you also should become familiar with the default values or settings for each.

Commands To Control Terminal Communications

Using VM/370, you control your virtual machine directly from your terminal. VM/370 provides a complement of commands for terminal communications.

ESTABLISHING AND TERMINATING COMMUNICATIONS WITH VM/370

To initiate your communication with VM/370, use the CP LOGON command:

```
cp logon sam
```

Optionally, you may enter your password on the same line:

```
cp logon sam 123456
```

When you are sure that your communication line is all right and you have difficulty logging on (for example, someone else has logged on under your userid), you can use the CP MESSAGE command:

```
cp message sam  this is sam...pls log off
```

Another way to access the VM/370 system is to use the CP command DIAL:

```
cp dial tsosys
```

In this example, TSOSYS is the userid of a virtual machine running a TSO system. After this DIAL command is successful, you can use your terminal as if you were actually connected to a TSO system, and you can begin TSO logon procedures.

To end your terminal session, use the CP command LOGOFF:

```
cp logoff
```

If you have used a switched (or dial-up) communication path to the VM/370 computer and you want the line to remain available, you can enter:

```
cp logoff hold
```

At times, you might be running a long program under one userid and wish to use your terminal for some other work. Then, you can disconnect your terminal:

```
cp disconn
```

-- or --

```
cp disconn hold
```

Your virtual machine continues to run, and is logged off the system when your program has finished executing. If you want to regain terminal control of your virtual machine after disconnecting, log on as you would to initiate your terminal session. Your virtual machine is placed in the CP environment, and to resume its execution, you use the CP command BEGIN.

You should not disconnect your virtual machine if a program requires an operator response, since the console read request cannot be satisfied.

CONTROLLING WHAT YOU RECEIVE AT YOUR TERMINAL

During the course of a terminal session, you can receive many kinds of messages from VM/370, from the system operator, from other users, or from your own programs. You can decide whether or not you want these messages to actually reach you. For example, if you use the command

```
cp set msg off
```

No one will be able to send messages to you with the CP MESSAGE command; if another virtual machine user tries to send you a message, he receives a message

```
userid NOT RECEIVING, MSG OFF
```

Similarly, you can use

```
cp set wng off
```

to prevent warning messages (which usually come from the system operator) from coming to you. You would probably do this, however, only in cases where you were typing some output at your terminal and did not want the copy ruined.

VM/370 issues error messages whenever you issue a command incorrectly or if a command or program fails. These messages have a long form,

consisting of the error message code and number, followed by text describing the error. If you wish to receive only the text portion of messages with severity codes I, E, and W (for Informational, Error, and Warning, respectively), you can issue the command:

```
cp set emsg text
```

If you want to receive only the message code and number, (from which you can locate an explanation of the error in VM/370: System Messages) you specify

```
cp set emsg code
```

You can also cancel error messages completely:

```
cp set emsg off
```

To restore the EMSG setting to its default, which is the message code and text, enter:

```
cp set emsg on
```

Some CP commands issue informational messages telling you that CP has performed a particular function. You can prevent the reception of these messages with the command

```
cp set imsg off
```

or restore the default by issuing

```
cp set imsg on
```

The setting of EMSG applies to CMS commands as well as to CP commands.

You can also control the format of the CMS Ready message. If you enter

```
set rdymsg smsg
```

you receive only the "R;" or shortened form of the Ready message after the completion of CMS commands. If you are not receiving error messages (as described above) and an error occurs, the return code from the command still appears in parentheses following the "R".

An additional feature exists for CMS. If you have a typewriter terminal with a two-color ribbon, you can specify

```
set redtype on
```

so that CMS error messages are typed in red.

Some commands or messages result in displays of lines that are very long. If you want to limit the width of lines that are received at your terminal (for example, if you are using terminal paper that is only eight inches wide), you can specify:

```
cp terminal linesize 80
```

so that all lines received at your terminal are formatted to fit within an 80-character display.

You can also control two special characters in VM/370. One is the exclamation point (!) that types when the Attention key is pressed. If you do not want this character to type when you press the Attention key, use the command:

```
cp terminal attn off
```

CMS allows you to specify a "blip" character: this character is typed or displayed whenever two seconds of CPU time are used. If you enter

```
set blip *
```

then, when a program is executing, this character types for every two seconds of CPU time. You can cancel the function:

```
set blip off
```

or set it to nonprintable characters:

```
set blip on
```

When this command has been entered on a typewriter terminal, the Selectric type ball tilts and rotates whenever a blip character is expected.

COMMANDS TO CONTROL HOW VM/370 PROCESSES INPUT LINES

You can manipulate VM/370's logical line editing function to suit your own needs. In addition to using the CP TERMINAL command to change the default logical line editing symbols, you can issue

```
cp set linedit off
```

so that none of the symbols are recognized by VM/370 when it interprets your input lines.

When you are in the CMS environment, there are a number of commands that you can use to control how CMS validates a command line. The SET command functions IMPCP (implied CP) and IMPEX (implied EXEC) control the recognition of CP commands and CMS EXEC procedures. For example, if you issue

```
set impcp off # set impex off
```

then, when you enter CP commands in CMS or try to execute EXEC procedures, you must preface the name of the command or procedure with CP (or #CP), or EXEC, respectively. If implied EXEC is set to off, you cannot use edit macros.

By using the SYNONYM and the SET ABBREV commands, you can control what command names, synonyms, or truncations are valid in CMS. For example, you could set up a file named MYSYN SYNONYM which contains the following records:

```
PRINT          PRT       1
RELEASE        LETGOOF   5
ACCESS         GET       1
DOSLKED        LNKEDT    3
```

The first column specifies an existing CMS command, module, or EXEC name; the second column specifies the alternate name, or synonym, you want to use; and the third column is a count field that indicates the minimum number of characters of the synonym that can be used to truncate the name. Using this file, after you enter the command

```
synonym mysyn
```

you can use PRT, LETGOOF, GET, and LNKEDT in place of the corresponding CMS command names. Also, if the ABBREV function is in effect, (it is the default; you can make sure it is in effect by issuing the command SET ABBREV ON), you can truncate any of your synonyms to the minimum number of characters specified in the count field of the record (that is, you could enter "p" for PRINT, "letgo" for RELEASE, and so on).

You can set up EXEC files with the same names as CMS commands, that may or may not perform the same function as the CMS names they duplicate. For example, if every time you used the GLOBAL command you used the same operands, you could have an EXEC file, named GLOBAL, that contained a single record:

```
global maclib cmslib osmacro
```

Then, every time you entered the command name

```
global
```

the command GLOBAL MACLIB CMSLIB OSMACRO would execute.

As another example, suppose you had an EXEC file named 'T', that contained the following records:

```
&CONTROL OFF
CP QUERY TIME
```

Then, whenever you entered

```
t
```

you would receive the CP time-of-day message, and you could no longer use the truncation "T" for the CMS command TYPE. In order to see the contents of a CMS file displayed at your terminal you would have to enter at least "TY" as a truncation.

CONTROLLING KEYBOARD-DEPENDENT COMMUNICATIONS

You are dependent on your terminal for communication with VM/370: when your virtual machine is waiting for a read either from the control program or from your virtual machine operating system, you can not receive messages until you press the Return key to enter a command or a null line. If you are in a situation where you must wait for a message before continuing your work, for example, if you are waiting for a tape device to be attached to your virtual machine, you can use the CP command SLEEP to lock your keyboard:

```
cp sleep
```

You must then press the Attention key to get out of sleep and unlock the keyboard so you can enter a command.

If your virtual machine is in the CP environment when you issue the SLEEP command, or if you issue the SLEEP command from the CMS environment using the #CP function, your virtual machine is in the CP environment after you press the Attention key. If your virtual machine is in the CMS environment when you enter the SLEEP command (or if you enter CP SLEEP), your virtual machine is in the CMS environment when you press the Attention key once.

You can control the effect of pressing the Attention key or your terminal with the CP TERMINAL command. If you specify:

```
cp terminal mode cp
```

then, whenever you press the Attention key, you are in the CP environment.

If you use the default terminal mode setting, which is VM, and then you press the Attention key once, you cause a read to your virtual machine; if you press the Attention key twice you cause a CP read, and you are in the CP environment.

The effect of pressing the Attention key is also important when you are executing a program. At times, you may wish to enter some CP commands while your program executes, but you do not want to interrupt the execution of the program. If, before you begin your program you issue the command

```
cp set run on
```

and then use the Attention key to get to the CP environment while your program executes, the program continues executing while you communicate with CP. The default setting for the RUN operand of the SET command is off; usually, when you press the Attention key (twice) during program execution, your program is interrupted.

SPECIAL CHARACTER SETS: If you are using a programming language or entering data that requires you to use characters that are not on your keyboard, you can select some characters that you do not use very often and establish a translate table with the SET command. For example, if your terminal does not have the special characters [and] (which have the hexadecimal values AD and BD, respectively), you could issue the commands

```
set input % ad
set input $ bd
```

Then, when you are entering data lines at your terminal, whenever you enter the characters "%" or "$", they are translated and written into your file as "[" and "]". When you display these lines, the character positions occupied by the special characters appear to be blanks, because they are not available on your keyboard. If you want these special characters to appear on your terminal in symbolic form, you should issue the commands

```
set output ad %
set output bd $
```

so that when you are displaying lines that contain these characters, they will appear translated as % and $ on your terminal. If you are going to use the input and output functions together, you must set the output character first; if you set the input character first, then you are unable to set the output function.

If you are an APL user and have the special APL type font or the APL 3270 feature and keyboard, you can tell VM/370 to use APL translation tables with the command

```
cp terminal apl on
```

Commands To Create, Modify, and Move Data Files and Programs

The CMS command language provides you with many different ways of manipulating files. A file, in CMS, is any collection of data; it is

most often a disk file, but it may also be contained on cards or tape, or it may be a printed or punched output file.

COMMANDS THAT CREATE FILES

You create files in CMS by several methods; either specifically or by default. The EDIT command invokes the CMS Editor to allow you to create a file directly at your terminal. You must specify a file identifier when you are creating a new file:

```
edit mother goose
```

In this example, the file has an identifier, or fileid, of MOTHER GOOSE. The EDIT subcommand INPUT allows you to begin inserting lines of data or source code into this file. When you issue the subcommands FILE or SAVE, the lines that you have entered are written into a CMS disk file.

Files are created, and sometimes named, by default, with the following types of commands:

- Commands that invoke programming language processors or compilers. For example, if you issue the command

  ```
  assemble myfile
  ```

  the assembler assembles source statements from an existing CMS file named MYFILE ASSEMBLE and produces an output file containing object code, as well as a listing. The files that are created are named:

  ```
  MYFILE TEXT
  MYFILE LISTING
  ```

- Commands that load CMS files onto a disk from cards or tapes. These commands are READCARD, TAPE LOAD, and DISK LOAD.

- The LISTFILE and LISTIO commands with the EXEC option create files named CMS EXEC and $LISTIO EXEC which you can execute as EXEC procedures.

- The TAPPDS and TAPEMAC commands create CMS disk files from OS data sets on tape. If the data set is a partitioned data set, the TAPPDS command creates individual CMS files from each of the members; the TAPEMAC command creates a CMS macro library, called a MACLIB, from an OS macro library.

- The MOVEFILE and FILEDEF commands, used together, can copy OS or DOS data sets or files into CMS files; they can also copy files from cards or tapes.

- CMS/DOS commands SSERV, ESERV, RSERV, and PSERV copy DOS files from source statement, relocatable, and procedure libraries into CMS files.

- Some CMS commands produce maps, or lists of files, data sets, or program entry points. For example, if you issue the command

  ```
  tape scan (disk
  ```

  A CMS disk file named TAPE MAP is created that contains a list of the CMS files that exist on a tape attached to your virtual machine at virtual address 181.

Some commands create new files from files that already exist on your virtual disks. The creation may involve a simple copy operation, or it may be a combining of many files of one type into a larger file of the same or a different type:

- The COPYFILE command, in its simplest form, copies a file from one virtual disk to another:

  ```
  copyfile yourprog assemble b myprog assemble a
  ```

- The MACLIB and TXTLIB commands create libraries from MACRO or COPY files, or from TEXT (object) files.

- The SORT command rearranges (in alphameric sequence) the records in a file and creates a new file to contain the result. You have to specify the name of the new file:

  ```
  sort nonseq recs a seq recs a
  ```

- The GENMOD command creates, from object modules that you have loaded into your virtual storage area, nonrelocatable modules. For example, the commands

  ```
  load test
  genmod payroll
  ```

  create a file named PAYROLL MODULE, which you can then execute as a user-written CMS command.

- The DOSLKED command creates or adds members to DOSLIBs, which are libraries containing link-edited CMS/DOS program phases.

- The UPDATE command creates an updated source file and special update files when you use it to apply updates to your source programs.

COMMANDS THAT MODIFY DISK FILES

You can use the CMS Editor to modify existing files on your virtual disks. You issue the EDIT command, giving the file identifier:

```
edit old file
```

CMS Editor subcommands allow you to make minor specific changes or global changes, which can affect many lines in a file at one time.

The MACLIB and TXTLIB commands also allow you to modify CMS macro and text libraries. You can add, delete, or replace members in these libraries using these commands.

The COPYFILE command has some options that allow you to change a file without creating a new output file. For example, if you enter the command

```
copyfile my file a (lowcase
```

then all of the uppercase characters in the file MY FILE are translated to lowercase.

You can change the file identifier of a file using the RENAME command:

```
rename test file a1 good file a1
```

The ERASE command deletes files from your virtual disks:

```
erase temporary file b1
```

For additional examples of CMS file system commands, see "Appendix D: Sample Terminal Sessions."

COMMANDS TO MOVE FILES

You can use CMS commands to transfer a data file from one device or medium to another device of the same or of a different type. The types of movement, and the commands to use, are described briefly here and in detail in "Section 7. Using Real Printers, Punches, Readers, and Tapes."

If you need to transfer files between virtual machines, you can use the PUNCH or DISK DUMP commands to punch virtual card image records. These are then placed in the virtual card reader of the receiving virtual machine.

Before you use either of these commands, you must indicate the output disposition of the files. You do this with the CP SPOOL command:

```
cp spool 00d to mickey
```

Then, you can use the PUNCH command to punch virtual card images:

```
punch acct records
```

The file ACCNT RECORDS is spooled to the userid MICKEY's virtual card reader. If the CMS file you are transferring does not have fixed-length, 80-character (card image) records, you can use the command

```
disk dump acct records
```

The CMS TAPE command allows you to dump CMS files onto tape, or to restore previously dumped files:

```
tape dump archive file
tape load archive file
```

VM/ 370 also provides a special utility program, DASD Dump Restore, that allows you to dump the entire contents of your virtual disk onto a tape and then later restore it to a disk. You might use this program, invoked by the DDR command in CMS, to back up your data files before using them to test a new program.

COMMANDS TO PRINT FILES AND PUNCH CARDS

The commands that you use most often to print and punch CMS files are the commands PRINT and PUNCH. For example,

```
print myprog listing
```

prints the contents of the LISTING file on the system printer, and

```
punch myprog assemble
```

punches the assembler language source statement file onto cards. You can also punch members of MACLIBs and TXTLIBs:

```
punch cmslib maclib (member fscb
```

Some CMS commands have a PRINT option, so that instead of having some kinds of output displayed at your terminal or placed in a disk file, you can request to have it printed on the real system printer. For example, if you want a list of the contents of a macro library to print, you could issue the command

```
maclib map mylib (print
```

You can see the contents of a file displayed at your terminal by using the TYPE command:

```
type week3 report
```

You can specify, on the TYPE command, that you want to see only some specific records in this file:

```
type week3 report a 1 20
```

Commands To Develop and Test OS and CMS Programs

Use CMS to prepare programs: you can create them with the CMS Editor, or write them onto your CMS disks using any of the methods discussed above. You can also assemble or compile source programs directly from cards, tapes, or OS data sets. If your source program is in a CMS disk file, then during the development process you can use the editor to make corrections and updates.

To compile your programs, use the assembler or any of the language processors available at your installation. If your program uses macros that are contained in either system or private program libraries, you must make these libraries known to CMS by using the GLOBAL command:

```
global maclib cmslib asmlib
```

In this example, you are using two libraries: the CMS macro library, CMSLIB MACLIB, and a private library, named ASMLIB MACLIB.

The output from the compilers, in relocatable object form, is stored on a CMS disk as a file with the filetype of TEXT. To load TEXT files into virtual storage to execute them, use the LOAD command:

```
load myprog
```

The LOAD command performs the linkage editor function in CMS. If MYPROG contains references to external routines, and these routines are the names of CMS TEXT files, those TEXT files are automatically included in the load. If you receive a message telling you that there is an undefined name (which might happen if you have a CSECT name or entry point that is not the same as the name of the TEXT file that contains it), you can then use the INCLUDE command to load this TEXT file:

```
include scanrtn
```

When you have loaded the object modules into storage, you can begin program execution with the START command:

```
start
```

If you want to begin execution at a specified entry point, enter

```
start scan1
```

where SCAN1 is the name of a control section, entry point, or procedure.

If you are testing a program that either reads or writes files or data sets using OS macros, you must use the FILEDEF command to supply a file definition to correspond to the ddname you specify in your program. The command

```
filedef indd reader
```

indicates that the input file is to be read from your virtual card reader. A disk file might be defined:

```
filedef outdd disk out file a1
```

The FILEDEF command, in CMS, performs the same function as a data definition (DD) card in OS.

The commands to load and execute OS programs are discussed in "Section 8. Developing OS Programs Under CMS."

The RUN command, which is actually an EXEC procedure, combines many of these commands for you, so that if you want to compile, load, and execute a single source file, or load and execute a TEXT or MODULE file, you can use the RUN command instead of issuing a series of commands. See the discussion of the RUN command in VM/370: CMS Command and Macro Reference for a list of the OS language processors available.

Commands To Develop and Test DOS Programs

CMS simulates many functions of the Disk Operating System (DOS/VS) in the CMS/DOS environment. CMS/DOS is not a separate system, but is part of CMS. When you enter the command

```
set dos on
```

you are in the CMS/DOS environment. If you want to use the libraries on the DOS/VS system residence volume, you should access the disk on which it resides and specify the mode letter on the SET DOS ON command line:

```
access 132 c
set dos on c
```

Using commands that are available only in the CMS/DOS environment, you can assign system and programmer logical units with the ASSGN command:

```
assgn sys200 reader
```

If the device is a disk device, you can set up a data definition with the DLBL command:

```
assgn sys100 b
dlbl infile b dsn myinput file (sys100
```

You can find out the current logical unit assignments and active file definitions with the LISTIO and QUERY DLBL commands, respectively:

```
listio a
query dlbl
```

If you are an assembler language programmer, you can assemble a source file with the ASSEMBLE command:

```
assemble myprog
```

A CMS file with a filetype of DOSLIB simulates a DOS core image library; you can link-edit TEXT files or relocatable modules from a DOS relocatable library and place the link-edited phase in a DOSLIB using the DOSLKED command:

```
doslked myprog newlib
```

Then, use the GLOBAL command to identify the phase library and issue the FETCH command to bring the phase into virtual storage:

```
global doslib newlib
fetch myprog
```

The START command begins program execution:

```
start
```

During program development with CMS, you can use DOS/VS system or private libraries. You can use files on these libraries or you can copy them into CMS files. The DSERV command displays the directories of DOS/VS libraries. The command

```
dserv cd
```

produces a copy of the directory for the core image library. To copy phases from relocatable libraries into CMS TEXT files, you could use the RSERV command:

```
rserv oldprog
```

The SSERV and ESERV commands are available for you to copy files from source statement libraries, or copy and de-edit macros from E sublibraries. Also, the PSERV command copies procedures from the procedure library.

The CMS/DOS commands are described in more detail in "Section 9. Developing DOS Programs Under CMS."

Commands Used in Debugging Programs

When you execute your programs under CMS, you can debug them as they execute, by forcing execution to halt at specific instruction addresses. You do this by entering the debug environment before you issue the START command. You enter the debug environment with the DEBUG command:

```
debug
```

To specify that execution be stopped at a particular virtual address, you can use the BREAK subcommand to set a breakpoint. For example,

```
break 1 20ad0
```

Then, when this instruction is encountered during the execution of the program, the debug environment is entered and you can examine registers or specific storage locations, or print a dump of your virtual storage. Subcommands that do these things might look like the following:

```
gpr 0 15
x 20c12 8
dump 20000 *
```

If, instead of using the CMS DEBUG subcommands, you use the CP ADSTOP command to set address stops, for example,

```
cp adstop 20ad0
```

then, in the CP environment, you can use CP commands to do the same things, for example

```
cp display g
cp display 20c12.8
cp dump 20000
```

Both sets of commands shown in these examples result in displays of (1) the contents of your virtual machine's general purpose registers, (2) a display of eight bytes of storage beginning at location X'20C12' and (3) a dump of virtual storage from location X'20000' to the end.

You can also use the CMS SVCTRACE command and the CP TRACE commands to see a record of interrupt activity in your virtual machine.

The DEBUG subcommands and the CMS and CP debugging facilities are described in more detail in "Section 11. How VM/370 Can Help You Debug Your Programs."

Commands To Request Information

All of the CP and CMS commands discussed in this section have required some action on your part: you set your terminal characteristics, manipulate disk files, develop, compile, and test programs, and control your virtual machine devices and spool files. During a terminal session you can change the status of many of your devices and virtual machine characteristics, modify the files on your disks and create spool files. VM/370 provides many commands to help you find out what is and what is not currently defined in your virtual machine.

COMMANDS TO REQUEST INFORMATION ABOUT TERMINAL CHARACTERISTICS

You can find out the status of your terminal characteristics by using the CP command QUERY with the TERMINAL or SET operands. If you issue the command

```
cp query terminal
```

you can see the settings for all of the functions controlled by the CP TERMINAL command, including the current line size and line editing symbols.

Similarly, the command

```
cp query set
```

tells you the settings for the functions controlled by the CP SET command, such as error message display, and the MSG and WNG flags.

For most of the functions controlled by the CMS SET command, there are corresponding CMS QUERY command operands; to find out a particular setting, you must specify the function in the QUERY command. For example,

```
query input
```

lists the current settings in effect for input character translation. Other functions that you can query this way are:

BLIP	INPUT	REDTYPE
IMPCP	OUTPUT	SYNONYM
IMPEX	RDYMSG	

COMMANDS TO REQUEST INFORMATION ABOUT DATA FILES

Use the LISTFILE command to get information about CMS files. The information you can obtain from the LISTFILE command includes:

- The names of all the files on your A-disk:

  ```
  listfile
  ```

- The names of all the files on any other accessed disk:

  ```
  listfile * * b
  ```

- The names of all files that have the same filename:

  ```
  listfile myprog *
  ```

- The names of all files with the same filetype:

  ```
  listfile * assemble
  ```

- The record length and format, blocksize, creation date and disk label for a particular file:

  ```
  listfile records saved a2 (label
  ```

Use the STATE command to find out whether a certain file exists:

```
state sales list c
```

If you want to know if the file is on a read/write disk, you can use the STATEW command.

To find out what CMS libraries have been made available, you can use the commands:

```
query doslib
query maclib
query txtlib
query library
```

To find out what members are contained in a particular macro or text library use the commands:

```
maclib map mylib (term
txtlib map proglib (term
```

The MODMAP command displays a load map of a MODULE file:

```
modmap payroll
```

To examine load maps created by the LOAD command, use the TYPE command:

```
type load map a5
```

The TYPE command can also be used to display the contents of any CMS file. To examine large files, you can use the PRINT command to spool a copy to the high-speed printer.

To compare the contents of two files to see if they are identical, use the COMPARE command:

```
compare labor stat a1 labor stat b1
```

Any records in these files that do not match are displayed at your terminal.

If you have OS or DOS disks attached to your virtual machine, you can display a list of OS data sets or DOS files by using the LISTDS command, for example

```
listds d
```

displays a list of the data sets or files on the OS or DOS disk accessed as your D-disk.

COMMANDS TO REQUEST INFORMATION ABOUT YOUR VIRTUAL DISKS

Use the CP QUERY command to find out:

- What virtual disks are currently part of your configuration:

  ```
  cp query virtual dasd
  ```

- Whether a particular virtual disk address is in use:

  ```
  cp query virtual 291
  ```

- What users might be linked to one of your disks:

  ```
  cp query links 330
  ```

The CMS QUERY command can tell you about your accessed disks. If you enter

```
query disk a
```

you can find out the number of files on your A-disk, the amount of space that is being used, and its percentage of the total disk space, and the read/write status. To get this information for all of your accessed disks, issue the command:

```
query disk *
```

To obtain information about the extents occupied by files on OS and DOS disks, enter the command

```
listds * (extent
```

If you want to know the current order in which your disks are searched for data files or programs, issue the command

```
query search
```

You could also use this command to find out what disks you have accessed, what filemode letters you have assigned to them, whether they are read/write or read-only, and whether they are CMS, OS, or DOS disks.

COMMANDS TO REQUEST INFORMATION ABOUT YOUR VIRTUAL MACHINE

If you issue the command

```
cp query virtual
```

you can find out the status of your virtual machine configuration. You can also request specific information; for example, the command

```
cp query storage
```

gives you the amount of virtual storage you have available.

To find out the current spooling characteristics of your printer, punch, or reader, issue the commands

```
cp query 00e
cp query 00d
cp query 00c
```

To see information about all three at once, use

```
cp query ur
```

For the status of spool files on any of these devices, issue the commands

```
cp query printer
cp query punch
cp query reader
```

Using these commands, you can request the status of particular spool files by referring to the spoolid number, for example:

```
cp query printer 4187
```

You can also request additional information about the files, including file identification and creation time:

```
cp query reader all
```

If you want to know the total number of spool files associated with your virtual machine, you can use the command

```
cp query files
```

The response to this message is the same as the message you receive if you have spool files when you log on.

Section 4. The CMS File System

The file is the essential unit of data in the CMS system. CMS disk files are unique to the CMS system and cannot be read or written using other operating systems. When you create a file in CMS, you name it using a file identifier. The file identifier consists of three fields:

- Filename (fn)
- Filetype (ft)
- Filemode (fm)

When you use CMS commands and programs to modify, update, or reference files, you must identify the file by using these fields. Some CMS commands require you to enter only the filename, or the filename and filetype; others require you to enter the filemode field as well. This section contains information about the things you must consider when you give your CMS files their identifiers, notes on the file system commands that create and modify CMS files, and additional notes on using CMS disks.

CMS File Formats

The CMS file management routines write CMS files on disk in 800-byte physical blocks, regardless of whether they have fixed- or variable-length records. For most of your CMS applications, you never need to specify either a logical record length and record format or block size when you create a CMS file.

When you create a file with the CMS Editor, the file has certain default characteristics, based on its filetype. The special filetypes recognized by the editor, and their applications, are discussed under "What are Reserved Filetypes?"

VSAM files written by CMS are in the same format as VSAM files written by OS/VS or DOS/VS and are recognized by those operating systems. You cannot, however, use any CMS file system commands to read and write VSAM files, because VSAM file formats are unique to the Virtual Storage Access Method.

A single CMS file can contain up to 12,848,000 bytes of data grouped into up to 65,535 logical records, all of which must be on the same minidisk. If the file is a source program, the file size limit may be smaller. The maximum number of files per real disk is 3400 for a 3330, 3333, 3340, or 3350 disk, or 3500 for a 2314 or 2319.

How CMS Files Get Their Names

When you create a CMS file, you can give it any filename and filetype you wish. The rules for forming filenames and filetypes are:

- The filename and filetype can each be from 1- to 8 characters.
- The valid characters are A-Z, 0-9, and $, #, @

When you enter a command line into the VM/370 system, your input line is always translated, by VM/370, into uppercase characters. So, when you specify a file identifier, you can enter it in lowercase.

Remember that, by default, the # and @ characters are line editing symbols in VM/370; when you use them to identify a file, you must precede them with the logical escape symbol (").

The third field in the file identifier, the filemode, indicates the mode letter (A-G, S, Y, or Z) currently assigned to the virtual disk on which you want the file to reside. When you use the CMS Editor to create a file, and you do not specify this field, the file you create is written on your A-disk, and has a filemode letter of A.

The filemode letter, for any file, can change during a terminal session. For example, when you log on, your virtual disk at address 191 is accessed as your A-disk, so a file on that disk named SPECIAL EVENTS has a file identifier of:

```
SPECIAL EVENTS A
```

If, however, you later access another disk as your A-disk, and access your 191 as your B-disk, then this file has a file identifier of:

```
SPECIAL EVENTS B
```

DUPLICATING FILENAMES AND FILETYPES

You can give the same filename to as many files on a given disk as you want, as long as you assign them different filetypes. Or you can create many files with the same filetype but different filenames.

For the most part, filenames that you choose for your files have no special significance to CMS. If, however, you choose a name that is the same as the name of a CMS command, and the file that you assign this name to is an executable module or EXEC procedure, then you may encounter difficulty if you try to execute the CMS command whose name you duplicated.

For an explanation of how CMS identifies a command name, see "CMS Command Search Order" later in this section.

Many CMS commands allow you to specify one or more of the fields in a file identifier as an asterisk (*) or equal sign (=), which identify files with similar fileids.

Using Asterisks (*) in Fileids

Some CMS commands that manipulate disk files allow you to enter the filename and/or filetype fields as an asterisk (*), indicating that all files of the specified filename/filetype are to be modified. These commands are:

```
COPYFILE   RENAME
ERASE      TAPE DUMP
```

For example, if you specify

```
erase * test a
```

all files with a filetype of TEST on your A-disk are erased.

Similarly, if you enter the command

```
rename temp * b perm = =
```

all files with a filename of TEMP are renamed to have filenames of PERM; the existing filetypes of the files remain unchanged.

The LISTFILE command allows you to request similar lists. If you specify an asterisk for a filename or filetype, all of the files of that filename or filetype are listed. There is an additional feature that you can use with the LISTFILE command, to obtain a list of all the files that have a filename or filetype that begin with the same character string. For example,

```
listfile t* assemble
```

produces a list of all files on your A-disk whose filenames begin with the letter T. The command

```
listfile tr* a*
```

produces a list of all files on your A-disk whose filenames begin with the letters TR and whose filetypes begin with the letter A.

Equal Signs in Output Fileids

The COPYFILE, RENAME, and SORT commands allow you to enter output file identifiers as equal signs (=), to indicate that it is the same as the corresponding input file identifier. For example,

```
copyfile myprog assemble b = = a
```

copies the file MYPROG ASSEMBLE from your B-disk to your A-disk, and uses the same filename and filetype as specified in the input fileid for those positions in the output fileid.

What Are Reserved Filetypes?

For the purposes of most CMS commands, the filetype field is used merely as an identifier. Some filetypes, though, have special uses in CMS; these are known as "reserved filetypes."

Nothing prevents you from assigning any of the reserved filetypes to files that are not being used for the specific CMS function normally associated with that filetype.

Reserved filetypes also have special significance to the CMS Editor. When you use the EDIT command to create a file with a reserved filetype, the editor assumes various default characteristics for the file, such as record length and format, tab settings, translation to uppercase, truncation column, and so on.

FILETYPES FOR CMS COMMANDS

Reserved filetypes sometimes indicate how the file is used in the CMS system: the filetype ASSEMBLE, for example, indicates that the file is to be used as input to the assembler; the filetype TEXT indicates that the file is in relocatable object form, and so on. Many CMS commands assume input files of particular filetypes, and require you to enter only the filename on the command line. For example, if you enter

```
synonym test
```

CMS searches for a file with a filetype of SYNONYM and a filename of TEST. A file named TEST that has any other filetype is ignored.

Some CMS commands create files of particular filetypes, using the filename you enter on the command line. The language processors do this as well; if you are recompiling a source file, but wish to save previous output files, you should rename them before executing the command.

Figure 2 lists the filetypes used by CMS commands and describes how they are used. Figure 3 lists the filetypes used by CMS/DOS commands.

In addition to these CMS filetypes, there are special filetypes reserved for use by the language processors, which are IBM program products. These filetypes, and the commands that use them, are:

Filetypes	Commands
COBOL, TESTCOB	COBOL, FCOBOL, TESTCOB
FORTRAN, FREEFORT, FTnn001, TESTFORT	FORTRAN, FORTGI, FORTHX GOFORT, TESTFORT
PLI, PLIOPT	DOSPLI, PLIC, PLICR, PLIOPT
VSBASIC, VSBDATA	VSBASIC

For details on how to use these filetypes, consult the appropriate program product documentation.

Filetype	Command	Comments
AMSERV	AMSERV	Contains VSAM Access Method Services control statements to be executed with the AMSERV command.
ASM3705	ASM3705 GEN3705	Used by system programmers to generate the 3704/3705 control program.
ASSEMBLE	ASSEMBLE	Contains source statements for assembler language programs.
AUXxxxx	UPDATE	Points to files that contain UPDATE control statements for multiple updates.
CNTRL	UPDATE	Lists files that either contain UPDATE control statements or point to additional files.
COPY	MACLIB	Can contain COPY control statements and macros or copy files to be added to MACLIBs.
DIRECT	DIRECT	Contains entries for the VM/370 user directory file. The system operator controls this file.
EXEC	EXEC GEN3705 LISTFILE	Can contain sequences of CMS or user-written commands, with execution control statements.
LISTING	AMSERV ASSEMBLE ASM3705	Listings are produced by the assembler and the language processors as well as the AMSERV command.
LKEDIT	LKED	Contains the listing created during the generation of the 3704/3705 control program.
LOADLIB	LKED	Is a library of 3704/3705 control program load modules created during 3704/3705 control program generation.
MACLIB	GLOBAL MACLIB	Library members contain macro definitions or copy files; the MACLIB command creates the library, and lists, adds, deletes, or replaces members. The GLOBAL command identifies which macro libraries should be searched during an assembly or compilation.
MACRO	MACLIB	Contains macro definitions to be added to a CMS macro library (MACLIB).
MAP	INCLUDE LOAD MACLIB TAPE TXTLIB	Maps created by the LOAD and INCLUDE commands indicate entry point locations; the MACLIB, TXTLIB, and TAPE commands produce MAP files.

Figure 2. Filetypes Used by CMS Commands (Part 1 of 2)

Filetype	Command	Comments
MODULE	GENMOD LOADMOD MODMAP	MODULE files created by the GENMOD command are nonrelocatable executable programs. The LOADMOD commands loads a MODULE file for execution; the MODMAP command displays a map of entry point locations.
SYNONYM	SYNONYM	Contains a table of synonyms for CMS commands and user-written EXEC and MODULE files.
SCRIPT[1]	SCRIPT	SCRIPT text processor input includes data and SCRIPT control words.
TEXT	ASSEMBLE INCLUDE LOAD TXTLIB	TEXT files contain relocatable object code created by the assembler and compilers. The LOAD and INCLUDE commands load them into storage for execution. The TXTLIB command manipulates libraries of TEXT files.
TXTLIB	GLOBAL TXTLIB	Library members contain relocatable object code. The TXTLIB command creates the library, and lists or deletes existing members. The GLOBAL command identifies TXTLIBs to search.
UPDATE	UPDATE	Contains UPDATE control statements for single updates applied to source programs.
UPDLOG	UPDATE	Contains a record of additions, deletions, or changes made with the UPDATE command.
UPDTxxxx	UPDATE	Contains UPDATE control statements for multilevel updates.
ZAP	ZAP	Contains control records for the ZAP command, which is used by system support personnel.

[1]SCRIPT is an IBM Installed User Program (IUP).

Figure 2. Filetypes Used by CMS Commands (Part 2 of 2)

OUTPUT FILES: TEXT AND LISTING

Output files from the assembler and the language processors are logically related to the source programs by their filenames. Some of these files are permanent and some are temporary. For example, if you issue the command

```
assemble myfile
```

CMS locates a file named MYFILE with a filetype of ASSEMBLE and the system assembler assembles it. If the file is on your A-disk, then when the assembler completes execution, the permanent files you have are:

```
MYFILE ASSEMBLE A1
MYFILE TEXT     A1
MYFILE LISTING  A1
```

where the TEXT file contains the object code resulting from the assembly, and the LISTING file contains the program listing generated by the assembly. If any TEXT or LISTING file with the same name previously

Filetype	Command	Comments
COPY	MACLIB SSERV	When the SSERV command copies books or macros from DOS source statement libraries, the output is written to CMS COPY files, which can be added to CMS macro libraries with the MACLIB command.
DOSLIB	DOSLIB DOSLNK FETCH GLOBAL	DOS core image phases are placed in a DOSLIB by linkage editor, invoked with the DOSLNK command. The GLOBAL command identifies DOSLIBs to be searched when the FETCH command is executed.
DOSLNK	DOSLKED	Contains linkage editor control statements for input to the CMS/DOS linkage editor.
ESERV	ESERV	Contains input control statements for the ESERV utility program.
EXEC	LISTIO	The LISTIO command with the EXEC option creates the $LISTIO EXEC that lists system and programmer logical unit assignments.
LISTING	ASSEMBLE ESERV	Listings contain processor output from the ESERV command, and compiler output from the assembler and language processors.
MACRO	ESERV MACLIB	Contains SYSPCH output from the ESERV program, suitable for addition to a CMS MACLIB file.
MAP	DOSLIB DOSLKED DSERV	The DSERV command creates listings of the directories of DOS libraries. The DOSLIB command with the MAP option produces a list of DOSLIB members. The linkage editor map from the DOSLKED command is written into a MAP file.
PROC	PSERV	The PSERV command copies procedures from DOS procedure libraries into CMS PROC files.
TEXT	ASSEMBLE DOSLKED RSERV	Object decks created by the assembler or compilers are written into TEXT files. The RSERV command creates TEXT files from modules in DOS relocatable libraries. TEXT files can also be used as input to the linkage editor.

Figure 3. Filetypes Used in CMS/DOS

existed, it is erased. The source input file, MYFILE ASSEMBLE A1, is neither erased nor changed.

The characteristics of the TEXT and LISTING files produced by the assembler are the same as those created by other processors and programs in CMS.

Because these files are CMS files, you can use the CMS Editor to examine or modify their contents. If you want a printed copy of a LISTING file, you can use the PRINT command to print it. If you want to examine a TEXT file, you can use the TYPE or PRINT command specifying the HEX option.

FILETYPES FOR TEMPORARY FILES

The filetypes of files created by the assembler and language processors for use as temporary workfiles are:

SYSUT1	SYS001	SYS004
SYSUT2	SYS002	SYS005
SYSUT3	SYS003	SYS006
SYSUT4		

The CMS AMSERV command, executing VSAM utility functions, uses two workfiles, that have filetypes of LDTFDI1 and LDTFDI2.

Disk space is allocated for temporary files on an as-needed basis. They are erased when processing is complete. If a program you are executing is terminated before completion, these workfiles may remain on your disk. You can erase them.

CMSUT1 Files

The CMSUT1 filetype is used by CMS commands that create files on your CMS disks. The CMSUT1 file is used as a workfile and is erased when the file is created. When a command fails to complete execution properly, the CMSUT1 file may not be erased. The commands, and the filenames they assign to files they create, are listed below.

Command	Filename
COPYFILE	COPYFILE
DISK LOAD	DISK
EDIT	EDIT
INCLUDE	DMSLDR
LOAD	DMSLDR
MACLIB	DMSLBM
READCARD	READCARD
TAPE LOAD	TAPE
UPDATE	fn (the filename of the UPDATE file)

FILETYPES FOR DOCUMENTATION

There are two CMS reserved filetypes that accept uppercase and lowercase input data. These are MEMO and SCRIPT. You can use MEMO files to document program notes or to write reports. The SCRIPT filetype is used by the SCRIPT command, which invokes a text processor that is an IBM Installed User Program (IUP).

Filemode Letters and Numbers

The filemode field of a CMS file identifier has two characters: the filemode letter and the filemode number. The filemode letter is established by the ACCESS command, and specifies the virtual disk on which a file resides: A through G, S, Y, or Z. The filemode number is a number from 0 to 5, which you can assign to the file when you create it or rename it; if you do not specify it, the value defaults to 1. How you access your disks and what filemode letters you give them with the

ACCESS command depends on how you want to use the files that are on them.

For most of the reading and writing you do of files, you use your A-disk, which is also known as your primary disk. This is a read/write disk. You may access other disks in your configuration, or access linked-to disks, in read-only or read/write status, depending on whether you have a read-only or read/write link.

When you load CMS (with the IPL command), your virtual disk at address 191 is accessed for you as your A-disk. Your virtual disk at address 190 (the system disk) is accessed as your S-disk; and the disk at 19E is accessed as an extension of your S-disk, with a mode letter of Y. In addition, if you have a disk defined at address 192, it is accessed for you as your D-disk.

The actual letters you assign to any other disks (and you may reassign the letters A, D, and Y), is arbitrary; but it does determine the CMS search order, which is the order in which CMS searches your disks when it is looking for a file. The order of search (when all disks are being searched) is alphabetical: A through G, S, Y, and Z. If you have duplicate file identifiers on different disks, you should check your disk search order before issuing commands against that filename to be sure that you will get the file you want. You can find out the current search order for your virtual disks by issuing the command:

```
query search
```

You can also access disks as logical extensions of other disks, for example:

```
access 235 b/a
```

The "/A" indicates that the B-disk is to be a read-only extension of the A-disk, and the A-disk is considered the "parent" of the B-disk. A disk may have many extensions, but only one level of extension is allowed.

How Extensions Are Used

If you have a disk accessed as an extension of another disk, the extension disk is automatically read-only, and you cannot write on it. You might access a disk as its own extension, therefore, to protect the files on it, so that you do not accidentally write on it, for example,

```
access 235 b/b
```

Another use of extensions is to extend the CMS search order. If you issue a command requesting to read a file, for example:

```
type alpha plan
```

CMS searches your A-disk for the file named ALPHA PLAN and if it does not find it, searches any extensions that your A-disk may have. If you have a file named ALPHA PLAN on your B-disk but have not accessed it as an extension of your A-disk, CMS will not find the file, and you will have to re-enter the command:

```
type alpha plan b
```

Additionally, if you issue a CMS command that reads and writes a file, and the file to be read is on an extension of a read/write disk, the output file is written to the parent read/write disk. The EDIT

command is a good example of this type of command. If you have a file named FINAL LIST on a B-disk extension of a read/write A-disk, and if you invoke the editor to modify the file with the command:

```
edit final list
```

after you have made modifications to the file, the changed file is written onto your A-disk. The file on the B-disk remains unchanged.

Accessing and Releasing Read-only Extensions

When you access a disk as a read-only extension, it remains an extension of the parent disk as long as both disks are still accessed. If either disk is released, the relationship is terminated.

If the parent disk is released, the extension remains accessed and you may still read files on it. If you access another disk at the mode letter of the original parent disk, the parent/extension relationship remains in effect.

If you release a read-only extension and access another disk with the same mode letter, it is not an extension of the original parent disk unless you access it as such. For example, if you enter

```
access 198 c/a
release c
access 199 c
```

the C-disk at virtual address 199 is not an extension of your A-disk.

WHEN TO SPECIFY FILEMODE LETTERS: READING FILES

When you request CMS to access a file, you have to identify it so that CMS can locate it for you. The commands that expect files of particular filetypes (reserved filetypes) allow you to enter only the filename of the file when you issue the command. When you execute any of these commands, or execute a MODULE or EXEC file, CMS searches all of your accessed disks (using the standard search order) to locate the file. The CMS commands that perform this type of search are:

AMSERV	GLOBAL	MODMAP
ASSEMBLE	LOAD	RUN
DOSLIB	LOADMOD	TXTLIB
EXEC	MACLIB	

Some CMS commands require you to enter the filename and filetype to identify a file. You may specify the filemode letter; if you do not specify the filemode, CMS searches only your A-disk and its extensions when it looks for the file. If you do specify a filemode letter, the disk you specify and its extensions are searched for the file. The commands you use this way are:

EDIT	PUNCH	TAPE DUMP
ERASE	STATE	TYPE
FILEDEF	SYNONYM	UPDATE
PRINT		

There are two CMS commands that do not search extensions of disks when looking for files. They are:

DISK DUMP
LISTFILE

You must explicitly enter the filemode if you want to use these commands to list or dump files that are on extensions.

Using Asterisks and Equal Signs

For some CMS commands, if you specify the filemode of a file as an asterisk, it indicates that you either do not know or do not care what disk the file is on and you want CMS to locate it for you. For example, if you enter

```
listfile myfile test *
```

the LISTFILE command responds by listing all files on your accessed disks named MYFILE TEST. When you specify an asterisk for the filemode of the COPYFILE, ERASE, or RENAME commands, CMS locates all copies of the specified file. For example,

```
rename temp sort * good sort =
```

renames all files named TEMP SORT to GOOD SORT on all of your accessed read/write disks. An equal sign (=) is valid in output fileids for the RENAME, SORT, and COPYFILE commands.

For some commands, when you specify an asterisk for the filemode of a file, CMS stops searching as soon as it finds the first copy of the file. For example,

```
type myfile assemble *
```

If there are files named MYFILE ASSEMBLE on your A-disk and C-disk, then only the copy on your A-disk is displayed. The commands that perform this type of search are:

COMPARE	PRINT	STATE
DISK DUMP	PUNCH	SYNONYM
EDIT	RUN	TAPE DUMP
FILEDEF	SORT	TYPE

For the COMPARE, COPYFILE, RENAME, and SORT commands, you must always specify a filemode letter, even if it is specified as an asterisk.

WHEN TO SPECIFY FILEMODE LETTERS: WRITING FILES

When you issue a CMS command that writes a file onto one of your virtual disks, and you specify the output filemode, CMS writes the file onto that disk. The commands that require you to specify the output filemode are:

COPYFILE
RENAME
SORT

The commands that allow you to specify the output filemode, but do not require it, are:

FILEDEF	TAPE LOAD
GENMOD	TAPPDS
READCARD	UPDATE

When you do not specify the filemode on these commands, CMS writes the output files onto your A-disk.

Some CMS commands that create files always write them onto your A-disk. The LOAD and INCLUDE commands write a file named LOAD MAP A5. The LISTFILE command creates a file named CMS EXEC, on your A-disk. The CMS/DOS commands DSERV, ESERV, SSERV, PSERV, and RSERV also write files onto your A-disk.

Other commands that do not allow you to specify the filemode write output files either:

- To the disk from which the input file was read
- To your A-disk, if the file was read from a read-only disk.

These commands are:

AMSERV
MACLIB
TXTLIB
UPDATE

The SORT command also functions this way if you specify the output filemode as an asterisk (*).

In addition, many of the language processors, when creating work files and permanent files, write onto the first read/write disk in your search order, if they cannot write on the source files's disk or its parent.

HOW FILEMODE NUMBERS ARE USED

Whenever you specify a filemode letter to reference a file, you can also specify a filemode number. Since a filemode number for most of your files is 1, you do not need to specify it. The filemode numbers 0, 2, 3, 4, and 5 are discussed below. Filemode numbers 6 through 9 are reserved for IBM use.

Filemode 0: A filemode number of 0 assigned to a file makes that file private. No other user may access it unless they have read/write access to your disk. If someone links to your disk in read-only mode and requests a list of all the files on your disk, the files with a filemode of 0 are not listed.

Filemode 2: Filemode 2 is essentially the same, for the purposes of reading and writing files, as filemode 1. Usually a filemode of 2 is assigned to files that are shared by users who link to a common disk, like the system disk. Since you can access a disk and specify which files on that disk you want to access, files with a filemode of 2 provide a convenient subset of all files on a disk. For example, if you issue the command:

```
access 489 e/a * * e2
```

you can only read files with a filemode of 2 on the disk at virtual address 489.

Filemode 3: Files with a filemode of 3 are erased after they are read. If you create a file with a filemode of 3 and then request that it be printed, the file is printed, and then erased. You can use this filemode if you write a program or EXEC procedure that creates files that you do not want to maintain copies of on your virtual disks. You can create the file, print it, and not have to worry about erasing it later.

The language processors and some CMS commands create work files and give these work files a filemode of 3.

Filemode 4: Files with a filemode of 4 are in OS simulated data set format. These files are created by OS macros in programs running in CMS. You specify that a file created by a program is to have OS simulated data set format by specifying a filemode of 4 when you issue the FILEDEF command for the output file. If you do not specify a filemode of 4, the output file is created in CMS format.

You can find more details about OS simulated data sets in "Section 8. Developing OS Programs Under CMS."

Note: There are no filemode numbers reserved for DOS or VSAM data sets, since CMS does not simulate these file organizations.

Filemode 5: This filemode number is the same, for purposes of reading and writing, as filemode 1. You can assign a filemode of 5 to files that you want to maintain as logical groups, so that you can manipulate them in groups. For example, you can reserve the filemode of 5 for all files that you are retaining for a certain period of time; then, when you want to erase them, you could issue the command:

```
erase * * a5
```

The CMS commands that create files with a filetype of MAP assign these files a filemode of 5.

When To Enter Filemode Numbers

You can assign filemode numbers when you use the following commands:

COPYFILE: You can assign a filemode number when you create a new file with the COPYFILE command. To change only the filemode number of an existing file, you must use the REPLACE option. For example

```
copyfile test module a1 = = a2 (replace
```

changes the filemode number of the file TEST MODULE A from 1 to 2.

EDIT: You can assign a filemode number when you create a file with the CMS Editor. To change the filemode number of an existing file, use the RENAME or COPYFILE commands, or use the FMODE subcommand when you are in the edit environment.

DLBL, FILEDEF: When you assign file definitions to disk files for programs or CMS command functions, you can specify a filemode number.

GENMOD: You can specify a filemode number on the GENMOD command line. To change the filemode number of an existing MODULE file, use the RENAME or COPYFILE commands.

READCARD: You can assign a filemode number when you specify a file identifier on the READCARD command line, or on a READ control card.

RENAME: When you specify the fileids on the RENAME command, you can specify the filemode numbers for the input and/or output files.

SORT: You can specify filemode numbers for the input and/or output fileids on the SORT command line.

Managing Your CMS Disks

The number of files you can write on a CMS disk depends on both the size of the disk and the size of the files that it contains. You can find out how much space is being used on a disk by using the QUERY DISK command. For example, to see how much space is on your A-disk, you would enter

```
query disk a
```

The response may be something like this:

```
A (191): 171 FILES; 1221 REC IN USE, 107 LEFT (of 1328),
   92% FULL (5 CYL), 3330, R/W
```

When a disk is becoming full, you should erase whatever files you no longer need. Or dump to tape files that you need to keep but do not need to keep active on disk.

When you are executing a command or program that writes a file to disk, and the disk becomes full in the process, you receive an error message, and you have to try to clear some space on the disk before you can attempt to execute the command or program again. To avoid the delays that such situations cause, you should try to maintain an awareness of the usage of your disks. If you cannot erase any more files from your disks, you should contact installation support personnel about obtaining additional read/write CMS disk space.

CMS File Directories

Each CMS disk has a master file directory that contains entries for each of the CMS files on the disk. When you access a disk, information from the master file directory is brought into virtual storage and written into a user file directory. The user file directory has an entry for each file that you may access. If you have accessed a disk specifying only particular files, then the user file directory contains entries only for those files.

If you have read/write access to a disk, then each time you write the file onto disk the user file directory and master file directory are updated to reflect the current status of the disk. If you have read-only access to a disk, then you cannot update the master file directory or user file directory. If you access a read-only disk while another user is writing files onto it, you may need to periodically reissue the ACCESS command for the disk, to obtain a fresh copy of the master file directory.

Note: You should never attempt to write on a disk at the same time as another user.

The user file directory remains in virtual storage until you issue the RELEASE command specifying the mode letter or virtual address of the disk. If you detach a virtual disk (with the CP DETACH command) without

releasing it, CMS does not know that the disk is no longer part of your virtual machine. When you attempt to read or write a file on the disk CMS assumes that the disk is still active (because the user file directory is still in storage) and encounters an error when it tries to read or write the file.

A similar situation occurs if you detach a disk and then add a new disk to your virtual machine using the same virtual address as the disk you detached. For example, if you enter the following sequence of commands:

```
cp link user1 191 195 rr rpass
access 195 d
cp detach 195
cp link user2 193 195 rr rpass2
listfile * * d
```

the LISTFILE command produces a list of the files on USER1's 191 disk; if you attempt to read one of these files, you receive an error message. You must issue the ACCESS command to obtain a copy of the master file directory for USER2's 193 disk.

The entries in the master file directory are sorted alphamerically by filename and filetype, to facilitate the CMS search for particular files. When you are updating disk files, the entries in the user file directory and master file directory tend to become unsorted as files are created, updated, and erased. When you use the RELEASE command to release a read/write disk, the entries are sorted and the master file directory is rewritten. If you or any other user subsequently access the disk, the file search may be more efficient.

CMS Command Search Order

When you enter a command line in the CMS environment, CMS has to locate the command to execute. If you have EXEC or MODULE files on any of your accessed disks, CMS treats them as commands, also: they are known as user-written commands.

As soon as the command name is found, the search stops and the command is executed. The search order is:

1. EXEC file on any currently accessed disk. CMS uses the standard search order (A through G, S, Y, and Z.)

2. Valid abbreviation or truncation for an EXEC file on any currently accessed disk, according to current SYNONYM file definitions in effect.

3. A command that has already been loaded into the transient area. The transient area commands are:

ACCESS	LISTFILE	RELEASE
ASSGN	MODMAP	RENAME
COMPARE	OPTION	SET
DISK	PRINT	SVCTRACE
DLBL	PUNCH	SYNONYM
FILEDEF	QUERY	TAPE
GENDIRT	READCARD	TYPE
GLOBAL		

4. A nucleus-resident command. The nucleus-resident CMS commands are:

CP	GENMOD	START
DEBUG	INCLUDE	STATE
ERASE	LOAD	STATEW
FETCH	LOADMOD	

5. Command module on any currently accessed disk. (All the remaining CMS commands are disk resident and execute in the user area.)

6. Valid abbreviation or truncation for nucleus-resident or transient area command module.

7. Valid abbreviation or truncation for disk resident command.

For example, if you create a command module that has the same name as a CMS nucleus-resident command, your command module cannot be executed, since CMS locates the nucleus-resident command first, and executes it.

Figure 4 shows more details of the command search order; you can find a complete description of the search order in the VM/370: System Programmer's Guide.

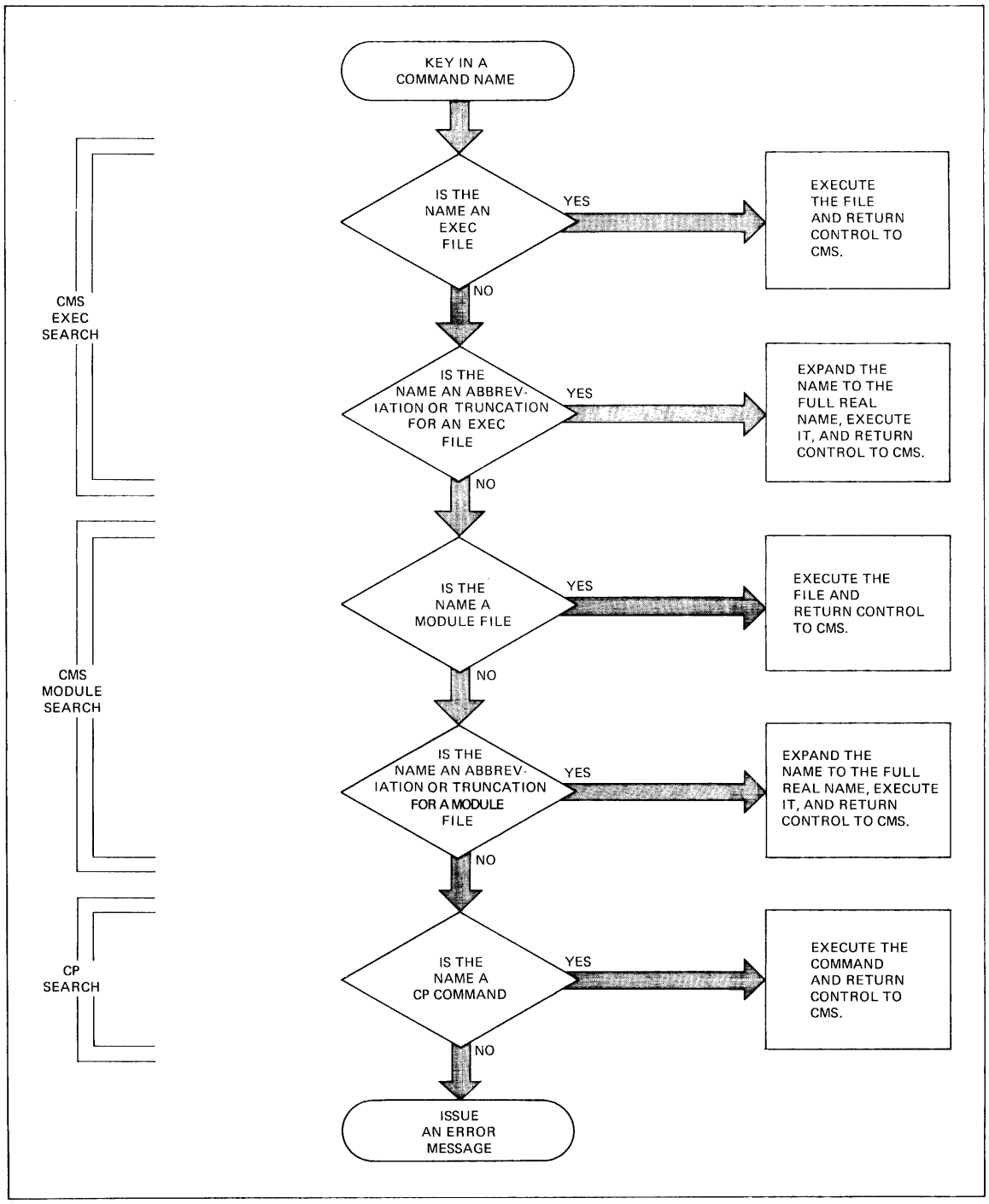


Figure 4. How CMS Searches for the Command to Execute

Section 5. The CMS Editor

In CMS usage, the term edit is used in a variety of ways, all of which refer, ultimately, to the functions of the CMS Editor, which is invoked when you issue the EDIT command.

To edit a file means to make changes, additions, or deletions to a CMS file that is on a disk, and to make these changes interactively: you instruct the editor to make a change, the editor does it, and then you request another change.

You can edit a file that does not exist; when you do so, you create the file online, and can modify it as you enter it.

To file a file means to write a file you are editing back onto a disk, incorporating any changes you made during the editing session. When you issue the FILE subcommand to write a file, you are no longer in the environment of the CMS Editor, but are returned to the CMS environment. You can, however, write a file to disk and then continue editing it, by using the SAVE subcommand.

An editing session is the period of time during which a file is in your virtual storage area, from the moment you issue the EDIT command and the editor responds EDIT: until you issue the FILE or QUIT subcommands to return to the CMS command environment.

The EDIT Command

When you issue the EDIT command you must specify the filename and filetype of the file you want to edit. If you issue

```
edit test file
```

CMS searches your A-disk and its extensions for a file with the identification TEST FILE. If the file is not found, CMS assumes that you want to create the file and issues the message

```
NEW FILE:
EDIT:
```

to inform you that the file does not already exist.

If the file exists on a disk other than your A-disk and its extensions, or if you want to create a file to write on a read/write disk other than your A-disk, you must specify the filemode of the file:

```
edit test file b
```

In this example, your B-disk and its extensions are searched for the file TEST FILE.

After you issue the EDIT command, you are in edit mode, or the environment of the CMS Editor. If you have specified the filename and filetype of a file that already exists, you can now use EDIT subcommands to make changes or corrections to lines in that file. If you want to add records to the file, as you would if you are creating a new file, issue the EDIT subcommand

```
input
```

to enter input mode. Every line that you enter is considered a data line to be written into the disk file. For most filetypes, the editor translates all of your input data to uppercase characters, regardless of how you enter it. For example, if you create a file and enter input mode as follows:

```
edit myfile test
NEW FILE:
EDIT:
input
INPUT:
This is a file I am
learning to create with the CMS Editor.
```

the lines are written into the file as

```
THIS IS A FILE I AM
LEARNING TO CREATE WITH THE CMS EDITOR.
```

You can use the VM/370 logical line editing symbols to modify data lines as you enter them.

To return to edit mode to modify a file or to terminate the edit session, you must press the Return key on a null line. If you have just entered a data line, for example, and your terminal's typing element or cursor is positioned at the last character you entered, you must press the Return key once to enter the data line, and a second time to enter a null line.

You may also use the logical line end symbol to enter a null line, for example,

```
last line of input#
#
```

Both of these lines cause you to return to edit mode from input mode.

If you do not enter a null line, but enter an EDIT subcommand or CMS command, the command line is written into your file as input. The only exception to this is a line that begins with the characters #CP. These characters indicate that the command is to be passed immediately to CP for processing.

WRITING A FILE ONTO DISK

A file you create and the modifications that you make to it during an edit session are not automatically written to a disk file. To save the results, you can do the following:

- Periodically issue the subcommand

  ```
  save
  ```

  to write onto disk the contents of the file as it exists when you issue the subcommand. Periodically issuing this EDIT subcommand protects your data against a system failure; you can be sure that changes you make are not lost.

- At the beginning of the edit session, issue the AUTOSAVE subcommand, with a number:

```
autosave 10
```

Then, for every tenth change or addition to the file, the editor issues an automatic save request, which writes the file onto disk.

- At the end of the edit session, issue the subcommand

```
file
```

This subcommand terminates the edit session, writes the file onto disk, replacing a previous file by that name (if one existed), and returns you to the CMS environment. You can return to the edit environment by issuing the EDIT command, specifying a different file or the same file.

The editor decides which disk to write the file onto according to the following hierarchy:

- If you specify a filemode on the FILE or SAVE subcommand line, the file is written onto the specified disk.
- If the current filemode of the file is the mode of a read/write disk, the file is written onto that disk. (If you have not specified a filemode letter, it defaults to your A-disk.)
- If the filemode is the mode of a read-only extension of a read/write disk, the file is written onto the read/write parent disk.
- If the filemode is the mode of a read-only disk that is not an extension of a read/write disk, the editor cannot write the file and issues an error message.

See "Changing File Identifiers" for information on how you can tell the editor what disk to use when writing a file.

If you are editing a file and decide, after making several changes, that you do not wish to save the changes, you can use the subcommand

```
quit
```

No changes that you made since you last used the SAVE subcommand (or the editor last issued an automatic save for you) are retained. If you have just begun an edit session, and have made no changes at all to a file, and for some reason you do not want to edit it at all (for example, you misspelled the name, or want to change a CMS setting before editing the file), you can use the QUIT subcommand instead of the FILE subcommand to terminate the edit session and return to CMS.

A file must have at least one line of data in order to be written.

EDIT SUBCOMMANDS

While you are in the edit environment, you can issue any EDIT subcommand or macro. An edit macro is an EXEC file that contains a sequence of EDIT subcommands that execute as a unit. You can create your own EDIT subcommands with the CMS EXEC facility. EDIT subcommands provide a variety of functions. You can:

- Position the current line pointer at a particular line, or record, in a file.

- Control which columns of a file are displayed or searched during an editing session.
- Modify data lines.
- Describe the characteristics that a file and its individual records will have
- Automatically write and update sequence numbers for fixed-length records.
- Edit files by line number.
- Control the editing session.

Entering EDIT Subcommands

Like CMS commands, EDIT subcommands have a subcommand name and some have operands. In most cases, a subcommand name (or its truncation) can be separated from its operands by one or more blanks, or no blanks. For example, the subcommand lines

```
type 5
ty    5
t5
```

are equivalent.

Several subcommands also use delimiters, which enclose a character string that you want the editor to operate on. For example, the CHANGE subcommand can be entered:

```
change/apple/pear/
```

The diagonal (/) delimits the character strings APPLE and PEAR. For the subcommands CHANGE, LOCATE, and DSTRING, the first nonblank character following the subcommand name (or its truncation) is considered the delimiter. No blank is required following the subcommand name. In the subcommand

```
locate $vm/$
```

the dollar sign ($) is the delimiter. You cannot use a / in this case, since the diagonal is part of the character string you want to locate.

When you enter these subcommands, you may omit the final delimiter, for example

```
dstring/csect
```

You must enter the final delimiter, however, when you specify a global change with the CHANGE subcommand.

For the FIND and OVERLAY subcommands, additional blanks following the subcommand names are interpreted as arguments. The subcommand

```
find   Pudding
```

requests the editor to locate the line that has " Pudding" in columns 1 through 9. Initial blanks are considered part of the character string.

An asterisk, when used with an EDIT subcommand, may mean "to the end of the file" or "to the record length." For example,

```
delete*
```

deletes all of the lines in a file, beginning with the current line.

```
verify *
```

indicates that the editor should display the entire length of records.

?EDIT:

When you make an error entering an EDIT subcommand, the editor displays the message

```
?EDIT:  line...
```

where line... is the line, as you entered it, that the editor does not understand.

The Current Line Pointer

When you begin an editing session, a file is copied into virtual storage; in the case of a new file, virtual storage is acquired for the file you are creating. In either case, you can picture the file as a series of records, or lines; these lines are available to you, one at a time, for you to modify or delete. You can also insert new lines or records following any line that is already in the file.

The line that you are currently editing is pointed to by the current line pointer. What you do during an editing session is:

- Position the current line pointer to access the line you want to edit.
- Edit the line: change character strings in it, delete it or insert new records following it.
- Position the line pointer at the next line you want to edit.

When you are editing a file and you issue an EDIT subcommand that either changes the position of the line pointer or that changes a line, the current line or the changed line (or lines) is displayed. You can also display the current line by using the TYPE subcommand:

```
type
```

If you want to examine more than one line in your file, you can use the TYPE subcommand with a numeric parameter. If you enter

```
type 10
```

the current line and the 9 lines that follow it are displayed; the line pointer then stays positioned at the last line that was displayed.

You can move the line pointer up or down in your file. "Up" indicates a location toward the beginning of the file (the first record); "down" indicates a location toward the end of the file (the last record). You use the EDIT subcommands UP and DOWN to move the line pointer up or down one or more lines. For example,

```
up 5
```

moves the current line pointer to a line 5 lines closer to the beginning of the file, and

```
down
```

moves the pointer to point at the next sequential record in the file.

You can also request that the line pointer be placed at the beginning, or top of the file, or at the end, or bottom of the file. When you issue the subcommand

```
top
```

you receive the message

```
TOF:
```

and the line pointer is positioned at a null line that is always at the top of the file. This null line exists only during your editing session; it is not filed on disk when you end the editing session.

When you issue the subcommand

```
bottom
```

the current line pointer is positioned at the last record in the file. If you now enter input mode, all lines that you enter are appended to the end of the file.

If the current line pointer is at the bottom of the file and you issue the DOWN subcommand, you receive the message

```
EOF:
```

and the current line pointer is positioned at the end-of-file, following the last record.

When you are adding records to your file, the current line pointer is always pointing at the line you last entered. When you delete a line from a file, the line pointer moves down to point to the next line down in the file.

Going from edit mode to input mode does not change the current line pointer. If you are creating a new file and, every 30 lines or so, you move the current line pointer to make corrections to the lines that you have entered, you must issue the BOTTOM subcommand to begin entering more lines at the end of the file.

The current line pointer is also moved as the result of the LOCATE and FIND subcommands. You use the FIND subcommand to get to a line when you know the characters at the beginning of the line. For example, if you want to change the line

```
BAXTER     J.F.     065941     ACCNTNT
```

you could first locate it by using the subcommand:

```
find baxter
```

If you do not know the first characters on a line, you can issue the LOCATE subcommand:

```
locate /accntnt/
```

Both of these subcommands work only in a top-to-bottom direction: you cannot use them to position the line pointer above the current line. If you use the FIND or LOCATE subcommands and the target (the character string you seek) is not found, the editor displays a message, and positions the line pointer at the end of the file. Subsequently, if you reissue the subcommand, the editor starts searching at the top of the file.

In a situation like that above, or in a case where you are repetitively entering the same LOCATE or FIND subcommand (if, for example, there are many occurrences of the same character string, but you seek a particular occurrence) you can use the = (REUSE) subcommand. To use the example above, you are looking for a line that contains the string ONCE UPON A TIME, but you do not know that it is above the current line. When you issue the subcommand:

```
locate /once upon a time/
```

the editor does not locate the line, and responds:

```
NOT FOUND
EOF:
```

if you enter

```
=
```

the editor searches again for the same string, beginning this time at the top of the file, and locates the line:

```
"ONCE UPON A TIME" IS A COMMON
```

This may still not be the line you are looking for. You can, again, enter:

```
=
```

The LOCATE subcommand is executed again. This time, the editor might locate the line:

```
A STORY THAT STARTED ONCE UPON A TIME
```

Figure 5 illustrates a simple CMS file, and indicates how the current line pointer would be positioned following a sequence of EDIT subcommands.

LINE-NUMBER EDITING: Some fixed-length files are suitable for editing by referencing line numbers instead of character strings. The EDIT subcommands that allow you to change the line pointer position by line number are discussed under "Line-Number Editing."

```
        EDIT PPRINT EXEC
  CLP
  --->   TOF:
       0 (null line)
       1 &CONTROL OFF
       2 &P =
       3 &IF .&1 EQ . &EXIT 100
       4 &FN = &1
       5 &IF &1 EQ ? &GOTO -TELL
       6 &NFN = &CONCAT $ &1
       7 &IF .&2 EQ . &EXIT 200
       8 &FT = &2
       9 &FM = &3
      10 &IF .&3 NE . &SKIP 2
      11       &FM = A
      12       &SKIP 3
      13 &IF &3 NE ( &SKIP 2
      14       &FM = A
      15       &P = (
      16 &CONTROL ALL
      17 COPY &FN &FT &FM &NFN &FT A ( UNPACK
      18 PRINT &NFN &FT A &P &4 &5 &6 &7 &8 &9 &10 &11 &12 &13 &14
      19 ERASE &NFN &FT A
      20 &EXIT
      21 -TELL    &TYPE THIS EXEC PRINTS A LISTING FROM PACKED FORMAT
         EOF:

The line numbers represented are symbolic: they are not an actual
part of the file, but are used below to indicate at which line the
current line pointer is positioned after execution of the EDIT
subcommand indicated.

     Subcommand          CLP Position
     ----                  ---> 0
     DOWN 5                ---> 5
     UP                    ---> 4
     LOCATE /UNP/          ---> 17
     TYPE 3                ---> 19
     BOTTOM                ---> 21
     DOWN                  ---> EOF:
     FIND -                ---> 21
     TOP                   ---> 0
     CHANGE /EQ/EQ/ 6      ---> 5
     DELETE 2              ---> 7 (lines numbered 5 and 6 are deleted)
     INPUT  *              ---> the line just entered (between 7 and 8)
```

Figure 5. Positioning the Current Line Pointer

Verification and Search Columns

There are two EDIT subcommands you can use to control what you and the editor "see" in a file. The VERIFY subcommand controls what you see displayed; the ZONE subcommand controls what columns the editor searches. Normally, when you edit a file, every request that you make of the editor results in the display of one or more lines at your terminal. If you do not want to see the lines, you can specify

```
verify off
```

Alternatively, if you want to see only particular columns in a file, you can specify the columns you wish to have displayed:

```
verify 1 30
```

Some filetypes have default values set for verification, which usually include those columns in the file that contain text or data, and exclude columns that contain sequence numbers. If a verification column is less than the record length, you can specify:

```
verify *
```

to indicate that you want to see all columns displayed.

In conjunction with the VERIFY subcommand, you can use the ZONE subcommand to tell the editor within which columns it can search or modify data. When you issue the subcommand

```
zone 20 30
```

The editor ignores all text in columns 1-19 and 31 to the end of the record when it searches lines for LOCATE, CHANGE, ALTER, and FIND subcommands. You cannot unintentionally modify data outside of these fields; you must change the zones in order to operate on any other data.

The zone setting also controls the truncation column for records when you are using the CHANGE subcommand; for more details, see "Setting Truncation Limits."

Changing, Deleting, and Adding Lines

You can change character strings in individual lines of data with the CHANGE subcommand. A character string may be any length, or it may be a null string. Any of the characters on your terminal keyboard, including blanks, are valid characters. The following example shows a simple data line and the cumulative effect of CHANGE subcommands.

```
ABC ABC ABC
```
is the initial data line.

```
CHANGE /ABC/XYZ/
```
changes the first occurrence of the character string "ABC" to the string "XYZ".

```
XYZ ABC ABC
```

```
CHANGE /ABC//
```
deletes the character string "ABC" and concatenates the characters on each side of it.

```
XYZ  ABC
```

```
CHANGE //ABC/
```
inserts the string "ABC" at the beginning of the line.

```
ABCXYZ  ABC
```

```
CHANGE /XYZ /XYZ/
```
deletes one blank character following "XYZ".

```
ABCXYZ ABC
```

CHANGE /C/C /
adds a blank following the first occurrence of the character "C".

ABC XYZ ABC
is the final line.

THE ALTER SUBCOMMAND: You can use the ALTER subcommand to change a single character; the ALTER subcommand allows you to specify a hexadecimal value so that you can include characters in your files for which there are no keyboard equivalents. Once in your file, these characters appear during editing as nonprintable blanks. For example, if you input the line

```
IF A = B THEN
```

in edit mode and then issue the subcommand

```
alter = 8c
```

the line is displayed:

```
IF A   B THEN
```

If you subsequently print the file containing this line on a printer equipped to handle special characters, the line appears as

```
IF A ≤ B THEN
```

since X'8C' is the hexadecimal value of the special character ≤.

Either or both of the operands on the ALTER subcommand can be hexadecimal or character values. To change the X'8C' to another character, for example <, you could issue either

```
alter 8c ae
```

-- or --

```
alter 8c <
```

THE OVERLAY SUBCOMMAND: The OVERLAY subcommand allows you to replace characters in a line by spacing the terminal's typing element or cursor to a particular character position to make character-for-character replacements, or overlays. For example, given the line:

```
ABCDEF
```

the subcommand

```
overlay xyz
```

results in the line

```
XYZDEF
```

A blank entered on an OVERLAY line indicates that the corresponding character is not to be changed; to replace a character with a blank, use an underscore character (_). Given the above line, XYZDEF, the subcommand

```
overlay ___  3
```

results in

DE3 (The "D" is preceded by blanks in columns 1, 2, and 3.)

Global Changes

You can make global, or repetitive changes, with the CHANGE and ALTER subcommands. On these subcommand lines, you can include operands that indicate:

- The number of lines to be searched for a character or character string. An asterisk (*) indicates that all lines, from the current line to the end of the file, are to be searched.
- Whether only the first occurrence or all occurrences on each line are to be modified. An asterisk (*) indicates all occurrences. If you do not specify an asterisk, only the first occurrence on any line is changed.

For example, if you are creating a file that uses the (•) special character (X'AF') and you do not want to use the ALTER subcommand each time you need to enter the •. You could use the character ¬ as a substitute each time you need to enter a •. When you are finished entering input, move the current line pointer to the top of the file, and issue the global ALTER subcommand:

```
top#alter ¬ af * *
```

All occurrences of the character ¬ are changed to X'AF'. The current line pointer is positioned at the end of the file.

When you use a global CHANGE subcommand, you must be sure to use the final delimiter on the subcommand line. For example,

```
change /hannible/hannibal/ 5
```

This subcommand changes the first occurrence of the string "HANNIBLE" on the current line and the four lines immediately following it.

You can also make global changes with the OVERLAY subcommand, by issuing a REPEAT subcommand just prior to the OVERLAY subcommand. Use the REPEAT subcommand to indicate how many lines you want to be affected. For example, if you are editing a file containing the three lines

```
A
B
C
```

with the current line pointer at line "A", issuing the subcommands:

```
repeat 3
overlay   |   |   |
```

results in

```
A |   |   |
B |   |   |
C |   |   |
```

The current line pointer is now positioned at the line beginning with the character "C".

Deleting Lines

You delete lines from a file with the DELETE subcommand; to delete more than one line, specify the number of lines:

```
delete 6
```

Or, if you want to delete all the lines from the current line to the end of the file, use an asterisk (*):

```
delete *
```

If you want to delete an undetermined number of lines, up to a particular character string, you can use the DSTRING subcommand:

```
dstring /weather/
```

When this subcommand is entered, all the lines from and including the current line down to and including the line just above the line containing the character string "WEATHER" are deleted. The current line pointer is positioned at the line that has "WEATHER" on it.

If you want to replace a line with another line, you can use the REPLACE subcommand:

```
replace *******
```

The current line is deleted and the line "********" is inserted in its place. The current line pointer is not moved.

To replace an existing line with many new lines, you can issue the REPLACE subcommand with no new data line:

```
replace
```

The editor deletes the current line and enters input mode.

Inserting Lines

You can insert a single line of data between existing lines using the INPUT subcommand followed by the line of data you want inserted. For example

```
input * this subroutine is for testing only
```

inserts a single line following the current line. If you want to insert many lines, you can issue the INPUT subcommand to enter input mode.

You can also add new lines to a file by using the GETFILE subcommand. This allows you to copy lines from other files to include in the file you are editing or creating. For example,

```
getfile single items c
```

inserts all the lines in the file SINGLE ITEMS C immediately following the current line pointer. The line pointer is positioned at the last line that was read in.

You could also specify

```
getfile double items c 10 25
```

to copy 25 lines, beginning with the tenth line, from the file DOUBLE ITEMS C.

The $MOVE and $DUP EDIT macros provide two additional ways of adding lines into a file in a particular position. The $MOVE macro moves lines from one place in a file to another, and deletes them from their former position. For example, if you want to move 10 lines, beginning with the current line, to follow a line 9 lines above the current line, you can enter

```
$move 10 up 8
```

The $DUP macro duplicates the current line a specified number of times, and inserts the new lines immediately following the current line. For example,

```
$dup 3
```

creates 3 copies of the current line, and leaves the current line pointer positioned at the last copy.

Describing Data File Characteristics

Whe you issue the EDIT command to create a new file, the editor checks the filetype. If it is one of the reserved filetypes, the editor may assign particular attributes to it, which can simplify the editing process for you. The default attributes assigned to most filetypes are as follows:

- Fixed-length, 80-character records
- All alphabetic characters are translated to uppercase, regardless of how they are entered
- Input lines are truncated in column 80
- Tab settings are in columns 1, 6, 11, 16, 21, ... 51, 61, and so on, and the tab characters are expanded to blanks
- Records are not serialized

The filetypes for some CMS commands and for the language processors deviate from these default values. Some of the attributes assigned to files and how you can adjust them to suit your needs are discussed below.

RECORD LENGTH

You can specify the logical record length of a file you are creating on the EDIT command line:

```
edit new file (lrecl 130
```

If you do not specify a record length, the editor assumes the following defaults:

- For editing old files, the existing record length is used.
- For creating new files, the following default values are in effect:

Filetype	Record Length	Format
EXEC	80 characters	Variable
LISTING	121 characters	Variable
SCRIPT	132 characters	Variable
FREEFORT	81 characters	Variable
All others	80	Fixed

If you edit a variable-length file and the existing record length is less than the default for the filetype, the record length is taken from the default value.

When you use the LRECL option of the EDIT command you can override these default record lengths; you can also change the record lengths of existing files to make them larger, but not smaller.

If you try to override the record length of an existing file and make it smaller, the editor displays an error message, and you must issue the EDIT command again with a larger record length. For example, suppose you have on your B-disk a file named MYFILE FREEFORT, which was created with the default record length of 81. If you try to edit that file by issuing:

```
edit myfile freefort b (lrecl 72
```

the editor displays the message:

```
GIVE A LARGER RECORD LENGTH.
```

You must then issue the EDIT command again and either specify a length of 81 or more, or allow it to default to the current record length of the file.

You can use the COPYFILE command to increase or decrease the record length of a file before you edit it. For example, if you have fixed-length, 132-character records in a file, and you want to truncate all the records at column 80 and create a file with 80-character records, you could issue the command

```
copyfile extra funds a (lrecl 80
```

Long Records

The largest record you can edit with the editor is 160 characters. A file with record length up to 160 bytes (for example, a listing file created by a DOS program) can be displayed and edited.

The largest record you can create with the CMS Editor, however, is 130 characters using a 3270 display terminal and 134 characters using a typewriter terminal such as a 2741 or 1050. If you enter more than 130 characters on a 3270, the record is truncated to 130 characters when you press the Enter key. If you type more than 134 characters on a line using a typewriter terminal, CP generates an attention interrupt to your virtual machine and the input line is lost when you press the Return key.

For most purposes, you will not need to create records longer than 130 characters. If it is necessary, however, you can expand a record that you have entered. You do this by issuing the CHANGE subcommand with operands, to add more characters to the record (for example, by changing a one-character string to a 31-character string).

You cannot create a record that is longer than the record length of the file. For example, if the file you are editing has a default record length of 80, or if you specified LRECL 80 when you created the file, the editor truncates all records to 80 characters.

Record Length and File Size

There is a relationship between the record length of a file and the maximum number of records it can contain. Figure 6 shows the approximate number of records, rounded to the nearest hundred, that the editor can handle in a virtual machine with different amounts of virtual storage.

These numbers apply to a CMS virtual machine with only one accessed disk.

Record Length	Virtual Machine Size			
	320K	512K	768K	1024K
80 Characters	1700	3800	6800	9800
120 Characters	1100	2600	4700	6800
132 Characters	1100	2400	4300	6200
160 Characters	900	2000	3600	5100

Figure 6. Number of Records Handled by the Editor

RECORD FORMAT

With the CMS Editor, you can create either fixed- or variable-length files. Except for the filetypes EXEC, LISTING, FREEFORT, and SCRIPT, all the files you create have fixed-length records, by default. You can change the format of a file at any time during an editing session by using the RECFM subcommand:

```
recfm v
```

This changes the record format to variable-length. This does not change the record length; in order to add new records with a greater length, you must write the file onto disk and then reissue the EDIT command.

The COPYFILE command also has an RECFM option, so that you can change the record format of a file without editing it. The command

```
copyfile * requests a1 (recfm v trunc
```

changes the record formats of all the files with a filetype of REQUESTS on your A-disk to variable-length. The TRUNC option specifies that you want trailing blanks removed from each of the records.

USING SPECIAL CHARACTERS

The IMAGE and CASE subcommands control how data, once entered on an input line, is going to be represented in a file. The specific characters affected, and the subcommands that control their representation, are:

- Alphabetic characters: CASE subcommand
- Tab characters (X'05'): IMAGE subcommand (ON and OFF operands)
- Backspaces ('16'): IMAGE subcommand (CANON operand)

Alphabetic Characters

If you are using a terminal that has only uppercase characters, you do not need to use the CASE subcommand; all of the alphabetic characters you enter are uppercase. On terminals equipped with both uppercase and lowercase letters, all lowercase alphabetic characters are converted to uppercase in your file, regardless of how you enter them. If you are creating a file and you want it to contain both uppercase and lowercase letters you can use the subcommand

```
case m
```

The "M" stands for "mixed." This attribute is not stored with the file on disk. If you create a new file, and you issue the CASE M subcommand, all the lowercase characters you enter remain in lowercase. If you subsequently file the file and later edit it again, you must issue the CASE M subcommand again to locate or enter lowercase data.

There are two reserved filetypes for which uppercase and lowercase is the default. These are SCRIPT and MEMO, both of which are text or document-oriented filetypes. For most programming applications, you do not need to use lowercase letters.

Tab Characters

Logical tab settings indicate the column positions where fields within a record begin. These logical tab settings do not necessarily correspond to the physical tab settings on a typewriter terminal. What happens when you press the Tab key on a typewriter terminal depends on whether the image setting is on or off. The default for all filetypes except SCRIPT is IMAGE ON. You can change the default by issuing the subcommand

```
image off
```

If the image setting is on, when you press the Tab key the editor replaces the tab characters with blanks, starting at the column where you pressed the Tab key, and ending at the last column before the next logical tab setting. The next character entered after the tab becomes the first character of the next field. For example, if you enter

```
tabset 1 15
```

and then enter a line that begins with a tab character, the first data character following the tab is written into the file in column 15, regardless of the tab stop on your terminal.

If the image setting is off, the tab character, X'05', is inserted in the record, just as any other data character is inserted. No blanks are inserted.

If you want to insert a tab character (X'05') into a record and the image setting is on, you can do one of the following:

1. Set IMAGE OFF before you enter or edit the record, and then use the Tab key as a character key.
2. Enter some other character at the appropriate place in the record, and then use the ALTER subcommand to alter that character to a X'05'.

SETTING TABS: When you create a file, there are logical tab settings in effect, so that you do not need to set them. The default values for the language processors correspond to the columns used by those processors. If you want to change them, or if you are creating a file with a nonreserved filetype, you may want to set them yourself. Use the TABSET subcommand, for example:

```
tabset 1 12 20 28 72
```

Then, regardless of what physical tab stops are in effect for your terminal, when you press the Tab key with image setting ON, the data you enter is spaced to the appropriate columns.

The default tab settings used by the editor follow.

Filetype	Default Tab Settings
ASSEMBLE, MACRO, UPDATE, UPDTxxxx, ASM3705	1, 10, 16, 31, 36, 41, 46, 69, 72, 80,
AMSERV	2, 6, 11, 16, 21, 26, 31, 36, 41, 46, 51, 61, 71, 80
FORTRAN	1, 7, 10, 15, 20, 25, 30, 80
FREEFORT	9, 15, 18, 23, 28, 33, 38, 81
BASIC, VSBASIC	7, 10, 15, 20, 25, 30, 80
PLIOPT, PLI	2, 4, 7, 10, 13, 16, 19, 22, 25, 31, 37, 43, 49, 55, 79, 80
COBOL	1, 8, 12, 20, 28, 36, 44, 68, 72, 80
All Others	1, 6, 11, 16, 21, 26, 31, 36, 41, 46, 51, 61, 71, 81, 91, 101, 111, 121, 131

Note: When you are specifying tab settings for files, the first tab setting you specify should be the column in which you want your data to begin. The editor will not allow you to place data in a column preceding this one. For example, if you issue

```
tabset 5 10 15 20
```

and then enter an input line:

```
input This is a line
```

Columns 1, 2, 3, and 4 contain blanks; text begins in column 5.

Backspaces

For most of your applications, you do not need to underscore or overstrike characters or character strings. If you are using a typewriter terminal, and are typing files that use backspaces and underscores, you should use either the IMAGE OFF or IMAGE CANON subcommands so that the editor handles the backspaces properly. IMAGE CANON is the default value for SCRIPT files.

CANON means that regardless of how the characters are keyed in (characters, backspaces, underscores), the editor orders, or canonizes, the characters in the file as: character-backspace-underscore, character-backspace-underscore, and so on. If, for example, you want an input line to look like:

A̲B̲C̲

You could enter it as:

ABC, 3 backspaces, 3 underscores

- or -

3 underscores, 3 backspaces, ABC

A typewriter types out the line in the following order:

A backspace, underscore
B backspace, underscore
C backspace, underscore, which results in:
A̲B̲C̲

If you need to modify a line that has backspaces, and you do not want to rekey all of the characters, backspaces, and overstrike characters in a CHANGE or REPLACE subcommand, you can use the ALTER subcommand to alter all of the backspaces to some other character and use a global CHANGE command. For example, the following sequences shows how to delete all of the backspace characters on a line:

```
A̲A̲A̲A̲A̲
alter 16 + 1 *
_+A_+A_+A_+A_+A
change /_+// 1 *
AAAAA
```

This technique may also be useful on a display terminal.

SETTING TRUNCATION LIMITS

Every CMS file that you edit has a truncation column setting: this column represents the last character position in a record into which you can enter data. When you try to input a record that is longer than the truncation column, the record is truncated, and the editor sends you a message telling you that it has been truncated.

You can change the truncation column setting with the TRUNC subcommand. For example, if you are creating a file with a record length of 80 and wish to insert some records that do not extend beyond column 20, you could issue the subcommand

```
trunc 20
```

Then, when you enter data lines, any line that is longer than 20 characters is truncated and the editor sends you a message. If you are entering data in input mode, your virtual machine remains in input mode.

When you use the CHANGE subcommand to modify records, the column at which truncation occurs is determined by the current zone setting. If you change a character string in a line to a longer string, and the resultant line extends beyond the current end zone, you receive the message

```
TRUNCATED.
```

If you need to create a line longer than the current end zone setting, use the ZONE subcommand to increase the setting. The subcommand

```
zone 1 *
```

extends the zone to the record length of the file. If the end zone already equals the record length, you have to write the file onto disk and reissue the EDIT subcommand specifying a longer record length.

For most filetypes, the truncation and end zone columns are the same as the record length. For some filetypes, however, data is truncated short of the record length. The default truncation and end zone columns are:

Filetype	Column
ASSEMBLE, MACRO UPDATE, UPDTxxxx	71
AMSERV, COBOL, DIRECT, FORTRAN PLI, PLIOPT	72

All other filetypes are truncated at their record length.

You can, when creating files for your own uses, set truncation columns so that data does not extend beyond particular columns.

ENTERING A CONTINUATION CHARACTER IN COLUMN 72

When you are using the editor to enter source records for an assembler language program and you need to enter a continuation character in column 72, or whenever you want to enter data outside a particular truncation setting, you can use the following technique:

1. Change the truncation setting to 72, so that the editor does not truncate the continuation character:

   ```
   trunc 72
   ```

2. Use the TABSET subcommand to set the left margin at column 72:

   ```
   tabset 72
   ```

3. Use the OVERLAY subcommand to overlay an asterisk in column 72:

   ```
   overlay *
   ```

   Since the left margin is set at 72, the OVERLAY subcommand line results in the character * being placed in column 72.

4. Restore the editor truncation and tab settings:

```
trunc 71
tabset 1 10 16 31 36 41 51 61 71 81
```

Note: If you issue the PRESERVE subcommand before you change the truncation and tab settings, then after you enter the OVERLAY subcommand, you can restore them with the RESTORE subcommand. See "Preserving and Restoring Editor Settings."

Use the $MARK Edit Macro: Another way to insert a continuation character is to use the $MARK edit macro. You can find out if the $MARK edit macro is available on your system by entering, in the CMS or CMS subset environment

```
listfile $mark exec *
```

If it is not available on your system, you can create the $MARK edit macro for your own use. See "Section 17. Writing Edit Macros" in "Part 3. Learning to Use EXEC."

If you have the $MARK macro, then when you need to enter a continuation character, you can enter a null line to get into edit mode, issue the command

```
$mark
```

and then return to input mode to continue entering text.

SERIALIZING RECORDS

Some CMS files that you create are automatically serialized for you. This means that columns 73 to 80 of each record contain an identifier in the form:

```
cccxxxxx
```

where ccc are the first 3 characters of the filename and xxxxx is a sequence number. Sequence numbers begin at 00010 and are incremented by 10.

The filetypes that are automatically serialized in columns 73 to 80 are:

ASSEMBLE	FORTRAN	PLIOPT
DIRECT	COBOL	UPDATE
MACRO	PLI	UPDTxxxx

You can serialize any file that has fixed-length, 80-character records by using the SERIAL subcommand:

```
serial on
```

The SERIAL subcommand can also be used to:

- Assign a particular 3-character identifier:

  ```
  serial abc
  ```

- Specify that all 8 bytes of the sequence field be used to contain numbers:

  ```
  serial all
  ```

- Specify a sequence increment other than 10:

  ```
  serial on 100

  -- or --

  serial ccc 100
  ```

- Indicate that no sequence numbers are to be assigned to new records being inserted:

  ```
  serial off
  ```

When you create a file or edit a file with sequence numbers, the sequence numbers are not written or updated until you issue a FILE or SAVE subcommand. Because the end verification columns for the filetypes that are automatically serialized are the same as their truncation columns, you do not see the serial numbers unless you specify

```
verify *

-- or --

verify 80
```

Although the serial numbers are not displayed while you edit the file, they do appear on your output listings or printer files.

If you are editing files with the following filetypes:

```
BASIC
VSBASIC
FREEFORT
```

the sequence numbers are on the left. For BASIC and VSBASIC files, columns 1-5 are used; numbers are blank-padded to the left. For FREEFORT files, the sequence numbers use columns 1-8, and are zero-padded to the left. To edit these files, you should use line-number editing, which is discussed next.

LINE-NUMBER EDITING

To edit a file by line numbers means that when you are adding new lines to a file or referencing lines that you wish to change, you refer to them by their line, or sequence numbers, rather than by character strings. You can use line-number editing only on files with fixed-length, 80-character records.

If you want to edit by line numbers, issue the subcommand

```
linemode right

  -- or --

linemode left
```

where "right" indicates that the sequence numbers are on the right, in columns 76-80, and "left" indicates you want sequence numbers on the

left in columns 1-5. LINEMODE LEFT is the default for BASIC, VSBASIC, and FREEFORT files. You do not have to specify it. You must specify LINEMODE for files with other filetypes.

If you specify LINEMODE RIGHT to use line-number editing on a typewriter terminal, the line numbers are displayed on the left, as a convenience, while you edit the file.

When you are using line-number editing in input mode, you are prompted to enter lines; the line numbers are in increments of 10. For example, when you are creating a new file, you are prompted for the first line number as follows:

```
10
```

On a typewriter terminal, you enter your input line following the 10. When you press the carriage return, you are prompted again:

```
20
```

and you continue entering lines in this manner until you enter a null line.

You can change the prompting increment to a larger or smaller number with the PROMPT subcommand:

```
prompt 100
```

When you are in edit mode you can locate a line by giving its line number:

```
700
```

This is the nnnnn subcommand. In line-number editing, you use it instead of the INPUT subcommand to insert a single line of text. For example,

```
905 x = a * b
```

inserts the text line "X = A * B" in the proper sequence in the file. If you use "nnnnn text" specifying the number of a line that already exists, that line is replaced; the current line pointer is moved to point to it.

The EDIT subcommands that you normally use for context editing, such as CHANGE, ALTER, LOCATE, UP, DOWN, and so forth, can also be used when you are line-number editing; their operation does not change.

Renumbering Lines

When you are using line-number editing, the editor uses the prompting increment set by the PROMPT subcommand. However, when you begin adding lines of data between existing lines, the editor uses an algorithm to select a line number between the current line number and the next line number. If a prompting number cannot be generated because the current line number and the next line number differ only by one, the editor displays the message

```
RENUMBER LINES
```

and you must resequence the line numbers in the file before you can continue line-number editing.

You can resequence the line numbers in one of three ways:

1. If you are a VSBASIC, BASIC, or FREEFORT user, you must use the RENUM subcommand:

   ```
   renum
   ```

   This subcommand resolves all references to lines that are renumbered.

2. If you are using right-handed line-number editing, you must

   a. Turn off line-number editing:

      ```
      linemode off
      ```

   b. If you want to change the 3-character identifier or specify 8-character sequence numbers, issue the SERIAL subcommand, for example:

      ```
      serial all
      ```

      If you want to use the default serialization setting, you do not need to issue the SERIAL subcommand.

   c. Issue the SAVE subcommand:

      ```
      save
      ```

   d. Reissue the LINEMODE subcommand and continue line-number editing:

      ```
      linemode right
      ```

3. If you are using left-handed line-number editing for a filetype other than VSBASIC, BASIC, or FREEFORT, you must manually change individual line numbers using EDIT subcommands. In order to modify the line numbers, you must change the zone setting and the tab setting:

   ```
   zone 1 *
   tabset 1 6
   ```

   so that you can place data in columns 1 through 6.

When you are using right-handed line-number editing, and a FILE, SAVE, or automatic save request is issued, the editor does not resequence the serial numbers, but displays the message

```
RESERIALIZATION SUPPRESSED
```

so that the lines numbers that are currently saved on disk match the line numbers in the file. You must cancel line-number editing (using the LINEMODE OFF subcommand) before you can issue a FILE or SAVE subcommand if you want to update the sequence numbers.

Controlling the Editor

There are a number of EDIT subcommands that you can use to maximize the use of the editor in CMS. A few techniques are suggested here; as you become more familiar with VM/370 and CMS you will develop additional techniques for your own applications.

COMMUNICATING WITH CMS AND CP

Often during a terminal session, you may need to issue a CMS command or a CP command. You can issue certain CMS commands and most CP commands without terminating the edit session. The EDIT subcommand CMS places your virtual machine in the CMS subset mode of the editor, where you can issue CMS commands that do not modify your virtual storage. Remember that the editor is using your virtual storage; if you overlay it with any other command or program, you will not be able to finish your editing.

One occasion when you may want to enter CMS subset is when you want to issue a GETFILE subcommand for a file on one of your virtual disks and you have not accessed the disk. You can enter:

```
cms
```

the editor responds:

```
CMS SUBSET
```

and you can enter

```
access 193 b/a
return
get setup script b
```

The special CMS SUBSET command RETURN returns your virtual machine to edit mode.

You can enter CP commands from CMS subset, or you can issue them directly from edit mode or input mode with the #CP function. For example, if you are inputting lines into a file and another user sends you a message, you can reply without leaving input mode:

```
#cp m oph i will call you later
```

If you enter #CP without specifying a command line, you receive the message

```
CP
```

which indicates that your virtual machine is in the CP command environment, and you can issue CP commands. You would not, however, want to issue any CP command that would modify your virtual storage or alter the status of the disk on which you want to write the file.

To return to edit or input mode from CP, use the CP command, BEGIN.

CHANGING FILE IDENTIFIERS

There are several methods you can use to change a file identifier before writing the file onto disk. You can use the FNAME and FMODE subcommands to change the filename or filemode, or you can issue a FILE or SAVE subcommand specifying a new file identifier.

For example, if you want to create several copies of a file while you are using the editor, you can issue a series of FNAME subcommands, followed by SAVE subcommands, as follows:

```
edit test file
EDIT:
   .
   .
   .
fn test1#save
   .
   .
   .
fn test2#save
   .
   .
   .
fn test3#file
```

Or, you could issue the SAVE and FILE subcommands as follows:

```
edit test file
   .
   .
   .
save test1
   .
   .
   .
save test2
   .
   .
   .
file test3
```

In both of the preceding examples, when the FILE subcommand is executed, there are files named TEST FILE, TEST1 FILE, TEST2 FILE, and TEST3 FILE. The original TEST FILE is unchanged.

To change the filemode letter of a disk, use the FMODE subcommand. You can do this in cases where you have begun editing a file that is on a read-only disk, and want to write it. Since you cannot write a file onto a read-only disk, you can issue the FMODE subcommand to change the mode before filing it:

```
fmode a
file
```

Or, you can use the FILE (or SAVE) subcommand specifying a complete file identifier:

```
file test file a
```

You should remember, however, that when you write a file onto disk, it replaces any existing file that has the same identifier. The editor does not issue any warning or informational messages. If you are changing a file identifier while you are editing the file, you must be careful that you do not unintentionally overlay existing files. To verify the existence of a file, you can enter CMS subset and issue the STATE or LISTFILE commands.

CONTROLLING THE EDITOR'S DISPLAYS

When you are using a typewriter terminal, you may not always want to see the editor verify the results of each of your subcommands. Particularly when you are making global changes, you may not want to see each line

displayed as it is changed. You can issue the VERIFY subcommand with the OFF operand to instruct the editor not to display anything unless specifically requested. After you issue

```
verify off
```

lines that are normally displayed as a result of a subcommand that moves the current line pointer (UP, DOWN, TOP, BOTTOM, and so forth), or that changes a line (CHANGE, ALTER, and so forth), are not displayed. If the current line pointer moves to the end of the file, however, the editor always displays the EOF: message.

If you are editing with verification off, then you must be particularly careful to stay aware of the position of your current line pointer. You can display the current line at any time using the TYPE subcommand:

```
type
```

Long and Short Error Messages: When you enter an invalid subcommand while you are using the editor, the editor normally responds with the error message

```
?EDIT: line...
```

displaying the line that it did not recognize. If you prefer, you can issue the SHORT subcommand so that instead of receiving the long form of the error, you receive the short form, which is:

```
¬
```

When you issue an invalid edit macro request (any line that begins with a $), you receive the message

```
¬$
```

To resume receiving the long form of the error message, use the LONG subcommand:

```
long
```

LONG and SHORT control the display of the error message regardless of whether you are editing with verification on or off.

PRESERVING AND RESTORING EDITOR SETTINGS

The PRESERVE and RESTORE subcommands are used together; the PRESERVE subcommand saves the settings of the EDIT subcommands that control the file format, message and verification display, and file identifier. If you are editing a file and you want to temporarily change some of these settings, issue the PRESERVE subcommand to save their current status. When you have finished your temporary edit project, issue the RESTORE subcommand to restore the settings.

For example, if you are editing a SCRIPT file and want to change the image setting to create a particular format, you can enter:

```
preserve
image on
tabset 1 15 40 60 72
zone 1 72
trunc 72
```

When you have finished entering data using these settings, you can issue the subcommand

```
restore
```

to restore the default settings for SCRIPT filetypes.

X, Y, =, ? SUBCOMMANDS

The X, Y, =, and ? subcommands all perform very simple functions that can help you to extend the language of the CMS Editor. They allow you to manipulate, reuse, or interrogate EDIT subcommands.

If you have an editing project in which you have to execute the same subcommand a number of times, you can assign it to the X or Y subcommands, as follows:

```
x locate /insert here/
y getfile insert file c
```

Each time that you enter the X subcommand:

```
x
```

the command line LOCATE /INSERT HERE/ is executed, and every time you enter the Y subcommand:

```
y
```

the GETFILE subcommand is executed.

When you specify a number following an X or Y subcommand, the subcommand assigned to X or Y is executed the specified number of times, for example

```
x locate /aa/
x 10
```

the LOCATE subcommand line is executed 10 times before you can enter another EDIT subcommand.

Another method of re-executing a particular subcommand is to use the = (REUSE) subcommand. For example, if you enter

```
locate /ard/
AARDVARK
=======
```

the LOCATE subcommand is re-executed 7 times.

What the = (REUSE) subcommand actually does is to stack the subcommand in the console stack. Since CMS, and the editor, read from the console stack before reading from the terminal, the lines in the stack execute before a read request is presented to the terminal. When you enter multiple equal signs, the subcommand is stacked once for each equal sign you enter.

You can also stack an additional EDIT subcommand following an equal sign. The subcommand line is also stacked, but it is stacked LIFO (last-in, first-out) so that it executes before the stacked subcommand. For example, if you enter:

```
delete
= next
```

a DELETE subcommand is executed, then a DELETE subcommand is stacked, and a NEXT subcommand is stacked in front of it. Then the stacked lines are read in and executed. The above sequence has the same effect as if you enter

```
delete
next
delete
```

In addition to stacking the last subcommand executed, you can also find out what it was, using the ? subcommand. For example, if you enter

```
next 10
?
```

the editor displays

```
NEXT 10
```

Since the subcommand line NEXT 10 was the last subcommand entered, if you enter an = subcommand, it is executed again. You cannot stack a ? subcommand.

Note: The ? subcommand, on a display terminal, copies the last EDIT subcommand into the user input area, where you may modify it before re-entering it.

WHAT TO DO WHEN YOU RUN OUT OF SPACE

There are two situations that may prevent you from continuing an edit session or from writing a file onto disk. You should be aware of these situations, know how to avoid them, and how to recover from them, should they occur.

When you issue the EDIT command to edit a file, the editor copies the file into virtual storage. If it is a large file, or you have made many additions to it, the editor may run out of storage space. If it does, it issues the message:

```
AVAILABLE STORAGE IS NOW FULL
```

When this happens, you cannot make any changes or additions to the file unless you first delete some lines. If you attempt to add a line, the editor issues the message

```
NO ROOM
```

If you were entering data in input mode, your virtual machine is returned to edit mode, and you may receive the message

```
STACKED LINES CLEARED
```

which indicates that any additional lines you entered are cleared and will not be processed.

You should use the FILE subcommand to write the file onto disk. If you want to continue editing, you should see that the editor has more

storage space to work with. To do this, you can find out how large your virtual machine is and then increase its size. To find out the size, issue the CP QUERY command:

```
cp query virtual storage
```

If the response is

```
STORAGE =  256K
```

You might want to redefine your storage to 512K. Use the CP command DEFINE, as follows:

```
cp define storage 512k
```

This command resets your virtual machine, and you must issue the CP IPL command to reload the CMS system before you can continue editing.

If a file is very large, the editor may not have enough space to allow you to edit it using the EDIT command. The message

```
DMSEDI132S FILE 'fn ft fm' TOO LARGE
```

indicates that you must obtain more storage space before you can edit the file. If this is the case, or if you are editing large files, you should redefine your storage before beginning the terminal session. If this happens consistently, you should see your installation support personnel about having the directory entry for your userid updated so that you have a large storage size to begin with.

Splitting CMS Files into Smaller Files

If the file you are editing is too large, and the data it contains does not have to be in one file, you can split the file into smaller files, so that it is easier to work with. Two of the methods you can use to do this are described below.

Use the COPYFILE Command: You can use the COPYFILE command to copy portions of a file into separate files, and then delete the copied lines from the original file. For example, if you have a file named TEST FILE that has 1000 records, and you want to split it into four files, you could enter:

```
copyfile test file a test1 file a (fromrec 1 for 250
copyfile test file a test2 file a (fromrec 251 for 250
copyfile test file a test3 file a (fromrec 501 for 250
copyfile test file a test4 file a (fromrec 751 for 250
```

When these COPYFILE commands are complete, you have four files containing the information from the original TEST FILE, which you can erase:

```
erase test file
```

Use the Editor: If you use the editor to create smaller files, you can edit them as you copy them, that is, if you have other changes that you want to make to the data. To copy files with the editor, you use the GETFILE subcommand. Using the file TEST FILE as an example, you might enter:

```
edit test1 file
getfile test file a 1 250
   .
   .
   .
file
edit test2 file
getfile test file a 251 250
   .
   .
   .
```

Again, you could erase the original TEST FILE when you are through with your edit session.

When Your Disk Is Full

When you enter a FILE or SAVE subcommand or when an automatic save request is issued, the editor writes a copy of the file you are editing onto disk, and names it EDIT CMSUT1. If this causes the disk to become full, you receive the message

```
DMSBWR170S DISK 'mode(cuu)' IS FULL
```

The editor erases the workfile, and issues the message

```
SET NEW FILEMODE, OR ENTER CMS SUBSET AND CLEAR SOME SPACE
```

The original file (as last written onto disk) remains unchanged. You can use the CMS subcommand to enter CMS subset, and erase any files that you do not need. You can use the LISTFILE command to list the files on the disk, then the ERASE command to erase the unwanted files.

If you cannot erase any of the file on the disk, there are several alternate recovery paths you can take:

1. If you have another read/write disk accessed, you can use the FMODE subcommand to change the filemode of the file, so that when you file it, it is written to the other disk. If you have a read/write disk that is not accessed, you can access it in CMS subset. After filing the file on the second disk, erase the original copy, and then use the COPYFILE command to transfer the file back to its original disk.

2. If you do not have any other read/write disk in your virtual machine, you may be able to transfer some of your files to another user, using the PUNCH or DISK DUMP commands in CMS subset. When the files have been read onto the other user's disk, you can erase them from your disk. Then, return to edit mode and issue the FILE subcommand.

3. In CMS subset, erase the original disk file (if it existed), then return to edit mode and file the copy that you are editing. You should not use this method unless absolutely necessary, since any unexpected problems may result in the loss of both the disk file and the copy.

After you use the FILE subcommand to write the file onto disk, you should continue erasing any files you no longer need.

Summary of EDIT Subcommands

The EDIT subcommands, and their formats, are shown in Figure 7. Refer to the VM/370: CMS Command and Macro Reference for complete details.

Subcommand Format	Function
ALter char1 char2 [n | * | 1] [G | *]	Scans the next n records of the file, altering the specified character, either once in each line or for all occurrences in the line.
AUTOsave [n | OFF]	Automatically saves the file on disk after the indicated number of lines have been processed.
BAckward [n | 1]	Points the current line pointer to a line above the line currently pointed to.
Bottom	Makes the last line of the file the current line.
CASE [M | U]	Indicates whether translation to uppercase is to be done, or displays the current status.
Change [/string1[/string2[/ [n | 1] [G | *]]]]	Changes string1 to string2 for n records or to EOF, either for the first occurrence in each line or for all occurrences.
CMS	Enters CMS subset command mode.
DELete [n | * | 1]	Deletes n lines or to the end of the file (*).
DOwn [n | 1]	Points to the nth line from the current line.
DString /[string [/]]	Deletes all lines from the current line down to the line containing the indicated string.
FILE [fn [ft [fm]]]	Saves the file being edited on disk or changes its identifiers. Returns to CMS.

Figure 7. Summary of EDIT Subcommands and Macros (Part 1 of 4)

Subcommand Format	Function
Find [line]	Searches the file for the given line.
FMode [fm]	Resets or displays the filemode.
FName [fn]	Resets or displays the filename.
FORMat {DISPLAY / LINE}	Switches the 3270 terminal between display mode and line mode. (3270 only)
FOrward [n / 1]	Points to the nth line after the current line.
Getfile fn [ft] [fm] [m / 1] [n / *]	Inserts a portion or all of the specified file after the current line.
IMAGE [ON / OFF / CANON]	Expands text into line images or displays current settings.
Input [line]	Inserts a line in the file or enters input mode.
LINEmode [LEFT / RIGHT / OFF]	Sets or displays current setting of line-number editing.
[Locate]/[string [/]]	Scans file from next line for first occurrence of 'string'.
LONG	Enters long error message mode.
Next [n / 1]	Points to the nth line down from the current line.
Overlay [line]	Replaces all or part of the current line.
PREserve	Saves current mode settings.
PROMPT [n / 10]	Sets or displays line number increment. Initial setting is 10.

Figure 7. Summary of EDIT Subcommands and Macros (Part 2 of 4)

Subcommand Format	Function
QUIT	Terminates edit session with no updates incorporated since last save request.
RECfm [F | V]	Sets or displays record format for subsequent files.
RENum [strtno [incrno]] (10, strtno)	Recomputes line numbers for VSBASIC and FREEFORT source files.
REPEAT [n | * | 1]	Executes the following OVERLAY subcommand n times.
Replace [line]	Replaces the current line or deletes the current line and enters input mode.
REStore	Restores Editor settings to values last preserved.
RETURN	Returns to edit environment from CMS subset.
{REUSE | =} [subcommand]	Stacks (LIFO) the last EDIT subcommand that does not start with REUSE or the question mark (?) and then executes any given EDIT subcommand.
SAVE [fn [ft [fm]]]	Saves the file on disk and stays in edit environment.
{SCroll | S[croll]U[p]} [n | * | 1]	Displays a number of screens of data above or below the current line (3270 only).
SERial {OFF | ON | ALL | seq} [incr] (10)	Turns serialization on or off in columns 73 through 80.
SHORT	Enters short error message mode.
STACK [n | 1 | 0 | subcommand]	Stacks data lines or EDIT subcommands in the console input stack.

Figure 7. Summary of EDIT Subcommands and Macros (Part 3 of 4)

Subcommand Format	Function
TABSet n1 [n2 ... nn]	Sets logical tab stops.
TOP	Moves the current line pointer to the null line at the top of the file.
TRUNC [n / *]	Sets or displays the column of truncation. An asterisk (*) indicates the logical record length.
Type [m / 1 / *] [n / *]	Displays m lines beginning with the current line. Each line may be truncated to n characters.
Up [n / 1]	Moves the current line pointer toward the top of the file.
Verify [ON / OFF] [startcol 1 endcol *]	Sets, displays, or resets verification. An asterisk (*) indicates the logical record length.
{ X / Y } [subcommand n / 1]	Assigns to X or Y the given EDIT subcommand or executes the previously assigned subcommand n times.
Zone [m / 1 / *] [n / *]	Sets or displays the columns between which editing is to take place.
?	Displays the last EDIT subcommand, except = or ?.
{ nnnnn / nnnnnnnn } [text]	Locates the line specified by the given line number and inserts text, if given.
$DUP [n / 1]	Duplicates the current line n times. $DUP is an edit macro.
$MOVE n { Up m / Down m / TO label }	Moves n lines up or down m lines. $MOVE is an edit macro.

Figure 7. Summary of EDIT Subcommands and Macros (Part 4 of 4)

Section 6. Introduction to the EXEC Processor

An EXEC is a CMS file that contains executable statements. The statements may be CMS or CP commands or EXEC control statements. The execution can be conditionally controlled with additional EXEC statements, or it may contain no EXEC statements at all. In its simplest form, an EXEC file may contain only one record, have no variables, and expect no arguments to be passed to it. In its most complex form, it can contain thousands of records and may resemble a program written in a high-level programming language. As a CMS user, you should become familiar with the EXEC processor and use it often to tailor CMS commands to your own needs, as well as to create your own commands.

The following is an example of a simple EXEC procedure that might be named RDLINKS EXEC:

```
CP LINK DEWEY 191 291 RR DEWEY
CP LINK LIBRARY 192 292 RR DEWEY
ACCESS 291 B/A
ACC 292 C/A
```

When you enter

```
rdlinks
```

each command line contained in the file RDLINKS EXEC is executed.

You could also create an EXEC procedure that functions like a cataloged procedure, and set it up to receive an argument, so that it executes somewhat differently each time you invoke it. For example, a file named ASM EXEC contains the following:

```
ASSEMBLE &1
PRINT &1 LISTING
LOAD &1
START
```

If you invoke the EXEC specifying the name of an assembler language source file, such as

```
asm myprog
```

the procedure executes as follows:

```
ASSEMBLE MYPROG
PRINT MYPROG LISTING
LOAD MYPROG
START
```

The variable &1 in the EXEC file is substituted with the argument you enter when you execute the EXEC. As many as 30 arguments can be passed to an EXEC in this manner; the variables thus set range from &1 through &30.

CREATING EXEC FILES

EXEC files can be created with the CMS Editor, by punching cards, or by using CMS commands or programs. When you create a file with the editor,

records are, by default, variable-length with a logical record length of 80 characters. EXEC can process variable length files of up to 130 characters. To can create a variable-length EXEC file larger than 80 characters, use the LRECL option of the EDIT command:

```
edit new exec a (lrecl 130
```

To convert a variable-length file to a fixed-length file, you can edit the EXEC file and issue the subcommand

```
recfm f
```

Or, you can use the COPYFILE command:

```
copyfile old exec a (recfm f
```

If you use fixed-length EXEC files, you should be aware that the EXEC interpreter only processes the first 72 characters of each record in a fixed-length file, regardless of the record length. You can, however, enter command or data lines that are longer than than 72 characters to be processed by using the &BEGSTACK, &BEGTYPE, &BEGPUNCH, and &BEGEMSG control statements preceding the line(s) you want to be processed. If you specify &BEGPUNCH ALL, EXEC processes lines up to 80 characters long; if you specify &BEGTYPE ALL, &BEGSTACK ALL, or &BEGEMSG ALL, EXEC processes lines up to 130 characters.

In variable-length EXEC files, there are no such restrictions; lines up to 130 characters are processed in their entirety.

Two CMS commands create EXEC files. One is LISTFILE, which can be invoked with the EXEC option; it creates a file named CMS EXEC. The uses of CMS EXEC files are discussed under the heading "CMS EXECs and How To Use Them." The CMS/DOS command LISTIO creates an EXEC file named $LISTIO EXEC, which creates records for each of the system and programmer logical unit assignments. The LISTIO command and the $LISTIO EXEC are described in "Section 9. Developing DOS Programs Under CMS."

INVOKING EXEC FILES

EXEC procedures are invoked when you enter the filename of the EXEC file. You can precede the filename on the command line with the CMS command, EXEC. For example:

```
exec test type list
```

where TEST is the filename of the EXEC file and TYPE and LIST are arguments (&1, &2, and so on) you are passing to the EXEC. For example, an EXEC named PREPEDIT would be executed when you entered either:

```
prepedit newfile replace
```

-- or --

```
exec prepedit newfile replace
```

You must precede the EXEC filename with the EXEC command when:

- You invoke an EXEC from within another EXEC.
- You invoke an EXEC from a program.
- You have the implied EXEC function set off for your virtual machine.

The implied EXEC function is controlled by the SET command. If you issue the command

```
set impex off
```

then you must use the EXEC command to invoke an EXEC procedure. The default setting is ON; you almost never need to change it.

There is one EXEC file that you never have to specifically invoke. This is a PROFILE EXEC, which is automatically executed after you load CMS, when your A-disk is accessed. PROFILE EXECs are discussed next.

PROFILE EXECs

A PROFILE EXEC must have a filename of PROFILE. It can contain the CP and CMS commands you normally issue at the start of every terminal session. For example:

- Commands that describe your terminal characteristics, such as

```
CP SET LINEDIT ON
SET BLIP *
SET RDYMSG SMSG
SYNONYM MYSYN
```

- Commands that spool your printer and punch for particular classes or characteristics:

```
CP SPOOL E CLASS S HOLD
```

- Commands to initialize macro and text libraries that you commonly use:

```
GLOBAL MACLIB OSMACRO CMSLIB
GLOBAL TXTLIB PRIVLIB
```

- Commands to access disks that are a permanent part of your configuration:

```
ACCESS 196 B
```

A PROFILE EXEC file that contains all of these commands might look like this:

```
&CONTROL OFF
CP SET LINEDIT ON
CP SPOOL E CLASS S HOLD
SET RDYMSG SMSG
SET BLIP *
SYNONYM MYSYN
GLOBAL MACLIB OSMACRO CMSLIB
GLOBAL TXTLIB PRIVLIB
ACCESS 196 B
```

&CONTROL OFF is an EXEC control statement that specifies that the CP and CMS command lines are not to be displayed on your terminal before they execute.

A PROFILE EXEC can be as simple or as complex as you require. As an EXEC file, it can contain any valid EXEC control statements or CMS commands. The only thing that makes it special is its filename,

PROFILE, which causes it to be executed the first time you press the Return key after loading CMS.

EXECUTING YOUR PROFILE EXEC

Usually, the first thing you do after loading CMS is to type a CMS command. When you press the Return key to enter this command or if you enter a null line, CMS searches your A-disk for a file with a filename of PROFILE and a filetype of EXEC. If such a file exists, it is executed before the first CMS command you enter is executed. Because you do not do anything special to cause your PROFILE EXEC to execute, you can say that it executes "automatically."

You can prevent your PROFILE EXEC from executing automatically by entering

```
access (noprof)
```

as the first CMS command after you IPL CMS. You can enter:

```
profile
```

at any time during a CMS session to execute the PROFILE EXEC, if you had accessed your A-disk without it, or if you had made changes to it and wanted to execute it, or if you had changed your virtual machine and wanted to restore its original characteristics.

CMS EXECs and How To Use Them

A file named CMS EXEC is created when you use the EXEC option of the LISTFILE command, for example

```
listfile pr* document a (exec
```

The usual display that results from this LISTFILE command is a list of all the files on your A-disk with a filetype of DOCUMENT that have filenames beginning with the characters "PR". CMS, however, creates a CMS EXEC file that contains a record for each file that would be listed. The records are in the format:

```
 &1 &2 filename filetype  filemode
```

Column 1 is blank. Now, if you have the following files on your A-disk:

```
PRFILE1 DOCUMENT
PRFILE2 DOCUMENT
PRFILE3 DOCUMENT
PRFILE4 DOCUMENT
```

The CMS EXEC file would contain the records:

```
&1 &2 PRFILE1  DOCUMENT  A1
&1 &2 PRFILE2  DOCUMENT  A1
&1 &2 PRFILE3  DOCUMENT  A1
&1 &2 PRFILE4  DOCUMENT  A1
```

In the preceding lines, &1 and &2 are variables that can receive values from arguments you pass to the EXEC when you execute it. For example, if you execute this CMS EXEC by issuing:

```
cms disk dump
```

the EXEC interpreter substitutes, on each line, the variable &1 with the DISK and the variable &2 with DUMP and executes the commands:

```
DISK DUMP PRFILE1 DOCUMENT A1
DISK DUMP PRFILE2 DOCUMENT A1
DISK DUMP PRFILE3 DOCUMENT A1
DISK DUMP PRFILE4 DOCUMENT A1
```

You can use this technique to transfer a number of files to another user. You should remember to spool your punch with the CONT option before you execute the EXEC, so that all of the files are transferred as a single spool file, for example:

```
cp spool d cont library
```

then, after executing the EXEC file, close the punch:

```
cp spool d nocont close
```

If you pass only one argument to your CMS EXEC file, the variable &2 is set to a null string. For example,

```
cms erase
```

executes as

```
ERASE PRFILE1   DOCUMENT  A1
ERASE PRFILE2   DOCUMENT  A1
ERASE PRFILE3   DOCUMENT  A1
ERASE PRFILE4   DOCUMENT  A1
```

You could also use a CMS EXEC to obtain a listing of files on a virtual disk. If you want, you can use one of the other LISTFILE command options in conjunction with the EXEC option to get more information about the files listed. For example,

```
listfile * * a (exec date
```

produces a CMS EXEC that contains, in addition to the filename, filetype, and filemode of each file listed, the file format and size, and date information. You can then use the PRINT command to obtain a printed copy:

```
print cms exec
```

Before printing this file, you may want to use the SORT command to sort the list into alphabetic order by filename, by filetype, or both, for example

```
sort cms exec a cmssort exec a
```

When you are prompted to enter sort fields, you can enter

```
1 26
```

The file CMSSORT EXEC that is created contains a completely alphabetical list.

A CMS EXEC is like any other CMS file; you can edit it, erase it, rename it, or change it. If you have created it to catalog a particular group of files, you might want to rename it; each time you use the LISTFILE command with the EXEC option a CMS EXEC is created, and any old CMS EXEC is erased. To rename it, you can use the CMS RENAME command, or, if you are editing it, you can rename it when you file it:

```
edit cms exec
input &control off
file prfile exec
```

You might also want to edit a CMS EXEC to provide it with more numeric variables, for example:

```
edit cms exec
input &control off
input cp spool printer class s cont
change /a1/a1   &3 &4 &5 &6/ *
     .
     .
     .
input cp spool printer nocont
input cp close printer
file prfile exec
prfile print % (cc
```

When this EXEC is executed, the variable &1 is substituted with PRINT, the variable &2 is set to a null string (the special character % indicates that you are not passing an argument to it), and &3 and &4 are set to the PRINT command option (CC, so that the files in the EXEC print with carriage control. The CP commands that are inserted ensure that the files print as a single spool file, and not individually.

Summary of the EXEC Language Facilities

The EXEC processor, or interpreter, recognizes keywords that begin with the special character ampersand (&). Keywords may indicate:

- Control statements
- Built-in functions
- Special variables
- Arguments

You may also define your own variables in an EXEC file; the EXEC interpreter can process them as long as they begin with an ampersand. The following pages briefly discuss the kinds of things you can do with an EXEC, introduce you to the control statements, built-in functions, and special variables, and give some examples of how to use the EXEC processor. If you want more information on writing EXEC procedures, see "Part 3. Learning To Use EXEC." For specific information on the format and usage rules for any EXEC statement or variable, consult the VM/370: CMS Command and Macro Reference.

In general the following rules apply to entering lines into an EXEC procedure:

1. Most input lines (with a few exceptions) are scanned during execution of the EXEC. Every word on a line is padded or truncated

to fit into an 8-character "token." So, for example, if you enter the EXEC control statement

```
&type today is wednesday
```

when this EXEC is executed, the line is displayed at your terminal:

```
TODAY IS WEDNESDA
```

The lines that are not tokenized are those that begin with an * (and are considered comments), and those that follow an &BEGEMSG, &BEGPUNCH, &BEGSTACK, or &BEGTYPE control statement, up to an &END statement.

2. You can enter input lines beginning in any column. The only time that you must enter an EXEC line beginning in column 1 is when you are using the &END control statement to terminate a series of lines being punched, stacked, or typed.

ARGUMENTS AND VARIABLES

Most EXEC processing is contingent on the value of variable expressions. A variable expression in an EXEC is a symbol that begins with an ampersand (&). When the EXEC interpreter processes a line and encounters a variable symbol, it substitutes the variable with a predefined value, if the symbol has been defined. Symbols can be defined in three ways: (1) when passed as arguments to the EXEC, (2) by assignment statements, (3) interactively, as a result of a &READ ARGS or &READ VARS control statement.

You can pass arguments to EXEC files when you invoke them. Each argument you enter is assigned a variable name: the first argument is &1, the second is &2, the third is &3, and so on. You can assign values for up to 30 variables this way. For example, if an EXEC is invoked:

```
scan alpha 2 notype print
```

the variable &1 has a value of ALPHA, the variable &2 has a value of 2, &3 is NOTYPE and &4 is PRINT. These values remain in effect until you change them.

You can test the arguments passed in several ways. The special variable &INDEX contains the number of arguments received. Using the example SCAN ALPHA 2 NOTYPE PRINT, the statement

```
&IF &INDEX EQ 4 &GOTO -SET
```

would be true, since four arguments were entered, so a branch to the label -SET is taken.

You can change the values of arguments or assign values using the &ARGS control statement. For example,

```
&IF &INDEX EQ 0 &ARGS A B C
```

assigns the values A, B, and C to the variables &1, &2, and &3 when the EXEC is invoked without any arguments.

Use the &READ ARGS control statement to enter arguments interactively. For example, if your EXEC file contains the line

```
&READ ARGS
```

when this line is executed, the EXEC issues a read to your virtual machine so that you can enter up to 30 arguments, to be assigned to the variables &1, &2, and so on.

ASSIGNMENT STATEMENTS

User-defined variable names begin with an ampersand (&) and contain up to seven additional characters. These variables can contain numeric or alphameric data. You define and initialize EXEC variables in assignment statements. In an assignment statement, the value of the expression on the right side of the equal sign is assigned to the variable named on the left of the equal sign. For example,

```
&A = 35
```

is an assignment statement that assigns the numeric value 35 to the variable symbol &A. A subsequent assignment statement might be:

```
&B = &A + 10
```

After this assignment statement executes, the value of &B would be 35 plus 10, or 45.

You can use the &READ control statement to assign variable names interactively. For example, when the statement

```
&READ VARS &NAME &AGE
```

is executed, the EXEC issues a read to your virtual machine, and you can enter a line of data. The first two words, or tokens, you enter are assigned to the variable symbols &NAME and &AGE, respectively.

Null Variables

If you use a variable name that has not been defined the variable symbol is set to a null string by the EXEC processor when the statement is executed. For example, if you have entered only two arguments on the EXEC command line, then the statement

```
&IF &3 EQ CONT &ERROR &CONTINUE
```

is interpreted

```
&IF  EQ CONT &ERROR &CONTINUE
```

&ERROR and &CONTINUE are recognized by EXEC as control statements. Since &3 is undefined, however, it is replaced by blanks and the resulting line produces an error during EXEC processing. You can prevent the error, and allow for null arguments or variables, by concatenating some other character with the variable. A period is used most frequently:

```
&IF .&3 EQ .CONT &ERROR &CONTINUE
```

If &3 is undefined when this line is scanned, the result is

```
&IF . EQ .CONT &ERROR &CONTINUE
```

which is a valid control statement line.

BUILT-IN FUNCTIONS AND SPECIAL VARIABLES

The EXEC built-in functions are similar to those of higher-level languages. You can use the EXEC built-in functions to define variable symbols in an EXEC procedure.

Figure 8 summarizes the built-in functions. It shows, given the variable &A, the values resulting in a variable &B when a built-in function is used to assign its value. Notice that all of the built-in functions are used on the right-hand side of assignment statements. Only the &LITERAL built-in function can be used in control statements, for example:

```
&TYPE &LITERAL &A
```

Function	Usage	Example	&B
&CONCAT	Concatenates tokens into a single token.	&A = 123 &B = &CONCAT &A 55	12355
&DATATYPE	Assigns the data type (NUM or CHAR) to the variable.	&B = &DATATYPE &A	NUM
&LENGTH	Assigns the length of a token to a variable.	&B = &LENGTH &A	3
&LITERAL	Prohibits substitution of a variable symbol.	&B = &LITERAL &A	&A
&SUBSTR	Extracts a character string from a token.	&B = &SUBSTR &A 2 2	23

Figure 8. Summary of EXEC Built-in Functions

FLOW CONTROL IN AN EXEC

An EXEC is processed line by line: if a statement is encountered that passes control to another line in the procedure, execution continues there and each line is, again, executed sequentially. You can pass control with an &GOTO control statement:

```
&GOTO -BEGIN
```

where BEGIN is a label. All labels in EXEC files must begin with a hyphen, and must be the first token on a line. For example,

```
-LOOP
```

A label may have control statements or commands following it, for example

```
-HERE &CONTINUE
```

which indicates that the processing is to continue with the next line, or

```
-END &EXIT
```

The &EXIT control statement indicates that the EXEC processor should terminate execution of the EXEC and return control to CMS. You can also specify a return code on the &EXIT control statement:

```
&EXIT 6
```

results in a "(00006)" following the "R" in the CMS Ready message. If you invoke a CMS command from the EXEC, you can specify that the return code from the CMS command be used:

```
&EXIT &RETCODE
```

Since the &RETCODE special variable is set after each CMS command that is executed, you can test it after any command to decide whether you want execution to end. For example, you could use the &IF control statement to test it:

```
&IF &RETCODE NE 0 &EXIT &RETCODE
```

"&EXIT &RETCODE" places the value of the CMS return code in the CMS Ready message. You could place a line similar to the above following each of your CMS command lines, or you could use the &ERROR control statement, that will cause an exit as soon as an error is encountered:

```
&ERROR &EXIT &RETCODE
```

or you could use the &ERROR control statement to transfer control to some other part of your EXEC:

```
&ERROR &GOTO -CHECK
      .
      .
      .
  -CHECK
      .
      .
      .
```

Another way to transfer control to another line is to use the &SKIP control statement:

```
&SKIP 10
```

transfers control to a line that is 10 lines below the &SKIP line. You can transfer control above the current line as well:

```
&IF &X NE &Y &SKIP -3
```

Transferring control with &SKIP is faster, when an EXEC is executing, than it is with &GOTO, but modifying your EXEC files becomes more difficult, particularly when you add or delete many lines.

You can use combinations of &IF, &GOTO, and &SKIP to set up loops in an EXEC. For example:

```
&X = 1
&IF &X = 4 &GOTO -ENDPRT
PRINT FILE&X TEST A
&X = &X + 1
&SKIP -3
-ENDPRT
```

Or, you can use the &LOOP control statement:

```
&X = 1
&LOOP 2 &X > 3
PRINT FILE&X TEST
&X = &X + 1
-ENDPRT
```

In both of these examples, a loop is established to print the files FILE1 TEST, FILE2 TEST, and FILE3 TEST. &X is initialized with a value of 1 and then incremented within the loop. The loop executes until the value of &X is greater than 3. As soon as this condition is met, control is passed to the label -ENDPRT.

COMPARING VARIABLE SYMBOLS AND CONSTANTS

In an EXEC, you can test whether a certain condition is true, and then perform some function based on the decision. Some examples have already appeared in this section, such as

```
&LOOP 3 &X EQ &Y
```

In this example, the value of the variable &X is tested for an equal comparison with the value of the variable &Y. The loop is executed until the condition (&X equal to &Y) is true.

The logical comparisons you can make are:

Condition	Mnemonic	Symbol
equal	EQ	=
not equal	NE	¬=
greater than	GT	>
less than	LT	<
greater than or equal to	GE	>=
less than or equal to	LE	<=

When you are testing a condition in an EXEC file, you can use either the mnemonic or the symbol to represent the condition:

```
&IF &A LT &B &GOTO -NEXT
```

is the same as

```
&IF &A < &B &GOTO -NEXT
```

DOING I/O WITH AN EXEC

You can communicate with your terminal using the &TYPE and &READ control statements. Use &TYPE to display a line at your terminal:

```
&TYPE ASMBLNG &1 ASSEMBLE
```

When this line is processed, if the variable &1 has a value of PROG1, the line is displayed as

```
ASMBLNG PROG1 ASSEMBLE
```

Use the &READ control statement when you want to be able to enter data, variables, or control statements into your EXEC file while it is executing. If you use it in conjunction with an &TYPE statement, for example

```
&TYPE DO YOU WANT TO CONTINUE ?
&READ &ANS
```

you could test the variable &ANS in your EXEC to find out how processing is to continue.

The &BEGTYPE control statement can be followed by a sequence of lines you want to be displayed at the terminal. For example, if you want to display 10 lines of data, instead of using 10 &TYPE control statements, you could use

```
&BEGTYPE
line1
line2
   .
   .
   .
line10
&END
```

The &END control statement indicates the end of the lines to be typed. You can also use the &BEGTYPE control statement when you want to type a line that contains a word with more than 8 characters in it, for example:

```
&BEGTYPE
TODAY IS WEDNESDAY
&END
```

The EXEC interpreter, however, does not perform substitutions on lines entered this way. The lines

```
&A = DOG
&BEGTYPE
MY &A IS NAMED FIDDLEFADDLE
&END
```

result in the display

```
MY &A IS NAMED FIDDLEFADDLE
```

You must use the &TYPE statement when you want to display variable data; you must use the &BEGTYPE control statement to display words with more than 8 characters.

To type null or blank lines at your terminal (to make output readable, for example), you can use the &SPACE control statement:

```
&SPACE 5
```

Using Your Virtual Card Punch

You can punch lines of tokens into your virtual card punch with the &PUNCH control statement:

```
&PUNCH &NAME &TOTAL
```

When you want to punch more than one line of data, or a line that contains a word of more than 8 characters in it, you should use the &BEGPUNCH control statement preceding the lines you want to punch, and follow them with an &END statement. The EXEC processor does not interpret these lines, however, so any variable symbols you enter on these lines are not substituted.

When you punch lines from an EXEC procedure what you are actually doing is creating a file in your virtual card punch. To release the file for processing, you must close the punch:

```
cp close punch
```

The destination of the file depends on how you have spooled your punch. If you have spooled it to yourself, the file is placed in your virtual card reader, and you can read it onto a virtual disk using the READCARD command.

Stacking Lines

The EXEC control statements &STACK and &BEGSTACK allow you to stack lines in your terminal console, to be executed as soon as a read occurs in your virtual machine. Stacking is useful when you use commands that require responses, for example, the SORT command:

```
&STACK 1 20
SORT INFILE FILE A OUTFILE FILE A
```

When the SORT command is executed, a prompting message is issued, the virtual machine read occurs, and the response that you have stacked is read. If you do not stack a response to this command, your EXEC does not continue processing until you enter the response from your terminal.

Stacking is useful in creating edit macros, or when you are editing files from EXEC procedures.

MONITORING EXEC PROCEDURES

Two EXEC control statements, &CONTROL and &TIME, control how much information is displayed at your terminal while your EXEC file is executing. This display is called an execution summary.

Since, usually, you do not receive a CMS Ready message after the execution of each CMS command in an EXEC, you do not receive the timing information that is provided with the Ready message. If you want this timing information to appear, you can specify

```
&TIME ON
```

or you can type the CPU times at particular places by using:

```
&TIME TYPE
```

The &CONTROL control statement allows you to specify whether certain lines or types of information are displayed during execution. By default, CP and CMS commands are displayed before they are executed. If you do not wish to see them displayed, you can specify

```
&CONTROL OFF
```

You might find it useful, when you are debugging your EXECs, to use

```
&CONTROL ALL
```

When you use this form, all EXEC statements, as well as all CP and CMS commands, are displayed and you can see the variable substitutions being performed and the branches being taken in a procedure.

Summary of EXEC Control Statements and Special Variables

Figures 9 and 10 summarize EXEC control statements and special variables.

Control Statement	Function
&variable = {string / ae / function / X'xxxxxx'}	Assigns a value to the symbol specified by &variable; the equal sign must be preceded and followed by a blank.
&ARGS [arg1 [arg2 ...[arg30]]]	Redefines the variable symbols &1, &2... with the values of 'arg1', 'arg2', ..., and resets the variable &INDEX.
&BEGEMSG [ALL] line1 line2 . . &END	Displays the following lines as CMS error messages, without scanning them.
&BEGPUNCH [ALL] line1 line2 . . &END	Punches the following lines in the virtual card punch, without scanning them.
&BEGSTACK [FIFO / LIFO] [ALL] line1 line2 . . &END	Stacks the following lines in the console input buffer, without scanning them.
&BEGTYPE [ALL] line1 line2 . . &END	Displays the following lines at the console, without scanning them.
&CONTINUE	Provides a branch address for &ERROR, &GOTO, and other conditional branching statements.

Figure 9. Summary of EXEC Control Statements (Part 1 of 3)

Control Statement	Function
&CONTROL [OFF | ERROR | CMS | ALL] [MSG | NOMSG] [TIME | NOTIME] [PACK | NOPACK]	Sets, until further notice, the characteristics of the execution summary of the EXEC, which is displayed at the console.
&EMSG mmmnnns [tok1 [...tokn]]	Displays a line of tokens as a CMS error message.
&END	Terminates a series of lines following an &BEGEMSG, &BEGPUNCH, &BEGSTACK, or &BEGTYPE control statement.
&ERROR [executable-statement | &CONTINUE]	Executes the specified statement whenever a CMS command returns a nonzero return code.
&EXIT [return-code | 0]	Exits from the EXEC file with the given return code.
&GOTO { TOP | linenumber | -label }	Transfers control to the top of the EXEC file, to the given line, or to the line starting with the given label.
&HEX { ON | OFF }	Turns on or off hexadecimal conversion.
&IF { tok1 | &$ | &* } { EQ | NE | LT | LE | GT | GE | = | ¬= | < | <= | > | >= } { tok2 | &$ | &* } executable-statement	Executes the specified statement if the condition is satisfied.
&LOOP { n | -label } { m | condition }	Loops through the following n lines, or down to (and including) the line at label, for m times, or until the condition is satisfied.
&PUNCH [tok1 [...tokn]]	Punches the specified tokens to your virtual card punch.

Figure 9. Summary of EXEC Control Statements (Part 2 of 3)

Control Statement	Function
&READ [n | 1 | ARGS | VARS [&var1 [...&var17]]]	Reads lines from the terminal or from the console stack. ARGS assigns the tokens read to the variables &1, &2 ... VARS assigns the tokens read to the specified variable symbols.
&SKIP [n | 1]	Transfers control forward or backward a specified number of lines.
&SPACE [n | 1]	Displays blank lines at the terminal.
&STACK [FIFO | LIFO] [tok1 [... tokn] | HT | RT]	Stacks a line in the terminal input stack.
&TIME [ON | OFF | RESET | TYPE]	Displays timing information following the execution of CMS commands.
&TYPE [tok1 [...tokn]]	Displays a line at the terminal.

Figure 9. Summary of EXEC Control Statements (Part 3 of 3)

Variable	Usage	Set By
&n	Arguments passed to an EXEC are assigned to the variables &1 through &30.	User
&* &$	Test whether all (&*) or any (&$) of the arguments passed to EXEC have a particular value.	EXEC
&DISKx	Indicates whether the disk access at mode 'x' is a CMS OS, or DOS disk, or not accessed (CMS, OS, DOS, or NA).	User
&DISK*	Contains the mode letter of the first read/write disk in the CMS search order, or NONE if no read/write disk is accessed.	User
&DISK?	Contains the mode letter of the read/write disk with the most available space or NONE, if no read/write disk is accessed.	User
&DOS	Indicates whether or not the CMS/DOS environment is active (ON or OFF).	User
&EXEC	Contains the filename of the EXEC file currently being executed.	EXEC
&GLOBAL	Has a value ranging from 1 to 19, to indicate the recursion (nesting) level of the EXEC that is currently executing.	EXEC
&GLOBALn	The variables &GLOBAL1 through &GLOBAL9 can contain integral numeric values, and can be passed among different recursion levels. If not explicitly set, the variable will have a value of 1.	User
&INDEX	Contains the number of arguments passed to the EXEC on the command line or the number of arguments entered as a result of an &ARGS or &READ ARGS control statement.	EXEC
&LINENUM	Contains the current line number in the EXEC.	EXEC
&READFLAG	Indicates whether (STACK) or not (CONSOLE) there are lines stacked in the terminal input buffer (console stack).	EXEC
&RETCODE	Contains the return code from the most recently executed CMS command.	CMS
&TYPEFLAG	Indicates whether (RT) or not (HT) output is being displayed at the console.	EXEC
&0	Contains the name of the EXEC file.	User

Key:
User: Variables are assigned values by EXEC but you may modify them.
EXEC: You may not modify these variables.
CMS: You may assign a value to this variable but it is reset at the completion of each CMS command.

Figure 10. EXEC Special Variables

Section 7. Using Real Printers, Punches, Readers, and Tapes

CMS Unit Record Device Support

CMS supports one virtual card reader at address 00C, one virtual card punch at address 00D, and one virtual printer at address 00E. When you invoke a CMS command or execute a program that uses one of these unit record devices, the device must be attached at the virtual address indicated.

USING THE CP SPOOLING SYSTEM

Any output that you direct to your virtual card printer or punch, or any output you receive through your card reader, is controlled by the spooling facilities of the control program (CP). Each output unit is known to CP as a spool file, and is queued for processing with the spool files of other users on the VM/370 system. Ultimately, a spooled printer file or a spooled punch file may be released to a real printer or card punch for printing or punching.

The final disposition of a unit record spool file depends on the spooling characteristics of your virtual unit record devices, which you can alter with the CP command SPOOL. To find out the current characteristics of your unit record devices you can issue the command:

```
cp query ur
```

You might see, as a response to this, the display:

```
RDR  00C CL A  NOCONT NOHOLD   EOF      READY
PUN  00D CL A  NOCONT NOHOLD COPY 01    READY
     00D FOR CMSGDE   DIST 13SCRIPT
PRT  00E CL A    CONT   HOLD COPY 01    READY
     00E FOR CMSGDE   DIST 13SCRIPT
```

Some of these characteristics, and the ways you can modify them, are discussed below. When you use the SPOOL command to control a virtual unit record device, you do not change the status of spool files that already exist, but rather set the characteristics for subsequent output. For information on modifying existing spool files, see "Altering Spool Files," below.

CLASS (CL): Spool files, in the CP spool file queue, are grouped according to class, and all files of a particular class may be processed together, or directed to the same real output device. The default values for your virtual machine are set in your VM/370 directory entry, and are probably the standard classes for your installation.

You may need, however, to change the class of a device if you want a particular type of output, or some special handling for a spool file. For example, if you are printing an output file that requires special forms, and your installation expects that output to be spooled class Y, issue the command:

```
cp spool printer class y
```

All subsequent printed output directed to your printer at virtual address 00E (all CMS output) is processed as class Y.

HOLD: If you place a HOLD on your printer or punch, any files that you print or punch are not released to the control program's spooling queue until you specifically alter the hold status. By placing your output spool files in a hold status, you can select which files you print or punch, and you can purge duplicate or unwanted files. To place printer and punch output files in a hold status issue the commands:

```
cp spool printer hold
cp spool punch hold
```

Note: When you issue a SPOOL command for a unit record device, you can refer to it by its virtual address, as well as by its generic device type (for example, CP SPOOL E HOLD).

When you have placed a hold status on printer or punch files and you produce an output file for one of these devices, CP sends you a message to remind you that you have placed the file in a hold:

```
PRT FILE xxxx FOR userid COPY xx HOLD
```

If, however, you have issued the command

```
cp set msg off
```

then you do not receive the message.

When you place a reader file in a hold status, then the file remains in the card reader until you remove the hold status and read it, or you purge it.

COPY: If you want multiple copies of a spool file, you should use the COPY operand of the SPOOL command:

```
cp spool printer copy 10
```

If you enter this command, then all subsequent printer files that you produce are each printed 10 times, until you change the COPY attribute of your printer.

FOR: You can spool printed or punched output under another userid's name by using the FOR operand of the SPOOL command. For example, if you enter

```
cp spool printer for charlie
```

Then, all subsequent printer files that you produce have, on the output separator page, the userid CHARLIE and the distribution code for that user. The spool file is then under the control of that user, and you cannot alter it further.

CONT, NOCONT: You can print or punch many spool files, but have them print or punch as one continuous spool file if you use the CONT operand on the SPOOL command. For example, if you issue the following sequence of commands:

```
cp spool punch cont to brown
punch asm1 assemble
punch asm2 assemble
punch asm3 assemble
cp spool punch nocont
cp close punch
```

Then, the three files ASM1 ASSEMBLE, ASM2 ASSEMBLE, and ASM3 ASSEMELE, are punched to user BROWN as a single spool file. When user BROWN reads this file onto a disk, however, CMS creates separate disk files.

TO: When you spool your printer or punch to another userid, all output from that device is transferred to the virtual card reader of the userid you specify. When you are punching a CMS disk file, as in the example above, you should use the TO operand of the SPOOL command to specify the destination of the punch file.

You can also use this operand to place output in your own virtual card reader by using the * operand:

```
cp spool printer to *
```

After you enter this command, subsequent printed output is placed in your virtual card reader. You might use this technique as an alternative way of preventing a printer file from printing, or, if you choose to read the file onto disk from your reader, of creating a disk file from printer output.

Similarly, if you are creating punched output in a program and you want to examine the output during testing, you could enter:

```
cp spool punch to *
```

so that you do not punch any real cards or transfer a virtual punch file to another user.

ALTERING SPOOL FILES

After you have requested that VM/370 print or punch a file, or after you have received a file in your virtual card reader and before the file is actually printed, punched, or read, you can alter some of its characteristics, change its destination, or delete it altogether.

Every spool file in the VM/370 system has a unique 4-digit number from 0 to 9900 assigned to it, called a spoolid. You can use the spoolid of a file to identify it when you want to do something to it. You can also change a group of files, by specifying that all files of a particular class be altered in some way, or you can manipulate all of your spool files for a certain device at the same time.

The CP commands that allow you to manipulate spool files are CHANGE, ORDER, PURGE, and TRANSFER. In addition, you can use the CP QUERY command to list the status and characteristics of spool files associated with your userid.

When you use any of these commands to reference spool files of a particular device, you have the choice of referring to the files by class or by spoolid. You can also specify ALL. For example, if you enter the command

```
cp query printer all
```

you might see the display:

```
ORIGINID FILE CLASS RECDS  CPY HOLD DATE  TIME     NAME    TYPE   DIST
SCARLET  0211 D PRT 000140 01  USER 07/09 10:25:23 TARA    FILE   BIN015
SCARLET  0245 A PRT 000026 01  NONE 07/09 10:25:41 CMSLIB  MACLIB BIN015
```

Until any of these files are processed, or in the case of files in the hold status, until they are released, you can change the spool file name and spool file type (this information appears on the first page or first card of output), the distribution code, the number of copies, the class, or the hold status, using the CP CHANGE command. For example,

```
cp change printer all nohold
```

changes all printer files that are in a hold status to a nohold status. The CP CHANGE command can also change the spooling class, distribution code, and so on.

If you decide that you do not want to print a particular printer file, you can delete it with the CP PURGE command:

```
cp purge printer 7615
```

After you have punched a file to some other user, you cannot change its characteristics or delete it unless you restore it to your own virtual reader. You can do this with the TRANSFER command:

```
cp transfer all from usera
```

This command returns to your virtual card reader all punch files that you spooled to USERA's virtual card reader.

You can determine, for your reader or printer files, in what order they should be read or printed. If you issue the command:

```
cp order printer 8195 6547
```

Then, the file with spoolid of 8195 is printed before the file with a spoolid of 6547.

The CP spooling system is very flexible, and can be a useful tool, if you understand and use it properly. The VM/370: CP Command Reference for General Users contains complete format and operand descriptions for the CP commands you can use to modify spool files.

USING YOUR CARD PUNCH AND CARD READER IN CMS

The CMS READCARD command reads cards from your virtual card reader at address 00C. Cards can be placed in the reader in one of two ways:

- By reading real punched cards into the system card reader. A CP ID card tells the CP spooling system which virtual card reader is to receive the card images.
- By transferring a file from another virtual machine. Cards are transferred as a result of a virtual punch or printer being spooled with the TO operand, or as a result of the TRANSFER command. Virtual card images are created with the CMS PUNCH command, or from user programs or EXEC procedures.

Using Real Cards

If you have a deck of punched cards that you want read into your virtual machine card reader, you should punch, preceding the deck, a CP ID card:

```
ID HAPPY
```

If you plan to use the READCARD command to read this file onto a CMS disk, you can also punch a READ control card that specifies the filename and filetype you want to have assigned to the file:

```
:READ PROG6 ASSEMBLE
```

Then, to read this file onto your CMS A-disk, you can enter the command

```
readcard *
```

If a file named PROG6 ASSEMBLE already exists, it is replaced.

If you do not punch a READ control card, you can specify a filename and filetype on the READCARD command:

```
readcard prog6 assemble
```

If this spool file contained a READ control card, the card is not read, but remains in the file; if you edit the file, you can use the DELETE subcommand to delete it.

If a file does not have a READ control card, and if you do not specify a filename and filetype when you read the file, CMS names the file READCARD CMSUT1.

If you are reading many files into the real system card reader, and you want to read them in as separate spool files (or you want to spool them to different userids), you must separate the cards and read the decks onto disk individually. The CP system, after reading an ID card, continues reading until it reaches a physical end of file.

Using Your Virtual Card Punch

When you use the CMS PUNCH command to punch a spool file, a READ control card is punched to precede the deck, so that it can be read with the READCARD command. If you do not wish to punch a READ control card (also referred to as a header card), you can use the NOHEADER option on the PUNCH command:

```
punch prog8 assemble * ( noheader
```

You should use the NOHEADER option whenever you punch a file that is not going to be read by the READCARD command.

The PUNCH command can only punch records of up to 80 characters in length. If you need to punch or to transfer to another user a file that has records greater than 80 characters in length, you can use the DISK DUMP command:

```
disk dump prog9 data
```

If your virtual card punch has been spooled to another user, that user can read this file using the DISK LOAD command:

```
disk load
```

Unlike the READCARD command, DISK LOAD does not allow you to specify a file identification for a file you are reading; the filename and filetype are always the same as those specified by the DISK DUMP command that created the spool file.

A card file created by the DISK DUMP command can only be read onto disk by the DISK LOAD command.

Using the MOVEFILE Command

You can use the MOVEFILE command, in conjunction with the FILEDEF command, to place a file in your virtual card reader, or to copy a file from your card reader to another device. For example,

```
cp spool punch to *
filedef punch punch
filedef input disk coffee exec a1
movefile input punch
```

the file COFFEE EXEC A1 is punched to your virtual card punch, (in card-image format) and spooled to your own virtual reader.

Creating Files Using Your Reader and Punch

Apart from the procedures shown above, that transfer whole files with one or two commands, there are other methods you can use to create files using your virtual card punch. From a program or an EXEC file, you can punch one line at a time to your virtual punch. Then use CLOSE command to close the spool file:

```
cp close punch
```

Depending on how the punch was spooled (the TO setting), the virtual punch file is either punched or transferred to a virtual card reader.

PUNCHING CARDS USING I/O MACROS: If you write an OS, DOS, or CMS program that produces punched card output, you should make an appropriate file definition. If you are an OS user, you should use the FILEDEF command to define the punch as an output data device; if you are a DOS user, you must use the ASSGN command. If you are using the CMS PUNCHC macro, the punch is assigned for you. The spooling characteristics of your virtual punch control the destination of the punched output.

PUNCHING CARDS FROM AN EXEC: The EXEC facilities provide two control statements for punching cards: &PUNCH, which punches a single line to the virtual card punch, and &BEGPUNCH, which precedes a number of lines to be punched. You can also, in an EXEC, use the commands PUNCH and DISK DUMP to punch CMS files.

Handling Tape Files in CMS

There are a variety of tape functions that you can perform in CMS, and a number of commands that you can use to control tape operations or to read or write tape files. One of the advantages of placing files on tapes is portability: it is a convenient method of transferring data from one real computing system to another. In CMS, you can use tapes created under other operating systems. There are also two CMS commands, TAPE and DDR, that create tape files in formats unique to CMS, that you can use to back up minidisks or to archive or transfer CMS files.

Under VM/370, virtual addresses 181 through 184 are usually reserved for tape devices. In most cases, you can refer to these tapes in CMS by using the symbolic names TAP1 through TAP4. In any event, before you can use a tape, you must have it mounted and attached to your virtual

machine by the system operator. When the tape is attached, you receive a message. For example, if the operator attaches a tape to your virtual machine at virtual address 181, you receive the message

```
TAPE 181 ATTACHED
```

The various types of tape files, and the commands and programs you can use to read or write them are:

TAPE Command: The CMS TAPE command creates tape files from CMS disk files. They are in a special format, and should only be read by the CMS TAPE LOAD command. For examples of TAPE command operands and options, see "Using the CMS TAPE Command."

TAPPDS Command: The TAPPDS command creates CMS disk files from OS or DOS sequential tape files, or from OS partitioned data sets.

TAPEMAC Command: The TAPEMAC command creates CMS MACLIB files from OS macro libraries that were unloaded onto tape with the IEHMOVE utility program.

MOVEFILE Command: The MOVEFILE command can copy a sequential tape file onto disk, or a disk file onto tape. Or, it can move files from your card reader to tape, or from tape to your card punch.

User Programs: You can write programs that read or write sequential tape files using OS, DOS, or CMS macros.

Access Method Services: Tapes created by the EXPORT function of Access Method Services can be read only using the Access Method Services IMPORT function. Both the IMPORT and EXPORT functions can be accomplished in CMS using the AMSERV command. The Access Method Services REPRO function can also be used to copy sequential tape files.

DDR Program: The DDR program, invoked with the CMS command DDR, dumps the contents of a virtual disk onto tape, and should be used to restore such files to disk.

USING THE CMS TAPE COMMAND

The CMS TAPE command provides a variety of tape handling functions. It allows you to selectively dump or load CMS files to and from tapes, as well as to position, rewind, and scan the contents of tapes. You can use the TAPE command to save the contents of CMS disk files, or to transfer them from one VM/370 system to another. The following example shows how to create a CMS tape with three tape files on it, each containing one or more CMS files, and then shows how you, or another user, might use the tape at a later time.

The example is in the form of a terminal session and shows, in the "Terminal Display" column, the commands and responses you might see. System messages and responses are in uppercase, and user-entered commands are in lowercase. The "Comments" column provides explanations of the commands and responses.

Terminal Display	Comments
TAPE 181 ATTACHED	Message indicates that the tape is attached.
listfile * assemble a (exec	Prepare to dump all ASSEMBLE files by using the LISTFILE command EXEC option; then execute the CMS EXEC using TAPE and DUMP as arguments.
R;	
cms tape dump	
TAPE DUMP PROG1 ASSEMBLE A1	
DUMPING.....	The TAPE command responds to each TAPE DUMP by printing the file identification of the file being dumped.
PROG1 ASSEMBLE A1	
TAPE DUMP PROG2 ASSEMBLE A1	
DUMPING.....	
PROG2 ASSEMBLE A1	
TAPE DUMP PROG3 ASSEMBLE A1	
.	
.	
.	
TAPE DUMP PROG9 ASSEMBLE A1	The last file, PROG9 ASSEMBLE, is dumped.
DUMPING.....	
PROG9 ASSEMBLE A1	
R;	
tape wtm	The TAPE command writes a tape mark to indicate an end-of-file.
R;	
tape dump mylib maclib a	Two macro libraries are dumped, by specifying the file identifiers.
DUMPING.....	
MYLIB MACLIB A1	
R;	
tape dump cmslib maclib *	
DUMPING.....	
CMSLIB MACLIB S2	
R;	
tape wtm	Another tape mark is written.
R;	
tape dump mylib txtlib a	A TEXT library is dumped.
DUMPING.....	
MYLIB TXTLIB A1	
R;	
tape wtm 2	Two tape marks are written to indicate the end of the tape.
R;	
tape rew	The tape is rewound.
R;	
tape scan (eof 4	The tape is scanned to verify that all of the files are on it.
SCANNING....	
PROG1 ASSEMBLE A1	
PROG2 ASSEMBLE A1	
PROG3 ASSEMBLE A1	
PROG4 ASSEMBLE A1	
PROG5 ASSEMBLE A1	
PROG6 ASSEMBLE A1	
PROG7 ASSEMBLE A1	
PROG8 ASSEMBLE A1	
PROG9 ASSEMBLE A1	
END-OF-FILE OR END-OF-TAPE	Tape mark indication.
MYLIB MACLIB A1	
CMSLIB MACLIB S2	
END-OF-FILE OR END-OF-TAPE	
MYLIB TXTLIB A1	
END-OF-FILE OR END-OF-TAPE	Two tape marks indicate the end of the tape.
END-OF-FILE OR END-OF-TAPE	
R;	
#cp det 181	The CP DETACH command rewinds and detaches the tape.
TAPE 181 DETACHED	

```
Terminal Display                    Comments
*********
*
* The tape created above is going to be read.
*
*********

TAPE 181 ATTACHED                   Message indicating the tape is
                                      attached.
tape load prog4 assemble            One file is to be read onto disk.
LOADING.....                        The TAPE command displays the
PROG4    ASSEMBLE A1                  name of the file loaded. Any
R;                                    existing file with the same
                                      filename and filetype is erased.
tape scan                           The remainder of the first tape
SCANNING....                          file is scanned.
PROG5    ASSEMBLE A1
PROG6    ASSEMBLE A1
PROG7    ASSEMBLE A1
PROG8    ASSEMBLE A1
END-OF-FILE OR END-OF-TAPE          Indication of end of first tape file.
R;
tape scan                           The second tape file is scanned
SCANNING....
MYLIB    MACLIB   A1
CMSLIB   MACLIB   S2
END-OF-FILE OR END-OF-TAPE
R;
tape bsf 2                          The tape is backed up and
R;                                    postioned in front of the
                                      last tape file.
tape fsf                            The tape is forward spaced past
R;                                    the tape mark.
tape load (eof 2                    The next two tape files are
LOADING.....                          going to be read.
MYLIB    MACLIB   A1
CMSLIB   MACLIB   A2
MYLIB    TXTLIB   A1
END-OF-FILE OR END-OF-TAPE
R;
#cp detach 181                      The tape is detached.
TAPE 181 DETACHED
```

TAPE LABELS IN CMS

CMS cannot read tape labels on tapes created under either OS or DOS. When you want to read a tape file created using either of these operating systems, you have to use the CMS TAPE command to position the tape following the tape label:

```
tape fsf
```

If you do not forward space the tape, you receive an end-of-file indication the first time you attempt to read the tape.

THE MOVEFILE COMMAND

The MOVEFILE command can copy sequential tape files into disk files, or sequential disk files onto tape. It can be particularly useful when you need to copy a file from a tape and you do not know the format of the tape.

To use the MOVEFILE command, you must first define the input and output files using the FILEDEF command. For example, to copy a file from a tape attached to your virtual machine at virtual address 181 to a CMS disk, you would enter:

```
filedef input tap1
filedef output disk tape file a
movefile input output
```

This sequence of commands creates a file named TAPE FILE A1. Then use CMS commands to manipulate and examine the contents of the file.

TAPES CREATED BY OS UTILITY PROGRAMS

The CMS command TAPPDS can read OS partitioned and sequential data sets from tapes created by the IEBPTPCH, IEBUPDTE, and IEHMOVE utility programs. When you use the TAPPDS command, the OS data set is copied into a CMS disk file, or in the case of partitioned data sets, into multiple disk files.

IEBPTPCH: Sequential or partitioned data sets created by IEBPTPCH must be unblocked for CMS to read them. If you have a tape created by this utility, each member (if the data set is partitioned) is preceded with a card that contains "MEMBER=membername". If you read this tape with the command:

```
tappds *
```

then, CMS creates a disk file from each member, using the membername for the filename and assigning a filetype of CMSUT1. If you want to assign a particular filetype, for example TEST, you could enter the command as follows:

```
tappds * test
```

If the file you are reading is a sequential data set, you should use the NOPDS option of the TAPPDS command:

```
tappds test file (nopds
```

The above command reads a sequential data set and assigns it a file identifier of TEST FILE. If you do not specify a filename or filetype, the default file identifier is TAPPDS CMSUT1.

IEBUPDTE: Tapes in control file format created by the IEBUPDTE utility program can be read by CMS. Data sets may be blocked or unblocked, and may be either sequential or partitioned. Since files created by IEBUPDTE contain ./ADD control cards to signal the addition of members to partitioned data sets, you must use the COL1 option of the TAPPDS command. Also, you must indicate to CMS that the tape was created by IEBUPDTE. For example, to read a partitioned data set, you would enter the command

```
tappds * test (update col1
```

The CMS disk files created are always in unblocked, 80-character format.

IEHMOVE: OS unloaded partitioned data sets on tapes created by the IEHMOVE utility program can be read either by the TAPPDS command or by the TAPEMAC command. The TAPPDS command creates an individual CMS file from each member of the PDS.

If the PDS is a macro library, you can use the TAPEMAC command to copy it into a CMS MACLIB. A MACLIB, a CMS macro library, has a special format, and can usually be created only by using the CMS MACLIB command. If you use the TAPPDS command, you have to use the MACLIB command to create the macro library from individual files containing macro definitions.

SPECIFYING SPECIAL TAPE HANDLING OPTIONS

For most of the tape handling that you do in CMS, you do not have to be concerned with the density or recording format of the magnetic tapes that you use. There are, however, some instances when it may be important and there are command options that you can use with the TAPE command MODESET operand and with ASSGN and FILEDEF command options.

The specific situations, and the command options you should use, are listed below.

- If you are reading or writing a 7-track tape, and the density of the tape is either 200 or 556 bpi, you must specify DEN 200 or DEN 556.
- If you are reading or writing a 7-track tape with a density of 800 bpi, you must specify 7TRACK.
- If you are reading or writing a 7-track tape without using the data convert feature, you must use the TRTCH option.
- If you are writing a tape using a 9-track dual density tape drive, and you want the density to be 800 (on an 800/1600 drive) or 6250 (on a 1600/6250 drive), then you must specify DEN 800 or DEN 6250.

Using the Remote Spooling Communications Subsystem (RSCS)

If your VM/370 installation is on a Remote Spooling Communications Subsystem (RSCS) network, you can send printer, punch, or reader spool files to users at remote locations. To send a spool file, you must know the userid of the virtual machine at your location that is running RSCS, and the location identification (locid) of the remote location. If you are sending a spool file to a particular user at the remote location, you should also know that userid of the user.

The CP commands that you can use to transmit files across the network are TAG and SPOOL. The TAG command allows you to specify the locid and userid that are to receive a spool file, or, in the case of tagging a printer or punch, of any spool files produced by that device. With the SPOOL command, you spool your virtual device to the RSCS virtual machine. You can also use the TRANSFER command to transfer files from your own virtual card reader.

The CP commands TAG, SPOOL, and TRANSFER are discussed in detail in the publication VM/370: CP Command Reference for General Users.

Part 2. Program Development Using CMS

You can use CMS to write, develop, update, and test:

- OS programs to execute either in the CMS environment (using OS simulation) or in an OS virtual machine.
- DOS programs to execute in either the CMS/DOS environment or in a DOS virtual machine.
- CMS programs to execute in the CMS environment.

The OS and DOS simulation capabilities of CMS allow you to develop OS and DOS programs interactively in a time-sharing environment. When your programs are thoroughly tested, you can execute them in an OS or DOS virtual machine under the control of VM/370.

"Section 8. Developing OS Programs Under CMS" is for programmers who use OS. It describes procedures and techniques for using CMS commands that simulate OS functions.

"Section 9. Developing DOS Programs Under CMS" is for programmers who use DOS. It describes procedures and techniques for using CMS/DOS commands to simulate DOS/VS functions.

If you use VSAM and Access Method Services, in either a DOS or an OS environment, "Section 10. Using Access Method Services and VSAM in CMS and CMS/DOS" provides usage information for you. It describes how to use CMS to manipulate VSAM disks and data sets.

You can use the interactive facilities of CP and CMS to test and debug programs directly at your terminal. "Section 11. How VM/370 Can Help You Debug Your Programs" shows examples of commands and debugging techniques.

The CMS Batch Facility is a CMS feature that allows you to send jobs to another machine for execution. How to prepare and send job streams to a CMS batch virtual machine is described in "Section 12. Using the CMS Batch Facility."

As you learn to use CMS, you may want to write programs for CMS applications. "Section 13. Programming for the CMS Environment" contains information for assembler language programmers: linkage conventions, programming notes, and macro instructions you can use in CMS programs.

Section 8. Developing OS Programs Under CMS

CMS simulates many of the functions of the Operating System (OS), allowing you to compile, execute and debug OS programs interactively. For the most part, you do not need to be concerned with the CMS OS simulation routines: they are built into the CMS system. Before you can compile and execute OS programs in CMS, however, you must be acquainted with the following:

- OS macros that CMS can simulate
- Using OS data sets in CMS
- How to use the FILEDEF command
- Creating CMS files from OS data sets
- Using CMS and OS Macro Libraries
- Assembling Programs in CMS
- Executing programs

These topics are discussed below. Additional information for OS VSAM users is in "Section 10. Using Access Method Services and VSAM Under CMS and CMS/DOS."

For a practice terminal session using the commands and techniques presented in Section 8, see "Appendix D: Sample Terminal Sessions."

A Note About Terminology

The CMS system uses many OS terms, but there are a number of OS functions that CMS performs somewhat differently. To help you become familiar with the some of the CMS equivalents (where they do exist) for OS terms and functions, see Figure 11. It lists some commonly-used OS terms and discusses how CMS handles the functions they imply.

OS Term/Function	CMS Equivalent
Cataloged procedure	EXEC files can execute command sequences similar to cataloged procedures, and provide for conditional execution based on return codes from previous steps.
Data set	Data sets are called files in CMS; CMS files are always sequential but CMS simulates OS partitioned data sets. CMS reads and writes VSAM data sets.
Data Definition (DD) card	The FILEDEF command allows you to perform the functions of the DD statement to specify device types and output file dispositions.
Data Set Control Block (DSCB)	Information about a CMS disk file is contained in a File Status Table (FST).
EXEC card	To execute a program in CMS you specify only the name of the program if it is an EXEC, MODULE file, or CMS command. To execute TEXT files, use the LOAD and START commands.
Job Control Language (JCL)	CMS and user-written commands perform the functions of JCL.
Link-editing	The CMS LOAD command loads object decks (TEXT files) into virtual storage, and resolves external references; the GENMOD command creates absolute nonrelocatable modules.
Load module	CMS MODULE files (resulting from the LOAD and GENMOD commands) are nonrelocatable.
Object module	Language compiler output is placed in CMS files with a filetype of TEXT.
Partitioned data set	CMS MACLIBs and TXTLIBs are the only CMS files that resemble partitioned data sets.
STEPCAT,JOBCAT	VSAM catalogs can be assigned for jobs or job steps in CMS by using the special ddnames IJSYSCT and IJSYSUC when identifying catalogs.
STEPLIB, JOBLIB	The GLOBAL command establishes macro and text libraries; you can indirectly provide job libraries by accessing and releasing CMS disks that contain the files and programs you need.
Utility program	Functions similar to those performed by the OS utility programs are provided by CMS commands.
Volume Table of Contents (VTOC)	The list of files on a CMS disk is contained in a master file directory.

Figure 11. OS Terms and CMS Equivalents

Using OS Data Sets in CMS

You can have OS disks defined in your virtual machine configuration; they may be either entire disks or minidisks: their size and extent depends on their VM/370 directory entries. You can use partitioned and sequential data sets on OS disks in CMS. If you want, you can create CMS files from your OS data sets. If you have data sets on OS disks, you can read them from programs you execute in CMS, but you cannot update them. The CMS commands that recognize OS data sets on OS disks are listed in Figure 12.

Command	Operation
ACCESS	Makes the OS disk containing the data set available to your CMS virtual machine.
ASSEMBLE	Assembles an OS source program under CMS.
DDR	Copies an entire OS disk to tape.
DLBL	Defines OS data sets for use with Access Method Services and VSAM files for program input/output.
FILEDEF	Defines the OS data set for use under CMS by associating an OS ddname with an OS data set name. Once defined, the data set can be used by an OS program running under CMS and can be manipulated by the other commands that support OS functions.
GLOBAL	Makes macro libraries available to the assembler. You can prepare an OS macro library for reference by the GLOBAL command by issuing a FILEDEF command for the data set and giving the data set a filetype of MACLIB.
LISTDS	Lists information describing OS data sets residing on OS disks.
MOVEFILE	Moves data records from one device to another device. Each device is specified by a ddname, which must have been defined via FILEDEF. You can use the MOVEFILE command to create CMS files from OS data sets.
QUERY	Lists (1) the files that have been defined with the FILEDEF and DLBL commands (QUERY FILEDEF, QUERY DLBL), or (2) the status of OS disks attached to your virtual machine (QUERY DISK, QUERY SEARCH).
RELEASE	Releases an OS disk you have accessed (via ACCESS) from your CMS virtual machine.
STATE	Verifies the existence of an OS data set on a disk. Before STATE can verify the existence of the data set, you must have defined it (via FILEDEF).

Figure 12. CMS Commands That Recognize OS Data Sets and OS Disks

ACCESS METHODS SUPPORTED BY CMS

OS access methods are supported, to varying extents, by CMS. Under CMS, you can execute programs that use the OS data management macros that are supplied for these access methods:

- BDAM
- BPAM
- BSAM
- QSAM
- VSAM

BPAM, BSAM, and QSAM: You can execute programs in CMS that read records from OS data sets using the BPAM, BSAM, or QSAM access methods. You cannot, however, write or update OS data sets that reside on OS disks.

BDAM: CMS can neither read nor write OS data sets on OS disks using the BDAM access method.

VSAM Files: CMS can read and write VSAM files on OS disks. For information on using VSAM under CMS, see "Section 10. Using Access Method Services and VSAM Under CMS and CMS/DOS."

OS Simulated Data Sets

If you want to test programs in CMS that create or modify OS data sets, you can write "OS simulated data sets." These are CMS files that are maintained on CMS disks, but in OS format rather than in CMS format. Since they are CMS files, you can edit, rename, copy, or manipulate them just as you would any other CMS file. Since they are in OS-simulated format, files with variable-blocked records may contain block and record descriptor words so that the access methods can manipulate them properly.

The files that you create from OS programs do not necessarily have to be OS simulated data sets. You can create CMS files. The format of an output file depends on how you specify the filemode number when you issue the FILEDEF command to identify the file to CMS. If you specify the filemode number as 4, CMS creates a file that is in OS simulated data set format on a CMS disk.

CMS can read and write OS simulated data sets using the BDAM, BPAM, BSAM, and QSAM access methods.

Restrictions for Reading OS Data Sets

The following restrictions apply when you read OS data sets from OS disks under CMS:

- Read-password-protected data sets are not read.
- BDAM and ISAM data sets are not read.
- Multivolume data sets are read as single-volume data sets. End-of-volume is treated as end-of-file and there is no end-of-volume switching.

- Keys in data sets with keys are ignored; only the data is read.
- User labels in user-labeled data sets are bypassed.

Using the FILEDEF Command

Whenever you execute an OS program under CMS that has input and/or output files, or you need to read an OS data set onto a CMS disk, you must first identify the files to CMS with the FILEDEF command. The FILEDEF command in CMS performs the same functions as the Data Definition (DD) card in OS job control language (JCL): it describes the input and output files.

When you enter the FILEDEF command, you specify:

- The ddname
- The device type
- A file identification, if the device type is DISK
- Options (if necessary)

Some guidelines for entering these specifications follow.

SPECIFYING THE DDNAME

If the FILEDEF command is issued for a program input or output file, then the ddname must be the same as the ddname or file name specified for the file in the source program. For example, you have an assembler language source program that contains the line:

```
INFILE   DCB   DDNAME=INPUTDD,MACRF=GL,DSORG=PS,RECFM=F,LRECL=80
```

For a particular execution of this program, you want to use as your input file a CMS file on your A-disk that is named MYINPUT FILE, then, you must issue a FILEDEF for this file before executing the program:

```
filedef inputdd disk myinput file a1
```

If the input file you want to use is on an OS disk accessed as your C-disk, and it has a data set name of PAYROLL.RECORDS.AUGUST, then your FILEDEF command might be

```
filedef inputdd c1 dsn payroll records august
```

SPECIFYING THE DEVICE TYPE

For input files, the device type you enter on the FILEDEF command indicates the device from which you want records read. It can be DISK, TERMINAL, READER (for input from real cards or virtual cards), or TAPn (for tape). Using the above example, if your input file is to be read from your virtual card reader, the FILEDEF command might be as follows:

```
filedef inputdd reader
```

Or, if you were reading from a tape attached to your virtual machine at virtual address 181 (TAP1):

```
filedef inputdd tap1
```

For output files, the device you specify can be DISK, PRINTER, PUNCH, TAPn (tape), or TERMINAL.

If you do not want any real I/O performed during the execution of a program for a disk input or output file, you can specify the device type as DUMMY:

```
filedef inputdd dummy
```

ENTERING FILE IDENTIFICATIONS

If you are using a CMS disk file for your input or output, you specify

```
filedef ddname disk filename filetype filemode
```

The filemode field is optional; if you do not specify it, your A-disk is assumed. If you want an output file to be constructed in OS simulated data set format, you must specify the filemode number as 4. For example, a program contains a DCB for an output file with a ddname of OUTPUTDD, and you are using it to create a CMS file named DAILY OUTPUT on your B-disk:

```
filedef outputdd disk daily output b4
```

If your input file is an OS data set on an OS disk, you can identify it in several ways:

- If the data set name has only two qualifiers, for example HEALTH.RECORDS, you can specify:

  ```
  filedef inputdd disk health records b1
  ```

- If it has more than two qualifiers, you can use the DSN keyword and enter:

  ```
  filedef inputdd b1 dsn health records august 1974
  ```

  Or you can request a prompt for a complete data set name:

  ```
  filedef inputdd b1 dsn ?
  ENTER DATA SET NAME:
  health.records.august.1974
  ```

  Note: When you enter a data set name using the DSN keyword, either with or without a request for prompting, you should omit the device type specification of DISK, unless you want to assign a CMS file identifier, as in the example below.

- You can also relate an OS data set name to a CMS file identifier:

  ```
  filedef inputdd disk ossim file c1 dsn monthly records
  ```

  Then you can refer to the OS data set MONTHLY.RECORDS by using the CMS file identifier, OSSIM FILE:

  ```
  state ossim file c
  ```

When you do not issue a FILEDEF command for a program input or output file, or if you enter only the ddname and device type on the FILEDEF command, such as:

```
filedef oscar disk
```

then CMS issues a default file definition, as follows:

```
FILEDEF ddname DISK FILE ddname A1
```

where ddname is the ddname you assigned in the DDNAME operand of the DCB macro in your program or on the FILEDEF command. For example, if you assign a ddname of OSCAR to an output file and do not issue a FILEDEF command before you execute the program, then the CMS file FILE OSCAR A1 is created when you execute the program.

SPECIFYING OPTIONS

The FILEDEF command has many options; those mentioned below are a sampling only. For complete descriptions of all the options of the FILEDEF command, see the VM/370: CMS Command and Macro Reference.

BLOCK, LRECL, RECFM, DSORG: If you are using the FILEDEF command to relate a data control block (DCB) in a program to an input or output file, you may need to supply some of the file format information, such as the record length and block size, on the FILEDEF command line. For example, if you have coded a DCB macro for an output file as follows:

```
OUTFILE  DCB   DDNAME=OUT,MACRF=PM,DSORG=PS
```

then, when you are issuing a FILEDEF for this ddname, you must specify the format of the file. To create an output file on disk, blocked in OS simulated data set format, you could issue:

```
filedef out disk myoutput file a4 (recfm fb lrecl 80 block 1600
```

To punch the output file onto cards, you would issue

```
filedef out punch (lrecl 80 recfm f
```

You must supply file format information on the FILEDEF command line whenever it is not supplied on the DCB macro, except for existing disk files.

PERM: Usually, when you execute one of the language processors, all existing file definitions are cleared. If the development of a program requires you to recompile and re-execute it frequently, you might want to use the PERM option when you issue file definitions for your input and output files. For example:

```
cp spool punch to *
filedef indd disk test file a1 (lrecl 80 perm
filedef outdd punch (lrecl 80 perm
```

In this example, since you spooled your virtual punch to your own virtual card reader, output files are placed in your virtual reader. You can either read or delete them.

All file definitions issued with the PERM option stay in effect until you log off, specifically clear those definitions, or redefine them:

```
filedef indd clear
filedef outdd tap1 (lrecl 80
```

In the above example, the definition for INDD is cleared; OUTDD is redefined as a tape file.

When you issue the command

```
filedef * clear
```

all file definitions are cleared, except those you enter with the PERM option.

When a program abends, or when you issue the HX Immediate command, all file definitions are cleared, including those entered with the PERM option.

DISP MOD: When you issue a FILEDEF command for an output file and assign it a CMS file identifier that is identical to that of an existing CMS file, then when anything is written to that ddname the existing file is replaced by the new output file. If you want, instead, to have new records added to the bottom of the existing file, you can use the DISP MOD option:

```
filedef outdd disk new update a1 (disp mod
```

MEMBER: If the file you want to read is a member of an OS partitioned data set (or a CMS MACLIB or TXTLIB), you can use the MEMBER option to specify the membername, for example

```
filedef test c dsn sys1 maclib (member test
```

defines the member TEST from the OS macro library SYS1.MACLIB.

Creating CMS Files From OS Data Sets

If you have data sets on OS disks, or on tapes or cards, you can copy them into CMS files so that you can edit, modify, or manipulate them with CMS commands. The CMS MOVEFILE command copies OS (or CMS) files from one device to another. You can move data sets from any valid input device to any valid output device.

Before using the MOVEFILE command, you must define the input and output data sets or files and assign them ddnames using the FILEDEF command. If you use the ddnames INMOVE and OUTMOVE, then you do not need to specify the ddnames when you issue the MOVEFILE command. For example, the following sequence of commands copies a CMS disk file into your virtual card punch:

```
filedef inmove disk diskin file a1
filedef outmove punch
movefile
```

The result of these commands is effectively the same as if you had issued the command

```
punch diskin file (noheader
```

The example does, however, illustrate the basic relationship between the FILEDEF and MOVEFILE commands. In addition to the MOVEFILE command, if the OS input data set is on tape or cards, you can use the TAPPDS or READCARD command to create CMS files. These are also discussed below.

COPYING SEQUENTIAL DATA SETS FROM DISK: The MOVEFILE command copies a sequential OS disk data set from a read-only OS disk into an integral CMS file on a CMS read/write disk. You use FILEDEF commands to identify the input file disk mode and data set name:

```
filedef inmove c1 dsn sales manual
```

the CMS output file's disk location and fileid:

```
filedef outmove disk sales manual a1
```

and then you issue the MOVEFILE command:

```
movefile
```

COPYING PARTITIONED DATA SETS FROM DISK: The MOVEFILE command can copy partitioned data (PDS) into CMS disk files, and create separate CMS files for each member of the data set. You can have the entire data set copied, or you can copy only a selected member. For example, if you have a partitioned data set named ASSEMBLE.SOURCE whose members are individual assembler language source files, your input file definition might be:

```
filedef inmove c1 dsn assemble source
```

To create individual CMS ASSEMBLE files, you would issue the output file definition as:

```
filedef outmove disk qprint assemble a1
```

Then use the PDS option of the MOVEFILE command:

```
movefile (pds
```

When the CMS files are created, the filetype on the output file definition is used for the filetype and the member names are used instead of the CMS filename you specified.

If you want to copy only a single member, you can use the MEMBER option of the FILEDEF command:

```
filedef inmove disk assemble source c (member qprint
```

and omit the PDS option on the MOVEFILE command:

```
movefile
```

Figure 13 summarizes the various ways that you can create CMS files from OS data sets.

Input File: An OS sequential data set named: COMPUTE.TEST.RECORDS		
Source	CMS Command Examples	CMS Output File
Disk: OS R/O C-disk	filedef indd c1 dsn compute test records filedef outdd disk compute records a1 movefile indd outdd	COMPUTE RECORDS A1
Tape: 181	filedef inmove tap1 (lrecl 80 filedef outmove disk test records a1 movefile	TEST RECORDS A1
	tappds newtest compute (nopds	NEWTEST COMPUTE A1
Cards	filedef cardin reader filedef diskout disk compute cards a1 movefile cardin diskout	COMPUTE CARDS A1
	readcard compute test	COMPUTE TEST A1
Input file: OS partitioned data set named: TEST.CASES Members named: SIMPLE, COMPLEX, MIXED		
Source	CMS Command Examples	CMS Output File(s)
Disk: OS R/O C-disk	filedef infile disk test cases c1 filedef outfile disk new testcase a1 movefile infile outfile (pds	SIMPLE TESTCASE A1 COMPLEX TESTCASE A1 MIXED TESTCASE
	filedef in c1 dsn test cases (member simple filedef run disk movefile in run	FILE RUN A1
Tape: 182	tappds * testrun (tap2	SIMPLE TESTRUN A1 COMPLEX TESTRUN A1 MIXED TESTRUN A1

Figure 13. Creating CMS Files From OS Data Sets

Using CMS Libraries

CMS provides two types of libraries to aid in OS program development:

- Macro libraries contain macro definitions and/or copy files
- Text, or program libraries contain relocatable object programs (compiler output)

These CMS libraries are like OS partitioned data sets; each has a directory and members. Since they are not like other CMS files, you create, update, and use them differently than you do other CMS files. Macro libraries are discussed below; text libraries are discussed under "TEXT Libraries (TXTLIBs)" later in this section.

A CMS macro library has a filetype of MACLIB. You can create a MACLIB from files with filetypes of MACRO or COPY. A MACRO file may contain macro definitions; COPY files contain predefined source statements.

When you want to assemble or compile a source program that uses macro or copy definitions, you must ensure that the library containing the code is identified before you invoke the compiler. Otherwise, the library is not searched. You identify libraries to be searched using the

GLOBAL command. For example, if you have two MACLIBs that contain your private macros and copy files whose names are TESTMAC MACLIB and TESTCOPY MACLIB, you would issue the command

```
global maclib testmac testcopy
```

The libraries you specify on a GLOBAL command line are searched in the order you specify them. A GLOBAL command remains in effect for the remainder of your terminal session, until you issue another GLOBAL MACLIB command or re-IPL CMS. To find out what macro libraries are currently available for searching, issue the command

```
query maclib
```

You can reset the libraries or the search order by reissuing the GLOBAL command.

THE MACLIB COMMAND

The MACLIB command performs a variety of functions. You use it to:

- Create the MACLIB (GEN function)
- Add, delete, or replace members (ADD, DEL, and REP functions)
- Compress the MACLIB (COMP function)
- List the contents of the MACLIB (MAP function)

Descriptions of these MACLIB command functions follow.

GEN Function: The GEN (generate) function creates a CMS macro library from input files specified on the command line. The input files must have filetypes of either MACRO or COPY. For example:

```
maclib gen osmac access time put regequ
```

creates a macro library with the file identifier OSMAC MACLIB A1 from macros existing in the files with the file identifiers:

ACCESS {MACRO / COPY}, TIME {MACRO / COPY}, PUT {MACRO / COPY}, and REGEQU {MACRO / COPY}

If a file named OSMAC MACLIB A1 already exists, it is erased.

Assume that the files ACCESS MACRO, TIME COPY, PUT MACRO, and REGEQU COPY exist and contain macros in the following form:

```
ACCESS MACRO     TIME COPY        PUT MACRO     REGEQU COPY
------------     ---------        ---------     -----------
   GET           *COPY TTIMER       PUT           XREG
                  TTIMER
   PUT           *COPY STIMER                     YREG
                  STIMER
```

The resulting file, OSMAC MACLIB A1, contains the members:

```
GET       STIMER
PUT       PUT
TTIMER    REGEQU
```

The PUT macro, which appears twice in the input to the command, also appears twice in the output. The MACLIB command does not check for

duplicate macro names. If, at a later time, the PUT macro is requested from OSMAC MACLIB, the first PUT macro encountered in the directory is used.

When COPY files are added to MACLIBs, the name of the library member is taken from the name of the COPY file, or from the *COPY statement, as in the file TIME COPY, above. Note that although the file REGEQU COPY contained two macros, they were both included in the MACLIB with the name REGEQU. When the input file is a MACRO file, the member name(s) are taken from macro prototype statements in the MACRO file.

ADD Function: The ADD function appends new members to an existing macro library. For example, if OSMAC MACLIB A1 exists as created in the example in the explanation of the GEN function and the file DCB COPY exists as follows:

```
*COPY DCB
 DCB macro definition
*COPY DCBD
 DCBD macro definition
```

if you issue the command

```
maclib add osmac dcb
```

the resulting OSMAC MACLIB A1 contains the members:

```
GET       PUT
PUT       REGEQU
TTIMER    DCB
STIMER    DCBD
```

REP Function: The REP (replace) function deletes the directory entry for the macro definition in the files specified. It then appends new macro definitions to the macro library and creates new directory entries. For example, assume that a macro library MYMAC MACLIB contains the members A, B, and C, and that the following command is entered:

```
maclib rep mymac a c
```

The files represented by file identifiers A MACRO and C MACRO each have one macro definition. After execution of the command, MYMAC MACLIB contains members with the same names as before, but the contents of A and C are different.

DEL Function: The DEL (delete) function removes the specified macro name from the macro library directory and compresses the directory so there are no unused entries. The macro definition still occupies space in the library, but since no directory entry exists it cannot be accessed or retrieved. If you attempt to delete a macro for which two macro definitions exist in the macro library, only the first one encountered is deleted. For example:

```
maclib del osmac get put ttimer dcb
```

deletes macro names GET, PUT, TTIMER, and DCB from the directory of the macro library named OSMAC MACLIB. Assume that OSMAC exists as in the ADD function example. After the above command, OSMAC MACLIB contains the following members:

```
STIMER
PUT
REGEQU
DCBD
```

COMP Function: Execution of a MACLIB command with the DEL or REP functions can leave unused space within a macro library. The COMP (compress) function removes any macros that do not have directory entries. This function uses a temporary file named MACLIB CMSUT1. For example, the command:

```
maclib comp mymac
```

compresses the library MYMAC MACLIB.

MAP Function: The MAP function creates a list containing the name of each macro in the directory, the size of the macro, and its position within the macro library. If you want to display a list of the members of a MACLIB at the terminal, enter the command

```
maclib map mylib (term
```

The default option, DISK, creates a file on your A-disk, which has a filetype of MAP and a filename corresponding to the filename of the MACLIB. If you specify the PRINT option, the list is spooled to your virtual printer, as well as being written onto disk.

Manipulating MACLIB Members

The following CMS commands have MEMBER options, which allow you to reference individual members of a MACLIB:

- PRINT (to print a member)
- PUNCH (to punch a member)
- TYPE (to display a member)
- FILEDEF (to establish a file definition for a member)

You can use the CMS Editor to create MACRO and COPY files and then use the MACLIB command to place the files in a library. Once they are in a library, you can erase the original files.

To extract a member from a macro library, you can use either the PUNCH or the MOVEFILE command. If you use the PUNCH command you can spool your virtual card punch to your own virtual reader:

```
cp spool punch to *
```

then punch the member:

```
punch testmac maclib (member get noheader
```

and read it back onto disk:

```
readcard get macro
```

In the above example, the member was punched with the NOHEADER option of the PUNCH command, so that a name could be assigned on the READCARD command line. If a header card had been created for the file, it would have indicated the filename and filetype as GET MEMBER.

If you use the MOVEFILE command, you must issue a file definition for the input member name and the output macro or copy name before entering the MOVEFILE command:

```
filedef inmove disk testcopy maclib (member enter
filedef outmove disk enter copy a
movefile
```

This example copies the member ENTER from the macro library TESTCOPY MACLIB into a CMS file named ENTER COPY.

When you use the PUNCH or MOVEFILE commands to extract members from CMS MACLIBs, each member is followed by a // record, which is a MACLIB delimiter. You can edit the file and use the DELETE subcommand to delete the // record.

System MACLIBs

The macro libraries that are on the system disk contain CMS and OS assembler language macros that you may want to use in your programs:

- CMSLIB MACLIB contains the CMS macros.
- OSMACRO MACLIB contains the OS macros that CMS simulates.
- OSMACRO1 MACLIB contains the macros CMS does not simulate. (You can assemble programs in CMS that contain these macros, but you must execute them in an OS virtual machine.)
- TSOMAC MACLIB contains TSO macros.
- DOSMACRO MACLIB contains macros used in CMS/DOS.

To obtain a list of the macros in any of these libraries, use the MAP function of the MACLIB command.

USING OS MACRO LIBRARIES

If you want to assemble source programs that contain macro statements that are defined in macro libraries on your OS disks, you can use the FILEDEF command to identify them to CMS so that you can name them when you issue the GLOBAL command. For example, the commands

```
filedef cmslib disk temp maclib c dsn test asm macros
global maclib temp
```

allow you to access the macro library TEST.ASM.MACROS on the OS disk accessed as your C-disk.

When you issue a FILEDEF command for an assembler language macro library you must use a ddname of CMSLIB; and you must provide a CMS file identifier for the OS data set. In the example above, the OS macro library TEST.ASM.MACROS is given the CMS file identifier TEMP MACLIB.

If you want to use more than one OS macro library you must issue a FILEDEF command for each library using the ddname CMSLIB and specifying the CONCAT option. For example:

```
filedef cmslib disk asp1 maclib * dsn asp1 macros r1 (concat recfm fb block 3360 lrecl 80
filedef cmslib disk asp2 maclib * dsn asp2 macros r1 (concat
filedef cmslib disk sys1 maclib *
global maclib asp1 asp2 sys1 osmacro cmslib
```

The GLOBAL command establishes the search order of the libraries as: ASP1.MACROS.RL, ASP2.MACROS.RL, SYS1.MACLIB, OSMACRO MACLIB, and CMSLIB MACLIB. Note that the third library specified is entered in an abbreviated form. You can use this form when the data set name of the

macro library has only two qualifiers and the second qualifier is MACLIB; thus, the equivalency is established between SYS1.MACLIB and the CMS file identifier SYS1 MACLIB.

The file format information describes the macro libraries to CMS; when you are concatenating OS macro libraries, they must all be in the same format, since the options entered on the first FILEDEF command are applied to all the libraries.

If you are using only one OS macro library in addition to CMS MACLIBs you can enter either

```
filedef cmslib disk lib1 maclib * dsn sys1 maclib (concat
global maclib lib1 cmslib

     -- or --

filedef cmslib disk lib1 maclib * dsn sys1 maclib
global maclib lib1 cmslib
```

To identify libraries for use with the language processors, you must use the ddname SYSLIB.

Using OS Macros Under CMS

You can assemble and execute programs under CMS that use OS macros. Figure 14 lists the OS macros that CMS simulates. The macros that are are listed as "Effective no-op" and "no-op" are macros that are not supported in CMS; you can assemble programs that contain these macros, but when you execute them in CMS the macro functions are not performed. To execute these programs, you must run them in an OS virtual machine.

For a more detailed description of how CMS simulates the functions of these macros, and to see whether any particular function of a macro is not supported, see the VM/370: System Programmer's Guide.

Assembling Programs in CMS

To assemble assembler language source programs into object module format, you can use the ASSEMBLE command, and specify assembler options on the command line, for example

```
assemble myfile (print
```

assembles a source program named MYFILE ASSEMBLE and directs the output listing to the printer. All of the ASSEMBLE command options are listed in the VM/370: CMS Command and Macro Reference.

When you invoke the ASSEMBLE command specifying a file with the filetype of ASSEMBLE, CMS searches all of your accessed disks, using the standard search order, until it locates the specified file. When the assembler creates its output listing and text deck, it creates files with filetypes of LISTING and TEXT, and writes them onto disk according to the following priorities:

1. If the source file is on a read/write disk, the TEXT and LISTING files are written onto that disk.

Macro	SVC No.	Function
ABEND	13	Terminate processing
ATTACH	42	Effective LINK
BLDL	18	Build a directory list for a PDS
BSP	69	Back up a record on a tape or disk
CHAP	44	Effective no-op
CHECK	-	Verify READ/WRITE macro completion
CHKPT	63	Effective no-op
CLOSE	20	Deactivate a data file
DCB	-	Construct a data control block
DCBD	-	Generate a DSECT for a data control block
DELETE	09	Delete a loaded phase
DEQ	48	Effective no-op
DETACH	62	Effective no-op
DEVTYPE	24	Obtain device-type characteristics
ENQ	56	Effective no-op
EXTRACT	40	Effective no-op
FIND	18	Locate a member of a partitioned data set
FREEDBUF	57	Release a free storage buffer
FREEMAIN	05	Release user-acquired storage
FREEMAIN	10	Manipulate user free storage
FREEPOOL	-	Simulate as SVC 10
GET	-	Read system-blocked data (QSAM)
GETMAIN	04	Conditionally acquire user storage
GETMAIN	10	Manipulate user free storage
GETPOOL	-	Simulate as SVC 10
IDENTIFY	41	Add entry to loader table
LINK	06	Link control to another phase
LOAD	08	Read a phase into storage
NOTE	-	Manage data set positioning
OPEN	19	Activate a data file
OPENJ	22	Activate a data file
POINT	-	Manage data set positioning
POST	02	Post the I/O completion
PUT	-	Write system-blocked data (QSAM)
RDJFCB	64	Obtain information from FILEDEF command
READ	-	Access system-record data
RETURN	-	Return from a subroutine
SAVE	-	Save program registers
SNAP	51	Dump specified areas of storage
SPIE	14	Allow processing program to handle program interrupts
STAE	60	Allow processing program to decipher abend conditions
STAX	96	Create an attention exit block
STIMER	47	Set timer
STOW	21	Manipulate partitioned directories
SYNADAF	-	Provide SYNAD analysis function
SYNADRLS	-	Release SYNADAF message and save areas
TCLEARQ	94	Clear terminal input queue
TCLOSE	23	Temporarily deactivate a data file
TGET/TPUT	93	Read or write a terminal line
TIME	11	Get the time of day
TRKBAL	25	no-op
TTIMER	46	Access or cancel timer
WAIT	01	Wait for an I/O completion
WRITE	-	Write system-record data
WTO/WTOR	35	Communicate with the terminal
XCTL	07	Delete, then link control to another load phase
XDAP	00	Read or write direct access volumes

Figure 14. OS Macros Simulated by CMS

2. If the source file is on a read-only extension of a read/write disk, the TEXT and LISTING files are written onto the parent disk.

3. If the source file is on any other read-only disk, the TEXT and LISTING files are written onto the A-disk.

In all of the above cases, the TEXT and LISTING files have a filename that is the same as the input ASSEMBLE file.

The input and output files used by the assembler are assigned by FILEDEF commands that CMS issues internally when the assembler is invoked. If you issue a FILEDEF command using one of the assembler ddnames before you issue the ASSEMBLE command, you can override the default file definitions.

The ddname for the source input file (SYSIN) is ASSEMBLE. If you enter

```
filedef assemble reader
assemble sample
```

then the assembler reads your input file from your card reader, and assigns the filename SAMPLE to the output TEXT and LISTING files.

You could assemble a source file directly from an OS disk by entering

```
filedef assemble disk myfile assemble b4 dsn os source file
assemble myfile
```

In this example, the CMS file identifier MYFILE ASSEMBLE is assigned to the data set OS.SOURCE.FILE and then assembled.

LISTING and TEXT are the ddnames assigned to the SYSPRINT and SYSLIN output of the assembler. You might assign file definitions to override these defaults as follows:

```
filedef listing disk assemble listfile a
filedef text disk assemble textfile a
assemble source
```

In this example, output from the assembly of the file, SOURCE ASSEMBLE, is written to the files, ASSEMBLE LISTFILE and ASSEMBLE TEXTFILE.

The ddnames PUNCH and CMSLIB are used for SYSPUNCH and SYSLIB data sets. PUNCH output is produced when you use the DECK option of the ASSEMBLE command. The default file definition for CMSLIB is the macro library CMSLIB MACLIB, but you must still issue the GLOBAL command if you want to use it.

Executing Programs

After you have assembled or compiled a source program you can execute the TEXT files that were produced by the assembly or compilation. You may not, however, be able to execute all your OS programs directly in CMS. There are a number of execution-time restrictions placed on your virtual machine by VM/370. You cannot execute a program that uses:

- Multitasking
- More than one partition
- Teleprocessing
- ISAM macros to read or write files

The above is only a partial list, representing those restrictions with which you might be concerned. For a complete list of restrictions, see the VM/370: Planning and System Generation Guide.

EXECUTING TEXT FILES

TEXT files, in CMS, are relocatable, and can be executed simply by loading them into virtual storage with the LOAD command and using the START command to begin execution. For example, if you have assembled a source program named CREATE, you have a file named CREATE TEXT. You can issue the command

```
load create
```

which loads the relocatable object file into storage, and then, to execute it, you can issue the START command:

```
start
```

In the case of a simple program, as in the above example, you can load and begin execution with a single command line, using the START option of the LOAD command:

```
load create (start
```

When you issue the START command or LOAD command with the START option, control is passed to the first entry point in your program. If you have more than one entry point and you want to begin execution at an entry point other than the first, you can specify the alternate entry point or CSECT name on the START command:

```
start create2
```

When you issue the LOAD command specifying the filename of a TEXT file, CMS searches all of your accessed disks for the specified file.

If your program expects a parameter list to be passed (via register 1), you can specify the arguments on the START command line. If you enter arguments, then you must specify the entry point:

```
start * name1
```

When you specify the entry point as an asterisk (*) it indicates that you want to use the default entry point.

Defining Input and Output Files

You can issue the FILEDEF command to define input and output files any time before you begin program execution. You can issue all your file definitions before loading any TEXT files, or issue them during the loading process. You can find out what file definitions are currently in effect by issuing the FILEDEF command with no operands:

```
filedef
```

You can also use the FILEDEF operand of the QUERY command.

TEXT LIBRARIES (TXTLIBS)

You may want to keep your TEXT files in text libraries, that have a filetype of TXTLIB. Like MACLIBs, TXTLIBs have a directory and members. TXTLIBs are created and modified by the TXTLIB command, which has functions similar to the MACLIB command:

- The GEN function creates the TXTLIB.
- The ADD function adds members to the TXTLIB.
- The DEL function deletes members and compresses the TXTLIB.
- The MAP function lists members.

There is no REP function; you must use a DEL followed by an ADD to replace an existing member. The CMS commands that recognize MACLIBs as special filetypes also recognize TXTLIBs, and allow you to display, print, or punch TXTLIB members.

The TXTLIB command reads the object files as it writes them into the library, and creates a directory entry for each entry point or CSECT name. If you have a TEXT file named MYPROG, which has a single routine named BEGIN, and create the TXTLIB named TESTLIB as follows:

```
txtlib gen testlib myprog
```

TESTLIB contains no entry for the name MYPROG; you must specify the membername BEGIN to reference this TXTLIB member.

When you want to load members of TXTLIBs into storage to execute them (just as you execute TEXT files), you must issue the GLOBAL command to identify the TXTLIB:

```
global txtlib testlib
load begin (start
```

When you specify more than one TXTLIB on the GLOBAL command line, the order of search is established for the TXTLIBs. However, if the AUTO option is in effect (it is the default), CMS searches for TEXT files before searching active TXTLIBs.

When the TXTLIB command processes a TEXT file, it writes an LDT (loader terminate) card at the end of the TEXT file, so that when a load request is issued for a TXTLIB member, loading terminates at the end of the member. If you add OS linkage editor control statements to the TEXT file (using the CMS Editor) before you issue the TXTLIB command to add the file to a TXTLIB, the control statements are processed as follows:

NAME: A NAME statement causes the TXTLIB command to create the directory entry for the member using the specified name. Thereafter, when you want to load that member into storage or delete it from the TXTLIB you must refer to it by the name specified on the NAME statement.

ENTRY: If you use an ENTRY statement, the entry point you specify is validated and checked for a duplicate. If the entry point name is valid and there are no duplicates in the TEXT file, the entry name is written in the LDT card. Otherwise, an error message is issued. When this member is loaded, execution begins at the entry point specified. (See "Determining Program Entry Points," below.)

ALIAS: An entry is created in the directory for the ALIAS name you specify. A maximum of 16 alias names can be used in a single text deck. You may load the single member and execute it by referring to the alias name, but you cannot use the alias name as the object of V-type address constant (VCON), because the address of the member cannot be resolved.

SETSSI: Information you specify on the SETSSI card is written in bytes 26 through 33 of the LDT card.

All other OS linkage editor control statements are ignored by the TXTLIB command and written into the TXTLIB member. When you attempt to load the member, the CMS loader flags these cards as invalid.

RESOLVING EXTERNAL REFERENCES

There is no real linkage editor in CMS; the link-edit function, that of locating external references and loading additional object modules into storage, is performed by the CMS loader. The CMS loader loads files into storage as a result of a LOAD or INCLUDE command, or when you issue a dynamic load request from a program (using the OS macros LOAD, LINK, or XCTL).

When a file is loaded, the loader checks for unresolved references; if there are any, the loader searches your disks for TEXT files with filenames that match the external entry name. When it finds a match, it loads the TEXT file into storage. If a TEXT file is not found, the loader searches any available TXTLIBs for members that match, and loads them when it does.

If there are still unresolved references, for example, if you load a program that calls routines PRINT and ANALYZE but the loader cannot locate them, you receive the message:

```
THE FOLLOWING NAMES ARE UNDEFINED:
 PRINT
 ANALYZE
```

You can issue the INCLUDE command to load additional TEXT files or TXTLIB members into storage so the loader can resolve any remaining references. For example, if you did not identify the TXTLIB that contains the routines you want to call, you may enter the GLOBAL command followed by the INCLUDE command:

```
global txtlib newlib
include print analyze (start
```

This situation might also occur if you have TEXT files with filenames that are different from the CSECT names; you must explicitly issue LOAD and INCLUDE commands for these files.

At execution time, if there are still any unresolved references, their addresses are all set to 0 by the loader, so any attempt to address them in a program may result in a program check.

The LOAD and INCLUDE Commands

The INCLUDE command has the same format and option list (with one exception) as the LOAD command. The main difference is that when you issue the INCLUDE command the loader tables are not reset; if you issue two LOAD commands in succession, the second LOAD command cancels the effect of the first, and the pointers to the files loaded are lost.

Conversely, the INCLUDE command, which you must issue when you want to load additional files into storage, should not be used unless you have just issued a LOAD command. You may specify as many INCLUDE

commands as necessary following a LOAD command to load files into storage.

CONTROLLING THE CMS LOADER

The LOAD and INCLUDE commands allow you to specify a number of options. You can:

- Change the entry point to which control is to be passed when execution begins (RESET option).
- Specify the location in virtual storage at which you want the files to be loaded (ORIGIN option).
- Control how CMS resolves references and handles duplicate CSECT names (AUTO, LIB, and DUP options).
- Clear storage to binary zeros before loading files (CLEAR option).

When the LOAD and INCLUDE commands execute, they produce a load map, indicating the entry points loaded and their virtual storage locations. You may find this load map useful in debugging your programs. If you do not specify the NOMAP option, the load map is written onto your A-disk, in a file named LOAD MAP A5. Each time you issue the LOAD command, the old file LOAD MAP is erased and the new load map replaces it. If you do not want to produce a load map, specify the NOMAP option.

You can find details about these, and other options under the discussion of the LOAD command in VM/370: CMS Command and Macro Reference.

Loader Control Statements

In addition to the options provided with the LOAD and INCLUDE commands that assist you in controlling the execution of TEXT files, you can also use loader control statements. These can be inserted in TEXT files, using the CMS Editor. The loader control statements allow you to:

- Set the location counter to specify the address at which the next TEXT file is to be loaded (SLC statement).
- Modify instructions and constants in a TEXT file, and change the length of the TEXT file to accomodate modifications (Replace and Include Control Section statements).
- Change the entry point (ENTRY statement).
- Nullify an external reference so that it does not receive control when it is called, and you do not receive an error message when it is encountered (LIBRARY statement).

These statements are also described under the LOAD command in VM/370: CMS Command and Macro Reference.

Determining Program Entry Points

When you load a single TEXT file or a TXTLIB member into storage for execution, the default entry point is the first CSECT name in the object file loaded. You can specify a different entry point at which to start execution either on the LOAD (or INCLUDE) command line with the RESET option:

```
load myprog (reset beta
```

where BETA is the alternate entry point of your program, or you can specify the entry point on the START command line:

```
start beta
```

When you load multiple TEXT files (either explicitly or implicitly, by allowing the loader to resolve external references), you also have the option of specifying the entry point on the LOAD, INCLUDE, or START command lines.

If you do not specifically name an entry point, the loader determines the entry point for you, according to the following hierarchy:

1. An entry point specified on the START command
2. The last entry specified with the RESET option on a LOAD or INCLUDE command
3. The name on the last ENTRY statement that was read
4. The name on the last LDT statement that contained an entry name that was read
5. The name on the first assembler- or compiler-produced END statement that was read
6. The first byte of the first control section loaded

For example, if you load a series of TEXT files that contain no control statements, and do not specify an entry point on the LOAD, INCLUDE, or START commands, execution begins with the first file that you loaded. If you want to control the execution of program subroutines, you should be aware of this hierarchy when you load programs or when you place them in TXTLIBs.

An area of particular concern is when you issue a dynamic load (with the OS LINK, LOAD, or XCTL macros) from a program, and you call members of CMS TXTLIBs. The CMS loader determines the entry point of the called program, and returns the entry point to your program. If a TXTLIB member that you load has a VCON to another TXTLIB member, the LDT card from the second member may be the last LDT card read by the loader. If this LDT card specifies the name of the second member, then CMS may return that entry point address to your program, rather than the address of the first member.

CREATING PROGRAM MODULES

When your programs are debugged and tested, you can use the LOAD and INCLUDE commands, in conjunction with the GENMOD command, to create program modules. A module is a nonrelocatable file whose external

references have been resolved. In CMS, these files must have a filetype of MODULE.

To create a program module, load the TEXT files or TXTLIB members into storage and issue the GENMOD command:

```
load create analyze print
genmod process
```

In this example, PROCESS is the filename you are assigning the module; it will have a filetype of MODULE. You could use any name; if you use the name of an existing MODULE file, the old one is replaced.

To execute the program composed of the source files CREATE, ANALYZE, and PRINT, enter:

```
process
```

If PROCESS requires input and/or output files, you will have to define these files before PROCESS can execute properly; if PROCESS expects arguments passed to it, you can enter them following the MODULE name, for example

```
process test1
```

For more information on creating program modules, see "Section 13. Programming for the CMS Environment."

USING EXEC PROCEDURES

During your program development and testing cycle, you may want to create EXEC procedures to contain sequences of CMS commands that you execute frequently. For example, if you need a number of MACLIBs, TXTLIBs, and file definitions to execute a particular program, you might have an EXEC procedure as follows:

```
&CONTROL ERROR TIME
&ERROR &EXIT &RETCODE
GLOBAL MACLIB TESTLIB OSMACRO OSMACRO1
ASSEMBLE TESTA
PRINT TESTA LISTING
GLOBAL TXTLIB TESTLIB PROGLIB
ACCESS 200 E
&BEGSTACK
OS.TEST3.STREAM.BETA
&END
FILEDEF INDD1 E DSN ?
FILEDEF INDD2 READER
FILEDEF OUTFILE DISK TEST DATA A1
LOAD TESTA (START
&IF &RETCODE = 100 &GOTO -RET100
&IF &RETCODE = 200 &GOTO -RET200
&EXIT &RETCODE
-RET100 &CONTINUE
   .
   .
   .
-RET200 &CONTINUE
   .
   .
   .
```

The &CONTROL and &ERROR control statements in the EXEC procedure ensure that if an error occurs during any part of the EXEC, the remainder of the EXEC does not execute, and the execution summary of the EXEC indicates the command that caused the error.

Note that for the FILEDEF command entered with the DSN ? operand, you must stack the response before issuing the FILEDEF command. In this example, since the OS data set name has more than 8 characters, you must use the &BEGSTACK control statement to stack it. If you use the &STACK control statement, the EXEC processor truncates all words to 8 characters.

When your program is finished executing, the EXEC special variable &RETCODE indicates the contents of general register 15 at the time the program exited. You can use this value to perform additional steps in your EXEC procedure. Additional steps are indicated in the preceding example by ellipses.

For detailed information on creating EXEC procedures, see "Part 3. Learning to Use EXEC."

Section 9. Developing DOS Programs Under CMS

You can use CMS to create, compile, execute and debug DOS programs written in assembler, COBOL, or PL/I programming languages. CMS simulates many DOS/VS functions so that you can use the interactive facilities of VM/370 to develop your programs, and then execute them in a DOS virtual machine.

Section 9 tells you how to use the CMS/DOS environment, and describes the CMS commands you can use to manipulate DOS disks and DOS files and CMS/DOS commands you can use to simulate the functions of the Disk Operating System (DOS/VS):

- The CMS/DOS environment
- Using DOS files on DOS disks
- Using the ASSGN command
- Using the DLBL command
- Using DOS libraries in CMS/DOS
- Using macro libraries
- DOS assembler language macros supported
- Assembling source programs
- Link-editing programs in CMS/DOS
- Executing programs in CMS/DOS

For a practice terminal session using the commands and techniques presented in this section, see "Appendix D: Sample Terminal Sessions."

A Word About Terminology

CMS/DOS is neither CMS nor is it DOS; it is a composite, and its vocabulary contains both CMS and DOS terms. CMS/DOS performs many of the same functions as DOS, but where, under DOS, a function is initiated by a control card, in CMS it is initiated by a command. Many CMS/DOS commands, therefore, have the same names as the DOS control statement that performs the same function. In those cases where the control statement you would use in DOS and the command you use in CMS are different, the differences are explained. For the most part, whenever a term that is familiar to you as a DOS term is used, it has the same meaning to CMS/DOS, unless otherwise indicated.

The CMS/DOS Environment

After you have loaded CMS into your virtual machine you can enter the CMS/DOS environment by issuing

```
set dos on
```

If you want to access a DOS system residence volume during your CMS/DOS terminal session, you should link to and access the disk that contains the DOS SYSRES before you issue the SET command. For example, if you share the system residence volume with other users and it is in your directory at virtual address 390, you would issue the command

```
access 390 g
```

and then issue the SET command as follows:

```
set dos on g
```

to indicate that the SYSRES is located on your G-disk. If you are going to use the CMS/DOS librarian facilities to access any of the libraries on the system residence volume, you must enter the CMS/DOS environment this way.

If you are using CMS exclusively for DOS applications, you could put the ACCESS and SET DOS ON commands in your PROFILE EXEC.

If you are going to use Access Method Services functions in CMS/DOS, or execute functions that read or write VSAM data sets, you must use the VSAM option of the SET DOS ON command:

```
set dos on g (vsam
```

When you are using CMS/DOS, you can use your virtual machine just as you would if you were in the CMS environment; but you cannot execute any CMS commands or program modules that load and/or use OS macros. The SCRIPT command, for example, uses OS macros, and is therefore invalid in the CMS/DOS environment.

You have, however, in addition to the CP and CMS commands available, a series of commands that simulate DOS/VS functions. Except for the DLBL and DOSLIB commands, these commands or operands should only be issued in the CMS/DOS environment.

The CMS/DOS commands are summarized in Figure 15.

Using DOS Files on DOS Disks

You can have DOS disks attached to your virtual machine by a directory entry or you can link to a DOS disk with the LINK command. You can use the ACCESS command to assign a mode letter to the disk:

```
access 155 b
```

and the RELEASE command to release it:

```
release b
```

Except for VSAM disks, you cannot write on DOS disks, or update DOS files on them. You can, however, execute programs and CMS/DOS commands that read from these files, and you can use the LISTDS command to display the file-ids of files on a DOS disk, for example:

```
listds b
```

You can also verify the existence of a particular file. For example, if the file-id is NEW.TEST.DATA you can enter

```
listds new test data b
```

You can use this form only if the file-id has 1- to 8-character qualifiers separated by blanks. If the file-id of the DOS file you want to verify contains embedded blanks, for example NEW.TEST DATA, then you have to enter the LISTDS commands with a question mark:

```
listds ? b
```

CMS responds

```
ENTER DATA SET NAME:
```

Command	Function
ASSGN	Relates system and programmer logical units to physical devices.
DLBL	Relates a program ddname (filename) to a real disk file so you can perform input/output operations on it.
DOSLIB	Lists or deletes phases from a CMS/DOS phase library, or compresses the library.
DOSLKED	Link-edits CMS TEXT files or DOS phases from system or private relocatable libraries.
DSERV	Displays the directories of DOS libraries.
DOSPLI	An EXEC procedure that invokes the DOS/VS PL/I compiler.
ESERV	An EXEC procedure that invokes the ESERV utility functions on edited assembler language macros.
FCOBOL	An EXEC procedure that invokes the DOS/VS COBOL compiler.
FETCH	Loads executable phases from a DOSLIB or DOS library into storage for execution, and optionally starts execution.
GLOBAL	When you want DOSLIBs searched for executable phases or macro libraries searched for macro definitions, you must identify them with the GLOBAL command.
LISTIO	Displays the current assignments of system and programmer logical units, and optionally creates an EXEC file to contain the information.
OPTION	Sets or changes the options in effect for the DOS/VS COBOL compiler.
QUERY	Use QUERY command operands to list current DLBL defintions (QUERY DLBL), to determine whether or not you are in the CMS/DOS environment (QUERY DOS), the setting of the UPSI byte (QUERY UPSI), the DOSLIBs identified by GLOBAL commands (QUERY DOSLIB or QUERY LIBRARY), which options are in effect for the COBOL compiler (QUERY OPTION), or to find out whether you have set a virtual partition size (QUERY DOSPART).
PSERV	Creates CMS files with a filetype of PROC from the DOS/VS procedure library, or displays, prints or punches procedures.
RSERV	Copies a relocatable module from a DOS library and places it in a CMS file with a filetype of TEXT, or displays, prints, or punches modules.
SET	The SET command has operands that allow you to enter or leave the CMS/DOS environment (SET DOS ON or SET DOS OFF), to set the UPSI byte (SET UPSI), and to set a virtual partition size (SET DOSPART).
SSERV	Creates CMS COPY files from books on DOS source statement libraries.

Figure 15. CMS/DOS Commands and CMS Commands with Special Operands for CMS/DOS

and you can enter the exact file-id:

```
new.test data
```

If the data set exists, you receive a response

```
FM DATA SET NAME
B  NEW.TEST DATA
```

READING DOS FILES

Under CMS/DOS, you can execute programs that read DOS sequential (SAM) files; you can also execute programs that read and write VSAM files. You cannot, however, execute programs to read direct (DAM) or indexed sequential (ISAM) DOS files.

Complete information on using CMS to access and manipulate VSAM files is described in "Section 10. Using Access Method Services and VSAM In CMS and CMS/DOS." The discussion below lists the restrictions placed on reading SAM files.

Restrictions on Reading DOS Disk Files in CMS

CMS cannot read DOS files that:

- Have the input security indicator on.
- Contain more than 16 user label and/or data extents. (If the file has user labels, they occupy the first extent; therefore the file must contain no more than 15 data extents.)
- Multivolume files are read as single-volume files. End-of-volume is treated as end-of-file. There is no end-of-volume switching.
- User labels in user-labeled files are bypassed.

CMS does not support duplicate volume labels; you cannot access more than one volume with the same 6-character label while you are using CMS/DOS.

CREATING CMS FILES FROM DOS LIBRARIES

You can create CMS files from existing DOS files on DOS disks. CMS simulates the DOS librarian functions DSERV, RSERV, SSERV, ESERV, and PSERV with commands of the same names; you can use these CMS/DOS commands to create CMS files from relocatable, source statement, or procedure libraries located either on the DOS system residence volume or in private libraries. The functions are fully described later in this section.

Copying DOS Disk and Tape Data Files

If you want to create CMS files from DOS files that are not cataloged in libraries, or from DOS files on tape, you can use the MOVEFILE command. The MOVEFILE command allows you to copy a file from one device to another device of the same or a different type. Before issuing the MOVEFILE command, the input and the output files must be described to CMS with the FILEDEF command.

The MOVEFILE and FILEDEF commands are described and examples are given of how to use them in "Section 8. Developing OS Program Under CMS." The procedures are the same for copying DOS files as for OS data sets. You must however, keep the following in mind:

- Since DOS files on DOS disks do not contain BLKSIZE, RECFM, or LRECL options, these options must be specified via the FILEDEF command; otherwise, defaults of BLOCKSIZE=32760 and RECFM=U are assigned. LRECL is not used for RECFM=U files.
- If a DOS file-id does not follow OS naming conventions (that is, 1- to 8-byte qualifiers with each qualifier separated by a period; up to 44 characters including periods), you must use the DSN ? operand of FILEDEF and the ? operand of LISTDS to enter the DOS file-id.

Reading in Real Card Decks

If you have DOS files or source programs on cards, you can create CMS files directly by having these cards read into the real system card reader. You direct the cards to your virtual machine by punching a CP ID card in this format:

```
ID HARMONY
```

and placing this card in front of your card deck. When the cards appear in your virtual card reader, you can read them onto your CMS A-disk with the READCARD command:

```
readcard dataproc assemble
```

You can use the editor to remove any DOS control cards that may be included in the deck.

Using Tapes in CMS/DOS

CMS/DOS does not process tape labels. In general, CMS/DOS either bypasses labels on input tapes or passes control to a user routine to process header labels on input tapes. CMS/DOS processes all output tapes as tapes with no labels. Trailer labels are not supported for input tapes or output tapes.

CMS/DOS passes control to user label routines, if there are any, for input tapes with standard or nonstandard labels.

If a tape which is opened as an output tape already has a header label (standard or nonstandard), CMS/DOS writes over that label when it writes data to the tape.

There is no equivalent in CMS/DOS to the DOS/VS TLBL control statement. The TLBL label function is not required in CMS/DOS.

Using the ASSGN Command

The ASSGN and DLBL commands perform the same functions for CMS/DOS as the ASSGN and DLBL control statements in DOS/VS. You use the ASSGN command to designate an I/O device for a system or programmer logical unit (SYSxxx) and, if the device is a disk device, you can use the DLBL command to establish a real file identification for a symbolic filename in a program. The DLBL command is described under "Using the DLBL Command."

In addition to using the ASSGN command to relate real I/O devices with symbolic units, you must use it in CMS/DOS to:

- Assign SYSIN or SYSIPT for the input source file for a language compiler when you use the DOSPLI or FCOBOL commands.
- Identify the disk, by mode letter, on which a private core image, relocatable, or source statement library resides.
- Assign SYSIN or SYSIPT to the CMS disk on which an ESERV file, containing control statements for the ESERV program, resides.

When you enter the ASSGN command, you must supply the logical unit and the device, for example

```
assgn sys100 printer
```

assigns the logical unit SYS100 to the printer. When you want to make an assignment to a disk device, you must specify the mode letter at which the disk is accessed. The command

```
assgn sys010 b
```

assigns the logical unit SYS010 to your B-disk.

The system logical units you can assign and the valid device types you can assign to them in CMS/DOS follow.

SYSIPT, SYSRDR, SYSIN: These units can be assigned to disk (mode), TAPE, or READER. If you make an assignment to SYSIN, both SYSRDR and SYSIPT are also assigned the same device.

SYSLST: The system logical unit for listings can be assigned to disk (mode), PRINTER, or TAPE.

SYSLOG: Terminal or operator output or messages can be assigned to PRINTER or TERMINAL. CMS/DOS always assigns SYSLOG to TERMINAL by default, so you never have to make this assignment except when you want to alter it.

SYSPCH: Punched output, for example text decks, can be assigned to PUNCH, disk (mode), or TAPE.

SYSCLB, SYSRLB, SYSSLB: The system logical units SYSCLB, SYSRLB, and SYSSLB can be assigned to private core image, relocatable, and source statement libraries, respectively. The only valid assignments for these units is to disk (mode). If you want to reference private libraries with the DSERV, ESERV, FETCH, SSERV, or RSERV commands, you must assign SYSCLB, SYSRLB, or SYSSLB to the disks on which the libraries reside.

Programmer Logical Units

You can assign programmer logical units SYS000 through SYS241 with the ASSGN command. This deviates from DOS/VS, where the number of programmer logical units varies according to the number of partitions.

MANIPULATING DEVICE ASSIGNMENTS

Besides assigning I/O devices, the ASSGN command can also negate a previous assignment:

```
assgn syspch ua
```

or specify that, for a given device, no real I/O operation is to be performed during the execution of a program:

```
assgn sys009 ign
```

When you release a disk from your virtual machine, any assignments made to that disk are unassigned.

You can find out the current assignments for system and programmer logical units with the LISTIO command, which lists all the system or programmer logical units, even those that are unassigned:

```
listio
```

To list only currently assigned units, enter

```
listio a
```

To find out the current assignment of one specific unit, for example SYS100, enter

```
listio sys100
```

With the EXEC option of the LISTIO command, you can create a disk file containing the list of assignments. The $LISTIO EXEC that is created contains two EXEC numeric variables, &1 and &2, for each unit listed. For example, if you entered the command

```
listio sys081 (exec
```

then the file $LISTIO EXEC may contain the record

```
 &1 &2 SYS081 PRINTER
```

When you use the STAT option, LISTIO lists, for disk devices, whether the disk is read-only or read/write, for example

```
listio sys100
SYS100 B   R/W
```

indicates that SYS100 is assigned to the B-disk, which is a read/write disk.

You can cancel all current assignments by leaving the CMS/DOS environment and then re-entering it:

```
set dos off
set dos on
```

VIRTUAL MACHINE ASSIGNMENTS

When you assign a physical device type to a system or programmer logical unit, CMS relates the device to your virtual machine configuration; you receive an error message if you try to assign a logical unit to a device not in your configuration. For example, if you are using the ASSGN command to assign a logical unit to a disk file, you must specify the access mode letter of the disk. If the disk is not accessed, the ASSGN command fails.

For another example, if you issue

```
assgn syspch punch
```

the punch specified is your own virtual machine card punch. The actual destination of punched output then depends on the spooling characteristics of the punch; if it is spooled to another user or to *, then no real cards are punched, but virtual card images are placed in the virtual reader of the destination userid, which may be another virtual machine or your own.

CMS supports only one reader, one punch, and one printer; you cannot make any assignments for multiple output devices in CMS/DOS. When you make an assignment for a logical unit that has already been assigned, it replaces the current assignment.

Using the DLBL Command

Use the DLBL command to supply CMS/DOS with specific file identification information for a disk file that is going to be used for input or output. For any DLBL command you issue, you must previously have issued an ASSGN command for the disk, specifying a system or programmer logical unit. The basic relationship is:

```
assgn SYSxxx mode
dlbl filename mode DSN ? (SYSxxx
```

Both the SYSxxx and the mode values must match on the ASSGN and DLBL commands; the disk on which the file resides must be accessed at mode.

The filename on the DLBL command line, called a ddname in CMS/DOS, corresponds to the symbolic name for a file in a program. If you want to reference a private DOS library, you must use one of the following ddnames:

System Logical Unit	Filename
SYSCLB	IJSYSCL
SYSRLB	IJSYSRL
SYSSLB	IJSYSSL

ENTERING FILE IDENTIFICATIONS

When you issue the DLBL command you must identify the file, by file-id (for a DOS file) or by file identifier (for a CMS file). The keywords DSN and CMS indicate whether it is a DOS file or a CMS file, respectively.

If the file is a DOS file residing on a DOS disk, you can enter the DLBL command in one of two ways. For example, for a file named TEST.INPUT you could enter either:

```
assgn sys101 d
dlbl infile d dsn test input (sys101

-- or --

assgn sys101 d
dlbl infile d dsn ? (sys101
ENTER DATA SET NAME:
test.input
```

For any DOS file with a file-id that contains embedded blanks or hyphens, you must use the "DSN ?" form.

When you issue a DLBL command for a CMS file, you enter the filename and filetype following the keyword CMS:

```
assgn sys102 a
dlbl outfile a cms new output (sys102
```

In this example, if SYS102 is defined as an output file for a program, the output is written to your CMS A-disk in a file named NEW OUTPUT.

You can, for convenience, use a CMS default file identifier. If you enter

```
dlbl outfile a cms (sys102
```

then the output filetype defaults to that of the ddname and the filename to FILE. So, this output file is named FILE OUTFILE.

Clearing and Displaying File Definitions

You can clear a DLBL definition for a file by using the CLEAR operand of the DLBL command:

```
dlbl outfile clear
```

To clear all existing definitions, except those entered with the PERM option, you can enter

```
dlbl * clear
```

This command is issued by the assembler and the language processors when they complete execution. Definitions entered with the PERM option must be individually cleared.

Whenever you use the HX Immediate command to halt the execution of a program, the DLBL definitions in effect are cleared, including those entered with the PERM option.

You can find out what definitions are currently in effect by issuing the DLBL command with no operands:

```
dlbl
```

or, you can use the QUERY command with the DLBL operand.

Using DOS Libraries in CMS/DOS

CMS/DOS provides you with the capability of using various types of files from DOS system or private libraries. You can copy, punch, display at the terminal, or print:

- Books from system or private source statement libraries using the SSERV command.
- Relocatable modules from system or private relocatable libraries using the RSERV command.
- Procedures from the system procedure library using the PSERV command.

You can also:

- Copy and de-edit macros from system and private E sublibraries using the ESERV command.
- Access the directories of system or private libraries using the DSERV command.
- Link-edit relocatable modules from system or private relocatable libraries with the DOSLKED command.
- Read core image phases from system or private core image libraries into storage for execution using the FETCH command.

THE SSERV COMMAND

If you have cataloged source programs or copy files on the system source statement library and you want to use CMS to modify and test them, you can copy them into CMS files using the SSERV command. For example, suppose you want to copy a book named PROCESS from the A sublibrary on the system residence volume. The DOS system residence is in your virtual machine configuration at virtual address 350, and you have accessed it as your F-disk. First, to indicate to CMS/DOS that the system residence is on your F-disk, you enter

```
set dos on f
```

then you can enter the SSERV command, specifying the sublibrary identification and the book name:

```
sserv a process
```

This creates, from the A sublibrary, a file named PROCESS COPY and places it on your A-disk. If the book contained assembler language source statements you would want the filetype to be ASSEMBLE, so you may enter

```
sserv a process assemble
```

If you want to copy a book from a private source statement library, you must first use the ASSGN and DLBL commands to make the library known to CMS/DOS. For example, to obtain a copy file from a private library on a DOS disk accessed as your D-disk, enter:

```
assgn syssslb d
dlbl ijsyssl d dsn ? (syssslb
ENTER DATA SET NAME:
program.test library
```

Now, when you enter the SSERV command

```
sserv t setup copy
```

the book named SETUP in the T sublibrary of PROGRAM.TEST LIBRARY is copied into a CMS file named SETUP COPY.

THE RSERV COMMAND

In CMS/DOS, to manipulate relocatable modules that have been cataloged either on the system or a private relocatable library you must first copy them into CMS files with the RSERV command. You can link-edit modules directly from DOS relocatable libraries, but if you want to add or modify linkage editor control statements for a module, you must place the control statements in a CMS file.

If you are copying a relocatable module from the system relocatable library, then you should make sure that you have indicated the system residence disk when you entered the CMS/DOS environment:

```
set dos on f
```

then you can issue the RSERV command specifying the name of the relocatable module you want to copy:

```
rserv rtna
```

The execution of this command results in the creation of a CMS file named RTNA TEXT on your A-disk.

If you want to copy a relocatable module from a private relocatable library, you must first use the ASSGN and DLBL commands to make the private library known to CMS/DOS:

```
assgn sysrlb d
dlbl ijsysrl d dsn reloc lib (sysrlb
```

Then, issue the RSERV command for a specific module in that library:

```
rserv testrtna
```

to create the CMS file TESTRTNA TEXT from the module named TESTRTNA.

THE PSERV COMMAND

If you want to copy DOS cataloged procedures into CMS files to use, for example, in preparing job streams for a DOS/VS virtual machine, you can use the PSERV command:

```
pserv prepjob
```

This command creates a CMS file on your A-disk; the file is named PREPJOB PROC. To copy a procedure from the procedure library you must

have entered the CMS/DOS environment specifying a disk mode for the system residence volume.

You cannot execute DOS/VS procedures directly from the CMS/DOS environment. However, if you modify a procedure, you can punch it to a virtual machine that is running a DOS/VS system, and execute it there.

THE ESERV COMMAND

The CMS/DOS ESERV command is actually an EXEC procedure that calls the DOS/VS ESERV utility program. To use the ESERV program, you first must use the CMS Editor to create a file with a filetype of ESERV that contains the ESERV control statements you want to execute. For example, if you want to write a de-edited copy of the macro DTFCD onto your A-disk, you might create a file named DTFCD ESERV, with the record:

```
PUNCH E.DTFCD
```

As when you submit ESERV jobs in DOS/VS, column 1 must be blank.

Then, you must assign SYSIN to the device on which the ESERV source file resides, usually your A-disk:

```
assgn sysin a
```

Then you can enter the ESERV command specifying the filename of the ESERV file:

```
eserv dtfcd
```

No other ASSGN commands are required; the CMS/DOS ESERV EXEC makes default assignments for SYSPCH and SYSLST to disk.

To copy and de-edit macros from a private E sublibrary, you must first issue the ASSGN and DLBL commands to identify the library, for example

```
assgn syssslb c
dlbl ijsyssl c dsn test macros (syssslb
```

The SYSLST output is contained in a CMS file with the same filename as the ESERV file and a filetype of LISTING; you must examine the LISTING file to see if the ESERV program executed successfully. You can either edit it (using the CMS Editor), or display its contents with the TYPE command:

```
type dtfcd listing
```

The SYSPCH output is contained in a file with the same name as the ESERV file and a filetype of MACRO. If you want to punch ESERV output to your virtual card punch, make an assignment of SYSPCH to PUNCH.

When you use the PUNCH or DSPCH ESERV control statements, CATAL.S, END, or /* records may be inserted in the output file. When you use the MACLIB command to add the MACRO file to a CMS macro library, these statements are ignored.

See "Using Macro Libraries" for information on creating and manipulating CMS macro libraries.

THE DSERV COMMAND

You can use the DSERV command to examine the contents of system or private libraries. If you do not specify any options with it, the DSERV command creates a disk file, named DSERV MAP, on your A-disk. You can use the PRINT or TERM options to specify that the directory list is either to be printed on your spooled printer or displayed at your terminal. You can also use the SORT option to create a list in collating sequence.

In order to examine a system directory, you must have entered the CMS/DOS environment specifying the mode letter of the DOS system residence:

```
set dos on f
```

If you want to examine the directory of a private source statement, core image, or relocatable library you must issue the ASSGN and DLBL commands establishing SYSSLB, SYSCLB, or SYSRLB, before using the DSERV command.

For example, to display at your terminal an alphameric list of procedures cataloged on the system procedure library, you would issue

```
dserv pd (sort term
```

If the directory you are examining is for a core image library, you can specify a particular phase name to ascertain the existence of the phase:

```
dserv cd phase $$bopen (term
```

To list the directory of a private source statement library, you would first issue the ASSGN and DLBL commands:

```
assgn syssslb b
dlbl ijsyssl b dsn test source (syssslb
```

then enter the DSERV command

```
dserv sd
```

The CMS file, DSERV MAP A, that is created in this example contains the directory of the private source statement library TEST.SOURCE.

USING DOS CORE IMAGE LIBRARIES

You can load core image phases from DOS core image libraries into virtual storage and execute them under CMS/DOS. Since CMS cannot write directly to DOS disks, linkage editor output under CMS/DOS is placed in a special CMS file called a DOSLIB. When you execute the FETCH command in CMS/DOS you can load phases from either system or private DOS core image libraries as well as from CMS DOSLIBs. More information on using the FETCH command is contained under "Executing Programs in CMS/DOS."

Using Macro Libraries

DOS/VS macro libraries cannot be accessed directly by the VM/370 assembler. If you want to assemble DOS programs in CMS/DOS that use DOS macro or copy files that are on the system or a private macro library you must first create a CMS macro library (MACLIB) containing the macros you wish to use. Since the process of creating a CMS MACLIB from the DOS system source statement library (E sublibrary) can be very time-consuming, you should check with your installation's system programmer to see if it has already been done, and to verify the filename of the macro library, so that you can use it in CMS/DOS.

Note: The DOS/VS PL/I and DOS/VS COBOL compilers executing in CMS/DOS cannot read macro or copy files from CMS MACLIBs.

If you want to extract DOS system macros to modify them for your private use, or if you want to use macros from a private library in CMS, you must use the procedure outlined below to create the MACLIB files.

CMS MACLIBS

A CMS macro library has a filetype of MACLIB. You can create a MACLIB from files with filetypes of MACRO or COPY. A MACRO file may contain macro definitions; COPY files contain predefined source statements.

When you want to assemble a source program that uses macro or copy definitions, you must ensure that the library containing the code is identified before you invoke the assembler. Otherwise, the library is not searched. You identify libraries to be searched using the GLOBAL command. For example, if you have two MACLIBs that contain your private macros and copy files whose names are TESTMAC MACLIB and TESTCOPY MACLIB, you would issue the command

```
global maclib testmac testcopy
```

The libraries you specify on a GLOBAL command line are searched in the order you specify them. A GLOBAL command remains in effect for the remainder of your terminal session, or until you IPL CMS. To find out what macro libraries are currently available for searching, issue the command

```
query maclib
```

You can reset the libraries or the search order by reissuing the GLOBAL command.

CREATING A CMS MACLIB

To create a CMS macro library, each macro or copy file you want included in the MACLIB must first be contained in a CMS file with a filetype of COPY or MACRO. If you are creating a CMS MACLIB file from a DOS library you must use the SSERV command to copy a file from any source statement library other than an E sublibrary, or use the ESERV command to copy and de-edit a macro from an E sublibrary. The SSERV command uses a default filetype of COPY; the ESERV command uses a default filetype of MACRO.

The following example shows how to copy macros from various sources and shows how to create and use the CMS MACLIB that contains these macros.

1. Enter the CMS/DOS environment with the DOS system residence on a disk accessed as mode C:

```
set dos on c
```

2. Copy the macro book named OPEN from the A sublibrary of the system source statement library:

```
sserv a open
```

3. Establish a private source statement library:

```
access 351 d
assgn syssl b d
dlbl ijsyssl d dsn ? (syssl b
test source.lib
```

4. Issue the SSERV command for a macro in the M sublibrary of TEST SOURCE.LIB:

```
sserv m releas
```

5. Create an ESERV file to copy from the E sublibrary:

```
edit contrl eserv
NEW FILE
EDIT:
input    punch contrl
file
```

6. Execute the ESERV command:

```
assgn sysin a
eserv contrl
```

7. Create a CMS macro library named MYDOSMAC from the files just created, which are named OPEN COPY, RELEAS COPY, and CONTRL MACRO:

```
maclib gen mydosmac open releas contrl
```

8. To use these macros in an assembler language program, you must indicate that this MACLIB is accessible before assembling a source file:

```
global maclib mydosmac
```

THE MACLIB COMMAND

The MACLIB command performs a variety of functions. You use it to:

- Create the MACLIB (GEN function)
- Add, delete, or replace members (ADD, DEL, and REP functions)
- Compress the MACLIB (COMP function)
- List the contents of the MACLIB (MAP function)

Descriptions of these MACLIB command functions follow.

GEN Function: The GEN (generate) function creates a CMS macro library from input files specified on the command line. The input files must have filetypes of either MACRO or COPY. For example:

```
maclib gen mymac get pdump put regequ
```

creates a macro library with the file identifier MYMAC MACLIB A1 from macros existing in the files with the file identifiers:

GET {MACRO / COPY}, PDUMP {MACRO / COPY}, PUT {MACRO / COPY}, and REGEQU {MACRO / COPY}

If a file named MYMAC MACLIB A1 already exists, it is erased.

Assume that the files GET MACRO, PDUMP COPY, PUT MACRO, and REGEQU COPY exist and contain macros in the following form:

GET MACRO	PDUMP COPY	PUT MACRO	REGEQU COPY
GET	*COPY PDUMP PDUMP	PUT	XREG
WAIT	*COPY WAIT WAIT		YREG

The resulting file, MYMAC MACLIB A1, contains the members:

```
GET       WAIT
WAIT      PUT
PDUMP     REGEQU
```

The WAIT macro, which appears twice in the input to the command, also appears twice in the output. The MACLIB command does not check for duplicate macro names. If, at a later time, the WAIT macro is requested from MYMAC MACLIB, the first WAIT macro encountered in the directory is used.

When COPY files are added to MACLIBs, the name of the library member is taken from the name of the COPY file, or from the *COPY statement, as in the file PDUMP COPY, above. Note that although the file REGEQU COPY contained two macros, they were both included in the MACLIB with the name REGEQU. When the input file is a MACRO file, the member name is taken from the macro prototype statement in the MACRO file.

ADD Function: The ADD function appends new members to an existing macro library. For example, if MYMAC MACLIB A1 exists as created in the example in the explanation of the GEN function and the file DTFDI COPY exists as follows:

```
*COPY DTFDI
 DTFDI macro definition
*COPY DIMOD
 DIMOD macro definition
```

if you issue the command

```
maclib add mymac dtfdi
```

the resulting MYMAC MACLIB A1 contains the members:

```
GET       PUT
WAIT      REGEQU
PDUMP     DTFDI
WAIT      DIMOD
```

REP Function: The REP (replace) function deletes the directory entry for the macro definition in the files specified. It then appends new macro definitions to the macro library and creates new directory entries. For example, assume that a macro library TESTMAC MACLIB contains the members A, B, and C, and that the following command is entered:

```
maclib rep testmac a c
```

The files represented by file identifiers A MACRO and C MACRO each have one macro definition. After execution of the command, TESTMAC MACLIB contains members with the same names as before, but the contents of A and C are different.

DEL Function: The DEL (delete) function removes the specified macro name from the macro library directory and compresses the directory so there are no unused entries. The macro definition still occupies space in the library, but since no directory entry exists, it cannot be accessed or retrieved. If you attempt to delete a macro for which two macro definitions exist in the macro library, only the first one encountered is deleted. For example:

```
maclib del mymac get put wait dtfdi
```

deletes macro names GET, PUT, WAIT, and DTFDI from the directory of the macro library named MYMAC MACLIB. Assume that MYMAC exists as in the ADD function example. After the above command, MYMAC MACLIB contains the following members:

```
PDUMP
WAIT
REGEQU
DIMOD
```

COMP Function: Execution of a MACLIB command with the DEL or REP functions can leave unused space within a macro library. The COMP (compress) function removes any macros that do not have directory entries. This function uses a temporary file named MACLIB CMSUT1. For example, the command:

```
maclib comp mymac
```

compresses the library MYMAC MACLIB.

MAP Function: The MAP function creates a list containing the name of each macro in the directory, the size of the macro, and its position within the macro library. If you want to display a list of the members of a MACLIB at the terminal, enter the command

```
maclib map mymac (term
```

The default option, DISK, creates a file on your A-disk which has a filetype of MAP and a filename equal to the filename of the MACLIB. If you specify the PRINT option, then a copy of the map file is spooled to your virtual printer as well as being written onto disk.

Manipulating MACLIB Members

The following CMS commands supply a MEMBER option, which allows you to reference individual members of a MACLIB:

- PRINT (to print a member)
- PUNCH (to punch a member)
- TYPE (to display a member)
- FILEDEF (to establish a file definition for a member)

You can use the CMS Editor to create the MACRO and COPY files and then use the MACLIB command to place them in a library. Once they are in a library, you can erase the original files.

To extract a member from a macro library, you can use either the PUNCH or the MOVEFILE command. If you use the PUNCH command you can spool your virtual card punch to your own virtual reader:

```
cp spool punch to *
```

then punch the member:

```
punch testmac maclib (member get noheader
```

and read it back onto disk:

```
readcard get macro
```

In the above example, the member was punched with the NOHEADER option of the PUNCH command, so that a name could be assigned on the READCARD command line. If a header had been created for the file, it would have indicated the filename and filetype as GET MEMBER.

If you use the MOVEFILE command, you must issue a file definition for the input member name and the output macro or copy file before entering the MOVEFILE command:

```
filedef inmove disk testcopy maclib (member enter
filedef outmove disk enter copy a
movefile
```

This example copies the member ENTER from the macro library TESTCOPY MACLIB A into a CMS file named ENTER COPY.

When you use the PUNCH or MOVEFILE commands to extract members from CMS MACLIBs, each member is followed by a // record, which is a MACLIB delimiter. You can edit the file and use the DELETE subcommand to delete the // record.

System MACLIBs

The macro libraries that are on the system disk contain CMS, DOS, and OS assembler language macros. The MACLIBs are:

- CMSLIB MACLIB contains the CMS macros.
- DOSMACRO MACLIB contains DOS/VS macros that CMS/DOS routines use.
- OSMACRO MACLIB, OSMACRO1 MACLIB, and TSOMAC MACLIB are used by OS programmers.

DOS Assembler Language Macros Supported

Figure 16 lists the DOS/VS Assembler Language macros supported by CMS/DOS. You can assemble source programs that contain these macros under CMS/DOS, provided that you have the macros available in either your own or a shared CMS macro library. The macros whose functions are described in the "Function" column with the term "no-op" are supported for assembly only; when you execute programs that contain these macros, the DOS/VS functions are not performed. To accomplish the macro function you must execute the program in a DOS/VS virtual machine.

Macro	SVC	Function
CALL	–	Pass control to another program
CANCEL	06	Terminate processing
CDLOAD	65	Load a VSAM phase
CHECK	–	Verify completion of a read or write operation
CLOSE/	–	Deactivate a data file
CLOSER	–	
CNTRL	–	Control a physical device
COMRG	33	Return address of background partition
	–	communication region
DEQ	42	no-op
DEQB	9	Release a resource
DTFxx[1]	–	Establish file definitions
DUMP	–	Dump storage and registers and terminate processing
ENQ	41	no-op
ENQB	2	Protect a resource
EOJ	14	Terminate processing normally
ERET	–	Provide an error routine
EXCP	00	Execute a channel program
EXIT PC	17	Return from program check routine
FCEPGOUT	86	no-op
FETCH	01	Load and pass control to a phase
	02	Load and pass control to a logical transient
FREEVIS	62	Release user free storage
GENL	–	Generate a phase directory list
GET	–	Access a sequential file
GETVIS	61	Obtain user free storage
GETIME	34	Get the time of day
JDUMP	–	Dump storage and registers and terminate processing
LOAD	04	Read a phase into storage
MVCOM	05	Modify bytes in the partition communication region
NOTE	–	Manage data set access
OPEN/	–	Activate a data file
OPENR	–	
PAGEIN	87	no-op
PDUMP	–	Dump storage and registers and continue processing
PFIX	67	no-op
PFREE	68	no-op
POINTR	–	Position a file for reading
POINTS	–	Reposition a file to its beginning
POINTW	–	Position a file for writing
POST	40	Post the Event Control Block
PRTOV	–	Control printer overflow
PUT	–	Write to a sequential file
PUTR	–	Communicate with the system operator
READ	–	Access a sequential file
RELEASE	64	Release a system resource
RELPAG	85	no-op
RELSE	–	Skip to begin reading next block
RETURN	–	Return control to calling program
RUNMODE	66	Check if program is running real or virtual
SECTVAL	75	Obtain a sector number
SEIZE	22	no-op
SETIME	10/24	no-op
SETPFA	71	no-op
STXIT AB	37	Provide or terminate linkage to abnormal ending
PC	16	routine
IT	20	no-op
OC	18	no-op

[1]The DOS declarative macros supported are:
DTFCN, DTFCD, DTFPR, DTFDI, DTFMT, DTFSD, DTFCP, and DTFSL

Figure 16. DOS/VS Macros Supported by CMS (Part 1 of 2)

Macro	SVC	Function
TRACK FREE	36	no-op
TRACK HOLD	35	no-op
TRUNC	-	Skip to begin writing next block
TTIMER	52	Return a 0 in Register 0 (effectively a noop)
USE	63	Reserve a system resource
WAIT	07	Wait for the completion of I/O
WRITE	-	Write to a sequential file
xxMOD[1]	-	Create Logical IOCS routine inline

[1]The DOS logic modules supported are:
CDMOD, PRMOD, DIMOD, MTMOD, SDMODxx, and CPMOD

Figure 16. DOS/VS Macros Supported by CMS (Part 2 of 2)

Assembling Source Programs

If you are a DOS/VS Assembler Language programmer using CMS/DOS, you should be aware that the assembler used is the VM/370 assembler, not the DOS/VS assembler. The major difference is that the VM/370 assembler, invoked by the ASSEMBLE command, is designed for interactive use, so that when you assemble a program, error messages are displayed at your terminal when compilation is completed, and you do not have to wait for a printed listing to see the results. You can correct your source file and reassemble it immediately. When your program assembles without errors, you can print your listing.

To specify options to be used during the assembly, you enter them on the ASSEMBLE command line. So, for example, if you do not want the output LISTING file placed on disk, you can direct it to the printer:

```
assemble myfile (print
```

All of the ASSEMBLE command options are listed in VM/370: CMS Command and Macro Reference.

When you invoke the ASSEMBLE command specifying a file with a filetype of ASSEMBLE, CMS searches all of your accessed disks, using the standard search order, until it locates the file. When the assembler creates the output LISTING and TEXT files, it writes them onto disk according to the following priorities:

1. If the source file is on a read/write disk, the TEXT and LISTING files are written onto the same disk.
2. If the source file is on a read-only disk that is an extension of a read/write disk, the TEXT and LISTING files are written onto the parent disk.
3. If the source is on any other read-only disk, the TEXT and LISTING files are written onto the A-disk.

In all of the above cases, the filenames assigned to the TEXT and LISTING files are the same as the filename of the input file.

The output files used by the assembler are defined via FILEDEF commands issued by CMS when it calls the assembler. If you issue a FILEDEF command using one of the assembler ddnames before you issue the ASSEMBLE command, you can override the default file definitions.

The ddname for the source input file is ASSEMBLE. If you enter

```
filedef assemble reader
assemble sample
```

then the assembler reads your input file from your card reader, and assigns the filename SAMPLE to the output TEXT and LISTING files. You can use this method to assemble programs directly from DOS sequential files on DOS disks.

LISTING and TEXT are the ddnames assigned to the SYSLST and and SYSPCH output of the assembler. You might issue file definitions to override these defaults as follows:

```
filedef listing disk assemble listfile a
filedef text disk assemble textfile a
assemble source
```

When these commands are executed, the output from the assembly of the file SOURCE ASSEMBLE is written to the disk files ASSEMBLE LISTFILE and ASSEMBLE TEXTFILE.

Link-editing Programs in CMS/DOS

When the assembler or one of the language compilers executes, the object module produced is written to a CMS disk in a file with a filetype of TEXT. The filename is always the same as that of the input source file. These TEXT files (sometimes referred to as decks, although they are not real card decks) can be used as input to the linkage editor, or can be the target of an INCLUDE linkage editor control statement.

You can invoke the CMS/DOS linkage editor with the DOSLKED command, for example:

```
doslked test testlib
```

where TEST is the is the filename of either a DOSLNK or TEXT file (that is, a file with a filetype of either DOSLNK or TEXT), or the name of a relocatable module in a system or private relocatable library. TESTLIB indicates the name of the output file which, in CMS/DOS, is a phase library with a filetype of DOSLIB.

When you issue the DOSLKED command, CMS first searches for a file with the specified name and a filetype of DOSLNK. If none are found, it searches the private relocatable library, if you have assigned one (you must issue an ASSGN command for SYSRLB and use the ddname IJSSYRL in a DLBL statement). If the module is still not found, CMS searches all of your accessed disks for a file with the specified name and a filetype of TEXT. Last, CMS searches the system relocatable library, if it is available (you must enter the CMS/DOS environment specifying the mode letter of the DOS/VS system residence if you want to access the system libraries).

LINKAGE EDITOR INPUT

You can place the linkage editor control statements ACTION, PHASE, INCLUDE, and ENTRY in a CMS file with a filetype of DOSLNK. When you use the INCLUDE statement, you may specify the filename of a CMS TEXT file or the name of a module in a DOS relocatable library:

```
INCLUDE XYZ
```

or you may use the INCLUDE control statement to indicate that the object code follows:

```
INCLUDE
(CMS TEXT file)
```

A typical DOSLNK file, named CONTROL DOSLNK, might contain the following:

```
ACTION REL
PHASE PROGMAIN,S
INCLUDE SUBA
PHASE PROGA,*
INCLUDE SUBB
```

When you issue the command

```
doslked control
```

the linkage editor searches the following for the object files SUBA and SUBB:

- A DOS private relccatable library, provided you have issued the ASSGN and DLBL commands to identify it:

  ```
  assgn sysrlb d
  dlbl ijsysrl d dsn ? (sysrlb
  ```

- Your CMS disks for files with filenames SUBA and SUBB and a filetype of TEXT

- The system relocatable library located on the DOS system residence volume (if it is available)

Link-editing TEXT Files

When you want to link-edit individual CMS TEXT files, you can insert linkage editor control statements in the file using the CMS Editor and then issue the DOSLKED command:

```
edit rtnb text
EDIT:
input    include rtnc
file
doslked rtnb mydoslib
```

When the above DOSLKED command is executed, the CMS file RTNB TEXT is used as linkage editor input, as long as there is no file named RTNB DOSLNK. The ACTION statement, however, is not recognized in TEXT files.

You can also link-edit relocatable modules directly from a DOS system or private relocatable library, provided that you have identified the library. If you do this, however, you cannot provide control statements for the linkage editor.

If you want to link-edit a relocatable module from a DOS private library and you want, also, to add linkage editor control statements to it, you could use the following procedure:

1. Identify the library and use the RSERV command to copy the relocatable module into a CMS TEXT file. In this example, the module RTNC is to be copied from the library OBJ.MODS:

```
assgn sysrlb e
dlbl ijsysrl e dsn obj mods (sysrlb
rserv rtnc
```

2. Create a DOSLNK file, insert the linkage editor control statements, and copy the TEXT file created in step 1 into it using the GETFILE subcommand.

```
edit rtnc doslnk
input    action rel
getfile rtnc text a
file
```

3. Invoke the linkage editor with the DOSLKED command.

```
doslked rtnc mydoslib
```

Alternatively, you could create a DOSLNK file with the following records:

```
ACTION REL
INCLUDE RTNC
```

and link-edit the module directly from the relocatable library. If you do not need a copy of the module on a CMS disk, you might want to use this method to conserve disk space.

When the linkage editor is reading modules, it may encounter a blank card at the end of a file, or a * (comment) card at the beginning of a file. In either case, it issues a warning message indicating an invalid card, but continues to complete the link-edit.

LINKAGE EDITOR OUTPUT: CMS DOSLIBS

The CMS/DOS linkage editor always places the link-edited executable phase in a CMS library with a filetype of DOSLIB. You should specify the filename of the DOSLIB when you enter the DOSLKED command:

```
doslked prog0 templib
```

where PROG0 is the relocatable module you are link-editing and TEMPLIB is the filename of the DOSLIB.

If you do not specify the name of a DOSLIB, the output is placed in a DOSLIB that has the same name as the DOSLNK or TEXT file being link-edited. In the above example, a CMS DOSLIB is created named TEMPLIB DOSLIB, or, if the file TEMPLIB DOSLIB already exists, the phase PROG0 is added to it.

DOSLIBs can contain relocatable and core image phases suitable for execution in CMS/DOS. Before you can access phases in it, you must identify it to CMS with the GLOBAL command:

```
global doslib templib permlib
```

When CMS is searching for executable phases, it searches all DOSLIBs specified on the last GLOBAL DOSLIB command line. If you have named a number of DOSLIBs, or if any particular DOSLIB is very large, the time required for CMS to fetch and execute the phase increases. You should use separate DOSLIBs for executable phases, whenever possible, and then specify only the DOSLIBs you need on the GLOBAL command.

When you link-edit a module into a DOSLIB that already contains a phase with the same name, the directory entry is updated to point to the new phase. However, the space that was occupied by the old phase is not reclaimed. You should periodically issue the command

```
doslib comp libname
```

where libname is the filename of the DOSLIB, to compress the DOSLIB and delete unused space.

Linkage Editor Maps

The DOSLKED command also produces a linkage editor map, which it writes into a CMS file with a filename that is that of the name specified on the DOSLKED command line and a filetype of MAP. The filemode is always A5. If you do not want a linkage editor map, use the NOMAP option on the ACTION statement in a DOSLNK file.

Executing Programs in CMS/DOS

After you have assembled or compiled a source program and link-edited the TEXT files, you can execute the phases in your CMS virtual machine. You may not, however, be able to execute all your DOS programs directly in CMS. There are a number of execution-time restrictions placed on your virtual machine by VM/370. You cannôt execute a program that uses:

- Multitasking
- More than one partition
- Teleprocessing
- ISAM macros to read or write files

The above is only a partial list, representing those restrictions with which you might be concerned. For a complete list of restrictions, see the VM/370: Planning and System Generation Guide.

EXECUTING DOS PHASES

You can load executable phases into your CMS virtual machine using the FETCH command. Phases must be link-edited before you load them. When you issue the FETCH command, you specify the name of the phase to be loaded:

```
fetch myprog
```

Then you can begin executing the program by issuing the START command:

```
start
```

Or, you can fetch a phase and begin executing it on a single command line:

```
fetch prog2 (start
```

When you use the FETCH command without the START option, CMS issues a message telling you at what virtual storage address the phase is loaded:

```
PHASE PROG2 ENTRY POINT AT LOCATION 020000
```

Location X'20000' is the starting address of the user program area for CMS; relocatable phases are always loaded starting at this address unless you specify a different address using the ORIGIN option of the FETCH command:

```
fetch prog3 (origin 22000
start
```

The program PROG3 executes beginning at location 22000 in the CMS user program area.

SEARCH ORDER FOR EXECUTABLE PHASES

When you execute the FETCH command, CMS searches for the phase name you specify in the following places:

1. In a DOS/VS private core image library on a DOS disk. If you have a private library you want searched for phases, you must identify it using the ASSGN and DLBL commands, using the logical unit SYSCLB:

   ```
   assgn sysclb d
   dlbl ijsyscl d dsn ? (sysclb
   ```

2. In CMS DOSLIBs on CMS disks. If you want DOSLIBs searched for phases, you must use the GLOBAL command to identify them to CMS/DOS:

   ```
   global doslib templib mylib
   ```

   You can specify up to eight DOSLIBs on the GLOBAL command line.

3. On the DOS system residence core image library. If you want the system core image library searched you must have entered the CMS/DOS environment specifying the mode letter of the system residence:

   ```
   set dos on z
   ```

When you want to fetch a core image phase that has copies in both the core image library and a DOSLIB, and you want to fetch the copy from the CMS DOSLIB, you can bypass the core image library by entering the command

```
assgn sysclb ua
```

When you need to use the core image library, enter

```
assgn sysclb c
```

where C is the mode letter of the system residence volume. You do not need to reissue the DLBL command to identify the library.

MAKING I/O DEVICE ASSIGNMENTS

If you are executing a program that performs I/O, you can use the ASSGN command to relate a system or programmer logical unit to a real I/O device. As in DOS/VS, device type assignment in CMS/DOS is dependent on device specifications in the program.

```
assgn sys052 reader
assgn syslst printer
```

In this example, your program is going to read input data from your virtual card reader; the output print file is directed to your virtual printer. If you want to reassign these units to different devices, you must be sure that the files have been defined as device independent.

If you assign a logical unit to a disk, you should identify the file by using the DLBL command. On the DLBL command, you must always relate the DLBL to the system or programmer logical unit previously specified in an ASSGN command:

```
assgn sys015 b
dlbl myfile b dsn ? (sys015
```

When you enter the DLBL command with the ? operand you are prompted to enter the DOS file-id.

You must issue all of the ASSGN and DLBL commands necessary for your program's I/O before you issue the FETCH command to load the program phase and begin executing.

SPECIFYING A VIRTUAL PARTITION SIZE

For most of the programs that you execute in CMS, you do not need to specify how large a partition you want a program to execute in. When you issue the START command or the START option on the FETCH command, CMS calculates how much storage is available in your virtual machine and sets a partition size.

In some instances, however, you may want to control the partition size, as a performance consideration (some programs may run better in smaller partitions). You can set the partition size with the DOSPART operand of the SET command. For example, after you enter the command

```
set dospart 300k
```

all programs that you subsequently execute will execute in a 300K partition. If you enter

```
set dospart off
```

then CMS calculates a partition size when you execute a program. This is the default setting.

SETTING THE UPSI BYTE

If your program uses the User Program Switch Indicator (UPSI) byte, you can set it by using the UPSI operand of the CMS SET command. The UPSI byte is initially binary zeros. To set it to 1s, enter

```
set upsi 11111111
```

To reset it to zeros, enter

```
set upsi off
```

Any value you set remains in effect for the duration of your terminal session, unless you reload CMS (with the IPL command).

DEBUGGING PROGRAMS IN CMS/DOS

You can debug your DOS programs in CMS/DOS using the facilities of CP and CMS. By executing your programs interactively, you can more quickly determine the cause of an error or program abend, correct it, and attempt to execute a program again.

The CP and CMS debugging facilities are described in "Section 11. How VM/370 Can Help You Debug Your Programs." Additional information for assembler language programmers is in "Section 13. Programming for the CMS Environment."

USING EXEC PROCEDURES IN CMS/DOS

During your program development and testing cycle, you may want to create EXEC procedures to contain sequences of CMS commands that you execute frequently. For example, if you need a number of MACLIBs, DOSLIBs, and DLBL definitions to execute a particular program, you might have an EXEC procedure as follows:

```
&CONTROL ERROR TIME
&ERROR &EXIT &RETCODE
GLOBAL MACLIB TESTLIB DOSMAC
ASSEMBLE TESTA
PRINT TESTA LISTING
DOSLKED TESTA TESTLIB
GLOBAL DOSLIB TESTLIB PROGLIB
ACCESS 200 E
ASSGN SYS010 E
&BEGSTACK
DOS.TEST3.STREAM.BETA
&END
DLBL DISK1 E DSN ? (SYS010
ASSGN SYS011 PUNCH
CP SPOOL PUNCH TO *
ASSGN SYS012 A
DLBL OUTFILE A CMS TEST DATA
FETCH TESTA (START
&IF &RETCODE = 100 &GOTO -RET100
&IF &RETCODE = 200 &GOTO -RET200
&EXIT &RETCODE
-RET100 &CONTINUE
   .
   .
   .
-RET200 &CONTINUE
   .
   .
   .
```

The &CONTROL and &ERROR control statements in the EXEC procedure ensure that if an error occurs during any part of the EXEC, the remainder of the EXEC does not execute, and the execution summary of the EXEC indicates the command that caused the error.

Note that for the DLBL command entered with the DSN ? operand, you must stack the response before issuing the DLBL command. In this example, since the DOS file-id has more than 8 characters, you must use the &BEGSTACK control statement to stack it. When you use the &STACK control statement, the EXEC processor truncates all words to 8 characters.

When your program is finished executing, the EXEC special variable &RETCODE indicates the contents of general register 15 at the time your program exited. You can use this value to perform additional steps in your EXEC procedure. Additional steps are indicated in the preceding example by ellipses.

For detailed information on creating EXEC procedures, see "Part 3. Learning To Use EXEC."

Section 10. Using Access Method Services and VSAM Under CMS and CMS/DOS

This section describes how you can use CMS to create and manipulate VSAM catalogs, data spaces, and files on OS and DOS disks using Access Method Services. The CMS support is based on DOS/VS Access Method Services and Virtual Storage Access Method (VSAM); this means that if you are an OS VSAM user and plan to use CMS to manipulate VSAM files you are restricted to those functions of Access Method Services that are available under DOS/VS Access Method Services. The control statements you can use are described in the publication DOS/VS Access Method Services User's Guide.

You can use CMS to

- Execute the Access Method Services utility programs for VSAM and SAM data sets on OS and DOS disks and minidisks. CMS can both read and write VSAM files using Access Method Services.
- Compile and execute programs that read and write VSAM files from DOS programs written in the COBOL or PL/I programming languages.
- Compile and execute programs that read and write VSAM files from OS programs written in the VS BASIC, COBOL, or PL/I programming languages.
- Assemble assembler language source programs under CMS that use VSAM macros. You must create your own macro library from OS or DOS macro libraries.

VSAM files written under CMS are wholly compatible for reading and writing under OS and DOS systems. None of the CMS commands normally used to manipulate CMS files are applicable to VSAM files, however. This includes such commands as PRINT, TYPE, EDIT, COPYFILE, and so on.

This section provides information on using the CMS AMSERV command with which you can execute Access Method Services. The discussion is divided as follows:

- "Using the AMSERV command" contains general information.
- "Manipulating OS and DOS Disks for Use With AMSERV" describes how to use CMS commands with OS and DOS disks.
- "Defining DOS Input and Output Files" is for CMS/DOS users only.
- "Defining OS Input and Output Files" is for OS users only.
- "Using AMSERV Under CMS" includes notes and examples showing how to perform various Access Method Services functions in CMS.

EXECUTING VSAM PROGRAMS UNDER CMS

The commands that are used to define input and output data sets for Access Method Services, DLBL and for CMS/DOS users, ASSGN, are also used to identify VSAM input and output files for program execution. Information on executing programs under CMS that manipulate VSAM files is contained in the Program Product documentation for the language processors. These publications are listed in the VM/370: Introduction.

Restrictions on the use of Access Method Services and VSAM under CMS for OS and DOS users are listed in VM/370: CMS Command and Macro Reference, which also contains complete CMS and CMS/DOS command formats, operand descriptions, and responses for each of the commands described here.

When you are going to execute VSAM programs in CMS or CMS/DOS, you should remember to issue the DLBL command to identify the master catalog, as well as any other program input or output file you need to define.

Using the AMSERV Command

In CMS, you execute Access Method Service utility programs with the AMSERV command, which has the basic format

```
amserv filename
```

"filename" is the name of a CMS file that contains the control statements for Access Method Services.

Note: Throughout the remainder of this section the term "AMSERV" is used to refer to both the CMS AMSERV command and the OS/VS or DOS/VS Access Method Services, except where a distinction is being made between CMS and Access Method Services.

You create an AMSERV file with the CMS Editor using a filetype of AMSERV and any filename you want, for example:

```
edit mastcat amserv
NEW FILE:
EDIT:
input
```

The Editor recognizes the filetype of AMSERV, and so automatically sets the margins for your input lines at columns 2 and 72. The sample AMSERV file being created in the example above, MASTCAT AMSERV, might contain the following control statements:

```
DEFINE MASTERCATALOG (NAME (MYCAT) -
   VOLUME (123456) CYL(2) -
   FILE (IJSYSCT) )
```

Note that the syntax of the control statements must conform to the rules for Access Method Services, including continuation characters and parentheses. The only difference is that the AMSERV file does not contain a "/*" for a termination indicator.

Before you can execute the DEFINE control statement in this AMSERV example, you must define the output file, using the ddname IJSYSCT. You can do this using the DLBL command. Since the exact form required in the DLBL command varies according to whether you are an OS or a DOS user, separate discussions of the DLBL command are provided later in this section. All of the following examples assume that any disk data set or file that you are referencing with an AMSERV command will have been defined by a DLBL command.

When you execute the AMSERV command, the AMSERV control statement file can be on any accessed CMS disk; you do not need to specify the filemode, and if you are a DOS user, you do not need to assign SYSIPT. The task of locating the file and passing it to Access Method Services is performed by CMS.

AMSERV OUTPUT LISTINGS

When the AMSERV command is finished processing, you receive the CMS Ready message, and if there was an error, the return code (from register 15) is displayed following the "R". For example,

```
R(00008);
```

or, if you are receiving the long form of the Ready message, it appears:

```
R(00008); T=0.01/0.11 10:50:23
```

If you receive a Ready message with an error return code, you should examine the output listing from AMSERV to determine the cause of the error.

AMSERV output listings are written in CMS files with a filetype of LISTING; by default, the filename is the same as that of the input AMSERV file. For example, if you have executed

```
amserv mastcat
```

and the CMS Ready message indicates an error return code, you should examine the file MASTCAT LISTING:

```
edit mastcat listing
EDIT:
locate /idc/#=
```

Issuing the LOCATE subcommand twice to find the character string IDC will position you in the LISTING file at the first Access Method Services message.

The publication DOS/VS Messages, Order No. GC33-5379, lists and explains all of the messages generated by Access Method Services together with the associated reason codes.

Instead of editing the file, you could also use the TYPE command to display the contents of the entire file, so that you would be able to examine the input control statements as well as any error messages:

```
type mastcat listing
```

If you need to make changes to control statements before executing the AMSERV command again, use the CMS Editor to modify the AMSERV input file.

If you execute the same AMSERV file a number of times, each execution results in a new LISTING file, which replaces any previous listing file with the same filename.

Output from PRINT, LISTCAT, and LISTCRA

When you use AMSERV to print a VSAM file, or to list catalog or recovery area contents using the PRINT, LISTCAT, or LISTCRA control statements, the output is written in a listing file on a CMS read/write disk, and not spooled to the printer unless you use the PRINT option of the AMSERV command:

```
amserv listcat (print
```

If you want to save the output, you should issue the AMSERV command without the PRINT option and then use the CMS PRINT command to print the LISTING file.

CONTROLLING AMSERV COMMAND LISTINGS

The final disposition of the listing, as a printer or disk file, depends on how you enter the AMSERV command. If you enter the AMSERV command with no options, you get a CMS file with a filetype of LISTING and a filename equal to that of the AMSERV input file. This LISTING file is usually written on your A-disk, but if your A-disk is full or not accessed, it is written on any other read/write CMS disk you have accessed.

If there is not enough room on your A-disk or any other disk, the AMSERV command issues an error message saying that it cannot write the LISTING file. If this happens, the LISTING file created may be incomplete and you may not be able to tell whether or not Access Method Services actually completed successfully. In this case, after you have cleared some space on a read/write disk, you may have to execute an AMSERV PRINT or LISTCAT function to verify the completion of the prior job.

LISTING files take up considerable disk space, so you should erase them as soon as you no longer need them.

AMSERV Command Listing Options

If you do not want AMSERV to create a disk file from the listing, you can execute the AMSERV command with the PRINT option:

```
amserv myfile (print
```

The listing is spooled to your virtual printer, and no disk file is created. You might want to use this option if you are executing a PRINT or LISTCAT control statement and expect a very large output listing that you know cannot be contained on any of your disks.

You can also control the filename of the output listing file by specifying a second name on the AMSERV command line:

```
amserv listcat listcat1
```

In this example, the input file is LISTCAT AMSERV and the output listing is placed in a file named LISTCAT1 LISTING. A subsequent execution of this same AMSERV file:

```
amserv listcat listcat2
```

creates a second listing file, LISTCAT2 LISTING, so that the listing created from the first execution is not erased.

Manipulating OS and DOS Disks for Use with AMSERV

To use CMS VSAM and AMSERV, you can have OS or DOS disks in your virtual machine configuration. They can be assigned in your directory entry, or you can link to them using the CP LINK command. You must have read/write access to them in order to execute any AMSERV function or VSAM program that requires opening the file for output or update.

Before you can use an OS or DOS disk you must access it with the CMS ACCESS command:

```
access 200 d
```

The response from the ACCESS command indicates that the disk is in OS or DOS format:

```
D(200) R/W - OS

   -- or --

D(200) R/W - DOS
```

You can write on these disks only through AMSERV or through the execution of a program writing VSAM data sets. Once an OS disk is used with AMSERV or VSAM, CMS considers it a DOS disk, so regardless of whether you are an OS user, when you access or request information about a VSAM disk, CMS indicates that it is a DOS disk. You can still use the disk in an OS or DOS system; its format is not changed.

USING VM/370 MINIDISKS

If you have a VM/370 minidisk in your virtual machine configuration, you can use it to contain VSAM files. Before you can use it, it must be formatted with the IBCDASDI program or other appropriate operating system utility program. When you request that a disk be added to your virtual machine configuration for use with VSAM files under CMS, you should indicate that it be formatted for use with OS or DOS. Or, you can format it yourself using the IBCDASDI program. A brief example of how to do this is given under "Using Temporary Disks," below. The IBCDASDI control statements are fully described in the VM/370: Operator's Guide.

Note: If you are an OS user, you should be careful about allocating space for VSAM on minidisks. Once you have used CMS AMSERV to allocate VSAM data space on a minidisk you should not attempt to allocate additional space on that minidisk using an OS/VS system. OS does not recognize minidisks, and would attempt to format the entire disk pack and thus erase any data on it. To allocate additional space for VSAM, you should use CMS again. If you use the IBCDASDI program to format the disk, and use the CYLNO parameter, the entire disk is flagged as full, so that OS cannot allocate additional space.

USING THE LISTDS COMMAND

For OS or DOS disks or minidisks, you can use the LISTDS command to determine the extents of free space available for use by VSAM. You can

also determine what space is already in use. You can use this information to supply the extent information when you define VSAM files.

The options used with VSAM disks are

- EXTENT, to find out what extents are in use, and
- FREE, to find out what extents are available.

For example, if you have an OS disk accessed as a G-disk, and you enter:

```
listds g (extent
```

The response might look like:

```
EXTENT INFORMATION FOR 'VTOC' ON 'G' DISK:
SEQ TYPE  CYL-HD(RELTRK) TO CYL-HD(RELTRK)   TRACKS
000 VTOC  099 00  1881     099 18   1899        19

EXTENT INFORMATION FOR 'PRIVAT.CORE.IMAGE.LIB' ON 'G' DISK:
SEQ TYPE  CYL-HD(RELTRK) TO CYL-HD(RELTRK)   TRACKS
000 DATA  000 01     1     049 18    949       949

EXTENT INFORMATION FOR 'SYSTEM.WORK.FILE.NO.6' ON 'G' DISK:
SEQ TYPE  CYL-HD(RELTRK) TO CYL-HD(RELTRK)   TRACKS
000 DATA  050 00    950    051 18    987        38
```

You could also determine the extent for a particular data set:

```
listds ? * (extent
DMSLDS220R ENTER DATA SET NAME:
system recorder file

EXTENT INFORMATION FOR 'SYSTEM RECORDER FILE' ON 'F' DISK:
SEQ TYPE  CYL-HD(RELTRK) TO CYL-HD(RELTRK)   TRACKS
000 DATA  102 00   1938     102 18   1956        19
002 DATA  010 06    206     010 08    208         3
```

LISTDS searches all minidisks accessed until it locates the specified data set. In this example, the data set occupies two separate extents on disk F. If the data set is a multivolume data set, extents on all accessed volumes are located and displayed.

If you want to find the free extents on a particular disk, enter:

```
listds g (free
FREESPACE EXTENTS FOR 'G' DISK:
CYL-HD(RELTRK) TO CYL-HD(RELTRK)   TRACKS
052 00    988     052 01    989         2
054 02   1028     080 00   1520       493
081 01   1540     098 18   1880       341
```

You can use this information when you allocate space for VSAM files. If you enter

```
listds * (free
```

CMS lists all the free space available on all of your accessed disks.

USING TEMPORARY DISKS

When you need extra space on a temporary basis for use with CMS VSAM and AMSERV, you can use the CP DEFINE command to define a temporary minidisk and then use the IBCDASDI program to format it. Once formatted and accessed, it is available to your virtual machine for the duration of your terminal session or until you detach it using the CP DETACH command. Remember that anything placed on a temporary disk is lost, so that you should copy output that you want to keep onto permanent disks before you log off.

Formatting a Temporary Disk

The example below shows a control statement file and an EXEC procedure that, together, can be used to format a minidisk with the IBCDASDI program. For a complete description of the control statements used, refer to the VM/370: Operator's Guide.

The input control statements for the IBCDASDI programs should be placed in a CMS file, so that they can be punched to your virtual card reader. For this example, suppose the statements are in a CMS file named TEMP IBCDASDI:

```
DASD198  JOB
         MSG    TODEV=1052,TOADDR=009
         DADEF  TODEV=3330,TOADDR=198,VOLID=SCRATCH,CYLNO=10
         VLD    NEWVOLID=123456
         VTOCD  STRTADR=185,EXTENT=5
         END
```

Now consider the CMS file named TEMPDISK EXEC:

```
&ERROR &EXIT 100
CP DEFINE T3330 198 10
CP CLOSE C
CP PURGE READER ALL
ACC 190 Z/Z IPL *
CP SPOOL PUNCH CONT TO *
PUNCH IPL IBCDASDI Z (NOH)
PUNCH TEMP IBCDASDI * (NOH)
CP SPOOL PUNCH NOCONT
CP CLOSE PUNCH
CP IPL 00C
```

You execute this procedure by entering the filename of the EXEC:

```
tempdisk
```

When the final line of this EXEC is executed, the IBCDASDI program is in control. You must then signal an Attention interrupt using the Attention or Enter key, and you receive the message:

```
IBC105A DEFINE INPUT DEVICE
```

you should enter

```
input=2540,00c
```

to indicate that the control statements should be read from your card reader, which is a virtual 2540 device at virtual address 00C.

When the IBCDASDI program is finished, your virtual machine is in the CP environment and must reload CMS (with the IPL command) to begin virtual machine execution. You can then access the temporary disk:

```
acc 198 c
```

and CMS responds

```
C(198) R/W - OS
```

Defining DOS Input and Output Files

Note: This information is for DOS/VS VSAM users. OS/VS VSAM users should refer to the section "Defining OS Input and Output Files."

You must use the DLBL command to define VSAM input and output files for both the AMSERV command and for program execution. The operands required on the DLBL command are:

```
dlbl ddname filemode DSN datasetname (options SYSxxx
```

where "ddname" corresponds to the FILE parameter in the AMSERV file and "datasetname" corresponds to the entry name or filename of the VSAM file.

There are several options you can use when issuing the DLBL command to define VSAM input and output files. These are:

- VSAM, which you must use to indicate that the file is a VSAM file.

  Note: You do not have to use the VSAM option to identify a file as a VSAM file if you are using any of the other options listed here, since they imply that the file is a VSAM file. In addition, the ddnames (filenames) IJSYSCT and IJSYSUC also indicate that the file being defined is a VSAM file.

- EXTENT, which you must use when you are defining a catalog or a VSAM data space; you are prompted to enter the volume information. This option effectively provides the function of the EXTENT card in DOS/VS.

- MULT, which you must use in order to access a multivolume VSAM file; you are prompted to enter the extent information.

- CAT, which you can use to identify a catalog which contains the entry for the VSAM file you are defining.

- BUFSP, which you can use to specify the size of the buffers VSAM should use during program execution.

Options are entered following the open parenthesis on the DLBL command line, with the SYSxxx:

```
assgn sys003 e
dlbl file1 b1 dsn workfile (extent cat cat2 sys003
```

Additional examples using some of these options are shown below.

USING VSAM CATALOGS

While you are developing and testing your VSAM programs in CMS, you may find it convenient to create and use your own master catalog, which may be on a CMS minidisk. VSAM catalogs, like any other cluster, can be shared read-only among several users.

You name the VSAM master catalog for your terminal session using the logical unit SYSCAT in the ASSGN command and the ddname IJSYSCT for the DLBL command. For example, if your VSAM master catalog is located on a DOS disk you have accessed as a C-disk, you would enter

```
assgn syscat c
dlbl ijsysct c dsn mastcat (syscat
```

Note: When you use the ddname IJSYSCT you do not need to specify the VSAM option on the DLBL command.

You must identify the master catalog at the start of every terminal session. If you are always using the same master catalog, you might include the ASSGN and DLBL commands in an EXEC procedure or in your PROFILE EXEC. You could also include the commands necessary to access the DOS system residence volume and enter the CMS/DOS environment:

```
ACCESS 350 Z
SET DOS ON Z (VSAM
ACCESS 555 C
ASSGN SYSCAT C
DLBL IJSYSCT C DSN MASTCAT (SYSCAT PERM
```

You should use the PERM option so that you do not have to reset the master catalog assignment after clearing previous DLBL definitions.

You must use the VSAM option on the SET DOS ON command line if you want to use any Access Method Services function or access VSAM files.

Defining a Master Catalog

The sample ASSGN and DLBL commands used in the above EXEC are almost identical with those you issue to define a master catalog using AMSERV. The only difference is that you must enter the EXTENT option so that you can list the data spaces that this master catalog is to control.

As an example, suppose that you have a 30-cylinder 3330 minidisk assigned to you to use for testing your VSAM programs under CMS. Assuming that the minidisk is in your directory at address 333, you should first access it:

```
access 333 d
D(333) R/W - OS
```

If you formatted the minidisk yourself, you know what its label is. If not, you can find out what the label is by using the CMS command

```
query search
```

The response might be

```
USR191  191  A    R/W
DOS333  333  C    R/W - OS
SYS190  190  S    R/O
SYS19E  19E  Y/S  R/O
```

Use the label DOS333 in the VOLUMES parameter in the MASTCAT AMSERV file:

```
DEFINE MASTERCATALOG -
   (NAME  (MASTCAT ) -
    VOLUME (DOS333) -
    CYL (4) -
    FILE (IJSYSCT)   )
```

Now, to find out what extents on the minidisk you can allocate for VSAM, use the LISTDS command with the EXTENT option:

```
listds d (free
```

The response from LISTDS might look like this:

```
FREESPACE INFORMATION FOR 'D' DISK:
CYL-HD(RELTRK) TO CYL-HD(RELTRK)   TRACKS
000 01      1     000 09      9        9
000 11     11     029 18    569      560
```

From this response, you can see that the volume table of contents (VTOC) is located on the first cylinder, so you can allocate cylinders 1 through 29 for VSAM:

```
assgn syscat c
dlbl ijsysct c dsn mastcat (syscat perm extent
DMSDLB331R ENTER EXTENT SPECIFICATIONS:
19 551
     (null line)
```

After entering the extents, in tracks, giving the relative track number of the first track to be allocated followed by the number of tracks, you must enter a null line to complete the command. A null line is required because, when you enter multiple extents, entries may be placed on more than one line. If you do not enter a null line, the next line you enter causes an error, and you must re-enter all of the extent information.

Note that, as in DOS/VS, the extents must be on cylinder boundaries, and you cannot allocate cylinder 0.

Now you can issue the AMSERV command:

```
amserv mastcat
```

A Ready message with no return code indicates that the master catalog is defined. You do not need to reissue the ASSGN and DLBL commands in order to use the master catalog for additional AMSERV functions.

Defining User Catalogs

You can use the AMSERV command to define private catalogs and spaces for them, also. The procedures for determining what space you can allocate are the same as those outlined in the example of defining a master catalog.

For a user catalog, you may use any programmer logical unit, and any ddname:

```
access 199 e
listds e (free
    .
    .
    .
assgn sys001 e
dlbl cat1 e dsn private cat1 (sys001 extent perm
    .
    .
    .
amserv usercat
```

The file USERCAT AMSERV might contain the following:

```
DEFINE USERCATALOG -
     (NAME (PRIVATE.CAT1) -
      FILE  (IJSYSUC) -
      CYL (4) -
      VOLUME (DOSVS2) -
      CATALOG (MASTCAT) )
```

After this AMSERV command has completed successfully you can use the catalog PRIVATE.CAT1. When you issue a DLBL command to identify a cluster or data set cataloged in this catalog, you must identify the catalog using the CAT option on the DLBL command for the file:

```
assgn sys100 c
dlbl file2 e dsn ? (sys100 cat cat1
```

Or, you can define this catalog as a job catalog.

Using a Job Catalog

If you want to set up a user catalog as a job catalog so that it will be searched during all subsequent jobs, you can define the catalog using the special ddname IJSYSUC. For example:

```
assgn sys101 c
dlbl ijsysuc c dsn private cat1 (sys101 perm
```

If you defined a user catalog (IJSYSUC) for a terminal session and you use the AMSERV command to access a VSAM file, the user catalog takes precedence over the master catalog. This means that for files that already exist, only the user catalog is searched. When you define a cluster, it is cataloged in the user catalog, rather than in the master catalog, unless you use the CAT option to override it.

If you want to use additional catalogs during a terminal session, you first define them just as you would any other VSAM file:

```
assgn sys010 f
dlbl mycat2 f dsn private cat2 (sys010 vsam
```

Then, when you enter the DLBL command for the VSAM file that is cataloged in PRIVATE.CAT2 use the CAT option to refer to the ddname of the catalog:

```
assgn sys011 f
dlbl input f dsn input file (sys011 cat mycat2
```

If you want to stop using a job catalog defined as IJSYSUC, you can clear it using the CLEAR option of the DLBL command:

```
dlbl ijsysuc clear
```

Then, the master catalog becomes the job catalog for files not defined with the CAT option.

Catalog Passwords

When you define passwords for VSAM catalogs in CMS, or when you use CMS to access VSAM catalogs that have passwords associated with them, you must supply the password from your terminal when the AMSERV command executes. The message that you receive to prompt you for the password is the same message you receive when you execute Access Method Services:

```
4221A ATTEMPT 1 OF 2. ENTER PASSWORD FOR JOB AMSERV   FILE catalog
```

When you enter the proper password, AMSERV continues execution.

DEFINING AND ALLOCATING SPACE FOR VSAM FILES

You can use CMS AMSERV to allocate additional data spaces for VSAM. To use the DEFINE SPACE control statement, you must have defined the catalog which that is to control the space, and you must have the volume or volumes on which the space is to be allocated mounted and accessed.

For example, suppose you have a DOS-formatted 3330 disk attached to your virtual machine at virtual address 255. After accessing the disk and determining the free space on it, you could create a file named SPACE AMSERV:

```
DEFINE SPACE -
   (FILE (FILE1) -
    TRACKS (1900) -
    VOLUME (123456) -
    CATALOG (PRIVATE.CAT2 CAT2) )
```

To execute this AMSERV file, define PRIVATE.CAT2 as a user catalog using the ddname CAT2, and then define the ddname for the FILE parameter:

```
access 255 c
assgn sys010 c
dlbl cat2 c dsn private cat2 (sys010 vsam
assgn sys011 c
dlbl file1 c (extent sys011 cat cat2
```

Note that you do not need to enter a data set name to define the space. When CMS prompts you for the extents of the space you can enter the extent specifications:

```
DMSDLB331R ENTER EXTENT SPECIFICATIONS:
190 1900
   .
   .
   .
```

When you define space for VSAM, you should be sure that the VOLUMES parameter and the space allocation parameter (whether CYLINDER, TRACKS, or RECORDS) in the AMSERV file agrees with the information you provide in the DLBL command. All data extents must begin and end on cylinder boundaries. Any additional space you provide in the extent information that is beyond what you specified in the AMSERV file is claimed by VSAM.

Specifying Multiple Extents

When you are specifying extents for a master catalog, data space, or unique file, you can specify up to 16 extents on a volume for a particular space. When prompted by CMS to enter the extents, you must separate different extents by commas, or place them on different lines. To specify a range of extents in the above example, you can enter

```
dlbl file1 c (extent sys011
190  190, 570  190, 1900 1520
   (null line)

  -- or --

dlbl file1 c (extent sys011
190  190
570  190
1900 1520
   (null line)
```

Again, the first number entered for each extent represents the relative track for the beginning of the extent and the second number indicates the number of tracks.

Specifying Multivolume Extents

You can define spaces that span up to 9 volumes for VSAM files; all of the volumes must be accessed and assigned when you issue the DLBL command to define or identify the data space.

You should remember, though, that if you are using AMSERV and you do not use the PRINT option, you must have a read/write CMS disk so that AMSERV can write the output LISTING file.

If you are defining a new multivolume data space or unique cluster, you must specify the extents on each volume that the data is to occupy (starting track and number of tracks), followed by the disk mode letter at which the disk is accessed and the programmer logical unit to which the disk is assigned:

```
access 135 b
access 136 c
access 137 d
assgn  sys001 b
assgn  sys002 c
assgn  sys003 d
dlbl newfile b (extent sys001
DMSDLB331R ENTER EXTENT SPECIFICATIONS:
100 60 b sys001, 400 80 b sys001, 60 40 d sys003
2000 100 c sys002
   (null line)
```

If you specify more than one extent on the same line, the extents must be separated by commas; if you enter a comma at the end of a line, it is ignored. Different extents for the same volume must be entered consecutively.

Note that in the preceding example, the extent information is for 2314 disks; and that these extents are also on cylinder boundaries.

When you enter multivolume extents you can use a default mode. For example:

```
dlbl newfile b (extent sys001
DMSDLB331R ENTER EXTENT SPECIFICATIONS:
100 60, 400 80, 60 40 d sys003,
2000 100 c sys002
   (null line)
```

Any extents you enter without specifying a mode letter and SYSxxx value default to the mode and SYSxxx on the DLBL command line, in this case, the B-disk, SYS001.

If you make any errors issuing the DLBL command or extent information, you must re-enter the entire command sequence.

IDENTIFYING EXISTING MULTIVOLUME FILES: When you issue a DLBL command to identify an existing multivolume VSAM file, you must use the MULT option of the DLBL command:

```
dlbl old b1 dsn ? (sys002 mult
DMSDLB220R ENTER DATA SET NAME:
dostest.file
DMSDLB330R ENTER VOLUME SPECIFICATIONS:
c sys004, d sys003
e sys007
   (null line)
```

When you enter the DLBL command you should specify the mode letter and logical unit for the first volume on the command line. When you enter the MULT option you are prompted to enter additional specifications for the remaining extents. In the preceding example, the data set has extents on disks accessed as B-, C-, D-, and E-disks.

USING TAPE INPUT AND OUTPUT

If you are using AMSERV for a function that requires tape input and/or output, you must have the tape(s) attached to your virtual machine. The valid addresses for tapes are 181, 182, 183, and 184. When referring to tapes, you can also refer to them using their CMS symbolic names TAP1, TAP2, TAP3, and TAP4.

Since CMS does not read tape labels, there is no CMS/DOS equivalent to the TLBL control statement. For AMSERV functions that use tape input/output, you are prompted for the ddname (filename).

When you invoke the AMSERV command, you must use the TAPIN or TAPOUT option to specify the tape device being used:

```
amserv export (tapout 181
```

In this example, the output from the AMSERV control statements in a file named EXPORT goes to a tape at virtual address 181. CMS prompts you to enter the ddname:

```
DMSAMS367R ENTER TAPE OUTPUT DDNAMES:
```

After you enter the ddname specified on the FILE parameter in the AMSERV file and press the carriage return, the AMSERV command executes.

Reading VSAM Tape Files

When you create a tape in CMS using AMSERV, CMS writes a tape mark preceding each output file that it writes. When this same tape is read using AMSERV under CMS, the tape mark is automatically skipped, so you do not have to forward space the tape. If you read this tape in a real DOS/VS system, you should use a TLBL card that specifies a filename, but no file-id.

Similarly, when you create a tape under a DOS/VS system using Access Method Services, if the tape is created with standard labels, CMS AMSERV has no difficulty reading it.

The only time you should worry about positioning a tape created by AMSERV is when you want to read the tape using a method other than AMSERV, for example, the MOVEFILE command. Then, you must forward space the tape using the CMS TAPE command before you can read it.

Defining OS Input and Output Files

Note: This information is for OS/VS VSAM users only. DOS/VS VSAM users should refer to "Defining DOS Input and Output Files" for information on defining files for use with VSAM.

If you are going to use Access Method Services to manipulate VSAM or SAM files or you are going to execute VSAM programs under CMS, you must use the DLBL command to define the input and output files. The basic format of the DLBL command is:

```
DLBL ddname filemode DSN datasetname (options
```

where ddname corresponds to the FILE parameter in the AMSERV file and datasetname corresponds to the entry name of the VSAM file, that is, the name specified in the NAME parameter of an Access Method Services control statement.

If you are using a CMS file for AMSERV input or output, use the CMS operand, and enter CMS file identifiers, as follows:

```
dlbl mine a cms out file1 (vsam
```

The maximum length allowed for ddnames under CMS VSAM is 7 characters. This means that if you have assigned 8-character ddnames (or filenames) to files in your programs, only the first 7 characters of each ddname are used. So, if a program refers to the ddname OUTPUTDD, you should issue the DLBL command for a ddname of OUTPUTD. Since you can encounter problems with a program that contains ddnames with the same first seven characters, you should recompile those programs using 7-character ddnames.

There are several options you can use when issuing the DLBL command to define VSAM input and output files. These are:

- VSAM, which you must use to indicate that the file is a VSAM file.

  Note: You do not have to use the VSAM option to identify a file as a VSAM file if you are using any of the other options listed here, since they imply that the file is a VSAM file. In addition, the ddnames (filenames) IJSYSCT and IJSYSUC also indicate that the file being defined is a VSAM file.

- EXTENT, which you must use when you are defining a catalog or a VSAM data space; you are prompted to enter the volume information.

- MULT, which you must use in order to access a multivolume VSAM file; you are prompted to enter the extent information.

- CAT, which you can use to identify a catalog which contains the entry for the VSAM file you are defining.

- BUFSP, which you can use to specify the size of the buffers VSAM should use during program execution.

ALLOCATING EXTENTS ON OS DISKS AND MINIDISKS

When you use Access Method Services to manipulate VSAM files under OS, you do not have to worry about allocating the real cylinders and tracks to contain the files. When you use CMS AMSERV, however, you are responsible for indicating which cylinders and tracks should contain particular VSAM spaces when you use the DEFINE control statement to define space.

Extents for VSAM data spaces can be defined, in AMSERV files, in terms of cylinders, tracks, or records. Extent information you supply to CMS when executing AMSERV must always be in terms of tracks. When you define data spaces or unique clusters, the extent information (number of cylinders, tracks, or records) in the AMSERV file must match the extents you supply when you issue the DLBL command to define the file. When you supply extent information for the master catalog, any extents you enter in excess of those required for the catalog are claimed by the catalog and used as data space.

CMS does not make secondary space allocation for VSAM data spaces. If you execute an AMSERV file that specifies a secondary space allocation, CMS ignores the parameter.

When you use the DLBL command to define VSAM data space, you must use the EXTENT option, which indicates to CMS that you are going to enter data extents. For example, if you enter

```
dlbl space b (extent
```

CMS prompts you to enter the extents:

```
DMSDLB331R ENTER EXTENT SPECIFICATIONS:
```

When you enter the extents, you specify the relative track number of the first track of the extent, followed by the number of tracks. For example, if you are allocating an entire 2314 disk, you would enter

```
20 3980
   (null line)
```

You can never write on cylinder 0, track 0; and, since VSAM data spaces must be allocated on cylinder boundaries, you should never allocate cylinder 0. Cylinder 0 is often used for the volume table of contents (VTOC), as well, so it is always best to begin defining space with cylinder 1.

The list below shows the DASD devices supported by CMS VSAM, the number of cylinders on each that can be allocated for VSAM space, and the number of tracks per cylinder:

Disk	Cylinders	Tracks/Cylinder
2314/2319	200	20
3330 Series	404	19
3340 Model 35	348	12
3340 Model 70	696	12

You can determine which disk extents on an OS disk or minidisk are available for allocation by using the LISTDS command with the FREE option, which also indicates the relative track numbers, as well as actual cylinder and head numbers.

USING VSAM CATALOGS

While you are developing and testing your VSAM programs in CMS, you may find it convenient to create and use your own master catalog, which may be on a CMS minidisk. VSAM catalogs, like any other cluster, can be shared read-only among several users.

You name the VSAM master catalog for your terminal session using the ddname IJSYSCT for the DLBL command. For example, if your VSAM master catalog is located on an OS disk you have accessed as a C-disk, you would enter

```
dlbl ijsysct c dsn master catalog (perm
```

You must define the master catalog at the start of every terminal session. If you are always using the same master catalog, you might include the DLBL command you need to define it in your PROFILE EXEC:

```
ACCESS 555 C
DLBL IJSYSCT C DSN MASTCAT (PERM
```

You should use the PERM option so that you do not have to reset the master catalog assignment after clearing previous DLBL definitions. The command

```
dlbl * clear
```

clears all file definitions except those entered with the PERM option.

Defining a Master Catalog

The sample DLBL command used in the preceding example is almost identical with the one you would issue to define a master catalog using AMSERV. The only difference is that you must enter the EXTENT option so that you can list the data spaces that this master catalog is to control.

As an example, suppose that you have a 30-cylinder 3330 minidisk assigned to you to use for testing your VSAM programs under CMS. Assuming that the minidisk is in your directory at address 333, you should first access it:

```
access 333 d
D(333) R/W - OS
```

If you formatted the minidisk yourself, you know what label you assigned it; if not, you can find out the label assigned to the disk by issuing the CMS command

```
query search
```

The response might be

```
USR191  191  A    R/W
VSAM03  333  C    R/W - OS
SYS109  190  S    R/O
SYS19E  19E  Y/S  R/O
```

Use the volume label VSAM03 in the MASTCAT AMSERV file:

```
DEFINE MASTERCATALOG -
   (NAME  (MASTCAT ) -
    VOLUME (VSAM03) -
    CYL (4) -
    FILE (IJSYSCT)   )
```

To find out what extents on this minidisk you can allocate for VSAM, use the LISTDS command with the FREE option:

```
listds d (free
```

The response from LISTDS might look like this:

```
FREESPACE INFORMATION FOR 'D' DISK:
CYL-HD(RELTRK) TO CYL-HD(RELTRK)   TRACKS
000 01      1     000 09      9        9
000 11     11     029 18    569      560
```

From this response, you can see that the VTOC is located on the first cylinder, so you can allocate cylinders 1 through 29 for VSAM:

```
dlbl ijsysct c dsn mastcat (perm extent
DMSDLB331R ENTER EXTENT SPECIFICATIONS:
19 551
     (null line)
```

After entering the extents, in tracks, giving the relative track number of the first track to be allocated followed by the number of tracks, you must enter a null line to complete the command. (A null line is required because, when you enter multiple extents, entries may be placed on more than one line.)

Now you can issue the AMSERV command:

```
amserv mastcat
```

A Ready message with no return code indicates that the master catalog is defined. You do not need to reissue the DLBL command in order to identify the master catalog for additional AMSERV functions.

Defining User Catalogs

You can use the AMSERV command to define private catalogs and spaces for them. The procedures for determining what space you can allocate are the same as those outlined in the example of defining a master catalog.

To define a user catalog, you can assign any ddname you want:

```
access 199 e
listds e (free
    .
    .
    .
dlbl cat1 e dsn private cat1 (extent
    .
    .
    .
amserv usercat
```

The file USERCAT AMSERV might contain the following:

```
DEFINE USERCATALOG -
     (NAME (PRIVATE.CAT1) -
      FILE  (CAT1) -
      CYL (4) -
      VOLUME (OSVSAM) -
      CATALOG (MASTCAT) )
```

After this AMSERV command has completed successfully you can use the catalog PRIVATE.CAT1. When you define a file cataloged in it, you identify it using the CAT option on the DLBL command:

```
dlbl file2 c dsn ? (cat cat1
```

Or, you can define it as a job catalog.

Using a Job Catalog

During a terminal session, you may be referencing the same private catalog many times. If this is the case, you can identify a job catalog by using the ddname IJSYSUC. Then, that catalog is searched during all subsequent jobs, unless you override it using the CAT option when you use the DLBL command to define a file.

If you defined a user catalog (IJSYSUC) for a terminal session and you use the AMSERV command to access a VSAM file, the user catalog takes precedence over the master catalog. This means that for files that already exist, the job catalog is searched. When you define a cluster, it is cataloged in the job catalog, rather than in the master catalog, unless you use the CAT option to override it. CMS never searches more than one VSAM catalog.

You should use the CAT option to name a catalog when the AMSERV file you are executing references, with the CATALOG parameter, a catalog that is not defined either as the master catalog or as a user catalog.

If you want to use additional catalogs during a terminal session, you first define them just as you would any other VSAM file:

```
dlbl mycat2 f dsn private cat2 (vsam
```

Then, when you enter the DLBL command for the VSAM file that is cataloged in PRIVATE.CAT2 use the CAT option to refer to the ddname of the catalog:

```
dlbl input f dsn input file (cat mycat2
```

If you want to stop using a job catalog defined with the ddname IJSYSUC, you can clear it using the CLEAR option of the DLBL command:

```
dlbl ijsysuc clear
```

or, you can assign the ddname IJSYSUC to some other catalog. If you clear the ddname for IJSYSUC, then the master catalog becomes the job catalog.

Catalog Passwords

When you define passwords for VSAM catalogs in CMS, or when you use CMS to access VSAM catalogs that have passwords associated with them, you must supply the password from your terminal when the AMSERV command executes. The message that you receive to prompt you for the password is the same message you receive when you execute Access Method Services:

```
4221A ATTEMPT 1 OF 2. ENTER PASSWORD FOR JOB AMSERV   FILE catalog
```

When you enter the proper password, AMSERV continues execution.

DEFINING AND ALLOCATING SPACE FOR VSAM FILES

You can use CMS AMSERV to allocate additional data spaces for VSAM. To use the DEFINE SPACE control statement, you must have defined either the master catalog or a user catalog which will control the space, and you must have the volume or volumes on which the space is to be allocated mounted and accessed.

For example, suppose you have an OS 3330 disk attached to your virtual machine at virtual address 255. After accessing the disk and determining the free space on it, you could create a file named SPACE AMSERV:

```
DEFINE SPACE -
   (FILE (FILE1) -
    TRACKS (1900) -
    VOLUME (123456) -
    CATALOG (PRIVATE.CAT2 CAT2) )
```

To execute this AMSERV file, you must define PRIVATE.CAT2 using the ddname CAT2, and then define the ddname for the file:

```
access 255 c
dlbl cat2 c dsn private cat2 (vsam
dlbl file1 c (extent cat cat2
```

You do not need to enter a data set name to define the space. When CMS prompts you for the extents of the space, you can enter the extent specifications:

```
DMSDLB331R ENTER EXTENT SPECIFICATIONS:
190 1900
   .
   .
   .
```

When you define space for VSAM, you should be sure that the VOLUMES parameter and the space allocation parameter (whether CYLINDER, TRACKS, or RECORDS) in the AMSERV file agree with the track information you provide in the DLBL command.

Specifying Multiple Extents

When you are specifying extents for a master catalog, data space, or unique file, you can specify up to 16 extents on a volume for a particular space. When prompted by CMS for the extents, you must separate the different extents by commas, or place them on different lines. To specify a range of extents in the above example, you could enter

```
dlbl file1 c (extent
190  190, 570  190, 1900 1520
   (null line)

  -- or --

dlbl file1 c (extent
190  190
570  190
1900 1520
   (null line)
```

Again, the first number entered for each extent represents the relative track for the beginning of the extent and the second number indicates the number of tracks.

Specifying Multivolume Extents

You can define spaces that span up to nine volumes for VSAM files; all of the volumes must be accessed and assigned when you issue the DLBL command to define or identify the data space.

You should remember, though, that if you are using AMSERV and you do not use the PRINT option, you must have a read/write CMS disk so that AMSERV can write the output LISTING file.

If you are defining a new multivolume data space or unique cluster, you must specify the extents on each volume that the data is to occupy (starting track and number of tracks), followed by the disk mode letter at which the disk is assigned:

```
access 135 b
access 136 c
access 137 d
dlbl newfile b (extent
DMSDLB331R ENTER EXTENT SPECIFICATIONS:
100 60 b, 400 80 b, 60 40 d ,
2000 100 c
   (null line)
```

If you enter more than one extent on the same line, the extents must be separated by commas; if you enter a comma at the end of a line, it is ignored. Different extents for the same volume must be entered consecutively. Note that in this example, the extent information is for 2314 disks and that these extents are also on cylinder boundaries.

When you enter multivolume extents, you do not have to enter a mode letter for those extents on the disk identified in the DLBL command. For the extents on disk B in the above example, you could enter

```
dlbl newfile b (extent
DMSDLB331R ENTER EXTENT SPECIFICATIONS:
100 400 80, 60, 60 40 d
2000 100 c
   (null line)
```

If you make any errors issuing the DLBL command or extent information, you must re-enter the entire command sequence.

IDENTIFYING EXISTING MULTIVOLUME FILES: When you issue a DLBL command to identify an existing multivolume VSAM file, you must use the MULT option of the DLBL command sequence:

```
dlbl old b1 dsn ? (mult
DMSDLB220R ENTER DATASET NAME:
vsamtest.file
DMSDLB330R ENTER VOLUME SPECIFICATIONS:
c, d
e
   (null line)
```

When you enter the DLBL command you should specify the mode letter for the first disk volume on the command line. When you enter the MULT option you are prompted to enter additional specifications for the remaining extents. In the above example, the data set has extents on disks accessed as B-, C-, D-, and E-disks.

USING TAPE INPUT AND OUTPUT

If you are using AMSERV for a function that requires tape input and/or output, you must have the tape(s) attached to your virtual machine. The valid addresses for tapes are 181, 182, 183, and 184. When referring to tapes, you can also refer to them using their CMS symbolic names TAP1, TAP2, TAP3, and TAP4.

When you use AMSERV to create or read a tape, you supply the ddname for the tape device interactively, after you issue the AMSERV command. To indicate to AMSERV that you are using tape for input or output, you must use the TAPIN or TAPOUT option to specify the tape device being used:

```
amserv export (tapout 181
```

In this example, the output from an EXPORT function is to a tape at virtual address 181. CMS prompts you to enter the ddname:

```
DMSAMS367R ENTER TAPE OUTPUT DDNAMES:
```

After you enter the ddname for the tape file, AMSERV begins execution.

Reading Tapes

When you create a tape file using AMSERV under CMS, CMS writes a tape mark preceding each output file. When CMS AMSERV is used to read this same file, it automatically skips past the tape mark to read the file. If you want to read the tape on a real OS/VS system, however, you must use the LABEL=(2,NL) parameter on the data definition (DD) card for the tape.

If you are creating a tape under OS/VS Access Method Services to be read by CMS AMSERV, you must be sure to create the tape using standard labels so that CMS can read it properly. CMS will not be able to read a tape created with LABEL=(,NL) on the DD card.

For CMS to read this tape for any other purpose (for example, to use the MOVEFILE command to copy it), you must remember to forward space the file past the tape mark before beginning to read it.

Using AMSERV Under CMS

This section provides examples of AMSERV functions executed under CMS. The examples are applicable to both the CMS (OS) and CMS/DOS environments. You should be familiar with the material presented in either "Defining DOS Input and Output Files" or "Defining OS Input and Output Files," depending on whether you are a DOS or an OS user, respectively. For the examples shown below, command lines and options that are required only for CMS/DOS users are shaded. OS users should ignore these shaded entries.

USING THE DEFINE AND DELETE FUNCTIONS

When you use the DEFINE and DELETE control statements of AMSERV, you do not need to specify the DSN parameter on the DLBL command:

```
assgn syscat c
dlbl ijsysct c (perm extent syscat
```

If the above commands are executed prior to an AMSERV command to define a master catalog, the DEFINE will be successful as long as you have assigned a data set name using the NAME parameter in the AMSERV file. The same is true when you define clusters, or when you use the DELETE function to delete a cluster, space, or catalog.

When you do not specify a data set name, AMSERV obtains the name from the AMSERV file. In the case of defining or deleting space, no data set name is needed; the FILE parameter corresponding to the ddname is all that is necessary, and AMSERV assigns a default data set name to the space.

When you define space on a minidisk using AMSERV, CMS does not check the extents you specify to see whether they are greater than the number of cylinders available. As long as the starting cylinder is a valid cylinder number and the extents you specify are on cylinder boundaries, the DEFINE function completes successfully. However, you receive an error message when you use an AMSERV function that tries to use this space.

Defining a Suballocated Cluster

To define a cluster for VSAM space that has already been allocated, you need (1) an AMSERV file containing the control statements necessary for defining the cluster, and (2) the master catalog (and, perhaps, user catalog) volume, which will point to the cluster. The volume on which the cluster is to reside does not have to be online when you define a suballocated cluster.

For example, the file CLUSTER AMSERV contains the following:

```
DEFINE CLUSTER  (  NAME (BOOK.LIST) -
      VOLUMES (123456) -
      TRACKS (40) -
      FILE (BOOK) -
      KEYS (14,0) RECORDSIZE (120,132)  ) -
    DATA (NAME (BOOK.LIST.DATA) ) -
    INDEX (NAME (BOOK.LIST.INDEX) )
```

To execute this file, you would need to enter the following command sequence (assuming that the master catalog, on volume 123456, is in your virtual machine at address 310):

```
access 310 b
assgn syscat b
dlbl ijsysct b (perm syscat
amserv cluster
```

Note that to define a suballocated cluster, you do not need to provide a DLBL command to define it to AMSERV.

Defining a Unique Cluster

For a unique cluster (one defined with the UNIQUE attribute), you must define the space for the cluster at the same time you define its name and attributes; thus the volume or volumes on which the cluster is to reside must be mounted and accessed when you execute the AMSERV command. You must supply extent information for the cluster's data and index portions separately.

To execute an AMSERV file named UNIQUE which contains the following (the ellipses indicate that the AMSERV file is not complete):

```
DEFINE CLUSTER -
      (NAME (PAYROLL) ) -
      DATA ( FILE (UDATA) -
             UNIQUE -
             VOLUMES (567890) -
             CYLINDERS (40) -
             ... ) -
      INDEX ( FILE (UINDEX) ) -
             UNIQUE -
             VOLUMES (567890) -
             CYLINDERS (10) -
             ... )
```

the command sequence should be:

```
access 350 c
assgn sys004 c
dlbl udata c (extent sys004
DMSDLB331R ENTER EXTENT SPECIFICATIONS:
800 800 c sys004
dlbl uindex c (extent sys004
600 200 c sys004
amserv unique
```

Deleting Clusters, Spaces, and Catalogs

When you use AMSERV to delete a VSAM cluster, the volume containing the cluster does not have to be accessed unless the volume also contains the catalog in which the cluster is defined. In the case of data spaces and user catalogs, or the master catalog, however, the volume(s) must be mounted and accessed in order to delete the space.

When you delete a cluster or a catalog, you do not need to use the DLBL command, except to define the master catalog; AMSERV can obtain the necessary file information from the AMSERV file. In the case of data spaces, you must supply a ddname (filename) with the DLBL command, but you do not need to use the DSN parameter.

You should be particularly careful when you are using temporary disks with AMSERV, that you have not cataloged a temporary data space or cluster in a permanent catalog. You will not be able to delete the space or cluster from the catalog.

USING THE REPRO, IMPORT, AND EXPORT (OR EXPORTRA/IMPORTRA) FUNCTIONS

You can manipulate VSAM files in CMS with the REPRO, IMPORT, and EXPORT functions of AMSERV. You can create VSAM files from sequential tape or disk files (on OS, DOS, or CMS disks) using the REPRO function. Using REPRO, you can also copy VSAM files into CMS disk files or onto tapes. For the IMPORT/EXPORT process, you have the option (for smaller files) of exporting VSAM files to CMS disks, as well as to tapes.

You cannot, however, use the EXPORT function to write files onto OS or DOS disks. Nor can you use the REPRO function to copy ISAM (indexed sequential) files into VSAM data sets, since CMS cannot read ISAM files.

You cannot use the ERASE or PURGE options of the EXPORT command if you are exporting a VSAM file from a read-only disk. The export operation succeeds, but the listing indicates an error code 184, meaning that the erase function could not be performed.

You should not use an EXPORT DISCONNECT function from a CMS minidisk and try to perform an IMPORT CONNECT function for that data set onto an OS system. OS incorrectly rebuilds the data set control block (DSCB) that indicates how much space is available.

The AMSERV file below gives an example of using the REPRO function to copy a CMS sequential file into a VSAM file. The CMS input file must be sorted in alphameric sequence before it can be copied into the VSAM file, which is a keyed sequential data set (KSDS). The VSAM cluster, NAME.LIST, is defined in an AMSERV file named PAYROLL:

```
DEFINE CLUSTER ( NAME (NAME.LIST  ) -
       VOLUMES (CMSDEV) -
       TRACKS (20) -
       FILE (BOOK) -
       KEYS (14,0) -
       RECORDSIZE (120,132) ) -
    DATA (NAME (NAME.LIST.DATA) ) -
    INDEX (NAME (NAME.LIST.INDEX ) )
```

To sort the CMS file, create the cluster and copy the CMS file into it, use the following commands:

```
sort name list a name sort a
DMSSRT604R ENTER SORT FIELDS:
1 14
access 135 c
assgn syscat c
dlbl ijsysct c (perm syscat
amserv payroll
assgn sys006 a
dlbl sort a cms name sort (sys006
assgn sys007 c
dlbl name c dsn name list (sys007 vsam
amserv repro
```

The file REPRO AMSERV contains:

```
REPRO   INFILE ( SORT  -
          ENV (RECORDFORMAT (F) -
               BLOCKSIZE (80) -
               PDEV (3330) ) ) -
         OUTFILE (NAME)
```

When you use the REPRO, IMPORT, or EXPORT functions with tape files, you must remember to use the TAPIN and TAPOUT options of the AMSERV command. These options perform two functions: they allow you to specify the device address of the tape, and they notify AMSERV to prompt you to enter a ddname.

In the example below, a VSAM file is being exported to a tape. The file, TEXPORT AMSERV, contains:

```
EXPORT  NAME.LIST -
        INFILE (NAME) -
        OUTFILE (TAPE ENV (PDEV (2400) ) )
```

To execute this AMSERV, you enter the commands as follows:

```
assgn sys006 c
dlbl name c (sys006 vsam
amserv texport (tapout 181
DMSAMS367R ENTER TAPE OUTPUT DDNAMES:
tape
```

WRITING EXECS FOR AMSERV AND VSAM

You may find it convenient to use EXEC procedures for most of your AMSERV functions, as well as setting up input and output files for program execution, and executing your VSAM programs. If, for example, a particular AMSERV function requires several disks and a number of DLBL statements, you can place all of the required commands in an EXEC file. For example, if the file below is named SETUP EXEC:

```
ACCESS 135 B
ACCESS 136 C
ACCESS 137 D
ACCESS 300 G
ASSGN SYSCAT G
DLBL IJSYSCT G (PERM
ASSGN SYS001 B
DLBL FILE1 B DSN FIRST FILE (VSAM
ASSGN SYS002 C
DLBL FILE2 C DSN SECOND FILE (VSAM
ASSGN SYS003 D
DLBL FILE3 D DSN THIRD FILE (VSAM
AMSERV MULTFILE
```

to invoke this sequence of commands, all you have to enter is the name of the EXEC:

```
setup
```

If you place, at the beginning of the EXEC file, the EXEC control statement

```
&ERROR &EXIT &RETCODE
```

then, you can be sure that the AMSERV command does not execute unless all of the prior commands completed successfully.

For those AMSERV functions that issue response messages, you can use the &STACK EXEC control statement. For example,

```
&ERROR &EXIT &RETCODE
ACCESS 305 D
ASSGN SYS007 D
DLBL OUTPUT D (VSAM
&ERROR &CONTINUE
&STACK TAPE
AMSERV TIMPORT (TAPIN 181
&IF &RETCODE NE 0 TYPE TIMPORT LISTING
TAPE REW
&EXIT 0
```

When the AMSERV command in the EXEC is executed, the request for the tape ddname is satisfied immediately, by the response stacked with the &STACK statement.

If you are executing a command that accepts multiple response lines, you have to stack a null line as follows:

```
&STACK C SYS002, D SYS003
&STACK
DLBL MULTFILE B (MULT
```

Note: You can use the &BEGSTACK control statement to stack a series of responses in an EXEC, but you must use &STACK to stack a null line.

Section 11. How VM/370 Can Help You Debug Your Programs

Debugging is a critical part of the program development process. When you encounter problems executing application programs, or when you want to test new lines of code, you can use a variety of CP and CMS debugging commands and techniques to explore your program while it is executing.

You can interrupt the execution of a program to examine and change your general registers, storage areas, or control words such as the Program Status Word (PSW), and then continue execution. Also, you can trace the execution of a program closely, so you can see where branches are being taken, and when supervisor calls or I/O interrupts occur.

In many cases, you may never need to look at a dump of a program to identify a problem.

Preparing To Debug

Before beginning to debug a program, you should have a current program listing for reference. When you use VM/370 to debug a program, you can monitor program execution, instruction by instruction, so you must have an accurate list of instruction addresses and addresses of program storage areas. You can obtain a listing of your program by using the PRINT command to print the LISTING file created by the assembler or compiler. To determine the virtual storage locations of program entry points, use the LOAD MAP file created by the LOAD and INCLUDE commands. If you are a CMS/DOS user, use the linkage editor map produced by the DOSLKED command.

If the program that you are debugging creates printed or punched output, and you will be executing the program repeatedly, you may not wish all of the output printed or punched. You should place your printer or punch in a hold status, so that any files spooled to these devices are not released until you specifically request it:

```
cp spool printer hold
cp spool punch hold
```

When you are finished debugging you can use the CP QUERY command to see what files are being held and then you can select which files you may want to purge or release.

When a Program Abends

The most common problem you might encounter is an abnormal termination resulting from a program interruption. When a program running in a CMS virtual machine abnormally terminates (abends), you receive, at your terminal, the message

```
DMSITP141T exception EXCEPTION OCCURRED AT address IN ROUTINE name
```

and your virtual machine is returned to the CMS environment. From the message you can determine the type of exception (program check, operation, specification, and so on), and, often, the instruction address in your program at which the error occurred.

Sometimes this is enough information for you to correct the error in your source program, recompile it and attempt to execute it again.

When this information does not immediately identify the problem in your program, you can begin debugging procedures using VM/370. To access your program's storage areas and registers you can enter the command

```
debug
```

immediately after receiving the abend message. This command places your virtual machine in the debug environment.

To check the contents of general registers 0 through 15, issue the DEBUG subcommand

```
gpr 0 15
```

If you want to look at only one register, enter

```
gpr 3
```

You might also wish to check the Program Status Word (PSW). Use the PSW subcommand:

```
psw
```

You can examine storage areas in your program using the X subcommand:

```
X 201AC 20
```

In this example, the subcommand requests a display of 20 bytes, beginning at location 201AC in your program. User programs executed in CMS are always loaded beginning at location X'20000' unless you specify a different address on the LOAD or FETCH command. To identify the virtual address of any instruction in a program, you only need to add 20000 to the hexadecimal instruction address.

RESUMING EXECUTION AFTER A PROGRAM CHECK

On occasion, you will be able to determine the cause of a program check and continue the execution of your program. There are DEBUG subcommands you can use to alter your program while it is in storage and resume execution.

If, for example, the error occurred because you had forgotten to initialize a register to contain a zero, you could use the DEBUG subcommand SET to place a zero in the register, and then resume execution with the GO subcommand. You can use the GO subcommand to specify the instruction address to which you want execution to begin:

```
set gpr 11 0000
go 200B0
```

An alternate method of specifying a starting address for execution to resume is by using the SET subcommand to change the last word of the PSW:

```
set psw  0  000200B0
go
```

If your program executes successfully, you can then make the necessary changes to your source file, recompile, and continue testing.

Using DEBUG Subcommands to Monitor Program Execution

The preceding examples did not represent a wide range of the possibilities for DEBUG subcommands. Nor do they represent the only way to approach program debugging. Some additional DEBUG subcommands are illustrated below. For complete details in using these subcommands, refer to the VM/370: CMS Command and Macro Reference.

When you prepare to debug a program with known problems, or when you are beginning to debug a program for the first time, you might want to stop program execution at various instructions, and examine the registers, constants, buffers, and so on. To temporarily stop program execution, use the BREAK subcommand to set breakpoints. You should set breakpoints after you load the program into storage, but before you begin executing it. You can set up to 16 breakpoints at one time. For each breakpoint, you assign a value (id), and an instruction address:

```
load myprog
debug
break 0  20BC0
break 1  20C10
break 2  20D00
```

Then, you can return to CMS and begin execution:

```
return
start
```

When the first breakpoint in this example is encountered, you receive the messages

```
DEBUG ENTERED.
BREAKPOINT 1 AT 20BC0
```

Then, in the debug environment, use the subcommands GPR, CSW, CAW, PSW, and X to display registers, control words, or storage locations.

You can resume program execution with the GO subcommand:

```
go
```

If, at any time, you decide that you do not want to finish executing your program, but want to return to the CMS environment immediately, you must use the HX subcommand

```
hx
```

There are three subcommands you can use to exit from the debug environment:

1. RETURN, to return to the CMS environment when DEBUG is entered with the DEBUG command.
2. GO, to resume program execution when it has been interrupted by a breakpoint.
3. HX, to halt program execution entirely and return to the CMS environment.

If you try to leave the debug environment with the wrong subcommand you receive the message

```
INCORRECT DEBUG EXIT
```

and you have to enter the proper subcommand.

USING SYMBOLS WITH DEBUG

To simplify the process of debugging in the CMS debug environment, you can use the ORIGIN and DEFINE subcommands. The ORIGIN command allows you to set an instruction location to serve as the base for all the addresses you specify. For example, if you specify

```
origin  20000
```

then, to refer to your virtual storage location 201BC, you only need to enter

```
x 1bc
```

By setting the DEBUG origin at your program's base address, you can refer to locations in your program by the virtual storage numbers in the listing, rather than having to compute the actual virtual storage address each time. The current DEBUG origin stays in effect until you set it to a different value or until you reload CMS (with the IPL command).

You can use the DEFINE subcommand to assign symbolic names to storage locations so that you can reference those locations by symbol, rather than by storage address. For example, suppose that during a DEBUG session you will repeatedly be examining three particular storage locations labeled in your program NAME1, NAME2, and NAME3. They are at locations 20EF0, 20EFA, and 20F04. Enter:

```
load nameprog
debug
origin 20000
define name1 EF0  10
define name2 EFA  10
define name3 F04  10
break 1 a04
return
start
```

When the specified breakpoint is encountered, you can examine these storage areas by entering:

```
x name1
x name2
x name3
```

You can also refer to these symbols by name when you use the STORE subcommand:

```
store name2 c4c5c3c5c1e4e5d6c9d9
```

The names you specify do not have to be the same as the labels in the program; you can define any name up to 8 characters.

Figure 17 summarizes the DEBUG subcommands.

Subcommand Format	Function
BReak id {symbol / hexloc}	Stops program execution at the specified breakpoint.
CAW	Displays the contents of the Channel Address Word.
CSW	Displays the contents of the Channel Status Word.
DEFine symbol hexlcc [bytecount 4]	Assigns a symbolic name to the virtual storage address.
DUmp [symbol1 / hexloc1 0] [symbol2 / hexloc2 * / 32] [ident]	Dumps the contents of specified virtual storage locations to the virtual spooled printer.
GO [symbol / hexloc]	Returns control to your program and starts execution at the specified location.
GPR reg1 [reg2]	Displays the contents of the specified general registers.
HX	Halts execution and returns to the CMS command environment.
ORigin [symbol / hexloc 0]	Specifies the base address to be added to locations specified in other DEBUG subcommands.
PSW	Displays the contents of the old Program Status Word.
RETurn	Exits from debug environment to the CMS command environment.
SET {CAW hexinfo / CSW hexinfo [hexinfo] / PSW hexinfo [hexinfo] / GPR reg hexinfo [hexinfo]}	Changes the contents of specified control words or registers.
STore {symbol / hexloc} hexinfo [hexinfo]	Stores up to 12 bytes of information starting at the specified virtual storage location.
X {symbol [n / length] / hexloc [n / 4]}	Examines virtual storage locations.

Figure 17. Summary of DEBUG Subcommands

What To Do When Your Program Loops

If, when your program is executing, it seems to be in a loop, you should first verify that it is looping, and then interrupt its execution and either (1) halt it entirely and return to the CMS environment or (2) resume its execution at an address outside of the loop.

The first indication of a program loop may be either what seems to be an unreasonably long processing time, or, if you have a blip character defined, an inordinately large number of blips.

You can verify a loop by checking the PSW frequently. If the last word repeatedly contains the same address, it is a fairly good indication that your program is in a loop. You can check the PSW by using the Attention key to enter the CP environment. You are notified by the message

```
CP
```

that your virtual machine is in the CP environment. You can then use the CP command DISPLAY to examine the PSW

```
cp display psw
```

and then enter the command BEGIN to resume program execution:

```
cp begin
```

If you are checking for a loop, you might enter both commands on the same line using the logical line end:

```
cp d p#b
```

When you have determined that your program is in a loop, you can halt execution using the CMS Immediate command HX. To enter this command, you must press the Attention key once to interrupt program execution, then enter

```
hx
```

If you want your program to continue executing at an address past the loop, you can use the CP command BEGIN to specify the address at which you want to continue execution:

```
cp begin 20cd0
```

Or, you could use the CP command STORE to change the instruction address in the PSW before entering the BEGIN command:

```
cp store psw 0 20cd0#begin
```

Tracing Program Activity

When your program is in a loop, or when you have a program that takes an unexpected branch, you might need to trace the execution closely to determine at what instruction the program goes astray. There are two commands you can use to do this. The SVCTRACE command is a CMS command which traces all SVCs (supervisor calls) in your program. The TRACE command is a CP command which allows you to trace different kinds of information, including supervisor call instructions.

USING THE CP TRACE COMMAND

You can trace the following kinds of activity in a program using the CP TRACE command:

- Instructions
- Branches
- Interrupts (including program, external, I/O and SVC interrupts)
- I/O and channel activity

When the TRACE command executes, it traces all your virtual machine's activity; when your program issues a supervisor call, or calls any CMS routine, the TRACE continues.

You can make most efficient use of the TRACE command by starting the trace at a specific instruction location. You should set an address stop for the location. For example, if you are going to execute a program and you want to trace all of the branches made, you would enter the following sequence of commands to begin executing the program and start the trace:

```
load progress
cp adstop 20004
start
ADSTOP AT 20004
cp trace branch
cp begin
```

Now, whenever your program executes a branch instruction, you receive information at the terminal that might look like this:

```
02001E BALR  05E6    ==> 020092
```

This line indicates that the instruction at address 2001E resulted in a branch to the address 020092. When this information is displayed, your virtual machine is placed in the CP environment, and you must use the BEGIN command to continue execution:

```
cp begin
```

When you locate the branch that caused the problem in your program, you should terminate tracing activity by entering

```
cp trace end
```

and then you can use CP commands to continue debugging or you can use the EXTERNAL command to cause an external interrupt that places your virtual machine in the debug environment:

```
cp external
```

You receive the message

```
DEBUG ENTERED.
EXTERNAL INTERRUPT
```

And you can use the DEBUG subcommands to investigate the status of your program.

Controlling a CP Trace

There are several things you can do to control the amount of information you receive when you are using the TRACE command, and how it is received. For example, if you do not want program execution to halt every time a trace output message is issued, you can use the RUN option:

```
cp trace svc run
```

Then, you can halt execution by pressing the Attention key when the interrupt you are waiting for occurs. You should use this option if you do not want to halt execution at all, but merely want to watch what is happening in your program.

Similarly, if you do not require your trace output immediately, you can specify that it be directed to the printer, so that your terminal does not receive any information at all:

```
cp trace inst printer
```

When you direct trace output to a printer, the trace output is mixed in with any printed program output. If you want trace output separated from other printed output, use the CP DEFINE command to define a second printer at a virtual address lower than that of your printer at 00E. For example:

```
cp define printer 006
```

Then, trace output will be in a separate spool file. CMS printed output always goes to the printer at address 00E.

When you finish tracing, use the CP CLOSE command to close the virtual printer file:

```
cp close e

  -- or --

cp close 006
```

If you want trace output at the printer and at the terminal, you can use the BOTH option:

```
cp trace all both
```

Suspending Tracing

If you are debugging a program that does a lot of I/O, or that issues many SVCs, and you are tracing instructions or branches, you might not wish to have tracing in effect when the supervisor or I/O routine has control. When you notice that addresses being traced are not in your program, you can enter

```
cp trace end
```

and then set an address stop at the location in your program that receives control when the supervisor or I/O routine has completed:

```
cp adstop 20688
begin
```

Then, when this address is encountered, you can re-enter the CP TRACE command.

USING THE SVCTRACE COMMAND

If your program issues many SVCs, you may not get all of the information you need using the CP TRACE command. The SVCTRACE command is a CMS command, which provides more detailed information about all SVCs in your program, including register contents before and after the SVC, the name of the called routine, and the location from which it was called, and the contents of the parameter list passed to the SVC.

The SVCTRACE command has only two operands, ON and OFF, to begin and end tracing. SVCTRACE information can be directed only to the printer, so you do not receive trace information at the terminal.

Since the SVCTRACE command can only be entered from the CMS environment, you must use the Immediate commands SO (suspend tracing) or HO (halt tracing) if you want tracing to stop while a program is executing. Use the Immediate command RO to resume tracing.

Since the CMS system is "SVC-driven", this debugging technique can be useful, especially, when you are debugging CMS programs. For more information on writing programs to execute in CMS, see "Section 13. Programming for the CMS Environment."

Using CP Debugging Commands

In addition to the CMS debugging facilities, there are CP commands that you can use to debug your programs. These commands are:

- DISPLAY, which you can use to examine virtual storages, registers, or control words, like the PSW.
- ADSTOP, which you can use to set an instruction address stop in your program.
- STORE, which you can use to change the contents of a storage location, register, or control word.

When you use the display command, you can request an EBCDIC translation of the display by prefacing the location you want display with a "T":

```
cp display t20000.10
```

This command requests a display of X'10' (16) bytes beginning at location X'20000'. The display is formatted 4 words to a line, with EBCDIC translation at the left, much as you would see it in a dump.

You can also use the DISPLAY command to examine the general registers. For example, the commands:

```
cp display g
cp display g1
cp display g2-5
```

result in displays of all the general registers, of general register 1, and of a range of registers 2 through 5.

The DISPLAY command also displays the PSW, CAW, and CSW:

```
cp display psw
cp display caw
cp display csw
```

With the STORE command, you can change the contents of registers, storage areas, or the PSW.

As you can see, the CMS DEBUG subcommands and the CP commands ADSTOP, DISPLAY, and STORE, have many duplicate functions. The environment you choose to work in, CP or debug, is a matter of personal preference. The differences are summarized in Figure 18. What you should be aware of, however, is that you should never attempt to use a combination of CP commands and DEBUG subcommands when you are debugging a program. Since DEBUG itself is a program, when it is running (that is, when you are in the debug environment), the registers that CP recognizes as your virtual machine's registers are actually the registers being used by DEBUG. DEBUG saves your program's registers and PSW and keeps them in a special save area. Therefore, if you enter the DEBUG and CP commands to display registers, you will see that the register contents are different:

```
gpr 0 15
#cp d g
```

DEBUGGING WITH CP AFTER A PROGRAM CHECK

When a program that is executing under CMS abends because of a program check, the DEBUG routine is in control and saves your program's registers, so that if you want to begin debugging, you must use the DEBUG command to enter the debug environment.

You can prevent DEBUG from gaining control when a program interrupt occurs by turning on the wait bit in the program new PSW (location X'68' in low storage):

```
cp store 68 00020000
```

You should do this before you begin executing your program. Then, a program check occurs during execution, when CP tries to load the program new PSW, the wait bit forces CP into a disabled wait state and you receive the message

```
DMKDSP450W CP ENTERED; DISABLED WAIT PSW
```

All of your program's registers and storage areas remain exactly as they were when program interrupt occurred. The PSW that was in effect when your program was interrupted is in the program old PSW, at location X'28'. Use the DISPLAY command to examine its contents:

```
cp display 28.8
```

The program new PSW, or the PSW you see if you enter the command DISPLAY PSW contains the address of the DEBUG routine.

If, after using CP to examine your registers and storage areas, you can recover from the problem, you must use the STORE command to restore the PSW, specifying the address of the instruction just before the one indicated at location X'28'. For example, if the instruction address in your program is X'566' enter:

```
cp store psw 0 20566
cp begin
```

In this example, setting the first word of the PSW to 0 turns the wait bit off, so that execution can resume.

Program Dumps

When a program you execute under CMS abnormally terminates, you do not automatically receive a program dump. If, after attempting to use CMS and CP to debug interactively, you still have not discovered the problem, you may want to obtain a dump. You might also want to obtain a dump if you find that you are displaying large amounts of information, which is not practical on a terminal.

Depending on whether you are using CMS DEBUG or CP to do your debugging, you can use the DUMP command to specify storage locations you want printed. The formats of the DUMP command (CP) and the DUMP subcommand (DEBUG) are a little different. See VM/370: CMS Command and Macro Reference for a discussion of the DEBUG subcommand, DUMP; see VM/370: CP Command Reference for General Users for a discussion of the CP DUMP command.

In either event, you can selectively dump portions of your virtual storage, your entire virtual storage area, or portions of real storage. For example, to dump the virtual storage space that contains your program from the debug environment you would enter

```
cp dump 20000 20810
```

The second value depends upon the size of your program.

From the CP environment, enter

```
cp dump t20000-20810
```

The CP DUMP command allows you to request EBCDIC translation with the hexadecimal dump. The dump produced by the DEBUG subcommand does not provide EBCDIC translation.

Debugging Modules

You can debug nonrelocatable MODULE files (created with the GENMOD command) in the same way you can debug object modules (TEXT files).

To load the MODULE into storage, use the LOADMOD command:

```
loadmod mymod
cp adstop 201C0
start
```

If you make any changes to the module while it is in your virtual storage area and then issue the GENMOD command, the changes are a permanent part of the executable module:

```
loadmod mymod
cp store 201C0 0002
genmod mymod
```

To debug MODULE files in this manner, you must have a listing of the program as it existed when the module was created.

Comparison Of CP And CMS Facilities For Debugging

If you are debugging problems while running CMS, you can choose the CP or CMS debugging tools. Refer to Figure 18 for a comparison of the CP and CMS debugging tools.

Function	CP	CMS
Setting address stops.	Can set only one address stop at a time.	Can set up to 16 address stops at a time.
Dumping contents of storage to the printer.	The dump is printed in hexadecimal format with EBCDIC translation. The storage address of the first byte of each line is identified at the left.	The dump is printed in hexadecimal format. The storage address of the first byte of each line is identified at the left. The contents of general and floating-point registers are printed at the beginning of the dump.
Displaying the contents of storage and control registers at the terminal.	The display is typed in hexadecimal format with EBCDIC translation. The CP command displays storage keys, floating-point registers and control registers.	The display is typed in hexadecimal format. The CMS commands do not display storage keys, floating-point registers or control registers as the CP command does.
Storing information.	The amount of information stored by the CP command is limited only by the length of the input line. The information can be fullword aligned when stored. CP stores data in floating-point and control registers, as well as in general registers. CP stores data in the PSW, but not in the CAW or CSW. However, data can be stored in the CSW or CAW by specifying the hardware address in the STORE command.	The CMS command stores up to 12 bytes of information. CMS stores data in the general registers but not in the floating-point or control registers. CMS stores data in the PSW, CAW, and CSW.
Tracing information.	CP traces: • All interrupts, instructions, and branches • SVC interrupts • I/O interrupts • Program interrupts • External interrupts • Privileged instructions • All user I/O operations • Virtual and real CCW's • All instructions The CP trace is interactive. You can stop it and display other fields.	CMS traces all SVC interrupts. CMS displays the contents of general and floating-point registers before and after a routine is called. The parameter list is recorded before a routine is called.

Figure 18. Comparison of CP and CMS Facilities for Debugging

What Your Virtual Machine Storage Looks Like

Figure 19 illustrates a simplified CMS storage map. The portion of storage that is of most concern to you is the user program area, since that is where your programs are loaded and executed. The user program area and some of the other areas of storage shown in the figure are discussed below in general terms.

When you issue a LOAD command (for OS or CMS programs) or a FETCH command (for DOS programs), and you do not specify the ORIGIN option, the first, or only, program you load is loaded at location X'20000', the beginning of the user program area.

The upper limit, or maximum size, of the user program area is determined by the storage size of your virtual machine. You can find out how large your virtual machine is by using the CP QUERY command:

```
cp query virtual storage
```

If you need to increase the size of your virtual machine, then you must use the CP command DEFINE. For example

```
cp define storage 1024k
```

increases the size of your virtual machine to 1024K bytes. If you are in the CMS environment when you enter this command, you receive a message like:

```
STORAGE = 01024K
DMKDSP450W CP ENTERED; DISABLED WAIT PSW '00020000 00000000'
```

and you must reload CMS with the IPL command before you can continue.

You might need to redefine your virtual machine to a larger size if you execute a program that issues many requests for free storage, with the OS GETMAIN or DOS/VS GETVIS macros. CMS allocates this storage from the user program area.

At the top of the user program area are the loader tables, that are used by the CMS loader to point to programs that have have been loaded. You can increase the size of this area with the CMS SET LDRTBLS command. If you use the SET LDRTBLS command, you should issue it immediately after you IPL CMS.

The transient program area is used for loading and executing disk-resident CMS MODULE files that have been created using the ORIGIN TRANS option of the LOAD command, followed by the GENMOD command. For more information on CMS MODULE files and the transient area, see "Executing Program Modules" in "Section 13. Programming for the CMS Environment."

SHARED AND NONSHARED SYSTEMS

The areas in storage labelled in Figure 19 as the CMS nucleus and the DCSS are system programs that are loaded by various types of requests. When you enter the command

```
cp ipl cms
```

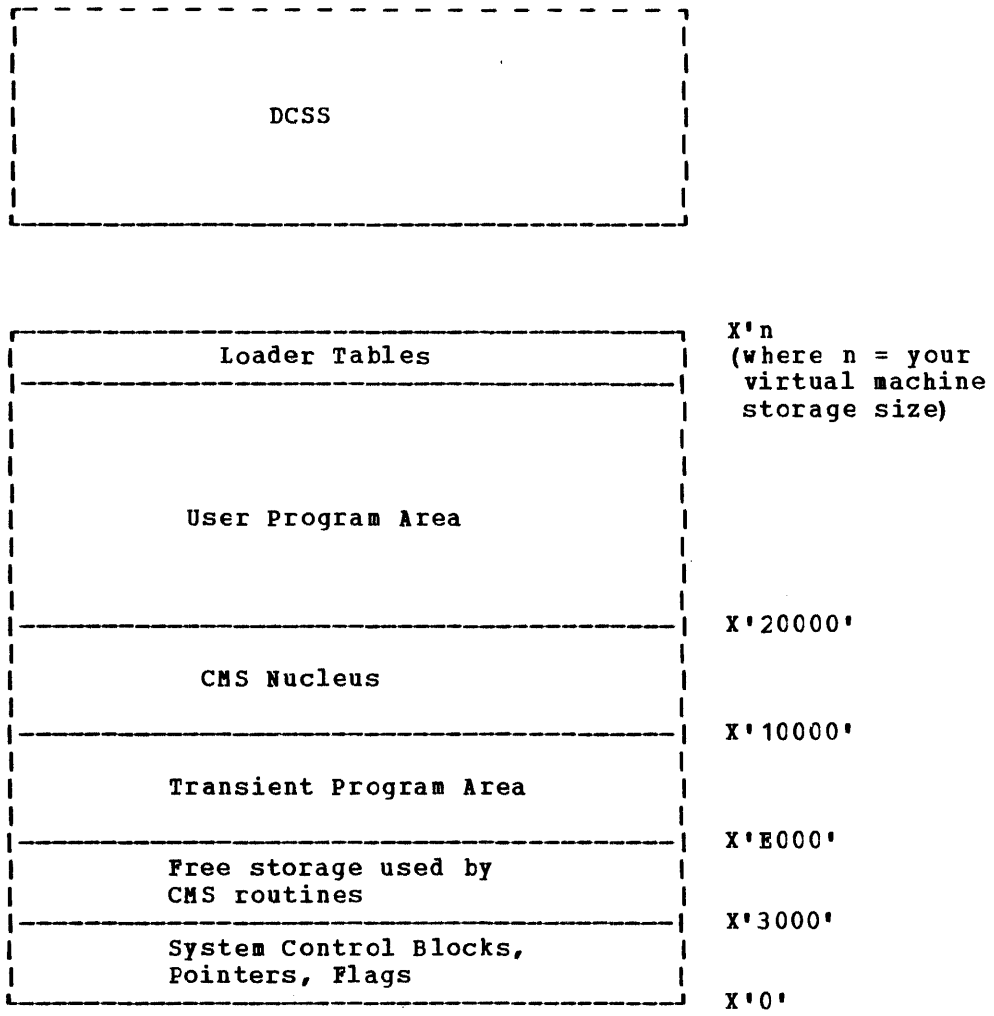


Figure 19. Simplified CMS Storage Map

the area shown as the CMS nucleus is loaded with the CMS system, which is known to CP by its saved name, CMS. This saved system is a copy of the CMS system that is available for many users to share. When you are using CMS, you share it with other users who have also issued the IPL command to load the saved CMS system. By having many users share the same system, CP can manage system resources more efficiently.

Under some circumstances, you may need to load the CMS system into your virtual machine by entering the IPL command as follows:

```
cp ipl 190
```

This IPL command loads the CMS system by referring to its virtual address, which in most installations is 190. The copy of CMS you load this way is nonshared; it is your own copy, but it is the same system, functionally, as the saved system CMS.

Some of the CP and CMS debugging commands do not allow you to trace or store information that is contained in shared areas of your virtual machine. For example, if you have entered the command

```
cp trace inst
```

to trace instructions in your virtual machine, some of the instructions may be located in the CMS nucleus. If you have a shared copy of CMS, you receive a message like

```
DMKVMA181E SHARED SYSTEM XCMS     REPLACED WITH NONSHARED COPY
```

and CP loads a copy of CMS for you that you do not share with other users.

Discontiguous Shared Segments (DCSS)

Some CMS routines and programs are stored on disks, and loaded into storage as needed. These segments include the CMS Editor, EXEC processor, and OS simulation routines; CMS/DOS; VSAM; and Access Method Services. Beyond the end of your virtual machine address space is an area of storage into which these segments are loaded when you need them. Since this area is not contiguous with your virtual storage, the segments that are loaded in this area are called discontiguous shared segments.

These segments are loaded only when you need them, and are released from the end of your virtual machine when you are through using them. Like the CMS system, they are saved systems, and can be shared by many users. For example, whenever you issue the EDIT command the segment named CMSSEG is loaded; when you enter the EDIT subcommands FILE or QUIT, the saved system CMSSEG is released. The other segments are named CMSDOS (for CMS/DOS), CMSVSAM (for VSAM interfaces), and CMSAMS (for Access Method Services Interfaces).

If during the course of debugging, you need a nonshared copy of one of these segments, you can use the SET command with the NONSHARE operand, for example

```
set nonshare cmsseg
```

If you do not specifically request a nonshared copy before you issue a command that alters a shared segment, CP replaces the shared copy with a nonshared copy for you and issues the DMKVMA181E message.

For additional information on saved systems, discontiguous shared segments, and CMS virtual storage, see the VM/370: System Programmer's Guide.

Section 12. Using the CMS Batch Facility

The CMS Batch Facility provides a way of submitting jobs for batch processing in CMS. You can use the CMS Batch Facility when:

- You have a job (like an assembly or execution) that takes a lot of time, and you want to be able to use your terminal for other work while the time-consuming job is being run.
- You do not have access to a terminal.

The CMS Batch Facility is really a virtual machine, generated and controlled by the system operator, who logs on VM/370 using the batch userid and invoking the CMSBATCH command. All jobs submitted for batch processing are spooled to the userid of this virtual machine, which executes the jobs sequentially. To use the CMS Batch Facility at your location, you must ask the system operator the userid of the batch virtual machine.

Submitting Jobs to the CMS Batch Facility

Under a real OS or DOS system, jobs submitted in batch mode are controlled by JCL specifications. Batch jobs submitted to the CMS Batch Facility are controlled by the control cards /JOB, /SET, and /*, and by CMS commands.

Any application or development program written in a language supported by VM/370 may be executed on the batch facility virtual machine. However, there are restrictions on programs using certain CP and CMS commands, as described later in this section.

INPUT TO THE BATCH MACHINE

Input records must be in card-image format, and may be punched on real cards, placed in a CMS file with fixed-length, 80-character records, or punched to your virtual card punch. These jobs are sent to the batch virtual machine in one of two ways:

- By reading the real punched card input into the system card reader.
- By spooling your virtual card punch to the virtual reader of the batch virtual machine.

When you submit a real card deck to the batch machine, the first card in the deck must be a CP ID card. The ID card takes the form:

```
ID  userid
```

where ID must begin in card column one and be separated from userid (the batch facility virtual machine userid) by one or more blanks.

For example, if your installation's batch virtual machine has a userid of BATCH1, you punch the card:

```
ID BATCH1
```

and place it in front of your deck.

When you are going to submit a job using your virtual card punch, you must first be sure that your punch is spooled to the virtual reader of the batch virtual machine:

```
cp spool punch to batch1
```

Submitting Virtual Card Input to the CMS Batch Facility

Virtual card input can be spooled to the batch machine in several ways. You may create a CMS file that contains the input control cards and use the CMS PUNCH command to punch the virtual cards:

```
punch batch jcl (noheader
```

When you punch a file this way, you must use the NOHEADER option of the PUNCH command, since the CMS Batch Facility cannot interpret the header card that is usually produced by the PUNCH command. As it does with cards in an invalid format, the batch virtual machine would flush the header card.

You can use an EXEC procedure to submit input to the batch machine. From an EXEC, you can punch one line at a time into your virtual punch, using the &PUNCH and &BEGPUNCH EXEC control statements. When you do this, you must remember to use the CP CLOSE command to release the spool punch file when you are finished:

```
CP CLOSE PUNCH
```

If you are using the EXEC to punch individual lines and entire CMS files to be read by the batch virtual machine as one continuous job stream, you must remember to spool your punch accordingly:

```
CP SPOOL PUNCH CONT
&PUNCH /JOB BOSWELL 999888
PUNCH BATCH JCL * (NOHEADER
CP SPOOL PUNCH NOCONT
CP CLOSE PUNCH
```

The /JOB and /* Cards

A /JOB card must precede each job to be executed under the batch facility. It identifies your userid to the batch virtual machine and provides accounting information for the system. It takes the form:

```
/JOB  userid accntnum [jobname] [comments]
```

where:

userid is your user identification, or the userid under which you want the job submitted. This parameter controls: (1) The userid charged by the CP accounting routines for the system resources used during a job. (2) The name and distribution code that appear on any spooled printer or punch output. (3) The userid to whom status messages are sent while the batch machine is executing the job.

accntnum is your account number. This account number appears in the accounting data generated at the end of your job. It overrides the account number in the CP directory entry for the userid specified for this job.

jobname is an optional parameter that specifies the name of the job being run. If you specify a jobname, it appears as the in the CP spool file identification in the filetype field. The filename field always contains CMSBATCH. See "Batch Facility Output" below.

comments may be any additional information you want to provide.

The /* card indicates the end of a job to the batch facility. It takes the form:

```
| /*                                                                    |
```

The batch facility treats all /* cards after the first as null cards. Therefore, if you want to ensure against the previous jcb not having a /* end-of-job indicator, you should precede your /JOB card with a /* card.

The /* card is also treated as an end-of-file indicator when a file is being read from the input stream. This is a special technique used in submitting source or data files through the card reader, and is discussed under "A Batch EXEC for Non-CMS Users."

The /SET Card

The /SET card sets limits on a system's time, printing, and punching resources during the execution of a job. It takes the form:

```
| /SET  [TIME seconds] [PRINT lines] [PUNCH cards]                      |
```

where:

seconds is a decimal value that specifies the maximum number of seconds of virtual CPU time a job can use.

lines is a decimal value that specifies the maximum number of lines a job can print.

cards is a decimal number that specifies the maximum number of cards a job can punch.

The default values for the batch facility are set at 32,767 seconds, printed lines, and punched cards per job. Any new limits defined using the /SET card must be less than these maximum settings. The system resources can be set at lesser values than the default values by an installation's system programmer; be sure you know the maximum installation values for batch resource limits before you use the /SET card.

HOW THE BATCH FACILITY WORKS

The CMS Batch Facility, once initialized, runs continuously. When it begins executing a job, it sends a message to the userid of the user submitting the job. So, if you are logged on when the batch machine begins executing a job you sent it, you receive the message:

```
MSG FROM BATCHID:  JOB 'yourjob' STARTED
```

When the batch machine finishes processing a job, it sends the message:

```
MSG FROM BATCHID:  JOB 'yourjob' ENDED
```

where yourjob is the jobname you specified on the /JOB card. Before it reads the next job from its card reader, the batch virtual machine:

- Closes all spooling devices and releases spool files.
- Resets any spooling devices identified by the CP TAG command.
- Detaches any disk devices that were accessed.
- Punches accounting information to the system.
- Reloads CMS.

All of this "housekeeping" is done by the CMS Batch Facility so that each job that is executed is unaffected by any previous jobs.

If a job that you send to the batch virtual machine terminates abnormally (abends), the batch machine sends you a message:

```
MSG FROM BATCHID:  JOB 'yourjob' ABEND
```

and spools a CP storage dump of your virtual machine to the printer. The remainder of your job is flushed.

Whenever the batch virtual machine has read and executed all of the jobs in its card reader, it waits for more input.

Preparing Jobs for Batch Execution

When you want to submit a job to the CMS Batch Facility for execution, you should provide the same CMS and CP commands you would use to prepare to execute the same job in your own virtual machine.

You must provide the batch virtual machine with read access to any disk input files that are required for the job. You do this by supplying the LINK and ACCESS command lines necessary. The batch virtual machine has an A-disk (195), so you can enter commands to access your disks as read-only extensions. For example, if you wanted the batch machine to execute a program module named LONDON on your 291 disk, your input file might contain the following:

```
/JOB FISH 012345
CP LINK BOSWELL 291 291 RR SECRET
ACCESS 291 B/A
LONDON
```

Similarly, if you are using the batch virtual machine to execute a program using input and output files, you must supply the file definitions:

```
CP LINK ARDEN 391 391 RR FOREST
ACCESS 391 B/A
FILEDEF INFILE D VITAL STAT
FILEDEF OUTFILE PUNCH
CP SPOOL PUNCH TO BOSWELL
LONDON
```

If you expect printed or punched output from your job, you may need to include the spooling commands necessary to control the output. In the above example, the batch machine's punch is spooled to userid BOSWELL's virtual reader.

Any output printer files produced by your job are spooled by the batch virtual machine to the printer. These files are spooled under your userid and with the distribution code associated with your userid. You can change the characteristics of these output files with the CP SPOOL command:

```
CP SPOOL E CLASS T
```

If you want output to appear under a name other than your userid, use the FOR operand of the SPOOL command:

```
CP SPOOL E FOR JONSON
```

Output punch files are spooled, by default, to the real system card punch (under your userid), unless you issue a SPOOL command in the batch job to control the virtual card punch of the batch virtual machine.

RESTRICTIONS ON CP AND CMS COMMANDS IN BATCH JOBS

The batch facility permits the use of many CP and most CMS commands. The following CP commands can be used to control the batch virtual machine:

CHANGE[1]	MSG
CLOSE[1]	QUERY
DETACH[2]	REWIND
DUMP	SPOOL[1]
DISPLAY	STORE
LINK[3]	TAG

Notes:

1. These commands may not be used to affect the virtual card reader.

2. You can not use this command to detach any spooling devices or the system or IPL disks.

3. The LINK command must be entered on one line in the format

   ```
   CP LINK userid vaddr vaddr mode password
   ```

   None of the LINK command keywords (AS, PASS, TO) are accepted. If the disk has no password associated with it, you must enter the

password as ALL. A maximum of 10 links may be in effect at any one time.

All CP commands in a batch job must be prefaced with the "CP" command.

Since the batch virtual machine reads input from its card reader, you can not use the following commands or operands that affect the card reader:

```
ASSGN SYSxxx READER (CMS/DOS only)
DISK LOAD
FILEDEF READER
READCARD
```

Invalid SET command operands are:

```
BLIP     OUTPUT
EMSG     REDTYPE
IMPCP    RELPAGE
INPUT    PROTECT
```

All the other operands of the SET command can be used in a job executing in the batch virtual machine.

BATCH FACILITY OUTPUT

Any files that you request to have printed during your job's execution are spooled to the real system printer under your userid, unless you have spooled it otherwise. Once released for processing, these output files are under the control of the CP spooling facilities; if you are logged on, you can control the disposition of these files before they are printed with the CLOSE, PURGE, ORDER, and CHANGE commands.

Output files produced by the batch virtual machine are identifiable by the filename CMSBATCH in the CP spool file name field. The spool file type field contains the filetype JOB, unless you specified a jobname on the /JOB card. This applies to both printer and punch output files.

In addition to your regular printed output, the CMS Batch Facility spools a console sheet that contains a record of all the lines read in, and the responses, error messages, and return codes that resulted from command or program execution. This file is identified by a spool file name of BATCH and a spool file type of CONSOLE.

Using EXEC Files for Input to the Batch Facility

There are a variety of ways that EXEC procedures can help facilitate the submission of jobs to the CMS Batch Facility. You can prepare an EXEC file that contains all of the CMS commands you want to execute, and then pass the name of the EXEC to the batch virtual machine. For example, consider the files COPY JCL and COPYF EXEC:

```
COPY JCL:   /JOB CARBON 999999
            EXEC COPYF
            /*

COPYF EXEC: COPYFILE FIRST FILE A SECOND = =
            COPYFILE THIRD FILE A FOURTH = =
```

Then, if you enter the commands

```
cp spool punch to cmsbatch
punch copy jcl * (noheader
```

the commands in the EXEC file are executed by the batch virtual machine.

You could also use an EXEC to punch input to the batch virtual machine. Using the same commands as in the example above, you might have an EXEC named BATCOPY:

```
CP SPOOL PUNCH TO BATCH3
&PUNCH /JOB CARBON 999999
&PUNCH COPYFILE FIRST FILE A SECOND = =
&PUNCH COPYFILE THIRD FILE A FOURTH = =
&PUNCH /*
CP CLOSE PUNCH
```

Then, when you enter the EXEC name:

```
batcopy
```

The input lines are punched to the batch virtual machine.

The examples above are very simple; you probably would not go to the trouble of sending such a job to the batch virtual machine for processing. The examples do, however, illustrate the two basic ways that you can use EXEC procedures with the batch facility:

1. Invoking an EXEC procedure from a batch virtual machine.
2. Using an EXEC procedure to create a job stream for the batch virtual machine.

In either case, the EXECs that you use may be very simple or very complicated. In the first instance, an EXEC might contain many steps, with control statements to conditionally control execution, error routines, and so on.

In the second instance, you might have an EXEC that is versatile, so that it can be invoked with different arguments so as to satisfy more than one situation. For example, if you want to create a simple EXEC to send jobs to the batch virtual machine to be assembled, it might contain:

```
/JOB ARIEL 888888
CP LINK ARIEL 191 391 RR LINKPASS
ACCESS 291 B/A
ASSEMBLE &1 (PRINT
CP SPOOL PUNCH TO ARIEL
PUNCH &1 TEXT A (NOHEADER
/*
```

If this file were named BATCHASM EXEC, then whenever you wanted the CMS Batch Facility to assemble a source file for you, you would enter

```
batchasm filename
```

and the batch virtual machine would assemble the source file, print the listing, and send you a copy of the resulting TEXT file.

To extend the above example a little further, suppose you wanted to process source files in languages other than the assembler language. You want, also, for any user to be able to use this EXEC. You might have a separate EXEC file for each language, and an EXEC to control the submission of the job. This example shows the controlling EXEC file BATCH and the ASSEMBLE EXEC.

BATCH EXEC:

```
*     THIS EXEC SUBMITS ASSEMBLIES/COMPILATIONS TO CMS BATCH
*
*     - PUNCH BATCH JOB CARD;
*     - CALL APPROPRIATE LANGUAGE EXEC (&3) TO PUNCH EXECUTABLE COMMANDS
*
      &CONTROL ERROR
      &IF &INDEX GT 2 &SKIP 2
      &TYPE CORRECT FORM IS: BATCH USERID FNAME FTYPE (LANGUAGE)
      &EXIT 100
      &ERROR &GOTO -ERR1
      CP SPOOL D CONT TO BATCHCMS
      &PUNCH /JOB &1 1111 &2
      &PUNCH CP LINK &1 191 291 RR SECRET
      &PUNCH ACCESS 291 B/A
      EXEC &3 &2 &1
      &PUNCH /*
      CP SPOOL D NOCONT
      CP CLOSE D
      CP SPOOL D OFF
      &EXIT
      -ERR1 &EXIT 100
```

ASSEMBLE EXEC:

```
*     CORRECT FORM IS: ASSEMBLE FNAME USERID
*
*     PUNCH COMMANDS TO:
*       - INVOKE CMS ASSEMBLER
*       - RETURN TEXT DECK TO CALLER
*
      &CONTROL ERROR
      &ERROR &GOTO -ERR2
      &PUNCH GLOBAL MACLIB UPLIB CMSLIB OSMACRO
      &PUNCH CP MSG &2 ASMBLING ' &1 '
      &PUNCH ASSEMBLE &1 (PRINT NOTERM)
      &PUNCH CP MSG &2 ASSEMBLY DONE
      &PUNCH CP SPOOL D TO &2 NOCONT
      &PUNCH PUNCH &1 TEXT A1 (NOHEADER)
      &BEGPUNCH
      CP CLOSE D
      CP SPOOL D OFF
      RELEASE 291
      CP DETACH 291
      &END
      &EXIT
      -ERR2 &EXIT 102
```

Executing the Sample EXEC Procedure

If the above EXEC procedure is invoked with the line:

```
batch fay payroll assemble
```

The BATCHCMS virtual machine's card reader should contain the following statements (in the same general form as a FIFO console stack):

```
/JOB FAY 1111 PAYROLL
CP LINK FAY 191 291 RR SECRET
ACCESS 291 B/B
GLOBAL MACLIB UPLIB CMSLIB OSMACRO
CP MSG FAY ASMBLING ' PAYROLL '
ASSEMBLE PAYROLL (PRINT NOTERM)
CP MSG FAY ASSEMBLY DONE
CP SPOOL D TO FAY NOCONT
PUNCH PAYROLL TEXT A1 (NOHEADER)
CP CLOSE D
CP SPOOL D OFF
RELEASE 291
CP DETACH 291
/*
```

When the batch facility executes this job, the commands are executed as you see them: if you are logged on, you receive, in addition to the normal messages that the batch facility issues, those messages that are included in the EXEC.

A BATCH EXEC FOR A NON-CMS USER

Many installations run the CMS Batch Facility for non-CMS users to submit particular types of jobs. Usually, a series of EXEC files are stored on the system disk so that each user only needs include a card to invoke the EXEC, which executes the correct CMS commands to process data included with the job stream.

For example, if a non-CMS user wanted to compile FORTRAN source files, the following BATFORT EXEC file could be stored on the system disk:

```
&CONTROL OFF
FILEDEF INMOVE TERM (RECFM F BLOCK 80 LRECL 80
FILEDEF OUTMOVE DISK &1 FORTRAN A1 (RECFM F LRECL 80 BLOCK 80
MOVEFILE IN OUT
GLOBAL TXTLIB FORTRAN
FORTGI &1 (PRINT)
&FORTRET = &RETCODE
&IF &RETCODE NE 0 &GOTO -EXIT
PUNCH &1 TEXT A1 (NOHEADER)
-EXIT &EXIT &FORTRET
```

To use this EXEC, a non-CMS user might place the following real card deck in the system card reader:

```
ID CMSBATCH
/JOB  JOEUSER 1234 JOB10
BATFORT  JOEFORT
   .
   .
source file
   .
   .
/* (end-of-file indicator)
/* (end-of-job indicator)
```

When the batch virtual machine executes this job, it begins reading the EXEC procedure from disk, and executes one line at a time. When it encounters the MOVEFILE command, it begins reading the source file from its card reader (the batch facility interprets a terminal read as a request to read from the card reader). It continues reading until it reaches the end-of-file indicator (the /* card), and then resumes processing the EXEC on the next line following the MOVEFILE command line.

Additional functions may be added to this EXEC procedure, or others may be written and stored on the system disk to provide, for example, a compile, load, and execute facility. These EXEC procedures would allow an installation to accommodate the non-CMS users and maintain common user procedures.

Section 13. Programming for the CMS Environment

This section contains information for assembler language programmers who may occasionally need to write programs to be used in the CMS environment. The conventions described here apply only to CMS virtual machines; you can not execute these programs under any other operating systems.

Program Linkage

Program linkages, in CMS, are generally made by means of a supervisor call instruction, SVC 202. The SVC handling routine takes care of program linkage for you. The registers used, and their contents, are discussed in the following paragraphs.

Register 1: Points to a parameter list of successive doublewords. The first entry in the list is the name of the called routine or program, and any successive doublewords may contain arguments passed to the program. Parameter lists are discussed under "Parameter Lists."

Register 13: Contains the address of a 24-fullword save area, which you can use to save your caller's registers. This save area is provided to satisfy standard OS and DOS linkage conventions; you do not need to use it in CMS, since the SVC routines save the registers.

Register 14: Contains the return address of the SVC handling routines. You must return control to this address when you exit from your program.

The CMS routines that get control by way of register 14 close files, update your disk file directory, and calculate and type the time used in program execution. These values appear in the CMS Ready message, which is displayed at your terminal when your program finishes execution:

```
R;T=n.nn/x.xx hh:mm:ss
```

where n.nn is the CMS CPU time (in seconds) and x.xx is the combined CP and CMS CP time. hh:.mm:ss is the time of day in hours, minutes, and seconds.

Register 15: Contains your program's entry point address. You can use this address to establish immediate addressability in your program. You should not use it as a base address, however, since all CMS SVCs use it for communication with your programs.

Figure 20 shows a sample CMS assembler language program entry and exit.

```
PROGRAM  CSECT
         USING PROGRAM,12      ESTABLISH ADDRESSABILITY
         LR    12,15
         ST    14,SAVRET       SAVE RETURN ADDRESS IN R14
          .
          .
          .
         L     14,SAVRET       LOAD RETURN ADDRESS
         LA    15,0            SET RETURN CODE IN R15
         BR    14              GO
SAVRET   DS    F               SAVE AREA
```

Figure 20. Sample CMS Assembler Program Entry and Exit Linkage

RETURN CODE HANDLING

Register 15, in addition to its role in entry linkage, is also used, in CMS, as a return code register. All of the CMS internal routines pass a completion code by way of register 15, and the SVC routines that receive control when any program completes execution examine register 15.

If register 15 contains a nonzero value, this value is placed in the CMS Ready message, following the "R":

```
R(nnnnn);T=n.nn/x.xx hh:mm:ss
```

It is good practice, when you are executing programs in CMS, if your programs do not use register 15 as a return code register, to place a zero in it before transferring control back to CMS. Otherwise, the Ready message may display meaningless data.

PARAMETER LISTS

When you execute a program from your terminal, a CMS scan routine sets up a parameter list based on your command input line. The parameter list is doubleword aligned, with parameters occupying successive doublewords. The scan routine recognizes blanks and parentheses as argument delimiters; parentheses are placed, in the parameter list, in separate doublewords.

For example, if you have a CMS MODULE file named TESTPROG, and you call it with the command line:

```
testprog (file2)
```

The scan routine sets up the parameter list:

```
CMNDLIST DS    0D
         DC    CL8'TESTPROG'
         DC    CL8'('
         DC    CL8'FILE2'
         DC    CL8')'
         DC    8X'FF'
```

The last doubleword is made up of all 1s, to act as a delimiter.

If you enter any argument longer than 8 characters, it is truncated and only the first 8 characters appear in the list. However, no error condition results.

The scan routine that sets up this parameter list places the address of the list in register 1, and then calls the SVC handling routine. The SVC routine gives control to the program named in the first doubleword of the parameter list.

When your program receives control, it can examine the argument list passed to it by way of register 1.

You can use this technique, also, to call CMS commands from your programs.

When you use the LOAD and RUN commands to execute a program in CMS, you can pass an argument list to the program on the command line. For example, if you enter

```
load myprog
start * run1 proga
```

the arguments RUN1 and PROGA are placed in a parameter list and register 1 contains the address of this list when your program receives control. If you want to use the RUN command to perform the load and start functions, you could enter

```
run myprog (run1 proga
```

The parenthesis indicates the beginning of the argument list.

Calling a CMS Command from a Program

You can call a CMS command from a program by setting up a parameter list, like that shown above, and then issuing an SVC 202. The parameter list you set up must have doublewords that contain the parameters or arguments you would enter if you were entering the command from the terminal. For example:

```
PUNCHER  DS    0D
         DC    CL8'PUNCH'
         DC    CL8'NAME'
         DC    CL8'TYPE'
         DC    CL8'*'
         DC    CL8'('
         DC    CL8'NOH'
         DC    8X'FF'
```

In your program, when you want to execute this command, you should load the address of the list into register 1, and issue the supervisor call instruction (SVC) as follows:

```
         LA    1,PUNCHER
         SVC 202
         DC    AL4(ERROR)
         . . .
```

When you issue an SVC 202, you must supply an error return address in the four bytes immediately after the SVC instruction. If the return code (register 15) contains a nonzero value after returning from the SVC call, control passes to the address specified. In the above example, control would go pass to the instruction at the label ERROR.

If you want to ignore errors, you can use the sequence:

```
LA    1,PUNCHER
SVC 202
DC    AL4(*+4)
```

If you do not specify an error address, control is returned to the next instruction after a normal return, but if there was an error executing the CMS command, your program terminates execution.

If you want to execute a CP command or an EXEC procedure from a program, you must use the CP and EXEC commands; for example

```
SPOOL    DS     0D
         DC     CL8'CP'
         DC     CL8'SPOOL'
         DC     CL8'PRINTER'
         DC     CL8'CLASS'
         DC     8X'FF'
EXEC     DC     CL8'EXEC'
         DC     CL8'PFSET'
         DC     8X'FF'
```

As an alternative, you can use the CMS LINEDIT macro to call a CP command from a program. Specify DISP=CPCOMM on the macro instruction, for example

```
LINEDIT TEXT'SPOOL E CLASS S',DISP=CPCOMM,DOT=NO
```

The LINEDIT macro is described in VM/370: CMS Command and Macro Reference.

Executing Program Modules

MODULE files, in CMS, are nonrelocatable programs. Using the GENMOD command, you can create a module from any program that uses OS or CMS macros. When you create a module, it is generated at the virtual storage address at which it is loaded, for example:

```
load myprog
genmod testit
```

The CMS disk file, TESTIT MODULE A, that is created as a result of this GENMOD command, always begins execution at location X'20000', the beginning of the user program area.

If you want to call your own program modules using SVC 202 instructions, you must be careful not to execute a module that uses the same area of storage that your program occupies. If you want to call a module that executes at location X'20000', you can load the calling program at a higher location, for example,

```
load myprog (origin 30000
```

As long as the MODULE file called by MYPROG is no longer than X'10000' bytes, it will not overlay your program.

Many CMS disk-resident command modules also execute in the user program area; if you call these commands from a program, you should load your program at a higher location.

THE TRANSIENT PROGRAM AREA

To avoid overlaying programs executing in the user program area, you can generate program modules to run in the CMS transient area, which is a 2-page area of storage that is reserved for the execution of programs that are called for execution frequently. Many CMS commands run in this area, which is located at X'E000'. To generate a module to run in the transient area, use the ORIGIN TRANS option when you load the TEXT file into storage, then issue the GENMOD command:

```
load myprog (origin trans
genmod setup (str
```

You should use the STR option of the GENMOD command so that when the module is loaded into the transient area, storage remaining from previously executed programs is cleared.

The two restrictions placed on command modules executing in the transient area are:

1. They may have a maximum size of 8192 bytes, since that is the size of the transient area. This size includes any free storage acquired by GETMAIN macros.

2. They must be serially reusable. When a program is called by an SVC 202, if it has already been loaded into the transient area, it is not reloaded.

The CMS commands that execute in the transient area are: ACCESS, ASSGN, COMPARE, DISK, DLBL, FILEDEF, GENDIRT, GLOBAL, LISTFILE, MODMAP, OPTION, PRINT, PUNCH, QUERY, READCARD, RELEASE, RENAME, SET, SVCTRACE, SYNONYM, TAPE, and TYPE.

CMS Macro Instructions

There are a number of assembler language macros distributed with the CMS system that you can use when you are writing programs to execute in the CMS environment. They are in the macro library CMSLIB MACLIB, which is normally located on the system disk. There are macros to manipulate CMS disk files, to handle terminal communications, to manipulate unit record and tape input/output, and to trap interrupts. These macros are discussed in general terms here; for complete format descriptions, see VM/370: CMS Command and Macro Reference.

MACROS FOR DISK FILE MANIPULATION

Disk files are described in CMS by means of a file system control block (FSCB). The CMS macro instructions that manipulate disk files use FSCBs to identify and describe the files. When you want to manipulate a CMS file, you can refer to the file either by its file identifier, specifying 'filename filetype filemode' in quotation marks, or you can refer to the FSCB for the file, specifying FSCB=fscb, where fscb is the label on an FSCB macro.

To establish an FSCB for a file, you can use the FSCB macro specifying a file identifier, for example:

```
INFILE   FSCB  'INPUT TEST A1'
```

You can also provide, on the FSCB macro, descriptive information to be used by the input and output macros. If you do not code an FSCB macro for a file, an FSCB is created inline (following the macro instruction) when you code an FSREAD, FSWRITE, or FSOPEN macro.

The format of an FSCB is listed below, followed by a description of each of the fields.

```
Label                          Description
FSCBCOMM DC    CL8' '          File system command
FSCBFN   DC    CL8' '          Filename
FSCBFT   DC    CL8' '          Filetype
FSCBFM   DC    CL2' '          Filemode
FSCBITNO DC    H'0'            Relative record number (RECNO)
FSCBBUFF DC    A'0'            Address of buffer (BUFFER)
FSCBSIZE DC    F'0'            Number of bytes to read or write (BSIZE)
FSCBFV   DC    CL2'F'          Record format - F or V  (RECFM)
FSCBNOIT DC    H'1'            Number of records to read or write (NOREC)
FSCBNORD DC    AL4(0)          Number of bytes actually read
```

The labels shown above are not generated by the FSCB macro; to reference fields within the FSCB by these labels, you must use the FSCBD macro to generate a DSECT.

FSCBCOMM: When the FSCBFN, FSCBFT, and FSCBFM fields are filled in, you can fill in the FSCBCOMM field with the name of a CMS command, and use the FSCB as a parameter list for an SVC 202 instruction. (You must place a delimiter to mark the end of the command line.)

FSCBFN, FSCBFT, FSCBFM: The filename, filetype and filemode fields identify the CMS file to be read or written. You can code the fileid on a macro line in the format 'filename filetype filemode' or you can use register notation. If you use register notation, the register that you specify must point to an 18-byte field in the format:

```
FILEID   DC    CL8'filename'
         DC    CL8'filetype'
         DC    CL2'fm'
```

The fileid must be specified either in the FSCB for a file or on the FSREAD, FSWRITE, FSOPEN, or FSERASE macro you use that references the file.

FSCBITNO: The record, or item number indicates the relative record number of the next record to be read or written; it can be changed with the RECNO option. The default value for this field is 0. When you are reading files, a 0 indicates that records are to be read sequentially, beginning with the first record in the file. When you are writing files, a 0 indicates that records are to be written sequentially, beginning at the first record following the end of the file, if the file already exists, or with record 1, if it is a new file.

FSCBBUFF: The buffer address, specified in the BUFFER option, indicates the label of the buffer from which the record is to be written, or into which the record is to be read. You should always supply a buffer large enough to accommodate the longest record you expect to read or write. This field must be specified, either in the FSCB, or on the FSREAD or FSWRITE macro.

FSCBSIZE: This field indicates the number of bytes that are read or written with each read or write operation. The default value is 0. If the buffer that you use represents the full length of the records you are going to be reading or writing, you can use the BSIZE option to set this field equal to your buffer length. This field must be specified.

FSCBFV: This 2-character field indicates the record format (RECFM) of the file. The default value is F (fixed).

FSCBNOIT: This field contains the number of whole records that are to be read or written in each read or write operation. You can use the NOREC option in conjunction with the BSIZE option, to block and deblock records. The default value is 1.

FSCBNORD: Following a read operation, this field contains the number of bytes that were actually read, so that if you are reading a variable-length file, you can determine the size of the last record read. The FSREAD macro places the information from this field into register 0.

Using the FSCB

The following example shows how you might code an FSCB macro to define various file and buffer characteristics, and then use the same FSCB to refer to different files:

```
          FSREAD 'INPUT FILE A1',FSCB=COMMON
          FSWRITE 'OUTPUT FILE A1',FSCB=COMMON
            .
            .
            .
COMMON    FSCB  BUFFER=SHARE,RECFM=V,BSIZE=200
SHARE     DS    CL200
```

In the above example, the fileid specifications on the FSREAD and FSWRITE macros modify the FSCB at the label COMMON each time a read or write operation is performed. You can also modify an FSCB directly by referring to fields by a displacement off the beginning of the FSCB, for example,

```
          MVC   FSCB+8,=CL8'NEWNAME'
```

moves the name NEWNAME into the filename field of the FSCB at the label FSCBFN.

As an alternative, you can use the FSCBD macro to generate a DSECT, and refer to the labels in the DSECT to modify the FSCB, for example:

```
          LA    R5,INFSCB
          USING FSCBD,R5
            .
            .
          MVC   FSCBFN,NEWNAME
            .
            .
INFSCB    FSCB  'INPUT TEST A1'
NEWNAME   DC    CL8'OUTPUT'
          FSCBD
```

In the above example, the MVC instruction places the filename OUTPUT into the FSCBFN (filename) field of the FSCB. The next time this FSCB is referenced, the file OUTPUT TEST is the file that is manipulated.

Reading and Writing CMS Disk Files

CMS disk files are sequential files; when you use CMS macros to read and write these files, you can access them sequentially with the FSREAD and FSWRITE macros. However, you may also refer to records in a CMS file by their relative record numbers, so you can, in effect, access records using a direct access method.

If you know which record you want to read or write, you can specify the RECNO option on the FSCB macro, or on the FSOPEN, FSREAD, or FSWRITE macros. When you use the RECNO option on the FSCB macro, you must specify it as a self-defining term; for the FSOPEN, FSREAD, or FSWRITE macros, you may specify either a self-defining term, as:

```
WRITE    FSWRITE FSCB=WFSCB,RECNO=10
```

or using register notation, as follows:

```
WRITE    FSWRITE FSCB=WFSCB,RECNO=(5)
```

where register 5 contains the record number of the record to be read.

When you want to access files sequentially, the FSCBITNO field of the FSCB must be 0. This is the default value. When you are reading files with the FSREAD macro, reading begins with record number 1. When you are writing records to an existing file with the FSWRITE macro, writing begins following the last record in the file.

To begin reading or writing files sequentially beginning at a specific record number, you must specify the RECNO option twice: once to specify the relative record number at which you want to begin reading, and a second time to specify RECNO=0 so that reading or writing will continue sequentially beginning after the record just read or written. You can specify the RECNO option on the FSREAD or FSWRITE macro, or you may change the FSCBITNO field in the FSCB for the file.

For example, to read the first record and then the 50th record of a file, you could code the following:

```
READ1    FSREAD FSCB=RFSCB
         FSWRITE FSCB=WFSCB
         LA     5,RFSCB
         USING FSCBD,5
         MVC    FSCBITNO,=H'50'
READ50   FSREAD FSCB=RFSCB
         FSWRITE FSCB=WFSCB
         .
         .
         .
RFSCB    FSCB 'INPUT FILE A1',BUFFER=COMMON
WFSCB    FSCB 'OUTPUT FILE A1',BUFFER=COMMCN,BSIZE=120
COMMON   DS     CL120
         .
         .
         .
         FSCBD
```

In this example, the statements at the label READ1 write record 1 from the file INPUT FILE A1 to the file OUTPUT FILE A1. Then, using the DSECT generated by the FSCBD macro, the FSCBITNO field is changed, and record 50 is read from the input file and written into the output file.

If you want to read and write records from the same file, you must issue an FSCLOSE macro to close the file whenever you switch from reading to writing. For example:

```
          LA     3,2
READ      FSREAD FSCB=UPDATE,RECNO=(3),ERROR=READERR
          FSCLOSE FSCB=UPDATE
          .
          .
          .
          FSWRITE FSCB=UPDATE,RECNO=(3),ERROR=WRITERR
          FSCLOSE FSCB=UPDATE
          LA     3,1(3)
          B      READ
          .
          .
          .
UPDATE    FSCB   'UPDATE FILE A1',BUFFER=BUF1,BSIZE=80
```

To execute a loop to read, update, and rewrite records, you must read a record, close the file, write a record, close the file, and so on. Since closing a file repositions the read pointer to the beginning of the file and the write pointer at the end of the file, you must specify the relative record number (RECNO) for each read and write operation. In the above example, register 3 is used to contain the relative record number. It is initialized to begin reading with the second record in the file and is incremented by 1 following each write operation.

Opening and Closing Files

The example above illustrated one of the situations in which you must explicitly close a file with the FSCLOSE macro. Usually, CMS opens a file whenever an FSREAD or FSWRITE macro is issued for the file. When control returns to CMS from a calling program, all open files are closed by CMS, so you do not have to close files at the end of a program.

If, however, you use an EXEC to execute a program to read or write a file, the file is not closed by CMS until the EXEC completes execution. Therefore, if you read or write the same file more than once during the EXEC procedure, you must use an FSCLOSE macro to close the file after using it in each program, or use the FSOPEN macro to open it before each use. Otherwise, the read or write pointer is positioned as it was when the previous program completed execution.

CREATING NEW FILES: When you want to begin writing a new file using CMS data management macros, there are two ways to ensure that the file you want to create does not already exist. One way is to issue the FSSTATE macro to verify the existence of the file.

A second way to ensure that a file does not already exist is to issue an FSERASE macro to erase the file. If the file does not exist, register 15 returns with a code of 28. If the file does exist, it is erased.

Figure 21 illustrates a sample program using CMS data management macros.

```
LINE    SOURCE STATEMENT

BEGIN   CSECT          (1)
        PRINT NOGEN
        USING *,12          ESTABLISH ADDRESSABILITY
        LR    12,15
        ST    14,SAVE
        LA    2,8(,1) R2=ADDR OF INPUT FILEID IN PLIST     (2)
        LA    3,32(,1) R3=ADDR OF OUTPUT FILEID IN PLIST
* DETERMINE IF INPUT FILE EXISTS
        FSSTATE (2),ERROR=ERR1
*
* READ A RECORD FROM INPUT FILE AND WRITE ON OUTPUT FILE
RD      FSREAD (2),ERROR=EOF,BUFFER=BUFF1,BSIZE=80    (3)
        FSWRITE (3),ERROR=ERR2,BUFFER=BUFF1,BSIZE=80
        B     RD            LOOP BACK FOR NEXT RECORD
*
* COME HERE IF ERROR READING INPUT FILE
EOF     C     15,=F'12'     END OF FILE ?    (4)
        BNE   ERR3          ERROR IF NOT
        LA    15,0          ALL O.K. - ZERO OUT R15
        B     EXIT          GO EXIT
* IF INPUT FILE DOES NOT EXIST
ERR1    WRTERM 'FILE NOT FOUND',EDIT=YES
        B     EXIT
*
* IF ERROR WRITING FILE
ERR2    LR    10,15         SAVE RET CODE IN REG 10     (5)
        LINEDIT TEXT='ERROR CODE .... IN WRITING FILE',SUB=(DEC,(10))
        B     EXIT
*
* IF READING ERROR WAS NOT NORMAL END OF FILE
ERR3    LR    10,15         SAVE RET CODE IN REG 10     (5)
        LINEDIT TEXT='ERROR CODE .... IN READING FILE',SUB=(DEC,(10))
*
EXIT    L     14,SAVE       LOAD RETURN ADDRESS
        BR    14            RETURN TO CALLER
*
BUFF1   DS    CL80
SAVE    DS    F
        END
```

Notes:

1. The program might be invoked with a parameter list in the format progname INPUT FILE A1 OUTPUT FILE A1. This line is placed in a parameter list by CMS routines and addressed by register 1 (see note 2).
2. The parameter list is a series of doublewords, each containing one of the words entered on the command line. Thus, 8 bytes past register 1 is the beginning of the input fileid; 24 bytes beyond that is the beginning of the second fileid.
3. The FSREAD and FSWRITE macros cause the files to be opened; no open macro is necessary. CMS routines close all open files when a program completes execution.
4. The return code in register 15 is tested for the value 12, which indicates an end-of-file condition. If it is the end of the file, the program exits; otherwise, it writes an error message.
5. The dots in the LINEDIT macro are substituted, during execution, with the decimal value in register 10.

Figure 21. A Sample Listing of a Program that Uses CMS Macros

CMS MACROS FOR TERMINAL COMMUNICATIONS

There are four CMS macros you can use to write interactive, terminal-oriented programs. They are RDTERM, WRTERM, LINEDIT, and WAITT. RDTERM and WRTERM only require a read/write buffer for sending and receiving lines from the terminal. The third, LINEDIT, has a substitution and translation capability.

When you use the WRTERM macro to write a line to your terminal you can specify the actual text line in the macro instruction, for example:

```
DISPLAY  WRTERM 'GOOD MORNING'
```

You can also specify the message text by referring to a buffer that contains the message.

The RDTERM macro accepts a line from the terminal and reads it into a buffer you specify. You could use the RDTERM and WRTERM macros together, as follows:

```
WRITE     WRTERM 'ENTER LINE'
READ      RDTERM BUFFER
          LR   3,0
REWRITE   WRTERM BUFFER,(3)
            .
            .
            .
BUFFER    DS   CL130
```

In this example, the WRTERM macro results in a prompting message. Then the RDTERM macro accepts a line from the terminal and places it in the buffer BUFFER. The length of the line read, contained in register 0 on return from the RDTERM macro, is saved in register 3. When you specify a buffer address on the WRTERM macro, you must specify the length of the line to be written. Here, register notation is used to indicate that the length is contained in register 3.

The LINEDIT macro converts decimal and hexadecimal data into EBCDIC, and places the converted value into a specified field in an output line. There are list and execute forms of the macro, which you can use in writing reentrant code. Another option allows you to write lines to the offline printer. The LINEDIT macro is described, with extensive examples, in VM/370: CMS Command and Macro Reference. Figure 21 shows how you might use the LINEDIT macro to convert and display CMS return codes.

The WAITT (wait terminal) macro instruction can help you to synchronize input and output to the terminal. If you are executing a program that reads and writes to the terminal frequently, you may want to issue a WAITT macro to halt execution of the program until all terminal I/O has completed.

CMS MACROS FOR UNIT RECORD AND TAPE I/O

CMS provides macros to simplify reading and punching cards (RDCARD and PUNCHC), and creating printer files (PRINTL). When you use either the PUNCHC or PRINTL macros to write or punch output files while a program is executing, you should remember to issue a CLOSE command for your virtual printer or punch when you are finished. You can do this either after your program returns control to CMS, by entering:

```
cp close e

  -- or --

cp close d
```

or, you can set up a parameter list with the command line CP CLOSE E or CP CLOSE D and issue an SVC 202.

The tape control macros, RDTAPE, WRTAPE and TAPECTL, can read and write CMS files from tape, or control the positioning of a tape.

INTERRUPT HANDLING MACROS

You can set up routines in your programs to handle interrupts caused by I/O devices, by SVCs, or by external interrupts using the HNDINT, HNDSVC, or HNDEXT macro instructions.

With the HNDINT macro instruction, you can specify addresses that are to receive control when an interrupt occurs for a specified device. If the WAIT option is used for a device specified in the HNDINT macro, then the interrupt handling routine specified for the device does not receive control until after the WAITD macro is issued for the device.

You can use the HNDSVC macro to trap Supervisor Call instructions of particular numbers, if, for example, you want to perform some additional function before passing control, or you do not want any SVCs of the specified number to be executed.

The CP EXTERNAL command simulates external interrupts in your virtual machine; if you want to be able to pass control to a particular internal routine in the event of an external interrupt, you can use the HNDEXT macro.

Part 3. Learning To Use EXEC

In previous sections, the CMS EXEC facilities were described in general terms to acquaint you with the expressions used in EXEC files and the basic way that EXECs function. Also, examples of EXEC procedures have appeared throughout this publication. You should be familiar at least with the material in "Introduction to the EXEC Processor" before you attempt to use the information in Part 3.

"Section 14. Building EXEC Procedures" describes the EXEC facilities in detail, with examples of techniques you may find useful as you learn about EXEC and develcp your own EXEC procedures.

Special considerations for using CMS commands in EXECs, and modifying CMS command functions using EXEC procedures, are described in "Section 15. Using EXECs With CMS Commands."

"Section 16. Refining Your EXEC Procedures" lists several techniques you can use to make your EXEC files easier to use, and provides some hints on debugging EXEC procedures.

If you are a frequent user of the CMS Editor, then you may be interested in "Section 17. Writing Edit Macros," which describes how to create your own EDIT subcommands using EXEC procedures.

Section 14. Building EXEC Procedures

This section discusses various techniques that you can use when you write EXEC procedures. The examples are intended only as suggestions: you should not feel that they represent either the only way or the best way to achieve a particular result. Many combinations and variations of control statements are possible; in most cases, there are many ways to do the same thing.

This section is called "Building EXEC Procedures" because you will often find that once you have created an EXEC procedure and begun to use it, you continually think of new applications or new uses for it. Using the CMS Editor, you may quickly build the additions and make the necessary changes. You are encouraged to develop EXEC procedures to help you in all the phases of your CMS work.

What is a Token?

An executable statement is any line in an EXEC file that is processed by the EXEC interpreter, including:

- CMS command lines
- EXEC control statements
- Assignment statements
- Null lines

Executable statements may appear by themselves on a line, or as the object of another executable statement, for example in an &IF or &LOOP control statement. If you want to execute CP commands or other EXEC procedures in an EXEC, you must use the CP and EXEC commands, respectively. CP commands are passed directly to CP for processing.

All executable statements in an EXEC are scanned by the CMS scan routine. This routine converts each word (words are delimited by blanks and parentheses) into an 8-character quantity, called a token. If a word contains more than 8 characters, it is truncated on the right. If it contains fewer than eight characters, it is padded with blanks. When a parenthesis appears on the line, it is treated both as a delimiter and as a token. For example, the line

```
&TYPE WHAT IS YOUR PREFERENCE (RED|BLUE)?
```

scans as follows:

```
&TYPE WHAT IS YOUR PREFEREN ( RED|BLUE ) ?
```

After a line has been scanned, each token is scanned for ampersands, and substitutions are performed on any variable symbols in the tokens before the statement is executed.

Nonexecutable statements are lines that are not processed by the EXEC interpreter, that is comment lines (those that begin with an *), and data lines following an &BEGEMSG, &BEGPUNCH, &BEGSTACK, or &BEGTYPE control statement. Since these lines are not scanned, words are not truncated, and tokens are neither formed nor substituted.

Since all executable statements in an EXEC are scanned, and the data items are treated as tokens, the term "token" is used throughout this

section to describe data items before and after scanning. The VM/370: CMS Command and Macro Reference, which contains the formats and descriptions of the EXEC control statements, uses this convention as well. Therefore, as you create your EXEC procedures, you may think of the items that you enter on an EXEC statement as tokens, since that is how they are used by the EXEC interpreter.

Variables

To make the best use of the CMS EXEC facilities, you should have an understanding of how the EXEC interpreter performs substitutions on variable symbols contained in tokens. Some examples follow. For each example, the input lines are shown as they would appear in an EXEC file and as they would appear after being interpreted and executed by EXEC. Notes concerning substitution follow each example.

SIMPLE SUBSTITUTION: Most of the EXEC examples in this publication contain variable symbols that result in one-for-one substitution. Most of your variables, too, will have a similar relationship.

Lines	After Substitution
&X = 123	&X = 123
&TYPE &X	&TYPE 123

The EXEC interpreter accepts the variable symbol &X and assigns it the value 123. In the second statement, &X is substituted with this value, and the control statement &TYPE is recognized and executed.

Lines	After Substitution
&Y = 456	&Y = 456
&Z = &Y	&Z = 456

The symbol &Y is assigned a value of 456. In the second statement, the symbol &Y is substituted with this value, and this value is assigned to &Z.

SUBSCRIPTS FOR VARIABLES: Since each token is scanned more than once for ampersands, you can simulate subscripts by using two variable values in the same token.

Lines	After Substitution
&1 = ALPHA	&1 = ALPHA
&2 = BETA	&2 = BETA
&INDEX1 = 1	&INDEX1 = 1
&TYPE &&INDEX1	&TYPE ALPHA
&INDEX1 = 2	&INDEX1 = 2
&TYPE &&INDEX1	&TYPE BETA

In the statement &TYPE &&INDEX1, the token &INDEX1 is scanned the first time, and the value &INDEX1 is substituted with the value 1. The token now contains &1, which is substituted with the value ALPHA on a second scan. When the value of &INDEX1 is changed to 2, the value of &&INDEX1 also changes.

Lines	After Substitution
&I = 2	&I = 2
&X&I = 5	&X2 = 5
&I = 1	&I = 1
&X&I = 2	&X1 = 2
&X = &X&I + &X&X&I	&X = 2 + 5

In the statement &X&I = 5, analysis of the first token results in the substitution of the symbol &I with the value of 2. The symbol &X2 is assigned a value of 5.

The value of &I is changed to 1, and the symbol &X1 is assigned a value of 2.

In the last statement, &X = &X&I + &X&X&I, the value of &I in the token &X&I is replaced with 1, then the symbol &X1 is substituted with its value, which is 2. The token &X&X&I is substituted after each of three scans: &I is replaced with the value 1, to yield the token &X&X1. The symbol &X1 has the value of 2, so the token is reduced to &X2, which has a value of 5.

COMPOUND VARIABLE SYMBOLS: Variable symbols may also be combined with character strings.

Lines	After Substitution
&X = BEE	&X = BEE
&TYPE HONEY&X	&TYPE HONEYBEE
&TYPE ABUMBLE&X	&TYPE ABUMBLE

In the above example, the first symbol encountered in the scan of HONEY&X is &X, which is substituted with the value &BEE. In the second &TYPE statement, the X is truncated when the line is scanned; the symbol & is an undefined symbol and is therefore set to blanks.

Lines	After Substitution
&X = HONEY	&X = HONEY
&Y = BEE	&Y = BEE
&TYPE &X&Y	&TYPE

In the above example, after the symbol &Y is substituted with the value BEE, the token contains the symbol &XBEE, which is an undefined symbol, so the symbol is discarded.

Lines	After Substitution
&123 = ABCDE	&123 = ABCDE
&X = 12345678	&X = 12345678
&TYPE ABLE&&X	&TYPE ABLEABCD

In this example, the substitution of &X in the token ABLE&&X results in the character string ABLE&12345678, which is truncated to 8 characters, or ABLE&123. The scan continues, and &123 is substituted with the appropriate value, to result in ABCDE. The token is again truncated to 8 characters.

SUBSTITUTING LITERAL VALUES: You might want an ampersand to appear in a token. You can use the &LITERAL built-in function to suppress the substitution of variable symbols in a token.

Lines	After Substitution
&9 = HELLO	&9 = HELLO
&A = &LITERAL &9	&A = &LITERAL &9
&TYPE &A	&TYPE &9

Because the value of &A was defined as a literal &9, no substitution is performed.

Lines	After Substitution
&TYPE = QUERY	&TYPE = QUERY
&TYPE BLIP	QUERY BLIP

In the above example, even though &TYPE is an EXEC keyword, it is assigned the value of QUERY, and substitution is performed when it

appears on an input line. In this example, when it is substituted with its value, the result is a command line which is passed to CMS for processing.

```
Lines                    After Substitution
&CONTROL = FIRST         &CONTROL = FIRST
&LITERAL &CONTROL ALL    &CONTROL ALL
```

In this example, &CONTROL is assigned a value as a variable symbol, but when it is preceded by the built-in function &LITERAL, the substitution is not performed, so EXEC processes it as a control statement.

HEXADECIMAL AND DECIMAL CONVERSIONS: You can perform hexadecimal to decimal and decimal to hexadecimal conversions in an EXEC if you use the control statement &HEX ON. To convert hexadecimal to decimal, you must use an assignment statement, prefacing the hexadecimal value you want to convert with the characters X' and assigning the value to a variable symbol.

```
Lines                    After Substitution
&HEX ON                  &HEX ON
&DEC = X'10              &DEC = X'10
&TYPE  &DEC              &TYPE 16
&COUNT = 15              &COUNT = 15
&DECNT = X'&COUNT        &DECNT = X'15
&TYPE &DECNT             &TYPE 21
```

When the characters X' are found in any EXEC statement other than an assignment statement, the value following them is considered a decimal value and is converted to its hexadecimal equivalent.

```
Lines                    After Substitution
&HEX ON                  &HEX ON
&TYPE X'20               &TYPE 14
&VAL = 3000              &VAL = 3000
&TYPE X'&VAL             &TYPE BB8
&TYPE X'13107299         &TYPE 2000
```

In the last statement above, the characters 99 are truncated before substitution occurs, since EXEC tokens can be a maximum of 8 characters.

To suppress hexadecimal conversion during an EXEC procedure after having used it, you can use the EXEC control statement

```
&HEX OFF
```

so you can use tokens containing the characters X' without the EXEC processor converting them to hexadecimal.

Arguments

An argument in an EXEC procedure is one of the special variable symbols &1 through &30 that are assigned values when the EXEC is invoked. For example, if the EXEC named LINKS is invoked with the line

```
links viola ariel oberon
```

the tokens VIOLA, ARIEL, and OBERON are arguments, and are assigned to the variable symbols &1, &2, and &3, respectively.

You can pass as many as 30 arguments to an EXEC procedure; thus the variable symbols you can set range from &1 to &30. These variables are collectively referred to as the special variable &n. Once these symbols are defined, they can be used and manipulated in the same manner as any other variable in an EXEC. They can be tested, displayed, changed, and, if they contain numeric quantities, used arithmetically.

```
&IF &2 EQ PRINT &GOTO -PR
&TYPE &1 IS AN INVALID ARGUMENT
&1 = 2
&CT = &1 + 100
```

The above examples illustrate some explicit methods of manipulating the &n variables. They can also be implicitly defined or redefined by two EXEC control statements: &ARGS and &READ ARGS.

An &ARGS control statement redefines all of the special &n variables. The statement

```
&ARGS A B C
```

assigns the value of A, B, and C to the variables &1, &2, and &3 and sets the remaining variables, &4 through &30, to blanks.

You can also redefine arguments interactively by using the &READ ARGS control statement. When EXEC processes this statement, a read request is presented to your terminal, and the tokens you enter are assigned to the &n variables. For example, the lines

```
&TYPE ENTER FILE NAME AND TYPE:
&READ ARGS
STATE &1 &2 *
```

request you to enter two tokens, and then treat these tokens as the arguments &1 and &2. The remaining variables &3 through &30 are set to blanks.

If you want to redefine specific &n variables, and leave the values of others intact, you can either redefine the individual variables in separate assignment statements, or use the variable symbol in the &ARGS or &READ ARGS statement. For example, the statement

```
&ARGS CONT &2 &3 RETURN &5 &6 &7 &8 &9 &10
```

assigns new values to the variables &1 and &4, but does not change the existing values for the remaining symbols through &10.

If you need to set an argument or &n special variable to blanks, either on an EXEC command line or in an &ARGS or &READ ARGS control statement, you can use a percent sign (%) in its place. For example, the lines:

```
&ARGS SET QUERY % TYPE
&TYPE &1 &2 &3 &4
```

result in the display

```
SET QUERY TYPE
```

The symbol &3 has a value of blanks, and as a null token, is discarded from the line.

USING THE &INDEX SPECIAL VARIABLE

The EXEC special variable, &INDEX, initially contains a numeric value corresponding to the number of arguments defined when the EXEC was invoked. The value of &INDEX is reset whenever an &ARGS or &READ ARGS control statement is executed.

&INDEX can be useful in many circumstances. If you create an EXEC that may expect any number of arguments, and you are going to perform the same operation for each, you might set a counter and use the value of &INDEX to test it. For example, an EXEC named PRINTX accepts arguments that are the filenames of ASSEMBLE files:

```
&CT = 1
&LOOP 2 &CT > &INDEX
PRINT &&CT ASSEMBLE
&CT = &CT + 1
```

In the preceding example, the token &CT is substituted with &1, &2, and so on until all of the arguments entered on the PRINTX line are used.

You can also use &INDEX to test the number of arguments entered. If you design an EXEC to expect at least two arguments, the procedure might contain the statements:

```
&IF &INDEX LT 2 &GOTO -ERR1
  .
  .
  .
-ERR1 &TYPE INVALID COMMAND LINE
&EXIT 1
```

In this example, if the EXEC is invoked with one or no arguments, an error message is displayed and the EXEC terminates processing with a return code of 1.

As another example, suppose you wanted to supply an EXEC with default arguments, which might or might not be overridden. If the EXEC is invoked with no arguments, the default values are in effect; if it is invoked with arguments, the arguments replace the default values:

```
&DISP = PRINT
&COUNT = 2
&IF &INDEX GT 2 &EXIT 1
&IF &INDEX EQ 0 &GOTO -GO
&COUNT = &1
&IF &INDEX = 2 &DISP = &2
-GO
```

Default values are supplied for the variables &DISP and &COUNT. Then, &INDEX is tested, and the variables are reset if any arguments were entered.

CHECKING ARGUMENTS

There are a number of tests that you can perform on arguments passed to an EXEC. In some cases, you may want to test for the length of a specific argument or to test whether an argument is character data or numeric data. To perform these tests, you can use the EXEC built-in functions &LENGTH and &DATATYPE.

To use either &LENGTH or &DATATYPE, you must first assign a variable to receive the result of the function, and then test the variable. For example, to test whether an entered argument is 5 characters long, you could use the statements:

```
&LIMIT = &LENGTH &1
&IF &LIMIT GT 5 &EXIT &LIMIT
```

When these statements are executed, if the first argument (&1) is greater than 5 characters, the exit is taken, and the return code indicates the length of &1.

If you wish to check whether a number was entered for an argument, use the &DATATYPE function:

```
&STRING = &DATATYPE &2
&IF &STRING ¬= NUM &GOTO -ERR4
```

In this example, the second argument expected by the EXEC must be a numeric quantity. If it is not, a branch is taken to an error exit routine.

Often, you may create an EXEC that tests for specific arguments and then takes various paths, depending on the argument. For example:

```
&IF &2 = PRINT &GOTO -PR
&IF &2 = TYPE &GOTO -TY
&IF &2 = ERASE &GOTO -ER
&EXIT
```

In this EXEC, if the value of &2 is not PRINT, TYPE, or ERASE, or was not entered, the EXEC terminates processing.

&* and &$

There are two special EXEC keywords that you may use to test arguments passed in an EXEC. They are &* and &$, which can be used only in an &IF or an &LOOP control statement. They test the entire range of numeric variables &1 through &30, as follows:

&$: The special token &$ is interpreted as "any of the variables &1, &2, ..., &30." That is, if the value of any one of the numeric variables satisfies the established condition, then the &IF statement is considered to be true. The statement is false only when none of the variables fulfills the specified requirements.

As an example, suppose you want to make sure that some particular value is passed to the EXEC. You can check to see if any of the arguments satisfy this condition, as follows:

```
&IF &$ EQ PRINT &SKIP 2
&TYPE PARM LIST MUST INCLUDE PRINT
&EXIT
```

In this example, the path to the &TYPE statement is taken only when none of the arguments passed to the EXEC procedure equal the character string PRINT.

&*: The special token &* is interpreted as "all of the variables &1, &2, ..., &30." That is, if the value of each of the numeric variables satisfies the established condition, then the &IF statement is considered to be true. The statement is false when at least one of the variables fails to meet the specified requirements.

Use &* to test for the absence of an argument as follows:

```
&IF &* NE ASSEMBLE &EXIT 3
```

In this example, if an EXEC is invoked, and none of the arguments equals ASSEMBLE, the EXEC terminates with a return code of 3.

The tokens &* and &$ are set by arguments entered when an EXEC is invoked and reset when you issue an &ARGS or &READ ARGS control statement. If either &* or &$ is null because no arguments are entered, the &IF statement is considered a null statement, and no error occurs.

Execution Paths in an EXEC

You have already seen examples of the &IF, &GOTO, &SKIP, and &LOOP control statements. A more detailed discussion on each of these statements and additional techniques for controlling execution paths in an EXEC procedure follow.

LABELS IN AN EXEC PROCEDURE

In many instances, an execution control statement in an EXEC procedure causes a branch to a particular statement that is identified by a label. The rules and conventions for creating syntactically correct EXEC labels are:

- A label must begin with a hyphen (dash), and must have at least one additional character following the hyphen.
- Up to seven additional alphameric characters may follow the hyphen (with no intervening blanks). However, the sequence,

```
&GOTO -PROBABLY
   .
   .
   .
-PROBABLY
```

  executes successfully, because when each statement is scanned, the token -PROBABLY is truncated to the same 8-character token, -PROBABL.

- A label name may be the object of an &GOTO or &LOOP control statement.
- A label that is branched to must be the first token on a line. It may stand by itself, with no other tokens on the line, or it may precede an executable CMS command or EXEC control statement.

The following are examples of the correct use of labels:

```
&GOTO -LAB1
-LAB1
-LAB2 &CONTINUE
-CHECK &IF &INDEX EQ 0 &GOTO -EXIT
&IF &INDEX LT 5 &SKIP
-EXIT &EXIT 4
&TYPE &LITERAL &INDEX VALUE IS &INDEX
```

CONDITIONAL EXECUTION WITH THE &IF STATEMENT

The main tool available to you for controlling conditional execution in an EXEC procedure is the &IF control statement. The &IF control statement provides the decision-making ability that you need to set up conditional branches in your EXEC procedure.

One approach to decision-making with the &IF control statement is to compare two tokens, and perform some action based on the result of the comparison. When the comparison specified is equal (or true), the executable statement is executed. When the comparison is unequal (or false), control passes to the next sequential statement in the EXEC procedure. An example of a simple &IF statement is:

```
&IF &1 EQ &2 &TYPE MATCH FOUND
```

If the comparand values are not equal, the statement &TYPE MATCH FOUND is not executed, and control passes to the next statement in the EXEC procedure. If the comparand values are equal, the statement &TYPE MATCH FOUND is executed before control passes to the next statement. &IF statements can also be used to establish a comparison between a variable and a constant. For example, if a terminal user could properly enter a YES or NO response to a prompting message, you could set up &IF statements to check the response as follows:

```
&READ ARGS
&IF &1 EQ YES &GOTO -YESANS
&IF &1 EQ NO &GOTO -NOANS
&TYPE &1 IS NOT A VALID RESPONSE (MUST BE YES OR NO)
&EXIT
-YESANS
   .
   .
   .
-NOANS
   .
   .
   .
```

In this example, the branch to -YESANS is taken if the entered argument is YES; otherwise, control passes to the next &IF statement. The branch to -NOANS is taken if the argument is NO; otherwise, control passes to the &TYPE statement, which displays the entered argument in an error message and exits.

The test performed in an &IF statement need not be a simple test of equality between two tokens; other types of comparisons can be tested, and more than two variables can be involved. The tests that can be performed and the symbols you can use to represent them are:

Symbol	Mnemonic	Meaning
=	EQ	A equals B
¬=	NE	A does not equal B
<	LT	A is less than B
<=	LE	A is less than or equal to B (not greater than)
>	GT	A is greater than B
>=	GE	A is greater than or equal to B (not less than)

Compound &IF Statements

You can place multiple &IF control statements on one line, to test a variable for more than one condition. For example, the statement

```
&IF &NUM GT 5 &IF &NUM LT 10 &TYPE O.K.
```

checks the variable symbol &NUM for a value greater than 5 and less than 10. If both of these conditions are satisfied, the &IF statement is true, and the &TYPE statement is executed. If either condition is false, then the &TYPE statement is not executed.

The number of &IF statements that may be nested is limited only by restrictions placed on the record length of the EXEC file.

BRANCHING WITH THE &GOTO STATEMENT

The &GOTO control statement allows you to transfer control within your EXEC procedure

- To a specified EXEC label somewhere in the EXEC file:

  ```
  &GOTO -TEST
  ```

  where -TEST is the label to which control is passed.

- To a particular line within the EXEC file. For example,

  ```
  &GOTO 15
  ```

  results in control being passed to statement 15 in the EXEC file.

- Directly to the top of the EXEC file. For example,

  ```
  &GOTO TOP
  ```

  passes control to the beginning of the EXEC procedure.

The &GOTO control statement can be coded wherever an executable statement is permitted in an EXEC procedure. One of its common uses is in conjunction with the &IF control statement. For example, in the statement:

```
&IF &INDEX EQ 0 &GOTO -ERROR
```

the branch to the statement labeled -ERROR is taken when the value of the &INDEX special variable is zero. Otherwise, control passes to the next sequential statement in the EXEC procedure.

An &GOTO statement can also stand alone as an EXEC control statement. When coded as such, it forces an unconditional branch to the specified location. For example, you might create an EXEC that has several execution paths, each of which terminates with an &GOTO statement leading to a common exit routine:

```
-PATH1 &CONTINUE
  .
  .
  .
&GOTO -EXIT
-PATH2 &CONTINUE
  .
  .
  .
&GOTO -EXIT
&PATH3 &CONTINUE
  .
  .
  .
-EXIT &CONTINUE
```

You can use the &GOTO control statement to establish a loop. For example:

```
&GLOBAL1 = &GLOBAL1 + 1
&TYPE ENTER NUMBER:
&READ VARS &NEXT
&IF .&NEXT = . &GOTO -FINIS
&IF &GLOBAL1 = 2 &TOTAL = 0
&TOTAL = &TOTAL + &NEXT
&GOTO TOP
-FINIS
&TYPE TOTAL IS &TOTAL
```

In this EXEC example, all of the statements, through the &GOTO TOP statement, are executed repeatedly until a null line is entered in response to the prompting message. Then, the branch is taken to the label -FINIS and the total is typed.

Note the use of the special variable &GLOBAL1 in the preceding example. The &GLOBALn special variables are self-initializing, and have an initial value of 1.

Using the &GOTO Control Statement

When an EXEC procedure processes an &GOTO statement, and searches for a given label or line number, the scan begins on the line following the &GOTO statement, proceeds to the bottom of the file, then wraps around to the top of the file and continues to the line immediately preceding the &GOTO statement. If there are duplicate labels in an EXEC file, the first label encountered during the search is the one that is branched to.

If the label or line number is not found during the scan, EXEC terminates processing and displays the message:

```
ERROR IN EXEC FILE filename, LINE n - &SKIP or &GOTO ERROR
```

If the label or line number is found, control is passed to that location and execution continues.

BRANCHING WITH THE &SKIP STATEMENT

The &SKIP control statement provides you with a second method of passing control to various points in an EXEC procedure. Instead of branching to a named or numbered location in an EXEC procedure, &SKIP passes control a specified number of lines forward or backward in the file.

You pass control forward in an EXEC by specifying how many lines to skip. For example, to handle a conditional exit from an EXEC procedure, you could code the following:

```
&IF &RETCODE EQ 0 &SKIP
&EXIT &RETCODE
```

where the &EXIT statement is skipped whenever the value of &RETCODE equals zero. If the value of &RETCODE does not equal zero, control passes out of the current EXEC procedure with a return code that is the nonzero value in &RETCODE. Note that when no &SKIP operand is specified, a value of 1 is assumed.

A succession of &SKIP statements can be used to perform multiple tests on a variable. For example, suppose an argument should ccntain a value from 5 to 10 inclusive:

```
&IF &1 LT 5 &SKIP
&IF &1 LE 10 &SKIP
&TYPE &1 IS NOT WITHIN RANGE 5-10
```

If the value of &1 is less than 5, control passes to the &TYPE control statement, which displays the erroneous value and an explanatory message. If the value of &1 is greater than or equal to 5, the next statement checks to see if it is less than or equal to 10. If this is true, then the value is between 5 and 10 inclusive, and execution continues following the &TYPE statement.

When you want to pass control to a statement that precedes the current line, determine how many lines backward you want to go, and code &SKIP with the desired negative value:

```
&VAL = 1
&TYPE &VAL
&VAL = &VAL + 1
&IF &VAL NE 10 &SKIP -2
```

In this EXEC, the &TYPE statement is executed repeatedly until the value of &VAL is 10, and then execution continues with the statement following the &IF statement.

USING COUNTERS FOR LOOP CONTROL

A primary consideration in designing a portion of an EXEC procedure that is to be executed many times is how to control the number of executions. One way to control the execution of a sequence of instructions is to create a loop that tests and changes the value of a counter.

Before entering the loop, the counter is initialized to a value. Each time through the loop, the counter is adjusted (increased or decreased) toward a limit value. When the limit value is reached (the counter value is the same as the limit value), control passes out of the loop and it is not executed again. For example, the following EXEC initializes a counter based on the argument &1:

```
&IF &INDEX EQ 0 &EXIT 12
&TYPE COUNT IS &1
&1 = &1 - 1
&IF &1 GT 0 &SKIP -2
```

When this EXEC procedure is invoked, it checks that at least one argument was passed to it. If an argument is passed, it is assumed to be a number that indicates how many times the loop is to execute. Each time it passes through the loop, the value of &1 is decremented by 1. When the value of &1 reaches zero, control passes from the loop to the next sequential statement.

There are several ways of setting, adjusting, and testing counters. Some ways to set counters are by:

- Reading arguments from a terminal, such as:

  ```
  &READ VARS &COUNT1 &COUNT2
  ```

- Assigning an arbitrary value, such as:

  ```
  &COUNTER = 43
  ```

- Assigning a variable value or expression, such as:

  ```
  &COUNTS = &INDEX - 1
  ```

Counter values can be increased or decreased by any increment or decrement that meets your purposes. For example:

```
&COUNTEM = &COUNTEM - &RETCODE
&COUNT1 = &COUNT + 100
```

LOOP CONTROL WITH THE &LOOP STATEMENT

A convenient way to control execution of a sequence of EXEC statements is with the &LOOP control statement. An &LOOP statement can be set up in four ways:

- To execute a particular number of statements a specified number of times. For example, the statement

  ```
  &LOOP 3 2
  ```

  indicates that the three statements following the &LOOP statement are to be executed twice.

- To execute a particular number of statements until a specified condition is satisfied. For example:

  ```
  &LOOP 4 &X = 0
  ```

  The four statements following this statement are executed until the value of &X is 0.

- To execute the statements down to (and including) the statement identified by a label for a specified number of times. For example:

  ```
  &LOOP -ENDLOOP 6
  ```

  The statements between this &LOOP statement and the label -ENDLOOP are executed six times.

- To execute the statements down to (and including) the statement identified by a label until a specified condition is satisfied. In the following example

```
&LOOP -ENDLOOP &X = 0
```

  the statements are executed repeatedly until the value of &X is 0.

The numbers specified for the number of lines to execute and the number of times through the loop must be positive integers. You can use a variable symbol to represent the integer. If a label is used to define the limit of the loop, it must follow the &LOOP statement (it cannot precede the &LOOP statement).

In a conditional &LOOP statement, any variable symbols in the conditional phrase are substituted each time the loop is executed. For example, the statements:

```
&X = 0
&LOOP -END &X EQ 2
&X = &X + 1
-END &TYPE &X
```

are interpreted and executed as follows:

1. The variable &X is assigned a value of 0.
2. The &LOOP statement is interpreted as a conditional form; that is, to loop to -END until the value of &X equals 2. Since the value of &X is not 2, the loop is entered.
3. The variable &X is incremented by 1 and is then displayed.
4. Control returns to the beginning of the loop, where &X is tested to see if it equals 2. Since it does not, the loop is executed again and 2 is displayed. The next time through the loop, when &X equals 2, control is passed to the EXEC statement immediately following the label -END.

When this EXEC procedure is executed, the following lines are displayed:

```
1
2
```

at which time the value of &X equals 2; the loop is not executed again.

Another example of a conditional loop is:

```
&Y = &LITERAL A&B
&LOOP 2 .&X EQ &LITERAL .&
&X = &SUBSTR &Y 2 1
&TYPE &X
```

These statements are interpreted and executed as follows:

1. The variable &Y is set to the literal value A&B.
2. The two statements following the &LOOP statement are to be executed until the value of &X is &.
3. The &SUBSTR built-in function is used to set the variable &X to the value of the second character in the variable &Y, which is a literal ampersand (&).

4. The ampersand is typed once, and the loop does not execute again because the condition that the value of &X be a literal ampersand is met.

NESTING EXEC PROCEDURES

If you want to use an EXEC procedure within another EXEC, you must use the EXEC command to execute it. For example, if you have the statement

```
EXEC TEST
```

in an EXEC procedure, it invokes the EXEC procedure TEST.

The EXEC interpreter can handle up to 19 levels of recursion at one time, that is, up to 19 EXECs may be active, one nested within anchter. An EXEC may also call itself.

You can test the &GLOBAL special variable to see if an EXEC is executing within another procedure or not. For example, if the file GLOBAL EXEC contained the lines:

```
&IF &GLOBAL EQ 2 &GOTO -2NDPASS
   .
   .
   .
EXEC GLOBAL
   .
   .
   .
-2NDPASS &TYPE SECOND PASS BEGINS
```

then when the line "EXEC GLOBAL" is executed, control passes to the beginning of the EXEC; the value of &GLOBAL changes from 1 to 2; and control is passed to the &TYPE statement at the label 2NDPASS.

Passing Arguments to Nested Procedures

Variables in an EXEC file have meaning only within the particular procedure in which they are defined. You cannot set up a variable in one EXEC, and test that variable in a nested procedure. The exceptions to this are the ten special variables &GLOBAL0 through &GLOBAL9. These variables can only contain integral numeric values; you cannot assign them character-string values. These variables can be used to set up arguments to pass to nested procedures, or to communicate between EXEC files at different recursion levels.

EXITING FROM EXEC PROCEDURES

Execution in an EXEC procedure proceeds sequentially through a file, line by line. When a statement causes control to be passed to another statement, execution continues at the second statement, and again proceeds sequentially through the file. When the end of the file is reached, the EXEC terminates processing. Frequently, however, you may not want processing to continue to the end of the file. You can use the &EXIT statement to cause an immediate exit from EXEC processing and a return to the CMS environment. If the EXEC has been invoked from

another EXEC, control is returned to the calling EXEC file. For example, the statement

```
&IF &RETCODE ¬= 0 &EXIT
```

would cause an immediate exit from the EXEC if the return code from the last issued CMS command was not zero.

You can use the &EXIT statement to terminate each of a series of execution paths in an EXEC. For example, using the following statements,

```
&IF &1 EQ PRINT &GOTO -PRINT
&IF &1 EQ TYPE &GOTO -TYPE
   .
   .
   .
-PRINT
   .
   .
   .
&EXIT
-TYPE
   .
   .
   .
&EXIT
```

you ensure that once the path through the -PRINT routine has been taken, the EXEC does not continue processing with the -TYPE routine.

Passing Return Codes From EXECs

The &EXIT control statement also provides a special function, which allows you to pass a return code to CMS, or to the program or EXEC which called this EXEC. You specify the return code value on the &EXIT control statement as follows:

```
&EXIT 4
```

Execution of this line results in a return to CMS with a Ready message:

```
R(00004);
```

If you have a variety of exits in an EXEC, you can use a different value following each &EXIT statement, to indicate which path had been taken in the EXEC.

You can also use a variable symbol as the value to be passed as the return code:

```
&EXIT &VAL
```

Another common use of the &EXIT statement is to cause an exit to be taken following an error in a CMS command, and using the return code from the CMS command in the &EXIT statement:

```
&IF &RETCODE NE 0 &EXIT &RETCODE
```

Terminal Communications

You can design EXECs to be used interactively, so that their execution depends on information entered directly from the terminal during the execution. With the &TYPE statement, you can display a line at the terminal, and with the &READ statement, you can read one or more lines from the terminal or console stack. Used together, these statements can provide a prompting function in an EXEC:

```
&TYPE WHAT DO YOU WANT TO DO NOW?
&TYPE ENTER (STOP CONTINUE REPEAT):
&READ VARS &LABEL
&GOTO -&LABEL
-STOP
   .
   .
   .
-CONTINUE
   .
   .
   .
-REPEAT
   .
   .
   .
```

In this example, the &READ control statement is used with the VARS operand, which accepts the words entered at the terminal as values to be assigned to variable symbols. If the word STOP is entered in response to the &READ VARS statement in this example, the variable symbol &LABEL is assigned the value STOP. Then, in the &GOTO statement, the symbol is substituted with the value STOP, so the branch is taken to the label -STOP.

You can specify up to 17 variable names on an &READ VARS control statement. If you enter fewer words than are expected, the remaining variables are set to blanks. If you enter a null line, any variable symbols on the &READ line are set to blanks. If the execution of your EXEC depends on a value entered as a result of an &READ VARS, you might want to include a test for a null line immediately following the statement, for example:

```
&READ VARS &TITLE &SUBJ
&IF .&TITLE = . &EXIT 100
```

If no tokens are entered in response to the terminal read request, the variable &TITLE is null, and the EXEC terminates with a return code of 100.

If you are writing an EXEC that may receive a number of tokens from the terminal, you may find it more convenient to use the &READ ARGS form of the &READ control statement. When the &READ ARGS statement reads a line from the terminal, the tokens entered are assigned to the &n special variables (&1, &2, and so on).

READING CMS COMMANDS AND EXEC CONTROL STATEMENTS FROM THE TERMINAL

When you use the &READ control statement with no operands, or with a numeric value, EXEC reads one line or the specified number of lines from the terminal. These lines are treated, by EXEC, as if they were in the EXEC file all along. For example, if you have an EXEC named COMMAND that looks like the following:

```
&TYPE ENTER NEXT COMMAND:
&READ 1
&SKIP -2
```

all the commands you enter during the terminal session are processed by the EXEC. Each time the &READ statement is executed, you enter a CMS command. When the command finishes, control returns to EXEC, which prompts you to enter the next command. Since the CMS commands are all being executed from within the EXEC, you do nct receive the CMS Ready message at the completion of each command.

You could also enter EXEC control statements or assignment statements. To terminate the EXEC and return to the CMS environment, you must enter the EXEC control statement &EXIT from the terminal:

```
&exit
```

DISPLAYING DATA AT A TERMINAL

You can use the &TYPE and &BEGTYPE control statements to display lines from your EXEC at the terminal. In addition, you can use the CMS TYPE command to display the contents of CMS files.

When you use the &TYPE control statement, you can display variable symbols as well as data. Variable symbols on an &TYPE control statement are substituted before they are displayed. For example, the lines:

```
&NAME = ARCHER
&TYPE &NAME
```

result in the display:

```
ARCHER
```

You can use the &TYPE statement to display prompting messages, error or information messages, or lines of data.

In an EXEC file with fixed-length records, only the first 72 characters of each line are processed by the EXEC interpreter. Therefore, if you want to use the &TYPE control statement to display a line longer than 72 characters, you must convert the file into variable-length records.

&BEGTYPE and &BEGTYPE ALL

All of the words in an &TYPE control statement are scanned into 8-character tokens. If you need to display a word that has more than 8 characters, you must use the &BEGTYPE control statement. The &BEGTYPE control statement precedes one or more data lines that you want to display, for example:

```
&BEGTYPE
THIS EXEC PERFORMS THE FOLLOWING FUNCTIONS:
1. IT ACCESSES DISKS 193, 194, and 195 AS
   B, C, AND D EXTENSIONS OF THE A-DISK.
2. IT DEFINES, FORMATS, AND ACCESSES A
   TEMPORARY 195 DISK (E).
&END
```

The &END statement must be used to terminate a series of lines introduced with the &BEGTYPE statement. "&END" must begin in column 1 of the EXEC file.

The lines following an &BEGTYPE statement, up to the &END statement, are not scanned by the EXEC interpreter. Therefore, no substitution is performed on the variable symbols on these data lines. If you need to display a symbol, you must use the &TYPE control statement. To display a combination of scanned and unscanned lines, you might need to use both the &TYPE and &BEGTYPE control statements:

```
&BEGTYPE
EVALUATION BEGINS...
&END
&TYPE &VAL1 IS &NUM1.
&TYPE &VAL2 IS &NUM2.
&BEGTYPE
EVALUATION COMPLETE.
&END
```

If you use the &BEGTYPE control statement in an EXEC file with fixed-length records, and you want to display lines longer than 72 characters, you must use the ALL operand. For example,

```
&BEGTYPE ALL
...data line of 103 characters
...data line of 98 characters
...data line of 50 characters
&END
```

You can display lines of up to 130 characters in this way. When you enter lines that are longer than the record length in an EXEC file, the records are truncated by the editor. You must increase the record length of the file by using the LRECL option of the EDIT command, for example:

```
edit old exec a (lrecl 130
```

In a variable-length EXEC file, you do not need to specify ALL to display long lines. If you originally created the file with a record length of 130 characters, you do not need to increase the size later to accomodate longer records.

Using the CMS TYPE Command

You can use the TYPE command in an EXEC file to display data files, or portions of data files. For example, you might have a number of files with the same filetype; the files contain various kinds of data. You could create an EXEC that invokes the TYPE command to display a particular file as follows:

```
&IF &INDEX EQ 2 &IF &2 EQ ? &GOTO -TYPE
   .
   .
   .
-TYPE
ACCESS 198 B
TYPE &1 MEMO B
```

The filetype MEMO is a reserved filetype, which accepts data in uppercase and lowercase; you can use it for documentation files or programming notes.

Controlling Terminal Displays

The two CMS Immediate commands that control terminal display are HT (halt typing) and RT (resume typing). When data is being displayed at your terminal, you can suppress the display by signaling an attention interrupt and entering:

```
ht
```

This command affects output that is being displayed:

- As a response to a CMS command, including prompting messages, error messages, or normal display responses (as from the TYPE command)
- From a program
- In response to an &TYPE or &BEGTYPE request in an EXEC

Once display has been suppressed, and before the command, program, or EXEC completes execution, you can request that display be resumed by signaling another interrupt and entering:

```
rt
```

In an EXEC file, if you want to halt or resume display, you must use the &STACK control statement to enter the RT or HT commands. For example, the ACCESS command issues a message when a disk is accessed:

```
D(198) R/O
```

If you are going to issue the ACCESS command within an EXEC and you do not wish this message displayed, you could enter the lines:

```
&STACK HT
ACCESS 198 D
```

Once you have stacked an HT command, all displaying is suppressed for the remainder of the EXEC file's execution, unless the RT Immediate command is processed, either following an attention interrupt (as described above) or within the EXEC. To execute the RT Immediate command in an EXEC, use the statement:

```
&STACK RT
```

A physical read to the terminal, for example, the result of an &READ control statement, also resets the display setting to RT.

The &TYPEFLAG Special Variable: You can test the current value of the display controlling an EXEC with the &TYPEFLAG special variable. The value of &TYPEFLAG can only be one of the literal values HT or RT. For example:

```
&IF &$ EQ NOTYPE &STACK HT
   .
   .
   .
&IF &TYPEFLAG EQ HT &SKIP 3
&TYPE LINE1
&TYPE LINE2
&TYPE LINE3
&CONTINUE
```

In this example, if NOTYPE is entered as an argument when the EXEC is invoked, an HT command is stacked, so that no displaying is done at the

terminal. Within the EXEC, the variable &TYPEFLAG is tested, and, if it is HT, then a series of &TYPE statements is skipped. Since EXEC does not have to process these lines, you can save time and system resources by not processing them.

Reading from the Console Stack

When you are in the CMS environment executing programs or CMS commands, you can stack commands, either by entering multiple command lines separated by the logical line end symbol, as follows:

```
print myfile listing#cp query printer
```

or by signaling an attention interrupt and entering a command line, as follows:

```
print myfile listing
!
cp query printer
```

In both of the preceding examples, the second command line is saved in a terminal input buffer, called the console stack. Whenever a read occurs in your virtual machine, CMS reads lines from the console stack, if there are any lines in it. If there are no lines in the stack, the read results in a physical read to your terminal (on a typewriter terminal, the keyboard unlocks).

A virtual machine read occurs whenever a command or subcommand finishes execution, or when an EXEC or a program issues a read request. Many CMS commands also issue read requests, for example, SORT and COPYFILE. If you want to execute one of these commands in an EXEC, you may want to stack, in the console stack, the response to the read request so that when it is issued it is immediately satisfied. For example:

```
&STACK 42-121 1
COPYFILE &NAME LISTING A = ASSEMBLE = (SPECS
```

When the COPYFILE command is issued with the SPECS option, a prompting message for a specification list is issued, followed by a read request. In this EXEC, the request is satisfied with the line stacked with the &STACK control statement. If the response was not stacked, you would have to enter the appropriate information from the terminal during the execution of the EXEC that contained this COPYFILE command line.

In addition to stacking predefined responses to commands and programs, you can use the console stack to stack CMS commands and EDIT subcommands, as well as data lines to be read within the EXEC.

The number of lines that you can place in the console stack at any one time varies according to the amount of storage available in your virtual machine for stacking. You may want to stack one or two lines at a time, or you may wish to stack many lines. There are several features available in EXEC that can help you manipulate the stack.

&BEGSTACK and &BEGSTACK ALL

Just as the &TYPE control statement has an &BEGTYPE counterpart, the &STACK control statement has an &BEGSTACK counterpart. You can stack

multiple data lines following an &BEGSTACK statement. Lines stacked in this way are not scanned by the EXEC processor, and no substitution is performed on variable symbols. For example, the lines

```
&BEGSTACK
...line of data
...line of data
...line of data
&END
```

stack three data lines in the stack. The stacked lines must be followed by an &END control statement, which must be entered in the EXEC file beginning in column 1.

If you have an EXEC with fixed-length records, and you want to stack data lines longer than 72 characters, you must use the ALL operand of the &BEGSTACK control statement:

```
&BEGSTACK ALL
...line of 103 characters
...line of 98 characters
...line of 60 characters
&END
```

The ALL operand is not necessary for variable-length EXEC files.

Stacking FIFO and LIFO

When you are stacking multiple lines in an EXEC, you may choose to reverse the sequence in which lines are read in from the stack. The default sequence is FIFO (first-in, first-out), but you may specify LIFO (last-in, first-out) when you enter the &STACK or &BEGSTACK control statement. For example, execution of the lines

```
&STACK &TYPE A
&STACK &TYPE B
&STACK LIFO &TYPE C
&STACK LIFO &TYPE D
&STACK &TYPE E
```

results in the display:

```
D
C
A
B
E
```

The &READFLAG Special Variable

The EXEC special variable &READFLAG always contains one of two values, STACK or CONSOLE. When it contains the value STACK, it indicates that there are lines in the stack. When it contains the value CONSOLE, it indicates that the stack is empty and that the next read request results in a physical read to the terminal (console).

You can test this value in an EXEC, for example:

```
&IF &READFLAG EQ STACK &SKIP 2
&TYPE STACK EMPTY
&EXIT
&CONTINUE
```

You might use a similar test in an EXEC that processes a number of lines from the stack, and loops through a series of steps until the stack is empty.

STACKING CMS COMMANDS

Whenever you place a command in the console stack, it remains there until a read request is presented to the terminal. If the request is the result of an &READ control statement, then the line is read from the stack. For example, the lines

```
&STACK CP QUERY TIME
&READ
```

result in the command line being stacked, read in, and then executed.

If there are no read requests in an EXEC file, then any commands that are stacked are executed after the EXEC has finished and has returned control to the CMS environment. For example, consider the lines:

```
TYPE &1 LISTING A
ACCESS 198 A
TYPE &1 LISTING A
```

If this EXEC is located on your 191 A-disk, then when the ACCESS command accesses a new A-disk, CMS can not continue reading the EXEC file, and issues an error message. However, if the EXEC was written as follows:

```
TYPE &1 LISTING A
&STACK ACCESS 198 A
&STACK TYPE &1 LISTING A
```

then, after the TYPE command, the next command lines are stacked, the EXEC finishes executing and returns control to CMS, which reads the next command lines from the console stack.

When you stack CMS commands in an EXEC procedure, you cannot place multiple command lines in one statement (for example, print abc listing#print xyz listing), because CMS does not recognize the logical line end (X'15').

Stacking EDIT Subcommands

If you want to issue the EDIT command from within an EXEC, you might want to stack EDIT subcommands to be read by the CMS Editor. You should stack these subcommands, either with &STACK statements, or with the &BEGSTACK statement, just before issuing the EDIT command. For example:

```
&BEGSTACK
CASE M
GET SETUP FILE A 1 20
TOP
LOCATE /XX/
&END
&STACK REPLACE
EDIT &1 DATA (LRECL 120
```

If this EXEC is named EDEX, and you invoke it with

```
edex fr01
```

the EDIT subcommands are stacked in the order they appear in the EXEC. The EDIT command is invoked to edit the file FR01 DATA, and the EDIT subcommands are read from the stack and executed. When the stack is empty, your virtual machine is in the edit environment in input mode, and the first line you enter replaces the existing line that contains the character string XX.

Note that all of the EDIT subcommands in the example, except for the REPLACE subcommand, are stacked within an &BEGSTACK stack, and that the REPLACE subcommand is stacked with &STACK. If you are creating EXEC files with fixed-length records, you must use &STACK to stack the INPUT and REPLACE subcommands. If you use &BEGSTACK, then the INPUT and REPLACE subcommands are treated as if they contain text data, and so insert or replace one line in the file (a line of blanks). This is not true, however, for variable-length EXEC files.

Similarly, if you want to stack a null line, to change from input mode to edit mode in an EXEC, you must use the &STACK statement with no other data on the line (in both fixed- and variable-length EXEC files), for example:

```
&STACK INPUT
&BEGSTACK
...data line
...data line
...data line
&END
&STACK
&STACK FILE
EDIT &1 &2
&EXIT
```

When this EXEC is invoked with a filename and filetype as arguments, the INPUT subcommand, data lines, null line, and FILE subcommand are placed in the stack before the EDIT command is issued. The data lines are placed in the specified file and the file is written onto disk before the EXEC returns control to CMS.

STACKING LINES FOR EXEC TO READ

Lines in the console stack can be read by the EXEC interpreter with an &READ control statement, for example,

```
-SETUP
   &LOOP 3 &NUM = 50
   &STACK &NUM &CHAR
   &NUM = &NUM + 1
   &CHAR = &CONCAT &STRNG &NUM
     .
     .
     .
-READ
   &LOOP -FINIS &READFLAG EQ CONSOLE
   &READ ARGS
     .
     .
     .
   -FINIS
```

In this EXEC procedure, the statements following the label -SETUP stack a number of lines. The variables &NUM and &CHAR are substituted before they are stacked. At the label -READ, the lines are read in from the stack and processed. The values stacked are read in as the variable symbols &1 and &2. Control passes out of the loop when the stack is empty.

CLEARING THE CONSOLE STACK

If you use the console stack in an EXEC procedure, you should be sure that it is empty before you begin stacking lines in it. Also, you should be sure that it is empty before exiting from the EXEC (unless you have purposely stacked CMS commands for execution).

One way to clear a line from the stack without affecting the execution of your EXEC is to use the &READ VARS or &READ ARGS control statement. You can use &READ VARS without specifying any variable symbols so that the line read is read in and effectively ignored. For example:

```
&LOOP 1 &READFLAG EQ CONSOLE
&READ VARS
```

If these lines occur at the beginning of an EXEC file, they ensure that any stacked lines are cleared. If the EXEC is named EXEC1 and is invoked with the line:

```
exec1#type help memo#type print memo
```

then the lines TYPE HELP MEMO and TYPE PRINT MEMO are cleared from the stack and are not executed.

You could use the same technique to clear the stack in case of an error encountered in your EXEC, so that the stack is cleared before returning to CMS. You would especially want to do this if you stacked data lines or EXEC control statements that have no meaning to CMS.

Another way to clear the console stack is with the CMS function DESBUF. For example,

```
&IF &READFLAG EQ STACK DESBUF
```

When you use the DESBUF function to clear the console input stack, the output stack is also cleared. The output stack contains lines that are waiting to be displayed or typed at the terminal. Frequently, when an EXEC is processing, output lines are stacked, and are not displayed immediately following the execution of an &TYPE statement. If you want to display all pending output lines before clearing the console input stack, you should use the CONWAIT function, as follows:

```
CONWAIT
&IF &READFLAG EQ STACK DESBUF
```

The CONWAIT (console wait) function causes a suspension of program execution until the console output stack is empty. If there are no lines waiting to be displayed, CONWAIT has no effect.

Clearing the stack is important when you write edit macros, since all subcommands issued in an edit macro must be first stacked. See "Section 17. Writing Edit Macros" for additional information on using the console stack.

File Manipulation with EXECs

You can, to a limited degree, read and write CMS disk files using EXECs. You can stack files with a filetype of EXEC in the console stack and then read them, one record at a time, with &READ control statements. All data items are truncated to 8 characters. You can write a file, one record at a time, with the &PUNCH control statement, and then you can read the spool punch file onto disk. Examples of these techniques follow.

STACKING EXEC FILES

There are two methods to stack EXEC files in the console stack. One is illustrated using a CMS EXEC file, as shown in the following PREFIX EXEC:

```
&LNAME = &CONCAT &1 *
LISTFILE &LNAME SCRIPT * (EXEC
EXEC CMS &STACK
&LOOP -END &READFLAG EQ CONSOLE
&READ VARS &NAME &TYPE &MOD
&SUFFIX = &SUBSTR &NAME 3 5
&NEWNAM = &CONCAT &2 &SUFFIX
RENAME &NAME &TYPE &MOD &NEWNAM &TYPE &MOD
&IF &RETCODE EQ 0 &SKIP
&TYPE FILE &NAME &TYPE NOT RENAMED
-END
```

This EXEC procedure is invoked with two arguments, each 2 characters in length, which indicate old and new prefixes for filenames. The EXEC renames files with a filetype of SCRIPT that have the first prefix, changing only the prefix in the filename.

The LISTFILE command, invoked with the EXEC option, creates a CMS EXEC file in the format:

```
&1 &2 filename SCRIPT mode
```

When the EXEC is invoked with the line

```
EXEC CMS &STACK
```

the argument &STACK is substituted for the variable symbol &1 in each line in the CMS EXEC. The execution of the CMS EXEC effectively stacks, in the console stack, the complete file identifications of the files listed:

```
&STACK filename SCRIPT mode
&STACK filename SCRIPT mode
   .
   .
   .
```

These stacked lines are read back into the EXEC, one at a time, and the tokens "filename", "SCRIPT", and "mode" are substituted for the variable symbols &NAME, &TYPE, and &MOD.

Using the &SUBSTR and &CONCAT built-in functions, the new name for each file is constructed, and the RENAME command is issued to rename the files.

For example, if you invoke the EXEC procedure with the line

```
prefix ab xy
```

all SCRIPT files that have filenames beginning with the characters AB are renamed so that the first two characters of the filename are XY. A sample execution summary of this EXEC is illustrated under "Debugging EXEC Procedures" in "Section 16. Refining Your EXEC Procedures."

Stacking Data Files

You can create a data file, containing fixed-length records, using a filetype of EXEC. To stack these data lines in the console stack, you can enter them following an &BEGSTACK (or &BEGSTACK ALL) control statement. For example, the file DATA EXEC is as follows:

```
&BEGSTACK
HARRY 10/12/48
PATTI 1/18/49
DAVID 5/20/70
KATHY 8/6/43
MARVIN 2/28/50
```

The file BDAY EXEC contains:

```
&CONTROL ERROR
EXEC DATA
&IF &READFLAG EQ CONSOLE &GOTO -NO
&READ VARS &NAME &DATE
&IF &NAME NE &1 &SKIP -2
-FOUND
&IF .&1 EQ . &EXIT
&TYPE &1 'S BIRTHDAY IS &DATE
CONWAIT
DESBUF
&EXIT
-NO &TYPE &1 NOT IN LIST
&EXIT
```

When the BDAY EXEC is invoked, it expects an argument that is a first name. The function of the EXEC is to display the birthday of the specified person. A sample execution of this EXEC might be:

```
bday kathy
KATHY 'S BIRTHDAY IS 8/6/43
R;
```

BDAY EXEC first executes the DATA EXEC, which stacks names and dates in the console stack. Then, BDAY EXEC reads one line at a time from the stack, assigning the variable names &NAME and &DATE to the tokens on each line. It compares &NAME with the argument read as &1. When it finds a match, it displays the message indicating the date, and clears the console stack after waiting for terminal output to finish.

Note that the file DATA EXEC begins with an &BEGSTACK control statement, but contains no &END statement. The stack is terminated by the end of the EXEC file. "Writing Data Files" describes a technique you might use to add new names and birth dates to the DATA EXEC file.

Writing Data Files

You can build a CMS file in your virtual card punch using the &PUNCH and &BEGPUNCH control statements. Depending on the spooling characteristics of your virtual punch, the file that you build may be sent to another user's card reader, or to your own virtual card reader. When you read the file with the CMS READCARD command, the spool reader file becomes a CMS disk file.

The following example illustrates how you might use your card punch and reader to update a CMS file by adding records to the end of it. The file being updated is the DATA EXEC, which is the input file for the BDAY EXEC, shown in the example in "Stacking Data Files." You could create a separate EXEC to perform the update, but this example shows how you might modify the BDAY EXEC to perform the addition function (ellipses indicate the body of the EXEC, which is unchanged):

```
&CONTROL ERROR
&IF &1 EQ ADD &GOTO -ADDNAME
   .
   .
   .
&EXIT
-ADDNAME
&TYPE ENTER FIRST NAME AND DATE IN FORM MM/DD/YY
&READ VARS &NAME &DATE
&IF .&NAME = . &SKIP 3
&PUNCH &NAME &DATE
&TYPE ENTER NEXT NAME OR NULL LINE:
&SKIP -4
CP SPOOL PUNCH TO *
CP CLOSE PUNCH
READCARD NEW NAMES
COPYFILE NEW NAMES A DATA EXEC A (APPEND
&IF &RETCODE = 0 &SKIP 2
&TYPE ERROR CREATING FILE
&EXIT &RETCODE
ERASE NEW NAMES
```

When BDAY EXEC is invoked with the keyword ADD, you are prompted to enter lines to be added to the data file. Each line that you enter is punched to the card punch. When you enter a null line, indicating that you have finished entering lines, the CP commands SPOOL and CLOSE direct the spool file to your card reader and close the punch.

The file is read in as the file NEW NAMES, which is appended to the file DATA EXEC using the COPYFILE command with the APPEND option. The file NEW NAMES is erased and the EXEC terminates processing.

Using Your Virtual Card Punch

When you punch lines in your virtual punch, the lines are not released as a CP spool file until the punch is closed. Since the EXEC processor does not close the virtual punch when it terminates processing, you must issue the CLOSE command to release the file. You can do this in the EXEC with the command line

```
CP CLOSE PUNCH
```

or from the CMS environment after the EXEC has finished. If you use the CLOSE command in the EXEC, you must preface it with CP.

The CMS PUNCH command, which you can use in an EXEC to punch an entire CMS file, does close the punch after punching a file. Therefore, if you want to create a punch file using a combination of &PUNCH control statements and PUNCH commands, you must spool your punch using the CONT option, so that a close request does not affect the file:

```
CP SPOOL PUNCH TO * CONT
&PUNCH FIRST FILE
&PUNCH
PUNCH FILE1 TEST ( NOHEADER
&PUNCH SECOND FILE
&PUNCH
PUNCH FILE2 TEST ( NOHEADER
CP SPOOL PUNCH CLOSE NOCONT
```

The preceding example punches title lines introducing the files punched with the CMS PUNCH command. The null &PUNCH statements punch blank lines. The PUNCH command is issued with the NOHEADER option, so that a read control card is not punched.

You can also use an EXEC procedure to punch a job to send to the CMS Batch Facility for processing. The batch facility, and an example of using an EXEC to punch a job to it, are described in "Section 12. Using the CMS Batch Facility."

Using &PUNCH and &BEGPUNCH

All lines punched to the virtual card punch are fixed-length, 80-character records. When you use the &PUNCH control statement in a fixed-length EXEC file, EXEC scans only the first 72 columns of the EXEC.

If you want to punch a word that contains more than 8 characters, you must use the &BEGPUNCH control statement, which also, in fixed-length files, causes EXEC to punch data in columns 1 through 80.

Section 15. Using EXECs with CMS Commands

Whenever you create an EXEC file you are, for all practical purposes, creating a new CMS command. When you enter a command line in the CMS environment, CMS searches for an EXEC file with the specified filename before searching for a MODULE file or CMS command. You can place the names of your EXEC files in a synonym table and assign minimum truncation values for the synonyms, just as you can for CMS command names.

While many of your EXEC procedures may be very simple, others may be very long and complicated, and perform many of the housekeeping functions performed by CMS commands, such as syntax checking, error message generation, and so on.

Monitoring CMS Command Execution

Many, or most, of your EXEC procedures may contain sequences of CMS commands that you want to execute. If your EXEC procedure contains no EXEC control statements, each command line is displayed and then the command is executed. If an error occurred, the CMS error message is displayed, followed by a return code in the format:

```
+++ R(nnnnn) +++
```

where nnnnn is the nonzero return code from the CMS command. If the command is not a valid CMS command, the return code is a -3:

```
+++ R(-0003) +++
```

You may also receive this error return when you use a CP command without prefacing it with the CP command. If you enter an unknown CP command following "CP", you receive a return code of 1.

If a command completes successfully, no return code is displayed.

If you do not want to see the command lines displayed before execution, nor return codes following execution, you can use the EXEC control statement:

```
&CONTROL OFF
```

Or, if you want to see only the command lines that produced errors, and the resultant return codes, you can specify:

```
&CONTROL ERROR
```

Regardless of these settings of the &CONTROL statement, CMS error messages are displayed, as long as the value of &READFLAG is RT, and the terminal is displaying output.

If you issue the LISTFILE, STATE, ERASE, or RENAME commands in an EXEC procedure, and you do not want to see the error message FILE NOT FOUND displayed, you can use the statement:

```
&CONTROL NOMSG
```

to suppress the display of these particular messages.

You can request that particular timing information be displayed during an EXEC's execution. If you want to display the time of day at which each command executes, you can specify

```
&CONTROL TIME
```

Then, as each command line is displayed, it is prefaced with the time, for example,

```
&CONTROL CMS TIME
QUERY BLIP
```

executes as follows:

```
10:34:16 QUERY BLIP
BLIP     = *
```

If you wish to see, following the execution of each CMS command, specific CPU timing information, such as the long form of the Ready message, you can use the &TIME control statement. For example,

```
&TIME ON
QUERY BLIP
QUERY FILEDEF
```

might execute as:

```
QUERY BLIP
BLIP     = OFF
T=0.01/0.04 10:44:21

QUERY FILEDEF
NO USER DEFINED FILEDEF'S IN EFFECT
T=0.01/0.04 10:45:26
```

Handling Error Returns From CMS Commands

In many cases, you want to execute a command only if previous commands were successful. For example, you would not want to execute a PRINT command to print a file if you had been unable to access the disk on which the file resided. There are two methods, using EXEC procedures, that allow you to monitor and control what happens following the execution of CMS commands. One method uses the EXEC control statement &ERROR to transfer control when an error occurs; the other tests the special variable &RETCODE upon completion of a CMS command to determine whether that particular command completed successfully.

USING THE &ERROR CONTROL STATEMENT

When a CMS command is executed within an EXEC, a return code is passed to the EXEC interpreter, indicating whether or not the command completed successfully. If the return code is nonzero, EXEC then activates the &ERROR control statement currently in effect. For example, if the following statement is included at the beginning of an EXEC file

```
&ERROR &EXIT
```

then, whenever a CMS command (or user program) completes with a nonzero return code, the &EXIT statement in the &ERROR statement is executed,

and the EXEC terminates processing. You might use a similar statement in your EXECs to ensure that they do not attempt to continue processing in the event of an error.

An &ERROR control statement can specify any executable statement. It may transfer control to another portion of the EXEC, or it many be a single statement that executes before control is returned to the next statement in the EXEC. For example,

```
&ERROR &GOTO -EXIT
```

transfers control to the label -EXIT, in case of any CMS error. The statement

```
&ERROR &TYPE CMS ERROR
```

results in the display of the message "CMS ERROR" before returning control to the statement following the command that caused the error.

If you do not have an &ERROR control statement in an EXEC, or if you specify &ERROR with no operands, EXEC takes no special action when a CMS command returns with an error return code. Specifying &ERROR with no operands is the same as specifying:

```
&ERROR &CONTINUE
```

Since an &ERROR control statement remains in effect for the remainder of the EXEC execution, or until another &ERROR control statement is encountered, you may use &ERROR &CONTINUE to restore default processing.

USING THE &RETCODE SPECIAL VARIAELE

An error return from a CMS command, in addition to calling an &ERROR control statement, also places the return code value in the EXEC special variable &RETCODE. Following the execution of any CMS command in an EXEC procedure, you can test whether or not the command completed without error. For example,

```
TYPE ALPHA FILE A
&IF &RETCODE ¬= 0 &EXIT
TYPE BETA FILE A
&IF &RETCODE ¬= 0 &EXIT
```

Note that the value of &RETCODE is modified after the execution of each CMS command.

The value of &RETCODE is affected by your own programs. If you execute a program in your EXEC using the LOAD and START (or FETCH and START) commands, or if you execute a MODULE file, then the &RETCODE special variable contains whatever value was in general register 15 when the program exited. If you are nesting EXEC procedures, then &RETCODE contains the value passed from the &EXIT statement of the nested EXEC.

You can use the value of the return code, as well, to analyze the extent or the cause of the error, and set up an error analysis routine accordingly. For example, suppose you want to set up an analysis routine to identify return codes 1 through 11, and to exit from the EXEC when the return code is greater than 11. When a return code is identified, control is passed to a corresponding routine that attempts to correct the error. You could set up such an analysis routine as follows:

```
-ERRANAL
&CNT = 0
&LOOP 2 &CNT EQ 12
&IF  &RETCODE EQ &CNT &GOTO -FIX&CNT
&CNT = &CNT + 1
   .
   .
   .
-FIX0 &GOTO -ALLOK
-FIX1
   .
   .
   .
&GOTO -ALLOK
-FIX2
   .
   .
   .
&GOTO -ALLOK
   .
   .
-FIX11
   .
   .
   .
-ALLOK
```

When the value of the &CNT variable equals the return code value in &RETCODE, the branch to the corresponding -FIX routine is taken. Each corrective routine performs different actions, depending on its code, and finishes at the routine labeled -ALLOK.

You can, in some cases, determine the cause of a CMS command error and attempt to correct it in your EXEC. To do this, you must know the return codes issued by VM/370 commands. See VM/370: System Messages for a discussion of the return codes for VM/370 commands. In addition, the error messages and corresponding return codes are listed under the command descriptions for each CMS command in the VM/370: CMS Command and Macro Reference.

As an example, all CMS commands that search for files issue a return code of 28 when a file is not found. If you want to test for a file not found condition in your EXEC, you might use statements similar to the following:

```
&CONTROL OFF NOMSG
   .
   .
   .
TYPE HELP MEMO A
&IF &RETCODE = 28 &GOTO -NOFILE
```

Tailoring CMS Commands for Your Own Use

You can create EXEC procedures that simplify or extend the use of a particular CMS command. Depending on your applications, you can modify the CMS command language to suit your needs. You can create EXEC files that have the same names as CMS commands, and, since CMS locates EXEC files before MODULE files, the EXEC is found first. For example, the COPYFILE command, when used to copy CMS disk files, requires six operands. If you change only the filename when you copy files, you could create a COPY EXEC as follows:

```
&CONTROL OFF
&IF &INDEX ¬= 3 &SKIP
COPYFILE &1 &2 = &3 &2 =
COPYFILE &1 &2 &3 &4 &5 &6 &7 &8 &9 &10 &11 &12 &13 &14 &15
```

If you always invoke the COPYFILE command using the truncation COPY, EXEC processes the command line for you, and if you have entered the three arguments, EXEC formats the COPYFILE command for you. If any other number of arguments are entered, the COPYFILE command is invoked with all the arguments as entered.

CREATING YOUR OWN DEFAULT FILETYPES

If you use special filetypes for particular applications and they are not among those that the CMS Editor supplies default settings for, but do require special editor settings, you can create an EXEC to invoke the editor. The EXEC can check for particular filetypes, and if it finds them, stack the appropriate EDIT subcommands. If you name this EXEC procedure E EXEC, then you can bypass it using a longer form of the EDIT command. The following is a sample E EXEC:

```
&CONTROL OFF
&IF &INDEX GT 1 &SKIP 2
EDIT &1 SCRIPT
&EXIT
&IF &2 EQ TABLE &GOTO -TABLE
&IF &2 EQ CHART &GOTO -CHART
&IF &2 EQ EXEC &GOTO -EX
&IF &2 EQ SYSIN &GOTO -SYSIN
-NORM EDIT &1 &2 &3 &4 &5 &6
&EXIT
-TABLE &BEGSTACK
IMAGE ON
TABS 1 10 20
CASE M
&END
EDIT &1 &2 &3 (LRECL 20
&EXIT
-CHART &BEGSTACK
CASE M
IMAGE ON
&END
EDIT &1 &2 &3
&EXIT
-EX
EDIT &1 &2 &3 (LRECL 130
&EXIT
-SYSIN &BEGSTACK
TABS 1 10 16 31 36 41 46 69 72 80
SERIAL ON
TRUNC 71
VERIFY 72
&END
EDIT &1 &2 &3
&EXIT
```

This EXEC defines special characteristics for filetypes CHART, TABLE, and SYSIN, and defaults an EXEC file to 130-character records. If only one argument is entered, it is assumed to be the filename of a SCRIPT file. Since the editor is invoked from within the EXEC, control returns to EXEC after you use the FILE or QUIT subcommands during the edit session, and you must use the &EXIT control statement so that the EXEC does not continue processing, and execute the next EDIT command in the file.

Section 16. Refining Your EXEC Procedures

This section provides supplementary information for writing complex EXEC procedures. Although the EXEC interpreter resembles, in some aspects, a high-level programming language, you do not need to be a programmer to write EXECs. Some of the techniques suggested here, for example, on annotating and writing error messages, are common programming practices, which help make programs self-documenting and easier to read and to use.

Annotating EXEC Procedures

Lines in an EXEC file that begin with an asterisk (*) are not processed by the EXEC interpreter. You can use * statements to annotate your EXECs. If you write EXECs frequently you may find it convenient to include a standard comment at the beginning of each EXEC, indicating its function and the date it was written, for example:

```
* EXEC TO HELP CONVERT LISTING FILES
* INTO SCRIPT FILES
*                J. BEAN 10/18/75
```

You can also use single asterisks or null lines to provide spacing between lines in an EXEC file to make examining the file easier.

In an EXEC, you cannot place comments on the same line with an executable statement. If you want to annotate a particular statement or group of statements, you must place the comments either above or below the lines you are annotating.

A good practice to use, when writing EXECs, is to set them up to respond to a ? (question mark) entered as the sole argument. For example, an EXEC named FSORT might contain:

```
&CONTROL OFF
&IF &INDEX = 1 &IF &1 = ? &GOTO -TELL
   .
   .
   .
-TELL &BEGTYPE
      CORRECT FORM IS ' FSORT USERID <VADDR> '

      PRINTS AN ALPHABETIC LISTING OF ALL FILES ON THE SPECIFIED
      USER'S DISK. IF A VIRTUAL ADDRESS (VADDR) IS NOT
      SPECIFIED, THE USER'S 191 IS THE DEFAULT.
&END
```

You may also wish to anticipate the situation in which a user might enter an EXEC name with no arguments, for an EXEC that requires arguments:

```
&IF &INDEX = 0 &GOTO -HELP
&IF &INDEX = 1 &IF &1 = ? &GOTO -TELL
   .
   .
   .
&EXIT
-HELP &BEGTYPE
      CORRECT FORM IS ' COPY OLDFN OLDFT NEWFN '
      TYPE  ' COPY ? ' FOR MORE INFO
&END
&EXIT
-TELL &BEGTYPE
      CORRECT FORM IS ' COPY OLDFN OLDFT NEWFN '
      USES COPYFILE COMMAND TO CHANGE ONLY THE FILENAME
&END
&EXIT
```

This type of annotating is especially useful if you share your disks or your EXECs with other users.

Error Situations

It is good practice, when writing EXECs, to anticipate error situations and to provide meaningful error or information messages to describe the error when it occurs. The following error situations, and suggestions for handling them, have already been discussed:

- Errors in invoking the EXEC, either with an improper number of arguments, or with invalid arguments. (See "Arguments" in "Section 14. Building EXEC Procedures.")
- Errors in CMS command processing that can be detected with an &ERROR control statement or with the &RETCODE special variable. (See "Handling Error Returns from CMS Commands" in "Section 15. Using EXECs With CMS Commands.")

Many different kinds of errors may occur, also, in the processing of your EXEC control statements. EXEC processing errors, such as an attempt to branch to a nonexistent label, or an invalid syntax, are "unrecoverable" errors. These errors always terminate EXEC processing and return your virtual machine to the CMS environment, or to the calling EXEC procedure or program. The error messages produced by EXEC, and the associated return codes, are described in the VM/370: System Messages.

WRITING ERROR MESSAGES

One way to make your EXECs more readable, especially if they are long EXECs, is to group all of your error messages in one place, probably at the end of the EXEC file. You may also wish to number your messages and associate the message number with a label number and a return code. For example:

```
&IF &CT > 100 &GOTO -ERR100
&IF &CT < 0 &GOTO -ERR200
.
.
.
&IF &RETCODE EQ 28 &GOTO -ERR300
.
.
.
-ERR100
&TYPE COUNT TOO HIGH
&EXIT 100
-ERR200
&TYPE COUNT TOO LOW
&EXIT 200
-ERR300
&TYPE &1 &2 NOT ON DISK 'C'.
&EXIT 300
```

Using the &EMSG Control Statement

There is a facility available in the EXEC processor, which allows you to write error messages that use the standard VM/370 message format, with an identification code and message number, as well as message text. When you use the &EMSG or &BEGEMSG control statement, the EXEC interpreter scans the first token and checks to see if the seventh (and last character) is an I, E, or W, representing information, error, or warning messages, respectively. If so, then the message is displayed according to the CP EMSG setting (ON, OFF, CODE, or TEXT). For example, if you have the statement

```
&EMSG ERROR1E BAD ARGUMENT ' &1 '
```

the ERROR1E is considered the code portion of the message and BAD ARGUMENT is the text. If you have issued the CP command

```
cp set emsg text
```

when this &EMSG statement is executed it may display

```
BAD ARGUMENT ' PRNIT '
```

where PRNIT is the argument that is invalid.

When you use &EMSG (or &BEGEMSG, which allows you to display error messages of unscanned data), the code portion of the message is prefixed with the characters DMS, when displayed. For example

```
&BEGEMSG
ERROR2E INCOMPATIBLE ARGUMENTS
&END
```

displays, when the EMSG setting is ON,

```
DMSERROR2E INCOMPATIBLE ARGUMENTS
```

You should use the &BEGEMSG control statement when you want to display lines that have tokens longer than 8 characters; however, no variable substitution is performed.

Debugging EXEC Procedures

If you have difficulty getting an EXEC procedure to execute properly, or if you are modifying an existing EXEC and wish to test it, there are a couple of simple techniques that you can use that may save you time.

One is to place the &CONTROL ALL control statement at the top of your EXEC file. When &CONTROL ALL is in effect, all the EXEC control statements are displayed before they execute, as well as the CMS command lines. One of the advantages of using this method is that the line is displayed after it is scanned, so that you can see the results of symbol and variable substitution.

"Stacking EXEC Files" in "Section 14. Building EXEC Procedures" described a PREFIX EXEC, which changes the prefixes of groups of files. If the EXEC had an &CONTROL ALL statement, it might execute as follows:

```
prefix pt ag
&CONTROL ALL
&LNAME = &CONCAT PT *
LISTFILE PT* SCRIPT * ( EXEC
EXEC CMS &STACK
&LOOP -END &READFLA EQ CONSOLE
LOOP UNTIL:     STAC K   EQ     CONS
&READ VARS &NAME &TYPE &MOD
&SUFFIX = &SUBSTR PTA 3 5
&NEWNAM = &CONCAT AG A
RENAME PTA SCRIPT A1 AGA SCRIPT A1
&IF 0 EQ 0 &SKIP
&SKIP
LOOP UNTIL:     STAC K   EQ     CONS
&READ VARS &NAME &TYPE &MOD
&SUFFIX = &SUBSTR PTB 3 5
&NEWNAM = &CONCAT AG B
RENAME PTB SCRIPT A1 AGB SCRIPT A1
&IF 0 EQ 0 &SKIP
&SKIP
LOOP UNTIL:     CONS OLE EQ     CONS
R;
```

You can see from this execution summary that the files named PTA SCRIPT and PTB SCRIPT are renamed to AGA SCRIPT and AGB SCRIPT. Notice that the &LOOP statement results in a special LOOP UNTIL statement in the execution summary, which indicates the condition under which the loop executes.

USING CMS SUBSET

When you are using the CMS Editor to create or modify an EXEC procedure, you can test the EXEC in the CMS subset environment, as long as the EXEC does not issue any CMS commands that are invalid in CMS subset.

Before entering CMS subset with the CMS subcommand, you must issue the SAVE subcommand to write the current version of the EXEC onto disk; then, in CMS subset, execute the EXEC. For example:

```
edit new exec
NEW FILE:
EDIT:
input
INPUT:
&a = &1 + &2 + &3
&type answer is &a

EDIT:
save
EDIT:
cms
CMS SUBSET
new 34 56 899
ANSWER IS 989
R;
return
EDIT:
quit
R;
```

If the EXEC does not execute properly, you can return to the edit environment using the RETURN command, modify the EXEC, reissue the SAVE and CMS subcommands, and attempt to execute the EXEC again.

SUMMARY OF EXEC INTERPRETER LOGIC

The following information is provided for those who have an interest in how the EXEC interpreter works. It may help you in debugging your EXEC procedures if you have some idea of how processing is done by EXEC. When an EXEC file is invoked for execution, the EXEC interpreter examines each statement and analyzes it, according to the following sequence:

1. If the first nonblank character of the line is an *, the line is ignored.

2. Null lines, except as a reponse to an &READ statement, are also ignored.

3. The line is scanned, and nonblank character strings are placed in tokens.

4. All EXEC special variables, and then all user variables, except for those that appear as the target of an assignment statement, are substituted.

6. All blank tokens (resulting from the substitution of undefined symbols) are discarded.

7. If the first nonblank character is a hyphen (-), indicating a label, the next token is considered the first token.

8. If the first logical token does not begin with an ampersand (&), the line is passed to CMS for execution. The return code from CMS is placed in the special variable &RETCODE.

9. If the first logical token begins with an ampersand (&) EXEC interprets the statement.

10. If a statement is syntactically invalid and can be made valid by adding a token of blanks at the end, EXEC adds blanks, for example:

```
&BLANK =
&TYPE
&LOOP 3 &X NE
```

All of the above are valid EXEC control statements.

11. EXEC executes the statement. If no error is encountered, control passes to the next logical statement. If an error is encountered, EXEC terminates processing.

Section 17. Writing Edit Macros

If you have a good knowledge of the CMS EXEC facilities, and an understanding of the CMS Editor, you may wish to write edit macros. An edit macro is simply an EXEC file that contains a sequence of EDIT subcommands. Edit macros can only be invoked from the edit environment. An edit macro may contain a simple sequence of EDIT subcommands, or its execution may be dependent on arguments you enter when you invoke it. This section provides information on creating edit macros, suggestions on how to manipulate the console stack, and some examples of macros that you can create and use.

Creating Edit Macro Files

An edit macro must have a filename beginning with a dollar sign ($) and a filetype of EXEC. Rules for file format, scanning and token substitution are the same as for all other EXEC files. A macro file may contain:

- EDIT subcommands
- EXEC control statements
- CMS commands that are valid in CMS subset

When you create an edit macro that accepts arguments, you should be sure to check the validity of the arguments, and issue appropriate error messages. If you are writing an edit macro to expect arguments, you must keep in mind that the macro command line is scanned, and that any data items you enter are padded or truncated into 8-character tokens. Tokens are always translated to uppercase letters.

You should annotate all of your macro files, and provide a response to a question mark (?) entered as the sole argument (as described under "Annotating EXEC Procedures" in "Section 16. Refining Your EXEC Procedures."

How Edit Macros Work

Since an edit macro is an EXEC file, it is actually executed by the EXEC interpreter, and not by the editor. The EXEC interpreter can only execute EXEC control statements and CMS commands. The only way to issue an EDIT subcommand from an EXEC file is to stack the subcommand in the console stack, so that when the editor is invoked, or receives control, it reads the subcommand(s) from the console stack before accepting input lines from the terminal. For example:

```
&STACK CASE M
&STACK RECFM V
EDIT &1 CHART A1
```

When the EDIT command is invoked from this EXEC, the editor reads the subcommands from the stack and executes them.

To execute these same subcommands from an edit macro file, you must use the same technique; that is, you must place the subcommands in the console stack, for example:

```
&BEGSTACK
CASE M
RECFM V
&END
&EXIT
```

If this were an EXEC file named $VARY, you might execute it from the edit environment as follows:

```
edit test file
NEW FILE.
EDIT:
$vary
```

Stacked subcommands are executed only when the EXEC completes its execution, either by reaching the end of the file, or by processing an &EXIT statement.

When you stack edit subcommands, you can use the &STACK and &BEGSTACK control statements. If you are stacking a subcommand that uses a variable expression, you must use the &STACK control statement, rather than the &BEGSTACK control statement. The following EXEC, named $T, displays a variable number of lines and then restores the current line pointer to the position it was in when the EXEC was invoked:

```
&CONTROL OFF
&IF &INDEX EQ 0 &GOTO -ERR
&CHECK = &DATATYPE &1
&IF &CHECK NE NUM &GOTO -ERR
&STACK TYPE &1
&UP = &1 - 1
&STACK UP &UP
&EXIT
-ERR &TYPE CORRECT FORM IS < $T N >
&EXIT 1
```

This edit macro uses the built-in function &DATATYPE to check that a numeric operand is entered.

CMS commands in an edit macro are executed as they are read by the EXEC interpreter, just as they would if the EXEC were invoked in the CMS environment. You could create a $TYPE edit macro, for example, that would allow you to display a file from the edit environment:

```
&CONTROL OFF
TYPE &1 &2 &3 &4 &5 &6 &7
```

Or you might create a $STATE EXEC that would verify the existence of another file:

```
&CONTROL OFF
STATE &1 &2 &3
```

In both of these examples, the macro file invokes the CMS command. Macros like these can eliminate having to enter CMS subset environment to execute one or two simple CMS commands. You must be careful, though, not to execute any CMS command that uses the storage occupied by the editor. Only commands that are valid in CMS subset are valid in an edit macro.

THE CONSOLE STACK

When you write an edit macro, you want to be sure that there are no EDIT subcommands in the stack that could interfere with the execution of the subcommands stacked by the macro file. Your macro should check whether there are any lines in the stack, and if there are, it should clear them from the stack. For example, you might use the lines:

```
&IF &READFLAG EQ CONSOLE &SKIP 2
DESBUF
&TYPE STACKED LINES CLEARED BY &0
```

The message "STACKED LINES CLEARED BY macro name" is issued by the edit macros distributed with the VM/370 system. You may also want to use this convention in your macros, to alert a user that the console stack has been cleared.

Top-of-File and End-of-File

When an edit macro is invoked and the current line pointer is positioned at the top of the file or at the end of the file, the editor stacks a token in the console stack. If the line pointer is at the top of the file, the token stacked is "TOF"; if the line pointer is at the end of the file the token stacked is "EOF". If you write an edit macro that does not check the status of the console stack, and the macro is invoked from the top or the end of the file, you receive the message

```
?EDIT: TOF
```

or:

```
?EDIT: EOF
```

The editor does not recognize these tokens as valid subcommands.

You may want to use these tokens to test whether the EXEC is invoked from the top or end of the file. If you want to clear these tokens in case the macro has been invoked from the top or end of the file, you might use the statement:

```
&IF &READFLAG EQ CONSOLE &READ VARS
```

which clears the token from the stack.

Stacking LIFO

If you do not want to clear the console stack when you execute an edit macro, you can stack all of the subcommands using the LIFO (last-in first-out) operand of the &STACK and &BEGSTACK control statements:

```
&BEGSTACK LIFO
TABSET 3 10 71
TRUNC 71
PRESERVE
&END
```

When this edit macro is executed, the subcommands are placed in the console stack in front of any existing lines. For example, if this macro were invoked

```
$format#input
```

the subcommands would execute in the following order: PRESERVE, TRUNC, TABSET, INPUT. If the subcommands were stacked FIFO (first-in first-out), the default, the INPUT subcommand would be the first to execute (since it is the first command in the stack) and the remaining subcommands would be read into the file as input lines.

Error Situations

If an EXEC processing error occurs during the execution of an edit macro, the editor clears the console stack and issues the "STACKED LINES CLEARED" message. An EXEC processing error is one that causes the error message DMSEXT072E:

```
ERROR IN EXEC FILE filename, LINE nnnn - description
```

These errors cause the EXEC interpreter to terminate processing. Any stacked subcommands are cleared before the editor regains control, so that none of the subcommands are executed, and the file remains unchanged.

You should also ensure that any error handling routines in your edit macros clear the stack if an error occurs. Otherwise, the editor may begin reading invalid data lines from the stack and attempt to execute them as EDIT subcommands.

You should not interrupt the execution of an edit macro by using the Attention or Enter key, and then entering a command or data line. Results are unpredictable, and you may inadvertently place unwanted lines in the stack.

If your edit macro contains a CMS command that is invalid in the CMS subset environment, you receive a return code of -2.

The maximum number of lines that you can stack in an edit macro varies according to the amount of free storage that is available to CMS at the time of the stacking request. If you stack tco many lines, the editor terminates abnormally.

Notes on Using EDIT Subcommands

You can use any EDIT subcommand in a macro file, and there is one special subcommand whose use only has meaning in a macro: the STACK subcommand. For the most part, there is not any difference between executing an EDIT subcommand from the edit environment, or from an EXEC edit macro. You do have to remember, however, that if you want a variable symbol on a subcommand line, you must stack that subcommand using the &STACK control statement rather than following an &BEGSTACK control statement.

Listed below are some notes on using various EDIT subcommands in your macro files. You may find these notes useful when you design your own macros.

PRESERVE, VERIFY, AND RESTORE: Often, you may want to create an edit macro that alters the characteristics of a file (format, tab settings, and so on). To ensure that the original characteristics are retained when the macro has finished executing, you can stack the PRESERVE subcommand as the first subcommand in the stack, and the RESTORE subcommand as the last subcommand in the stack:

```
&BEGSTACK
PRESERVE
CASE M
I A lowercase line
RESTORE
&END
```

The PRESERVE and RESTORE subcommands save and reinitialize the settings for the CASE, FMODE, FNAME, IMAGE, LINEMODE, LONG, RECFM, SERIAL, SHORT, TABSET, TRUNC, VERIFY, and ZONE subcommands.

In an edit macro that issues many subcommands that display lines in response to CHANGE or LOCATE subcommands, you may want to turn the verification setting to OFF to suppress displays during the execution of the edit macro:

```
&BEGSTACK
PRESERVE
VERIFY OFF
   .
   .
   .
RESTORE
&END
```

You would particularly want to turn verification off for a macro that executes in a loop, or that issues a global request. If you want a line or series of lines displayed, you can use the TYPE subcommand.

If you have verification set off in an edit macro, then when you execute it you may not receive any indication that the edit macro completed execution. The keyboard unlocks to accept your next EDIT subcommand from the terminal. To indicate that the macro is finished, you can stack, as the last subcommand in the procedure, a TYPE subcommand, to display the current line. Or, if you write an edit macro that terminates when an end-of-file condition occurs the EOF: message issued by the editor may indicate the completion of the macro.

INPUT, REPLACE: To change from edit mode to input mode in an edit macro, you can use the INPUT and REPLACE subcommands. In a fixed-length EXEC file, you must stack these subcommands using the &STACK control statement:

```
&STACK INPUT

  -- or --

&STACK REPLACE
```

If you use either of these subcommands following an &BEGSTACK control statement, the subcommand line is padded with blanks to the line length and the result is a line of blanks inserted into the file.

In a variable-length EXEC file, lines are not padded with blanks, so the INPUT and REPLACE subcommands with no data line execute the same following an &BEGSTACK control statement as they do when stacked with the &STACK control statement.

Going From Input Mode to Edit Mode: To stack a null line in an edit macro, to cause the editor to leave input mode, you must use the &STACK control statement with no other tokens, as follows:

```
&STACK
```

CHANGE, DSTRING, LOCATE: If you want to use the CHANGE, DSTRING, or LOCATE subcommands in an EXEC, you must take into account that when you stack any of these subcommands using the &STACK control statement, all of the character strings on the line are truncated or padded to 8 characters. Also, if you want to use a variable value for a character string, you are limited to 8 characters, all uppercase.

For example, if a macro is used to locate a character string and delete the line on which it appears, the LOCATE subcommand has a variable symbol:

```
&STACK LOCATE /&1
&STACK DEL
```

IMAGE, TABSET, OVERLAY: The TABSET and OVERLAY subcommands allow you to set margins and column stops for records in a file and to overlay character strings in particular positions. For example, the following macro places a vertical bar in columns 1, 15, 40, and 60 for all records in the file from the current line to the end of the file:

```
&BEGSTACK
PRESERVE
IMAGE ON
TABSET 1 15 40 60
REPEAT *
O |->|->|->|
RESTORE
&END
```

In the above example, the "->" symbol represents a tab character (X'05'). To create this EXEC, you can either issue the EDIT subcommand

```
image off
```

and use the Tab key (or equivalent) on your terminal when you enter the line, or you can enter some other character and use the ALTER subcommand to alter that character to a X'05'.

If you want to overlay only one character string in a particular position in a file, you can use the TABSET subcommand to set that column position as the left margin, and then use the OVERLAY command, as follows:

```
&CONTROL OFF
&BEGSTACK
PRESERVE
VERIFY OFF
TRUNC *
TABS 72
&END
&STACK REPEAT &1
&BEGSTACK
OVERLAY C
RESTORE
&END
```

If you name this file $CONT EXEC, and if you invoke it with the line:

```
$cont 3
```

then the OVERLAY subcommand is executed on three successive lines, to place the continuation character "C" in column 72.

THE STACK SUBCOMMAND

The STACK subcommand allows you to stack up to 25 lines from a file in the console stack. The lines are not deleted from the file, but the line pointer is moved to point to the last line stacked.

You can also use the STACK subcommand to stack EDIT subcommands. You might do this if there were subcommands that you wanted to place in the stack to execute after all the subcommands stacked by the EXEC had executed.

These techniques are used in the two edit macros that are distributed with the VM/370 system:, $MOVE and $DUP. If you want to examine these files for examples of how to use the STACK subcommand, you can display the files by entering, from the CMS environment:

```
type $move exec *

type $dup exec *
```

An additional use of the STACK subcommand is shown in "An Annotated Edit Macro."

An Annotated Edit Macro

The edit macro shown below, $DOUBLE, can be used to double space a CMS file. Regardless of where the current line pointer is, a blank line is inserted in the file following every existing line. The statements in the edit macro are separated into groups; the number to the left of a statement or group of statements indicates an explanatory note. The numbers are not part of the EXEC file.

```
1   &CONTROL OFF

2   &IF &INDEX = 1 &IF &1 = ? &GOTO -TELL

3   &IF &INDEX = 1 &IF &1 = TWO &GOTO -LOOP

4   &IF &INDEX NE 0 &GOTO -TELL

5   &IF &READFLAG EQ STACK &READ VARS &GARB

6   &STACK
    &STACK PRESERVE
    &STACK VERIFY OFF

7   &STACK BOTTOM
    &STACK I XXXXXXXX
    &STACK TOP
```

Notes:

1. The &CONTROL statement suppresses the display of CMS commands, in this case, the DESBUF command.
2. The first &IF statement checks whether $DOUBLE has been invoked with a question mark (?), in which case control is passed to the statement at the label -TELL. &TYPE control statements at -TELL explains what the macro does.
3. The second &IF statement checks whether $DOUBLE has been invoked with the argument TWO, which indicates that the macro has executed itself, so the subcommands that initialize the file are stacked only once.
4. There are three ways to properly invoke this edit macro: with a ?, with the argument TWO, or with no arguments. The third &IF statement checks for the (no arguments) condition; if the macro is invoked any other way, control is passed to the label -TELL, which explains the macro usage.
5. The &READFLAG special variable is checked. If $DOUBLE is executed at the top or at the end of the file, the token TOF or EOF is in the stack, and should be read out.
6. A null line is placed in the console stack for loop control (see Note 9.) The PRESERVE and VERIFY subcommands are stacked so that the editor does not display each line in the file as it executes the stacked subcommands.
7. The BOTTOM, INPUT, and TOP subcommands initialize the file by placing a marker at the bottom of the file, and then positioning the current line pointer at the top of the file.

```
(8) -LOOP
    &BEGSTACK
    NEXT
    STACK 1
    INPUT
    &END

(9) &READ ARGS
    &IF .&1 = . &SKIP
    &IF &1 EQ XXXXXXXX &SKIP 2

(10) -ENDLOOP &STACK $DOUBLE TWO

(11) &EXIT

(12) DESBUF
     &BEGSTACK
     UP 2
     DEL 3
     TYPE
     RESTORE
     &END

     &EXIT

(13) -TELL
     &IF &READFLAG EQ STACK &READ VARS
     &BEGTYPE
     CORRECT FORM IS: $DOUBLE

     THIS EXEC DOUBLE SPACES A FILE BY INSERTING
     A BLANK LINE FOLLOWING EVERY LINE IN THE FILE
     EXCEPT THE LAST.
     &END
```

---

(8) The NEXT, STACK, and INPUT subcommands are going to be repeated for each line in the file. The INPUT subcommand with no data line stacks a null line. Note that in order for $DOUBLE to execute this subcommand properly, $DOUBLE EXEC must have fixed-length records. Each line is stacked, with the STACK subcommand; this stacked line is checked in the read loop (Note 9). When the stacked line is equal to the marker, XXXXXXXX, it indicates that the end of the file has been reached.

(9) These lines check for an end of file, which occurs when the line containing the marker is read. The first time this loop is executed, the stack contains the null line (statement 6), so the check for the marker is skipped.

(10) The last subcommand stacked is $DOUBLE TWO, which re-invokes $DOUBLE, but causes it to skip the first sequence of subcommands.

(11) The &EXIT statement causes an exit from $DOUBLE, so that all the EDIT subcommand stacked thus far are executed.

(12) When the marker is read in, the EXEC clears the stack, moves the current line pointer to pcint to the null line added above the marker, and deletes that line, the marker, and the null line that was inserted following the marker. The RESTORE subcommand restores editor settings.

(13) This edit macro is self-documenting. If $DOUBLE is invoked with a question mark, or invoked with an argument, information regarding its proper use is displayed.

User-Written Edit Macros

You can create the edit macros shown below, for your own use in CMS. You may want to refer to them as examples when you are learning to write your own macros. The macros have not been formally tested by IBM; they are presented for your convenience only.

$MACROS

The $MACROS edit macro verifies the existence of and describes the usage of edit macros. If you enter

```
$macros
```

it lists the filenames of all the edit macros on your accessed disks. If you enter

```
$macros name1 name2
```

it displays, for each valid macro name entered, the macro format and usage. (This macro assumes that all macros have been designed to respond to a ? request.) The format of the $MACROS edit macro is:

```
| $MACROS | [filename1 [filename2 [filenamen]]]                    |
```

filename is the filename(s) of macro files whose usage is to be displayed. If filename is omitted, the filenames of all available macro files are listed.

To create $MACROS, enter:

```
edit $macros exec
```

and in input mode, enter the following:

```
&CONTROL OFF
&IF &INDEX EQ 1 &IF &1 EQ ? &GOTO -TELL
&IF &INDEX GT 0 &GOTO -PARTIC
*
&BEGTYPE ALL
EXEC FILES STARTING WITH A DOLLAR-SIGN ARE AS FOLLOWS.
FOR INFORMATION ON ONE OR MORE OF THEM, TYPE:
$MACROS FILENAME1 <FILENAME2>
&END
LISTF $* EXEC * (NOHEADER FNAME)
&EXIT
*
-PARTIC &TRIP = 0
&INDEX1 = 0
*
&LOOP -ENDLOOP &INDEX
&INDEX1 = &INDEX1 + 1
&SUB = &SUBSTR &&INDEX1 1 1
&IF &SUB EQ $ &GOTO -STATIT
     &TYPE &&INDEX1 IS INVALID
&TRIP = 1
&GOTO -ENDLOOP
-STATIT STATE &&INDEX1 EXEC *
&IF &RETCODE EQ 0 &GOTO -CALLIT
&TYPE &&INDEX1 NOT FOUND
&TRIP = 1
&GOTO -ENDLOOP
-CALLIT EXEC &&INDEX1 ?
-ENDLOOP
*
&EXIT &TRIP
*
-TELL &BEGTYPE
'$MACROS' HANDLES THE '$MACROS' REQUEST.
TYPE '$MACROS' ALONE FOR MORE INFORMATION.
&END
&EXIT
```

$MARK

The $MARK edit macro inserts from 1 to 6 characters, starting with the current line and in the column specified, for a specified number of records. If you enter

```
$mark
```

the macro places an asterisk (*) in column 72 of the current line. If you enter

```
$mark 10 30 abc
```

the macro places the string ABC beginning in column 30 in each of ten records, beginning with the current record. The format of the $MARK edit macro is:

where:

n indicates the number of consecutive lines, starting with the record currently being pointed to, that will be marked. If n is not specified, 1 is assumed, and the other default values are also assumed.

col indicates the starting column in each record where the character string is to be inserted. The default is column 72.

char indicates from 1 to 6 characters to be inserted in each record. The default is an asterisk (*).

To create $MARK, enter:

```
edit $mark exec
```

and in input mode, enter the following:

```
&CONTROL OFF
&IF &INDEX EQ 1 &IF &1 EQ ? &GOTO -TELL
&IF &INDEX GT 3 &GOTO -BADPARM
&INDEX1 = 1
&IF &INDEX GT 0 &INDEX1 = &1
&IF &INDEX1 LT 0 &GOTO -BADPARM
&INDEX2 = 72
&IF &INDEX GT 1 &INDEX2 = &2
&IF &INDEX2 LT 0 &GCTO -BADPARM
&IF &INDEX2 GT 133 &GOTO -BADPARM
&CHAR = *
&IF &INDEX EQ 3 &CHAR = &3
&LEN3 = &LENGTH &CHAR
&IF &LEN3 GT 6 &GOTO -BADPARM
&STACK LIFO RESTORE
&STACK LIFO OVERLAY (TAB)[1] &CHAR
&STACK LIFO REPEAT &INDEX1
&STACK LIFO TABS &INDEX2
&BEGSTACK LIFO
IMAGE ON
TRUNC *
VERIFY OFF
LONG
PRESERVE
&END
&EXIT
*
-BADPARM &BEGTYPE
INVALID $MARK OPERANDS
&END
&EXIT 1
*
-TELL &BEGTYPE
CORRECT FORM IS:  $MARK  <N  <COL  <CHAR>>>
PUTS A 1-6 CHARACTER  STRING IN COLUMN 'COL' OF 'N' LINES, STARTING
WITH THE CURRENT LINE.  THE NEW CURRENT LINE IS THE LAST LINE
MARKED.  DEFAULTS ARE:  N=1;  COL=72;  CHAR=*.
&END
&EXIT
```

---

[1]The word (TAB) represents pressing the Tab key (or equivalent logical tab) and should not be included in the data line. Instead, enter the appropriate tab character.

$POINT

The $POINT edit macro positions the current line pointer at the specified line number. The line numbers must be in columns 73 through 80 and padded with zeros. For example, if you enter

```
$point 800
```

the current line pointer is positioned at the line that has the serial number 00000800 in columns 73 through 80. The format of the $POINT macro is:

```
| $POINT | key |
```

where:

key is a 1- to 8-character line number. If the specified key is less than 8 characters long, it is padded with leading zeros.

To create $POINT, enter:

```
edit $point exec
```

and in input mode, enter the following:

```
&CONTROL OFF
&IF &INDEX EQ 0 &GOTO -TELL
&IF &INDEX EQ 1 &IF &1 EQ ? &GOTO -TELL
&IF &INDEX GT 1 &GOTO -BADPARM
&KEYL = &LENGTH &1
&INDEX1 = 8 - &KEYL
&Z = &SUBSTR 00000000 1 &INDEX1
&1 = &CONCAT &Z &1
&STACK LIFO RESTORE
&STACK LIFO FIND (TAB)[1]   &1
&BEGSTACK LIFO
TOP
TABS 1 72
IMAGE ON
LONG
PRESERVE
&END
&EXIT
*
-BADPARM &BEGTYPE ALL
INVALID $POINT OPERANDS
&END
&EXIT 1
*
-TELL &BEGTYPE ALL
CORRECT FORM IS:  $POINT  KEY
IF 'KEY' CONTAINS LESS THAN 8 CHARACTERS, IT IS PADDED WITH LEADING
ZEROS. THE FILE IS THEN SEARCHED FROM THE TOP FOR 'KEY' IN COLUMNS
73-80.
&END
&EXIT
```

---

[1]The word (TAB) represents pressing the Tab key (or equivalent logical tab) and should not be included in the data line. Instead, enter the appropriate tab character.

The $COL edit macro inserts, after the current record in the file, a line containing column numbers (that is, 1, 6, 11, ..., 76). The format of the $COL macro is:

```
| $COL |
```

No operands are used with $COL.
If any arguments are entered, the macro usage is explained.

To create $COL, enter:

```
edit $col exec
```

and in input mode, enter the following:

```
&CONTROL OFF
&IF &INDEX NE 0 &GOTO -TELL
&STACK LIFO RESTORE
&STACK LIFO
&BEGSTACK LIFO ALL
1    6    11   16   21   26   31   36   41   46   51   56   61   66   71   76
&END
&STACK LIFO INPUT
&BEGSTACK LIFO
TRUNC *
VERIFY OFF
LONG
PRESERVE
&END
&EXIT
*
-TELL &BEGTYPE
CORRECT FORM IS:  $COL
INSERTS A LINE INTO THE FILE SHOWING COLUMN NUMBERS.
&END
&EXIT
```

Appendixes

This publication contains the following appendixes:

A. Summary of CMS Commands

B. Summary of CP Commands

C. Considerations for 3270 Display Terminal Users

D. Sample Terminal Sessions

Appendix A: Summary of CMS Commands

Figure 22 contains an alphabetical list of the CMS commands and the functions performed by each. Unless otherwise noted, CMS commands are described in VM/370: CMS Command and Macro Reference.

Code	Meaning
DOS PP	indicates that this command invokes a DOS Program Product, available from IBM for a license fee.
EREP	indicates that this command is described in VM/370: Environmental Recording, Editing, and Printing (EREP) Program.
IPCS	indicates that this command is a part of the Interactive Problem Control System (IPCS) and is described in VM/370: IPCS User's Guide.
Op Gd	indicates that this command is described in the VM/370: Operator's Guide.
OS PP	indicates that this command invokes an OS Program Product, available from IBM for a license fee.
SCRIPT	indicates that this command invokes a text processor that is an IBM Installed User Program, available from IBM for a license fee.
SPG	indicates that this command is described in the VM/370: System Programmer's Guide.
SYSGEN	indicates that this command is described in the VM/370: Planning and System Generation Guide.

In addition to the commands listed in Figure 22, there are seven commands called Immediate commands which are handled in a different manner from the others. They may be entered while another command is executing by pressing the Attention key (or its equivalent) and are executed immediately. The Immediate commands are:

- HB - Halt batch execution
- HO - Halt tracing
- HT - Halt typing
- HX - Halt execution
- RO - Resume tracing
- RT - Resume typing
- SO - Suspend tracing

Command	Code	Usage
ACCESS		Identify direct access space to a CMS virtual machine, create extensions and relate the disk space to a logical directory.
AMSERV		Invoke Access Method Services utility functions to create, alter, list, copy, delete, import, or export VSAM catalogs and data sets.
ASM3705	SYSGEN	Assemble 3704/3705 source code.
ASSEMBLE		Assemble Assembler Language source code.
ASSGN		Assign or unassign a CMS/DOS system or programmer logical unit for a virtual I/O device.
CMSBATCH		Invoke the CMS Batch Facility.
COBCL	OS PP	Compile OS ANS Version 4 or OS/VS COBOL source code.
COMPARE		Compare records in CMS disk files.
CONVERT	OS PP	Convert free form FORTRAN statements to fixed form.
COPYFILE		Copy CMS disk files according to specifications.
CP		Enter CP commands from the CMS environment.
CPEREP	EREP	Edit and print error information which was recorded by VM/370 error recording routines.
DDR	Op Gd, SYSGEN	Perform backup, restore, and copy operations for disks.
DEBUG		Enter DEBUG subcommand environment, debug mode.
DIRECT	Op Gd, SYSGEN	Set up VM/370 directory entries.
DISK		Perform disk-to-card and card-to-disk operations for CMS files.
DLBL		Define a DOS filename or VSAM ddname and relate that name to a disk file.
DOSGEN	SYSGEN	Load and save the CMSDOS shared segment.
DOSLIB		Delete, compact, or list information about the phases of a CMS/DOS phase library.
DOSLKED		Link-edit CMS text decks or object modules from a DOS/VS relocatable library and place them in executable form in a CMS/DOS phase library.
DOSPLI	DOS PP	Compile DOS PL/I source code under CMS/DOS.
DSERV		Display information contained in the DOS/VS core image, relocatable, source, procedure, and transient directories.

Figure 22. CMS Command Summary (Part 1 of 4)

Command	Code	Usage
DUMPSCAN	IPCS	Provide interactive analysis of CP abend dumps.
EDIT		Invoke the CMS Editor to create or modify a disk file.
ERASE		Delete CMS disk files.
ESERV		Display, punch or print an edited (compressed) macro from a DOS/VS source statement library (E sublibrary).
EXEC		Execute special procedures made up of frequently used sequences of commands.
FCOBOL	DOS PP	Compile DOS/VS COBOL source code under CMS/DOS.
FETCH		Fetch a CMS/DOS or DOS/VS executable phase.
FILEDEF		Define an OS ddname and relate that ddname to any device supported by CMS.
FORMAT		Prepare disks in CMS 800-byte block format.
FORTGI	OS PP	Compile FORTRAN source code using the G1 compiler.
FORTHX	OS PP	Compile FORTRAN source code using the H-extended compiler.
GEN3705	SYSGEN	Generate an EXEC file that assembles and link-edits the 3704/3705 control program.
GENDIRT		Fill in auxiliary module directories.
GENMOD		Generate non-relocatable CMS files (MODULE files).
GLOBAL		Identify specific CMS libraries to be searched for macros, copy files, missing subroutines, or DOS executable phases.
GOFORT	OS PP	Compile FORTRAN source code and execute the program using the FORTRAN Code and Go compiler.
INCLUDE		Bring additional TEXT files into storage and establish linkages.
LISTDS		List information about data sets and space allocation on OS, DOS, and VSAM disks.
LISTFILE		List information about CMS disk files.
LISTIO		Display information concerning CMS/DOS system and programmer logical units.
LKED	SYSGEN	Link-edit the 3704/3705 control program.
LOAD		Bring TEXT files into storage for execution.
LOADMOD		Bring a single MODULE file into storage.
MACLIB		Create or modify CMS macro libraries.

Figure 22. CMS Command Summary (Part 2 of 4)

Command	Code	Usage
MODMAP		Display the load map of a MODULE file.
MOVEFILE		Move data from one device to another device of the same or a different type.
NCPDUMP	Op Gd, SYSGEN, SPG	Process CP spool reader files created by 3704/3705 dumping operations.
OPTION		Change the DOS COBOL compiler (FCOBOL) options that are in effect for the current terminal session.
PLIC	OS PP	Compile and execute PL/I source code using the PL/I Checkout Compiler.
PLICR	OS PP	Execute the PL/I object code generated by the OS PL/I Checkout Compiler.
PLIOPT	OS PP	Compile PL/I source code using the OS PL/I Optimizing Compiler.
PRB	IPCS	Update IPCS problem status.
PRINT		Spool a specified CMS file to the virtual printer.
PROB	IPCS	Enter a problem report in IPCS.
PSERV		Copy a procedure from the DOS/VS procedure library onto a CMS disk, display the procedure at the terminal, or spool the procedure to the virtual punch or printer.
PUNCH		Spool a copy of a CMS file to the virtual punch.
QUERY		Request information about a CMS virtual machine.
READCARD		Read data from spooled card input device.
RELEASE		Make a disk and its directory inaccessible to a CMS virtual machine.
RENAME		Change the name of a CMS file or files.
RSERV		Copy a DOS/VS relocatable module onto a CMS disk, display it at the terminal, or spool a copy to the virtual punch or printer.
RUN		Initiate series of functions to be performed on a source, MODULE, TEXT, or EXEC file.
SAVENCP	SYSGEN, SPG	Read 3704/3705 control program load into virtual storage and save an image on a CP-owned disk.
SCRIPT	SCRIPT	Format and print documents according to embedded SCRIPT control words in the document file.
SET		Establish, set, or reset CMS virtual machine characteristics.

Figure 22. CMS Command Summary (Part 3 of 4)

Command	Code	Usage
SETKEY	SPG	Assign storage protect keys to storage assigned to named systems.
SORT		Arrange a specified file in ascending order according to sort fields in the data records.
SSERV		Copy a DOS/VS source statement book onto a CMS disk, display it at the terminal, or spool a copy to the virtual punch or printer.
START		Begin execution of programs previously loaded (OS and CMS) or fetched (CMS/DOS).
STAT	IPCS	Display the status of reported system problems.
STATE		Verify the existence of a CMS disk file.
STATEW		Verify a file on a read/write CMS disk.
SVCTRACE		Record information about supervisor calls.
SYNONYM		Invoke a table containing synonyms you have created for CMS and user-written commands.
TAPE		Perform tape-to-disk and disk-to-tape operations for CMS files, and position tapes.
TAPEMAC		Create CMS MACLIB libraries directly from an IEHMOVE-created partitioned data set on tape.
TAPPDS		Load OS partitioned data set (PDS) files or card image files from tape to disk.
TESTCOB	OS PP	Invoke the OS COBOL Interactive Debug Program.
TESTFORT	OS PP	Invoke the FORTRAN Interactive Debug Program.
TXTLIB		Generate and modify text libraries.
TYPE		Display all or part of a CMS file at the terminal.
UPDATE		Make changes in a program source file as defined by control cards in a control file.
VMFDUMP	Op Gd IPCS	Format and print system abend dumps; under IPCS, create a problem report.
VMFLOAD	SYSGEN	Generate a new CP, CMS or RSCS module.
VSAMGEN	SYSGEN	Load and save the VSAM shared segment.
VSAPL	OS PP	Invoke the VS APL interface.
VSBASIC	OS PP	Compile and execute VS BASIC programs under CMS.
VSBUTIL	OS PP	Convert BASIC 1.2 data files to VS BASIC format.
ZAP	Op Gd, SYSGEN, SPG	Modify or dump LOADLIB, TXTLIB, or MODULE files.

Figure 22. CMS Command Summary (Part 4 of 4)

Appendix B: Summary of CP Commands

Figure 23 describes the CP command privilege classes.

Class	User and Function
A[1]	Primary System Operator: The class A user controls the VM/370 system. Class A is assigned to the user at the VM/370 system console during IPL. The primary system operator is responsible for the availability of the VM/370 system and its communication lines and resources. In addition, the class A user controls system accounting, broadcast messages, virtual machine performance options and other command operands that affect the overall performance of VM/370. Note: The class A system operator who is automatically logged on during CP initialization is designated as the primary system operator.
B[1]	System Resource Operator: The class B user controls all the real resources of the VM/370 system, except those controlled by the primary system operator and spooling operator.
C[1,2]	System Programmer: The class C user updates certain functions of the VM/370 system.
D[1]	Spooling Operator: The class D user controls spool data files and specific functions of the system's unit record equipment.
E[1,2]	System Analyst: The class E user examines and saves certain data in the VM/370 storage area.
F[1,3]	Service Representative: The class F user obtains, and examines, in detail, certain data about input and output devices connected to the VM/370 system.
G[4]	General User: The class G user controls functions associated with the execution of his virtual machine.
Any[1,4]	The Any classification is given to certain CP commands that are available to any user. These are primarily for the purpose of gaining and relinquishing access to the VM/370 system.
H	Reserved for IBM use.

[1]Described in the VM/370: Operator's Guide.
[2]Described in the VM/370: System Programmer's Guide and the VM/370: System Logic and Problem Determination Guide.
[3]Described in the VM/370: OLTSEP and Error Recording Guide.
[4]Described in the VM/370: CP Command Reference for General Users.

Figure 23. CP Privilege Class Descriptions

Figure 24 contains an alphabetical list of the CP commands, the privilege classes which may execute the command, and a brief statement about the use of each command.

Command	Privilege Class	Usage
*	any	Annotate the console sheet.
#CP	any	Execute a CP command while remaining in the virtual machine environment.
ACNT	A	Create accounting records for logged on users and reset accounting data.
ADSTOP	G	Halt execution at a specific virtual machine instruction address.
ATTACH	B B B	Attach a real device to a virtual machine. Attach a DASD device for CP control. Dedicate all devices on a particular channel to a virtual machine.
ATTN	G	Make an attention interruption pending for the virtual machine console.
AUTOLOG	A,B	Automatically log on a virtual machine and have it operate in disconnect mode.
BACKSPAC	D	Restart or reposition the output of a unit record spooling device.
BEGIN	G	Continue or resume execution of the virtual machine at either a specific storage location or at the address in the current PSW.
CHANGE	D,G	Alter one or more attributes of a closed spool file.
CLOSE	G	Terminate spooling operations on a virtual card reader, punch, printer, or console.
COUPLE	G	Connect channel-to-channel adapters.
CP	any	Execute a CP command while remaining in the CMS virtual machine environment.
DCP	C,E	Display real storage at terminal.
DEFINE	G	Reconfigure your virtual machine.

Figure 24. CP Command Summary (Part 1 of 4)

Command	Privilege Class	Usage
DETACH	B	Disconnect a real device from a virtual machine.
	B	Detach a DASD device from CP.
	B	Detach a channel from a specific user.
	G	Detach a virtual device from a virtual machine.
	G	Detach a channel from your virtual machine.
DIAL	any	Connect a terminal or display device to the virtual machine's virtual communication line.
DISABLE	A,B	Disable 2701/2702/2703, 3704/3705 in EP mode, and 3270 local communication lines.
DISCONN	any	Disconnect your terminal from your virtual machine.
DISPLAY	G	Display virtual storage on your terminal.
DMCP	C,E	Dump the specified real storage location on your virtual printer.
DRAIN	D	Halt operations of specified spool devices upon completion of current operation.
DUMP	G	Print the following on the virtual printer: virtual PSW, general registers, floating-point registers, storage keys, and contents of specified virtual storage locations.
ECHO	G	Test terminal hardware by redisplaying data entered at the terminal.
ENABLE	A,B	Enable communication lines.
EXTERNAL	G	Simulate an external interruption for a virtual machine and return control to that machine.
FLUSH	D	Cancel the current file being printed or punched on a specific real unit record device.
FORCE	A	Cause logoff of a specific user.
FREE	D	Remove spool HOLD status.
HALT	A	Terminate the active channel program on specified real device.
HOLD	D	Defer real spooled output of a particular user.
INDICATE	E,G	Indicate resource utilization and contention.
IPL	G	Simulate IPL for a virtual machine.
LINK	G	Provide access to a specific DASD device by a virtual machine.
LOADBUF	D	Load real UCS/UCSB or FCB printer buffers.

Figure 24. CP Command Summary (Part 2 of 4)

Command	Privilege Class	Usage
LOADVFCB	G	Load virtual forms control buffer for a virtual 3211 printer.
LOCATE	C,E	Find CP ccntrol blocks.
LOCK	A	Bring virtual pages into real storage and lock them; thus excluding them from future paging.
LOGOFF	any	Disable access to CP.
LOGON	any	Provide access to CP.
MESSAGE	A,B,any	Transmit messages to other users.
MONITOR	A,E	Trace events of the real machine and record system performance data.
NETWORK	A,B,F	Load, dump, trace and control the operation of the 3704/3705 control program. Control the operation of 3270 remote devices.
NOTREADY	G	Simulate "not ready" for a device to a virtual machine.
ORDER	D,G	Rearrange closed spool files in a specific order.
PURGE	D,G	Remove closed spool file from system.
QUERY	A,B,C,D,E,F,G	Request information about machine configuration and system status.
READY	G	Simulate device end interruption for a virtual device.
REPEAT	D	Repeat (a specified number of times) printing or punching of a specific real spool output file.
REQUEST	G	Make an attention interruption pending for the virtual machine console.
RESET	G	Clear and reset all pending interruptions for a specified virtual device and reset all error conditions.
REWIND	G	Rewind (to load point) a tape and ready a tape unit.
SAVESYS	E	Save virtual machine storage contents, registers, and PSW.
SET	A,B,F,G	Operator--establish system parameters. User--control various functions within the virtual machine.

Figure 24. CP Command Summary (Part 3 of 4)

Command	Privilege Class	Usage
SHUTDOWN	A	Terminate all VM/370 functions and checkpoint CP system for warm start.
SLEEP	any	Place virtual machine in dormant state.
SPACE	D	Force single spacing on printer.
SPOOL	G	Alter spooling control options; direct a file to another virtual machine or to a remote location via the RSCS virtual machine.
START	D	Start spooling device after draining or changing output classes.
STCP	C	Change the contents of real storage.
STORE	G	Alter specified virtual storage locations and registers.
SYSTEM	G	Simulate RESET, CLEAR STORAGE and RESTART buttons on a real system console.
TAG	G	Specify variable information to be associated with a spool file or output unit record device. Interrogate the current TAG text setting of a given spool file or output unit record device.
TERMINAL	G	Define or redefine the input and attention handling characteristics of your virtual console.
TRACE	G	Trace specified virtual machine activity at your terminal, spooled printer, or both.
TRANSFER	D,G	Transfer input files to or reclaim input files from a specified user's virtual card reader.
UNLOCK	A	Unlock previously locked page frames.
VARY	B	Mark a device unavailable or available.
WARNING	A,B	Transmit a high priority message to a specified user or to all users.

Figure 24. CP Command Summary (Part 4 of 4)

Appendix C: Considerations for 3270 Display Terminal Users

The IBM 3270 Display terminal, commonly referred to as a 3270, functions somewhat differently from a typewriter-style terminal when you use it as a virtual machine console under VM/370. Apart from the obvious difference in the way output is displayed, there are special techniques you can use with a 3270 that you cannot use on a 2741 or other typewriter terminal. This appendix describes how to use a 3270, and provides additional notes to supplement discussions in the first part of this publication.

Entering Commands

Since the keyboard on a 3270 is never locked during the execution of a command or program, you can enter successive command lines without waiting for the completion of the previous command. This stacking function can be combined with the other methods of stacking lines, such as using the logical line end symbol (#) to stack several command lines. If you try to enter more lines than the terminal buffer can accommodate, however, you receive the status message NOT ACCEPTED and you must wait until the buffer is cleared before you can enter the line.

You will find, as you become accustomed to using a 3270, that the #CP function is very useful. The #CP function, remember, is a function that allows you to pass a command line to the control program immediately, bypassing any processing by the virtual machine (CMS). The #CP function can be used in any VM/370 environment, and you can enter it even when a program is executing. You do not have to interrupt a program's execution to enter a command line such as

```
#cp display psw
```

to display the current PSW, or

```
#cp spool printer class s
```

to spool your virtual printer.

Setting Program Function Keys

If there are CP and CMS commands that you use frequently, you can set the program function (PF) keys on your terminal to execute them. Some examples of commands you might wish to catalog on PF keys are

```
#CP DISPLAY PSW
#CP QUERY PRINTER ALL
QUERY SEARCH
```

To set functions keys 1, 2, and 3 to perform these command functions, enter:

```
cp set pf1 immed "#cp display psw
cp set pf2 immed "#cp query printer all
cp set pf3 immed query search
```

When you want to execute a #CP function with a PF key, or you want a PF key to execute a series of commands, you must use the logical escape symbol (") when you enter the SET command.

```
cp set pf5 immed edit test file"#bo"#input line"#file
```

sets the PF5 key as

```
EDIT TEST FILE#BO#INPUT LINE#FILE
```

You cannot set lowercase characters in a PF key.

The above examples use the IMMED operand of the SET command, which specifies that the function is performed as soon as you press the PF key. You can also set a key so that it is delayed, that is, that the command or data line is placed in the user input area. Then, you must press the Enter key to execute the command; you may modify the line before you enter it. This is the default setting (DELAY) for program function keys. For example, you might set a key as

```
QUERY DISK X@
```

When you press this PF key, the command line is placed in the user input area, with the cursor positioned following the "@" logical character delete symbol; you can enter the mode letter of the disk you are querying before you press the Enter key to execute the command.

You can set all of your program function keys in your PROFILE EXEC, so they are set each time you load CMS. You can change a PF key setting any time during a terminal session, according to your needs. If, for example, you discover that you are repeating several procedures a number of times, and the procedure does not lend itself to being written into an EXEC, you could use your program function keys.

All the lines in an EXEC procedure are scanned, and all character strings are truncated to 8 characters, so if you enter a long command line, insert spaces where possible:

```
CP SET PF5 IMMED EDIT TEST FILE #BO# INPUT
```

To change PF settings within the edit environment, give the EXEC a filename that begins with a dollar sign ($), so it functions as an edit macro.

Controlling the Display Screen

A major feature of a 3270 display screen is the screen status area, which indicates, at all times that you are logged on, the current operating condition your virtual machine is in. Understanding the status conditions can help you use CMS on a 3270 more effectively. The screen status area indicates one of six conditions:

CP READ: After you log on, this is the first status message you see; it indicates that the terminal is waiting for a line to be read by the control program. You can enter only CP commands when the screen status area indicates a CP READ.

VM READ: This status indicates that your terminal is waiting for a line to be issued to your virtual machine; you may be in the CMS environment, in the edit or debug environments, or you may be executing a program or an EXEC that has issued a read to the console.

RUNNING: This status means that your virtual machine is operating. Once you have loaded CMS and are using the CMS environment, this status is almost continually in effect, even when you are not currently executing a command or program.

You can alter the way this works by using the AUTOREAD function of the SET command. When the AUTOREAD setting is OFF, (the default for display terminals), your terminal displays a RUNNING status after the execution of each CMS command. If you want the terminal to be in a VM READ status following each command, issue

```
set autoread on
```

The CN setting is the default for typewriter terminals, since a read on a typewriter terminal must be accompanied by the unlocking of the keyboard.

The advantage of keeping your virtual machine in a running status even when it is not actually executing a program is that it makes your terminal ready to receive messages. If your terminal is waiting for a read, either from CP or from the virtual machine, and if a user or a program sends a message to your virtual console, then the message is not displayed until you use the Enter key to enter a command or null line. When your machine is in a running status, the terminal console is always ready to accept messages.

If your virtual machine is in the CP environment, and you want your terminal to be in a running status, you can use the command:

```
cp sleep
```

To return to the CP READ status, you must press the PA1 key or the Enter key.

MORE...: This status indicates that your display screen is full, but that there is more data to be displayed. This message, in addition to indicating that there is more data, gives you a chance to freeze your screen's current display so you can continue to examine it, if necessary.

When you see the screen is in a MORE... status, you can either (1) press the Clear, Cancel, or PA2 keys to clear the screen and see the next screen, or (2) press the Enter key to hold the screen in its present status. If you do not do either, then after 60 seconds, the screen is cleared and the next screen is displayed.

HOLDING: This indicates that you have pressed the Enter key to freeze the screen. You must use the Cancel, Clear, or PA2 keys to erase this screen and go on to the next display.

A holding status also results if you have received a message that appeared on this screen. When the screen becomes full, it does not automatically pass to the next display after 60 seconds, but waits until you specifically clear the screen. (This feature ensures that any important messages you receive are not lost.)

NOT ACCEPTED: Indicates that you are trying to enter a command line but the terminal buffer is full and cannot accept it.

CONSOLE OUTPUT

When you use a 3270 terminal as your virtual machine console, you do not ordinarily retain a console log, as you do on typewriter terminal. There may be many circumstances in which you need a printed record of your console output, whether it be to obtain a copy of program-generated output, or to retain a record of CP and/or CMS commands that resulted in an error condition. There are two techniques you can use in VM/370 to obtain hardcopy representations of display terminal sessions: spooling console output and the 3270 copy function.

Spooling Console Output

The CP SPOOL command provides the CONSOLE operand, which allows you to begin and end console spooling. You enter

```
cp spool console start
```

when you want to begin recording your terminal session, and

```
cp spool console stop
```

when you have finished. In between, you can periodically close the console file to release for printing whatever has been spooled thus far:

```
cp spool console close
```

Other operands that you can enter are the same as you might specify for any printer file, such as CLASS, COPY, CONT, and HOLD.

An alternate technique is to spool your console to your own virtual reader:

```
cp spool console start * class a
```

Then, when you close the console file, instead of being released to the CP printer spool file queue, it is routed to your virtual card reader, and you can load it onto your A-disk as a CMS disk file:

```
readcard console file
```

You can then use the editor to examine it (or to delete sections you don't need) and use the PRINT command to spool it to the printer.

3270 COPY Function

If you are using a 3270 display terminal, and you have available a 3284, 3286, or 3288 printer, you can copy the full screen display currently appearing on the screen. To copy the screen, you have to assign the copying function to a program function key, with the SET command:

```
cp set pf9 copy
```

Then, whenever you want to copy a screen display, you can press the PF9 key (or whichever key you set). The display is printed on any 3284, 3286, or 3288 printer that is attached to the same control unit as the display terminal. If, when you press the PF key, the screen status area indicates NOT ACCEPTED, it means that the printer is either not ready or not available. When you press the PF key and receive no response, it means that the screen has been copied.

Figure 25 is an example of a 3270 screen display that could be copied on the printer. When you use the copy function to copy a screen, all 24 lines of the display screen are copied; the screen status area (indicated as RUNNING in Figure 25) is blank. You can use the user input area of your screen to key in comments, or you name or userid, if several users are spooling copy files

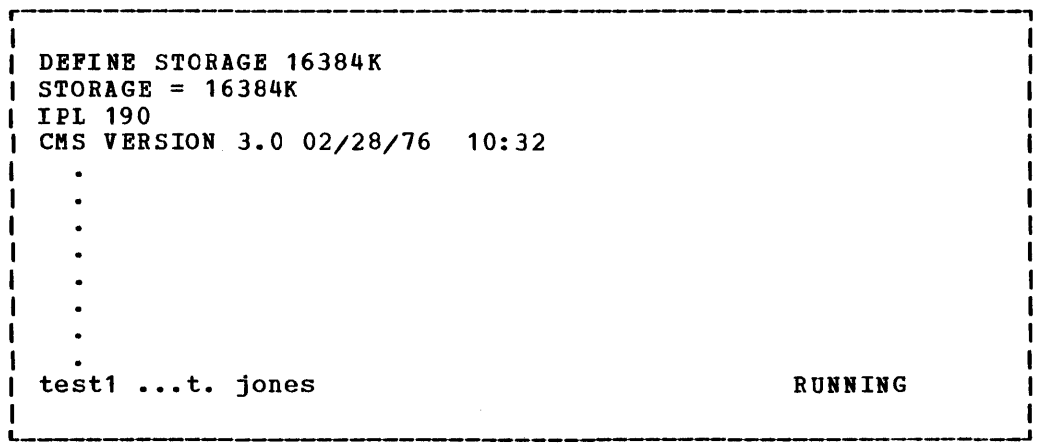


Figure 25. 3270 Screen Display

Signaling Interrupts

The two keys on your 3270 keyboard that signal interrupts are the PA1 key and the Enter key. Throughout this publication, interrupt signaling has been described in terms of the Attention key, which is the interrupt signaling key on a 2741.

On a typewriter terminal, the Attention key, pressed once, causes a virtual machine interrupt (if the terminal mode is set to VM); you must use it when you want to enter an Immediate command, such as HT or HX. On a display terminal, you can enter these commands whenever your virtual machine is in a running status, without having to signal an interrupt before you enter the command.

Sometimes, however, if your terminal is displaying output very rapidly, you must wait until the screen is full and the screen status area indicates a MORE... status before you attempt to enter the HT or HX command.

The Enter key can also be used as an interrupt signaling key. If you press it once when your virtual machine is running, you will place your virtual machine in the VM READ status, so you can enter a command line. If you press the Enter key twice, quickly, you enter the CP environment, with your console in a CP READ status.

An easier way to enter the CP environment is by pressing the PA1 key. Whenever you press this key, your virtual machine is placed in a CP READ status, and you can enter any CP command. From the CP environment, you must use the CP command BEGIN to resume execution of your virtual machine.

HALTING SCREEN DISPLAYS

When your terminal is displaying successive screens of output from a program or a CMS command, you can use the HT or HX Immediate commands to halt the display or the execution of the command, respectively. If your terminal is writing the information at a very rapid rate, you may have difficulty entering the HT or HX command. In these circumstances, you can use the PA1 key (or press the Enter key twice) to force your terminal to a CP READ status. Then, you can use the CP command ATTN or REQUEST to to signal a virtual machine read. When the screen status area indicates VM READ, you can enter HX or HT.

Using the CMS Editor with a 3270

The CMS Editor has a special format and operation, called display mode, that makes editing CMS disk files with a 3270 more convenient than on a typewriter terminal. It uses most of the display screen, and displays up to 20 lines of a file at once. In addition to displaying data lines of the file, the editor also indicates, on the topmost line of the screen, the filename, filetype, record format, and logical record length of the file being edited, as well as showing your current mode: input or edit. The format of the screen is shown in Figure 26.

The screen lines that you are most concerned with, while editing, are the current line (on the same line as the system available indicator), the user input area (the bottom two lines), and the editor's message line, the second line from the top, in which the editor's responses and error messages are displayed.

When you first invoke the editor to edit a file, whatever is currently on the screen (including your EDIT command line) is erased and the full screen is controlled by the editor. The current line pcinter is positioned at the top of the file, the top part of the display screen appears blank. The editor displays the characters "TOF:" and "EOF:" to indicate the top and end of the file, respectively.

ENTERING EDIT SUBCOMMANDS

When you enter an EDIT subcommand into the user input area and press the Enter key the subcommand is not displayed on the screen, but the change (or line pointer movement) is reflected in the screen display. If you enter a subcommand that moves the current line pointer, all of the lines on the screen are shifted up or down, according to the action taken by the subcommand.

If you use the INPUT subcommand to enter input lines, the edit status field indicates INPUT; all of the lines that you enter are placed in the file and appear on the screen as the current line. (Entering input lines from a remote 3270 is somewhat different. "Editing on a Remote 3270" below, discusses the differences.)

If you enter an invalid EDIT subcommand, or if you enter a subcommand that requests information, the edit response appears in the message field of the screen. For example, if you enter

```
trunc
```

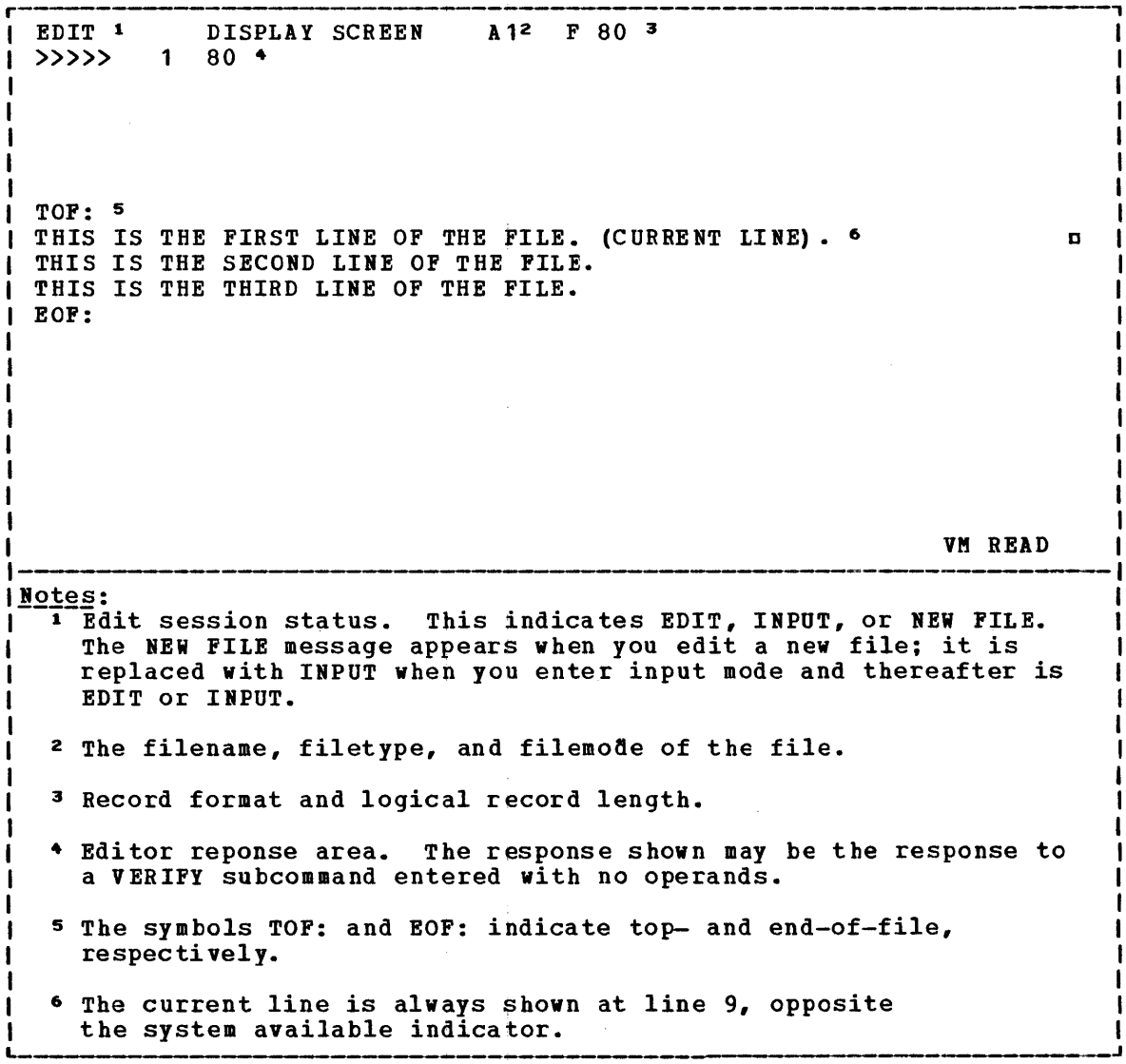


Figure 26. How the CMS Editor Formats a 3270 Screen

the editor responds by displaying the current truncation setting, which might be:

```
>>>>>   81
```

If you enter

```
copyfile myfile edit (trunc
```

the editor would respond:

```
>>>>> ?EDIT: copyfile myfile edit (trunc
```

to indicate that it does not recognize the entered line (COPYFILE is not an EDIT subcommand). When you use line-number editing, the prompting message appears in this area; after you enter text in the user input area, the text line is written in the output display area, at the current line position.

Two EDIT subcommands, CHANGE and ?, result in lines being copied in the user input area. In the case of the CHANGE subcommand, the line that is displayed is the current line. Once in the user input area, you can modify it and re-enter it. While you are changing it, the original line appears unchanged in the output display area. If you decide that you do not want changes entered, you must press the Erase Input key and then press the Enter key before you enter any other EDIT subcommands.

You can use the ? subcommand to request that the last EDIT subcommand you entered be displayed in the user input area. If, for example, you enter a CHANGE or LOCATE subcommand that results in a NOT FOUND condition, or some other error, you can enter

```
?
```

and modify the subcommand line and re-enter it, if you want; otherwise, use the Erase Input key to delete it.

CONTROLLING THE DISPLAY SCREEN

Usually the editor controls the entire screen display during an edit session. Occasionally, the screen goes into a MORE... status, and you must use the Cancel key to clear the screen. There are two other situations in which the screen must be cleared, either by the editor, or by you. When you use the CMS subcommand to enter CMS subset to enter CMS commands, the screen is cleared and the message CMS SUBSET is displayed at the top of the screen. When you issue the subcommand RETURN to return to edit mode, the screen display is restored to its original appearance.

The situation is slightly different, however, whenever you communicate with the control program (CP), or receive messages from other users during an edit session. Any CP message or command response causes your screen to go into a MORE... status; you must use the PA2 (Cancel) key to see the response. To restore your screen to its edit display, you should use the EDIT subcommand TYPE. If you use the PA1 key to place your virtual machine in the CP environment, and the screen status area indicates CP READ, use the CP command BEGIN to restore edit mode. Then enter the TYPE subcommand. If you enter a subcommand other than TYPE, the entire screen is not restored, and the top two lines (the editor's data and response fields) may contain lines of the CP response.

If your virtual machine was in input mode when you entered the CP command, you may continue entering lines of input; the third through the ninth lines of the screen are restored after you enter the next line.

If you enter a CP command that does not produce a response, then there is no change to the screen.

Verification Settings on a 3270

The VERIFY subcommand allows you to alter the verification columns when you are editing a file, or to cancel verification altogether. If, for example, you are editing a file with records longer than 80 characters, each line is displayed on two lines of the display screen. Sometimes, you may be editing only specific columns in a file, and do not need to see the lines displayed in their entirety. To see only the first 80 columns, you could enter:

```
verify 1 80
```

Or, if you wanted to see the last 80 columns of a file with 120-character records, you could enter

```
verify 41 120
```

If you cancel verification entirely by entering

```
verify off
```

then, modifications that you make to the file (including movement of the current line pointer) are not reflected on the display screen until you use the TYPE subcommand.

THE CURRENT LINE POINTER

There is one aspect of the CMS Editor on a 3270 that is much the same as on a typewriter terminal: you must still be concerned with the positioning of the current line pointer, and you can only add or modify data on the current line, even though you see many lines being displayed. The current line, on the screen, appears near the middle, on the same line as the SYSTEM AVAILABLE light.

To move the current line pointer, you can use the subcommands UP and DOWN: UP indicates movement toward the top of the file and DOWN indicates movement toward the bottom of the file. When you issue either of these subcommands, the entire display of the file shifts down the screen (if you use the UP subcommand) or up the screen (if you use the DOWN subcommand).

If you have never used the CMS Editor on a typewriter terminal, you may find the UP and DOWN subcommands confusing to use, so you can use instead the BACKWARD (UP) and FORWARD or NEXT (DOWN) subcommands to shift the display backward (toward the top of the file) and forward (toward the bottom of the file).

You can also use the EDIT subcommand SCROLL, which allows you to display successive screen displays, and to examine an entire file quickly. If you enter the SCROLL subcommand with no operands, it is the equivalent of entering the subcommand DOWN (FORWARD) 20, which results in the screen changing to display the 20 lines following the lines currently being displayed. If you enter

```
scroll 10
```

Then, the SCROLL subcommand executes 10 times, placing the screen in a MORE... state at the end of each display.

If the file you are editing has verification column settings greater than 80 characters (so each line takes up 2 display lines), then the SCROLL subcommand moves the screen 10 lines at once instead of 20.

The UP (or BACKWARD) counterpart of SCROLL is SCROLLUP, which can be abbreviated SU.

USING PROGRAM FUNCTION KEYS

You can enhance the use of the CMS Editor on a 3270 by setting the program function (PF) keys on your terminal to correspond to some cf the more frequently-used EDIT subcommands, such as UP, DOWN, SCROLL, FILE, SAVE, and so on. You can also set a program function key to contain a line of data, so that if you are creating a file that has many duplicate lines in it, you can use the PF key instead of having tc key in the entire line each time. PF keys, cannot, however, contain lowercase character strings.

You can set a program function key while you are in edit mode either by using the PA1 key to enter the CP environment or by using the #CP function.

USING THE EDITOR IN LINE MODE

The editor's display mode is the most common format of operation on a 3270. There are, however, instances when it is not possible or not desirable to use the editor in display mode. For these instances, you should use the line mode of operation, which is the equivalent to using a typewriter terminal. When you use line mode, each EDIT subcommand you enter, and the response (if you have verification on), is displayed, a line at a time, on the screen in the output display area. There is no full screen display of the file.

You need only be concerned with using line mode if you are connected to VM/370 by a remote 3270 line, or if you are editing a file from within an EXEC and you want to control the screen display. Although it is possible to use the editor in line mode on a local 3270, it is rarely necessary for normal editing purposes.

Editing on a Remote 3270

When you invoke the editor from a remote 3270, you are placed in line mode by the editor. The advantage of using the 3270 in line mode (particularly on a remote terminal) is that the terminal can respond more quickly to display requests. When you use display mode, the terminal has to write out the entire output display area when you move the current line pointer; in line mode, it has only to write a single line.

If you want to use display mode, you enter the EDIT subcommand

```
format display
```

And the editor begins operating in display mode, and you can use the special editing functions available in display mode.

However, when you are using a remote 3270 in display mode, and you enter the INPUT subcommand to begin entering input lines, the screen is cleared, and your input lines are displayed as if you were in line mode, beginning at the top of the screen. When you enter a null line to return to edit mode, the editor returns to a full screen display.

You can resume editing in line mode by using the subcommand:

```
format line
```

Editing From an EXEC File

If you invoke the editor from an EXEC, but you do not want the screen cleared when the editor gets control, you can specify the NODISP option on the EDIT command line:

```
edit test file (nodisp
```

This places the 3270 in line mode, so that the lines already on the screen are not erased.

The 3270 remains in line mode for the remainder of the edit session, and you cannot use the FORMAT subcommand to place it in display mode.

USING SPECIAL CHARACTERS ON A 3270

There are two special characters available on a typewriter terminal whose functions have no meaning on a display terminal. They are the tab character (X'05') and the backspace character (X'16'). For most file creation and editing purposes, you will probably not need to use the backspace, but many CMS filetypes use tab settings to set up the proper column alignment in files. There are two methods you can use to enter any special character on a 3270 (including tabs), and an additional method of using tabs, which involves setting a program function key.

To enter any special character (a backspace is used in this example) you can either:

1. Enter another character at the appropriate place in the record, and then use the ALTER subcommand to alter that character to the hexadecimal value of the character you want to represent (a backspace character is a X'16'). For example:

   ```
   input ABC>>>___
   alter > 16 1 *
   ```

   When you enter backspaces and overstrike characters on a 3270, however, the characters and backspaces each occupy character positions, so that a single compound character occupies three character positions on the screen. If the image setting is CANON, and you want to use the backspace to enter compound characters, you must not enter the backspace character first.

2. Before you begin to create the file, use the CMS SET command to define some other character as the backspace character:

   ```
   set input > 16
   ```

   CMS then translates all occurrences of the character > to X'16'.

If you need to correct a line that contains backspaces, you can reverse the above sequence; alter the X'16' characters to asterisks and enter the CHANGE subcommand.

Defining a 3270 Program Function Key for Tab Settings

You can set up a program function key to operate like a tab key on a typewriter terminal. You must use the CP SET command as follows:

```
SET PFnn TAB n1 n2 . . . nn
```

where:

PFnn	is any valid function key from PF1 to PF12.
n1 n2 . . . nn	are the logical tab settings desired, expressed as decimal numbers. Invalid tab settings are ignored. You can specify the setting values in any order, but they are normally specified in ascending order.

You can define different PF keys with different tab settings for different filetypes. Whenever you press the PF key you have set for a tab, the cursor moves to the corresponding position in the user input area, in much the same way that a typing element on a typewriter would move to the next tab stop.

If you press the PF tab key to a position that already contains a data character, the data remains intact. If there is no data in that position, a tab character is entered in the file. The effect of the tab in the file depends, as in normal usage, on the image setting of the editor. If the image setting is set to on (the default), the tab expands to an appropriate number of blanks, to correspond to the settings in effect for the TABSET subcommand. When the TABSET settings match the tab settings of the PF key, then any lines you enter in the user input area appear exactly as they will appear in the output display area.

If you tab beyond the last defined tab position, the cursor is repositioned at the beginning of the user input area.

Changing and Displaying Special Characters

When you edit a file on a 3270 terminal in display mode, you should not copy a line containing tabs or backspaces into the user input area. The tabs or backspaces are converted to blanks (X'40'). Similarly, if the line contains VM/370 logical line editing symbols that have been entered as data characters, the symbols are reinterpreted when you enter the line.

If you use the SET OUTPUT function to display nonprintable characters in CMS, the character translations do not appear when the editor is in display mode. They are, however, displayed when the editor is in line mode.

Using APL with a 3270

If you have a 3277 display station equipped with an APL keyboard, you can use APL on a 3270 terminal in CMS. You invoke the APL virtual machine by issuing the command specified in the VSAPL Program Product documentation. This command invokes the VSAPL-CMS interface program. You are then prompted to press the APL On/Off key which is on your terminal; pressing this key changes the keyboard to APL character input mode. You are then prompted to press the Enter key to continue.

EBCDIC or APL characters can always be displayed; the APL On/Off key does not change this. The VSAPL-CMS interface program issues the TERMINAL APL ON command for you and selects the appropriate translation tables. The interface program then invokes the VSAPL program. When the VSAPL ready message appears on the screen, you can use APL.

You can send a copy of your display screen to a locally or remotely-attached printer. Be sure that the printer you send your output to has the APL feature installed; if it does not, the APL characters are not printed. Most system printers do not have an APL print chain; therefore you may need to use the copy function to direct your screen output displays to a 3284 or 3286 printer.

ERROR SITUATIONS

If you do not have the APL hardware feature installed on your 3270 but you invoke APL:

- The VSAPL program is invoked and the TERMINAL APL ON command is issued.
- You cannot communicate with the VSAPL program.
- Any APL characters that are written to the screen appear as blanks.

If you have the APL feature installed on your terminal, but invoke APL manually without issuing the TERMINAL APL ON command or issue TERMINAL APL OFF at sometime during APL processing:

- The VSAPL program is activated.
- You cannot communicate with the VSAPL program.
- Any APL characters written to the screen appear as blanks.

If you attempt to use the APL O/S (overstrike) key when the APL hardware key is set off, it acts as a backtab key and repositions the cursor to the beginning of the user input area.

LEAVING THE APL ENVIRONMENT

Issue the APL command

```
) OFF
```

to log off VM/370.

Issue the APL command

```
) OFF HOLD
```

to return to CMS. This APL command invokes the VSAPL-CMS interface program, which

- Issues the TERMINAL APL OFF command
- Prompts you to press the APL hardware key
- Returns to CMS

Note: The APL hardware feature is a key, not a switch. Each time you press the APL key you reverse its on/off setting. To determine whether APL is on or off, press a key that represents a special APL character. If the character displayed is an APL character, the hardware APL feature is set on. If the character displayed is a non-APL character, you must press the APL key once to set the APL feature on.

Appendix D: Sample Terminal Sessions

This appendix provides sample terminal sessions showing you how to use:

- The CMS Editor (using context editing), and the CMS COPYFILE, SORT, RENAME, and ERASE commands.
- The CMS Editor (using line-number editing)
- CMS OS simulation to create, assemble, and execute a program using OS macros in the CMS environment.
- CMS DOS/VS simulation to create, assemble, and execute a program using DOS/VS macros in the CMS/DOS environment.
- Access Method Services under CMS, to create VSAM catalogs and data spaces, and to use the define and repro functions of AMSERV.

Sample Terminal Session Using the Editor and CMS File System Commands

This terminal session shows you how to create a CMS file and make changes to it using the CMS Editor, and then manipulate it using the CMS file system commands, COPYFILE, ERASE, RENAME, and SORT.

Note: Throughout this terminal session whenever a TYPE subcommand or command is issued that results in a display of the entire file, the complete display is not shown; omitted lines are indicated by vertical ellipses (...). When you enter the TYPE command or subcommand, you should see the entire display.

```
(1) edit command data
    NEW FILE:
    EDIT:
(2) image
    ON
    tabs 1 12 80
    trunc 72
(3) input
    INPUT:
    copyfile    copy cms files
    sort        sort cms files in alphameric order by specific columns
    edit        create a cms file
    edit        modify a cms file
    rename      change the name of a cms file
    punch       punch a copy of a cms file on cards
    print       print a cms file
    erase       erase a cms file
    listfile    list information on a cms file
    state       verify the existence of a cms file
    statew      verify the existence of a cms file on a read/write disk
    readcard    read a cms file from your card reader onto disk
    disk dump   punch a cms file in cms disk dump format into your virtual card punch for
(4) TRUNCATED
    DISK DUMP  PUNCH A CMS FILE IN CMS DISK DUMP FORMAT INTO YOUR VIRTUAL CA
    disk load   read a disk dump file onto disk
    compare     compare the contents of cms disk files
    tape dump   dump cms files onto tape
    tape load   read cms files onto disk from tape
(5)
    EDIT:
```

---

(1) Use the EDIT command to invoke the CMS Editor to create a file with a filename of COMMAND and a filetype of DATA. Since the file does not exist, the editor issues the message NEW FILE.

(2) Check that the image setting is ON. This is the default for all filetypes except SCRIPT. Then, set the logical tab stops for this file at 1, 12, and 80, and set a truncation limit of 72.

(3) Enter the subcommand INPUT to enter input mode and begin entering lines in the file. For these input files, you should press the Tab key (or equivalent) on your terminal following each CMS command name. If there is a physical tab stop on your terminal in column 12, the input data appears aligned.

(4) The message, TRUNCATED, indicates that the line you just entered exceeded the truncation limit you set for the file (column 72). The editor displays the line, so you can see how much of the line was accepted. Your virtual machine is still in input mode, so continue entering input lines.

(5) To get out of input mode, enter a null line (press the Return or Enter key without entering any data). The editor responds with the message EDIT:.

```
6  top
   TOF:
7  type *
   TOF:
   COPYFILE   COPY CMS FILES
      .
      .
      .
   TAPE LOAD  READ CMS FILES ONTO DISK FROM TAPE
8  EOF:
   locate /disk dump
   DISK DUMP  PUNCH A CMS FILE IN CMS DISK DUMP FORMAT INTO YOUR VIRTUAL CA
9  replace disk dump punch a cms file onto cards
   input
   INPUT:
   type         display the contents of a cms file at your terminal
   rename       alter the name of a cms file
   sort         resequence the records in a cms file
   copyfile     reformat a file, by columns
   comprae      verify that two files are identical
10
   EDIT:
   change /rae/are/
   COMPARE    VERIFY THAT TWO FILES ARE IDENTICAL
11 bo
   TAPE LOAD  READ CMS FILES ONTO DISK FROM TAPE
   input
   INPUT:
12
   EDIT:
13 file
   R;
```

---

6 Use the TOP subcommand to position the current line pointer at the top of the file. The editor responds TOF:.

7 Use the TYPE subcommand to display the entire file. Note that all of your input lines are translated to uppercase characters, and that the tab characters you entered have been expanded, so that the first word following each command name begins in column 12.

8 The message EOF: indicates that the end of the file is reached. You can issue the LOCATE subcommand to locate a line. Since you are at the bottom of the file, the editor begins searching from the top of the file. Notice that you can enter the character string you want to locate in lowercase characters; the editor translates it to uppercase to locate the line. The editor displays the line.

9 Use the REPLACE subcommand to replace this line, in a shortened form so that it is not truncated. Remember to enter a tab character after the command name; when you enter the line, the tab stop does not have to be in column 12. Then, use the INPUT subcommand again to resume entering input. The lines that you enter next are written into the file following the DISK DUMP line.

10 When you make a spelling error or other mistake, you may want to correct it immediately. Enter a null line to return to edit mode, and use the CHANGE subcommand to correct the error. In this example, the string RAE is changed to ARE. The editor displays the line as changed.

11 Use the BOTTOM subcommand to move the current line pointer to point to the last line in the file. Enter input mode with the INPUT subcommand.

12 If you enter input mode and decide that you do not want to enter input lines, all you have to do to return to edit mode is enter a null line.

13 To write the file onto disk, use the FILE subcommand. This writes it onto disk using the name with which you invoked the editor, COMMAND DATA. The CMS Ready message indicates that you are in the CMS command environment.

```
⓮ type command data

  COPYFILE   COPY CMS FILES
  SORT       SORT CMS FILES IN ALPHAMERIC ORDER BY SPECIFIC COLUMNS
     .
     .
     .
  TAPE LOAD  READ CMS FILES ONTO DISK FROM TAPE
  R;
⓯ edit command data
  EDIT:
⓰    .
     .
     .
  save
  EDIT:
⓱ fname comm2
  file
  R;
⓲ copyfile comm2 data a (lowcase
  R;
⓳ copyfile command data a comm2 data a (ovly specs
  DMSCPY601R ENTER SPECIFICATION LIST:
  1-12 1
  R;
⓴ type comm2 data

  COPYFILE   Copy cms files
  SORT       Sort cms files in alphameric order by specific columns
  EDIT       Create a cms file
  EDIT       Modify a cms file
  RENAME     Change the name of a cms file
  PUNCH      Punch a copy of a cms file on cards
  PRINT      Print a cms file
  ERASE      Erase a cms file
  LISTFILE   List information on a cms file
㉑ ht
  R;
```

⓮ To display the entire file at your terminal, use the CMS TYPE command. Note any errors that you made that you might want to correct.

⓯ Use the EDIT command to edit the file COMMAND DATA again. This time, since the file exists, the editor does not issue the message, NEW FILE:

⓰ While you are in edit mode, make any changes that you need to; then issue the SAVE subcommand to save these changes, and replace the existing copy of the file onto disk.

⓱ Use the FNAME subcommand to change the filename of the file to COMM2 (the filetype remains unchanged). When you issue the FILE subcommand this time, the file is written onto disk with the name COMM2 DATA.

⓲ You can rewrite the entire file, COMM2 DATA in lowercase characters, using the COPYFILE command with the LOWCASE option.

⓳ The file COMM2 DATA is now all lowercase characters (you can display the file with the TYPE command if you want to verify it). However, the command names, and the first character of the description should be uppercase characters. You can use the COPYFILE command again, to overlay the original uppercase characters of COMMAND DATA in columns 1 through 12 over the lowercase characters in columns 1 through 12 of COMM2 DATA.

⓴ Use the TYPE command to verify that the COPYFILE command did, in fact, overlay only the columns that you wanted.

㉑ The HT Immediate command suppresses the display of the remainder of the file; you can see from the first few lines that the format of the file is correct.

```
(22) listfile * data
     COMMAND  DATA      A1
     COMM2    DATA      A1
     R;
(23) sort comm2 data a command sort a
     DMSSRT604R ENTER SORT FIELDS:
     1 9
     R;
(24) type command sort

     COMPARE    Verify that two files are identical
     COMPARE    Compare the contents of cms disk files
        .
        .
        .
     TYPE       Display the contents of a cms file at your terminal

     R;
(25) copyfile comm2 data a function data a ( specs
     DMSCPY601R ENTER SPECIFICATION LIST:
     12-72 1 1-9 70
     R;
(26) type function data

     Copy cms files                                                  COPYFILE
     Sort cms files in alphameric order by specific columns          SORT
        .
        .
        .
     Read cms files onto disk from tape                              TAPE LOAD
     R;
(27) sort function data a function sort a
     DMSSRT604R ENTER SORT FIELDS:
     1 70
     R;
     type function sort

     Alter the name of a cms file                                    RENAME
     Change the name of a cms file                                   RENAME
        .
        .
        .
     Verify the existence of a cms file on a read/write disk         STATEW
     R;
```

---

(22) The LISTFILE command lists your two files with the filetype of DATA. (If you previously had files with these filetypes, they are also listed.)

(23) To sort the file COMM2 DATA into alphabetic order, by command, issue the SORT command. When you are prompted for the sort fields, enter the columns that contain the command names, 1 through 9.

(24) The output file from the SORT command is named COMMAND SORT. You can use the TYPE command to verify that the records are now sorted alphabetically by command.

(25) To create another copy of the file, this time with the command names on the right and the functional description on the left, use the COPYFILE command with the SPECS option again. To create a file this way, you must know the columns in your input file (COMM2 DATA) and how you want them arranged in your output file (FUNCTION DATA). Columns 1 through 9 contain the command names; columns 12 through 72 contain the descriptions. The specification list entered after the prompting message indicates that columns 12 through 72 should be copied and placed beginning in column 1, and that columns 1 through 9 should be copied beginning in column 70.

(26) Verify the COPYFILE operation with the TYPE command.

(27) Sort the file FUNCTION DATA so that the functional descriptions appear in alphabetic order. You may also want to display the output file, FUNCTION SORT.

```
(28) listfile
     COMMAND  DATA       A1
     COMM2    DATA       A1
     COMMAND  SORT       A1
     FUNCTION DATA       A1
     FUNCTION SORT       A1
     R;
(29) erase command data
     R;
(30) rename comm2 data a command data a
     R;
     listfile * * a ( label
     FILENAME FILETYPE  FM  FORMAT    RECS BLOCKS   DATE    TIME   LABEL
     FUNCTION SORT      A1  F     80    22      3  10/13/75  7:52  ABC191
     COMMAND  DATA      A1  F     80    22      3  10/13/75  7:48  ABC191
     COMMAND  SORT      A1  F     80    22      3  10/13/75  7:48  ABC191
     FUNCTION DATA      A1  F     80    22      3  10/13/75  7:51  ABC191
     R;
(31) edit function sort
     EDIT:
(32) zone
      1 80
     zone 60
(33) change /     // *
     Alter the name of a cms file                                    RENAME
     Change the name of a cms file                                   RENAME
        .
        .
        .
     Verify the existence of a cms file on a read/write disk         STATEW
     EOF:
(34) top
     TOF:
     find List
(35) NOT FOUND
     EOF:
     case
      U
     case m
     find List
     List information on a cms file                                  LISTFILE
```

---

(28) If these are the only files on your A-disk, the LISTFILE command entered with no operands produces a list of the files created so far.

(29) The file COMM2 was created for a workfile, in case any errors might have happened. Since you no longer need the original file, COMMAND DATA, you can erase it.

(30) Use the RENAME command to rename the workfile COMM2 DATA to have the name COMMAND DATA. The LISTFILE command verifies the change.

(31) To begin altering the file FUNCTION SORT, invoke the editor again.

(32) The ZONE command requests a display of the current zone settings, which are columns 1 and 80. When you issue the command ZONE 60, it changes the settings to columns 60 and 80, so that you cannot modify data in columns 1 through 59.

(33) The CHANGE subcommand requests that the first appearance of five consecutive blanks on each line in the file be compressed. The editor displays the results of this CHANGE request by displaying each line changed (which is each line in the file). The net effect is to shift the command column 5 spaces to the left.

(34) Position the current line pointer at the top of the file, and then issue a FIND subcommand to move the line pointer to the line that begins with "List".

(35) The editor indicates that the line is not found. Checking the current setting for the CASE subcommand, you can see that it is U, or uppercase, which indicates that the editor is translating your input data to uppercase. You can issue the CASE M subcommand to change this setting, then reissue the FIND subcommand.

```
(36) change /on a cms/about a CMS
     NOT FOUND
     = zone 1 *
(37) List information about a CMS file                          LISTFILE
     top
     TOF:
(38) change /cms/CMS/ *
     Alter the name of a CMS file                               RENAME
     Change the name of a CMS file                              RENAME
        .
        .
        .
     Verify the existence of a CMS file on a read/write disk    STATEW
     EOF:
(39) save
     EDIT:
     top
     TOF:
     next
(40) Alter the name of a CMS file                               RENAME
     $dup
     Alter the name of a CMS file                               RENAME
     change /name/filetype/
     Alter the filetype of a CMS file                             RENAME
     next
(41) Change the name of a CMS file                              RENAME
     change /name/filename/
     Change the filename of a CMS file                            RENAME
     next
(42) Compare the contents of CMS disk files                     COMPARE
     next
(43) Copy CMS files                                             COPYFILE
     find M
     Modify a CMS file                                          EDIT
     up
     List information about a CMS file                            LISTFILE
(44) i Make a copy of a CMS disk file                               COPYFILE
     top
     TOF:
```

---

(36) The editor locates the line and displays it. You want to change the character string "on a cms" to "about a CMS". The editor does not find the string you specify because the zone setting for columns 60 through 80 is still in effect. You can enter the ZONE subcommand, and reissue the CHANGE subcommand, or you can enter the = (REUSE) subcommand to stack the CHANGE subcommand, and enter the ZONE subcommand to execute first.

(37) The ZONE subcommand is executed, then the CHANGE subcommand. The editor displays the changed line.

(38) At the top of the file, enter another global change request, to change lowercase occurrences of the string cms to uppercase. The editor displays each line changed.

(39) When the EOF: message indicates that the end of the file is reached, you can save the changes made during this edit session with the SAVE subcommand before continuing.

(40) Move the current line pointer to point to the first line in the file. You want to add an entry that is similar; use the $DUP edit macro to duplicate the line, then change the copy that you made of the line.

(41) You can change the word name to filename in the next line also.

(42) You can scan a file, a line at a time, by issuing successive NEXT subcommands.

(43) To insert a line beginning with the character M, and to maintain alphabetic sequencing, use the FIND subcommand to find the first line beginning with an M. The line to be inserted begins with the characters MA, so you want to move the line pointer up.

(44) You can insert a single line into a file with the INPUT subcommand. Here, the INPUT subcommand is truncated to I, so that when you space over to write the command name in the right column, you can align it (you only have to allow for the two character spaces use by "i ".

```
(45) /COPYFILE
     Copy CMS files                                                    COPYFILE
(46) n
     Create a CMS file                                                 EDIT
     n
     Display the contents of a CMS file at your terminal               TYPE
     n
     Dump CMS files onto tape                                          TAPE DUMP
     n
     Erase a CMS file                                                  ERASE
(47) up 3
     Create a CMS file                                                 EDIT
     i Delete a file from a CMS disk                                    ERASE
     file
     R;
(48) type function sort a

     Alter the name of a CMS file                                      RENAME
     Alter the filetype of a CMS file                                      RENAME
     Change the filename of a CMS file                                     RENAME
        .
        .
        .
     Verify the existence of a CMS file on a read/write disk           STATEW

     R;
(49) edit function sort
     zone 58
     change / // * *
     Alter the name of a CMS file                              RENAME
     Alter the filetype of a CMS file                          RENAME
     Change the filename of a CMS file                         RENAME
        .
        .
        .
     Verify the existence of a CMS file on a read/write disk   STATEW
     EOF:
(50) top
     TOF:
     change //| / *
     Alter the name of a CMS file                              | RENAME
     Alter the filetype of a CMS file                          | RENAME
     Change the filename of a CMS file                         | RENAME
        .
        .
        .
     Verify the existence of a CMS file on a read/write disk   | STATEW
     EOF:
```

---

(45) Move the line pointer to the top of the file and begin scanning again. A diagonal (/) is interpreted as a LOCATE subcommand.

(46) The NEXT subcommand can be truncated to "N".

(47) In front of the line beginning "Display", insert a line beginning with "Delete". If you want to make any other modifications, do so. Otherwise, write this file onto disk with the FILE subcommand.

(48) Verify your changes.

(49) Edit the file again. To compress unnecessary spaces in right hand columns, change the zone setting. This time, issue a CHANGE subcommand that will delete all blank spaces occuring after column 58. Since some changes you made to the file might have spoiled the alignment in the command column, this CHANGE subcommand should realign all of the columns.

(50) Return the current line pointer to the top of the file. Change a null string to the string "| " for all lines in the file; since the left zone is still column 58, the characters are inserted in columns 58 and 59.

```
(51) zone 1 *
     top
     TOF:
     c //| / *
     | Alter the name of a CMS file                              | RENAME
     | Alter the filetype of a CMS file                          | RENAME
     | Change the filename of a CMS file                         | RENAME
        .
        .
        .
     | Verify the existence of a CMS file on a read/write disk   | STATEW
     EOF:
(52) top
     TOF:
     next
     | Alter the name of a CMS file                              | RENAME
     tabset 72
     repeat *
     overlay |
     | Alter the name of a CMS file                              | RENAME    |
     | Alter the filetype of a CMS file                          | RENAME    |
     | Change the filename of a CMS file                         | RENAME    |
     | Compare the contents of CMS disk files                    | COMPARE   |
        .
        .
        .
     | Verify the existence of a CMS file on a read/write disk   | STATEW    |
     EOF:
     bottom
     | Verify the existence of a CMS file on a read/write disk   | STATEW    |
(53) input
(54) zone 1 72
     c / /-/ 1 *
     ------------------------------------------------------------------------
     top
     TOF:
(55) input
     c / /-/ 1 *
     ------------------------------------------------------------------------
(56) file
     R;
     print function sort
     R;
```

---

(51) Change the left zone setting to column 1 and let the right zone be equal to the record length; issue the CHANGE subcommand to insert the "|" in columns 1 and 2. CHANGE can be abbreviated as "C".

(52) At the top of the file, change the TABSET subcommand setting to 72. This makes column 72 the left margin. The REPEAT * subcommand, followed by the OVERLAY subcommand, indicates that all the lines in the file are to be overlayed with a | in the leftmost column (column 72).

(53) When you enter this INPUT subcommand, enter a number of blank spaces following it; this places a blank line in the file.

(54) Reset the ZONE setting to columns 1 and 72. The CHANGE subcommand indicates that all blanks on this line should be changed to hyphens (-). Only the blanks within the specified zone are changed.

(55) Insert another blank line at the top of the file and change it to hyphens.

(56) Write the file onto disk and use the CMS PRINT command to spool a copy to the offline printer.

Sample Terminal Session Using Line-Number Editing

This terminal session shows how a terminal session using right-handed line-number editing might appear on a typewriter terminal. The commands function the same way on a display terminal, but the display is somewhat different. When you enter these input lines, you should have physical tab stops set at your terminal at positions 16 and 22 (for assembler columns 10 and 16; the difference compensates for the line numbers, as you will see). On a display terminal, tab settings have no significance; once the line is in the output display area, it has the proper number of spaces.

```
❶  edit test assemble
   NEW FILE:
   EDIT:
❷  linemode right
   input
   INPUT:
❸  00010 * sample of linemode right
   00020 test     csect
   00030          balr  12,0
   00040          using *,12
   00050          st    14,sav14
   00060          wrterm testing...
   00070          l     14,sav14
   00080          br    14
   00090          end
   00100
❹
   EDIT:
❺  60
   00060          WRTERM               TESTING...
❻  c /testing.../'testing...'
   00060          WRTERM               'TESTING...'
❼  80
   00080          BR    14
   input
   INPUT:
```

---

❶ Use the EDIT command to invoke the CMS Editor. Since this is a new file, the editor issues the NEW FILE message.

❷ Issue the LINEMODE subcommand to indicate that you want to begin line-number editing. For ASSEMBLE files, you cannot have line numbers on the left, because the assembler expects data in columns 1 through 7.

❸ As soon as you issue the INPUT subcommand, the editor begins prompting you to enter input lines. For convenience in entering lines, the line numbers appear on the left, as they would if you were using left-handed line-number editing. In your ASSEMBLE file, however, the line numbers are actually on the right.

❹ When you are have finished entering these input lines, enter a null line to return to edit mode from input mode.

❺ To locate lines when you are using line-number editing, you can enter the line number of the line. In this case, enter 60 to position the current line pointer at the line numbered 00060. The editor displays the line.

❻ Issue the CHANGE subcommand to place quotation marks around the text line for the WRTERM macro. The editor redisplays the line, with the change.

❼ Issue the nnnnn subcommand, specifying line number 80, and use the INPUT subcommand so you can begin entering more input lines.

```
(8) 00083 sav14    ds   f
    00085 wkarea   ds   3d
    00087 flag     ds   x
    00088 runon    equ  x'80'
    00089 runoff   equ  x'40'
(9) RENUMBER LINES
    EDIT:
    linemode off
    serial on abc
    save
(10) EDIT:
(11) linemode right
    type
    00030 RUNOFF    EQU   X'40'
(12) verify 1 *
    type
    00030 RUNOFF    EQU   X'40'                                        ABC00130
(13) 135            runmix   equ x'20'
(14) 50
    00050            ST    14,SAV14                                    ABC00050
    input
    INPUT:
    00053           tm    flag,runon
    00055           bcr   1,14
    00057

(15) EDIT:
    top
    TOF:
    next
    * SAMPLE OF LINEMODE RIGHT                                        ABC00010
(16) restore
```

---

(8) When you begin entering input lines between two existing lines, the editor uses an algorithm to assign line numbers.

(9) The editor ran out of line numbers, since the next line in the file is already numbered 90. You must renumber the lines. Before you can renumber the lines, you must turn line-number editing off. Before issuing the SAVE subcommand, which writes the file and its new line numbers onto disk, you can issue the SERIAL subcommand. SERIAL ABC indicates that you want the characters ABC to appear as the first three characters of each serial number.

(10) The EDIT message indicates that the SAVE request has completed.

(11) Issue the LINEMODE subcommand to restore line-number editing. Use the TYPE subcommand to verify the position of the current line pointer.

(12) If you want to see the serial numbers in columns 72 through 80, issue the VERIFY subcommand, specifying *, or the record length. Normally, the editor does not display the columns containing serial numbers while you are editing.

(13) You can use the nnnnn subcommand to insert individual lines of text. This subcommand inserts a line that you want numbered 135, and places it in its proper position in the file. Note that although, in this example, the current line pointer is positioned at line 130, it does not need to be at the proper place in the file. When the subcommand is complete, however, the current line pointer is positioned following the line just inserted.

(14) Position the line pointer at the line numbered 50, and again begin entering the input lines indicated.

(15) Enter a null line to return to edit mode, move the current line pointer to the top of the file, and display the first line.

(16) The RESTORE subcommand restores the default settings of the editor, and the the verification columns are restored to 1 and 72, so that line numbers are not displayed in columns 72 through 80.

```
⓱ type *
* SAMPLE OF LINEMODE RIGHT
TEST     CSECT
         BALR  12,0
         USING *,12
         ST    14,SAV14
         TM    FLAG,RUNON
         BCR   1,14
         WRTERM                'TESTING...'
         L     14,SAV14
         BR    14
SAV14    DS    F
WKAREA   DS    3D
FLAG     DS    X
RUNON    EQU   X'80'
RUNOFF   EQU   X'40'
RUNMIX   EQU   X'20'
         END
EOF:
file
⓲ RESERIALIZATION SUPPRESSED
R;
⓳ type test assemble

* SAMPLE OF LINEMODE RIGHT                                        ABC00010
TEST     START X'20000'                                          ABC00020
         BALR  12,0                                              ABC00030
         USING *,12                                              ABC00040
         ST    14,SAV14                                          ABC00050
         TM    FLAG,RUNON                                          00053
         BCR   1,14                                                00055
         TYPE  'TESTING...'                                      ABC00060
         L     14,SAV14                                          ABC00070
         BR    14                                                ABC00080
SAV14    DS    F                                                 ABC00090
WKAREA   DS    3D                                                ABC00100
FLAG     DS    X                                                 ABC00110
RUNON    EQU   X'80'                                             ABC00120
RUNOFF   EQU   X'40'                                             ABC00130
RUNMIX   EQU   X'20'                                               00135
         END                                                     ABC00140
```

⓱ Use the TYPE subcommand to display the file.

⓲ When you issue the FILE subcommand to write the file onto disk, the editor issues the message RESERIALIZATION SUPPRESSED to indicate that it is not going to update the line numbers, so that the current line numbers match the line numbers as they existed when the SAVE subcommand was issued.

⓳ If you want to see how the file exists on disk, use the CMS TYPE command to display the file. Note that the lines inserted after the SAVE subcommand do not have the initial ABC characters, and that they retain the line numbers they had when they were inserted.

Sample Terminal Session for OS Programmers

The following terminal session shows how you might create an assembler language program in CMS, assemble it, correct assembler errors, and execute it. All the lines that appear in lowercase are lines that you should enter at the terminal. Uppercase data represents the system response that you should receive when you enter the command.

The input data lines in the example are aligned in the proper columns for the assembler; if you are using a typewriter terminal, you should set your terminal's tab stops at columns 10, 16, 31, 36, 41, and 46, and use the Tab key when you want to enter text in these columns. If you are using a display terminal, when you use a PF key defined as a tab, or some input character, the line image is expanded as it is placed in the screen output area.

There are some errors in the terminal session, so that you can see how to correct errors in CMS.

```
(1) edit ostest assemble
    NEW FILE:
    EDIT:
    input
    INPUT:
    dataproc csect
             print nogen
             space
    r0       equ   0
    r1       equ   1
    r2       equ   2
    r10      equ   10
    r12      equ   12
    r13      equ   13
    r14      equ   14
    r15      equ   15
             space
             stm   r14,r12,12(r13)  save caller's regs
             balr  r12,0            establish
             using *,r12               addressability
             st    r13,savearea+4   store addr of caller's savearea
             la    r15,savearea     get the address of my savearea
             st    r15,8(r13)       store addr in caller's savearea
             lr    r13,r15          save addr of my savearea
             space
    *open files and check that they opened okay
             space
             la    r3,0             initially set return code
             open  (indata,outdata,(output))     open files
             using ihadcb,r10       get dsect to check files
             la    r10,indata       prepare to check output file
             tm    dcboflgs,x'10'   everything ok?
             bnz   checkout         ...continue
             la    r3,100           set return code
             b     exit             ...exit
    checkout la    r10,outdata      check output file
             tm    dcboflgs,x'10'   is it okay?
             bnz   process          ...
             la    r3,200           set return code
             b     exit
```

---

(1) The EDIT command is issued to create a file named OSTEST ASSEMBLE. Since the file does not exist, the editor indicates that it is a new file and you can use the INPUT subcommand to enter input mode and begin entering the input lines.

```
         space
process  equ   *
         get   indata          read a record from input file
         lr    r2,r1           save address of record
         put   outdata,(2)     move it to output
         b     process         continue until end-of-file
         space
exit     equu  *
         close (indata,,outdata)   close files
         l     r13,savearea+4 addr of caller's save area
         lr    r15,r3          load return code
         l     r14,12(r13)     get return address
         lm    r0,r12,20(r13) restore regs
         br    r14             bye...
         space
savearea dc    18f'0'
indata   dcb   ddname=indd,macrf=gl,dsorg=ps,recfm=f,lrecl=80,
```
❷
```
EDIT:
$mark
```
❸
```
save#input
EDIT:
INPUT:
               eodad=exit
outdata  dcb   ddname=outdd,macrf=pm,dsorg=ps
         dcbd
         space
         end
```
❹
```
EDIT:
file
R;
```
❺
```
global maclib osmacro
R;
```
❻
```
assemble ostest
*
*
*
*
*
*
*
```

---

❷ Since the DCB macro statement takes up more than one line, you have to enter a continuation character in column 72. To do this, you can enter a null line to return to edit mode and execute the $MARK edit macro, which places an asterisk in column 72. If the $MARK edit macro is not on your system, you will have to enter a continuation character some other way. (See "Entering a Continuation Character in Column 72" in "Section 5. The CMS Editor.")

❸ Before continuing to enter input lines, the EDIT subcommand SAVE is issued to write what has already been written onto disk. The CP logical line end symbol (#) separates the SAVE and INPUT subcommands.

❹ A null line returns you to edit mode. You may wish, at this point, to proofread your input file before issuing the FILE subcommand to write the ASSEMBLE file onto disk.

❺ Since this assembler program uses OS macros, you must issue the GLOBAL command to identify the CMS macro library, OSMACRO MACLIB, before you can invoke the assembler.

❻ The ASSEMBLE command invokes the VM/370 assembler to assemble the source file; the asterisks (*) indicate the CMS blip character, which you may or may not have made active for your virtual machine.

```
❼ ASSEMBLER DONE
OST00230       23          LA     R3,0           INITIALLY SET RETURN CODE
IFO188 R3 IS AN UNDEFINED SYMBOL
OST00240       24          OPEN   (INDATA,OUTDATA,(OUTPUT))    OPEN FILES
 4000000       27+   12,***  IHB002  INVALID OPTION OPERAND SPECIFIED-OUTDATA
IFO197 *** MNOTE ***
OST00290       32          LA     R3,100         SET RETURN CODE
IFO188 R3 IS AN UNDEFINED SYMBOL
OST00340       37          LA     R3,200         SET RETURN CODE
IFO188 R3 IS AN UNDEFINED SYMBOL
OST00460       63          LR     R15,R3         LOAD RETURN CODE
IFO188 R3 IS AN UNDEFINED SYMBOL
NUMBER OF STATEMENTS FLAGGED IN THIS ASSEMBLY =     5
R(00012);
❽ edit ostest assemble
locate /r2
R2       EQU   2
i r3       equ   3
/open
           OPEN   (INDATA,OUTDATA,(OUTPUT))    OPEN FILES
c /,/,,/
           OPEN   (INDATA,,OUTDATA,(OUTPUT))    OPEN FILES
❾ file
R;
assemble ostest
*
*
*
*
*
*

❿ ASSEMBLER DONE
NO STATEMENTS FLAGGED IN THIS ASSEMBLY
R;
⓫ filedef indd disk test data a
R;
⓬ filedef outdd punch
R;
⓭ #cp spool punch to *
```

---

❼ The assembler displays errors encountered during assembly. Depending on how accurately you copied the program in this sample session, you may or may not receive some of these messages; you may also have received additional messages.

❽ You must edit the file OSTEST ASSEMBLE and correct any errors in it. The errors placed in the example included a missing comma on the OPEN macro, and the omission of an EQU statement for a general register. These changes are made as shown. The CMS Editor accepts a diagonal (/) as a LOCATE subcommand.

❾ After all the changes have been made to the ASSEMBLE file, you can issue the FILE subcommand to replace the existing copy on disk, and then reassemble it.

❿ This time, the assembler completes without encountering any errors. If your ASSEMBLE file still has errors, you should use the editor to correct them.

⓫ The FILEDEF command is used to define the input and output files used in this program. The ddnames INDD and OUTDD, defined in the DCBs in the program, must have a file definition in CMS. To execute this program, you should have a file on your A-disk name TEST DATA, which must have fixed-length, 80-character records. If you have no such file, you can make a copy of your ASSEMBLE file as follows:

```
copyfile ostest assemble a test data a
```

⓬ The output file is defined as a punch file, so that it will be written to your virtual card punch.

⓭ The CP SPOOL command is issued, using the #CP function, to spool your virtual punch to your virtual card reader. When you use the #CP function, you do not receive a Ready message.

```
(14) load ostest
     R;
     start
     DMSLIO740I EXECUTION BEGINS...
(15) DMSSOP036E OPEN ERROR CODE '04' ON 'OUTDD '.
     R(00200);
(16) filedef
     INDD     DISK     TEST     DATA     A1
     OUTDD    PUNCH
     R;
(17) filedef outdd punch (lrecl 80 recfm f
     R;
(18) #cp query reader all
     NO RDR FILES
(19) load ostest (start
     DMSLIO740I EXECUTION BEGINS...
(20) PUN FILE 6198  TO  BILBO    COPY 01 NOHOLD
     R;
(21) fi indd reader
     R;
     fi outdd disk new osfile a4 (recfm fb block 1600 lrecl 80
     R;
(22) listfile new osfile a4 (label
     DMSLST002E FILE NOT FOUND.
     R(00028);
(23) run ostest
     EXECUTION BEGINS...
     *
     R;
(24) listfile new osfile a4 (label
     FILENAME FILETYPE  FM  FORMAT    RECS BLOCKS   DATE   TIME   LABEL
     NEW      OSFILE    A4  F  1600     5    10   9/30/75  8:26  PAT198
     R;
```

---

(14) The LOAD command loads the TEXT file produced by the assembly into virtual storage. The START command begins program execution.

(15) An open error is encountered during program execution. The CMS Ready message indicates a return code of 200, which is the value placed in it by your program.

(16) The FILEDEF command, with no operands, results in a display of the current file definitions in effect.

(17) Error code 4 on an open request means that no RECFM or LRECL information is available. An examination of the program listing would reveal that the DCB for OUTDD does not contain any information about the file format; you must supply it on the FILEDEF command. Re-enter the FILEDEF command.

(18) You can use the CP QUERY command to determine whether there are any files in your card reader. It should be empty; if not, determine whether they might be files you need, and if so, read them into your virtual machine; otherwise, purge them.

(19) Use the LOAD command to execute the program again; this time, use the START option of the LOAD command to begin the program execution.

(20) The PUN FILE message indicates that a file has been transferred to your virtual card reader. The Ready message indicates that your program executed successfully.

(21) For the next execution of this program, you are going to read the file back out of your card reader and create a new CMS disk file, in OS simulated data set format. FI is an acceptable system truncation for the command name, FILEDEF.

(22) The LISTFILE command is issued to check that the file NEW OSFILE does not exist.

(23) The RUN command (which is an EXEC procedure) is used instead of the LOAD and START commands, to load and execute the program. The Ready message indicates that the program completed execution.

(24) The LISTFILE command is issued again, and the file NEW OSFILE is listed. (If you issue another CP QUERY READER command, you will also see that the file is no longer in your card reader.)

Sample Terminal Session For DOS Programmers

The following terminal session shows how you might create an assembler language program in CMS, assemble it, correct assembler errors, and execute it. All the lines that appear in lowercase are lines that you should enter at the terminal. Uppercase data represents the system response that you should receive when you enter the command.

The input data lines in the example are aligned in the proper columns for the assembler; if you are using a typewriter terminal, you should set your terminal's tab stops at columns 10, 16, 31, 36, 41, and 46 and use the Tab key when you want to enter text in these columns. If you are using a display terminal, when you use a PF key or an input character defined as a tab, the line image is expanded as it is placed in the screen output area.

Note: The assembler, in CMS, cannot read macros from DOS/VS libraries. This sample terminal session shows how to copy macros from DOS/VS libraries and create CMS MACLIB files. Ordinarily, the macros you need should already be available in a system MACLIB file. You do not have to create a MACLIB each time you want to assemble a program.

There are some errors in the terminal session, so that you can see how to correct errors in CMS.

```
(1) cp link dosres 130 130 rr linkdos
    DASD 130 LINKED R/O
    R;
    access 130 z
    Z (130) R/O - DOS
    R;
(2) set dos on z
    R;
(3) edit dostest assemble
    NEW FILE:
    EDIT:
    input
    INPUT:
    begpgm   csect
             balr  12,0
             using *,12
             la    13,savearea
             open  infile,outfile
    loop     get   infile
             put   outfile
             b     loop
    eodad    equ   *
             close infile,outfile
             eoj
             eject
    buffer   dc    CL80' '
    infile   dtfdi modname=shrmod,ioarea1=buffer,devaddr=sysipt,
```

---

(1) Use the CP LINK command to link to the DOS system residence volume and the ACCESS command to access it. In this example, the system residence is at virtual address 130 and is accessed as the Z-disk.

(2) Enter the CMS/DOS environment, specifying the mode letter at which the DOS/VS system residence is accessed.

(3) Use the EDIT command to create a file named DOSTEST ASSEMBLE. Since the file does not exist, the editor indicates that it is a new file and you can use the INPUT subcommand to enter input mode and begin entering the input lines.

```
EDIT:
$mark
save#input
EDIT:
INPUT:
                eofaddr=eodad,recsize=80
outfile  dtfdi modname=shrmod,ioarea1=buffer,devaddr=syspch,

EDIT:
$mark
save#input
EDIT:
INPUT:
                 recsize=81
shrmod   dimod typefle=output
endpgm   equ   *
         end

EDIT:
file
R;
edit getmacs eserv
NEW FILE:
EDIT:
tabs 2 72
input
INPUT:
punch open,close,get,put,dimod,dtfdi

EDIT:
file
R;
assgn sysipt a
R;
eserv getmacs
R;
```

---

4 Since the DTFDI macro statement takes up more than one line, you have to enter a continuation character in column 72. To do this, you can enter a null line to return to edit mode and execute the $MARK edit macro, which places an asterisk in column 72. If the $MARK edit macro is not on your system, you will have to enter a continuation character some other way. (See "Entering a Continuation Character in Column 72" in "Section 5. The CMS Editor.")

5 Before continuing to enter input lines, the EDIT subcommand SAVE is issued to write what has already been written onto disk. The CP logical line end symbol (#) separates the SAVE and INPUT subcommands.

6 Another continuation character is needed.

7 A null line returns you to edit mode. You may want, at this point, to proofread your input file before issuing the FILE subcommand to write the ASSEMBLE file on disk.

8 To obtain the macros you need to assemble this file, use the editor to create an ESERV file. By setting the logical tabs at columns 2 and 72, you can protect yourself from entering data in column 1.

9 PUNCH is an ESERV program control statement that copies and de-edits macros from source statement libraries; in this case, the system source statement library. The output is directed to the SYSPCH device, which the CMS/DOS ESERV EXEC assigns by default to your A-disk.

10 You must assign the logical unit SYSIPT before you invoke the ESERV command. GETMACS is the filename of the ESERV file containing the ESERV control statements.

```
⓫ listfile getmacs *
  GETMACS  ESERV     A1
  GETMACS  MACRO      A1
  GETMACS  LISTING   A1
  R;
⓬ maclib gen dosmac getmacs
  R;
  erase getmacs *
  R;
⓭ global maclib dosmac
  R;
⓮ assemble dostest
  *
  *

⓯ ASSEMBLER DONE
  DOS00040        4          LA    13,SAVEAREA
  IFO188 SAVEAREA IS AN UNDEFINED SYMBOL
  DOS00110       35          EOJ
  IFO078 UNDEFINED OP CODE
  NUMBER OF STATEMENTS FLAGGED IN THIS ASSEMBLY =     2
  R(00008);
⓰ edit dotest assemble
  EDIT:
  locate /buffer/
  BUFFER    DC    CL80' '
  input savearea  ds    9d
  file
  R;
⓱ edit eoj eserv
  NEW FILE:
  EDIT:
  i   punch eoj
  file
  R;
⓲ listio sysipt
   SYSIPT  DISK      A
  R;
  eserv eoj
  R;
```

⓫ After the ESERV EXEC completes execution, you have three files. You may want to examine the LISTING file to check the ESERV program listing. The MACRO file contains the punch (SYSPCH) output.

⓬ The MACLIB command creates a macro library named DOSMAC MACLIB. Since the MACLIB command completed successfully, you can erase the files GETMACS ESERV, GETMACS LISTING, and GETMACS MACRO; an asterisk in the filetype field of the ERASE command indicates that all files with the filename of GETMACS should be erased.

⓭ Before you can invoke the assembler, you have to identify the macro library that contains the macros; use the GLOBAL command, specifying DOSMAC MACLIB.

⓮ The ASSEMBLE command invokes the VM/370 assembler to assemble the source file; the asterisks (*) indicate the CMS blip character, which you may or may not have made active for your virtual machine.

⓯ The assembler displays errors encountered during assembly. Depending on how accurately you copied the program in this sample session, you may or may not receive some of these messages; you may also have received additional messages.

⓰ To correct the first error, which was the omission of a DS statement for SAVEAREA, edit the file DOSTEST ASSEMELE and insert the missing line.

⓱ The second error indicates that the macro EOJ is not available, since it was not copied from the source statement library. Create another ESERV file to punch this macro.

⓲ Use the LISTIO command to check that SYSIPT is still assigned to your A-disk, so that you do not have to issue the ASSGN command again. Then issue the ESERV command again, this time specifying the filename EOJ.

```
(19) maclib add dosmac eoj
     R;
     maclib map dosmac (term
     MACRO    INDEX  SIZE
     OPEN         2    43
     CLOSE       46    43
     GET         90    56
     PUT        147    93
     DIMOD      241   647
     DTFDI      889   284
     EOJ       1174     6
     R;
(20) erase eoj *
     R;
     assemble dostest
     *
     *
     *

(21) ASSEMBLER DONE
     NO STATEMENTS FLAGGED IN THIS ASSEMBLY
     R;
(22) listfile dostest *
     DOSTEST  ASSEMBLE  A1
     DOSTEST  LISTING   A1
     DOSTEST  TEXT      A1
     R;
     print dostest listing
     R;
(23) doslked dostest
     R;
(24) listfile dostest *
     DOSTEST  ASSEMBLE  A1
     DOSTEST  DOSLIB    A1
     DOSTEST  TEXT      A1
     DOSTEST  LISTING   A1
     DOSTEST  MAP       A5
     R;
```

---

(19) Use the ADD function of the MACLIB command to add the macro EOJ to DOSMAC MACLIB. Then, issue the MACLIB command again, using the MAP function and the TERM option to display a list of the macros in the library.

(20) Erase the EOJ files. You should always remember to erase files that you do not need any longer. Reassemble the program.

(21) This time, the assembler completes without encountering any errors. If your ASSEMBLE file still has errors, you should use the editor to correct them.

(22) Use the LISTFILE command to check for DOSTEST files. The assembler created the files, DOSTEST LISTING and DOSTEST TEXT. The TEXT file contains the object module. You can print the program listing, if you want a printed copy. Then, you may want to erase it.

(23) Use the DOSLKED command to link-edit the TEXT file into an executable phase and write it into a DOSLIB. Since this program has no external references, you do not need to add any linkage editor control statements.

(24) Now, you have a DOSTEST DOSLIB, containing the link-edited phase, and a MAP file, containing the linkage editor map. You can display the linkage editor map with the TYPE command, or use the PRINT command if you want a printed copy.

```
(25) #cp spool punch to *
     punch test data a
     PUN FILE 0100  TO BILBO     COPY 01 NOHOLD
     R;
     #cp query reader all
     ORIGINID FILE CLASS RECDS  CPY HOLD DATE  TIME     NAME        TYPE     DIST
     PATTI    5840 A PUN 000097 01  NONE 09/29 15:00:39 TEST        DATA     BIN211
(26) assgn sysipt reader
     R;
     assgn syspch a
     R;
(27) dlbl outfile a cms punch output (syspch
     R;
     state punch output a
     DMSSTT002E FILE NOT FOUND.
     R(00028);
(28) global doslib dostest
     R;
     fetch dostest
     DMSFET710I PHASE 'DOSTEST' ENTRY POINT AT LOCATION 020000.
     R;
(29) start
     DMSLIO740I EXECUTION BEGINS...
     R;
     listfile punch output a (label
     FILENAME FILETYPE  FM  FORMAT    RECS BLOCKS   DATE   TIME   LABEL
     PUNCH    OUTPUT    A1  F    80    97    10   9/29/75 14:50  BBB191
     R;
     #cp query reader all
     NO RDR FILES
```

---

(25) To execute this program in CMS/DOS, punch a file that has fixed-length 80-character records into your virtual card punch. If you do not have any files that have fixed-length, 80-character records, you can create a file named TEST DATA with the CMS Editor, or by copying your ASSEMBLE source file with the COPYFILE command, as follows:

```
copyfile dostest assemble a test data a
```

Use the CP SPOOL command to spool the punch to your own virtual machine, then use the PUNCH command to punch the file. The PUN FILE message indicates that the file is in your card reader. Use the CP QUERY command to check that it is the first, or only file in your reader.

(26) Use the ASSGN command to assign SYSIPT to your card reader and SYSPCH to your A-disk.

(27) When you assign a logical unit to a disk mode, you must issue the DLBL command to identify the disk file to CMS. For this program execution, you are creating a CMS file named PUNCH OUTPUT. The STATE command ensures that the file does not already exist. If it does exist, rename it, or else use another filename or filetype on the DLBL command.

(28) Use the GLOBAL command to identify the DOSLIB, DOSTEST, you want to search for executable phases, then issue the FETCH command specifying the phase name. The FETCH command loads the executable phase into storage. When the FETCH command is executed without the START option, a message is displayed indicating the entry point location of the program loaded.

(29) The START command begins program execution. The CMS Ready message indicates that your program completed successfully. You can check the input and output activity by using the LISTFILE command to list the file PUNCH OUTPUT. If you use the CP QUERY command, you can see that the file is no longer in your virtual card reader.

```
(30) assgn sysipt a
     R;
     dlbl infile a cms punch output (sysipt
     R;
     assgn syspch punch
     R;
(31) fetch dostest (start
     DMSLIO740I EXECUTION BEGINS...
(32) PUN FILE 5829  TO  BILBO    COPY 01 NOHOLD
     R;
     read punch2 output
     R;
     listfile punch2 output a (label
     FILENAME FILETYPE  FM  FORMAT    RECS BLOCKS   DATE   TIME   LABEL
     PUNCH2   OUTPUT    A1  F    80    97    10   9/29/75 14:50  BBB191
     R;
```

---

(30) If you want to execute this program again, you can assign SYSIPT and SYSPCH to different devices; in this example, the input disk file PUNCH OUTPUT is written to the virtual punch. You do not need to reissue the GLOBAL DOSLIB command; it remains in effect until you reissue it or IPL CMS again.

(31) This time, the program execution starts immediately, because the START option is specified on the FETCH command line.

(32) Again, the PUN FILE message indicates that a file has been received in your virtual card reader. You can use the CMS command READCARD to read it onto disk and assign it a filename and filetype, in this example, PUNCH2 OUTPUT.

Sample Terminal Session Using Access Method Services

This sample terminal session shows you how to use Access Method Services under CMS. You should have an understanding of VSAM and Access Method Services before you use this terminal session.

The terminal session uses a number of CMS files, which you may create during the course of the terminal session; or, you may prefer to create all of the files that you need before-hand. Within the sample terminal session, the file that you should create is displayed prior to the commands that use it.

This terminal session is for both CMS OS VSAM programmers and CMS/DOS VSAM programmers; all the ASSGN commands and SYSxxx operands that apply when the CMS/DOS environment is active are shaded. If you have issued the command SET DOS ON, you must enter the shaded entries; if not, you must omit the shaded entries.

Notes:

1. This terminal session assumes that you have, to begin with, a read/write CMS A-disk. This is the only disk required. Additional disks used in this exercise are temporary disks, formatted with the IBCDASDI disk initialization program under CMS. If you have OS or DOS disks available, you should use them, and remember to supply the proper volume and virtual device address information, where appropriate. The number of cylinders available to users for temporary disk space varies among installations; if you cannot acquire ample disk space, see your system support personnel for assistance.

2. Output listings created by AMSERV take up disk space, so if your A-disk does not have a lot of space on it, you may want to erase the LISTING files created after each AMSERV step.

3. If any of the AMSERV commands that you execute during this sample terminal session issue a nonzero return code, for example,

   ```
   R(00012);
   ```

   you should edit the LISTING file to examine the Access Method Services error messages. The publication DOS/VS Messages contains the return codes and reason codes issued by Access Method Services. You should determine the cause of the error, examine the DLBL commands and AMSERV files you used, correct any errors, and retry the command.

```
#cp define t3330 200 10
DASD 200 DEFINED 010 CYL
#cp define t3330 300 10
DASD 300 DEFINED 010 CYL
#cp define t3330 400 10
DASD 400 DEFINED 010 CYL
```

(1) These commands define temporary 3330 mindisks at virtual addresses 200, 300, and 400.

❷ File: PUNCH IBCDASDI

```
222222  JOB
        MSG TODEV=1052,TOADDR=009
        DADEF TODEV=3330,TOADDR=200,VOLID=SCRATCH,CYLNO=10
        VLD NEWVOLID=222222
        VTOCD STRTADR=10,EXTENT=5
        END
333333  JOB
        MSG TODEV=1052,TOADDR=009
        DADEF TODEV=3330,TOADDR=300,VOLID=SCRATCH,CYLNO=10
        VLD NEWVOLID=333333
        VTOCD STRTADR=10,EXTENT=5
        END
444444  JOB
        MSG TODEV=1052,TOADDR=009
        DADEF TODEV=3330,TOADDR=400,VOLID=SCRATCH,CYLNO=10
        VLD NEWVOLID=444444
        VTOCD STRTADR=10,EXTENT=5
        END
```

❸ File: IBCDASDI EXEC

```
CP CLOSE C
CP PURGE RDR ALL
0003 FILES PURGED
ACC 190 Z/Z IPL *
DMSACC724I '190' REPLACES ' Z (350) '- DOS
DMSACC723I Z (190) R/O
DMSACC725I 190 ALSO = S-DISK
CP SPOOL D CONT *
PUNCH IPL IBCDASDI Z ( NOH
PUNCH 222222 IBCDASDI * ( NOH
CP SPOOL PUNCH NOCONT
CP CLOSE PUNCH
PUN FILE 2753  TO  PATTI    COPY 01 NOHOLD
CP IPL 00C
```

❹ ibcdasdi
IBC105A DEFINE INPUT DEVICE. DASDI 7.77
❺ input=2540,00c

---

❷ This file contains control statements for the IBCDASDI program, which formats and initializes disks for OS and DOS. These disks are labelled 222222, 333333, and 444444. Any messages produced by the IBCDASDI program are sent to your terminal.

❸ This file contains the commands necessary to use the IBCDASDI program under CMS. You must punch a copy of the IBCDASDI program, followed by the file containing your control statements, to your virtual card reader, and then load the IBCDASDI program. This is all done in the file IBCDASDI EXEC.

❹ Execute the IBCDASDI EXEC. The last command in the EXEC is the IPL command, which passes control to the IBCDASDI program, which prompts you to enter the address of the control statements.

❺ Since the control statements are in your card punch, you indicate the device type (2540) and the address (00C) on the INPUT= statement.

```
                    DASDI  7.77
222222  JOB
        MSG TODEV=1052,TOADDR=009
        DADEF TODEV=3330,TOADDR=200,VOLID=SCRATCH,CYLNO=10
        VLD NEWVOLID=222222
        VTOCD STRTADR=10,EXTENT=5
        END
IBC163A  END OF JOB.
                    DASDI  7.77
333333  JOB
        MSG TODEV=1052,TOADDR=009
        DADEF TODEV=3330,TOADDR=300,VOLID=SCRATCH,CYLNO=10
        VLD NEWVOLID=333333
        VTOCD STRTADR=10,EXTENT=5
        END
IBC163A  END OF JOB.
                    DASDI  7.77
444444  JOB
        MSG TODEV=1052,TOADDR=009
        DADEF TODEV=3330,TOADDR=400,VOLID=SCRATCH,CYLNO=10
        VLD NEWVOLID=444444
        VTOCD STRTADR=10,EXTENT=5
        END
IBC163A  END OF JOB.
DMKDSP450W CP ENTERED; DISABLED WAIT PSW '00060000 0000EEEE'
ipl cms
CMS...VERSION 3.0 02/28/76

R;
cp link dosres 350 350 rr read
DASD 350 LINKED R/O; R/W BY GANDALF
access 350 z
DMSACC723I Z (350) R/O - DOS
set dos on z ( vsam
R;
access 200 b
DMSACC723I B (200) R/W - OS
R;
access 300 c
DMSACC723I C (300) R/W - OS
R;
access 400 d
DMSACC723I D (400) R/W - OS
R;
query search
BBB191  191  A    R/W
222222  200  B    R/W - OS
333333  300  C    R/W - OS
444444  400  D    R/W - OS
CMS190  190  S    R/O
DOSRES  350  Z    R/O - DOS
R;
```

---

6 These messages are issued by the IBCDASDI program, which displays the statements executed and indicates the end of each job.

7 When the last IBCDASDI job is complete, your virtual machine is in the CP environment and you must reload the CMS system before you can continue.

8 If you are a CMS/DOS user, you must reaccess the DOS/VS system residence volume and issue the SET DOS ON command line, specifying the VSAM option. If you have not previously linked to the system residence, you must use the CP LINK command before you issue the ACCESS command.

9 Access the three newly formatted disks as your B-, C-, and D-disks.

10 You can issue the QUERY SEARCH command to verify the status of all disks you currently have accessed.

```
(11) File: MASTCAT AMSERV

     DEFINE MASTERCATALOG -
       (  NAME  (MASTCAT)  -
          VOLUME (222222) -
          CYL (4) -
          UPDATEPW (GAZELLE) -
          FILE (IJSYSCT) )
(12) assgn syscat b
     R;
     dlbl ijsysct b dsn mastcat (syscat perm extent
     DMSDLB331R ENTER EXTENT SPECIFICATIONS:
     19 171
(13)
     R;
(14) amserv mastcat
     R;



(15) File: CLUSTER AMSERV

     DEFINE CLUSTER ( NAME (BOOK.LIST  ) -
        VOLUMES (222222) -
        TRACKS (20) -
        FILE (BOOK) -
        KEYS (14,0) -
        RECORDSIZE (120,132) ) -
        DATA (NAME (BOOK.LIST.DATA) ) -
        INDEX (NAME (BOOK.LIST.INDEX ) )

(16) amserv cluster
     4221A ATTEMPT 1 OF 2. ENTER PASSWORD FOR JOB AMSERV   FILE MASTCAT
     gazelle
     R;

(17) File: REPRO AMSERV

      REPRO INFILE (BFILE -
            ENV ( RECORDFORMAT(F) -
            BLOCKSIZE(120) -
            PDEV (3330) ) ) -
            OUTFILE (BOOK)
```

---

(11) The file MASTCAT AMSERV defines the VSAM master catalog that you are going to use.

(12) Identify the master catalog volume, and use the EXTENT option on the DLBL command so that you can enter the extents. For this extent, specify 171 tracks (9 cylinders) for the master catalog. Since 4 cylinders are specified in the AMSERV file, the remaining 5 cylinders will be used for suballocation by VSAM.

(13) You must enter a null line to indicate that you have finished entering extent information.

(14) Issue the AMSERV command, specifying the MASTCAT file. The Ready message indicates that the master catalog is created.

(15) Define a suballccated cluster. This cluster is for a key-sequenced data set, named BOOK.LIST.

(16) No DLBL command is necessary when you define a suballocated cluster. Note that since the password was not provided in the AMSERV file, Access Method Services prompts you to enter the password of the catalog, which is defined as GAZELLE.

(17) Use the Access Method Services REPRO command to copy a CMS data file into the cluster that you just defined.

```
(18) assgn sys001 a
     R;
     copyfile test data a (recfm f lrecl 120
     R;
     sort test data a book file a
     DMSSRT604R ENTER SORT FIELDS:
     1 14
     R;
     dlbl bfile a cms book file (sys001
     R;
(19) assgn sys002 b
     R;
     dlbl book b dsn book list (vsam sys002
     R;
     amserv repro
     R;

(20) File: SPACE AMSERV

       DEFINE SPACE -
            ( FILE (SPACE) -
            TRACKS (57) -
            VOLUME (333333) )


     R;
     assgn sys003 c
     R;
(21) dlbl space c (extent sys003
     DMSDLB331R ENTER EXTENT SPECIFICATIONS:
     19 57

     R;
(22) amserv space
     4221A ATTEMPT 1 OF 2. ENTER PASSWORD FOR JOB AMSERV   FILE MASTCAT
     gazelle
     R;
```

---

(18) You must identify the dnames for the input and output files for the REPRO function. BFILE is a CMS file, which must be a fixed-length, 120-character file, and it must be sorted alphamerically in columns 1 through 14. The COPYFILE command can copy any existing file that you have to the proper record format; the SORT command sorts the records on the proper fields.

(19) The output file is the VSAM cluster, so you must use the VSAM option on this DLBL command.

(20) Create an AMSERV file to define additional space for the master catalog on the volume labelled 333333.

(21) Again, use the EXTENT option on the DLBL command so that you can enter extent information, and a null line to indicate that you have finished entering extents.

(22) Issue the AMSERV command. Again, you are prompted to enter the password of the master catalog.

(23) File: UNIQUE AMSERV

```
 DEFINE  CLUSTER -
   ( NAME (UNIQUE.FILE) -
     UNIQUE ) -
   DATA  -
   ( CYL (3) -
     FILE (KDATA) -
     RECORDSIZE (100 132) -
     KEYS(12,0) -
     VOLUMES (333333 ) ) -
   INDEX -
   ( CYL  (1) -
     FILE (KINDEX) -
     VOLUMES (333333) )
```

(24)
```
dlbl kdata c (extent sys003
DMSDLB331R ENTER EXTENT SPECIFICATIONS:
76 57

R;
dlbl kindex c (extent sys003
DMSDLB331R ENTER EXTENT SPECIFICATIONS:
133 19

R;
amserv unique
4221A ATTEMPT 1 OF 2. ENTER PASSWORD FOR JOB AMSERV   FILE MASTCAT
gazelle
R;
```

(25) File: USERCAT AMSERV

```
 DEFINE USERCATALOG -
      ( CYL (4) -
        FILE (IJSYSUC) -
        NAME (PRIVATE.CATALOG) -
        VOLUME (444444) -
        UPDATEPW (UNICORN) -
        ATTEMPTS (2) ) -
       DATA  (CYL (3)  ) -
       INDEX ( CYL (1) ) -
       CATALOG (MASTCAT/GAZELLE )
```

(26)
```
assgn sys004 d
R;
dlbl ijsysuc d dsn private catalog (extent sys004 perm
DMSDLB331R ENTER EXTENT SPECIFICATIONS:
19 152

R;
amserv usercat
*
R;
```

---

(23) This AMSERV file defines a unique cluster, with data and index components.

(24) You must enter DLBL commands and extent information for both the data and index components of the unique cluster.

(25) Next, define a private (user) catalog for the volume 444444. This catalog is named PRIVATE.CATALOG and has a password of UNICORN.

(26) When you define a user catalog that you are going to use as the job catalog for a terminal session, you should use the ddname IJSYSUC.

```
(27) TAPE 181 ATTACHED
(28) File: EXPORT AMSERV

       EXPORT BOOK.LIST  -
          INFILE (BOOK) -
          OUTFILE (TEMP  ENV (PDEV (2400)  ) )


(29) dlbl
     IJSYSCT  DISK     FILE     IJSYSCT  B1  MASTCAT
     BFILE    DISK     BOOK     FILE     A1
     BOOK     DISK     FILE     BOOK     B1  BOOK.LIST
     SPACE    DISK     FILE     SPACE    C1
     KDATA    DISK     FILE     KDATA    C1
     KINDEX   DISK     FILE     KINDEX   C1
     IJSYSUC  DISK     FILE     IJSYSUC  D1  PRIVATE.CATALOG
     R;
(30) dlbl book b dsn book list (cat ijsysct SYS002
     R;
(31) amserv texport (tapout 181
     DMSAMS361R ENTER TAPE OUTPUT DDNAMES:
     temp
     R;


(32) File: IMPORT AMSERV

      IMPORT  -
              CATALOG (PRIVATE.CATALOG/UNICORN) -
              INFILE (TEMP ENV (PDEV (2400))) -
              OUTFILE (BOOK2)


(33) tape rew
     R;
     dlbl book2 d dsn book list (vsam SYS004
     R;
     amserv timport (tapin 181
     DMSAMS361R ENTER TAPE INPUT DDNAMES:
     temp
     R;
```

---

(27) You may want to try an EXPORT/IMPORT function, if you can obtain a scratch tape from the operator. When the tape is attached to your virtual machine, you receive this message.

(28) The file that is being exported is the cluster BOOK.LIST created above. If you do not have access to a tape, you can export the file to your CMS A-disk. Remember to change the PDEV parameter to reflect the appropriate device type.

(29) Before issuing the AMSERV command to perform the export function, you may want to check the DLBL definitions in effect. Issue the DLBL command with no operands to obtain a list of current DLBL definitions.

(30) You must reissue the DLBL for BOOK.LIST, because there is a job catalog in effect, and the file is cataloged in the master catalog. Use the CAT option to override the job catalog.

(31) There is no default tape value when you are using tapes with the AMSERV command. You must specify the TAPIN or TAPOUT option and indicate the virtual address of the tape. You are prompted to enter the ddname, which for this file is TEMP.

(32) The last AMSERV file imports the cluster BOOK.LIST to the user catalog, PRIVATE.CATALOG.

(33) You should rewind the tape before reading it as input.

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