

**Systems**

**OS/VS-VM/370 Assembler  
Programmer's Guide**



#### **Fifth Edition (September 1982)**

This is a reprint of GC33-4021-3 incorporating changes released in the following technical newsletters: GN33-8205 (dated 15 February, 1976), GN33-8236 (dated 31 October, 1978), and GN20-9373 (dated 28 December, 1981).

This edition applies to Release 5 of IBM OS/VS1, Release 3 of IBM OS/VS2, and Release 3 of IBM VM/370, and to any subsequent releases of these systems until otherwise indicated in new editions or technical newsletters.

Changes are periodically made to the information herein; before using this publication in connection with the operation of IBM systems, consult the latest IBM System/370 and 4300 Processors Bibliography, GC20-0001, for the editions that are applicable and current.

References in this publication to IBM products, programs, or services do not imply that IBM intends to make these available in all countries in which IBM operates. Any reference to an IBM program product in this publication is not intended to state or imply that only IBM's program product may be used. Any functionally equivalent program may be used instead.

Publications are not stocked at the address given below; requests for IBM publications should be made to your IBM representative or to the IBM branch office serving your locality.

Comments may be addressed to IBM Corporation, P.O. Box 50020, Programming Publishing, San Jose, California, U.S.A. 95150. IBM may use or distribute whatever information you supply in any way it believes appropriate without incurring any obligation to you.

© Copyright International Business Machines Corporation 1972, 1973, 1974, 1975

# Read This First

## This Manual and Who It Is For

This manual is for programmers who code in the assembler language. It is intended to help you assemble, link edit, and execute your program; to choose and specify the assembler options you need; and to interpret the listing and the diagnostic messages issued by the assembler. This manual also serves as a guide to information contained in other publications which is of importance to you as an assembler-language programmer. To use this manual you should have a basic understanding of the operating system as described in Introduction to OS, GC28-6534 and VM/370 Introduction, GC20-1800. You should also have a good understanding of the assembler language as described in OS/VS - DOS/VSE - VM/370 Assembler Language, GC33-4010.

## OTHER MANUALS YOU WILL NEED

In addition to OS/VS - DOS/VSE - VM/370 Assembler Language, you should have the following publications available when using this manual:

IBM System/370 Principles of Operation, GA22-7000  
IBM 4300 Processors Principles of Operation for ECPS:VSE Mode, GA22-7070  
VS1 JCL Reference, GC24-5099  
VS2 JCL Reference, GC28-0692  
VS JCL Reference, GC28-0618  
OS/VS Linkage Editor and Loader, GC26-3813  
OS/VS1 Storage Estimates, GC24-5094

## How This Manual Is Organized

This manual has six main sections and seven appendixes:

Introduction describes the purpose of the assembler, its relationship to the operating system, and its input and output. It also describes how the operating system processes your program and reviews the concepts of job, job step, job control language, and cataloged procedures.

Job Control Statements for Assembler Jobs shows you how to invoke the assembler for simple jobs (using cataloged procedures); describes the assembler options and how to specify them; lists the job control statements that make up the four assembler cataloged procedures; and gives examples of how to use the cataloged procedures for more complex jobs.

The Assembler Listing tells you how to interpret the printed listing produced by the assembler.

Programming Considerations serves as a guide to information contained in other programming manuals which you will find useful as an assembler-language programmer. Among the topics discussed are:

- Designing your program
- Specifying the entry point
- Linking with modules written in other languages
- Linking with processing programs

Adding Macro Definitions to a Library tells you how to catalog macro definitions in the system macro library or in a private library.

Assembler Language Programming under CMS (Conversational Monitor System) is for programmers using the CMS operating system. Where OS information differs from CMS information (for example, the SYSTEM listing), a separate version of the information is located in the section for CMS users. Two manuals will provide useful when you are using CMS, VM/370: Command Language Guide for General Users, GC20-1804, and VM/370: Edit Guide, GC20-1805.

Six of the following seven appendixes, apply to both OS/VS and VM/370. Appendix F applies only to OS/VS. The SYSTEM listing for VM/370 is discussed in 'Assembler Language Programming under the CMS'.

Appendix A gives definitions of terms used in this manual.

Appendix B gives the listing of the assembler sample program.

Appendix C shows the detailed format of the object deck.

Appendix D tells you how to invoke the assembler dynamically from a problem program.

Appendix E describes the data sets used by the assembler and the assembler's storage requirements.

Appendix F describes the SYSTEM listing for OS/VS.

Appendix G explains the diagnostic messages issued by the assembler.

# Contents

INTRODUCTION . . . . .	9
Purpose of the Assembler . . . . .	9
Relationship of the Assembler to the Operating System . . . . .	9
Input . . . . .	9
Output . . . . .	9
Compatibility . . . . .	10
How the Operating System Handles Your Program . . . . .	10
Assembler . . . . .	10
Linkage Editor . . . . .	10
Execution of Your Program . . . . .	10
Loader . . . . .	11
Job Control Language and Cataloged Procedures . . . . .	12
Jobs and Job Steps . . . . .	12
Job Control Language . . . . .	13
JOB CONTROL STATEMENTS FOR ASSEMBLER JOBS . . . . .	14
Simple Assembly and Execution . . . . .	14
Assembly . . . . .	14
Assembly and Execution . . . . .	15
Assembler Options . . . . .	16
What Assembler Options Are . . . . .	16
How to Specify Assembler Options . . . . .	17
The Assembler Cataloged Procedures . . . . .	23
Assembly (ASMFC) . . . . .	24
Assembly and Link Editing (ASMFL) . . . . .	26
Assembly, Link Editing, and Execution (ASMFLG) . . . . .	28
Assembly and Loader-Execution (ASMFCG) . . . . .	30
Examples . . . . .	32
THE ASSEMBLER LISTING . . . . .	34
External Symbol Dictionary (ESD) . . . . .	36
The Source and Machine Language Statements . . . . .	38
Source Statement Fields . . . . .	38
Relocation Dictionary (RLD) . . . . .	40
Symbol Cross Reference . . . . .	41
Literal Cross Reference . . . . .	42
Diagnostics and Statistics . . . . .	44
PROGRAMMING CONSIDERATIONS . . . . .	46
Designing Your Program . . . . .	46
Specifying Your Entry Point into Your Program . . . . .	47
Linking with Modules Produced by Other Language Translators . . . . .	47
Linking with IBM-Supplied Processing Programs . . . . .	48
ADDING MACRO DEFINITIONS TO A LIBRARY . . . . .	49
ASSEMBLER LANGUAGE PROGRAMMING UNDER CMS . . . . .	50
Introduction . . . . .	50
Creating an Assembler Language Program: The CMS Editor . . . . .	51
Overriding CMS File Defaults . . . . .	51
Assembling Your Program: The Assemble Command . . . . .	53
ASSEMBLE Command Format . . . . .	53
Using SYSPARM Under CMS . . . . .	57
CMS Management of Your Assembly . . . . .	57
Loading and Executing Your Assembler Program . . . . .	59
CMS Register Usage During Execution of Your Program . . . . .	59
Passing Parameters to Your Assembler Language Program . . . . .	59
Assembler Macros Supported by CMS . . . . .	59
Creating a Module of Your Program . . . . .	60

Programming Aids . . . . .	60
Assembler Data Sets and Storage Requirements . . . . .	60
The CMS SYSTEM Listing . . . . .	61
Diagnostic Messages Written by CMS . . . . .	63
Assemble Command Error Messages . . . . .	63
APPENDIX A: GLOSSARY . . . . .	67
APPENDIX B: ASSEMBLER SAMPLE PROGRAM . . . . .	73
APPENDIX C: OBJECT DECK OUTPUT . . . . .	81
ESD Card Format . . . . .	81
TXT Card Format . . . . .	82
RLD Card Format . . . . .	82
END Card Format . . . . .	83
SYM Card Format . . . . .	83
APPENDIX D: DYNAMIC INVOCATION OF THE ASSEMBLER . . . . .	86
APPENDIX E: ASSEMBLER DATA SETS AND STORAGE REQUIREMENTS . . . . .	88
Assembler Data Sets . . . . .	88
Assembler Virtual Storage Requirements . . . . .	89
APPENDIX F: THE SYSTEM LISTING FOR OS/VS . . . . .	91
APPENDIX G: ASSEMBLER DIAGNOSTIC ERROR MESSAGES . . . . .	94
How to Use this Section . . . . .	94
Recurring Errors . . . . .	96
INDEX . . . . .	159

# Figures

Figure 1.	How the Operating System Handles Your Program . . . . .	11
Figure 2.	Jobs and Job Steps . . . . .	12
Figure 3.	The Cataloged Procedure Concept . . . . .	13
Figure 4.	The Assembler Options (Part 1 of 5) . . . . .	19
Figure 5.	Cataloged Procedure for Assembly (ASMFC) . . . . .	25
Figure 6.	Cataloged Procedure for Assembly and Link Editing (ASMFL) . . . . .	27
Figure 7.	Cataloged Procedure for Assembly, Link Editing, and Execution (ASMFLG) . . . . .	29
Figure 8.	Cataloged Procedure for Assembly and Loader-Execution (ASMFCG) . . . . .	31
Figure 9.	Assembler Listing . . . . .	35
Figure 10.	External Symbol Dictionary . . . . .	37
Figure 11.	Source and Machine Language Statements . . . . .	39
Figure 12.	Relocation Dictionary . . . . .	40
Figure 13.	Symbol Cross Reference . . . . .	42
Figure 14.	Literal Cross Reference . . . . .	43
Figure 15.	Diagnostics and Statistics . . . . .	45
Figure 16.	Minimum Requirements for a Simple Program . . . . .	47
Figure 17.	Files Created During Assembly . . . . .	58
Figure 18.	SYSTEM Listing . . . . .	62
Figure 19.	Assembler Sample Program (Part 1 of 11) . . . . .	73
Figure 20.	SYM Card Format . . . . .	85
Figure 21.	Assembler Data Set Characteristics . . . . .	90
Figure 22.	SYSRINT Listing of the Source Statements Used to Show SYSTEM Output . . . . .	92
Figure 23.	SYSTEM Listing Produced for the Source Statements Shown in Figure 22 . . . . .	93





# Introduction

This section describes the purpose of the VS Assembler, its relationship to the operating system, and its input and output. It also tells you how the operating system processes your assembler-language program and reviews the concepts of job, job step, job control language, and cataloged procedure.

## Purpose of the Assembler

The purpose of the VS Assembler is to translate programs written in the assembler language into object modules, that is, code suitable as input to the linkage editor or loader.

## Relationship of the Assembler to the Operating System

The VS Assembler is supplied with the OS/VS control program package. In the same way as the linkage editor or loader, it is executed under control of the OS control program. For a complete description of the relationship between a processing program and the various components of the control program, refer to Introduction to OS.

## Input

As input the assembler accepts a program written in the Assembler language as defined in Assembler Language. This program is referred to as a source module. Some statements in the source module (macro or COPY instructions) may cause additional input to be obtained from a macro library.

## Output

The output from the assembler consists of an object module and program listing. The object module can either be punched, or included in a data set residing on a direct-access device or a magnetic tape. From that data set the object module can be read into the computer and processed by the linkage editor or loader. The format of the object module is described in Appendix C.

The program listing lists all the statements in the module, both in source and machine language format, and gives other important information about the assembly (such as error messages). The listing is described in detail in the section "The Assembler Listing".

## Compatibility

The language supported by the VS Assembler is compatible with the language supported by the OS Assembler F. All programs which assemble error-free under Assembler F will also assemble error-free under the VS Assembler. However, the resulting object code may in odd cases be different because of the extended features of the language supported by the VS Assembler (the extended attribute reference and SETC facilities).

## How the Operating System Handles Your Program

Once you have coded and punched your program, it must be processed by the assembler and the linkage editor or loader before it can be executed. (See Figure 1.)

### ASSEMBLER

The assembler translates your source module into an object module, the machine language equivalent of the source module. The object module, however, is not ready for execution; it must first be processed by the linkage editor or loader.

### LINKAGE EDITOR

The linkage editor prepares your program for execution. The output of the linkage editor is called a load module and can be executed by the computer. The linkage editor can combine your program with other object modules and load modules to produce a single load module. The linkage editor stores your program in a load module library, a collection of data sets on a direct-access device. These load modules can be read into the computer and given control. The load module library may be either permanent, so that you can execute your program in later jobs, or temporary, so that the program is deleted at the end of your job.

### EXECUTION OF YOUR PROGRAM

Once you have included your program in a permanent load module library, you can execute it any number of times without assembly and linkage editing. However, if you need to change your program, you must assemble and linkage edit it again. Therefore, you should not store your program in a permanent load module library until it has been tested properly. To save time during test runs, you can use a program that combines the basic functions of the linkage editor with the execution of your program. That program is the loader.

## LOADER

The loader performs most of the functions of the linkage editor; in addition, it loads your program into the computer and passes control to your program. The loader cannot, however, include your program in a load module library. For a full description of the linkage editor and loader, refer to Linkage Editor and Loader.

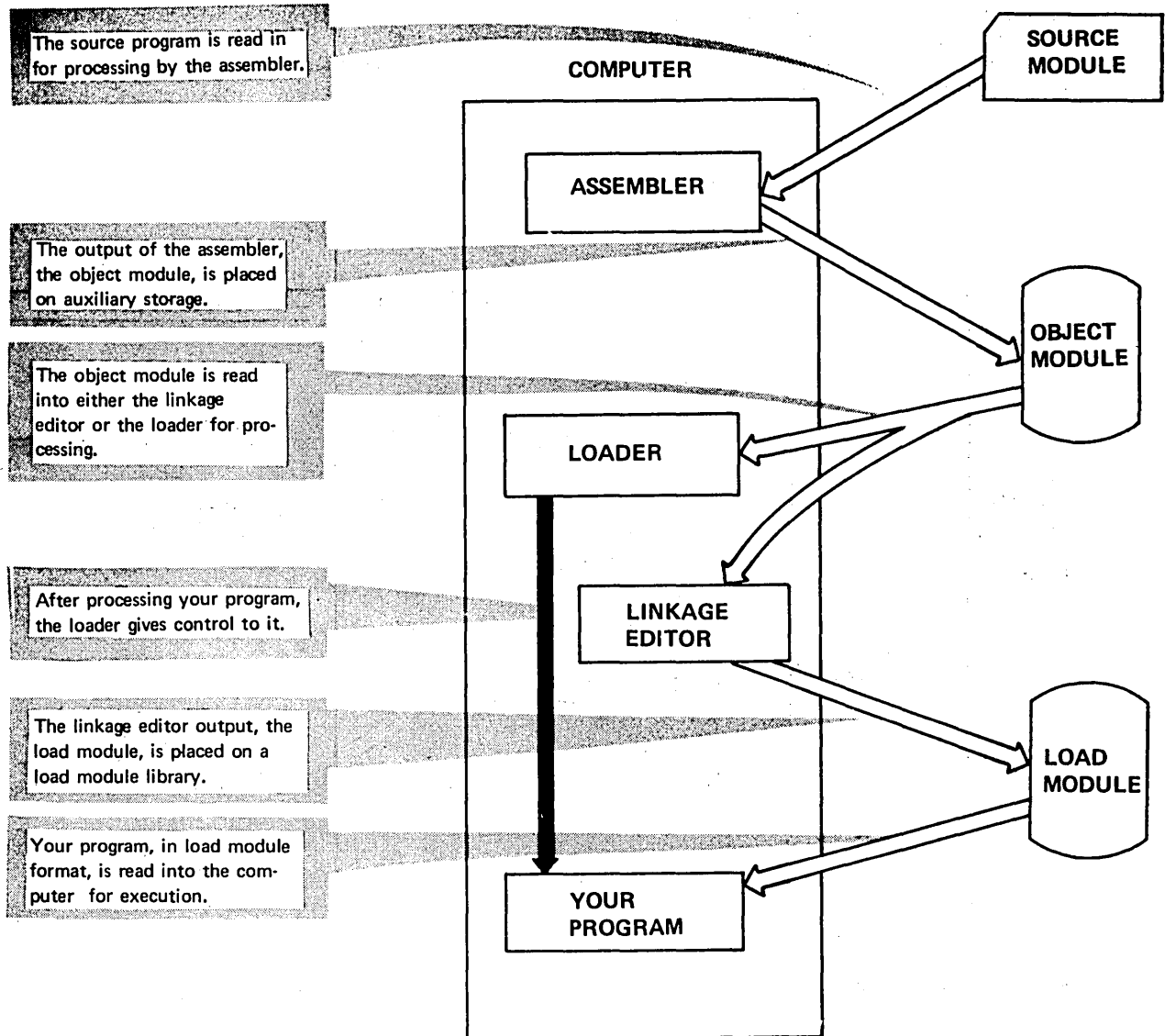


Figure 1. How the Operating System Handles Your Program

# Job Control Language and Cataloged Procedures

## JOBS AND JOB STEPS

Each time you request a service from the operating system, you are asking it to perform a job. A job may consist of several steps, each of which usually involves the execution of one processing program under the control of the VS control program. For example, if you submit a job to the computer calling for assembly and linkage editing of a program, that job will be a two-step job. The concepts of jobs and job steps are illustrated in Figure 2.

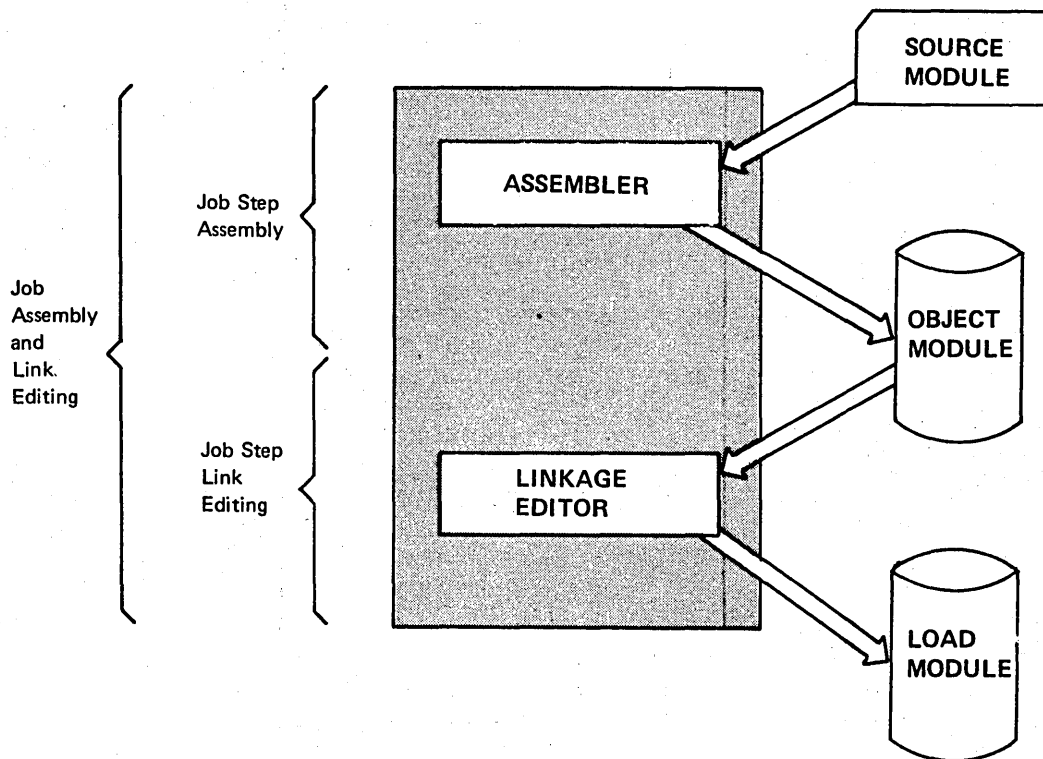


Figure 2. Jobs and Job Steps

## JOB CONTROL LANGUAGE

The job control language is your way of communicating to the operating system control program what services you want performed and what auxiliary devices you want used. Job control language (JCL) statements are usually punched into cards and supplied in the job stream together with your source module and other data needed by the job.

For a detailed discussion of job control language statements, see JCL Reference.

To save time and trouble, you can use predefined sets of JCL statements that reside in a library. Such a set of statements, called a cataloged procedure, can be included in your job by means of a single JCL statement naming the set. Figure 3 illustrates the concept of a cataloged procedure.

There are several cataloged procedures available for assembler jobs. They are described in the section "Job Control Statements for Assembler Jobs".

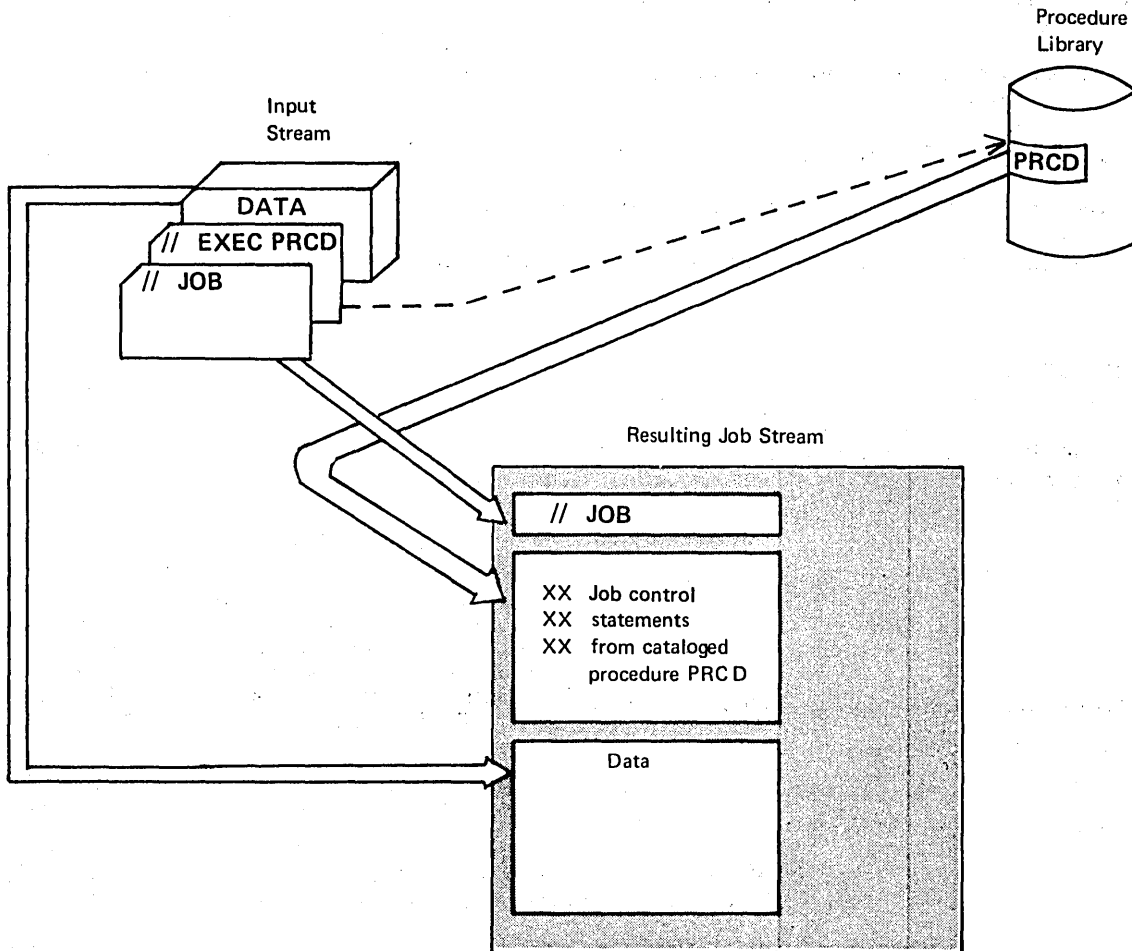


Figure 3. The Cataloged Procedure Concept

# Job Control Statements for Assembler Jobs

The purpose of this section is to:

- Show you how to invoke the assembler for simple jobs (using cataloged procedures).
- Describe the assembler options and how to request them.
- List the job control statements that make up the four assembler cataloged procedures.
- Give examples of how to use the cataloged procedures for more complex jobs.

## Simple Assembly and Execution

This section gives you the minimum JCL statements needed for two simple assembler jobs:

- Assembly of your program to produce a listing and an object deck.
- Assembly and execution of your program.

Both jobs use cataloged procedures to call the assembler.

### ASSEMBLY

To assemble your program, use the following job control language (JCL) statements:

```
//jobname JOB accountno,progrname,MSGLEVEL=1  
// EXEC ASMFC  
//SYSIN DD *
```

(your source program)

Identifies the beginning of your job to the operating system. 'jobname' is the name you assign to the job. 'accountno' specifies the account to which your job is charged, and 'progrname' the name of the programmer responsible for the job. 'MSGLEVEL=1' specifies that the job control statements connected with this job are to be listed. Check what parameters are required at your installation and how they must be specified.

Calls the cataloged procedure ASMFC. As the result a number of job control statements are included in the job from the procedure library. ASMFC is described under "The Assembler Cataloged Procedures".

Specifies that the assembler language source program follows immediately after this statement.

These statements cause the assembler to assemble your program and to produce a listing (described in the section "The Assembler Listing") and an object module punched on cards (described in Appendix C).

If you do not want any object module cards to be punched during the job, use the following statements:

```
//jobname JOB accountno,progrname,MSGLEVEL=1
//          EXEC ASMFC,PARM.ASM=NODECK
//ASM.SYSIN DD *
```

(your source program)

The second parameter (PARM) specifies the assembler option NODECK, telling the assembler not to produce any punched object module. For a full discussion of the assembler options, see "Assembler Options".

## ASSEMBLY AND EXECUTION

To run a job that both assembles and executes your program, code the following statements:

```
//jobname JOB accountno,progrname,MSGLEVEL=1
//          EXEC ASMFCG
//ASM.SYSIN DD *
```

(your source program)

Calls the procedure ASMFCG, containing job control statements for execution of the assembler (in procedure step ASM) and the loader in (in step GO).

Specifies that the input for procedure step ASM (assembly) follows immediately after this statement.

```
//GO.SYSIN DD *
```

(data, if any, for your program)

Specifies that the input for step GO (execution of your program under control of the loader) follows immediately after this statement.

The first step of the ASMFCG procedure executes the assembler. The assembler produces a listing, a punched object module on cards, and an object module on a direct access device. The second step causes the loader to be executed. The loader transforms the object module, which was written on a direct access device by the assembler, into a load module. In addition, the loader causes the load module (that is, your program) to be executed.

If you do not want the assembler to punch an object deck in this example, supply the following statements instead:

```
//jobname      JOB   accountno,progrname,MSGLEVEL=1
//             EXEC  ASMFCG,PARM.ASM=(OBJ,NODECK)
//ASM.SYSIN    DD    *
```

(your source program)

```
//GO.SYSIN     DD    *
```

(data for your program)

The PARM parameter specifies the assembler options OBJ (telling the assembler to produce an object module on the partitioned data set used as input by the loader) and NODECK for step ASM (assembly) of the procedure.

## Assembler Options

### WHAT ASSEMBLER OPTIONS ARE

Assembler options are functions of the assembler that you, as an assembler language programmer, can select. For example, you can use assembler options to specify whether or not you want the assembler to produce an object deck; whether or not you want it to print certain items in the listing; and whether or not you want it to check your program for reenterability.

The assembler options can be divided into four categories:

- Listing control options, which determine the information to be included in the program listing.
- Output control options, which specify the device on which the assembler object module is to be written and the contents of the module.
- SYSTEM options, which determine the information to be included in the listing produced on the SYSTEM data set. This data set is primarily for use by the Time Sharing Option (TSO) of VS2.
- Other assembler options, which specify miscellaneous functions and values for the assembler.

Figure 4 lists all the assembler options. The underlined values are the standard or default values. These values are used by the assembler for options that you do not specify.

As you can see from the figure, the options fall into two format types:

- Simple pairs of keywords: a positive form (for example, DECK) that requests a function, and an alternative negative form (for example, NODECK) that rejects the function.
- Keywords that permit you to assign a value to a function (for example, LINECOUNT(40)).



## HOW TO SPECIFY ASSEMBLER OPTIONS

You use the PARM field of the EXEC JCL statement calling the assembler to specify the assembler options. Code PARM= followed by a list of options that you have selected. For example,

```
//STEPA EXEC PGM=IFOX00,PARM='NODECK,FLAG (5),NORLD'
```

IFOX00 is the name of the assembler; three options are specified for the execution of it. Default values are used for the other options.

When you use cataloged procedures, you will notice that most of them contain an option specification in the EXEC statement for the assembly. To override such a specification, include a PARM field with your options in the EXEC statement calling the procedure. If the cataloged procedure contains more than one step, you must add the procedure step name as a qualifier to the PARM operand. For example,

```
//STEP1 EXEC ASMFCG,PARM.ASM='OBJ,NODECK'
```

The .ASM is necessary to indicate the assembly step. As you can see in the section "The Assembler Cataloged Procedures", the stepname for assembly is always ASM. You must also remember that when you override the PARM field in a procedure, the entire PARM field is overridden. The PARM field specification in the cataloged procedure ASMFCG is PARM=OBJ, and the OBJ option must be repeated when you override the PARM field. Otherwise the assembler default value NOOBJ will be used. (For a more detailed description of overriding operands on EXEC statements in cataloged procedures, refer to JCL Reference.)

The PARM field is coded according to the following rules:

- Single quotes or parentheses must surround the entire PARM value if you specify two or more options.
- The options must be separated by commas. You may specify as many options as you wish, and in any order. However, the length of the option list must not exceed 100 characters, including separating commas.
- The BUFSIZE, FLAG, LINECOUNT, WORKSIZE, or SYSPARM options must appear within single quotes.
- If you need to continue the PARM field onto another card, the entire PARM field must be enclosed in parentheses. However, any part of the PARM field enclosed in quotes must not be continued on another card.

The following examples illustrate these rules:

,PARM.ASM=DECK

Only one option specified.

,PARM.ASM='LINECOUNT(40)'

LINECOUNT, BUFSIZE, FLAG, WORKSIZE, and SYSPARM must be surrounded by quotes.

,PARM.ASM=(DECK,NOOBJECT)

or

,PARM.ASM='DECK,NOOBJECT'

More than one option specified. None of them requires quotes.

,PARM.ASM='DECK,NOLIST,SYSPARM(PARAM)'

or

,PARM.ASM=(DECK,NOLIST,'SYSPARM(PARAM)')

More than one option specified. SYSPARM must appear within quotes.

or

,PARM.ASM=(DECK,'NOLIST,SYSPARM(PARAM)')

,PARM.ASM=(DECK,NOLIST,'LINECOUNT(35)',  
NOALIGN,MCALL,'BUFSIZE(MIN)',NORLD)

The whole field must be enclosed by parentheses, because it is continued onto another card. The LINECOUNT and BUFSIZE options must be within quotes, and the portions of the field that are enclosed within quotes cannot be continued onto another card.

Listing Control Options	
<u>A</u> LOGIC	Conditional assembly statements processed in open code are listed.
NOA <u>L</u> OGIC	The ALOGIC option is suppressed.
<u>E</u> SD	The external symbol dictionary (ESD) is listed. (Refer to 'The Assembler Listing' for further information on the ESD.)
NO <u>E</u> SD	No ESD listing is printed.
<u>F</u> LAG { (nnn) (0) }	Diagnostic messages and MNOTE messages below severity code nnn will not appear in the listing. Diagnostic messages can have severity codes of 4, 8, 12, 16, or 20 (20 is the most severe), and MNOTE severity codes can be between 0 and 255. For example, FLAG (8) suppresses diagnostic messages with a severity code of 4 and MNOTE messages with severity codes of 0 through 7.
<u>Y</u> FLAG	Diagnostic message IFO205 and its severity code will appear in the listing.
NO <u>Y</u> FLAG	The YFLAG option is suppressed.
<u>L</u> INECOUNT { (nnn) (55) }	nnn specifies the number of lines to be printed between headings in the listing.
<u>L</u> IST	An assembler listing is produced.
NO <u>L</u> IST	No assembler listing is produced. This option overrides ESD, RLD, and XREF.
<u>M</u> CALL	Inner macro instructions encountered during macro generation are listed following their respective outer macro instructions. The assembler assigns statement numbers to these instructions. The MCALL option is implied by the MLOGIC option; NOMCALL has no effect if MLOGIC is specified.
<u>N</u> OMCALL	The MCALL option is suppressed.
<u>M</u> LOGIC	All statements of a macro definition processed during macro generation are listed after the macro instruction. The assembler assigns statement numbers to them.
<u>N</u> OMLOGIC	The MLOGIC option is suppressed.

Figure 4. The Assembler Options.  
(Part 1 of 5)

Listing Control Options (continued)

<u>RLD</u>	The assembler produces the relocation dictionary as part of the listing. (Refer to "The Assembler Listing" for further information on the relocation dictionary.)
NORLD	The RLD is not printed.
LIBMAC	The macro definitions read from the macro libraries and any assembler statements following the logical END statement are listed after the logical END statement. The logical END statement is the first END statement processed during macro generation. It may appear in a macro or in open code; it may even be created by substitution. The assembler assigns statement numbers to the statements that follow the logical END statement.
<u>NOLIBMAC</u>	The LIBMAC option is suppressed.
XREF (FULL)	The assembler listing will contain a cross reference table of all symbols used in the assembly. This includes symbols that are defined but never referenced. The assembler listing will also contain a cross reference table of literals used in the assembly.
<u>XREF (SHORT)</u>	The assembler listing will contain a cross reference table of all symbols that are referenced in the assembly. Any symbols defined but not referenced are not included in the table. The assembler listing will also contain a cross reference table of literals used in the assembly.
NOXREF	No cross reference tables are printed.

Figure 4. The Assembler Options  
(Part 2 of 5)

Output Control Options	
<u>DECK</u>	The object module is written on the device specified in the SYSPUNCH DD statement. If this option is specified together with the OBJECT option, the object module will be written both on SYSPUNCH and on SYSGO.
NODECK	The DECK option is suppressed.
OBJECT or OBJ	The object module is written on the device specified in the SYSGO DD statement. If this option is specified together with the DECK option, the object module will be written both on SYSGO and on SYSPUNCH.
<u>NOOBJECT</u> or <u>NOOBJ</u>	The OBJECT option is suppressed.
TEST	The special source symbol table (SYM cards) is included in the object module. (See Appendix C for details.)
<u>NOTEST</u>	No SYM cards are produced.

Figure 4. The Assembler Options  
(Part 3 of 5)

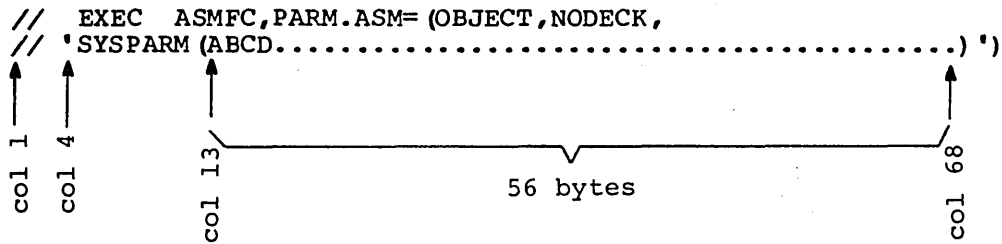
SYSTEM Options	
<u>NUMBER</u> or <u>NUM</u>	The line number field (columns 73-80 of the input cards) is written in the SYSTEM listing for statements for which diagnostic information is given. This option is valid only if TERMINAL is specified.
NONUMBER or NONUM	The NUMBER option is suppressed.
<u>STMT</u>	The statement number assigned by the assembler is written in the SYSTEM listing for statements for which diagnostic information is given. This option is valid only if TERMINAL is also specified.
NOSTMT	The STMT option is suppressed.
TERMINAL or TERM	The assembler writes diagnostic information on the SYSTEM data set. The diagnostic information, described in detail in Appendix F, consists of the diagnosed statement followed by the error message issued.
<u>NOTERMINAL</u> or <u>NOTERM</u>	The TERMINAL option is suppressed.

Figure 4. The Assembler Options  
(Part 4 of 5)

Other Assembler Options	
<u>ALIGN</u>	All data is aligned on the proper boundary in the object module; for example, an F-type constant is aligned on a fullword boundary. In addition, the assembler checks storage addresses used in machine instructions for alignment violations.
<u>NOALIGN</u>	The assembler does not align data areas other than those specified in CCW instructions. The assembler does not skip bytes to align constants on proper boundaries. Alignment violations in machine instructions are not diagnosed.
<u>BUFSIZE (MIN)</u>	The assembler uses the minimum buffer size (790 bytes) for each of the utility data sets (SYSUT1, SYSUT2, and SYSUT3). Storage normally used for buffers is allocated to work space. Because more work space is available, more complex programs can be assembled in a given region, but the speed of the assembly is substantially reduced.
<u>BUFSIZE (STD)</u>	The buffer size that gives optimum performance is chosen. The buffer size depends on the size of the region or partition. Of the assembler working storage in excess of minimum requirements, 37% is allocated to the utility data set buffers, and the rest to macro generation dictionaries.
<u>BUFSIZE (MAX)</u>	The assembler uses up to 15 save areas for input records and saves them according to their frequency of use, to optimize the macro generation phase. This option is useful when large and/or many macros are used in the assembly. This option has no effect unless a big enough region or partition is available. The number of allocated save areas is printed in the statistics page of the assembler listing.  Refer to Appendix E for a more complete description of the effects of BUFSIZE.
<u>WORKSIZE</u> (nnnnnK) (2048K)	This option allows the user to delimit the use of region space. The value specified does not include the space for modules and system areas. Allowed range is 32K to 10240K bytes. The WORKSIZE option has no effect, unless the region or partition specified for the assembler step in JCL is bigger.
<u>RENT</u>	The assembler checks your program for a possible violation of program reentrability. Code that makes your program non-reentrant is identified by an error message, but it cannot be an exhaustive check, as the assembler cannot check the logic of the code. Therefore, it is possible to have non-reentrant code not flagged.
<u>NORENT</u>	The RENT option is suppressed.
<u>SYSPARM</u> (string) 0	'string' is the value assigned to the system variable symbol &SYSPARM (explained in Assembler Language). Because of JCL restrictions, the length of the SYSPARM value is limited, as explained in the Note following this figure. Two quotes are needed to represent a single quote, and two ampersands to represent a single ampersand. For example,  PARM='OBJECT,SYSPARM ((&&AM, 'BO) .FY  assigns the following value to &SYSPARM:  (&AM, 'BO) .FY  Any parentheses inside the string must be paired. If you call the assembler from a problem program (dynamic invocation), SYSPARM can be up to 255 characters long.

Figure 4. The Assembler Options  
(Part 5 of 5)

Note: The restrictions imposed upon the PARM field limit the maximum length of the SYSPARM value to 56 characters unless you use symbolic procedure parameters to substitute the value or the value contains commas that can be used as breaking points between cards. Consider the following example:



Since SYSPARM uses parentheses, it must be surrounded by quotes. Thus, it cannot be continued onto a continuation card. The leftmost column that can be used is column 4 on a continue card. A quote and the keyword must appear on that line as well as the closing quotes. In addition, either a right parenthesis, indicating the end of the PARM field, or a comma, indicating that the PARM field is continued on the next card, must be coded before or in the last column of the statement field (column 71).

## The Assembler Cataloged Procedures

This section describes the four assembler cataloged procedures and tells you how to use them. They are:

- ASMFC (assembly)
- ASMFCL (assembly and linkage editing)
- ASMFCG (assembly and loader-execution)
- ASMFCLG (assembly, linkage editing, and execution)

The procedure you choose on each occasion will depend on the type of job you want to run. First, you may want to run an assembly to correct your coding and keypunching errors. For this, you would use the ASMFC procedure with the option NODECK specified. In the next run you may want to assemble and execute your program, in which case you can use ASMFCG (or possibly ASMFCLG, if you use linkage editor features not supported by the loader). When you have debugged your program, you may want to include it in a load module library using ASMFCL.

The examples given in this section assume that the cataloged procedures you are using are identical to the cataloged procedures delivered by IBM. Therefore, you should first make sure that your installation has not modified the procedures after they were delivered.





```

① //ASMFC      PROC  MAC='SYS1.MACLIB',MAC1='SYS1.MACLIB'
② //ASM       EXEC  PGM=IFOX00,REGION=128K
③ //SYSLIB    DD    DSN=&MAC,DISP=SHR
//           DD    DSN=&MAC1,DISP=SHR
④ //SYSUT1    DD    DSN=&&SYSUT1,UNIT=SYSSQ,SPACE=(1700,(600,100)),
//           SEP=(SYSLIB)
//SYSUT2     LD    DSN=&&SYSUT2,UNIT=SYSSQ,SPACE=(1700,(300,50)),
//           SEP=(SYSLIB,SYSUT1)
//SYSUT3     DD    DSN=&&SYSUT3,UNIT=SYSSQ,SPACE=(1700,(300,50))
⑤ //SYSPRINT DD    SYSOUT=A,DCB=BLKSIZE=1089
⑥ //SYSPUNCH DD    SYSOUT=B

```

① This statement names the procedure and gives default values to the symbolic parameters MAC and MAC1.

② This statement specifies that the program to be executed is IFOX00, which is the name of the assembler. The REGION parameter specifies the virtual storage region that gives best performance. It is possible to run the assembler in 64K, in which case you must change the region size parameter. You can also add COND and PARM parameters.

③ This statement identifies the macro library data set. The succeeding statement concatenates another macro library with it. The default values for the DSN parameters of both data sets are SYS1.MACLIB, the system macro library. You can change either or both of the data sets in the EXEC statement calling the procedure. For example, to concatenate your own macro library with SYS1.MACLIB, code your EXEC statement as follows:

```
// EXEC ASMFC,MAC1=MYMACS
```

DISP=SHR indicates that the data set can be used simultaneously by other jobs in the system.

④ SYSUT1, SYSUT2, and SYSUT3 specify the assembler work data sets. The device classname SYSSQ represents either a direct access device or a tape drive. The I/O units assigned to the classnames are specified by your installation during system generation. Instead of a classname you can specify a unit name, such as 2314. The DSN parameters guarantee dedicated work data sets, if this is supported by your installation. The SEP and SPACE parameters are effective only if SYSSQ is a direct access device. The space required depends on the source program.

⑤ This statement defines the standard system output class as the destination of the assembler listing. You can specify any blocksize that is a multiple of 121.

⑥ This statement describes the data set that will receive the punched object module.

Figure 5. Cataloged Procedure for Assembly (ASMFC)



```

//ASMFCL  PROC MAC='SYS1.MACLIB',MAC1='SYS1.MACLIB'
//ASM     EXEC PGM=IFOX00,PARM=OBJ,REGION=128K
//SYSLIB  DD   DSN=&MAC,DISP=SHR
//        DD   DSN=&MAC1,DISP=SHR
//SYSUT1  DD   DSN=&&SYSUT1,UNIT=SYSSQ,SPACE=(1700,(600,100)),
//        SEP=(SYSLIB)
//SYSUT2  DD   DSN=&&SYSUT2,UNIT=SYSSQ,SPACE=(1700,(300,50)),
//        SEP=(SYSLIB,SYUT1)
//SYSUT3  DD   DSN=&&SYSUT3,UNIT=SYSSQ,SPACE=(1700,(300,50))
//SYSPRINT DD  SYSOUT=A,DCB=BLKSIZE=1089
//SYSPUNCH DD  SYSOUT=B
① //SYSGO  DD   DSN=&&OBJSET,UNIT=SYSSQ,SPACE=(80,(200,50)),
//        DISP=(MOD,PASS)
② //LKED   EXEC PGM=IEWL,PARM=(XREF,LET,LIST,NCAL),REGION=128K,
//        COND=(8,LT,ASM)
③ //SYSLIN DD   DSN=&&OBJSET,DISP=(OLD,DELETE)
④ //        DD   DDNAME=SYSIN
⑤ //SYSLMOD DD  DSN=&&GOSET(GO),UNIT=SYSDA,SPACE=(1024,(50,20,1)),
//        DISP=(MOD,PASS)
⑥ //SYSUT1 DD   DSN=&&SYSUT1,UNIT=(SYSDA,SEP=(SYSLIN,SYSLMOD)),
//        SPACE=(1024,(50,20))
⑦ //SYSPRINT DD  SYSOUT=A

```

- ① The SYSGO DD statement describes a temporary data set--the object module--which is to be passed to the linkage editor.
- ② This statement initiates linkage editor execution. The linkage editor options in the PARM= field cause the linkage editor to produce a cross-reference table, module map, and a list of all control statements processed by the linkage editor. The NCAL option suppresses the automatic library call function of the linkage editor.
- ③ This statement identifies the linkage editor input data set as the same one produced as output by the assembler.
- ④ This statement is used to concatenate any input to the linkage editor from the input stream with the input from the assembler.
- ⑤ This statement specifies the linkage editor output data set (the load module). As specified, the data set will be deleted at the end of the job. If it is desired to retain the load module, the DSN parameter must be respecified and a DISP parameter added. If the output of the linkage editor is to be retained, the DSN parameter must specify a library name and member name designating where the load module is to be placed. The DISP parameter must specify either KEEP or CATLG.
- ⑥ This statement specifies the utility data set for the linkage editor.
- ⑦ This statement identifies the standard output class as the destination for the linkage editor listing.

Figure 6. Cataloged Procedure for Assembly and Link Editing (ASMFCL)

ASSEMBLY, LINK EDITING AND EXECUTION (ASMFCGLG)

The ASMFCGLG consists of three job steps: assembly, link editing and execution. An assembler listing, an object deck, and a linkage editor listing are produced.

The statements entered in the input stream to use this procedure are:

```
//jobname      JOB
//stepname     EXEC      ASMFCGLG
//ASM.SYSIN    DD      *
.
.
.
source program statements
.
.
/*
//LKED.SYSIN   DD      *
.
.
object module or
linkage editor
control statements
.
.
} necessary only if linkage
editor is to combine modules
or read linkage editor control
information from the job stream
/*
//GO.ddname   DD      parameters
//GO.ddname   DD      parameters
//GO.ddname   DD      *
.
.
} only
if
necessary
problem program input
.
.
/*
```

Figure 7 shows the statements that make up the ASMFCGLG procedure. Only those statements not previously discussed are explained in the figure.

```

//ASMFLG  PROC MAC='SYS1.MACLIB',MAC1='SYS1.MACLIB'
//ASM     EXEC PGM=IFOX00,PARM=OBJ,REGION=128K
//SYSLIB  DD   DSN=&MAC,DISP=SHR
//        DD   DSN=&MAC1,DISP=SHR
//SYSUT1  DD   DSN=&&SYSUT1,UNIT=SYSSQ,SPACE=(1700,(600,100)),
//        SEP=(SYSLIB)
//SYSUT2  DD   DSN=&&SYSUT2,UNIT=SYSSQ,SPACE=(1700,(300,50)),
//        SEP=(SYSLIB,SYSUT1)
//SYSUT3  DD   DSN=&&SYSUT3,UNIT=SYSSQ,SPACE=(1700,(300,50))
//SYSPRINT DD  SYSOUT=A,DCB=BLKSIZE=1089
//SYSPUNCH DD  SYSOUT=B
//SYSGO   DD   DSN=&&OBJSET,UNIT=SYSSQ,SPACE=(80,(200,50)),
//        DISP=(MOD,PASS)
① //LKED   EXEC PGM=IEWL,PARM=(XREF,LET,LIST,NCAL),REGION=128K,
//        COND=(8,LT,ASM)
//SYSLIN  DD   DSN=&&OBJSET,DISP=(OLD,DELETE)
//        DD   DDNAME=SYSIN
② //SYSLMOD DD  DSN=&&GOSET(GO),UNIT=SYSDA,SPACE=(1024,(50,20,1)),
//        DISP=(MOD,PASS)
//SYSUT1  CD   DSN=&&SYSUT1,UNIT=(SYSDA,SEP=(SYSLIN,SYSLMOD)),
//        SPACE=(1024,(50,20))
//SYSPRINT CD  SYSOUT=A
③ //GO     EXEC PGM=*.LKED.SYSLMOD,COND=(8,LT,ASM),(4,LT,LKED)

```

① The LET linkage editor option specified in this statement causes the linkage editor to mark the load module as executable even though errors were encountered during processing.

② The output of the linkage editor is specified as a member of a temporary data set, residing on a direct-access device, and is to be passed to a succeeding job step.

③ This statement initiates execution of the assembled and linkage edited program. The notation \*.LKED.SYSLMOD identifies the program to be executed as being in the data set described in job step LKED by the DD statement named SYSLMOD.

Figure 7. Cataloged Procedure for Assembly, Link Editing, and Execution (ASMFLG)



```

//ASMFCG  PROC MAC='SYS1.MACLIB',MAC1='SYS1.MACLIB'
//ASM     EXEC PGM=IFOX00,PARM=OBJ,REGION=128K
//SYSLIB  DD   DSN=&MAC,DISP=SHR
//        DD   DSN=&MAC1,DISP=SHR
//SYSUT1  DD   DSN=&&SYSUT1,UNIT=SYSSQ,SPACE=(1700,(600,100)),
//          SEP=(SYSLIB)
//SYSUT2  DD   DSN=&&SYSUT2,UNIT=SYSSQ,SPACE=(1700,(300,50)),
//          SEP=(SYSLIB,SYSUT1)
//SYSUT3  DD   DSN=&&SYSUT3,UNIT=SYSSQ,SPACE=(1700,(300,50))
//SYSPRINT DD  SYSOUT=A,DCB=BLKSIZE=1089
//SYSPUNCH DD  SYSOUT=B
//SYSGO   DD   DSN=&&OBJSET,UNIT=SYSSQ,SPACE=(80,(200,50)),
//          DISP=(MOD,PASS)
① //GO     EXEC PGM=LOADER,PARM='MAP,PRINT,NOCALL,LET',
//          COND=(8,LT,ASM)
② //SYSLIN DD  DSN=&&OBJSET,DISP=(OLD,DELETE)
③ //SYSLOUT DD  SYSOUT=A

```

① This statement initiates the loader-execution. The loader options in the PARM= field cause the loader to produce a map and print the map and diagnostics. The NOCALL option is the same as NCAL for linkage editor and the LET option is the same as for linkage editor.

② This statement defines the loader input data set as the same one produced as output by the assembler.

③ This statement identifies the standard output class as the destination for the loader listing.

Figure 8. Cataloged Procedure for Assembly and Loader-Execution (ASMFCG)

## EXAMPLES

The following examples demonstrate the use of the assembler cataloged procedures. Normally, you will want to change or add parameters to the procedures you use. The examples illustrate how you use the EXEC statement calling the procedure to change or add parameters to EXEC statements in the procedure; and how you add DD statements after the EXEC statement calling the procedure to change or add DD statement parameters. The rules for overriding parts of cataloged procedures for the duration of a job are explained in JCL Reference.

### Example 1:

In the procedure ASMFC, the punched object deck can be suppressed and the UNIT and SPACE parameters of data set SYSUT1 can be respecified by coding the following statements:

```
//stepname EXEC ASMFC, PARM.ASM=NODECK
//SYSUT1 DD UNIT=2311,SPACE=(200,(300,40))
//ASM.SYSIN DD *
.
source statements
/*
```

### Example 2:

In the procedure ASMFCLG, the assembler listing can be suppressed and the COND parameter, which sets conditions for execution of the linkage editor, can be changed by the following statements:

```
//stepname EXEC ASMFCLG, PARM.ASM= (NOLIST,OBJECT) ,
// COND.LKED= (8,LT,PREVSTEP.ASM)
//ASM.SYSIN DD *
.
source statements
/*
```

Here PREVSTEP is the name of a previous exec statement calling an assembler procedure in the same job.

Note: You cannot override individual options in the PARM field. The whole PARM field is always overridden. Therefore, you must repeat OBJECT in the example above.

### Example 3:

The following example shows the use of the procedure ASMFCL to:

- Read input from a unlabeled nine-track tape on tape drive 282. The tape has a blocking factor of ten.
- Put the output listing on a tape labeled VOLID=TAPE10, with a data set name of PROG1 and a blocking factor of five (605 divided by 121, the record size for the assembler listing).
- Block the SYSGO output of the assembler and use it as input to the linkage editor with a blocking factor of five.



- Link-edit the module only if there are no errors in the assembly (COND=0) .
- Link-edit the module onto a previously allocated and cataloged data set, USER.LIBRARY with a member name of PROG.

```
// EXEC ASMFCL,COND.LKED=(0,NE,ASM)
//ASM.SYSPRINT DD DSN=PROGR1,UNIT=TAPE,DISP=(NEW,KEEP),
// VOL=SER=TAPE10,DCB=BLKSIZE=605
//ASM.SYSGO DD DCB=BLKSIZE=400
//ASM.SYSIN DD UNIT=282,LABEL=(,NL),DISP=OLD,
// DCB=(RECFM=FSB,BLKSIZE=800)
//LKED.SYSLMOD DD DSN=USER.LIBRARY (PROG),DISP=OLD
```

**Note:** The order in which the overriding DD statements are specified corresponds to the order of DD statements in the procedure. For example, SYSPRINT precedes SYSGO in step ASM. The DD name ASM.SYSIN is placed last among the overriding statements for step ASM, because SYSIN does not exist in step ASM of the procedure.

Example 4:

The following example shows assembly of two programs, link editing of the two object modules into one load module, and execution of the load module:

```
//STEP1 EXEC ASMFCL,PARM.ASM=OBJ
//ASM.SYSGO DD DSN= &&OBJSET,UNIT=SYSSQ,SPACE=(80,(200,50)),
// DISP=(MOD,PASS),DCB=BLKSIZE=400
//ASM.SYSIN DD *
.
source module 1
.
/*
//STEP2 EXEC ASMFCLG
//ASM.SYSGO DD DCB=BLKSIZE=400,DISP=(MOD,PASS)
//ASM.SYSIN DD *
.
source module 2
.
/*
//LKED.SYSIN DD *
ENTRY PROG
/*
//GO.ddname DD
// . (dd cards for GO step)
```

The LKED.SYSIN statement indicates that input to the linkage editor follows. In this case it is a linkage editor control statement. ENTRY, which identifies PROG, an external symbol in one of the two modules, as the entry point into the load module. When the load module is executed, that point in the module gets control first.

JCL Reference provides additional information on overriding techniques.

# The Assembler Listing

This section tells you how to interpret the printed listing produced by the assembler. The listing is obtained only if the option LIST is in effect. Parts of the listing can be suppressed by using other options; for information on the listing options, refer to "Assembler Options".

The six parts of the assembler listing are:

- External symbol dictionary (ESD)
- Source and object program
- Relocation dictionary (RLD)
- Symbol cross reference
- Literal cross reference
- Diagnostics and statistics

Figure 9 shows the different parts of the listing. The function and purpose of each of them, as well as the individual details, are explained in the following text and illustrations.

EXAM		EXTERNAL SYMBOL DICTIONARY				PAGE 1
SYMBOL	TYPE ID ADDR LENGTH LDID					ASM 0100 09.46 01/05/72
SEARCH	PC 0001 000000 0001C0 LD 000024 0001					
PAGE 3						
EXAM SAMPLE PROGRAM						ASM 0100 09.46 01/05/72
LOC	OBJECT CODE	ADDR1 ADDR2	STMT	SOURCE STATEMENT		
			52	*****	SAMPL050	
			53	* MAIN ROUTINE	* SAMPL051	
			54	*****	SAMPL052	
			55	CSEC1	SAMPL053	
000000			56	ENTRY SEARCH	SAMPL054	
			57	BEGIN BALR R12,0	ESTABLISH ADDRESSABILITY OF PROGRAM SAMPL055	
000000	05C0		58	USING *,R12	AND TELL THE ASSEMBLER SAMPL056	
		00002	59	LM R5,R7,=A(LISTAREA,16,LISTEND)	LOAD LIST AREA PARAMS SAMPL057	
000002	9857 C1A6	001A8	60	USING LIST,R5	REGISTER 5 POINTS TO THE LIST SAMPL058	
		00000	61	MORE BAL R14,SEARCH	FIND LIST ENTRY IN TABLE SAMPL059	
000006	45E0 C022	00024	62	TM SWITCH,NONE	CHECK TO SEE IF NAME WAS FOUND SAMPL060	
00000A	9180 C020	00022	63	BO NOTHERE	BRANCH IF NOT SAMPL061	
00000E	4710 C018	0001A	64	USING TABLE,R1	REGISTER 1 NOW POINTS TO TABLE ENTRY SAMPL062	
		00000	65	MOVE TSWITCH,LSWITCH	MOVE FUNCTIONS SAMPL063	
	*** ERROR ***		66+	1,IMPROPER OPERAND TYPES, NO STATEMENTS GENERATED		
			67	MOUE TNUMBER,LNUMBER FROM LIST ENTRY	SAMPL066	
	*** ERROR ***		68	MOVE ADDRESS,LADDRESS TO TABLE ENTRY	SAMPL069	
			69+*	NEXT TWO STATEMENTS GENERATED FOR MOVE MACRO	SAMPL028	
			70+	L 2,LADDRESS	SAMPL029	
000012	5820 500C	0000C	71+	ST 2,TADDRESS	SAMPL030	
000016	5020 1004	00004	72	NOTHERE OI LSWITCH,NONE	TURN ON SWITCH IN LIST ENTRY SAMPL075	
00001A	9680 5008	00008	73	EXLE R5,R6,MORE	LOOP THROUGH THE LIST SAMPL076	
00001E	8756 C004	00006	74	EOJ	END OF PROGRAM, USER LIBRARY MACRO SAMPL077	
PAGE 6						
EXAM		RELOCATION DICTIONARY				ASM 0100 09.46 01/05/72
POS.ID	REL.ID	FLAGS	ADDRESS			
0001	0001	0C	000154			
0001	0001	0C	000164			
0001	0001	0C	000174			
0001	0001	0C	0001A8			
0001	0001	0C	0001B0			
PAGE 7						
EXAM		CROSS-REFERENCE				ASM 0100 09.46 01/05/72
SYMBOL	LEN	VALUE	DEFN	REFERENCES		
BEGIN	00002	00000000	00057	00135 00143 00183		
HIGHER	00002	0000004A	00090	00085		
LADDRESS	00004	0000000C	00174	00070		
LIST	00001	00000000	00170	00060		
LISTAREA	00008	00000148	00132	00184		
LISTEND	00008	00000198	00152	00184		
LNAME	00008	00000000	00171	00084		
LNUMBER	00003	00000009	00173			
LOOP	00004	00000030	00083	00088 00091 00139		
PAGE 8						
EXAM		LITERAL CROSS-REFERENCE				ASM 0100 09.46 01/05/72
SYMBOL	LEN	VALUE	DEFN	REFERENCES		
=A(LISTAREA,16,LISTEND)						
	00004	000001A8	00184	00059		
=F'128,4,128'						
	00004	000001B4	00185	00081		
PAGE 9						
EXAM		ASSEMBLER DIAGNOSTICS AND STATISTICS				ASM 0100 09.46 01/05/72
STMT	ERROR CODE	MESSAGE				
0	IFO076	SEQUENCE SYMBOL .TYPECGK IS UNDEFINED IN MACRO MOVE				
36	IFO016	ILLEGAL OR INVALID NAME FIELD				
65	IFO090	UNDEFINED SEQUENCE SYMBOL ENCOUNTERED DURING CONDITIONAL ASSEMBLY				
66	IFO197	*** MNOTE ***				

Figure 9. Assembler Listing

## External Symbol Dictionary (ESD)

The external symbol dictionary (ESD) describes the contents of the ESD records included in the object module produced by the assembler. It describes to the linkage editor or loader the control sections and external symbols defined in the module.

This section helps you find references between modules in a multi-module program. The ESD may be particularly helpful in debugging the execution of large programs constructed from several modules.

The ESD is explained in detail in Figure 10. For a full understanding of the terms and concepts used in the figure, refer to "Section E: Program Sectioning" and "Section F: Addressing" in Assembler Language.

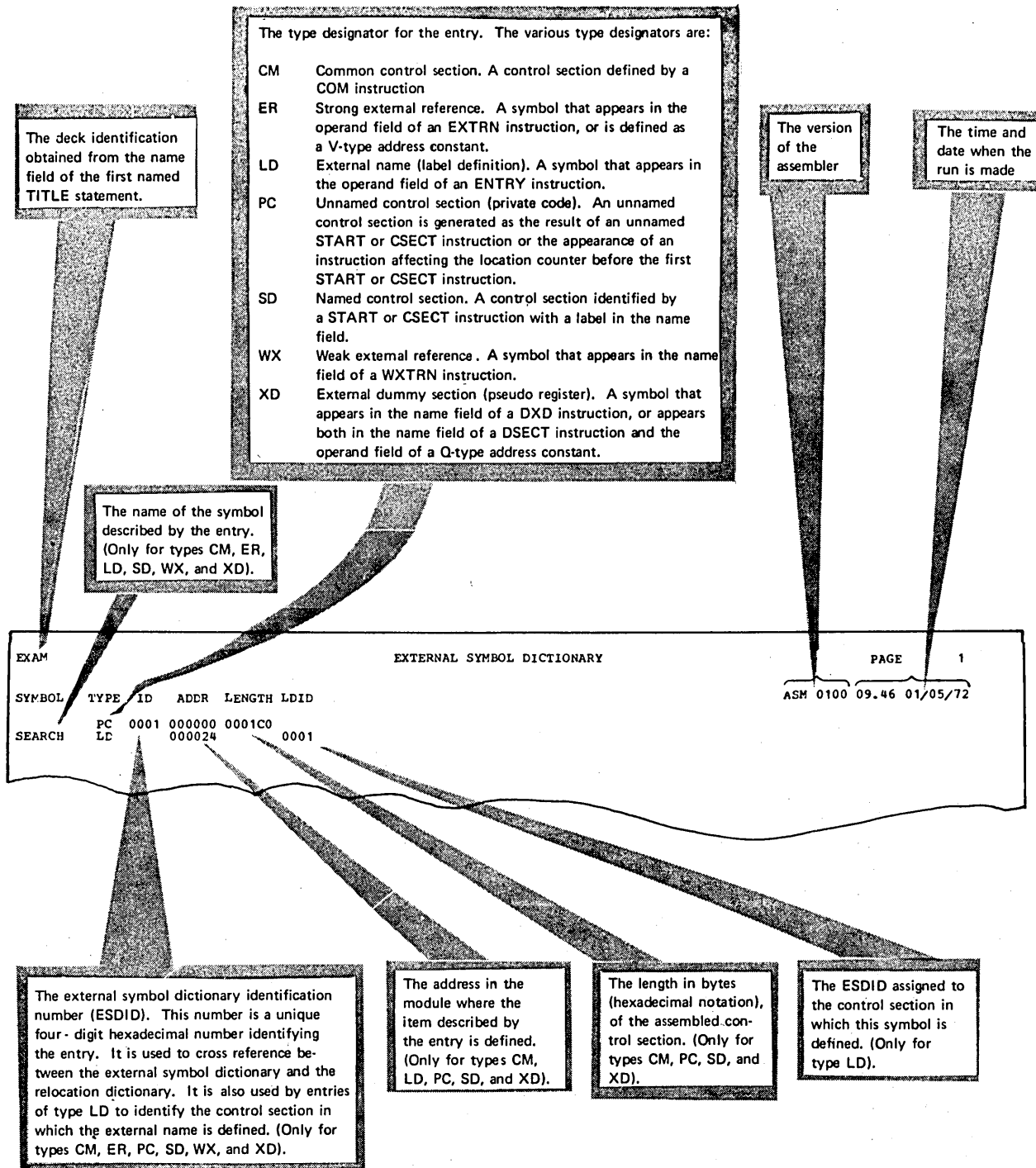


Figure 10. External Symbol Dictionary

## The Source and Machine Language Statements

The second section of the listing contains a copy of the source statements of the module together with a copy of the object code produced by the assembler for each of the source statements.

This section is the most useful part of the listing because it gives you a copy of all the statements in your source program (except listing control statements) exactly as they are entered into the machine. You can use it to find simple punching errors, and together with the diagnostics and statistics, to locate and correct errors detected by the assembler. By using this section together with the cross reference section, you can check that your branches and data references are in order. The location counter values and the object code listed for each statement help you locate any errors in a storage dump. Finally, you can use this part of the listing to check that your macro instructions have been expanded properly.

The source and machine language statements section is described in detail in Figure 11. For terms that you are unfamiliar with, refer to Assembler Language.

### SOURCE STATEMENT FIELDS

The contents of the source statement fields in the listing (see Figure 11) are as follows:

- All source statements except listing control statements are listed, including statements generated from macros and inserted by COPY instructions.
- The definitions of library macros that are called by the program are listed only if the LIBMAC option has been specified.
- The statements generated as the result of a macro instruction are listed after the macro instruction in the listing unless PRINT NOGEN is in effect.
- Unless the NOALOGIC option has been specified, assembler and machine instructions with variable symbols in open code are listed both as they appear in the input to the assembler and with values substituted for the variable symbols.
- When the assembler detects an error, it normally inserts an error indicator in the listing after the statement in error, and prints an error message in the diagnostics and statistics section. Using the FLAG option you can suppress error messages below a severity code that you choose.
- MNOTE messages appear inline where they are generated. MNOTE messages can be suppressed in the same way as error messages using the FLAG option.
- Literals that have not been assigned locations by LTOrg instructions appear after the END instruction.
- A generated statement has the same format as the statement from which it was generated, unless a substituted value is longer than the variable symbol used in the model statement.

- Any statement in which the assembler finds an error is listed, even if it would not otherwise be listed. (For example, an AIF statement in a called library macro definition).
- For a statement generated from a macro definition, columns 73-80 contain the columns from the model statement from which it was generated.

The location counter value (address in hexadecimal notation) of the assembled code. Exceptions are the following values:

- For END with an operand: the address of the symbol in the operand.
- For ORG: the location counter value before the ORG operation.
- For COM, CSECT, or DSECT: the current address of the control section.
- For ENTRY, EXTRN, WXTRN, or DXD: blank.
- For LTORG: the address assigned to the literal pool.

The title defined in the operand field of the TITLE statement

Columns 1 - 80 of the source statements records, as explained under "Source Statement Fields".

EXAM	SAMPLE PROGRAM		PAGE 3
LOC	OBJECT CODE	ADDR1 ADDR2	STMT SOURCE STATEMENT
			ASM 0100 09.46 01/05/72
000000			52 ***** 53 * MAIN ROUTINE * 54 ***** 55 CSECT 56 ENTRY SEARCH 57 BEGIN BALR R12,0 ESTABLISH ADDRESSABILITY OF PROGRAM 58 USING *,R12 AND TELL THE ASSEMBLER 59 LM R5,R7,=A(LISTAREA,16,LISTEND) LOAD LIST AREA PARAMS 60 USING LIST,R5 REGISTER 5 POINTS TO THE LIST 61 MORE BAL R14,SEARCH FIND LIST ENTRY IN TABLE 62 TM SWITCH,NONE CHECK TO SEE IF NAME WAS FOUND 63 NO NOTHERE BRANCH IF NOT 64 USING TABLE,R1 REGISTER 1 NOW POINTS TO TABLE ENTRY 65 MOVE TSWITCH,LSWITCH MOVE FUNCTIONS
			SAMPL050 SAMPL051 SAMPL052 SAMPL053 SAMPL054 SAMPL055 SAMPL056 SAMPL057 SAMPL058 SAMPL059 SAMPL060 SAMPL061 SAMPL062 SAMPL063
			66+ 1,INPROPER OPERAND TYPES, NO STATEMENTS GENERATED 67 MOVE TNUMBER,LNUMBER FROM LIST ENTRY
			SAMPL066
			68 MOVE ADDRESS,ADDRESS TO TABLE ENTRY 69+ NEXT TWO STATEMENTS GENERATED FOR MOVE MACRO 70+ L 2,ADDRESS 71+ ST 2,ADDRESS
			SAMPL069 SAMPL028 SAMPL029 SAMPL030

The machine language code produced from the source statement on the same line. The entries are left-justified. Machine instructions are printed in full, with a blank inserted after every four digits. Assembler instructions are printed in full only if the PRINT instruction option DATA is in effect. For instructions that do not generate any object code this field is blank.

The source statement number (wraps around to zero after 65,535 statements). Used to cross reference between this section and the cross reference and diagnostics section.

The effective address (result of adding together a base register value and a displacement value) for:  
 First column: the first operand of an SI or SS type instruction.  
 Second Column: the second operand of an RS, RX, or SS type machine instruction.  
 This column also contains:  
 For ORG: the location counter value after the ORG operation.  
 For USING: the first operand value.  
 For EQU: the value of the symbol.  
 Both fields contain six digits; however, if the high order digit is zero, it is not printed.

Figure 11. Source and Machine Language Statements

# Relocation Dictionary (RLD)

The relocation dictionary (RLD) describes the contents of the RLD records passed to the linkage editor or loader in the object module. The entries describe those address constants in the module that are affected by program relocation.

The section helps you find the relocatable constants in your program.

The RLD section is described in detail in Figure 12. For a description of the different address constants mentioned in the figure, refer to the section "G3 -- Defining Data", in Assembler Language.

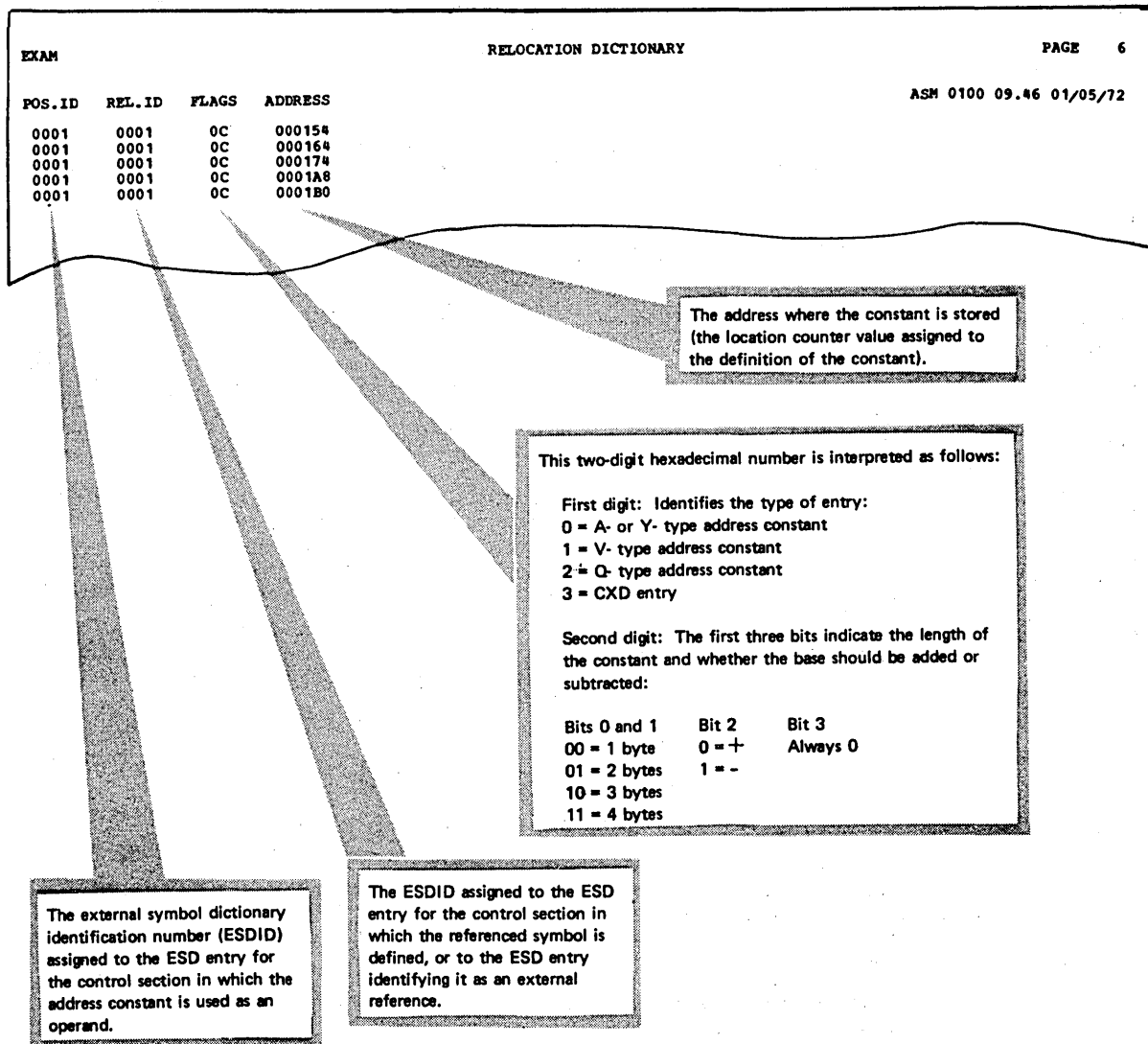


Figure 12. Relocation Dictionary



## Symbol Cross Reference

The symbol cross reference section of the listing lists the symbols used in the module, indicating both where they are defined and where they are referenced. This is a useful tool in checking the logic of your program; it helps you see if your data references and branches are in order.

The symbol cross reference section contains all symbols in the module, except those appearing in the operand field of V-type address constants. Thus, symbols that are not listed in the source and machine language statements section because of a PRINT OFF or PRINT NOGEN instruction will appear in the cross reference table. (For a description of V-type address constants and the PRINT instruction, refer to Assembler Language.)

Symbols that are undefined but referenced will also be listed, and identified as undefined. Duplicate definitions will also be identified in the table.

Figure 13 describes in detail the items of the cross reference table.

Note: The cross reference entry for a symbol used in a literal refers to the assembled literal in the literal pool. Look up the literal cross reference table to find where the symbol is used.

ASM 0100 09.46 01/05/72

SYMBOL	LEN	VALUE	DEFN	REFERENCES
BEGIN	00002	00000000	00057	00135 00143 00183
HIGHER	00002	0000004A	00090	00085
LADDRESS	00004	0000000C	00174	00070
LIST	00001	00000000	00170	00060
LISTAREA	00008	00000148	00132	00184
LISTEND	00008	00000198	00152	00184
INAME	00008	00000000	00171	00084
LNUMBER	00003	00000009	00173	
LOOP	00004	00000030	00083	00088 00091 00139
LSWITCH	00001	00000008	00172	00072
MORE	00004	00000006	00061	00073
MORE	00004	00000042	00088	****DUPLICATE****
NONE	00001	00000080	00076	00062 00072 00080 00092
NOTFOUND	00004	00000050	00092	00089
NOTHERE	00004	0000001A	00072	00063
R1	00001	00000001	00159	00064 00081 00082 00082 00087 00090
R12	00001	0000000C	00165	00057 00058
R14	00001	0000000E	00166	00061 00086 00093
R2	00001	00000002	00160	00088 00091
R3	00001	00000003	00161	00081 00083 00087 00090
R5	00001	00000005	00162	00059 00060 00073
R6	00001	00000006	00163	00073
R7	00001	00000007	00164	00059
SEARCH	00004	00000024	00080	00056 00061
SWITCH	00001	00000022	00075	00062 00080 00092
TABLAREA	00008	00000058	00099	00082
TABLE	00001	00000000	00178	00064
TADDRESS	00004	00000004	00181	00071
TNAME	00008	00000008	00182	00084
TNUMBER	00003	00000000	00179	
TSWITCH	00001	00000003	00180	

The Symbol

The length (decimal notation), in bytes, of the field occupied by the value of the symbol.

Either the address represented by the symbol, or the value to which it is equated.

The statement number of the statement in which the symbol is defined.

The statement numbers of the statements in which the symbol appears in the operand field.

Figure 13. Symbol Cross Reference

# Literal Cross Reference

The literal cross reference section lists all the literals that are used in the program.

Figure 14 gives a detailed explanation of the items of the literal cross reference table.

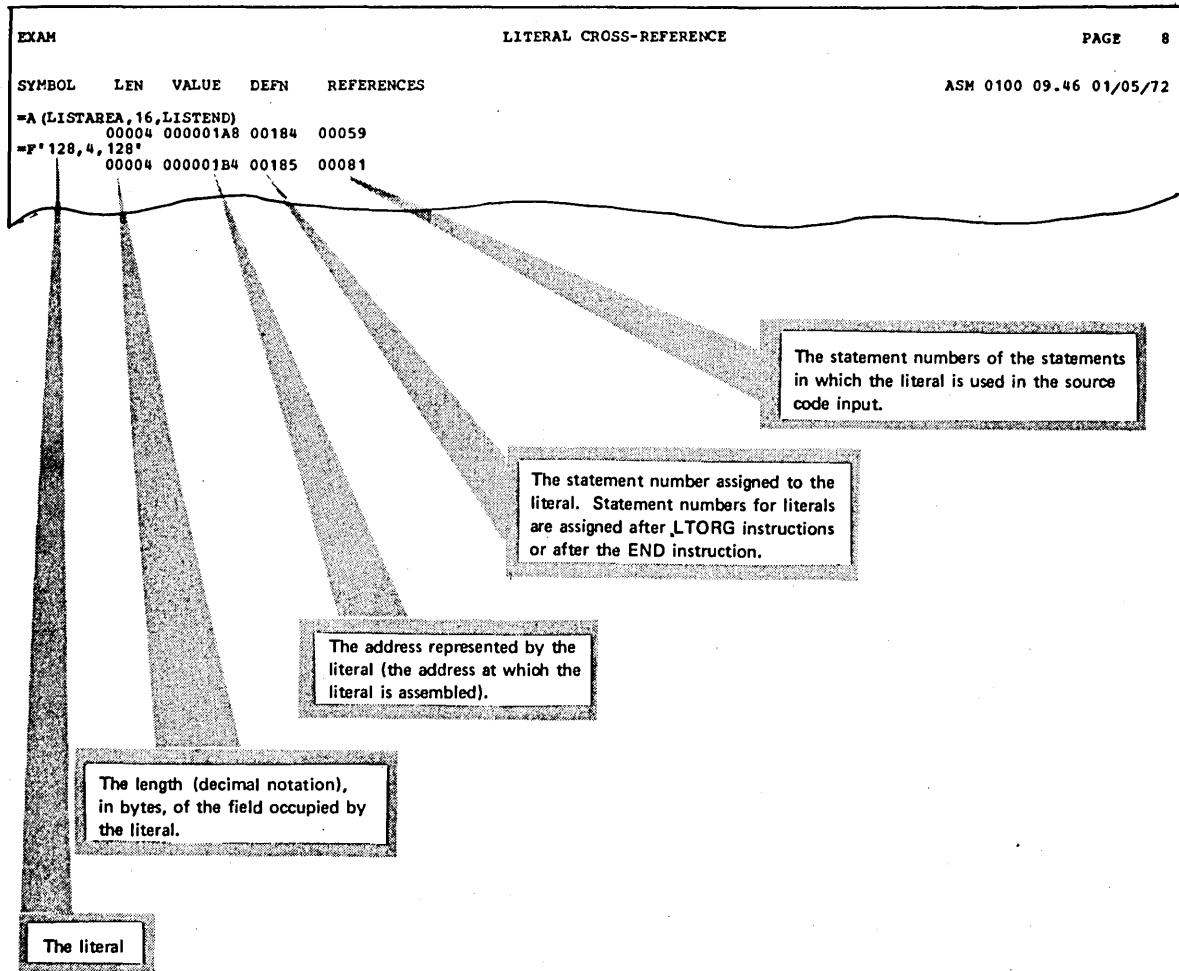


Figure 14. Literal Cross Reference

## Diagnostics and Statistics

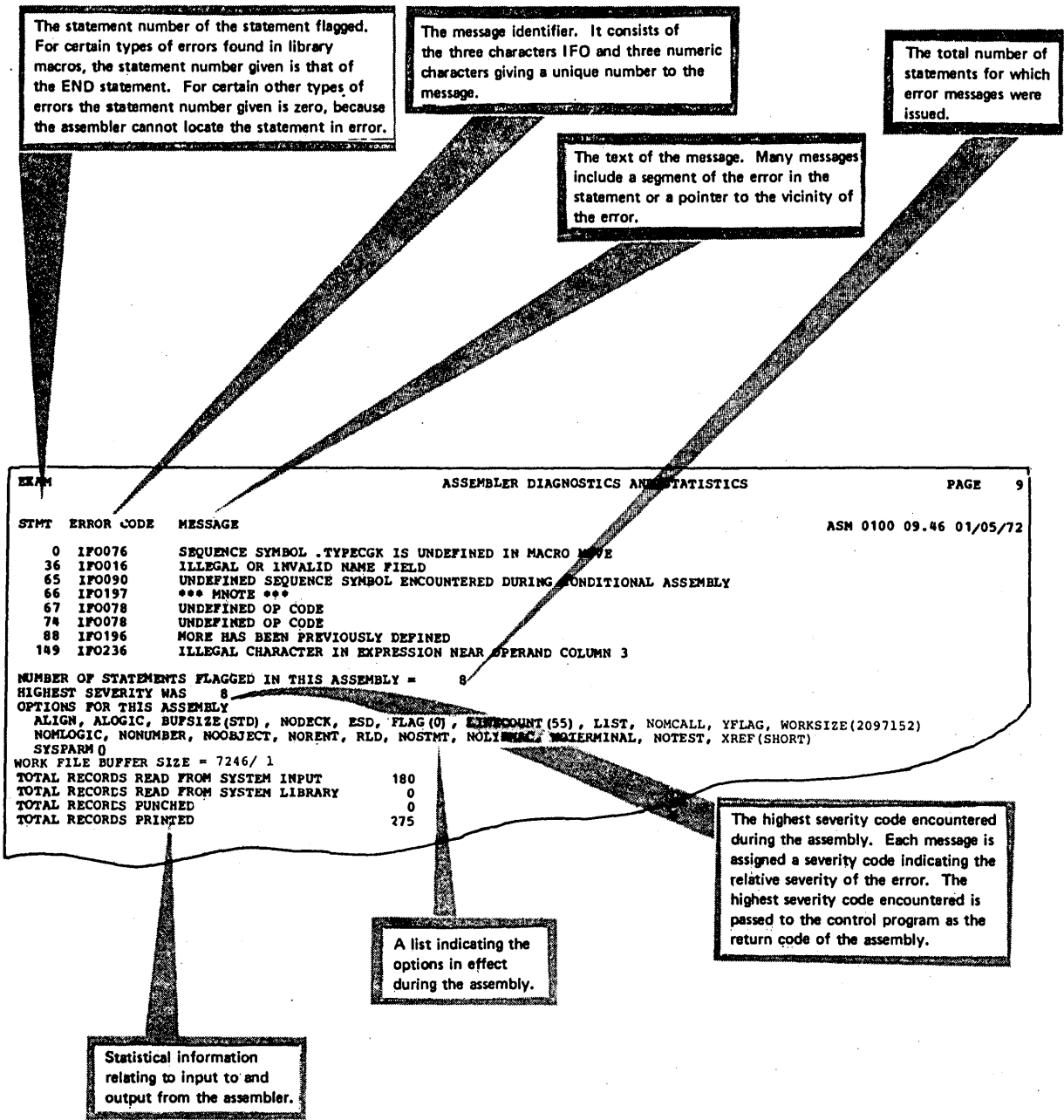
Figure 15 gives a detailed explanation of the diagnostics and statistics section of the listing. The following information may also be helpful in interpreting this section.

The diagnostic messages issued by the assembler are fully documented in Appendix G of this manual.

Error messages with the text IFO197 \*\*\*MNOTE\*\*\* indicate that an MNOTE message has been written in the source statement section of the listing. The MNOTE message is given a statement number which is indicated together with this diagnostic message.

Errors encountered during the processing of library macro definitions reference the END statement. (This is because library macros are read in by the assembler after the source code.) However, if you specify the LIBMAC assembler option, all system macro definitions will be listed after the END statement; an error will then reference the statement within the macro definition that caused the error.

To suppress error messages and MNOTE messages below a specified severity level, you can use the FLAG option.



```

EXAM                               ASSEMBLER DIAGNOSTICS AND STATISTICS                               PAGE 9
STMT ERROR CODE MESSAGE                                                    ASM 0100 09.46 01/05/72
 0 IFO076 SEQUENCE SYMBOL .TYPECGK IS UNDEFINED IN MACRO MOVE
36 IFO016 ILLEGAL OR INVALID NAME FIELD
65 IFO090 UNDEFINED SEQUENCE SYMBOL ENCOUNTERED DURING CONDITIONAL ASSEMBLY
66 IFO197 *** MNOTE ***
67 IFO078 UNDEFINED OP CODE
74 IFO078 UNDEFINED OP CODE
88 IFO196 MORE HAS BEEN PREVIOUSLY DEFINED
149 IFO236 ILLEGAL CHARACTER IN EXPRESSION NEAR OPERAND COLUMN 3

NUMBER OF STATEMENTS FLAGGED IN THIS ASSEMBLY = 8
HIGHEST SEVERITY WAS 8
OPTIONS FOR THIS ASSEMBLY
ALIGN, ALOGIC, BUFSIZE(STD), NODECK, ESD, FLAG(0), LINECOUNT(55), LIST, NOMCALL, YFLAG, WORKSIZE(2097152)
NOMLOGIC, NONUMBER, NOOBJECT, NORENT, RLD, NOSTMT, NOLYMIC, NOITERMINAL, NOTEST, XREF(SHORT)
SYSPARM 0
WORK FILE BUFFER SIZE = 7246/ 1
TOTAL RECORDS READ FROM SYSTEM INPUT 180
TOTAL RECORDS READ FROM SYSTEM LIBRARY 0
TOTAL RECORDS PUNCHED 0
TOTAL RECORDS PRINTED 275

```

Figure 15. Diagnostics and Statistics

# Programming Considerations

The purpose of this section is to serve as a bridge between Assembler Language and other manuals that you will use frequently when programming in the assembler language. Among the topics discussed are:

- Designing your program
- Specifying the entry point into your program.
- Linking with modules written in other programming languages.
- Linking with processing programs.

## Designing Your Program

When you design your program to run under VS, you must make sure that it follows the conventions required by that operating system. The minimum requirements for a very simple program are given in Figure 16.

However, you will hardly ever write such a simple program and will therefore want to refer to the section "Program Design" in OS/VS Supervisor Services and Macro Instructions. Among the topics covered there are:

- The linkage registers that the operating system uses in passing control between various components of the control program, and between the control program and your problem program. You should use the same registers when calling your own programs.
- Acquiring the information in the PARM field of the EXEC statement. In the same way as the assembler checks the options you specify for it in the PARM field, you can have your own program check the contents of that field.
- Saving the calling program's registers, so that they are not modified by the called program.
- Establishing a base register.
- Providing a save area, so that any programs called by your program can save the contents of your registers and restore the contents upon return. Note that certain system macro instructions (such as GET or PUT) call subroutines that assume that your program has provided a save area.
- Virtual storage considerations.
- Task creation.

The following coding shows the minimum number of instructions you need for a simple program. The program will be less than 4096 bytes long and will consist of only one control section. It will not call any subroutines or use any other IBM-supplied macros than SAVE and RETURN.

```

CSA      SAVE      (14,12)   Save registers for calling routine
        USING     CSA,15    The control program passes control
                               to the routine using register 15;
                               use that register as a base
        ST        13,SAVE13 Store address of calling routine's
                               save area
        .
        (your program)
        .
        L          13,SAVE13 Reload address of save area
        RETURN    (14,12)   Return to calling routine in AOS
SAVE13   DS        F        Space to save address of calling
                               routine's save area
        .
        (your constants and data areas)
        .
        END

```

Figure 16. Minimum Requirements for a Simple Program

## Specifying the Entry Point into Your Program

When your object module is link edited, either alone, or together with other modules, the entry point into the load module produced is determined by the linkage editor. (The entry point is the address in the load module to which control is given by the control program, when the load module is to be executed.)

You can use the assembler END instruction or the linkage editor ENTRY control statement to specify the entry point to the linkage editor, as explained under "Output From The Linkage Editor" in Linkage Editor and Loader.

## Linking with Modules Produced by other Language Translators

The modules produced by the assembler can be combined with other modules by the linkage editor. These modules can be object modules or load modules, and may have been originally written in any of the languages supported by the operating system. This makes it possible for you to use different programming languages for different parts of your program, allowing each part to be written in the language best suited for it.

However, when linking between modules produced by different language translators you must make sure that each module conforms to the data formats and linkage conventions required. If input/output operations are performed, you must also make sure that the appropriate DD statements are supplied for the data sets used in the different modules. For information on the requirements for linking between modules written in the assembler language and the problem-oriented languages, refer to the programmer's guide for the particular compiler you are using.

**Note:** The name `%%OBJSET` in the standard ASM cataloged procedures is incompatible with the procedures of most other processors.

## Linking with IBM-Supplied Processing Programs

You usually use the EXEC job control statement to load and give control to a processing program of the operating system. However, you can also load and give control to a sort program, a utility program, or even a compiler "dynamically", that is, by using a system macro instruction (LINK, XCTL, CALL, or ATTACH) in your own program. When calling a program dynamically, make sure you follow the OS/VS linking conventions described under "Program Design" in OS/VS Supervisor Services and Macro Instructions. You must also pass certain parameters to the processing program. These parameters give the same information to the program as you would supply in job control statements, if you called the program with an EXEC statement. Appendix D describes how to call the assembler dynamically. Dynamic invocation of each of the other IBM-supplied processing programs is covered in one of the manuals describing that program.



## Adding Macro Definitions to a Library

You can include your own macro definitions or other sections of often-used source code in the system macro library or in a private library that you concatenate with the system macro library. A macro library can consist of both macro definitions and sections of code to be inserted by the COPY assembler instruction.

You use the IEBUPDTE program to add members to a macro library. For further information on IEBUPDTE and the utility control statements needed, refer to OS/VS Utilities, Order No. GC35-0005. The following example shows how a new macro definition, NEWMAC, is added to the system macro library (SYS1.MACLIB).

```
//CATMAC      JOB          12345,BROWN.JR,...
//STEP1      EXEC        PGM=IEBUPDTE,PARM=MOD
//SYSUT1     DD          DSN=SYS1.MACLIB,DISP=OLD
//SYSUT2     DD          DSN=SYS1.MACLIB,DISP=OLD
//SYSPRINT   DD          SYSOUT=A
//SYSIN      DD          DATA
./           ADD         LIST=ALL,NAME=NEWMAC,LEVEL=01,SOURCE=0
              MACRO
              NEWMAC  &OP1,&OP2
              LCLA   &PAR1,&PAR2
              .
              .
              MEND
./           ENDUP
/*
```

The SYSUT1 and SYSUT2 DD statements indicate that SYS1.MACLIB, an existing program library, is to be updated. Output from the IEBUPDTE program is printed on the Class A output device (specified by SYSPRINT). The utility control statement ./ ADD and the macro definition follow the SYSIN statement. The ./ ADD statement specifies that the statements following it are to be added to the macro library under the name NEWMAC. When you include macro definitions in the library, the name specified in the NAME parameter of the ./ ADD statement must be the same as the operation code of the macro definition.

# Assembler Language Programming under CMS

This section of the manual is for programmers who code in the assembler language under CMS (Conversational Monitor System). It is intended to help you assemble and execute your program, to choose and specify the options you need and to interpret the listing and the diagnostic messages issued by the Assembler. To use this section effectively, you should be familiar with the Assembler language described in OS/VS - DOS/VS - VM/370 Assembler Language.

'Creating Your Assembler Language Program Using CMS' describes how you create an assembler language program using the CMS Editor, this section also describes how to define an OS data set as a CMS file.

'Assembling Your Program' describes the format of the CMS ASSEMBLE command, how you use the assembler options with CMS, and how CMS manages the assembly process.

'Executing Your Assembled Program' describes the commands for execution and for executing more than one module in an assembly. This section also describes CMS register usage during program execution and how parameters are passed to the program. Finally this section tells you how to create a module of your program, so that it will execute when you invoke its filename.

'Programming Aids' describes the assembler data sets and storage requirements of the assembler, and the diagnostics produced by CMS.

## Introduction

This section describes the purpose of the assembler, the relationship of the assembler to CMS, and the input for and the output of the assembler.

### Purpose of the Assembler

The purpose of the OS/VS - VM/370 assembler is to translate programs written in the assembler language into object code, that is, suitable for execution on an IBM System/370 machine.

### Relationship of the Assembler to CMS

The OS/VS - VM/370 assembler program is a part of VM/370; it is executed under control of the Conversational Monitor System (CMS). This assembler program is the same as that supplied with the OS/VS System. When you are using CMS, the VM/370: Command Language Guide for General Users, and the VM/370: EDIT Guide should be used for more detailed information about CMS.

### Input

As input, the assembler accepts a program written in the assembler language as defined in the publication OS/VS - DOS/VS - VM/370 Assembler Language. This program is referred to as a source module.

## Output

The output from the assembler consists of an object module and program listing. The object module is stored on your virtual disk in a TEXT file. You can bring it into your virtual storage and execute it by using the CMS LOAD and START commands. The program listing lists all the statements in the module, both in source and machine language format, and gives other important information about the assembly (such as error messages). The listing is described in detail in the section 'The Assembler Listing'.

## **Creating an Assembler Language Program: The CMS Editor**

To create an assembler language program using CMS, you can use the CMS EDIT command. The EDIT command invokes the CMS Editor, which provides an interactive environment for program creation, including subcommands that allow you to perform such functions as inserting and deleting lines and automatic tab setting. When you create an assembler language program under CMS, the EDIT command is entered in the following form:

```
EDIT      filename ASSEMBLE
```

where filename is the name of your file. You must ensure that you enter a filetype of ASSEMBLE, thus specifying to the Editor (and CMS) that you are creating an assembler language program. You can find a complete description of the Editor and its facilities in the publication VM/370: EDIT Guide.

When you have created your assembler language program, you use the CMS ASSEMBLE command to invoke the assembler program to assemble your program file.

### OVERRIDING CMS FILE DEFAULTS

When you issue the ASSEMBLE command, there are default FILEDEF's issued for Assembler data sets. You may want to override these with explicit FILEDEF's. The ddnames most likely to be overridden are:

```
ASSEMBLE      (SYSIN input to the assembler)
TEXT          (SYSLIN output of the assembler)
LISTING       (SYSPRINT output of the assembler)
PUNCH         (SYSPUNCH output of the assembler)
CMSLIB        (SYSLIB input to the assembler)
```

The default FILEDEF's issued by the assembler for the ddnames are:

```
FILEDEF ASSEMBLE DISK fn ASSEMBLE fm
```

```
(RECFM FB LRECL 80 Block 800
```

```
FILEDEF TEXT DISK fn TEXT fm
```

```
FILEDEF LISTING DISK fn LISTING fm
```

(RECFM FBA Block 1210

FILEDEF PUNCH PUNCH

FILEDEF CMSLIB DISK CMSLIB MACLIB \*

(RECFM FB LRECL 80 Block 800

A FILEDEF, issued to any of the above ddnames prior to invoking the assembler processor, will override the default FILEDEF issued by the assembler. Let's assume that there is an assembler source file in card deck form which you want to assemble. If you have this card deck read into your virtual machine reader, you must issue an overriding FILEDEF prior to assembling, i.e., FILEDEF ASSEMBLE READER. Now we can invoke the assembler as follows:

ASSEMBLE SAMPLE (options . . . .

The name "SAMPLE" will be used by the assembler as the filename for any TEXT or LISTING files produced by the assembler, provided a file SAMPLE ASSEMBLE does not exist on any accessed disk, in which case, an error message will be issued.

Similarly, if you have a tape containing an assembler input file which you want to assemble, you must issue the following commands:

FILEDEF ASSEMBLE TAPn (RECFM F LRECL 80 Block 80 or,

if the file is blocked,

FILEDEF ASSEMBLE TAPn (RECFM FB LRECL 80 Block 80\*N

followed by

ASSEMBLE SAMPLE (options . . . .

You can use OS data sets on CMS files by defining those data sets with the FILEDEF command. For example,

FILEDEF ASSEMBLE DISK HAPPY ASSEMBLE B4 DSN=OS.DATASET

where:

B4 is the mode of the OS disk to be accessed.

DSN=OS.DATASET is the name of the OS data set to be used for input.

To assemble this, issue:

ASSEMBLE HAPPY

The same examples used here for input files can be applied to other ddnames. Care should be taken that any attributes specified for the file conform to the assembler expected attributes or to the defined attributes for the device, i.e., PUNCH LRECL 80 BLOCK 80, TERMINAL 132.

## Assembling Your Program: The Assemble Command

Once you have created or defined a source program, you assemble the program using the CMS ASSEMBLE command. This command invokes the Assembler Program. This section describes how you use ASSEMBLE.

### ASSEMBLE COMMAND FORMAT

You use the ASSEMBLE command to create an object file from a source file. The source program can be created by the CMS Editor or it can be created externally and defined for use under CMS by the FILEDEF command. ASSEMBLE takes the following form:

```
ASSEMBLE Filename (options [])
```

where filename is the name of the file you are assembling and options is a series of keywords used to specify functions associated with the assembler.

### The Filename Entry

When your file has been created by the CMS Editor, you use the filename associated with the file when you issue the ASSEMBLE command. If your file has been defined for use under CMS by the FILEDEF command, you use a dummy or unique filename to be used by the assembler to define the LISTING and TEXT files the assembler produces. You need not enter the standard CMS filetype field, since the default filetype is ASSEMBLE.

### Assemble Options for CMS

Assembler options are functions of the assembler that you, as an assembler language programmer, can select. For example, you can use assembler options to specify whether or not you want the assembler to produce an object deck; whether or not you want it to print certain items in the listing; and whether or not you want it to check your program for reenterability. In CMS, the assembler options can be divided into four categories:

- Listing control options, which determine the information to be included in the program listing.
- Output control options, which specify the device on which the assembler object module is to be written and the contents of the module.
- SYSTEM options, which determine the information to be included in the listing produced on the SYSTEM data set. This data set is primarily for use by the Time Sharing Option (TSO) of VS2.
- Other assembler options, which specify miscellaneous functions and values for the assembler.

You will notice that in the discussion that follows, the options fall into two types:

- Simple pairs of keywords: a positive form (for example, DECK) that requests a function, and an alternative negative form (for example, NODECK) that rejects the function.
- Keywords that permit you to assign a value to a function, for example, LINECOUNT (40).

You use the option field of the ASSEMBLE command line to enter the assembler options. The list of options must be preceded by a left parenthesis. Each option must be separated from the next by a blank space. The closing parenthesis of the option field is optional.

THE LISTING CONTROL OPTIONS: The list below describes the assembler options you can use to control the assembler listing. The default values are underscored.

<u>ALOGIC</u>	Conditional assembly statements processed in open code are listed.
NOALOGIC	The ALOGIC option is suppressed.
<u>ESD</u>	The external symbol dictionary (ESD) is listed.
NOESD	No ESD listing is printed.
<u>LIST</u>	An assembler listing is produced.
NOLIST	No assembler listing is produced. This option overrides ESD, RLD, and XREF.
MCALL	Inner macro instructions encountered during macro generation are listed following their respective outer macro instruction. The assembler assigns statement numbers to these instructions. The MCALL option is implied by the MLOGIC option; NOMCALL has no effect if MLOGIC is specified.
<u>NOMCALL</u>	The MCALL option is suppressed.
MLOGIC	All statements of a macro definition processed during macro generation are listed after the macro instruction. The Assembler assigns statement numbers to them.
<u>NOMLOGIC</u>	The MLOGIC option is suppressed.
LIBMAC	The macro definitions read from the macro libraries and any assembler statements following the logical END statement are listed after the logical END statement. The logical END statement is the first END statement processed during macro generation. It may appear in a macro or in open code: it may even be created by substitution. The assembler assigns statement numbers to the statements that follow the logical END statement.
<u>NOLIBMAC</u>	The LIBMAC is suppressed.
<u>RLD</u>	The assembler produces the relocation dictionary as part of the listing.
NORLD	The RLD is not printed.
XREF (FULL)	The assembler listing will contain a cross reference table of all symbols used in the assembly. This includes symbols that are defined but never referenced. The assembler listing will also contain a cross reference table of literals used in the assembly.

XREF (SHORT) The assembler listing will contain a cross reference table of all symbols that are referenced in the assembly. Any symbols defined but not referenced are not included in the table. The assembler listing will also contain a cross reference table of literals used in the assembly.

NOXREF No cross reference tables are printed.

PRINT PRINT writes the LISTING file to the printer.

NOPRINT You should select this option if you do not want the assembler to produce a LISTING file.

DISK DISK is the default value and places the LISTING file on a minidisk.

FLAG  $\left. \begin{array}{l} (nnn) \\ (0) \end{array} \right\}$  Diagnostic messages and MNOTE messages below severity code nnn will not appear in the listing. Diagnostic messages can have severity codes of 4, 8, 12, 16, or 20 (20 is the most severe), and MNOTE severity codes can be between 0 and 255. For example, FLAG(8) suppresses diagnostic messages with severity codes of 0 through 7.

YFLAG Diagnostic message IF0205 and its severity code will appear in the listing.

NOYFLAG The YFLAG option is suppressed.

LINECOUNT  $\left. \begin{array}{l} (nnn) \\ (55) \end{array} \right\}$  nnn specifies the number of lines to be listed between headings in the listing.

THE OUTPUT CONTROL OPTIONS: are used to control the object module output of the assembler.

DECK The object module is written on the device specified for the PUNCH file. If this option is specified together with the OBJECT option, the object module will be written both on the PUNCH and TEXT files.

NODECK. The DECK option is suppressed.

OBJECT or OBJ The object module is written on the device specified in the TEXT DD statement. If this option is specified together with the DECK option, the object module will be written both on the TEXT and on PUNCH files.

NOOBJECT or NOOBJ The OBJECT is suppressed.

TEST The special source symbol table (SYM cards) is included in the object module.

NOTEST No SYM cards are produced.

THE SYSTEM OPTIONS: Are used to control the SYSTEM file associated with your assembly.

TERMINAL or TERM The assembler writes diagnostic information on the SYSTEM data set. The diagnostic information, described in detail in the section Assembler Data Sets and Storage Requirements, consists of the diagnosed statement followed by the error message issued.

NOTERM                   The terminal option is suppressed.

NUMBER or               The line number field (columns 73-80 of the input  
NUM                    records is written in the SYSTEM listing for  
                          statements for which diagnostic information is given.  
                          This option is valid only if TERMINAL is specified.

NONUMBER or              The number option is suppressed.  
NONUM

STMT                    The statement number assigned by the assembler is  
                          written in the SYSTEM listing for statements for which  
                          diagnostic information is given. This option is valid  
                          only if TERMINAL is specified.

NOSTMT                   The STMT option is suppressed.

OTHER ASSEMBLER OPTIONS: The options below allow you to specify various functions and values for the assembler.

RENT                     The assembler checks your program for a possible  
                          violation of program reenterability. Code that makes  
                          your program non-reentrant is identified by an error  
                          message.

NORENT                 The RENT option is suppressed.

ALIGN                 All data is aligned on the proper boundary in the  
                          object module for example, an F-type constant is  
                          aligned on a fullword boundary. In addition, the  
                          assembler checks storage addresses used in machine  
                          instructions for alignment violations.

NOALIGN                 The assembler does not align data areas other than  
                          specified in CCW instructions. The assembler does not  
                          skip bytes to align constants on proper boundaries.  
                          Alignment violations in machine instructions are not  
                          diagnosed.

BUFSIZE (MIN)           The assembler uses the minimum buffer size (790 bytes)  
                          for each of the utility data sets (SYSUT1, SYSUT2, and  
                          SYSUT3). Storage normally used for buffers is  
                          allocated to work space. Because more work space is  
                          available, more complex programs can be assembled in a  
                          given region; but the speed of the assembly is  
                          substantially reduced.



BUFSIZE (STD)

The buffer size that gives the optimum performance is chosen. The buffer size depends on the size of the virtual machine. Of the assembler working storage in excess of minimum requirements, 37% is allocated to the utility data set buffers, and the rest to macro generation dictionaries.

BUFSIZE (MAX)

The assembler uses up to 15 save areas for input records and saves them, according to their frequency of use, to optimize the macro generation phase. This option is useful when large and/or many macros are used in the assembly. This option has no effect unless a region big enough is available. The number of allocated save areas is printed in the statistics page of the assembler listing.

Refer to the section Assembler Data Sets and Storage Requirements for a more complete description of the effects of BUFSIZE.

WORKSIZE { (nnnnnK)  
(2048K) }

This option allows user to delimit the use of region space. The value specified does not include the space for modules and system areas. Allowed range is 32K to 10240K. WORKSIZE - option has no effect, unless specified for the assembler step in JCL is bigger.

SYSPARM { (string)  
(?)  
(null  
string) }

'string' is the value assigned to the system variable symbol SYSPARM (explained in Assembler Language, GC33-4010).



## Using SYSPARM under CMS

In its parsing of the command line, CMS breaks the line into eight-character tokens. Therefore, the SYSPARM field under CMS is limited to an eight-character entry. However, you can enter larger items using the special question mark symbol (?) in the option field. When CMS encounters this symbol in the command line, it will prompt you with the message

```
ENTER SYSPARM:
```

You may then enter as many characters as you want up to the option limit of 100 characters.

To use parentheses or embedded blanks in your SYSPARM field, you must also use the question mark.

The following code is an example of how to use the question mark in the SYSPARM field:

```
assemble test (load deck sysparm(?)
ENTER SYSPARM:
EEam,'bo) .fy
.
.
.
R;
```

### Overriding the SYSPARM Question Mark Entry

If you enter the question mark in the SYSPARM field and attempt to override it with a subsequent SYSPARM entry, that SYSPARM entry overrides the question mark symbol, just as it is supposed to.

However, once CMS encounters the question mark symbol you are prompted whether or not you override it.

Therefore, if you have overridden the question mark you must press the Enter Key when CMS prompts you with ENTER SYSPARM.

## CMS Management of Your Assembly

When you assemble a program under CMS, permanent and temporary files are created and CMS performs certain processing steps. This section describes how CMS manages this processing.

### Files Created During Assembly

During the assembly of your program, files are created by CMS. Some files are permanent, others temporary. The permanent files are:

- An ASSEMBLE File, which is the source code used as input by the assembler.
- The LISTING File, which contains the listing produced by the assembler, describing the results of the assembly.
- The TEXT File, which contains the object code created during the assembly.

Temporary files created during assembly are the SYSUT1, SYSUT2, and SYSUT3 files, which are used as work files during assembly of your program.

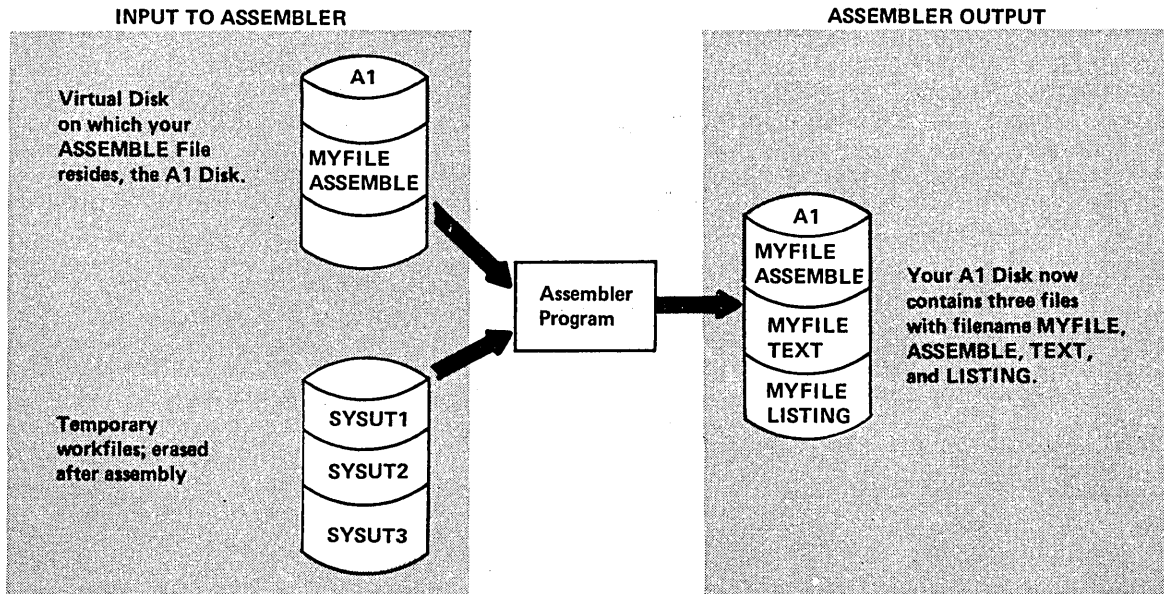


Figure 17. Files Created During Assembly

The utility files are placed on the Read/Write disk with the most available write space.

The TEXT and LISTING files are placed on one of three possible disks, if they are available.

1. The disk on which the source file resides.
2. The parent disk of the above disk (if it exists).
3. The primary disk.

If all three attempts fail to place the information on a Read/Write disk, the assembly will terminate with an error message.

#### File Processing by the Assembler

When assembling under CMS, there are two new files created, each with the filename of the source ASSEMBLE file, but with filetypes of TEXT and LISTING. During assembly, any files residing on the virtual disk being processed, with the filename of the file you are processing and filetypes of TEXT or LISTING will be erased. The new TEXT and LISTING files created during assembly take their place on your processing disk unless you specify otherwise. These files are erased even if you specify via NOOBJ and NOLIST that there will be no new files to replace them. CMS also defines the utility files for your assembly, thus eliminating the need for you to define them. At the end of assembly, all of the utility files are erased.

## Loading and Executing Your Assembled Program

Once you have assembled your program file, you can load and execute the resulting TEXT file (containing object code) using the CMS LOAD and START commands. The LOAD command causes your TEXT file to be loaded into storage in your virtual machine and the START command begins execution of the program. If you are assembling more than one file, use the CMS INCLUDE command to bring the additional files into storage. These commands and the options associated with them are described in VM/370: Command Language Guide for General Users.

### CMS REGISTER USAGE DURING EXECUTION OF YOUR PROGRAM

CMS reserves four registers for its own use during the execution of an assembler language program. When control is received from the user program, the entry point address for the program is placed in register 15. Register 1 contains the address of a parameter list, which contains any parameters passed to the program. Register 13 contains the address of the save area. Register 14 contains the section address to return control to the control program.

### PASSING PARAMETERS TO YOUR ASSEMBLER LANGUAGE PROGRAM

CMS provides you with the ability to pass parameters to an assembler language program by means of the START command. The statement below shows how to pass parameters to your program using the CMS START command:

```
START MYJOB PARM1 PARM2
```

The parameters must be no longer than eight characters and must be separated by blanks.

CMS creates a list of the parameters for use during execution. The parameter list for the command above would look like:

```
PLIST DS OD
      DC CL8'MYJOB'
      DC CL8'PARM1'
      DC CL8'PARM2'
      DC 8X'FF'
```

where the list is delimited by the hexadecimal fence of FF's.

## Assembler Macros Supported by CMS

There are several macros you can use in assembler programs. Among the services provided by these macros are the ability to write a record to disk, to read a record from disk, to write lines to a virtual printer etc, etc. All of the CMS Assembler Macros are described in VM/370: Command Language Guide for General Users.

## Creating a Module of Your Program

When you are sure that your program executes properly, you may want to create a module of it, so that you can execute it by simply invoking its filename on the command line.

To create a module, you use the LOAD, GENMOD, and, in some cases, the LOADMOD commands. See the section on creating a module in VM/370: Command Language Guide for General Users for more information.

## Programming Aids

This section gives you reference information about the assembler. It describes the data sets used by the assembler, assembler storage requirements, information about the assembler listing and SYSTERM listing, and about the diagnostic messages generated by CMS.

### ASSEMBLER DATA SETS AND STORAGE REQUIREMENTS

This section describes the data set used by the assembler. It also describes the main storage and auxiliary storage requirements of the assembler. This description is intended for programmers who want to alter the assembler's region or partition size or data set parameters (such as buffer size).

#### Assembler Data Sets for CMS Users

This section describes the data sets used by the assembler to assemble your program under CMS; these data sets are referred to as files.

DDname SYSUT1, SYSUT2, and SYSUT3: The assembler uses the utility data sets as intermediate external storage devices when processing the source program. These data sets must be organized sequentially, and the devices assigned to them must be direct access devices, magnetic tape units, or a combination of both. The assembler does not support multivolume utility data sets.

DDname ASSEMBLE: This data set contains the input to the assembler -- the source statements to be processed. The input device assigned to this data set may be DISK, RDR, or TAPE, or another sequential input device that you have designated. The FILEDEF command describing this data set appears in the input stream.

DDname CMSLIB: From this data set whose filetype must be MACLIB the assembler obtains macro definitions and assembler language statements that can be called by the COPY or a macro assembler instruction. It is a partitioned data set: each macro definition or sequence of assembler language statements is a separate member, with the member name being the macro instruction mnemonic or COPY code name. The data set may be CMSLIB or a private macro library. OSMACRO contains macro definitions for the IBM-supplied macro instructions supported by CMS. Private libraries and CMSLIB can be concatenated with each other in any order by the GLOBAL command.

DDname LISTING: This data set is used by the assembler to produce a listing. Output may be directed to a printer, magnetic tape, or direct-access storage device. The default device is DISK. The assembler uses the ANSI carriage-control characters for this data set. The smallest blocksize recommended is 1089 (blocking factor of 9).

DDname PUNCH: The assembler uses this data set to produce a punched copy of the object module. The output unit assigned to this data set may be either a card punch or an intermediate storage device capable of sequential access.

DDname TEXT: This is a direct-access storage device or magnetic tape data set used by the assembler. It contains the same output text (object module) as SYSPUNCH. It is used as input for the CMS LOADER.

DDname SYSTEM: This data set is used by the assembler to produce diagnostic information. The output may be directed to a remote terminal, a printer, a magnetic tape, or a direct-access storage device. The assembler uses the ANSI carriage control characters for this data set. The smallest blocksize recommended is 1089 (blocking factor of 9).

### Assembler Virtual Storage Requirements

The minimum size virtual machine required by the assembler is 256K bytes. However, better performance is generally achieved if the assembler is run in 320K bytes of virtual storage. This size is recommended for medium and large assemblies.

If more virtual storage is allocated to the assembler, the size of buffers and work space can be increased. The amount of storage allocated to buffers and work space determines assembler speed and capacity. Generally, as more storage is allocated to work space, larger and more complex macro definitions can be handled.

You can control the buffer sizes for the assembler utility data sets (SYSUT1, SYSUT2, and SYSUT3) and the size of the work space used during macro processing, by specifying the BUFSIZE assembler option. Of the storage given, the assembler first allocates storage for the ASSEMBLE and CMSLIB buffers according to the specifications in the DD statements supplied by the FILEDEF for the data sets. It then allocates storage for the modules of the assembler. The remainder of the virtual machine is allocated to utility data set buffers and macro generation dictionaries according to the BUFSIZE option specified:

BUFSIZE (STD) : 37% is allocated to buffers, and 63% to work space. This is the default chosen, if you do not specify any BUFSIZE option.

BUFSIZE (MIN) : Each utility data set is allocated a single 790-byte buffer. The remaining storage is allocated to work space. This allows relatively complex macro definitions to be processed in a given virtual machine size, but the speed of the assembly is substantially reduced.

### THE CMS SYSTEM LISTING

The SYSTEM data set gives you rapid access to the diagnostic messages issued during an assembly. The data set can also be directed to a printer, a magnetic tape, or a direct-access device.

You use the assembler option TERMINAL to specify that you want a SYSTEM listing to be produced.

Each diagnosed statement in the assembly listing printed in the SYSTEM listing immediately followed by the messages that are issued for the statement. To help identify the position of the statement in your program, two additional assembler options are available:

- NUMBER, which prints the line number(s) of the diagnosed statement.
- STMT, which prints the statement number assigned to the diagnosed statement by the assembler.

The format of the flagged statement as it appears in the listing is:

Line No.(s) (option NUM)	Statement No. (option STMT)	Source record(s) (Columns 1-72 of the source statement lines)
-----------------------------	--------------------------------	--

If a statement contains continuation lines, it will occupy several lines in the listing, each identified by a line number (if option NUMBER is used). If a statement in error is discovered during the expansion of a macro, or of any inner macro called by an outer macro, the first line of the outer macro instruction is listed before the flagged statement. If a statement is flagged during variable symbol substitution in open code, the first line of the model statement is listed as well as the generated statement.

Figure 18 shows the SYSTEM listing produced during the same assembly. The example illustrates the rules given above. Options TERMINAL, NUMBER, and STMT were in effect during the assembly.

The SYSTEM listing starts with the statement ASSEMBLER DONE. At the end of the listing the number of statements flagged in the assembly is generated:

NUMBER OF STATEMENTS FLAGGED IN THIS ASSEMBLY = nn  
(Indicates the total number of source statements in error)

ASSEMBLER (XF) DONE				
17	L	R2,END	END OF AREA	
IF0188 END IS AN UNDEFINED SYMBOL				
18	LA	R3,A	THIS IS A	*
			DUMMY COMMENT	*
			TO SHOW	*
IF0188 A IS AN UNDEFINED SYMBOL				
IF0069 EXCESSIVE CONTINUATION CARDS, TWO ALLOWED				
			A STATEMENT CONTAINING	*
			TOO MANY CONTINUATION CARDS	*
25	SR	EQ,EQ	OPEN CODE MODEL STATEMENT	*
			WITH CONTINUATION CARD	*
26+	SR	B,B	OPEN CODE MODEL STATEMENT	*
+			WITH CONTINUATION CARD	*
IF0188 B IS AN UNDEFINED SYMBOL				
IF0188 B IS AN UNDEFINED SYMBOL				
35	GENF	1,234	EXAMPLE OF MORE THAN ONE CARD	*
36+1234	DC	F'234'		
IF0125 INVALID NAME- ILLEGAL EMBEDDED CHARACTER OR NON-ALPHABETIC FIRST CHARACTER				
NUMBER OF STATEMENTS FLAGGED IN THIS ASSEMBLY =			4	

Figure 18. SYSTEM listing



## DIAGNOSTIC MESSAGES WRITTEN BY CMS

If an error occurs during execution of the ASSEMBLE command, a message may be typed at the terminal, and, at completion of the command, register 15 contains a nonzero return code. The messages are in two parts; a message code and the message text. The message code is in the form 'DMSASMnnnt', where DMSASM indicates that the message was generated by the ASSEMBLE command program, nnn is the number of the message, and t is the type of the message. The message text describes the error condition.

The actual message typed may not be complete. By using the CP SET (EMSG) command, the user can specify that the entire error message be typed, or only the error code, or only the text, or neither code nor text. The VM/370: Command Language Guide for General Users contains a description of the CP SET command.

Diagnostic and error messages originating in the assembler are typed at the terminal in the form IFOnnn text, unless NOTERM is specified. Errors detected by the ASSEMBLE command program, which terminate the command before the system assembler is called, result in error messages (type E).

For additional information about the text, format, or codes regarding the messages for ASSEMBLE see VM/370 System Messages, Order No. GC20-1808.

## ASSEMBLE COMMAND ERROR MESSAGES

DSMASM001E NO FILENAME SPECIFIED

Explanation: You have not included a filename in the ASSEMBLE command.

Assembler Action: RC = 24

Execution of the command terminates. The system remains in the same status as before the command was entered.

Programmer Response: Reissue the ASSEMBLE command and specify a filename.

DMSASM002E FILE 'filename' ASSEMBLE NOT FOUND

Explanation: The filename that you included in the ASSEMBLE command does not correspond to the names of any of the files on your disks.

Supplemental Information: The variable filename in the text of the message indicates the name of the file that could not be found.

Assembler Action: RC = 28

Execution of the command terminates. The system remains in the same status as before the command was entered.

Programmer Response: Reissue the ASSEMBLE with an appropriate filename.

DMSASM003E INVALID OPTION 'option'

Explanation: you have included an invalid option with your ASSEMBLE command.

Supplemental Information: The variable option in the text of the message indicated the invalid option.

Assembler Action: RC = 24

Execution of the command terminates. The system remains in the same status as before the command was entered.

Programmer Response: check the format of the ASSEMBLE command and reissue the command with the correct option.

DMSASM006E NO READ/WRITE DISK ACCESSED

Explanation: Your virtual machine configuration does not include a read/write disk for this terminal session or you failed to specify a read/write disk.

Assembler Action: RC = 36

Execution of the command terminates. The system remains in the same status as before the command was entered.

Programmer Response: Issue an ACCESS command specifying a read/write disk.

DMSASM007E FILE 'filename' ASSEMBLE IS NOT FIXED, 80 CHAR RECORDS

Assembler Action: The ASSEMBLE source file that you specified in the ASSEMBLE command does not contain fixed length records of 80 characters. The command cannot be executed.

Supplemental Information: The variable filename in the text of the message indicates the name of the file that is in error.

Programmer Response: You must reformat your file into the correct record length. CMS EDIT or COPYFILE can be used to reformat the file.

DMSASM038E FILE ID CONFLICT FOR DDNAME "ASSEMBLE"

Explanation: You issued a FILEDEF command that conflicts with an existing FILEDEF for the ddname specified.

Supplemental Information: The variable ddname in the text of the message indicates the ddname in error.

Assembler Action: RC = 40

Execution of the command terminates. The system remains in the same status as before the command was entered.

Programmer Response: Reissue the FILEDEF command with an appropriate ddname.

DMSASM052E MORE THAN 100 CHARS, OPTIONS SPECIFIED

Explanation: The string of options that you specified with your ASSEMBLE command exceeded 100 characters in length.

Assembler Action: RC = 24

Execution of the command terminates. The system remains in the same status as before the command was entered.

Programmer Response: Reissue your ASSEMBLE command with fewer options specified.

DMSASM070E INVALID PARAMETER 'parameter'

Explanation: You specified an invalid parameter for an option in the ASSEMBLE command.

Supplemental Information: The variable parameter in the text of the message indicates the invalid parameter.

Assembler Action: RC = 24

Execution of the command terminates. The system remains in the same status as before the command was entered.

Programmer Response: Check the format of the option with its appropriate parameters and reissue the command with the correct parameter.

DMSASM074E ERROR { SETTING } AUXILIARY DIRECTORY  
          { RESETTING }

Explanation: There are two conditions which could cause the message to be generated:

1. The disk containing the assembler modules (that is, the disk specified at Auxiliary Directory generation via the GENDIRT mode field) has not been accessed.
2. An attempt to reset the File Status Table has failed, thereby removing the Auxiliary Directory from the search chain. Either the Auxiliary Directory was not included in the File Status Table chain, or a processing error has caused the disk containing the assembler modules to appear to be not accessed.

Assembler Action: RC = 40

Execution of the command terminates. The system remains in the same status as before the command was entered.

Programmer Response: Verify that the disk containing the assembler modules has been accessed using the proper mode specification (that is, the mode specified via GENDIRT when the Auxiliary Directory was generated). If the error occurred resetting the Auxiliary Directory, contact installation maintenance personnel.

DMSASM075E    DEVICE device name ILLEGAL FOR INPUT

Explanation: The device specified in your FILEDEF command cannot be used for the input operation that is requested in your program. For example, you have tried to read data from the printer.

Supplemental Information: The variable device name in the text of the message indicates the incorrect device that was specified.

Assembler Action: RC = 40  
Execution of the command terminates. The system remains in the same status as before the command was entered.

Programmer Response: Reissue your FILEDEF command specifying an appropriate device for the desired input operation.

## Appendix A: Glossary

The following terms are defined as they are used in this manual. If you do not find the term you are looking for, refer to the Index or to the IBM Data Processing Glossary, Order No. GC20-1699.

The terms are of three different kinds:

- Definitions made by the American National Standards Institute (ANSI). Such definitions are marked by an asterisk (\*).
- Definitions valid for OS. Such definitions are marked by an O.
- Definitions of terms that are used in describing the logic of the OS Assembler. They are included here only because they are used in the assembler diagnostic messages. For further information on these terms, refer to OS/VS - VM/370 Assembler Logic, GY33-8041. Such definitions are marked by an A.

IBM is grateful to the American National Standards Institute (ANSI) for permission to reprint its definitions from the American National Standard Vocabulary for Information Processing, which was prepared by Subcommittee X3K5 on Terminology and Glossary of American National Standards Committee X3.

This glossary does not explain terms pertaining to the assembler language. Such terms are covered in the glossary of Assembler Language.

Oassemble. To prepare a machine language program from a symbolic language program by substituting machine operation codes for symbolic operation codes and absolute or relocatable addresses for symbolic addresses.

★assembler. A computer program that assembles.

Oassembler instruction. An assembler language source statement that causes the assembler to perform a specific operation. Assembler instructions are not translated into machine instructions.

Oassembler language. A source language that includes symbolic machine language statements in which there is a one-to-one correspondence with the instruction formats and data formats of the computer. The assembler language also contains statements that represent assembler instructions and macro instructions.

Oassembler option. A function of the assembler requested for a particular job step.

Oauxiliary storage. Online storage other than main storage; for example storage on magnetic tapes or on direct access devices.

Ocataloged procedure. A set of job control statements that has been placed in a partitioned data set called the procedure library, and can be retrieved by naming it in an execute (EXEC) statement or started by the START command.

Oconcatenated data sets. A group of logically connected data sets that are treated as one data set for the duration of a job step.

control program. A program that is designed to schedule and supervise the performance of data processing work by a computing system.

Control section. That part of a program specified by the programmer to be a relocatable unit, all elements of which are to be loaded into adjoining main storage locations.

Odata set. The major unit of data storage and retrieval in the operating system, consisting of a collection of data in one of several prescribed arrangements and described by control information to which the system has access.

\*diagnostic. Pertaining to the detection and isolation of a malfunction or mistake.

Aedited text. Source statements modified by the assembler for internal use. The initial processing of the assembler is referred to as editing.

\*entry point. A location in a module to which control can be passed from another module or from the control program.

ESD. (See external symbol dictionary)

Oexecute (EXEC) statement. A job control language (JCL) statement that marks the beginning of a job step and identifies the program to be executed or the cataloged or in-stream procedure to be used.

Oexternal symbol dictionary (ESD). Control information associated with an object or load module which identifies the external symbols in the module.

Aglobal dictionary. An internal table used by the assembler during macro generation to contain the current values of all unique global SETA, SETB, and SETC variables from all text segments.

Aglobal vector table. A table of pointers in the skeleton dictionary of each text segment showing where the global variables are located in the global dictionary.

Oinput stream. The sequence of job control statements and data submitted to an operating system on an input unit especially activated for this purpose by the operator.

instruction.

- \* 1. A statement that specifies an operation and the values and locations of its operands.
- 2. (See assembler instruction, machine instruction, and macro instruction)

JCL. (See job control language)

\*job. A specified group of tasks prescribed as a unit of work for a computer. By extension, a job usually includes all necessary computer programs, linkages, files, and instructions to the operating system.

Ojob control language (JCL). A language used to code job control statements.

\*job control statement. A statement in a job that is used in identifying the job or describing its requirements to the operating system.

job step.

- \* 1. The execution of a computer program explicitly identified by a job control statement. A job may specify that several job steps be executed.
- 0 2. A unit of work associated with one processing program or one cataloged procedure and related data. A job consists of one or more job steps.

Ojobname. The name assigned to the JOB statement; it identifies the job to the system.  
language. A set of representations, conventions, and rules used to convey information.

\*language translator. A general term for any assembler, compiler, or other routine that accepts statements in one language and produces equivalent statements in another language.

Olibrary. (See partitioned data set)

Olibrary macro definition. A macro definition that is stored in a macro library. The IBM-supplied supervisor and data management macro definitions are examples of library macro definitions.

Olinkage editor. A processing program that prepares the output of language translators for execution. It combines separately produced object or load modules; resolves symbolic cross references among them; replaces, deletes, and adds control sections; and generates overlay structures on request; and produces executable code (a load module) that is ready to be fetched into main storage and executed.

Olinking conventions. A set of conventions for passing control between different routines of the operating system.

Oload module. The output of a single linkage editor execution. A load module is in a format suitable for loading into virtual storage for execution.

Oload module library. A partitioned data set that is used to store and retrieve load modules.

Oloader. A processing program that performs the basic editing functions of the linkage editor, and also fetches and gives control to the processed program, all in one job step. It accepts object modules and load modules created by the linkage editor and generates executable code directly in storage. The loader does not produce load modules for program libraries.

Alocal dictionary. An internal table used by the assembler during macro generation to contain the current values of all local SET symbols. There is one local dictionary for open code, and one for each macro definition.

Olocation counter. A counter whose value indicates the assembled address of a machine instruction or a constant or the address of an area of reserved storage, relative to the beginning of the control section.

\*machine instruction. An instruction that a machine can recognize and execute.

\*machine language. A language that is used directly by the machine.

macro. (See macro instruction and macro definition)

macro call. (See macro instruction)

Macro definition. A set of statements that defines the name of, format of, and conditions for generating a sequence of assembler language statements from a single source statement. This statement is a macro instruction that calls the definition. (See also library macro definition and source macro definition)

macro expansion. (See macro generation)

Macro generation (macro expansion). An operation in which the assembler generates a sequence of assembler language statements from a single macro instruction, under conditions described by a macro definition.

Macro instruction (macro call). An assembler language statement that causes

Macro library. A library containing macro definitions. The supervisor and data management macro definitions supplied by IBM (GET, LINK, etc.) are contained in the system macro library. Private macro libraries can be concatenated with the system macro library.

Main storage. All program addressable storage from which instructions may be executed and from which data can be loaded directly into registers.

Module. (see load module, object module, and source module)

Object module. The machine-language output of a single execution of an assembler or a compiler. An object module is used as input to the linkage editor or loader.

\*online storage. Storage under the control of the central processing unit.

Open code. The portion of a source module that lies outside of and after any source macro definitions that may be specified.

\*operating system. Software which controls the execution of computer programs and which may provide scheduling, debugging, input/output control, accounting, compilation, storage assignment, data management, and related services.

Ordinary symbol attribute reference dictionary. A dictionary used by the assembler. The assembler puts an entry in it for each ordinary symbol encountered in the name field of a statement. The entry contains the attributes (type, length, etc.) of the symbol.

Option. (See assembler option)

Partitioned data set (library). A data set in direct access storage that is divided into partitions, called members, each of which can contain a program or a part of a program. Each partitioned data set contains a directory (or index) that the control program can use to locate a program in the partitioned data set.

Procedure step. A unit of work associated with one processing program and related data within a cataloged procedure. A cataloged procedure consists of one or more procedure steps.

Processing program.

1. A general term for any program that is not a control program.



2. Any program capable of operating in the problem program state. This includes IBM-distributed language translators, application programs, service programs, and user-written programs.

Oprogram.

1. A general term for any combination of statements that can be interpreted by a computer or language translator, and that serves to perform a specific function.
2. To write a program.

programmer macro definition. (See source macro definition)

Oreal storage. The storage of a System/370 computer from which the central processing unit can directly obtain instructions and data and to which it can directly return results.

\*relocation dictionary. The part of an object or load module that identifies all addresses that must be adjusted when a relocation occurs.

Oreturn code. A value placed in the return code register at the completion of a program. The value is established by the user and may be used to influence the execution of succeeding programs or, in the case of an abnormal end of task, may simply be printed for programmer analysis.

Osequential data set. A data set whose records are organized on the basis of their successive physical positions such as on magnetic tape.

Oseverity code. A code assigned by the assembler to each error detected in the source code. The highest code encountered during assembly becomes the return code of the assembly step.

Askeleton dictionary. A dictionary built by the assembler for each text segment. It contains the global vector, the sequence symbol reference dictionary, and the local dictionary.

Osource macro definition. A macro definition included in a source module, either physically or as the result of a COPY instruction.

Osource module. The source statements that constitute the input to a language translator for a particular translation.

Osource statement. A statement written in symbols of a programming language.

\*statement. A meaningful expression or generalized instruction in a source language.

step. (See job step and procedure step)

Ostepname. The name assigned to an execute (EXEC) statement. It identifies a job step within a job.

Osymbolic parameter.

1. In JCL, a symbol preceded by an ampersand that appears in a cataloged procedure. Values are assigned to symbolic parameters when the procedure in which they appear is called.
2. In assembler programming, a variable symbol declared in the prototype statement of a macro definition.

Asymbol file. A data set used by the assembler for symbol definitions and references and literals.

Osystem macro definition. Loosely, an IBM-supplied library macro definition which provides access to operating system facilities.

\*terminal. A point in a system or communication network at which data can either enter or leave or both.

Atext segment. The range over which a local dictionary has meaning. The source module is divided into text segments with a segment for open code and one for each macro definition.

\*transform. To change the form of data according to specific rules.

\*translate. To transform statements from one language into another without significantly changing the meaning.

Ovirtual storage. Address space appearing to the user as real storage from which instructions and data are mapped into real storage locations. The size of virtual storage is limited by the addressing scheme of the computing system and by the amount of auxiliary storage available, rather than by the actual number of real storage locations.

## Appendix B: Assembler Sample Program

The sample program shown in Figure 17 can be used as a test of the functioning of the assembler after your system has been generated (see OS/VS1 System Generation Reference, Order No. GC26-3791). It also serves as a good example of assembler language coding and of the listing produced by the assembler.

The program illustrates the definition and use of user-written macro instructions, use of IBM-supplied macro instructions, use of dummy control sections, and the method of saving and restoring registers upon entry to and exit from a program.

The data to be processed is assembled as part of the program. It consists of a table and a list of entries that are compared with the table. Each item in the table contains an argument name (such as ALPHA) and space in which information concerning the name is to be placed. Each entry in the list contains an argument name and function values. The formats of the table entries and the list entries are different, and both formats are described in dummy sections.

The program searches the table for an argument name in the list. If a match is found, the function values are reformatted and moved to the appropriate table entry. If an argument name in the list cannot be found in the table, a switch is set in the list entry. After all the list entries have been processed, the list area and the table area are compared with a table and a list containing the predefined results. If the tables and lists are equal, the routine executed properly, and a message written on the operator's console to indicate this.

IFOSAMP						EXTERNAL SYMBOL DICTIONARY			PAGE 1	
SYMBOL	TYPE	ID	ADDR	LENGTH	LDID	ASM 0100 15.00 01/03/72				
SAMPLR	SD	0001	000000	0003C0						

Figure 19. Assembler Sample Program  
(Part 1 of 11)

LOC	OBJECT CODE	ADDR1	ADDR2	STMT	SOURCE STATEMENT	ASM 0100 15.00 01/03/72
2					PRINT DATA	SAMPL002
3	*				MEXIT	SAMPL003
4	*				THIS IS THE MACRO DEFINITION	SAMPL004
5	*					SAMPL005
6					MACRO	SAMPL006
7					MOVE \$TO,\$FROM	SAMPL007
8	*					SAMPL008
9	*				DEFINE SETC SYMBOL	SAMPL009
10	*					SAMPL010
11					LCLC \$TYPE	SAMPL011
12	*					SAMPL012
13	*				CHECK NUMBER OF OPERANDS	SAMPL013
14	*					SAMPL014
15					AIF (N*\$SYSLIST NE 2).ERROR1	SAMPL015
16	*					SAMPL016
17	*				CHECK TYPE ATTRIBUTES OF OPERANDS	SAMPL017
18	*					SAMPL018
19					AIF (T*\$TO NE T*\$FROM).ERROR2	SAMPL019
20	AIF				(T*\$TO EQ 'C' OR T*\$TO EQ 'G' OR T*\$TO EQ 'K').TYPECGK	SAMPL020
21	AIF				(T*\$TO EQ 'D' OR T*\$TO EQ 'E' OR T*\$TO EQ 'H').TYPEDEH	SAMPL021
22	AIF				(T*\$TO EQ 'F').MOVE	SAMPL022
23	AGO				.ERROR3	SAMPL023
24	.TYPEDEH				ANOP	SAMPL024
25	*					SAMPL025
26	*				ASSIGN TYPE ATTRIBUTE TO SETC SYMBOL	SAMPL026
27	*					SAMPL027
28	\$TYPE				SETC T*\$TO	SAMPL028
29	.MOVE				ANOP	SAMPL029
30	*				NEXT TWO STATEMENTS GENERATED FOR MOVE MACRO	SAMPL030
31					L\$TYPE 2,\$FROM	SAMPL031
32					S\$TYPE 2,\$TO	SAMPL032
33					MEXIT	SAMPL033
34	*					SAMPL034
35	*				CHECK LENGTH ATTRIBUTES OF OPERANDS	SAMPL035
36	*					SAMPL036
37	.TYPECGK				AIF (L*\$TO NE L*\$FROM OR L*\$TO GT 256).ERROR4	SAMPL037
38	*				NEXT STATEMENT GENERATED FOR MOVE MACRO	SAMPL038
39					MVC \$TO,\$FROM	SAMPL039
40					MEXIT	SAMPL040
41	*					SAMPL041
42	*				ERROR MESSAGES FOR INVALID MOVE MACRO INSTRUCTIONS	SAMPL042
43	*					SAMPL043
44	.ERROR1				MNOTE 1,'IMPROPER NUMBER OF OPERANDS, NO STATEMENTS GENERATED'	SAMPL044
45					MEXIT	SAMPL045
46	.ERROR2				MNOTE 1,'OPERAND TYPES DIFFERENT, NO STATEMENTS GENERATED'	SAMPL046
47					MEXIT	SAMPL047
48	.ERROR3				MNOTE 1,'IMPROPER OPERAND TYPES, NO STATEMENTS GENERATED'	SAMPL048
49					MEXIT	SAMPL049
50	.ERROR4				MNOTE 1,'IMPROPER OPERAND LENGTHS, NO STATEMENTS GENERATED'	SAMPL050
51					MEND	SAMPL051
52	*					SAMPL052
53	*				MAIN ROUTINE	SAMPL053
54	*					SAMPL054
55	SAMPLR				CSECT	SAMPL055
56	BEGIN				SAVE (14,12),,*	SAMPL056

000000

Figure 19. Assembler Sample Program  
(Part 2 of 11)

IFOSAMP - SAMPLE PROGRAM							PAGE 3	
LOC	OBJECT CODE	ADDR1	ADDR2	STMT	SOURCE STATEMENT	ASM 0100 15.00 01/03/72		
000000	47F0 F00A	0000A		57+BEGIN	B 10(0,15)	BRANCH AROUND ID	00860000	
000004	05			58+	DC AL1(5)		00880000	
000005	C2C5C7C9D5			59+	DC CL5'BEGIN'	IDENTIFIER	00900000	
00000A	90EC D00C	0000C		60+	STM 14,12,12(13)	SAVE REGISTERS	01180000	
00000E	05C0			61	BALR R12,0	ESTABLISH ADDRESSABILITY OF PROGRAM	SAMPL057	
			00010	62	USING *,R12	AND TELL THE ASSEMBLER WHAT BASE TO USE	SAMPL058	
000010	50D0 C0C0	000D0		63	ST 13,SAVE13		SAMPL059	
000014	9857 C398	003A8		64	LM R5,R7,=A(LISTAREA,16,LISTEND)	LOAD LIST AREA PARAMETERS	SAMPL060	
			00000	65	USING LIST,R5	REGISTER 5 POINTS TO THE LIST	SAMPL061	
000018	45E0 C0C6	000D6		66 MORE	BAL R14,SEARCH	FIND LIST ENTRY IN TABLE	SAMPL062	
00001C	9180 C0C4	000D4		67	TM SWITCH,NONE	CHECK TO SEE IF NAME WAS FOUND	SAMPL063	
000020	4710 C0B6	000C6		68	BO NOTHERE	BRANCH IF NOT	SAMPL064	
			00000	69	USING TABLE,R1	REGISTER 1 NOW POINTS TO TABLE ENTRY	SAMPL065	
				70	MOVE TSWITCH,LSWITCH	MOVE FUNCTIONS	SAMPL066	
				71+*		NEXT STATEMENT GENERATED FOR MOVE MACRO	SAMPL038	
000024	D200 1003 5008	00003 00008		72+	MVC TSWITCH,LSWITCH		SAMPL039	
				73	MOVE TNUMBER,LNUMBER	FROM LIST ENTRY	SAMPL067	
				74+*		NEXT STATEMENT GENERATED FOR MOVE MACRO	SAMPL038	
00002A	D202 1000 5009	00000 00009		75+	MVC TNUMBER,LNUMBER		SAMPL039	
				76	MOVE TADDRESS,LADDRESS	TO TABLE ENTRY	SAMPL068	
				77+*		NEXT TWO STATEMENTS GENERATED FOR MOVE MACRO	SAMPL030	
000030	5820 500C	0000C		78+	L 2,LADDRESS		SAMPL031	
000034	5020 1004	00004		79+	ST 2,TADDRESS		SAMPL032	
000038	875E C008	00018		80 LISTLOOP	BXLE R5,R6,MORE	LOOP THROUGH THE LIST	SAMPL069	
00003C	D5EF C248 C0F8	00258 00108		81	CLC TESTTABL(240),TABLAREA		SAMPL070	
000042	4770 C080	00090		82	BNE NOTRIGHT		SAMPL071	
000046	D55F C338 C1E8	00348 001F8		83	CLC TESTLIST(96),LISTAREA		SAMPL072	
00004C	4770 C080	00090		84	BNE NOTRIGHT		SAMPL073	
				85	WTO 'SAMPLE PROGRAM IFOSAMP SUCCESSFUL',ROUTCDE=(2,11)		SAMPL074	
000050				86+	CNOP 0,4		00480000	
000050	4510 C06E	0007E		87+	BAL 1,IHB0005A	BRANCH AROUND MESSAGE	00500000	
000054	0025			88+	DC AL2(IHB0005=*)	MESSAGE LENGTH	00428018	
000056	8000			89+	DC B'1000000000000000'	MCSFLAGS FIELD	00428818	
000058	E2C1D4D7D3C540D7			90+	DC C'SAMPLE PROGRAM IFOSAMP SUCCESSFUL' MESSAGE		00429618	
000060	D9D6C7D9C1D440C9							
000068	C6D6E2C1D4D740E2							
000070	E4C3C3C5E2E2C6E2							
000078	D3							
			00079	91+IHB0005	EQU *		00430418	
000079	0000			92+	DC B'0000000000000000'	DESCRIPTOR CODES	00432018	
00007B	4020			93+	DC B'0100000000100000'	ROUTING CODES	00432818	
00007E				94+IHB0005A	DS 0H		00560000	
00007E	0A23			95+	SVC 35	ISSUE SVC	00600000	
000080	58D0 C0C0	000D0		96 EXIT	L R13,SAVE13		SAMPL075	
				97	RETURN (14,12),RC=0		SAMPL076	
000084	98EC D00C	0000C		98+	LM 14,12,12(13)	RESTORE THE REGISTERS	00260000	
000088	41F0 0000	00000		99+	LA 15,0(0,0)	LOAD RETURN CODE	00700000	
00008C	07FE			100+	BR 14	RETURN	00800000	
				101 *			SAMPL077	
				102 NOTRIGHT	WTO 'SAMPLE PROGRAM IFOSAMP UNSUCCESSFUL',ROUTCDE=(2,11)		SAMPL078	
				103+	CNOP 0,4		00480000	
00008E	0700			104+NOTRIGHT	BAL 1,IHB0007A	BRANCH AROUND MESSAGE	00500000	
000090	4510 C0B0	000C0		105+	DC AL2(IHB0007=*)	MESSAGE LENGTH	00428018	
000094	0027			106+	DC B'1000000000000000'	MCSFLAGS FIELD	00428818	
000096	8000			107+	DC C'SAMPLE PROGRAM IFOSAMP UNSUCCESSFUL' MESSAGE		00429618	
000098	E2C1D4D7D3C540D7							

Figure 19. Assembler Sample Program (Part 3 of 11)

LOC	OBJECT CODE	ADDR1	ADDR2	STMT	SOURCE STATEMENT	ASN 0100 15.00 01/03/72
0000A0	D9D6C7D9C1D440C9					
0000A8	C6D6E2C1D4D740E4					
0000B0	D5E2E4C3C3C5E2E2					
0000B8	C6E4D3					
		000BB	108+IHB0007	EQU *		00430418
0000BB	0000		109+	DC	B'0000000000000000'	00432018
0000BD	4020		110+	DC	B'01000000000100000'	00432818
0000C0			111+IHB0007A	DS	0H	00560000
0000C0	0A23		112+	SVC	35	00600000
0000C2	47F0 C070	00080	113	B	EXIT	SAMPL079
0000C6	9680 5008	00008	114	OI	LSWITCH,NONE TURN ON SWITCH IN LIST ENTRY	SAMPL080
0000CA	47F0 C028	00038	115	B	LISTLOOP GO BACK AND LOOP	SAMPL081
0000CE	0000					
0000D0	00000000		116	DC	F'0'	SAMPL082
0000D4	00		117	DC	X'00'	SAMPL083
		00080	118	DC	X'80'	SAMPL084
			119 *			SAMPL085
			120 *		BINARY SEARCH ROUTINE	SAMPL086
			121 *			SAMPL087
0000D5	00					
0000D6	947F C0C4	000D4	122	SEARCH	NI SWITCH,255-NONE TURN OFF NOT FOUND SWITCH	SAMPL088
0000DA	9813 C3A4	003B4	123	LM	R1,R3,=F'128,4,128' LOAD TABLE PARAMETERS	SAMPL089
0000DE	4111 C0E8	000F8	124	LA	R1,TABLAREA-16 (R1) GET ADDRESS OF MIDDLE ENTRY	SAMPL090
0000E2	8830 0001	00001	125	LOOP	SRL R3,1 DIVIDE INCREMENT BY 2	SAMPL091
0000E6	D507 5000	1008 00000 00008	126	CLC	LNAME,TNAME COMPARE LIST ENTRY WITH TABLE ENTRY	SAMPL092
0000EC	4720 C0EC	000FC	127	BH	HIGHER BRANCH IF SHOULD BE HIGHER IN TABLE	SAMPL093
0000F0	078E		128	BCR	8,R14 EXIT IF FOUND	SAMPL094
0000F2	1B13		129	SR	R1,R3 OTHERWISE IT IS LOWER IN THE TABLE	SAMPL095
					SO SUBTRACT INCREMENT	SAMPL096
0000F4	4620 C0D2	000E2	130	BCT	R2,LOOP LOOP 4 TIMES	SAMPL097
0000F8	47F0 C0F2	00102	131	B	NOTFOUND ARGUMENT IS NOT IN THE TABLE	SAMPL098
0000FC	1A13		132	HIGHER	AR R1,R3 ADD INCREMENT	SAMPL099
0000FE	4620 C0D2	000E2	133	BCT	R2,LOOP LOOP 4 TIMES	SAMPL100
000102	9680 C0C4	000D4	134	NOTFOUND	OI SWITCH,NONE TURN ON NOT FOUND SWITCH	SAMPL101
000106	07FE		135	BR	R14 EXIT	SAMPL102
			136 *			SAMPL103
			137 *		THIS IS THE TABLE	SAMPL104
			138 *			SAMPL105
			139	DS	0D	SAMPL106
000108	0000000000000000		140	TABLAREA	DC XL8'0',CL8'ALPHA'	SAMPL107
000110	C1D3D7C8C1404040					
000118	0000000000000000		141	DC	XL8'0',CL8'BETA'	SAMPL108
000120	C2C5E3C140404040					
000128	0000000000000000		142	DC	XL8'0',CL8'DELTA'	SAMPL109
000130	C4C5D3E3C1404040					
000138	0000000000000000		143	DC	XL8'0',CL8'EPSILON'	SAMPL110
000140	C5D7E2C9D3D6D540					
000148	0000000000000000		144	DC	XL8'0',CL8'ETA'	SAMPL111
000150	C5E3C14040404040					
000158	0000000000000000		145	DC	XL8'0',CL8'GAMMA'	SAMPL112
000160	C7C1D4D4C1404040					
000168	0000000000000000		146	DC	XL8'0',CL8'IOTA'	SAMPL113
000170	C9D6E3C140404040					
000178	0000000000000000		147	DC	XL8'0',CL8'KAPPA'	SAMPL114
000180	D2C1D7D7C1404040					

Figure 19. Assembler Sample Program (Part 4 of 11)

IFOSAMP - SAMPLE PROGRAM						PAGE	5
LOC	OBJECT CODE	ADDR1	ADDR2	STMT	SOURCE STATEMENT	ASM	0100 15.00 01/03/72
000188	0000000000000000			148	DC XL8'0',CL8'LAMBDA'		SAMPL115
000190	D3C1D4C2C4C14040						
000198	0000000000000000			149	DC XL8'0',CL8'MU'		SAMPL116
0001A0	D4E4404040404040						
0001A8	0000000000000000			150	DC XL8'0',CL8'NU'		SAMPL117
0001B0	D5E4404040404040						
0001B8	0000000000000000			151	DC XL8'0',CL8'OMICRON'		SAMPL118
0001C0	D6D4C9C3D9D6D540						
0001C8	0000000000000000			152	DC XL8'0',CL8'PHI'		SAMPL119
0001D0	D7C8C94040404040						
0001D8	0000000000000000			153	DC XL8'0',CL8'SIGMA'		SAMPL120
0001E0	E2C9C7D4C1404040						
0001E8	0000000000000000			154	DC XL8'0',CL8'ZETA'		SAMPL121
0001F0	E9C5E3C140404040						
				155 *			SAMPL122
				156 *	THIS IS THE LIST		SAMPL123
				157 *			SAMPL124
0001F8	D3C1D4C2C4C14040			158 LISTAREA	DC CL8'LAMBDA',X'0A',FL3'29',A (BEGIN)		SAMPL125
000200	0A0001D000000000						
000208	E9C5E3C140404040			159	DC CL8'ZETA',X'05',FL3'5',A (LOOP)		SAMPL126
000210	05000005000000E2						
000218	E3C8C5E3C1404040			160	DC CL8'THETA',X'02',FL3'45',A (BEGIN)		SAMPL127
000220	0200002D00000000						
000228	E3C1E44040404040			161	DC CL8'TAU',X'00',FL3'0',A (1)		SAMPL128
000230	0000000000000001						
000238	D3C9E2E340404040			162	DC CL8'LIST',X'1F',FL3'465',A (0)		SAMPL129
000240	1F0001D100000000						
000248	C1D3D7C8C1404040			163 LISTEND	DC CL8'ALPHA',X'00',FL3'1',A (123)		SAMPL130
000250	000000010000007B						
				164 *			SAMPL131
				165 *	THIS IS THE CONTROL TABLE		SAMPL132
				166 *			SAMPL133
000258	000001000000007B			167	DS 0D		SAMPL134
000260	C1D3D7C8C1404040			168 TESTTABL	DC FL3'1',X'00',A (123),CL8'ALPHA'		SAMPL135
000268	0000000000000000			169	DC XL8'0',CL8'BETA'		SAMPL136
000270	C2C5E3C140404040						
000278	0000000000000000			170	DC XL8'0',CL8'DELTA'		SAMPL137
000280	C4C5E3E3C1404040						
000288	0000000000000000			171	DC XL8'0',CL8'EPSILON'		SAMPL138
000290	C5D7E2C9D3D6D540						
000298	0000000000000000			172	DC XL8'0',CL8'ETA'		SAMPL139
0002A0	C5E3C14040404040						
0002A8	0000000000000000			173	DC XL8'0',CL8'GAMMA'		SAMPL140
0002B0	C7C1D4D4C1404040						
0002B8	0000000000000000			174	DC XL8'0',CL8'IOTA'		SAMPL141
0002C0	C9D6E3C140404040						
0002C8	0000000000000000			175	DC XL8'0',CL8'KAPPA'		SAMPL142
0002D0	D2C1D7D7C1404040						
0002D8	00001D0A00000000			176	DC FL3'29',X'0A',A (BEGIN),CL8'LAMBDA'		SAMPL143
0002E0	D3C1D4C2C4C14040						
0002E8	0000000000000000			177	DC XL8'0',CL8'MU'		SAMPL144
0002F0	D4E4404040404040						
0002F8	0000000000000000			178	DC XL8'0',CL8'NU'		SAMPL145
000300	D5E4404040404040						

Figure 19. Assembler Sample Program  
(Part 5 of 11)

IFOSAMP - SAMPLE PROGRAM						PAGE 6
LOC	OBJECT CODE	ADDR1	ADDR2	STMT	SOURCE STATEMENT	ASM 0100 15.00 01/03/72
000308	0000000000000000			179	DC XL8'0',CL8'OMICRON'	SAMPL146
000310	D6D4C9C3D9D6E540					
000318	0000000000000000			180	DC XL8'0',CL8'PHI'	SAMPL147
000320	D7C8C94040404040					
000328	0000000000000000			181	DC XL8'0',CL8'SIGMA'	SAMPL148
000330	E2C9C7D4C1404040					
000338	00000505000000E2			182	DC FL3'5',X'05',A (LOOP),CL8'ZETA'	SAMPL149
000340	E9C5E3C140404040					
				183 *		SAMPL150
				184 *	THIS IS THE CONTROL LIST	SAMPL151
				185 *		SAMPL152
000348	D3C1D4C2C4C14040			186	TESTLIST DC CL8'LAMBDA',X'0A',FL3'29',A (BEGIN)	SAMPL153
000350	0A00001D00000000					
000358	E9C5E3C140404040			187	DC CL8'ZETA',X'05',FL3'5',A (LOOP)	SAMPL154
000360	05000005000000E2					
000368	E3C8C5E3C1404040			188	DC CL8'THETA',X'82',FL3'45',A (BEGIN)	SAMPL155
000370	8200002D00000000					
000378	E3C1E44040404040			189	DC CL8'TAU',X'80',FL3'0',A (1)	SAMPL156
000380	8000000000000001					
000388	D3C9E2E340404040			190	DC CL8'LIST',X'9F',FL3'465',A (0)	SAMPL157
000390	9F0001D100000000					
000398	C1D3D7C8C1404040			191	DC CL8'ALPHA',X'00',FL3'1',A (123)	SAMPL158
0003A0	000000010000007B					
				192 *		SAMPL159
				193 *	THESE ARE THE SYMBOLIC REGISTERS	SAMPL160
				194 *		SAMPL161
	00000	195	R0	EQU	0	SAMPL162
	00001	196	R1	EQU	1	SAMPL163
	00002	197	R2	EQU	2	SAMPL164
	00003	198	R3	EQU	3	SAMPL165
	00005	199	R5	EQU	5	SAMPL166
	00006	200	R6	EQU	6	SAMPL167
	00007	201	R7	EQU	7	SAMPL168
	0000C	202	R12	EQU	12	SAMPL169
	0000D	203	R13	EQU	13	SAMPL170
	0000E	204	R14	EQU	14	SAMPL171
	0000F	205	R15	EQU	15	SAMPL172
				206 *		SAMPL173
				207 *	THIS IS THE FORMAT DEFINITION OF LIST ENTRYS	SAMPL174
				208 *		SAMPL175
000000		209	LIST	DSECT		SAMPL176
000000		210	LNAME	DS	CL8	SAMPL177
000008		211	LSWITCH	DS	C	SAMPL178
000009		212	LNUMBER	DS	FL3	SAMPL179
00000C		213	LADDRESS	DS	F	SAMPL180
		214 *				SAMPL181
		215 *			THIS IS THE FORMAT DEFINITION OF TABLE ENTRYS	SAMPL182
		216 *				SAMPL183
000000		217	TABLE	DSECT		SAMPL184
000000		218	TNUMBER	DS	FL3	SAMPL185
000003		219	TSWITCH	DS	C	SAMPL186
000004		220	TADDRESS	DS	F	SAMPL187
000008		221	TNAME	DS	CL8	SAMPL188
000000		222		END	BEGIN	SAMPL189
0003A8	000001F800000010	223			=A (LISTAREA,16,LISTEND)	

Figure 19. Assembler Sample Program  
(Part 6 of 11)



IFOSAMP - SAMPLE PROGRAM						PAGE 7
LOC	OBJECT CODE	ADDR1	ADDR2	STMT	SOURCE STATEMENT	ASM 0100 15.00 01/03/72
0003B0	00000248					
0003B4	0000080000000004			224	=F'128,4,128'	
0003BC	00000800					

Figure 19. Assembler Sample Program  
(Part 7 of 11)

IFOSAMP				RELOCATION DICTIONARY	PAGE 8
POS.ID	REL.ID	FLAGS	ADDRESS		ASM 0100 15.00 01/03/72
0001	0001	0C	000204		
0001	0001	0C	000214		
0001	0001	0C	000224		
0001	0001	0C	0002DC		
0001	0001	0C	00033C		
0001	0001	0C	000354		
0001	0001	0C	000364		
0001	0001	0C	000374		
0001	0001	0C	0003A8		
0001	0001	0C	0003B0		

Figure 19. Assembler Sample Program  
(Part 8 of 11)

IFOSAMP				CROSS-REFERENCE	PAGE 9
SYMBOL	LEN	VALUE	DEFN	REFERENCES	ASM 0100 15.00 01/03/72
BEGIN	00004	00000000	00057	00158 00160 00176 00186 00188 00222	
EXIT	00004	00000080	00096	00113	
HIGHER	00002	000000FC	00132	00127	
IHB0005	00001	00000079	00091	00088	
IHB0005A	00002	0000007E	00094	00087	
IHB0007	00001	000000BB	00108	00105	
IHB0007A	00002	000000C0	00111	00104	
LADDRESS	00004	0000000C	00213	00078	
LIST	00001	00000000	00209	00065	
LISTAREA	00008	000001F8	00158	00083 00223	
LISTEND	00008	00000248	00163	00223	
LISTLOOP	00004	00000038	00080	00115	
LNAME	00008	00000000	00210	00126	
LNUMBER	00003	00000009	00212	00075	
LOOP	00004	000000E2	00125	00130 00133 00159 00182 00187	
LSWITCH	00001	00000008	00211	00072 00114	
MORE	00004	00000018	00066	00080	
NONE	00001	00000080	00118	00067 00114 00122 00134	
NOTFOUND	00004	00000102	00134	00131	
NOTRIGHT	00004	00000090	00104	00082 00084	
NOTTHERE	00004	000000C6	00114	00068	
R0	00001	00000000	00195		
R1	00001	00000001	00196	00069 00123 00124 00124 00129 00132	
R12	00001	0000000C	00202	00061 00062	
R13	00001	0000000D	00203	00096	
R14	00001	0000000E	00204	00066 00128 00135	
R15	00001	0000000F	00205		
R2	00001	00000002	00197	00130 00133	
R3	00001	00000003	00198	00123 00125 00129 00132	
R5	00001	00000005	00199	00064 00065 00080	
R6	00001	00000006	00200	00080	
R7	00001	00000007	00201	00064	
SAMPLR	00001	00000000	00055		
SAVE13	00004	000000D0	00116	00063 00096	
SEARCH	00004	000000D6	00122	00066	
SWITCH	00001	000000D4	00117	00067 00122 00134	
TABLAREA	00008	00000108	00140	00081 00124	
TABLE	00001	00000000	00217	00069	
TADDRESS	00004	00000004	00220	00079	
TESTLIST	00008	00000348	00186	00083	
TESTTABL	00003	00000258	00168	00081	
TNAME	00008	00000008	00221	00126	
TNUMBER	00003	00000000	00218	00075	
TSWITCH	00001	00000003	00219	00072	

Figure 19. Assembler Sample Program  
(Part 9 of 11)

IFOSAMP		LITERAL CROSS-REFERENCE			PAGE 10
SYMBOL	LEN	VALUE	DEFN	REFERENCES	ASM 0100 15.00 01/03/72
=A (LISTAREA,16,LISTEND)					
	00004	000003A8	00223	00064	
=F'128,4,128'					
	00004	000003B4	00224	00123	

Figure 19. Assembler Sample Program  
(Part 10 of 11)

IFOSAMP		ASSEMBLER DIAGNOSTICS AND STATISTICS		PAGE 11
				ASM 0100 15.00 01/03/72
NO STATEMENTS FLAGGED IN THIS ASSEMBLY				
HIGHEST SEVERITY WAS 0				
OPTIONS FOR THIS ASSEMBLY				
ALIGN, ALOGIC, BUFSIZE(STD), NODECK, ESD, FLAG(0), LINECOUNT(55), LIST, NOMCALL, YFLAG, WORKSIZE(2097152)				
NOMLOGIC, NONUMBER, NOOBJECT, NORENT, RLD, NOSTMT, NOLIBMAC, NOTERMAL, NOTEST, XREF(SHORT)				
SYSPARM 0				
WORK FILE BUFFER SIZE = 7246/ 1				
TOTAL RECORDS READ FROM SYSTEM INPUT				189
TOTAL RECORDS READ FROM SYSTEM LIBRARY				833
TOTAL RECORDS PUNCHED				0
TOTAL RECORDS PRINTED				373

Figure 19. Assembler Sample Program  
(Part 11 of 11)

# Appendix C: Object Deck Output

## ESD CARD FORMAT

<u>Columns</u>	<u>Contents</u>
1	12-2-9 punch
2-4	ESD
5-10	Blank
11-12	Variable field count -- number of bytes of information in variable field (columns 17-64)
13-14	Blank
15-16	ESDID of first SD, XD, CM, PC, ER, or WX in variable field
17-64	Variable field. One to three 16-byte items of the following format:  8 bytes -- Name, padded with blanks  1 byte -- ESD type code The HEX value is: 00 SD 01 LD 02 ER 04 PC 05 CM 06 XD (PR) 0A WX  3 bytes -- Address  1 byte -- Alignment if XD; otherwise blank  3 bytes -- Length, LDID, or blank
65-72	Blank
73-80	Deck ID and/or sequence number -- The deck ID is the name from the first named TITLE statement. The name can be one to eight alpha-numeric characters long. If the name is less than eight characters long or if there is no name, the remaining columns contain a card sequence number. (Columns 73-80 of cards produced by PUNCH or REPRO statements do not contain a deck ID or a sequence number.)

## TXT CARD FORMAT

<u>Columns</u>	<u>Contents</u>
1	12-2-9 punch
2-4	TXT
5	Blank
6-8	Relative address of first instruction on card
9-10	Blank
11-12	Byte count -- number of bytes in information field (columns 17-72)
13-14	Blank
15-16	ESDID
17-72	56-byte information field
73-80	Deck ID and/or sequence number -- The deck ID is the name from the first named TITLE statement. The name can be one to eight alphameric characters long. If the name is less than eight characters long or if there is no name, the remaining columns contain a card sequence number. (Columns 73-80 of cards produced by PUNCH or REPRO statements do not contain a deck ID or a sequence number.)

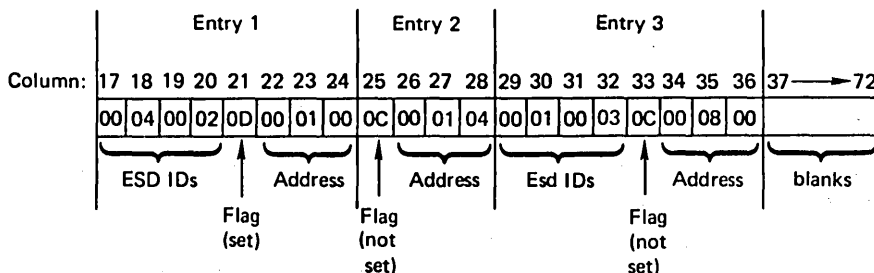
## RLD CARD FORMAT

<u>Columns</u>	<u>Contents</u>
1	12-2-9 punch
2-4	RLD
5-10	Blank
11-12	Data field count -- number of bytes of information in data field (columns 17-72)
13-16	Blank
17-72	Data field
17-18	Relocation ESDID
19-20	Position ESDID
21	Flag byte
22-24	Absolute address to be relocated
25-72	Remaining RLD entries
73-80	Deck ID and/or sequence number -- The deck ID is the name from the first named TITLE statement. The name can be one to eight alphameric characters long. If the name is less than eight characters long or if there is no name, the remaining columns contain a card sequence number. (Columns 73-80 of cards produced by PUNCH or REPRO statements do not contain a deck ID or a sequence number.)

If the rightmost bit of the flag byte is set, the following RLD entry has the same relocation ESDID and position ESDID, and this information will not be repeated; if the rightmost bit of the flag byte is not set, the next RLD entry has a different relocation ESDID and/or position ESDID, and both ESDIDs will be recorded.

For example, if the RLD Entries 1, 2, and 3 of the program listing contain the following information:

	Position ESDID	Relocation ESDID	Flag	Address
Entry 1	02	04	0C	000100
Entry 2	02	04	0C	000104
Entry 3	03	04	0C	000800



### END CARD FORMAT

#### Columns

#### Contents

1	12-2-9 punch
2-4	END
5	Blank
6-8	Entry address from operand of END card in source deck (blank if no operand)
9-14	Blank
15-16	ESDID of entry point (blank if no operand)
17-32	Blank
33	1 or 2
34-43	Order number of the assembler: 5741SC103
44-45	Version level of the assembler
46-47	Modification level of the assembler
48-49	Last two digits of the year in which the assembly was run
50-52	Day of the year (counted sequentially: Jan 3 = 3, Feb 3 = 34, etc) in which the assembly was run
53-72	Normally not used
73-80	Deck ID and/or sequence number. The deck ID is the name field from the first named TITLE statement. The name can be one to eight alphameric characters long. If there is no name or the name is less than eight characters long, the remaining columns contain a card sequence number. (Columns 73-80 of cards produced by PUNCH or REPRO statements do not contain a deck ID or a sequence number.)

### SYM CARD FORMAT

If you specify the TEST assembler option, the assembler punches out symbolic information concerning the assembled program. This output appears ahead of the object module. The format of the card images for SYM output is as follows:

<u>Columns</u>	<u>Contents</u>
1	12-2-9 punch
2-4	SYM
5-10	Blank
11-12	Variable field count -- number of bytes of text in variable field (columns 17-72)
13-16	Blank
17-72	Variable field (see below)
73-80	Deck ID and/or sequence number -- The deck ID is the name from the first named TITLE statement. The name can be one to eight alphameric characters long. If the name is less than eight characters long or if there is no name, the remaining columns contain a card sequence number. (Columns 73-80 of cards produced by PUNCH or REPRO statements do not contain a deck ID or a sequence number.)

The variable field (columns 17-72) contains up to fifty-six bytes of SYM text. The items making up the text are packed together; consequently, only the last card may contain less than fifty-six bytes of text in the variable field. The formats of a text card and an individual text item are shown in Figure 20. The contents of the fields within an individual entry are as follows:

1. Organization (one byte)

Bit 0:

0 = non-data type  
1 = data type

Bits 1-3 (if non-data type):

000 = space  
001 = control section  
010 = dummy control section  
011 = common  
100 = machine instruction  
101 = CCW  
110 = Simply relocatable EQU, named LTORG, named CNOP, or named ORG

Bit 1 (if data type):

0 = no multiplicity  
1 = multiplicity (indicates presence of M field)

Bit 2 (if data type):

0 = independent (not a packed or zoned decimal constant)  
1 = cluster (packed or zoned decimal constant)

Bit 3 (if data type):

0 = no scaling  
1 = scaling (indicates presence of S field)

Bit 4:

0 = name present  
1 = name not present

Bits 5-7:

Length of name minus 1

2. Address (three bytes) -- displacement from base of control section

3. Symbol Name (zero to eight bytes) -- symbolic name of particular item

Note: The following fields are present only for data-type items. If the entry is non-data type and space, an extra byte is present which contains the number of bytes that have been skipped.

4. Data Type (one byte) -- contents in hexadecimal

- 00 = C-type data
- 04 = X-type data
- 08 = B-type data
- 10 = F-type data
- 14 = H-type data
- 18 = E-type data
- 1C = D-type data
- 20 = A-type or Q-type data
- 24 = Y-type data
- 28 = S-type data
- 2C = V-type data
- 30 = P-type data
- 34 = Z-type data
- 38 = L-type data

5. Length (two bytes for character, hexadecimal, or binary items; one byte for other types) -- length of data item minus 1

6. Multiplicity - M field (three bytes) -- equals 1 if not present

7. Scale - signed integer - S field (two bytes) -- present only for F, H, E, D, L, P and Z type data, and only if scale is non-zero.

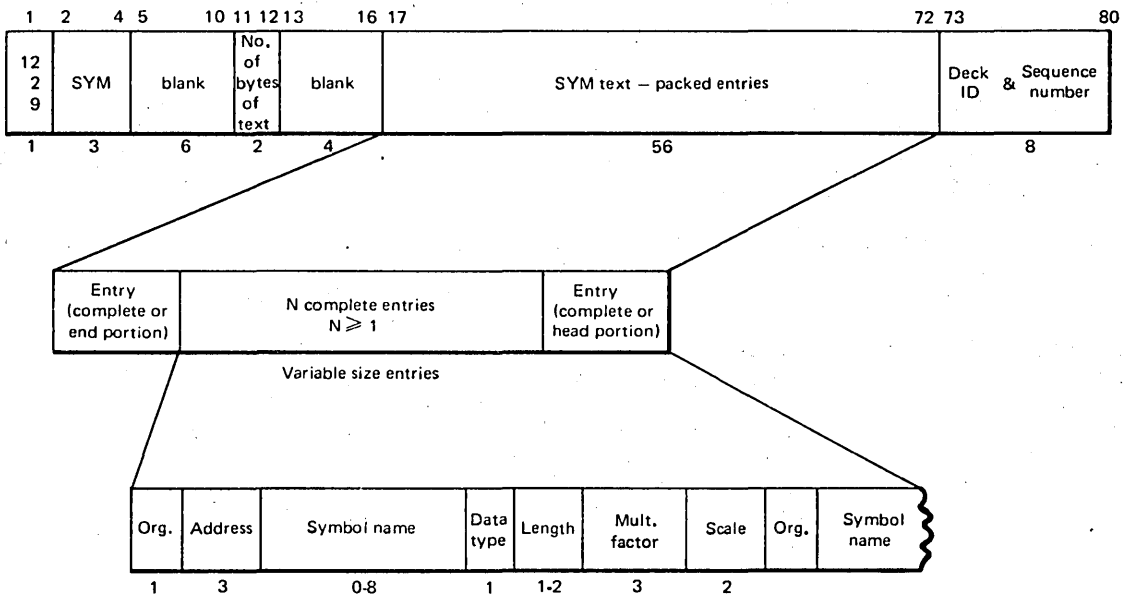


Figure 20. SYM Card Format

## Appendix D: Dynamic Invocation of the Assembler

You can invoke the assembler from your problem program when it is executed, by using the CALL, LINK, XCTL, or ATTACH macro instruction. If you use the XCTL instruction, you cannot specify any assembler options. The assembler will use the standard or default options. If you use CALL, LINK, or ATTACH, you can specify both the assembler options and DD names of the data sets to be used by the assembler. The formats of these macros are:

Name	Operation	Operand
[symbol]	CALL	IFOX00, (optionlist [ddnamelist]), VL
	{ LINK ATTACH }	EP=IFOX00, PARAM=(optionlist [ddnamelist]), VL=1

EP -- specifies the symbolic name of the assembler (IFOX00).

PARAM -- specifies, as a sublist, address parameters to be passed from the problem program to the assembler. The first word in the address parameter list contains the address of the option list. The second word contains the address of the ddname list.

optionlist -- specifies the address of a variable length list containing the options. This address must be written even if no option list is provided.

The option list must begin on a halfword boundary. The first two bytes contain a count of the number of bytes in the remainder of the list. If no options are specified, the count must be zero. The option list is free form with each field separated from the next by a comma. No blanks or zeros should appear in the list.

ddnamelist -- specifies the address of a variable length list containing alternate DDnames for the data sets used during assembler processing. If standard DDnames are used, this operand can be omitted.

The DDname list must begin on a halfword boundary. The first two bytes contain a count of the number of bytes in the remainder of the list. Each name of less than eight bytes must be left-justified and padded with blanks. If an alternate DDname is omitted, the standard name will be assumed. If the name is omitted within the list, the eight-byte entry must contain binary zeros. Names can be omitted from the end merely by shortening the list. The sequence of the eight-byte entries in the DDname list is as follows:



<u>Entry</u>	<u>Standard Name</u>
1	not applicable
2	not applicable
3	not applicable
4	SYSLIB
5	SYSIN
6	SYSPRINT
7	SYSPUNCH
8	SYSUT1
9	SYSUT2
10	SYSUT3
11	SYSGO
12	SYSTEM

VL -- specifies that the high-order bit is to be set to 1 in the last word of the list of address parameters in the macro expansion. The assembler checks this bit to find out if a DDname list is specified or not.

Note: If you invoke the assembler more than once from the same program, make sure that RECFM=S is not specified for the SYSPRINT data set.

# Appendix E: Assembler Data Sets and Storage Requirements

This appendix describes the data sets used by the assembler (see Figure 21). It also describes the main storage and auxiliary storage requirements of the assembler. This description is intended for programmers who want to alter the assembler's region or partition size or data set parameters (such as buffer size). A more detailed description of assembler storage requirements appears in OS/VS1 Storage Estimates.

## ASSEMBLER DATA SETS

### DDname SYSUT1, SYSUT2, and SYSUT3

The assembler uses the utility data sets as intermediate external storage devices when processing the source program. These data sets must be organized sequentially, and the devices assigned to them must be direct access devices, magnetic tape units, or a combination of both. The assembler does not support multivolume utility data sets. For optimum performance, SYSUT1 should be on a direct access device.

### DDname SYSIN

This data set contains the input to the assembler -- the source statements to be processed. The input/output device assigned to this data set may be either the device transmitting the input stream, or another sequential input device that you have designated. The DD statement describing this data set appears in the input stream. The IBM-supplied procedures do not contain this statement.

### DDname SYSLIB

From this data set the assembler obtains macro definitions and assembler language statements that can be called by the COPY assembler instruction. It is a partitioned data set: each macro definition or sequence of assembler language statements is a separate member, with the member name being the macro instruction mnemonic or COPY code name.

The data set may be SYS1.MACLIB or a private macro library. SYS1.MACLIB contains macro definitions for the IBM-supplied macro instructions. Private libraries and SYS1.MACLIB can be concatenated with each other in any order. Concatenated libraries must have the same record length, but the blocking factors may be different. However, a library with a high blocking factor must always come before a library with a low blocking factor.

### DDname SYSPRINT

This data set is used by the assembler to produce a listing. Output may be directed to a printer, magnetic tape, or direct-access storage device. The assembler uses the ANSI carriage-control characters for this data set. The smallest blocksize recommended is 1089 (blocking factor of 9).

### DDname SYSPUNCH

The assembler uses this data set to produce the object module. The input/output unit assigned to this data set may be either a card punch or an intermediate storage device capable of sequential access. This output can be used as input to the linkage editor.

### DDname SYSGO

This is a direct-access storage device or magnetic tape data set used by the assembler. It contains the same output text (object module) as SYSPUNCH. It is used as input for the linkage editor.

### DDname SYSTEM

This data set is used by the assembler to produce diagnostic information. The output may be directed to a remote terminal, a printer, a magnetic tape, or a direct-access storage device. The assembler uses the ANSI carriage control characters for this data set. The smallest blocksize recommended is 1089 (blocking factor of 9).

## ASSEMBLER VIRTUAL STORAGE REQUIREMENTS

The minimum virtual storage partition or region required by the assembler is 64K bytes. However, better performance is generally achieved if the assembler is run in 128K bytes of virtual storage. This region size is recommended and is specified in the assembler cataloged procedures.

If more storage is allocated to the assembler, the size of buffers and work space can be increased. The amount of storage allocated to buffers and work space determines assembler speed and capacity. Generally, as more storage is allocated to buffers, a given assembly will run faster; as more storage is allocated to work space, larger and more complex macro definitions can be handled.

You can control the buffer sizes of SYSIN, SYSLIB, SYSPRINT, SYSPUNCH, and SYSGO by specifying the blocksize (BLKSIZE) and number of buffers (BUFNO) as shown in Figure 21.

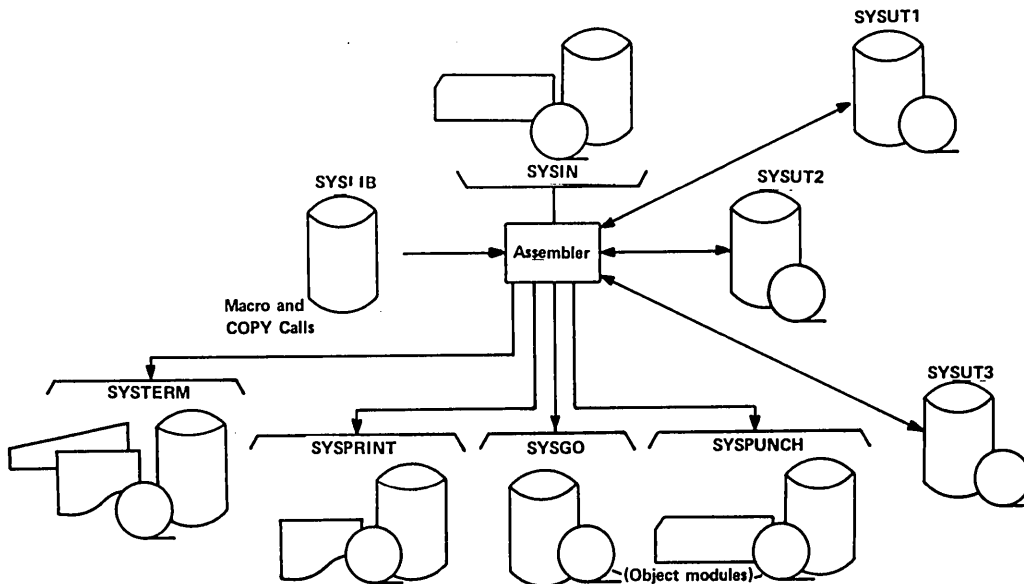
You can control the buffer sizes for the assembler utility data sets (SYSUT1, SYSUT2, and SYSUT3) and the size of the work space used during macro processing, by specifying the BUFSIZE assembler option. Of the storage given to the assembler, the assembler first allocates storage for the SYSIN and SYSLIB buffers according to the specifications in the DD statements or the labels of the data sets. It then allocates storage for the modules of the assembler. The remainder of the partition or region is allocated to utility data set buffers and macro generation dictionaries according to the BUFSIZE option specified:

- BUFSIZE (STD) : 37% is allocated to buffers, and 63% to work space. This is the default chosen, if you do not specify any BUFSIZE option.
- BUFSIZE (MIN) : Each utility data set is allocated a single 790-byte buffer. The remaining storage is allocated to work space. This allows relatively complex macro definitions to be processed in a given region or partition size, but the speed of the assembly is substantially reduced.

**BUFSIZE (MAX) :** The largest possible buffer size is used. The limit is set by the track capacity of the direct access work device and the amount of main storage allocated to buffers, whichever is smaller. If there is room for more than one buffer, as many as possible up to 15 buffers are allocated. 37% is set aside for buffer usage.

The **WORKSIZE** option is another way to (indirectly) control the buffer size for **SYSUT**-files, and number of **SYSUT**-buffers, when **BUFSIZE (MAX)** is specified. By using the **WORKSIZE** option you can limit the amount of virtual storage occupied by assembler.

It depends on practices in each installation, which is more suitable to use; **JCL**-parameter **REGION** or assembler-option **WORKSIZE**. Default value is **WORKSIZE (2048K)**.



	SYSIN	SYSLIB	SYSPRINT SYSTEM	SYSPUNCH	SYSGO	SYSUT1 SYSUT2 SYSUT3
<b>LRECL</b>	Fixed at 80	Fixed at 80	Fixed at 121	Fixed at 80	Fixed at 80	N/A
<b>RECFM</b> ①	You must specify in LABEL or DD card  F,FS,FBS,FB,FBST,FBT	You must specify in LABEL or DD card  F,FS,FBS,FB,FBST,FBT	F and A set by assembler. B set by assembler except when F is specified and BLKSIZE is not specified. You may add S or T FA,FAB,FAS,FAT FABS,FABT	F set by assembler, you may specify B and/or T in label or DD card  F,FB,FT,FBT	F set by assembler, you may specify B and/or T in label or DD card  F,FB,FT,FBT	Set by assembler to U
<b>BLKSIZE</b> ②	You must specify in LABEL or DD card, must be a multiple of LRECL	You must specify in LABEL or DD card, must be a multiple of LRECL	Optional, but must be a multiple of LRECL; if omitted BLKSIZE=LRECL	Optional, but must be a multiple of LRECL; if omitted BLKSIZE=LRECL	Optional, but must be a multiple of LRECL; if omitted BLKSIZE=LRECL	③
<b>BUFNO</b>	Optional; if omitted 2 is used	Set by assembler to 1	Optional; if omitted 2 is used	Optional; if omitted 3 is used for unit record and 2 for other devices	Optional; if omitted 3 is used for unit record and 2 for other devices	Must not be specified

① U = undefined, F = fixed length records, B = blocked records, S = standard blocks, T = track overflow, A = ASCII code carriage control

② Blocking is not allowed on unit record devices. Blocking on other direct access can not be greater than the track size unless T is specified on RECFM. If the BLKSIZE specified is not a multiple of LRECL, the assembler truncates it to a multiple. For example, if LRECL = 80, a BLKSIZE of 850 is truncated to 800.

③ If BUFSIZE(STD) is in effect, a value between 790 and 8192 is chosen.  
If BUFSIZE(MIN) is in effect, 790 is chosen.  
If BUFSIZE(MAX) is in effect, a value between 790 and the track capacity on the used disk is chosen.

Figure 21. Assembler Data Set Characteristics



## Appendix F: The SYSTEM Listing for OS/VS

The SYSTEM data set, which gives you rapid access to the diagnostic messages issued during an assembly, is primarily designed for the user of the Time Sharing Option (TSO) of VS2. However, the data set can also be directed to a printer, a magnetic tape, or a direct-access device.

You use the assembler option `TERMINAL` to specify that you want a SYSTEM listing to be produced. Of course, you must also make sure that a DD statement describing the data set is included.

Each diagnosed statement in the assembly listing printed in the SYSTEM listing immediately followed by the messages that are issued for the statement. To help identify the position of the statement in your program, two additional assembler options are available:

- `NUMBER`, which prints the line number(s) of the diagnosed statement.
- `STMT`, which prints the statement number assigned to the diagnosed statement by the assembler.

The format of the flagged statement as it appears in the listing is:

Line No.(s) (option NUM)	Statement No. (option STMT)	Source record(s) (Columns 1-72 of the source statement lines)
-----------------------------	--------------------------------	--

If a statement contains continuation lines, it will occupy several lines in the listing, each identified by a line number (if option `NUMBER` is used). If a statement in error is discovered during the expansion of a macro, or of any inner macro called by an outer macro, the first line of the outer macro instruction is listed before the flagged statement. If a statement is flagged during variable symbol substitution in open code, the first line of the model statement is listed as well as the generated statement.

Figures 22 and 23 illustrate the content and format of SYSTEM output. Figure 22 shows the source statement section of a `SYSPRINT` listing, and Figure 23 shows the SYSTEM listing produced during the same assembly. The example illustrates the rules given above. Options `TERMINAL`, `NUMBER`, and `STMT` were in effect during the assembly.

The SYSTEM listing starts with the statement `ASSEMBLER DONE`. At the end of the listing the following diagnostic information is given:

- `NUMBER OF STATEMENTS FLAGGED IN THIS ASSEMBLY = nn`  
(Indicates the total number of source statements in error)
- `HIGHEST SEVERITY CODE WAS nn`  
(Indicates the maximum severity code encountered)
- `OPTIONS FOR THIS ASSEMBLY`  
(Indicates the options in effect for this assembly)

LOC	OBJECT CODE	ADDR1	ADDR2	STMT	SOURCE STATEMENT	ASM 0100 14.59 01/03/72
				1	MACRO	
				2	GENF 6P,6L	
				3	LCLA 6K	
				4	.LOOP ANOP	
				5	6K SETA 6K+1	
				6	6P6L (6K) DC F'6L (6K)'	
				7	AIF (6K LT N'6L) .LOOP	
				8	.DONE MEND	
				9	GBLC 6Q	
000000				10	SAMPL2 CSECT	
				11	SAVE (14,12)	ALL REGS ARE SAVED IN SUPERVISOR SAVEAREA
000000				12+	DS 0H	00660000
000000	90EC D00C	0000C		13+	STM 14,12,12 (13)	SAVE REGISTERS 01180000
000004	05C0			14	BALR R12,0	
			00006	15	USING *,R12	SET UP BASE REGISTER
				16	6Q SETC 'B'	
000006	0000 0000	00000		17	L R2,END	END OF AREA
	*** ERROR ***					
00000A	0000 0000	00000		18	LA R3,A	THIS IS A DUMMY COMMENT TO SHOW *
	*** ERROR ***					
						A STATEMENT CONTAINING TOO MANY CONTINUATION CARDS ZERO CONSTANT FOR RESETTING AREA *
00000E	5840 C022	00028		19	L R4,F0	
000012	5043 0000	00000		20	LOOP ST R4,0 (R3)	
000016	4130 3004	00004		21	LA R3,4 (,R3)	RESET AREA A
00001A	1923			22	CR R2,R3	
00001C	4770 C00C	00012		23	BNE LOOP	
				24	AIF ('A' EQ '6Q') .GO	
				25	SR 6Q,6Q	OPEN CODE MODEL STATEMENT WITH CONTINUATION CARD *
000020	0000			26+	SR B,B	OPEN CODE MODEL STATEMENT WITH CONTINUATION CARD *
	*** ERROR ***					
				27	.GO RETURN (14,12)	EXIT FROM RTN
000022	98EC D00C	0000C		28+	LM 14,12,12 (13)	RESTORE THE REGISTERS 00260000
000026	07FE			29+	BR 14	RETURN 00800000
				30	*	
				31	* CONSTANTS AND AREA ARE DELETED ON PURPOSE	
				32	*	
				33	GENF F,0	GENERATION OF CONSTANTS
000028	00000000			34+F0	DC F'0'	
				35	GENF 1,234	EXAMPLE OF MORE THAN ONE CARD IN A MACRO INSTRUCTION *
00002C	000000EA			36+1234	DC F'234'	
	*** ERROR ***					
		00002		37	R2 EQU 2	
		00003		38	R3 EQU 3	
		00004		39	R4 EQU 4	
		0000C		40	R12 EQU 12	
				41	END	

Figure 22. SYSPRINT Listing of the Source Statements Used to Show SYSTEM Output



```

ASSEMBLER (XF) DONE
17 L R2,END END OF AREA
IFO188 END IS AN UNDEFINED SYMBOL
18 LA R3,A THIS IS A
DUMMY COMMENT
TO SHOW
*
*
*
IFO188 A IS AN UNDEFINED SYMBOL
IFO069 EXCESSIVE CONTINUATION CARDS, TWO ALLOWED
A STATEMENT CONTAINING
TOO MANY CONTINUATION CARDS
25 SR 6Q,6Q OPEN CODE MODEL STATEMENT
WITH CONTINUATION CARD
*
26+ SR B,B OPEN CODE MODEL STATEMENT
WITH CONTINUATION CARD
*
+
IFO188 B IS AN UNDEFINED SYMBOL
IFO188 B IS AN UNDEFINED SYMBOL
35 GENF 1,234 EXAMPLE OF MORE THAN ONE CARD
36+1234 DC F'234'
*
IFO125 INVALID NAME- ILLEGAL EMBEDDED CHARACTER OR NON-ALPHABETIC FIRST CHARACTER
NUMBER OF STATEMENTS FLAGGED IN THIS ASSEMBLY = 4
HIGHEST SEVERITY WAS 8
OPTIONS FOR THIS ASSEMBLY
ALIGN, ALOGIC, BUFSIZE(STD), NODECK, ESD, FLAG(0), LINECOUNT(55), LIST, NOMCALL
NOMLOGIC, NUMBER, NOOBJECT, NORENT, RLD, STMT, NOLIBMAC, TERMINAL, NOTEST, XREF
SYSPARM 0

```

Figure 23. SYSTEM Listing Produced for the Source Statements Shown in Figure 22.

# Appendix G: Assembler Diagnostic Error Messages

This appendix lists all the diagnostic messages issued by the VS Assembler. The messages are listed sequentially by statement number.

## HOW TO USE THIS SECTION

Once you have found an error message in the diagnostics section of your listing that you are not sure you understand fully, look up the entry for the message in this appendix. The entry for the message will give you the following items:

- The message number and the text of the message.
- Explanation of the message.
- Assembler action in response to the message.
- Programmer response to correct the error.
- Operator response to correct the error (only for certain messages).
- Severity code assigned to the message.

The following paragraphs describe the messages as they appear in your listing and explain in detail the various items of each entry in this appendix.

## The Message Itself

In the diagnostics section of your assembler listing you will find the following items for each message:

- The number of the statement in error.
- The message identification number.
- The text of the message.

**STATEMENT NUMBER:** For certain messages the statement number given is always 0, either because the assembler cannot identify the number of the statement in which the error occurs when it finds the error, or because the error cannot be associated with a specific statement. For some of these messages, the text of the message identifies the macro in which the error is found.

For errors found during the editing of a library macro, the statement number given is that of the last numbered statement in the source module, unless the LIBMAC and MLOGIC assembler options are in effect, as described below under "Explanation".

**MESSAGE NUMBER:** The message identification number is a unique number consisting of the letters IFO followed by a three digit number.

**TEXT:** The text of the message is not always printed out in full in the diagnostics section of the listing. However, the corresponding text in this appendix is always fully printed out.

Certain messages include information in the message text to help you localize the error within the statement. In the message text as it appears in this section, 'nn' denotes a number and 'xxxxxxx' a character string. The number identifies a column in the operand of the

statement in error that is close to the column where the error is found. The character string may represent a symbol or the word MACRO. It is limited to eight characters, so if the string containing the error is longer, it is truncated.

#### Explanation

This item gives the probable cause or causes of the error message. An error message is issued at the point where the assembler can no longer make sense of the text, not necessarily at the point where the real error occurred. For example, if you want to code the following instructions LR 3,5, and leave out the R in the operation code, the assembler will treat the instruction as a storage-to-register instruction, and give an error message for the second operand (unless NOALIGN is specified).

If errors occur during the editing or expansion of a library macro and the assembler options specified cause the logic of the macro expansions not to be printed, error messages for the library macro will be logged against the last numbered statement in the program. However, if you use the LIBMAC and MLOGIC assembler options, errors in library macros will be logged against the statements in error. See the section "Assembler Options" for a discussion of these options.

#### Assembler Action

This item tells you how the assembler reacts to the error. A machine instruction usually causes zeros to be generated in its place in the object module if a major error occurs anywhere in that instruction. An assembler instruction is usually printed out but not processed ("processed as a comment"). Some machine and assembler instructions, however, are partially processed or processed with a default value. In some cases the assembler terminates the whole assembly.

#### Programmer Response

This item tells you how to correct the statement in error. It is assumed that you will detect certain errors when an error message draws your attention to the statement. Thus, the programmer response for each message does not tell you to check for keypunching errors or to check the use of the flagged statement.

#### Operator Response

This item tells the operator how to correct certain errors. The operator response is only given for messages that are printed on the operator's console. The operator will not change your source deck. He may, however, do such things as change partition or region size, or correct certain job control errors.

## Severity Code

The severity code indicates the seriousness of the error. The severity codes used by the VS Assembler and their meanings are shown in the following table.

Severity Code	Explanation
4	Minor error; successful program execution is probable
8	Significant error; unsuccessful program execution is possible
12	Serious error; unsuccessful program execution is probable
16	Critical error; normal execution is impossible
20	Critical error; further assembly impossible, assembly terminated

The severity code is the return code issued by the assembler when it returns control to the operating system. The IBM-supplied cataloged procedures include a COND parameter on the linkage edit and execution steps. The COND parameter prevents execution of these steps if the return code from the assembler is greater than 8.

## RECURRING ERRORS

If an error message recurs after the error situation has been corrected and there seems to be nothing wrong with the statement, there may be an error in the assembler. If you suspect that this is the case, make sure the program is correct and reassemble if necessary. If the problem still persists, do the following before calling IBM:

- If problem is inside a macro, reassemble with option MLOGIC. Use PRINT assembler instruction to avoid printing of unimportant parts of the listing, so as to limit the amount of assembler printout.
- Have your source program, macro definitions, and associated listings available.
- If a COPY statement was used, execute the IEBTPCH utility to obtain a copy of the partitioned data set member specified in the COPY statement.
- Make sure that MSGLEVEL=(1,1) was specified in the JOB statement.

If IBM central program support is needed, note that the purpose of the material to be submitted with an APAR (Authorized Program Analysis Report) is to give the program support team possibility to reproduce the failure. Since assembler normally processes a lot of statements that are not visible on a listing, both the source and all macros called by the source (except standard IBM-supplied supervisor and data management macros), and possible COPY-code, should be included in machine-readable format.



IFO000 UNDEFINED ERROR CODE IFOxxx

Explanation: An error code has been generated by the assembler for which no message has been defined. This is caused by a logical error in the assembler.

Assembler Action: Assembly continues.

Programmer Response: Perform the actions described under "Recurring Errors" above before calling IBM.

Severity Code: 16

IFO001 SYSTEM VARIABLE SYMBOL xxxxxxxx USED AS SYMBOLIC PARAMETER IN MACRO PROTOTYPE

Explanation: A variable symbol used as a symbolic parameter on a macro prototype statement has the same characters as a system variable symbol. The system variable symbols are:

&SYSECT	&SYSPARM
&SYSLIST	&SYSTIME
&SYSNDX	&SYSDATE

Assembler Action: Editing of the macro definition is terminated. All statements in the macro definition are processed as comments.

Programmer Response: Redefine the parameter with a variable symbol other than &SYSPARM, &SYSDATE, &SYSTIME, &SYSLIST, &SYSECT, or &SYSNDX.

Severity Code: 8

IFO002 SYMBOLIC PARAMETER xxxxxxxx IS DUPLICATED IN SAME MACRO PROTOTYPE

Explanation: Two identical symbolic parameters have been specified in the same macro prototype statement.

Assembler Action: Editing of the macro definition is terminated. All statements in the macro definition are processed as comments.

Programmer Response: Redefine one of the symbolic parameters with a variable symbol that is unique to that particular macro definition.

Severity Code: 8

IFO003 SYSTEM VARIABLE SYMBOL xxxxxxxx USED IN OPERAND OF GLOBAL OR LOCAL DECLARATION

Explanation: A system variable symbol has been used in the operand of a global or local declaration. The system variable symbols are:

&SYSECT           &SYSPARM  
&SYSLIST          &SYSTIME  
&SYSNDX           &SYSDATE

Assembler Action: The declaration conflicting with the system variable symbol is ignored. All subsequent references to the variable symbol in error are treated as references to the system variable symbol.

Programmer Response: Redefine the variable symbol using character combinations other than those listed above in the explanation.

Severity Code: 8

IFO004   GLOBAL OR LOCAL VARIABLE xxxxxxxx DUPLICATES A SYMBOLIC  
PARAMETER IN SAME MACRO DEFINITION

Explanation: A variable symbol that appears in the operand field of a global or local declaration is identical to a symbolic parameter defined on the macro prototype earlier in the macro definition.

Assembler Action: The declaration conflicting with the symbolic parameter is ignored. All subsequent references to it are treated as references to the symbolic parameter that it duplicates.

Programmer Response: Redefine the global or local variable with a variable symbol that is unique to the macro definition.

Severity Code: 8

IFO005   GLOBAL OR LOCAL VARIABLE SYMBOL xxxxxxxx DUPLICATES PREVIOUS  
DECLARATION

Explanation: A global or local variable symbol was declared twice in the same macro definition or in open code.

Assembler Action: The second declaration of the variable symbol is ignored. All subsequent references to it are treated as references to the first declaration.

Programmer Response: If the second declaration is LCLx, redeclare it using a variable symbol unique to the macro definition or to open code. If the second declaration is GBLx, redeclare it as for LCLx, but be sure that all declarations of that global variable elsewhere in the program are identical.

Severity Code: 8

IFO006   UNDEFINED VARIABLE SYMBOL xxxxxxxx

Explanation: A variable symbol has been referenced in this statement that is not a system variable symbol; has not been defined within the macro definition as a symbolic parameter, a



local variable, or a global variable; or has not been defined in open code as a local or global variable.

Assembler Action: The statement is processed as a comment, unless the error has occurred in a macro instruction parameter. If the macro instruction parameter contains an undefined variable symbol, the parameter is assigned the value of a null string.

Programmer Response: Define the variable symbol as a symbolic parameter, a local variable, or a global variable; or, if desired, reference a previously-defined variable symbol of the appropriate type. This message may be issued if an ampersand erroneously appears as the first character of an ordinary symbol, and thus creates an unintended variable symbol.

Severity Code: 8

IFO007 USAGE OF xxxxxxxx IS INCONSISTENT WITH ITS DECLARATION

Explanation: A global or local variable symbol was defined as dimensioned but was used without a subscript, or a global or local variable symbol was defined as undimensioned but was used with a subscript.

Assembler Action: Editing of the statement that contains the inconsistent usage is terminated, and the statement is processed as a comment.

Programmer Response: Make the usage of the SET symbol consistent with its global or local declaration, or make the declaration of the SET symbol consistent with its usage.

Severity Code: 8

IFO008 CIRCULAR OPSYN STATEMENTS

Explanation: The assignment of a synonym in the operand field of an OPSYN statement to the established mnemonic in the name field results in the mnemonic being its own synonym. For example:

```
ADD      OPSYN A
PLUS     OPSYN ADD
XYZ      OPSYN PLUS
ADD      OPSYN XYZ
```

The final OPSYN statement in the above sequence is flagged.

Assembler Action: The flagged OPSYN statement is processed as a comment.

Programmer Response: Remove any OPSYN statement that results in a circular definition, or alter such an OPSYN statement by respecifying the synonym or the mnemonic.

Severity Code: 8

IFO009 EDIT DICTIONARY SPACE EXHAUSTED

Explanation: The work space available is not sufficient to contain the dictionaries that are required to edit the macro definition or open code.

Assembler Action: If a macro definition is being edited, the remaining statements up to the MEND statement are processed as comments, and editing resumes. If open code is being edited, the remaining statements up to the end-of-file are processed as comments.

Programmer Response: Increase the size of the region or partition that is allocated to assembly, or allocate more dictionary space via the BUFSIZE and/or the WORKSIZE assembler option. See Appendix E of this manual.

Severity Code: 12

IFO010 PROGRAMMER MACRO xxxxxxxx HAS BEEN PREVIOUSLY DEFINED

Explanation: The mnemonic on the macro instruction prototype of a source (programmer) macro duplicates a mnemonic already defined as a source macro.

Assembler Action: All statements in this macro definition are processed as comments. All subsequent references to the mnemonic are treated as references to the first definition associated with that op code.

Programmer Response: Provide a unique mnemonic op code for the flagged macro prototype.

Severity Code: 8

IFO012 ICTL OR OPSYN STATEMENT APPEARS TOO LATE IN THE PROGRAM

Explanation:

- The ICTL statement does not precede all other statements in the source module; or
- The OPSYN statement does not appear before source macro definitions and open code statements. The only statements that can precede an OPSYN statement are: ICTL, ISEQ, TITLE, PRINT, EJECT, SPACE, OPSYN, COPY (unless the member copied contains any other than the statements listed here), and comments statements.

Assembler Action: The ICTL or OPSYN statement is processed as a comment.

Programmer Response: Place the ICTL or OPSYN statement at the beginning of your program as described in the explanation above.

Severity Code: 8

IFO013 OPSYN NAME FIELD NOT ORDINARY SYMBOL, OR OPSYN OPERAND FIELD NOT ORDINARY SYMBOL OR BLANK

Explanation: The name or operand field of an OPSYN instruction contains more than 8 alphanumeric characters or does not begin with an alphabetic character.

Assembler Action: The OPSYN statement is processed as a comment.

Programmer Response: Correct the invalid name field or operand field.

Severity Code: 8

IFO014 INVALID OPCODE IN OPSYN OPERAND OR NAME FIELD

Explanation:

- The name field of an OPSYN instruction with a blank operand field does not specify a machine instruction operation code, an extended machine instruction operation code, or an assembler operation code; or
- The operand field of an OPSYN instruction does not specify a machine instruction operation code, an extended machine instruction operation code, or an assembler operation code.

Assembler Action: The OPSYN statement is treated a comment.

Programmer Response: Make sure that the name field contains a valid operation code, or supply a valid operation code in the operand.

Severity Code: 8

IFO016 ILLEGAL OR INVALID NAME FIELD

Explanation: One of the following errors was detected.

- No name was found where one is required.
- A name was supplied where none is allowed.
- An invalid character was found in the name field.

Assembler Action: The statement is processed as a comment, unless the error has occurred in the name field of a macro instruction. If the macro name field parameter contains an error, the parameter is assigned the value of a null string.

Programmer Response: Supply a name if one is required, omit the name if one is not allowed, or correct the invalid character.

Severity Code: 8

IFO017 \* COMMENTS STATEMENT IS ILLEGAL OUTSIDE MACRO DEFINITION

Explanation: An internal macro comments statement (.\* ) appears outside macro definitions (in open code) .

Assembler Action: The statement is printed.

Programmer Response: Remove the .\* comments statement. If you want a comment, put an \* in the begin column and follow it by the comment.

Severity Code: 4

IFO018 MORE THAN 5 ERRORS IN THIS STATEMENT, ERROR ANALYS OF THE STATEMENT IS TERMINATED

Explanation: The maximum number of error messages issued during editing to each statement is 5. The sixth error causes this message.

Assembler Action: Error analysis for this statement is terminated.

Programmer Response: Correct the indicated errors and reassemble. Any additional errors on this statement will be detected in the next assembly.

Severity Code: 4

IFO019 INVALID OPERAND IN ICTL OR ISEQ STATEMENT

Explanation:

(1) The value of one or more operands in an ICTL statement is incorrect. The begin column must be within columns 1 to 40; the end column must be within columns 41 to 80 and at least 5 columns away from the begin column; and the continue column must be within columns 2 to 40.

(2) One of the following errors has occurred in an ISEQ statement:

- The operand has an illegal range; the operand value cannot fall between the begin and end columns, and the second operand must not be less than the first.
- The operand field is invalid. The operand field must contain two valid decimal self-defining terms, separated by a comma or be blank.

Assembler Action: If a program contains an ICTL error, the whole program is processed as comments. If one of the ISEQ errors has occurred, no sequence checking is performed.

Programmer Response: Supply valid operand (s) .

Severity Code: 8

IFO021 INVALID TERM IN OPERAND

Explanation: An invalid term has been used in an expression of the operand.

Assembler Action: The statement is processed as a comment.

Programmer Response: Make sure the operand is a character relation, an arithmetic relation, a logical relation, a SETx symbol, a symbolic parameter, or a decimal self-defining term.

Severity Code: 8

IFO022 ICTL STATEMENT IS ILLEGAL IN COPY CODE

Explanation: An ICTL statement appears in code that is inserted in the program by a COPY instruction.

Assembler Action: The ICTL statement is processed as a comment.

Programmer Response: Make sure the ICTL instruction is not in code inserted by the COPY instruction. If used, the ICTL instruction must always be the first instruction in your source module.

Severity Code: 8

IFO023 ILLEGAL MACRO, MEND, OR MEXIT STATEMENT - MAY APPEAR ONLY WITHIN MACRO DEFINITIONS

Explanation: MACRO, MEND, or MEXIT statements are not allowed in open code. They can be used only in macro definitions. This message will be issued if an instruction other than ICTL, ISEQ, OPSYN, TITLE, PRINT, EJECT, SPACE, or COPY appears before any macro definitions in your program. Of course, any such COPY instruction cannot copy any other statements than ISEQ, OPSYN, TITLE, PRINT, EJECT, or SPACE. This message will also be issued, if an undefined operation code appears before your macro definitions.

Assembler Action: The illegal MACRO, MEND, or MEXIT statement is processed as a comment.

Programmer Response: Remove the statement from open code on place it within a macro definition. Make sure that all your macro definitions are placed at the beginning, before open code.

Severity Code: 8

IFO024 UNPAIRED PARENS, OR BLANK FOUND INSIDE PAIRED PARENS

Explanation:

- Unpaired parentheses appear in the operand field; or
- A blank appears inside paired parentheses in the operand field of a macro instruction. This may be an error in sublist structure; or

- A blank appears inside parentheses of an arithmetic expression; or
- A term is missing in a logical expression.

Assembler Action: The operand in error is ignored.

Programmer Response: If unpaired parentheses appear, be sure that there is a right parenthesis for every left parenthesis. Remove illegal blanks inside paired parentheses.

Severity Code: 8

IFO025 STATEMENT OUT OF SEQUENCE

Explanation: The input sequence checking specified by the ISEQ instruction has determined that the flagged statement is out of sequence.

Assembler Action: The statement is flagged and assembled, however, the sequence number of the following statements will be checked relative to this statement and not relative to the sequence of previous statements.

Programmer Response: Put the statement in the proper sequence.

Severity Code: 4

IFO026 CHARACTERS APPEAR BETWEEN THE BEGIN AND CONTINUE COLUMNS ON CONTINUATION CARD

Explanation: On a continuation card, the begin column and all columns between the begin column and the continue column (usually column 16) must be blank.

Assembler Action: Characters that appear between the begin column and the continue column are ignored.

Programmer Response: Determine whether the operand started in the wrong continue column or whether the preceding card contained an erroneous continue punch in column 72.

Severity Code: 4

IFO027 ICTL, ISEQ, MACRO, OR OPSYN STATEMENT APPEARS IN MACRO DEFINITION

Explanation: One of the specified operations is used within a macro definition, which is illegal.

Assembler Action: The illegal operation is ignored and the statement is processed as a comment.

Programmer Response: Remove all ICTL, ISEQ, MACRO, and OPSYN statements from within macro definitions. Make sure your ICTL and OPSYN instructions precede your macro definitions, and that each macro definition ends with a MEND statement.

Severity Code: 8

IFO028 ILLEGAL PROTOTYPE KEYWORD PARAMETER DEFAULT VALUE

Explanation: A variable symbol is used as the default value of a keyword parameter.

Assembler Action: The statement is ignored.

Programmer Response: Supply a valid default value for the keyword parameter.

Severity Code: 8

IFO029 xxxxxxxx IS AN ILLEGAL OPERAND IN A GLOBAL OR LOCAL DECLARATION

Explanation: In a global (GBLx) or local (LCLx) SET symbol declaration, the indicated operand does not consist of one or more variable symbols that are separated by commas and terminated with a blank.

Assembler Action: The attempted global or local SET symbol declaration is processed as a comment. Recovery is made in certain circumstances and some valid variable symbols in the declaration are recognized and defined correctly.

Programmer Response: Supply the operand with valid variable symbols and delimiters. Check all global and local declarations.

Severity Code: 8

IFO030 DECLARED DIMENSION OF xxxxxxxx IS ILLEGAL

Explanation: The declared dimension, which appears in the error message, must be a nonzero, unsigned decimal integer, not greater than 32,767, and enclosed in parentheses.

Assembler Action: If the declared dimension was a decimal self-defining term greater than 32,767, a default dimension of 32,767 is assigned to the variable symbol. In all other cases, the variable symbol declaration is ignored.

Programmer Response: Supply a valid dimension.

Severity Code: 8

IFO031 SET STATEMENT NAME NOT A VARIABLE SYMBOL, OR SET STATEMENT NAME INCONSISTENT WITH DECLARED TYPE

Explanation: (1) The name field of a SET statement does not consist of an ampersand followed by from 1 to 7 alphameric characters, the first of which is alphabetic.

(2) The symbol does not match its previously declared type. For instance, the symbol might have been previously defined as LCLA, but the flagged statement may have tried to assign a SETC character string to it.

(3) A system variable symbol appears in the name field of a SETx instruction. The system variable symbols are &SYSECT, &SYSLIST, &SYSNDX, &SYSPARM, &SYSDATE, and &SYSTEMTIME.

Assembler Action: The flagged statement is processed as a comment.

Programmer Response: Assign a valid variable symbol to the name field of the SET statement (the symbol must be previously defined as a global or local variable), or be sure that the usage of the symbol corresponds to its previously declared type.

Severity Code: 8

IFO032 xxxxxxxx APPEARS IMPROPERLY IN THE OPERAND OF THIS STATEMENT

Explanation: The specified operand part is invalid.

Assembler Action: The statement is processed as a comment.

Programmer Response: Check the syntax required for the operand field of this statement, and supply a valid operand.

Severity Code: 8

IFO033 xxxxxxxx IS AN INVALID LOGICAL OPERATOR

Explanation: The specified character string was found where a logical operator (AND or OR) was expected.

Assembler Action: The statement is processed as a comment.

Programmer Response: Use either AND or OR, as appropriate, for the logical operator.

Severity Code: 8

IFO035 QUOTES NOT PAIRED, OR ILLEGAL TERMINATION OF QUOTE STRING

Explanation: The quotes in the operand field of this statement are unpaired, or the string is illegally terminated.

Assembler Action: The statement is processed as a comment.



Programmer Response: Supply any missing quotes.

Severity Code: 8

IFO036 ATTRIBUTE REFERENCE FOR xxxxxxxx IS INVALID

Explanation: The flagged statement has attempted to reference a symbol that is not a valid ordinary or variable symbol. The attributes referenced were one or more of the following: type (T'), length (L'), scaling (S'), integer (I'), count (K'), and number (N').

Assembler Action: The attribute referenced is ignored, and/or the statement is ignored, and/or default values for type, length, and scaling attributes are supplied.

Programmer Response: Determine if a clerical error was made in coding either the reference or the definition of the symbol that appears in the message text; or supply a valid ordinary or variable symbol where necessary.

Severity Code: 8

IFO037 xxxxxxxx IS AN ILLEGAL SUBSCRIPT

Explanation: The subscript that appears in the message text either is not enclosed by paired parentheses, or is an illegal subscript.

Assembler Action: The statement that contains the illegal subscript is processed as a comment.

Programmer Response: Be sure the parentheses are paired, and that a valid subscript appears inside them.

Severity Code: 8

IFO038 xxxxxxxx IS AN INVALID SELF-DEFINING TERM

Explanation: The characters specified in the message are invalid in the operand field of a binary (type B), character (type C), decimal, or hexadecimal (type X) self-defining term.

Assembler Action: The statement that contains the invalid self-defining term is processed as a comment.

Programmer Response: Make sure that the characters used for a self-defining term are consistent with the type of term.

Severity Code: 8

IFO039        xxxxxxxx IS AN INVALID VARIABLE SYMBOL

Explanation: The specified symbol does not consist of an ampersand followed by from 1 to 7 alphameric characters, the first of which is alphabetic.

Assembler Action: The statement that contains the invalid variable symbol is processed as a comment. If the statement is a macro prototype statement, all statements in the macro definition are treated as comments.

Programmer Response: Supply a valid variable symbol, or check that a single ampersand is not used where a double ampersand is needed.

Severity Code: 8

IFO042        PARAMETER IN MACRO PROTOTYPE OR MACRO INSTRUCTION EXCEEDS 255 CHARACTERS

Explanation: A parameter value that appears in the operand field of either a macro prototype or a macro instruction exceeds 255 characters in length.

Assembler Action:

- If the pertinent parameter is a sublist, assembler tries to process the statement in its entirety.
- If the parameter is a suboperand, or any other independent parameter, it is truncated to 255 characters and the rest of the statement is processed as comments.

Programmer Response: Limit the parameter to 255 characters or separate it into two or more parameters.

Severity Code: 8

IFO043        MACRO INSTRUCTION PROTOTYPE STATEMENT HAS INVALID OP CODE

Explanation:

- The operation code of a macro prototype statement is previously defined as the operation code of a machine, assembler, or macro instruction; or
- The operation code of a macro prototype statement is not a valid ordinary symbol; that is, it does not consist of a letter, followed by 0 to 7 letters or digits or both.

Assembler Action: The entire macro definition is processed as comments.

Programmer Response: Supply a valid ordinary symbol that does not conflict with any machine, assembler, or macro instruction operation code.

Severity Code: 8

IFO046 STATEMENT COMPLEXITY EXCEEDED

Explanation: The expression evaluation work area has overflowed because the expression is too complex. The complexity of an expression is determined by the number of nested operators and levels of parentheses. Up to 35 operators and levels of parentheses are allowed. For logical expressions, this total allows 18 unary and binary operators, and 17 levels of parentheses. For arithmetic expressions in conditional assembly, the total allows 24 unary and binary operators, and 11 levels of parentheses.

Assembler Action: The statement is processed as a comment.

Programmer Response: Simplify the expression to the limits described in the explanation.

Severity Code: 8

IFO047 UNEXPECTED END OF FILE ON SYSTEM INPUT (SYSIN)

Explanation:

- A continuation record was expected when an end-of-file occurred on SYSIN (the source program ended); or
- End-of-file immediately follows a REPRO statement; or
- End-of-file occurs before an END card has been read.

Assembler Action: An END statement is generated and assembly continues.

Programmer Response: Determine if any statements were omitted from the source program.

Severity Code: 4



IFO048 ICTL STATEMENT HAS NO OPERAND

Explanation: The ICTL statement requires an operand, but none is present.

Assembler Action: The entire source module is processed as comments.

Programmer Response: Supply from 1 to 3 decimal self-defining terms to indicate respectively the begin, end, and continue columns. If the ICTL statement is omitted, columns 1, 71, and 16, respectively, are the default values.

Severity Code: 8

IFO049 COPY STATEMENT OPERAND NOT A VALID ORDINARY SYMBOL

Explanation: The operand of a COPY statement is not a symbol of 1 to 8 alphameric characters, the first of which is alphabetic.

Assembler Action: The COPY request is processed as a comment.

Programmer Response: Supply a valid ordinary symbol in the operand field.

Severity Code: 8

IFO050 COPY STATEMENT DOES NOT HAVE AN OPERAND

Explanation: No operand found on this COPY statement.

Assembler Action: The statement is processed as a comment.

Programmer Response: Place the name of a member to be copied in the operand field, or remove the COPY statement.

Severity Code: 8

IFO051 UNEXPECTED END OF DATA ON SYSTEM LIBRARY (SYSLIB)

Explanation: An end-of-file occurred on the input from a system library before a MEND statement terminating a macro definition was encountered.

Assembler Action: The missing MEND statement is generated.

Programmer Response: Determine if the MEND statement was omitted from the library macro, or if the library contains an otherwise incomplete macro definition, or if a macro call has been made to a non-macro definition.

Severity Code: 4

IFO052 UNARY OPERATOR NOT A PLUS OR MINUS SIGN

Explanation: An operator other than a plus or minus sign appears as a unary operator. Except for unary operators, which are limited to plus and minus signs, only one operator can appear between two terms.

Assembler Action: The statement is processed as a comment.

Programmer Response: Supply the missing term or a correct operator.

Severity Code: 8

IFO053 OP CODE NOT FOUND ON FIRST OR ONLY CARD

Explanation: The complete statement name (if one is used) and the operation code, each followed by a blank, do not appear before the continuation indicator column on the first card of a continued statement.

Assembler Action: The entire statement is processed as a comment.

Programmer Response: Make sure that both the name and operation code of the statement appear on the first card. Check for syntactic errors.

Severity Code: 8

IFO054 INVALID OPERATION CODE

Explanation:

- The operation code specified is not a valid ordinary symbol;  
or
- A variable symbol in the operation field is invalid; or
- The resulting operation code after substitution with or without concatenation is not a valid ordinary symbol.

Assembler Action: The statement is processed as a comment.

Programmer Response: Make sure that ordinary or variable symbols used in the operation field are valid. If you use variable symbols with or without concatenation, make sure the resulting symbol is a valid ordinary symbol.

Severity Code: 8

IFO055 MEND STATEMENT GENERATED

Explanation: An end-of-file occurred on the input from the system input device (SYSIN) or the system library (SYSLIB) before a MEND statement terminating a macro definition was encountered.

Assembler Action: A MEND statement is generated.

Programmer Response: Supply a MEND statement to terminate the macro definition.

Severity Code: 8

IFO057 DUPLICATION FACTOR xxxxxxxx IN SETC EXPRESSION NOT TERMINATED BY A RIGHT PARENTHESIS

Explanation: A SETC operand begins with a left parenthesis, but a comma, a period, or a blank appears before the closing right parenthesis.

Assembler Action: The statement is processed as a comment.

Programmer Response: Supply a right parenthesis.

Severity Code: 8

IFO058 NO ENDING QUOTE ON SETC EXPRESSION

Explanation: The character expression in the operand field of a SETC statement must be enclosed in quotes. The statement ends before a delimiting quote.

Assembler Action: The statement is processed as a comment.

Programmer Response: Supply any missing quotes.

Severity Code: 8

IFO059 INVALID TERM IN LOGICAL EXPRESSION

Explanation: One of the terms in the logical expression is invalid in the context.

Assembler Action: The statement is processed as a comment.

Programmer Response: Make sure that the terms in the logical expression are valid.

Severity Code: 8

IFO060 END STATEMENT GENERATED

Explanation: One of two errors occurred.

(1) End-of-file occurred on the system input device (SYSIN) before an END card was read.

(2) The ACTR limit was exceeded in open code.

Assembler Action: An END statement is generated.

Programmer Response:

(1) Supply a valid END statement; or

(2) Either correct the conditional assembly loop in open code so that the ACTR limit is not exceeded, or set the ACTR limit in open code to a higher value.

Severity Code: 4

IFO061 COPY NEST GREATER THAN FIVE

Explanation: The maximum limit of five nested levels of COPY statements is exceeded.

Assembler Action: COPY processing terminates.

Programmer Response: Eliminate excessive levels of COPY statements.

Severity Code: 8

IFO062 REQUIRED OPERAND FIELD MISSING

Explanation: This statement requires an operand in the operand field and none is present.

Assembler Action: The statement is processed as a comment.

Programmer Response: Supply the missing operand.

Severity Code: 8



IFO064 INTERLUDE DICTIONARY SPACE EXHAUSTED

Explanation: The work space available is not sufficient to contain the dictionaries required to build either

(1) The skeleton dictionary for a macro definition or all of open code, or

(2) The ordinary symbol reference dictionary.

This message is always logged against statement number 0.

Assembler Action: If a macro is being processed, building of the skeleton dictionary for that macro definition is terminated and the macro will not be expanded. If open code is being processed, the building of the open code skeleton dictionary is terminated and the program is processed as comments. If space for the ordinary symbol attribute reference dictionary is exhausted, the building of it is abandoned.

Programmer Response: Within the partition, increase the size of the region that is allocated to assembly, or allocate more of the partition to dictionary space via the BUFSIZE and/or the WORKSIZE assembler option (see Appendix E).

Severity Code: 12

IFO065 EXPRESSION 2 OF EQU SYMBOL xxxxxxxx NOT IN RANGE 0-65535

Explanation: The value of the expression specified in the second operand of the EQU instruction where this symbol is defined is not in the range 0-65535.

This message is always logged against statement number 0.

Assembler Action: The length attribute of the symbol is set to 1

Programmer Response: Make sure the value of the second operand of the EQU instruction is in the range 0-65535, or delete the second operand.

Severity Code: 8

IFO066 EXPRESSION 3 OF EQU SYMBOL xxxxxxxx NOT IN RANGE 0-255

Explanation: The value of the expression specified in the third operand of the EQU instruction where this symbol is defined is not in the range 0-255.

This message is always logged against statement number 0.

Assembler Action: The type attribute of the symbol is set to U.

Programmer Response: Make sure the value of the third operand of the EQU instruction is in the range 0-255, or delete the third operand.

Severity Code: 8

IF0067    DECLARED DIMENSION FOR GLOBAL VARIABLE xxxxxxxx IN xxxxxxxx  
          xxxxxxx IS INCONSISTENT

Explanation: The declared dimension of a global variable defined in a macro definition or in open code is not consistent with the declared dimension of the same global variable in another macro definition or in open code.

This message is always logged against statement number 0. The message text identifies the macro (or open code) where the error is found.

Assembler Action: All references to the global variable in the macro definition or in open code where the inconsistency was detected result in a null (zero) value.

Programmer Response: Be sure that all definitions of a given global variable have the same declared dimension.

Severity Code: 4

IF0068    COPY MEMBER xxxxxxxx NOT FOUND IN LIBRARY

Explanation: The COPY member shown in the message text was not found in the library.

Assembler Action: The COPY statement is processed as a comment.

Programmer Response: Determine whether the library member name is misspelled or whether an incorrect member name was referenced. Make sure the proper macro library is assigned in your JCL statements.

Severity Code: 8

IF0069    TOO MANY CONTINUATION CARDS, TWO ALLOWED

Explanation: Only two continuation cards are allowed for each statement, except for macro definition prototype and macro call statements.

Assembler Action: Excess continuation cards are processed as comments.

Programmer Response: Restructure the statement so that it can be contained on a total of three cards. Extensive remarks may be recorded as comment statements by coding an asterisk in column 1 and eliminating the continuation indicators.

Severity Code: 4

IF0070    SUBSTRING NOTATION IS NOT DELIMITED BY COMMA OR RIGHT  
          PARENTHESIS

Explanation: Two SETA expressions used in substring notation are not separated by a comma or enclosed in parentheses.

Assembler Action: The statement is processed as a comment.

Programmer Response: Supply the missing delimiter, or check for other syntax errors that make this appear as substring notation.

Severity Code: 8

IFO073 AGO OR AIF OPERAND NOT A SEQUENCE SYMBOL

Explanation: The symbol in the operand field of an AIF or AGO statement is not a period (.) followed by from 1 to 7 alphameric characters, the first of which is alphabetic.

Assembler Action: The statement is processed as a comment.

Programmer Response: Supply a valid sequence symbol.

Severity Code: 8

IFO074 SEQUENCE SYMBOL xxxxxxxx IS MULTIPLY DEFINED IN xxxxxxxx  
xxxxxxx

Explanation: The sequence symbol in the name field has been used in the name field of a previous statement within the same macro definition or open code.

This message is always logged against statement number 0. The message text identifies the macro (or open code) where the error is found.

Assembler Action: All definitions of the sequence symbol after the first one are ignored. All references to the sequence symbol are treated as references to the first definition.

Programmer Response: Provide unique sequence symbols for the macro definition or open code.

Severity Code: 4

IFO076 SEQUENCE SYMBOL xxxxxxxx IS UNDEFINED IN xxxxxxxx xxxxxxxx

Explanation: A sequence symbol appears in the operand of an AIF or AGO statement, but does not appear in the name field of another statement in the same macro definition or open code.

This message is always logged against statement number 0. The message text identifies the macro (or open code) where the error is found.

Assembler Action: All statements which reference the undefined sequence symbol are processed as comments.

Programmer Response: Define the sequence symbol at the appropriate point, or reference a sequence symbol that is already defined.

Severity Code: 4

IFO078 UNDEFINED OP CODE

Explanation: The mnemonic operation code of this statement does not correspond to any of the following:

- a machine instruction operation code
- an extended machine instruction operation code
- an assembler instruction operation code
- a macro instruction operation code
- an operation code that has been defined by an OPSYN instruction.

This message is also issued for operation codes that have been deleted by OPSYN instructions.

Assembler Action: The statement is treated as a comment. If the statement appears before open code, all statements following it are considered to belong to open code. This means that any macro definitions following the error are treated as errors.

Programmer Response: Either make sure you use a valid mnemonic operation code, or make sure that the proper OPSYN instructions are included in your program.

Severity Code: 8

IFO080 ATTRIBUTE REFERENCE TO UNDEFINED SYMBOL

Explanation: The symbol specified in a length (L'), scaling (S'), or integer (I') attribute reference is either an undefined symbol or a symbolic parameter (or a &SYSLIST specification) representing an undefined symbol.

Assembler Action:

- The length attribute, if specified, is set to 1.
- The integer or scaling attribute, if specified, is set to 0.

Programmer Response: Make sure the symbol is defined.

Severity Code: 4

IFO081 DECLARED TYPE FOR GLOBAL VARIABLE xxxxxxxx IN xxxxxxxx xxxxxxxx IS INCONSISTENT

Explanation: The type (GBLA, GBLB, or GBLC) of a global variable declared in a macro definition or in open code is not consistent with the type of the same global variable declared in another macro definition or in open code.

This message is always logged against statement number 0. The message text identifies the macro (or open code) where the error is found.

Assembler Action: All references to the global variable in the macro definition or in open code where the inconsistency was detected result in a null (zero) value.

Programmer Response: Make all declarations of the same global variable consistent.

Severity Code: 4

IFO085 MACRO HEADER MISSING, MACRO NOT EXPANDABLE

Explanation: The first statement of a library macro definition was not a MACRO statement, and the search for the macro definition is terminated.

Assembler Action: The macro call is processed as a comment.

Programmer Response: Be sure that the library macro definition begins with a MACRO statement. Rerun the macrocall with assembler option LIBMAC on to get a complete diagnostic display of the macro definition.

Severity Code: 8

IFO087 INVALID MACRO DEFINITION PROTOTYPE, MACRO NOT EXPANDABLE

Explanation: A comment statement appears immediately after a macro header (MACRO statement).

Assembler Action: All the statements of the macro definition are processed as comments.

Programmer Response: Make sure that the statement immediately following the macro header is a macro prototype statement. No comments or any other statements are permitted between the macro header and the prototype of a macro definition. Rerun the macrocall with assembler option LIBMAC on to get a complete diagnostic display of the macro definition.

Severity Code: 8

IFO088 LIBRARY MACRO PROTOTYPE DOES NOT MATCH MEMBER NAME, MACRO NOT EXPANDABLE.

Explanation: The mnemonic operation code in the macro prototype in a library macro definition does not match the entry in the macro library.

Assembler Action: The macro instruction is processed as a comment.

Programmer Response: Enter the macro definition in the library under the same name as the mnemonic op code that appears on the macro prototype.

Severity Code: 8

IFO089 GENERATION-TIME DICTIONARY SPACE EXHAUSTED

Explanation: The workspace available is not sufficient to contain the dictionaries required to expand the macro, to extend a SETC variable, or to contain the basic global dictionaries.

Assembler Action: If the global dictionary workspace is insufficient, the text is processed as comments. If there is

insufficient space to extend the SETC variable, expansion of the macro that contains the variable is terminated. If the space for macro definition dictionaries is insufficient, calls to those macros are not expanded.

Programmer Response: Within the partition, increase the size of the region that is allocated to assembly, or allocate more of the partition to dictionary space via the BUFSIZE and/or the WORKSIZE assembler option (see Appendix E).

Severity Code: 12

IFO090 UNDEFINED SEQUENCE SYMBOL ENCOUNTERED DURING CONDITIONAL ASSEMBLY

Explanation: A sequence symbol referenced in the operand field of this statement is undefined in the macro definition or open code. This statement has been encountered during conditional assembly.

Assembler Action: The statement is processed as a comment.

Programmer Response: Define the sequence symbol at an appropriate point, or reference a sequence symbol that is already defined.

Severity Code: 8

IFO091 KEYWORD PARAMETER xxxxxxxx IS DUPLICATED ON SAME MACRO CALL

Explanation: A keyword parameter has appeared more than once on the same macro instruction.

Assembler Action: The last value assigned to the parameter is used, the other value(s) are ignored.

Programmer Response: Define only one value for each parameter.

Severity Code: 8

IFO092 KEYWORD PARAMETER xxxxxxxx UNDEFINED IN MACRO DEFINITION

Explanation: A keyword parameter has been used on the macro instruction that is not a keyword parameter on the macro prototype, or an equal sign not surrounded by quotes is found in a positional parameter.

Assembler Action: The extra keyword parameter on the macro instruction is ignored.

Programmer Response:

1. Delete the keyword parameter and its value from the macro instruction; or
2. make the keyword parameter on the macro call correspond to one of the keyword parameters on the macro prototype; or

3. define the keyword parameter in the operand field of the macro prototype; or
4. if you want to include an equal sign in a positional parameter, enclose the parameter within single quotes.

Severity Code: 8

IFO100      DICTIONARY SPACE EXHAUSTED, NO SKELETON DICTIONARY BUILT

Explanation:

- If the message is given for a macro definition or for open code: no available space is left to build the skeleton dictionary, after space has been used for the definition of global symbols, sequence symbols, or referenced ordinary symbols.
- If the message is given for a macro instruction: dictionary space was exhausted during the editing of a library macro.

Assembler Action: The macro is not considered defined, and any calls to it are processed as comments. If the error occurs in open code, the entire assembly is processed as comments.

Programmer Response: Within the partition, increase the size of the region that is allocated to assembly, or allocate more of the partition to dictionary space via the BUFSIZE and/or the WORKSIZE assembler option (see Appendix E).

Severity Code: 8

IFO101      GENERATED OP CODE INVALID OR UNDEFINED

Explanation: The operation code created by substitution is not a valid ordinary symbol or is not a valid machine, assembler, or macro instruction, or defined by an OPSYN instruction.

Assembler Action: The generated statement is treated as a comment.

Programmer Response: Be sure that substitution results in a valid ordinary symbol that consists of from 1 to 8 alphanumeric characters, the first of which is alphabetic, and that the resulting symbol is a defined operation code.

Severity Code: 8

IFO102      GENERATED OP CODE IS BLANK

Explanation: The op code created by substitution contains no characters, or from 1 to 8 blank characters.

Assembler Action: The generated statement is processed as a comment.

Programmer Response: Be sure that substitution results in a valid ordinary symbol that consists of from 1 to 8 alphameric characters, the first of which is alphabetic.

Severity Code: 8

IFO104 MORE THAN ONE TITLE STATEMENT NAMED

Explanation: This is at least the second TITLE statement that contains something other than a sequence symbol or blanks in the name field.

Assembler Action: The name field is ignored.

Programmer Response: Be sure that the name fields of all but one TITLE statement contain only sequence symbols or blanks.

Severity Code: 4

IFO105 GENERATED FIELD EXCEEDS 255 CHARACTERS

Explanation: As a result of substitution, a character string that is longer than 255 characters has been generated.

Assembler Action: The first 255 characters are used.

Programmer Response: Limit the generation of any character string to 255 characters, minus the number of non-substituted characters. (Limit substitution in the name and operation fields to 8 characters, in the operand field to 255 characters.)

Severity Code: 8

IFO107 CHARACTER STRING USED AS AN ARITHMETIC TERM EXCEEDS 10 CHARACTERS

Explanation: A character string used in a SETA expression or in an arithmetic relation in a SETB expression is longer than 10 characters. Ten is the maximum number of characters permitted in a decimal self-defining term.

Assembler Action: The character string is replaced by an arithmetic value of zero.

Programmer Response: Be sure that all character strings used as described in the explanation are from 1 to 10 decimal digits with a value in a range of 0 to 2,147,483,647. Also be sure that the values of all variables that contribute to the generation of the character string are valid for their type.

Severity Code: 8



IFO108 CHARACTER STRING USED AS AN ARITHMETIC TERM CONTAINS NON-DECIMAL CHARACTERS

Explanation: A character string used in a SETA expression or in an arithmetic relation in a SETB expression contains characters other than 0 through 9.

Assembler Action: The character string is replaced by an arithmetic value of zero.

Programmer Response: Be sure that all character strings used in a SETA expression or as an arithmetic relation in a SETB expression contain from 1 to 10 decimal digits with a value in the range of 0 to 2,147,483,647. Also be sure that the values of all variables that contribute to the generation of the character string are valid for their type.

Severity Code: 8

IFO109 CHARACTER STRING USED AS ARITHMETIC TERM IS A NULL STRING

Explanation: A character string used in a SETA expression or in an arithmetic relation in a SETB expression is zero characters in length.

Assembler Action: The character string is replaced by an arithmetic value of zero.

Programmer Response: Be sure that all character strings used in an arithmetic context are from 1 to 10 decimal digits with a value in a range of 0 to 2,147,483,647. Also make sure that the values of all variables that contribute to the generation of the character string are valid.

Severity Code: 8

IFO110 ARITHMETIC OVERFLOW IN INTERMEDIATE RESULT OF SETA EXPRESSION

Explanation: During the evaluation of a SETA expression, an intermediate value was produced that was outside the range of -231 to 231-1.

Assembler Action: The intermediate result is replaced by an arithmetic value of zero.

Programmer Response: Be sure that the values of all variables that contribute to the intermediate result are valid. No expression should ever attempt a value outside the range of -231 to 231-1. Overflow may be avoided if you adjust the sequence of expression evaluation, or if you separate components of the expression and evaluate them individually (perhaps by additional SET statements) before combining them.

Severity Code: 8

IFO111 SUBSCRIPT EXPRESSION HAS A ZERO OR NEGATIVE VALUE

Explanation: A term or a SETA expression used as the subscript on a dimensioned global or local variable symbol results in a zero or negative value.

Assembler Action: Any such reference to the dimensioned variable results in a null (zero) value.

Programmer Response: Be sure that the values of all the variables that contribute to the subscript are valid. Expressions that are used as subscripts must have a value in the range of 1 through the declared dimension of the global or local variable. A zero subscript is allowed only on the system variable &SYSLIST.

Severity Code: 8

IFO112 SUBSCRIPT EXPRESSION EXCEEDS MAXIMUM DIMENSION

Explanation: A term or a SETA expression used as the subscript on a dimensioned global or local variable results in a value greater than the declared dimension of the variable.

Assembler Action: Any such reference results in a null (zero) value.

Programmer Response: Be sure that all terms and variables that contribute to the subscript have valid values. Be sure that a term or a SETA expression used as a subscript has a value in the range of 1 through the declared dimension of the global or local variable.

Severity Code: 8

IFO113 ILLEGAL REFERENCE MADE TO A PARAMETER THAT IS A SUBLIST

Explanation: A reference has been made in a SETA or SETB expression (i.e., in an arithmetic context) to a parameter that is a sublist.

Assembler Action: The reference to the parameter results in an arithmetic value of zero.

Programmer Response: Check to see that the proper parameter is being referenced. Be sure that an appropriate value is assigned to a parameter that is referenced in a SETA or SETB expression. Check for a missing subscript.

Severity Code: 8

IFO114 NEGATIVE DUPLICATION FACTOR IN CHARACTER STRING

Explanation: A term or a SETA expression that is used as the duplication factor in a SETC operand results in a negative value.

Assembler Action: The duplication factor is set to an arithmetic value of zero.

Programmer Response: Be sure that any term or expression used as a duplication factor has a positive value, and that the values of all variables that contribute to the duplication factor are valid.

Severity Code: 8

IFO115 FIRST EXPRESSION IN SUBSTRING NOTATION HAS ZERO OR NEGATIVE VALUE

Explanation: A term or SETA expression that is used to specify the starting character for a substring operation has a zero or negative value.

Assembler Action: The assembler assigns the value of null to the substring.

Programmer Response: A term, a SETA expression, or a combination of variables used to produce the first expression in a substring notation must result in a positive, nonzero value, not exceeding the length of the character string.

Severity Code: 8

IFO116 SECOND EXPRESSION IN SUBSTRING NOTATION HAS NEGATIVE VALUE

Explanation: A term or SETA expression that is used to specify the number of characters affected by a substring operation has a negative value.

Assembler Action: The value of the second expression of the substring notation is set to 0, that is, the assembler assigns a value of null to the substring.

Programmer Response: A term, a SETA expression, or a combination of variables used to produce the second expression in a substring notation must result in a non-negative value.

Severity Code: 4

IFO117 FIRST EXPRESSION IN SUBSTRING NOTATION EXCEEDS THE LENGTH OF THE STRING

Explanation: A term or SETA expression that specifies the starting character for a substring operation specifies a character beyond the end of the string.

Assembler Action: The assembler assigns the value of null to the substring.

Programmer Response: Make sure the term, SETA expression, or combination of variables used to produce the first expression in a substring notation results in a value in the range of 1 through the length of the character string.

Severity Code: 8

IFO118 ACTR LIMIT HAS BEEN EXCEEDED

Explanation: The number of AIF and AGO branches within the text segment exceeds the value specified in the ACTR instruction or the conditional assembly loop counter default value.

Assembler Action: If a macro is being expanded, the expansion is terminated. If open code is processed, all remaining statements are processed as comments.

Programmer Response: Correct the conditional assembly loop that caused the ACTR limit to be exceeded, or set the ACTR value to a higher number.

Severity Code: 8

IFO119 ILLEGAL TYPE ATTRIBUTE REFERENCE

Explanation: A type attribute reference is made to a symbol defined by an EQU instruction with an invalid third operand.

Assembler Action: The type attribute value is set to U.

Programmer Response: Correct the third operand on the EQU instruction. It must be a self-defining term in the range 0-255.

Severity Code: 4

IFO120 ILLEGAL LENGTH ATTRIBUTE REFERENCE

Explanation:

- A length attribute reference specifies a SETx symbol; or
- A length attribute reference specifies a symbolic parameter (or a &SYSLIST representation) that does not represent an ordinary symbol; or
- The ordinary symbol referenced by a length or integer attribute reference is defined by an EQU instruction, and the value of the second operand of that instruction is not in the range 0-65535; or
- The ordinary symbol referenced by a length or integer reference has a type attribute of U; or
- The ordinary symbol referenced by a length or integer attribute reference is defined in a DC or DS instruction, and the instruction contains a length modifier that is not a self-defining term.

Assembler Action: The length attribute is set to 1.

Programmer Response: Review the use of the length attribute and recode.

Severity Code: 4

IFO123 ILLEGAL SCALE ATTRIBUTE REFERENCE

Explanation:

- A scaling attribute reference specifies a SETx symbol; or
- A scaling attribute reference specifies a symbolic parameter (or a &SYSLIST representation) that does not represent an ordinary symbol; or
- A scaling attribute reference is made to an ordinary symbol whose type attribute is not H, F, G, E, D, L, K, P, or Z; or
- The ordinary symbol referenced by a scaling or integer attribute reference is defined in a DC or DS instruction containing a scaling modifier that is not a self-defining term.

Assembler Action: The scale attribute is set to 0.

Programmer Response: Review the use of the scale attribute and recode.

Severity Code: 4

IFO124 ILLEGAL INTEGER ATTRIBUTE REFERENCE

Explanation:

- An integer attribute reference specifies a SETx symbol; or
- An integer attribute reference specifies a symbolic parameter (or a &SYSLIST representation) that does not represent an ordinary symbol; or
- An integer attribute reference is made to an ordinary symbol whose type attribute is not H, F, G, E, D, L, K, P, or Z.

Assembler Action: The integer attribute is set to 0.

Programmer Response: Review the use of the integer attribute and recode.

Severity Code: 4

IFO125 INVALID NAME - ILLEGAL EMBEDDED CHARACTER OR NON-ALPHABETIC FIRST CHARACTER

Explanation:

- The symbol generated in the name field does not begin with an alphabetic character or it contains a special character or an embedded blank after substitution; or
- for the TITLE instruction: the name field contains a special character.

Assembler Action: The name field is ignored.

Programmer Response: Be sure that the symbol generated in the name field conforms to the rules for forming valid ordinary

symbols, or is a valid TITLE name field entry. Also check to make sure that the values of all variables that contribute to the generation of the symbol in the name field are valid.

Severity Code: '8

IFO126 MORE THAN 5 ERRORS IN THIS STATEMENT, PROCESSING OF THE STATEMENT IS TERMINATED

Explanation: Six or more errors were detected in processing this statement. The maximum number of error messages issued by the processor to each statement is five.

Assembler Action: The sixth error causes this message to be issued, and messages are not issued for any further errors in this statement.

Programmer Response: Correct the indicated errors and check carefully for errors beyond the point indicated by the fifth error message. Assemble again. Any additional errors will be located in the next assembly.

Severity Code: 8

IFO127 VALUE OF CHARACTER STRING USED IN ARITHMETIC CONTEXT EXCEEDS 2,147,483,647

Explanation: A character string used in a SETA expression or in an arithmetic relation in a SETB expression exceeds a value of 2,147,483,647, which is the maximum value allowed for a decimal self-defining term.

Assembler Action: The character string is replaced by an arithmetic value of zero.

Programmer Response: Be sure that all character strings used in an arithmetic context are from 1 to 10 decimal digits and have a value in the range of 0 to 2,147,483,647. Be sure that the values of all variables that contribute to the generation of the character string are valid.

Severity Code: 8

IFO128 GENERATED OP CODE EXCEEDS 8 CHARACTERS

Explanation: The syntax for mnemonic operation codes must follow the same rules as ordinary symbols; that is, they must be from 1 to 8 alphanumeric characters long and the first character must be alphabetic.

Assembler Action: The statement that contains the illegal op code is processed as a comment. Only the first 8 characters of the generated op code appear in the printed statement.

Programmer Response: Be sure that the values of all variables that contribute to the generation of the op code are valid, and be sure that no attempt is made to generate an op code of more than 8 characters.

Severity Code: 8

IFO129 GENERATED SYMBOL IN NAME FIELD EXCEEDS 8 CHARACTERS

Explanation: A generated symbol that appears in the name field exceeds 8 characters. It should be from 1 to 8 alphanumeric characters in length, and the first character should be alphabetic.

Assembler Action: The name field is ignored. Only the first eight characters of the generated symbol appear in the printed statement.

Programmer Response: Be sure that the values of all variables that contribute to the generation of the symbol in the name field are valid. Be sure that no attempt is made to generate a symbol of more than 8 characters.

Severity Code: 8

IFO130 FIRST SUBSCRIPT OF &SYSLIST REFERENCE IS NEGATIVE

Explanation: A term or an arithmetic (SETA) expression that is used as the first subscript of a &SYSLIST reference has resulted in a negative value.

Assembler Action: The parameter reference is treated as a reference to an omitted operand.

Programmer Response: Be sure that the values of all variables that contribute to the generation of the first subscript are valid.

Severity Code: 8

IFO131 INCONSISTENT GLOBAL VARIABLE DECLARATION| SETx INSTRUCTION IGNORED

Explanation: Global variable declaration inconsistent with a previous definition of the variable in another macro definition or in open code.

Assembler Action: The value of the global variable remains the same and the SETx instruction is ignored.

Programmer Response: Correct all inconsistencies between global variable declarations regarding dimension and type.

Severity Code: 8

IFO132 REFERENCE TO INCONSISTENTLY DECLARED GLOBAL VARIABLE RESULTS IN ZERO VALUE

Explanation: An attempt to obtain a value from a global variable has been ignored because the declaration of the global variable was inconsistent with a previous declaration of the same variable in another macro definition or in open code. Either the dimension or the type does not agree.

Assembler Action: The reference to the global variable is replaced by a null or zero value.

Programmer Response: Correct all inconsistencies among declarations of the same global variable.

Severity Code: 8

IFO133 NO OPEN CODE SKELETON DICTIONARY, ENTIRE ASSEMBLY FLUSHED

Explanation: The allotted dictionary work space is insufficient to build the skeleton dictionary for open code. Since the generation process requires the open code dictionary, generation is not attempted.

Assembler Action: The entire assembly is processed as comments.

Programmer Response: Within the partition, increase the size of the region that is allocated to assembly, or allocate more of the partition to dictionary space via the BUFSIZE assembler option (see Appendix E).

Severity Code: 12

IFO157 DC OPERAND VALUE TOO LONG

Explanation: The specified value of an operand in a DC instruction is too long. The maximum length of a DC operand is 16,777,215 bytes.

Assembler Action: The specified value is ignored.

Programmer Response: Make the constant shorter, or break it up into two constants.

Severity Code: 8

IFO158 NAME OF STATEMENT IN DSECT USED IN RELOCATABLE ADDRESS CONSTANT

Explanation: A non-paired relocatable term used in an A-type or Y-type address constant is defined in a dummy section.

Assembler Action: The constant is ignored.

Programmer Response:

- Make sure the relocatable term is not defined in a dummy section; or
- Make sure the term defined in the dummy section is paired with another term (with the opposite sign) from the same dummy section.

Severity Code: 8



IFO159 RELOCATABLE EXPRESSION AS EXPLICIT DISPLACEMENT IN S-TYPE  
CONSTANT

Explanation: The displacement used in an explicit S-type address constant specification is a relocatable expression.

Assembler Action: The value of the operand is set to zero and no entry is made in the relocation dictionary.

Programmer Response: Make sure the displacement is specified as an absolute expression, or specify an implicit address.

Severity Code: 8

IFO161 INVALID LITERAL NEAR OPERAND COLUMN nn

Explanation: An invalidly constructed literal appears near the specified operand column.

Assembler Action: The value of any reference to the invalid literal is set to 0.

Programmer Response: A literal should be constructed like a DC or DS constant with the following exceptions:

- The literal is preceded by a equal sign.
- The duplication factor must not be 0.

Severity Code: 8

IFO162 VALUE ERROR - SHOULD BE BETWEEN 0 AND 9 NEAR OPERAND COLUMN nn

Explanation: A value is negative or is not in the range of 0 to 9, which is required by this instruction.

Assembler Action: The entire machine instruction is set to 0.

Programmer Response: Be sure the operand field has a positive value in the range of 0 to 9.

Severity Code: 8

IFO163 MISSING OR INVALID SYMBOL IN NAME FIELD

Explanation: One of two errors has occurred:

- A symbol is missing in the name field where one is required.
- The symbol in the name field is invalid.

Assembler Action: The statement is processed as a comment.

Programmer Response: Supply a valid name.

Severity Code: 4

IFO164 INVALID OR ILLEGAL START STATEMENT

Explanation: The START statement did not start the first control section in the assembly, or the operand on the START statement was not an absolute value.

Assembler Action: The START statement is treated as a CSECT statement.

Programmer Response: Be sure that the START statement has an absolute operand and that it begins the first control section in the assembly.

Severity Code: 4

IFO165 NULL PUNCH OPERAND OR PUNCH OPERAND EXCEEDS 80 CHARACTERS

Explanation: The operand of a PUNCH instruction either specifies only a null string surrounded by quotes, or is more than 80 characters long.

Assembler Action: The PUNCH statement is processed as a comment.

Programmer Response: Be sure that the operand of a PUNCH statement consists of from 1 to 80 characters surrounded by quotes.

Severity Code: 4

IFO167 SYMBOL FILE OUT OF SYNC

Explanation: The symbol file, which is an internal data file, has got out of step with the rest of the assembly process because of error recovery on a user error.

Assembler Action: A soft recovery is attempted by continuing the assembly. Assembly results subsequent to the point of error may not be valid.

Programmer Response: This message will always be accompanied by user errors. Correct them and reassemble the program.

If the problem recurs, do the following before calling IBM:

- Have your source program, macro definitions, and associated listings available.
- If a COPY statement was used, execute the IEBPTPCH utility to obtain a copy of the partitioned data set member specified in the COPY statement.
- Make sure that MSGLEVEL=(1,1) was specified in the JOB statement.

Severity Code: 16

IFO168 AN ARITHMETIC EXPRESSION NOT USED IN CONDITIONAL ASSEMBLY  
CONTAINS MORE THAN 20 TERMS

Explanation: An arithmetic expression used in a macro definition or in open code, but not in a conditional assembly statement, contains more than 19 unary and binary operators and 6 levels of parentheses. The maximum number of terms this combination allows is 20.

Assembler Action: The value of the expression is set to 0.

Programmer Response: Be sure that this arithmetic expression does not contain more than 19 operators (unary and binary) and 6 levels of parentheses. If greater complexity is necessary, use EQU statements to evaluate intermediate results.

Severity Code: 8

IFO169 INVALID SELF-DEFINING TERM NEAR OPERAND COLUMN nn

Explanation: A self-defining term was invalidly specified.

Assembler Action: The value of the term is set to zero.

Programmer Response: Check the syntax and correct the error.

Severity Code: 8

IFO170 TWO ADJACENT BINARY OPERATORS, OR BINARY OPERATOR EXPECTED BUT  
NOT FOUND NEAR OPERAND COLUMN nn

Explanation: One of two errors has occurred.

(1) Two binary operators appear consecutively near the column specified in the message text. This applies only to "\*" (multiply) and "/" (divide).

(2) A binary operator was expected near the column specified in the message text, but none was found. A single binary operator must occur between all terms of an expression.

Assembler Action: The expression that contains the absent or illegal operator is set to zero.

Programmer Response:

(1) Eliminate one of the binary operators.

(2) Provide a binary operator.

Severity Code: 8

IFO171 TITLE STATEMENT OPERAND EXCEEDS 100 CHARACTERS

Explanation: The operand of a TITLE instruction contains more than 100 characters.

Assembler Action: The character string in the operand is truncated to 100 characters.

Programmer Response: Be sure that the length of the character string in the operand of a TITLE statement does not exceed 100 characters.

Severity Code: 4

IFO172 VALUE OF ORG OPERAND IS LESS THAN THE CONTROL SECTION STARTING ADDRESS

Explanation: The operand of an ORG statement results in a value less than the starting address of the control section.

Assembler Action: The ORG statement is processed as a comment and has no effect on the value of the location counter.

Programmer Response: Be sure that the operand of the ORG statement is a positive relocatable expression, greater than the starting address of the control section, or blank.

Severity Code: 8

IFO173 ONE OR MORE SYMBOLS IN AN ORG OPERAND DO NOT BELONG TO THE CURRENT CSECT, DSECT, OR COM

Explanation: One or more of the symbols used in the operand of an ORG statement are not defined in the current control section (dummy, common or ordinary).

Assembler Action: The ORG statement is processed as a comment and the value of the location counter remains unchanged.

Programmer Response: Be sure that all symbols used in the operand field of an ORG statement belong to (are defined by appearing in the name field of a statement within) the current control section.

Severity Code: 8

IFO174 ORG OPERAND IS ABSOLUTE, MUST BE RELOCATABLE

Explanation: An absolute term or expression used in the operand of an ORG statement must be a relocatable term, a relocatable expression, or a blank.

Assembler Action: The ORG instruction is processed as a comment and the value of the location counter remains unchanged.

Programmer Response: Be sure that the operand of an ORG statement is a relocatable term, a relocatable expression, or a blank. An ORG to an absolute address is not possible because the assembler assumes that all location references are relocatable. A common error is an ORG to 0. Since the start of the program is not absolute machine location 0 but relocatable 0, replace the 0 with a symbol or expression that makes reference to the labeled program start.

Severity Code: 8

IFO175 OPERAND SHOULD BEGIN WITH A QUOTE

Explanation: A quote was expected to begin a character string in the operand field, but was not found.

Assembler Action: The invalid character string is ignored.

Programmer Response: Supply the missing leading quote in the character string of the operand.

Severity Code: 8

IFO176 UNPAIRED AMPERSAND NEAR OPERAND COLUMN nn

Explanation: A single ampersand followed by a blank was found in a quoted character string. If an ampersand is desired as a character in a quoted character string, two ampersands must be coded. Ampersands must be either paired or part of a valid variable symbol.

Assembler Action: The character string that contains the illegal ampersand is ignored.

Programmer Response: Determine whether the ampersand is desired as a character in a quoted character string or whether the ampersand is intended as the beginning of a valid variable symbol, and correct the error.

Severity Code: 8

IFO177 MISSING OPERAND

Explanation: This statement requires an operand, but none is found.

Assembler Action: The statement which lacks the operand is processed as a comment.

Programmer Response: Supply a valid operand.

Severity Code: 12

IFO178 SYNTAX ERROR NEAR OPERAND COLUMN nn

Explanation: A syntax error has occurred in the operand of this statement.

Assembler Action: The statement which contains the invalid operand is processed as a comment.

Programmer Response: Correct the syntax of the operand. There are a large number of syntactic errors that can produce this diagnostic. All of them require careful checking of the syntax of the specific type of statement being processed. The error is logged at the point where the syntax becomes ambiguous or unrecognizable, not necessarily at the point where the actual error occurs.

Severity Code: 8

IFO179 OPERAND SUBFIELD NEAR OPERAND COLUMN nn MUST BE ABSOLUTE

Explanation: All terms and expressions used in the operand field of this statement must result in an absolute value.

Assembler Action: The operand is processed as a comment.

Programmer Response: Be sure that each term or expression used in the operand field of this statement has an absolute value. No relocatable expressions are allowed.

Severity Code: 8

IFO180 OPERAND 2 OF CNOP MUST BE EITHER 4 OR 8

Explanation: The second operand of a CNOP statement must be either 4 or 8.

Assembler Action: The CNOP statement is processed as a comment and no alignment is performed.

Programmer Response: Be sure that the second operand of a CNOP statement is either a 4 or an 8.

Severity Code: 12

IFO181 OPERAND 1 OF CNOP MUST BE 0, 2, 4, OR 6

Explanation: The first operand of a CNOP statement must be 0, 2, 4, or 6.

Assembler Action: The CNOP statement is ignored and no alignment is performed.

Programmer Response: Be sure that the first operand of a CNOP statement is a 0, 2, 4, or 6.

Severity Code: 12

- IFO182 OPERAND 1 OF CNOP IS NOT LESS THAN OPERAND 2
- Explanation: The value of the first operand of a CNOP statement must be less than the value of the second operand.
- Assembler Action: The CNOP statement is processed as a comment and no alignment is performed.
- Programmer Response: Check the validity of each operand of the CNOP statement to be sure that the value of the second operand is greater than the value of the first operand.
- Severity Code: 12
- 
- IFO183 MNOTE/CCW OPERAND EXCEEDS 255
- Explanation: The value of an operand used as an MNOTE severity code or as the first operand in a channel command word (CCW) exceeds 255.
- Assembler Action: The MNOTE is processed as a comment. Space is allocated for the CCW, but the value for the flagged operand is set to 0.
- Programmer Response: Check the validity of the operand.
- Severity Code: 12
- 
- IFO184 INVALID RANGE ON CCW NEAR OPERAND COLUMN nn, 65535 IS MAXIMUM VALUE
- Explanation: The value of the fourth operand of a channel command word has exceeded X'FFFF' (65535).
- Assembler Action: Space is allocated for the CCW, but the value of the flagged operand is set to 0.
- Programmer Response: Check the validity of the fourth operand of the channel command word.
- Severity Code: 12
- 
- IFO185 BLANK EXPECTED AS A DELIMITER NEAR OPERAND COLUMN nn
- Explanation: A blank was expected as a delimiter but none was found. Subsequent characters have no syntactic meaning, and the statement is ambiguous.
- Assembler Action: The statement that contains the invalid delimiter is processed as a comment.
- Programmer Response: Supply a blank delimiter.
- Severity Code: 8

IFO186 INVALID SYMBOL NEAR OPERAND COLUMN nn OF ENTRY, EXTRN, OR WXTRN

Explanation: An improperly constructed symbol was found in the operand field of an ENTRY, EXTRN, or WXTRN statement.

Assembler Action: The statement that contains the invalid symbol is processed as a comment.

Programmer Response: Be sure that the symbol in the operand field of EXTRN, WXTRN, or ENTRY statements contain from 1 to 8 alphanumeric characters, the first of which is alphabetic.

Severity Code: 8

IFO187 SYMBOL LONGER THAN 8 CHARACTERS NEAR OPERAND COLUMN NN

Explanation: A symbol that is more than 8 characters in length has appeared in the operand field of this statement.

Assembler Action: The invalid symbol in the operand field is replaced by a zero.

Programmer Response: Be sure that symbols do not exceed 8 characters in length. A missing or misplaced delimiter or operator may cause a symbol to appear longer than intended.

Severity Code: 8

IFO188 xxxxxxxx IS AN UNDEFINED SYMBOL

Explanation: The symbol that appears in the message text has not appeared in the name field of another statement, or as an operand of an EXTRN or WXTRN statement.

Assembler Action: Reference to the undefined symbol results in a zero value.

Programmer Response: Define the symbol in the program.

Severity Code: 8

IFO189 INVALID ENTRY OPERAND, LINKAGE CANNOT BE PERFORMED

Explanation: The symbol in the operand field of an ENTRY statement is invalid because it is either undefined or improperly defined.

Assembler Action: The invalid symbol in the operand field is processed as a comment, and no linkage is provided if another program references it.

Programmer Response: Define the symbol at an appropriate place in this program, or correct it. A valid symbol consists of from 1 to 8 alphanumeric characters, the first of which must be an alphabetic character.

Severity Code: 8



- IFO190 OPERAND OF PUSH STATEMENT IS NOT USING OR PRINT NEAR OPERAND COLUMN nn
- Explanation: The only symbols allowed in the operand field of a PUSH or POP statement are PRINT and USING, in any order, separated by commas.
- Assembler Action: The PUSH instruction is processed as a comment.
- Programmer Response: Be sure the operand of the PUSH statement is either PRINT or USING or both.
- Severity Code: 4
- 
- IFO191 PUSH LEVELS EXCEED 4 NEAR OPERAND COLUMN nn
- Explanation: More than 4 levels of PUSH and POP statements were attempted for either PRINT or USING.
- Assembler Action: The PUSH instruction is processed as a comment.
- Programmer Response: Rework the program logic to require no more than 4 levels of PUSH and POP for USING and 4 for PRINT.
- Severity Code: 8
- 
- IFO192 OPERAND OF POP STATEMENT IS NOT USING OR PRINT NEAR OPERAND COLUMN nn
- Explanation: The only symbols allowed in the operand of a PUSH or POP statement are USING and PRINT, in any order, separated by commas.
- Assembler Action: The POP instruction is processed as a comment.
- Programmer Response: Be sure the operand of the POP statement is either PRINT or USING or both.
- Severity Code: 4
- 
- IFO193 POP REQUEST NOT BALANCED BY PREVIOUS PUSH
- Explanation: No PUSH request was issued prior to this POP request, or more POP statements have been issued than PUSH statements. A POP statement restores the USING or PRINT status saved by the most recent PUSH statement, on a one for one basis.
- Assembler Action: The POP instruction is processed as a comment.

Programmer Response: Check for errors in balancing PUSH and POP statements, or rework the program logic to request balanced PUSH and POP statements. Repetition of a given operand (i.e., USING or PRINT) on a single PUSH or POP statement is treated as multiple statements, and could cause unbalanced PUSH and POP statements.

Severity Code: 8

IFO194 INVALID OPTION IN PRINT STATEMENT NEAR OPERAND COLUMN nn

Explanation: An option appears in the operand field of a PRINT statement that is not one of the following: ON, OFF, GEN, NOGEN, DATA, and NODATA.

Assembler Action: The invalid operand is ignored.

Programmer Response: Be sure that only the options listed in the explanation above appear in the operand field of a PRINT statement.

Severity Code: 4

IFO195 INVALID USING OR DROP STATEMENT NEAR OPERAND COLUMN nn

Explanation: One of three errors has occurred:

(1) register 0 is specified for other than the second operand of a USING statement, or

(2) a register number outside the range of 0 to 15 has been used, or

(3) a DROP statement has been issued for a register that was never assigned for use by a USING statement.

Assembler Action: The invalid register specification is set to zero.

Programmer Response: The second and following operands of a USING or DROP instruction must be decimal terms 0 to 15. Register 0 may only be specified as the second operand of a USING statement.

Severity Code: 12

IFO196 xxxxxxxx HAS BEEN PREVIOUSLY DEFINED

Explanation: The specified symbol has previously appeared in the name field of a statement or in the operand field of an EXTRN or WXTRN instruction.

Assembler Action: All references to the symbol are interpreted as references to the first definition of the symbol.

Programmer Response: A given symbol must be defined only once. Determine which occurrence of the symbol you want to use, and change all others.

Severity Code: 8

IFO197 \*\*\* MNOTE \*\*\*

Explanation: An MNOTE statement has been encountered during the generation of a macro or open code. The text of the MNOTE message appears in-line in the listing at the point where it is encountered. (Refer to OS/VS - DOS/VS - VM/370 Assembler Language for a description of the MNOTE instruction.)

Assembler Action: None.

Programmer Response: Investigate the reason for the MNOTE. Errors flagged by MNOTE will often cause unsuccessful execution of the program, depending upon the severity code.

Severity Code: An MNOTE is assigned a severity code of 0 to 255 by the writer of the MNOTE statement.

IFO198 INVALID TYPE DECLARED ON DC/DS/DXD CONSTANT NEAR OPERAND COLUMN nn

Explanation: Operand subfield 2 is not a valid type for a DC, DS, or DXD statement. Valid types are the following: A, B, C, D, E, F, H, L, P, Q, S, V, X, Y, and Z.

Assembler Action: The statement that contains the invalid type declaration is processed as a comment.

Programmer Response: Supply a valid type in operand subfield 2.

Severity Code: 8

IFO199 INVALID LENGTH MODIFIER NEAR OPERAND COLUMN nn

Explanation: The length modifier in operand subfield 3 of this statement is invalid. The length attribute of a symbol is not allowed as a term in the length modifier expression for the first operand of the DC, DS, or DXD statement in which the symbol is defined. For example, SYM DC CL(L'SYM) 'AA' is invalid.

Assembler Action: The statement that contains the invalid length modifier is processed as a comment.

Programmer Response: Supply a valid length modifier, or eliminate the explicit length modifier.

Severity Code: 8

IFO200      INVALID SCALE MODIFIER NEAR OPERAND COLUMN nn

Explanation: The scale modifier in operand subfield 3 of a DC, DS, or DXD statement is invalid. The scale modifier should be either a decimal value or an absolute expression enclosed in parentheses.

Assembler Action: The statement that contains the invalid scale modifier is processed as a comment.

Programmer Response: Supply a valid scale modifier for the type of constant used.

Severity Code: 8

IFO201      ILLEGAL OR INVALID EXPONENT MODIFIER IN DC/DS/DXD CONSTANT NEAR OPERAND COLUMN nn

Explanation: An exponent modifier used in a DC, DS, or DXD constant is not a decimal self-defining term, an absolute expression enclosed in parentheses, or produces a value outside the range allowed for that constant type.

Assembler Action: The invalid or illegal operand is ignored.

Programmer Response: Be sure that the exponent modifier used conforms to the rules for exponent modifiers for each type of DC, DS, or DXD constant.

Severity Code: 8

IFO202      ARITHMETIC PRECISION OF FLOATING-POINT CONSTANT LOST NEAR OPERAND COLUMN nn

Explanation: Low order digits were lost during the construction of an L-, D-, or E-type constant, because the designated field was too small to contain the whole constant.

Assembler Action: The value of the constant is set to zero.

Programmer Response: Check the length, scale, and exponent modifier of the flagged constant.

Severity Code: 8

IFO203      L-, D-, E-, F-, H-, OR Y-TYPE CONSTANT TRUNCATED, HIGH ORDER DIGITS LOST NEAR OPERAND COLUMN nn

Explanation: The high order digits of an L-, D-, E-, F-, H-, or Y-type constant were lost because the designated field was too small to contain the whole constant.

Assembler Action: Processing continues using the truncated constant.

Programmer Response: Modify the explicit or implicit length of the constant, so that the value may be contained within the area designated for it.

Severity Code: 8

IFO204 RELOCATABLE EXPRESSION NOT ALLOWED IN A- OR Y-TYPE ADDRESS CONSTANT WITH THE SPECIFIED LENGTH

Explanation: The value specified for an address constant of an A or Y-type was relocatable and either:

- a) the length modifier specified bit length, or
- b) the length was not 3 or 4 bytes for a A-type constant, or
- c) the length was not 2 bytes for a Y-type constant.

Note that if the length for a Y-type is 2 bytes and the constant is relocatable, another error message is given.

Assembler Action: The value of the operand is set to 0 and no entry for this constant is made in the relocation dictionary.

Programmer Response: Convert the operand to an absolute expression, or use a length of 3 or 4 bytes for A-type or 2 bytes for Y-type constants.

Severity Code: 8

IFO205 RELOCATABLE Y-TYPE CONSTANT, VALUE TRUNCATED TO RIGHTMOST 2 BYTES

Explanation: A relocatable Y-type constant has been declared. This is a warning only. All relocatable Y-type constants are diagnosed in this manner because the assembler must provide an entry in the Relocation Dictionary for each one. If the actual address is contained within the rightmost 2 bytes and the coding is otherwise correct, when the program is loaded and relocation is considered the constant will be resolved. If the address cannot be contained in the rightmost two bytes, it is likely that further relocatability errors will result.

Assembler Action: The value of the constant is truncated to the rightmost 2 bytes.

Programmer Response: Be sure that the value of the Y-type constant will not exceed 2 bytes when the program has been loaded and the relocation factor has been considered.

Severity Code: 4

IFO206 DUPLICATION FACTOR ERROR

Explanation: The duplication factor in a DC, DS, or DXD statement is negative.

Assembler Action: No storage is reserved for the operand, but alignment is performed as required by the type of constant used.

Programmer Response: Supply a non-negative duplication factor.

Severity Code: 8

IFO207 OPERAND OF Q-TYPE CONSTANT DOES NOT NAME A DSECT OR DXD

Explanation: The symbol in the operand field of a Q-type constant must have been previously defined as the name of a DSECT or DXD section.

Assembler Action: The value of the constant is set to 0.

Programmer Response: Define the symbol as the name of a DSECT or DXD section. The symbol must be defined before being used in the constant.

Severity Code: 8

IFO208 DISPLACEMENT GREATER THAN X'FFF'

Explanation: The displacement of this statement or the address referenced by this statement is greater than X'FFF' (decimal 4095). The displacement field in the machine instruction must contain a value of from 0 to 4095.

Assembler Action: The base and displacement fields of the machine instruction are set to 0.

Programmer Response: Correct the displacement term or expression or provide another base register with a USING statement.

Severity Code: 8

IFO209 ADDRESSABILITY ERROR - BASE AND DISPLACEMENT CANNOT BE RESOLVED AND ARE SET TO 0

Explanation: The assembler cannot resolve the address of this statement or the address referenced by this statement for one of the following reasons:

- Current USING registers produce a displacement of less than 0 or greater than 4095.
- No USING registers are available.

Assembler Action: The base and displacement fields of the machine instruction are set to 0.

Programmer Response: Make sure you have correctly set up base registers with the USING instruction. Be sure the referenced address can be specified by the value in a USING register plus a displacement in the range of 0 through 4095.

Severity Code: 8

IFO210 TOO FEW OPERANDS

Explanation: More operands are required for this statement, but they were not found.

Assembler Action: The value of any missing operand is set to 0.

Programmer Response: Supply the necessary operands. Refer to Principles of Operation for details on the operands required for this instruction.

Severity Code: 12

IFO211 TOO MANY OPERANDS

Explanation:

- More than 255 operands on a DC, DS, or DXD instruction; or
- Too many operands on a machine instruction.

Assembler Action: The extra operands are ignored.

Programmer Response: Delete the extra operands. Refer to Principles of Operation for details on operands required for individual machine instructions.

Severity Code: 12

IFO212 PREMATURE END OF OPERAND NEAR OPERAND COLUMN nn

Explanation: A term or an expression used as an operand is incomplete.

Assembler Action: The value of the operand is set to 0.

Programmer Response: Supply the characters necessary to terminate the operand.

Severity Code: 8

IFO213 COMPLEXLY RELOCATABLE EXPRESSION NEAR OPERAND COLUMN nn

Explanation: The indicated operand contains a complexly relocatable expression. The expression should be absolute or simply relocatable.

Assembler Action: The value of the complexly relocatable expression is set to 0.

Programmer Response: Be sure that only absolute and simply relocatable expressions are used in the operand field of this statement.

Severity Code: 8

IFO214 ILLEGAL USE OF LITERAL NEAR OPERAND COLUMN nn

Explanation: A literal is used in an assembler instruction, in another literal, or in a field of a machine instruction where it is not allowed.

Assembler Action: The value of the operand where the literal is used is set to 0.

Programmer Response: Use a valid relocatable term or expression in place of the literal. If applicable, replace the literal with the name of a DC statement which defines the same constant as the literal.

Severity Code: 12

IFO215 ILLEGAL DELIMITER, RIGHT PARENTHESIS EXPECTED NEAR OPERAND COLUMN nn

Explanation: A right parenthesis was expected as a delimiter, but none was found.

Assembler Action: The value of the operand that is lacking a right parenthesis is set to 0.

Programmer Response: Supply a right parenthesis.

Severity Code: 8

IFO216 ILLEGAL OPERAND FORMAT NEAR OPERAND COLUMN nn

Explanation: The operand of this statement is illegally constructed.

Assembler Action: The value of the operand is set to 0.

Programmer Response: Refer to Principles of Operation for details on the operand structure of this statement, and supply a valid operand.

Severity Code: 12

IFO217 RELOCATABILITY ERROR NEAR OPERAND COLUMN nn

Explanation: One of the following fields contains a relocatable value. All values in these fields must be absolute.

- Immediate field in an SI instruction
- Mask field
- Register specification
- Length modifier



Assembler Action: If any of the above fields contains a relocatable value, the value of the field is set to 0.

Programmer Response: Be sure that the field contains an absolute value.

Severity Code: 12

IFO218 INVALID REGISTER SPECIFICATION - EVEN-NUMBERED REGISTER REQUIRED

Explanation: An odd-numbered register was specified in a context that requires an even-numbered register.

Assembler Action: The invalid operand is set to 0.

Programmer Response: Specify an available even-numbered register. Refer to the Principles of Operation for details on the register requirements of this instruction.

Severity Code: 12

IFO219 REGISTER OR IMMEDIATE FIELD OVERFLOW NEAR OPERAND COLUMN nn

Explanation:

- The value of the immediate field used in an SI instruction is greater than 255; or
- A register number was specified that was greater than 15.

Assembler Action: The value of the field where the overflow occurred is set to 0.

Programmer Response: Be sure the value of an immediate field does not exceed 255 and that no register number greater than 15 is specified.

Severity Code: 8

IFO220 ALIGNMENT ERROR NEAR OPERAND COLUMN nn

Explanation: The operand of this instruction refers to a main storage location that is not on the boundary required by the instruction.

Assembler Action: The faulty alignment is unchanged.

Programmer Response: Align the main storage location referenced in the operand field. Refer to the Principles of Operation for details on the boundary requirements of this instruction. For machines that do not require data to be aligned to certain boundaries, specify NOALIGN as an assembly option and no error will occur.

Severity Code: 4

IFO221 ILLEGAL INDEX REGISTER OR LENGTH MODIFIER NEAR OPERAND COLUMN nn

Explanation: An index register or a length field was specified for a machine instruction where none is expected.

Assembler Action: The invalid specification is ignored.

Programmer Response: Correct the index register or length field specification.

Severity Code: 12

IFO222 INVALID INDEX REGISTER SPECIFIED NEAR OPERAND COLUMN nn

Explanation: A register number not in the range 0 - 15 has been specified as an index register.

Assembler Action: A default value of 0 (to indicate that no indexing is used) replaces the invalid index register specification in the machine instruction.

Programmer Response: Specify an available register in the range of 0 to 15 as an index register.

Severity Code: 12

IFO223 RELOCATABLE INDEX REGISTER SPECIFIED NEAR OPERAND COLUMN nn

Explanation: A relocatable value has been specified as an index register.

Assembler Action: A default value of 0 (to indicate that no indexing is used) replaces the invalid index register specification in the machine instruction.

Programmer Response: Specify an absolute value in the range of 0 to 15 as an index register.

Severity Code: 12

IFO224 LENGTH ERROR NEAR OPERAND COLUMN nn

Explanation:

- The length modifier of a constant is illegal or invalid for that type of constant; or
- A constant of type C, X, B, Z, or P is too long; or
- A relocatable address constant has an illegal length.

Assembler Action: The operand in error and any following operands of the DC, DS, or DXD statement are processed as comments. An address constant with an illegal length is truncated.

Programmer Response: Supply a valid length modifier or decrease the length of the operand.

Severity Code: 8

IFO225 RELOCATABLE LENGTH FIELD IN MACHINE INSTRUCTION NEAR OPERAND COLUMN nn

Explanation: The length field of this machine instruction is specified as relocatable; an absolute term or expression is required.

Assembler Action: The length field in error is assembled to 0.

Programmer Response: Use an absolute term or expression to specify the length field.

Severity Code: 4

IFO226 BASE REGISTER OF MACHINE INSTRUCTION NOT ABSOLUTE NEAR OPERAND COLUMN nn

Explanation: An explicit base register has been specified as a relocatable value; an absolute term or expression is required.

Assembler Action: The operand in error (base and displacement) is assembled to 0.

Programmer Response: Use an absolute term or expression to specify the base register.

Severity Code: 12

IFO228 RELOCATABLE DISPLACEMENT IN MACHINE INSTRUCTION NEAR OPERAND COLUMN nn

Explanation: In a machine instruction that has an explicit base register specification, the specification for the displacement field is relocatable. As this would imply a second base register, the combination is invalid.

Assembler Action: The displacement field of the machine instruction is assembled to 0.

Programmer Response: Either specify the displacement as an absolute term or expression, or delete the explicit base register.

Severity Code: 8

IFO229 POSSIBLE REENTERABILITY ERROR NEAR OPERAND COLUMN nn

Explanation: This machine instruction could store data into a control section or common area that is not dynamically acquired.

This message is produced only when the RENT assembler option is specified in the PARM field of the EXEC statement.

Assembler Action: The statement is assembled as written.

Programmer Response: If you want reentrant code, correct the instruction so that it references a DSECT or other dynamically acquired space. Otherwise you can suppress reentrant checking by specifying the NORENT assembler option.

Note: Absence of this message does not guarantee reentrant code, as the assembler has no control over addresses actually loaded into base and index registers at program execution time.

Severity Code: 4

IFO230 BASE REGISTER NUMBER GREATER THAN 15 NEAR OPERAND COLUMN nn

Explanation: An explicit base register in a machine instruction or S-type address constant is greater than 15.

Assembler Action: The base register field of the machine instruction is assembled to 0.

Programmer Response: Specify the base register in the range of 0 to 15.

Severity Code: 12

IFO231 SYMBOL NOT PREVIOUSLY DEFINED - xxxxxxxx

Explanation: A symbol in this statement is used in a way that requires previous definition, but it has not been previously defined. For example, a symbol in a duplication factor expression or modifier expression of a DC statement must be previously defined.

Assembler Action: The value of the symbol or the expression that contains it is set to 0.

Programmer Response: Define the symbol earlier in the program. Add a defining statement if it does not exist, or place the existing defining statement ahead of the statement that references it.

Severity Code: 8

IFO233 MORE THAN 6 LEVELS OF PARENTHESES NEAR OPERAND COLUMN NN

Explanation: An expression in this statement contains more than 6 nested levels of parentheses.

Assembler Action: The value of the expression is set to 0.

Programmer Response: Rewrite the expression to reduce the number of levels of parentheses, or use a preliminary statement (such as an EQU) to partially evaluate the expression.

Severity Code: 8

IFO234 PREMATURE END OF EXPRESSION NEAR OPERAND COLUMN nn

Explanation: An expression in this statement ended prematurely due to one of the following errors:

- Unpaired parenthesis
- Illegal character
- Illegal operator
- Operator not followed by a term

Assembler Action: The value of the expression is set to 0.

Programmer Response: Check the expression for omitted or mispunched characters or terms.

Severity Code: 8

IFO235 ARITHMETIC OVERFLOW NEAR OPERAND COLUMN nn

Explanation: The intermediate value of a term or an expression is not in the range  $-2^{31}$  through  $2^{31}-1$ .

Assembler Action: The value of the expression is set to 0.

Programmer Response: Rewrite the expression or term. The assembler computes all values using fixed-point full-word arithmetic. Or, perform arithmetic operations in a different sequence to avoid overflow.

Severity Code: 8

IFO236 ILLEGAL CHARACTER IN EXPRESSION NEAR OPERAND COLUMN nn

Explanation: Syntax error. A character in an expression has no syntactic meaning in the context used; the assembler cannot determine if it is a symbol, an operator, or a delimiter.

Assembler Action: The value of the expression is set to 0.

Programmer Response: Check the expression for unpaired parentheses, invalid delimiter, invalid operator, or a character (possibly unprintable) that is not recognized by the assembler. The 51 characters recognized by the assembler are:

Letters: A through Z and \$ # @  
Digits: 0 through 9  
Special Characters: + - , = . \* ( ) ' / &  
Blank

Severity Code: 8

IFO237 CIRCULAR DEFINITION

Explanation: The value of the first expression in the operand field of an EQU statement is dependent upon the value of the symbol being defined in the name field.

Assembler Action: The value of the expression defaults to the current location counter value.

Programmer Response: Remove circularity in the definition.

Severity Code: 8

IFO238 ILLEGAL AMPERSAND IN SELF-DEFINING TERM NEAR OPERAND COLUMN nn

Explanation: An ampersand in a self-defining term is unpaired and/or not part of a quoted character string.

Assembler Action: The value of the expression containing the self-defining term is set to 0.

Programmer Response: Check that all ampersands in the term are paired and part of a quoted character string. (The only valid use of a single ampersand is as the first character of a variable symbol.) Note that ampersands produced by substitution must also be paired.

Severity Code: 8

IFO239 INVALID FLOATING POINT CHARACTERISTIC

Explanation: A converted floating-point constant is too large or too small for the field assigned to it. The allowable range is  $7.2 \times 10^{75}$  to  $5.3 \times 10^{-77}$ .

Assembler Action: The floating-point constant is assembled to 0.

Programmer Response: Check the characteristic (exponent), exponent modifier, scale modifier, and mantissa (fraction) for validity. Remember that a floating-point constant is rounded, not truncated, after conversion.

Severity Code: 8

IFO240 CHARACTER STRING OR SELFDEFINING TERM TERMINATED BEFORE ENDING QUOTE FOUND

Explanation: The assembler has found what appears to be a quoted character string or a self-defining term, but the closing quote is missing, or an illegal character is found before the closing quote.

Assembler Action: The term or expression is ignored.

Programmer Response: Supply the missing quote or check for other syntax errors.

Severity Code: 8

- IFO241 SECOND OPERAND OF CCW NOT BETWEEN 0 and X'FFFFFF'
- Explanation: The second operand of a CCW instruction, which specifies the data address, is outside the range of 0 to X'FFFFFF'.
- Assembler Action: The low-order three bytes of the operand are used.
- Programmer Response: Supply a correct term or expression for the second operand.
- Severity Code: 8
- 
- IFO242 SPACE OPERAND NOT A SINGLE POSITIVE DECIMAL SELFDEFINING TERM
- Explanation: The operand of a SPACE instruction is not a zero or positive decimal self-defining term.
- Assembler Action: The SPACE statement is processed as a comment.
- Programmer Response: Use a single decimal self-defining term with a zero or positive value.
- Severity Code: 4
- 
- IFO243 FIRST CCW OPERAND CANNOT BE NEGATIVE
- Explanation: The first operand (command code) of a CCW instruction is negative. The value of the operand must be in the range 0-255.
- Assembler Action: The CCW is processed as a comment.
- Programmer Response: Supply an operand with a value in the range of 0-255.
- Severity Code: 8
- 
- IFO244 BITS 38 AND 39 OF CCW OPERAND NOT ZERO
- Explanation: The bits specified as bits 38 and 39 of a CCW instruction are not zero.
- Assembler Action: The bits are set as specified.
- Programmer Response: Correct the third operand of the CCW instruction.
- Severity Code: 8
- 
- IFO246 LOCATION COUNTER OVERFLOW
- Explanation: The location counter is greater than X'FFFFFF' (224-1), the largest address that can be contained in 3 bytes.

Assembler Action: The location counter is 4 bytes long (only 3 bytes appear in the listing and the object deck). The overflow is carried into the high-order byte and the assembly continues. However, the resulting code will probably not execute correctly.

Programmer Response: The probable cause of the error is a high ORG statement value or a high START statement value. Correct the value or split up the control section.

Severity Code: 8

IFO254 ILLEGAL FORMAT OF SECOND OPERAND OF END STATEMENT

Explanation: Second operand of END instruction is inconsistent with the format required.

Assembler Action: Second operand ignored.

Programmer Response: Correct the operand according to the specifications given in OS/VS - VM/370 Assembler Logic.

Severity Code: 8

IFO255 FIXED OR FLOATING POINT EXPRESSION ERROR NEAR OPERAND COLUMN nn

Explanation: An error occurred during conversion of a decimal number into a fixed-point or floating-point number.

Assembler Action: The value of the operand is set to zero.

Programmer Response: Check the scale and exponent modifier of the number for validity.

Severity Code: 4

IFO256 SYSGO DD CARD MISSING -- NOOBJECT OPTION USED

Explanation: A DD statement for the SYSGO data set is not included in the JCL for this assembly. The SYSGO data set normally receives the object module output of the assembler when it is to be used as input to the linkage editor or loader, executed in the same job.

Assembler Action: The program is assembled using the NOOBJECT option. No output is written on SYSGO. If the DECK option is specified, the object module will be written on the device specified in the SYSPUNCH DD statement.

Programmer Response: Optional. If the assembly is error free and the object module has been produced on SYSPUNCH, you can execute it without reassembling. Otherwise, reassemble the program and include a SYSGO DD statement in the JCL or use a cataloged procedure that includes it. (See the section "Assembler Cataloged Procedures" in this manual.)

Severity Code: 16



IFO257 SYSPUNCH DD CARD MISSING -- NODECK OPTION USED

Explanation: A DD statement for the SYSPUNCH data set is not included in the JCL for this assembly. The SYSPUNCH data set is normally used when the object module of the assembly is directed to the card punch.

Assembler Action: The program is assembled using the NODECK option. No deck is punched on SYSPUNCH. If the OBJECT option has been specified, the object module will be written on the device specified in the SYSGO DD statement.

Programmer Response: Optional. The object module can be link edited and executed from SYSGO instead of SYSPUNCH by adjusting JCL. Otherwise, if you want a punch data set, reassemble the program with a SYSPUNCH DD statement.

Severity Code: 16

IFO258 INVALID ASSEMBLER OPTION ON EXEC CARD -- OPTION IGNORED

Explanation: One or more of the assembler options specified in the PARM field of the EXEC statement are invalid. The error may be caused by use of the wrong option, a misspelled option, or syntax errors in coding the options.

Assembler Action: Invalid options are ignored. The assembly is performed using the valid options.

Programmer Response: Check the spelling of the options, the length of the option list (100 characters maximum), and the syntax of the option list. The options must be separated by commas, and parentheses in the option list (including SYSPARM) must be paired. Two quotes or ampersands are needed to represent a single quote or ampersand in a SYSPARM character string. The section "Assembler Options" in this manual describes the assembler options and how to code them.

Severity Code: 16

IFO260 ASSEMBLY TERMINATED -- DD CARD MISSING FOR SYSxxx

Explanation: This assembler job step cannot be executed because a DD statement is missing for one of the following assembler data sets: SYSUT1, SYSUT2, SYSUT3, or SYSIN. The missing DD statement is indicated in the message text.

Assembler Action: The assembly is terminated before any statements are assembled. No assembler listing is produced, so this message is printed on the system output unit following the job control language statements for the assembly job step and on the operator's console.

Programmer Response: Supply the missing DD statement and reassemble the program. The cataloged procedures supplied by IBM contain all the required DD statements. They are described in the section "Assembler Cataloged Procedures" in this manual.

If the problem recurs, do the following before calling IBM:

- Have your source program, macro definitions, and associated listings available.
- If a COPY statement was used, execute the IEBTPCH utility to obtain a copy of the partitioned data set member specified in the COPY statement.
- Make sure that MSGLEVEL=(1,1) was specified in the JOB statement.

Operator Response: If possible, supply the missing DD statement in the JCL statements for the assembly and run the job again.

Severity Code: 20

IFO261 ASSEMBLY TERMINATED -- PERM I/O ERROR| jobname, stepname, unit address, device type, ddname, operation attempted, error description

Explanation: A permanent I/O error occurred on the assembler data set indicated in the message text. This message, produced by a SYNADAF macro instruction, also contains more detailed information about the cause of the error and where it occurred.

Note: If assembler was executed under VM/370-CMS, consult IBM Virtual Machine Facility/370: System Messages, GC20-1808, for explanation of message DMSxxx120S.

Assembler Action: The assembly is terminated. Depending on where the error occurred, the assembly listing up to the point of the I/O error may be produced. If the listing is produced, this message appears on it. If the listing is not produced, this message appears on the operator's console and on the system output unit following the job control language statements for the assembler job step.

Programmer Response: If the I/O error is on SYSIN or SYSLIB, you may have concatenated the input or library data sets incorrectly. Make sure the DD statement for the data set with the largest blocksize (BLKSIZE) is placed in the JCL before the DD statements of the data sets concatenated to it. Also, make sure that all input or library data sets have the same device class (all DASD or all tape).

In any case, reassemble the program: it may assemble correctly. If the problem recurs, do the following before calling IBM:

- Have your source program, macro definitions, and associated listings available.
- If a COPY statement was used, execute the IEBPTPCH utility to obtain a copy of the partitioned data set member specified in the COPY statement.
- Make sure that MSGLEVEL=(1,1) was specified in the JOB statement.

Operator Response: If the I/O error is on SYSUT1, SYSUT2, or SYSUT3, allocate the data set to a different volume and rerun the job. If the I/O error is on tape, check the tape for errors.

Severity Code: 20



IFO262 ASSEMBLY TERMINATED -- INSUFFICIENT MAIN STORAGE

Explanation: The assembler was unable to get at least 32K bytes of main storage for working storage, utility file buffers, and assembler tables and constants.

Assembler Action: The assembly is terminated before any statements are assembled. No assembler listing is produced, so this message is printed on the system-output device following the JCL statements for the assembler job step and on the operator's console.

Programmer Response: Increase the size of the region or partition allocated to the assembler. Reassemble the program. If the problem recurs, do the following before calling IBM:

- Have your source program, macro definitions, and associated listings available.
- Make sure that MSGLEVEL=(1,1) was specified in the JOB statement.

Operator Response:

- Increase the size of the region allocated on the JOB card or on the EXEC card for the assembler job step and rerun the job; or
- Run the job in a larger partition.

Severity Code: 20

IFO263 ASSEMBLY TERMINATED -- PROGRAM LOGIC ERROR

Explanation: The assembly has been abnormally terminated because of a logic error within the assembler, or inconsistent input to the assembler.

Examples:

- &A(3.5) as an opcode or
- Assembler input ends with a macrocall with a non-blank character in the column after end column.

Assembler Action: Abnormal termination. No assembler listing is produced; the assembler prints this message on the system output device following the JCL statements for the assembler job step.

Programmer Response: Do the following before calling IBM:

- Have your source program, macro definitions, and associated listings available.
- If a COPY statement was used, execute the IEBTPCH utility program to obtain a copy of the partitioned data set member specified in the operand field of the COPY statement.
- Make sure that MSGLEVEL=(1,1) was specified on the JOB statement.

Severity Code: 20

IFO264 TOO MANY ESD ENTRIES

Explanation: More than 399 entries have been made in the External Symbol Dictionary. Entries in the External Symbol Dictionary are made for the following: control sections, dummy sections, external references (EXTRN and WXTRN), ENTRY symbols, and external dummy sections.

Assembler Action: Entries over the 399 limit are not added to the dictionary and linkage is not provided for them.

Programmer Response: Subdivide your program and reassemble each section individually. Be sure that there are not more than 399 ESD entries in each assembly.

Severity Code: 16

IFO265 SYMBOL RESOLUTION DATA AREA HAS BEEN EXHAUSTED

Explanation:

- Too many literals have been encountered since a LTOrg statement was encountered, and the assembler has filled available work space with literals; or
- The assembler has filled available work space with ESD entries.

Assembler Action: No assembly is performed.

Programmer Response:

- Insert more LTOrg statements in the source deck or allocate more working storage to the assembler; or
- If there are more than 399 ESD entries in your source module, segment it into several modules.

Severity Code: 16

IFO266 LAST ASSEMBLER PHASE LOADED WAS xxxxxxxx

Explanation: This message is issued by the abort routine when the assembly is abnormally terminated.

Assembler Action: Abnormal termination.

Programmer Response: Correct problems indicated by other error messages and reassemble.

Severity Code: 4

IFO267    SYSPRINT DD CARD MISSING -- NOLIST OPTION USED

Explanation: The LIST option is specified, but the DD statement for the SYSPRINT data set is not included in the JCL for this assembly. The SYSPRINT data set holds the object module output of the assembly normally directed to the printer.

Assembler Action: The program is assembled using the NOLIST option. The message is printed on the system output device following the JCL statements for the assembler job step and on the operator's console.

Programmer Response: If you want a listing, reassemble the program with a SYSPRINT DD statement. Otherwise, do not specify the LIST option.

Operator Response: Supply, if possible, a SYSPRINT DD card for the assembler job step and rerun the job.

Severity Code: 16

IFO268    SYSTEM DD CARD MISSING - NOTERMINAL OPTION USED

Explanation: The TERMINAL option is specified, but the DD statement for the SYSTEM data set is not included in the JCL statements for this assembly. The SYSTEM data set contains diagnostic information output of the assembly, normally directed to a remote terminal.

Programmer Response: If you want a SYSTEM listing, reassemble the program with a SYSTEM DD statement. Otherwise, do not specify the TERMINAL option.

Operator Response: Supply, if possible, a SYSTEM DD card for the assembly step and rerun the job.

Severity Code: 16

IFO269    SYSLIB DD CARD MISSING

Explanation:

- A COPY instruction appears in the assembly, but no SYSLIB DD statement is included in the JCL statements; or
- An operation code that is not a machine, assembler, or source macro instruction operation code appears in the assembly, but no SYSLIB DD statement is included in the JCL statements. The assembler assumed the operation code to be a library macro operation code.

Assembler Action:

- The COPY instruction is ignored; or
- The operation code is treated as an undefined operation code.

Programmer Response: Supply the missing DD statement or correct the invalid operation code.

Severity Code: 16





**A**

adding macro definitions to a library 49  
 ALGN option 22  
 ALIGN option 23  
     under CMS 56  
 alignment of instructions and data (see  
     ALIGN option)  
 ALOGIC option 19  
     under CMS 54  
 ASMFC  
     description 24-25  
     example of use 14-15,32,33  
 ASMFCG  
     description 30-31  
     example of use 15-16  
 ASMFCL  
     description 26-27  
     example of use 33  
 ASMFCLG  
     description 28-29  
     example of use 32,33  
 ASSEMBLE command, CMS 53  
     format of 53  
     filename entry 53  
 ASSEMBLE ddname 51,60  
 ASSEMBLE file,  
     created by assembly 57  
 assembler  
     dynamic invocation of 86,22  
     name of 17  
     purpose 9  
 assembler cataloged procedures 23-33  
 assembler data sets 88-89  
 assembler data sets (CMS) 60  
 Assembler F, compatibility 10  
 assembler language 9  
 assembler listing 34-45  
     cross reference 41-43  
     diagnostics 44-45  
     external symbol dictionary 36-37  
     literal cross reference 43  
     relocation dictionary 40  
     source and machine language  
         statements 38-39  
     statistics 44-45  
     symbol cross reference 41-42  
 assembler macros under CMS 59  
 assembler options  
     description 16-23  
     how to specify 17-18  
 assembler options under CMS, 53-56  
     listing control options 53,54  
     other options 53,56  
     output control options 53,55  
     SYSTEM options 53,55-56  
 assembler sample program 73-80  
 assembler speed and capacity 89  
 assembler storage requirements 89-90  
 assembler storage requirements (CMS) 60

assembler work space 22,89  
 assembling a CMS program 53  
 assembly, JCL for (see ASMFC)  
 assembly and execution, JCL for (see  
     ASMFCG; ASMFCLG)  
 assembly and link editing, JCL for (see  
     ASMFCL)  
 assembly, link editing and execution, JCL  
     for (see ASMFCLG)  
 assembly and loader-execution, JCL for  
     (see ASMFCG)  
 ATTACH macro 86

**B**

base register, establishing 46  
 BLKSIZE for assembler data sets 89  
 blocking and buffering information 89  
 buffer size  
     of SYSIN, SYSLIB, SYSPRINT, SYSGO, and  
         SYSPUNCH 89  
     of SYSUT1, SYSUT2, and SYSUT3 89  
         (see also BUFSIZE option)  
 BUFNO for assembler data sets 90  
 BUFSIZE option 20, 89  
     under CMS 56

**C**

CALL macro 86  
 cataloged procedures  
     description 12  
     assembler 23-33  
     (see also ASMFC, ASMFCG, ASMFCL, ASMFCLG)  
     overriding parts of 32-33  
 changing parts of  
     cataloged procedures 32-33  
 CMS editor program 51  
 CMS, relationship to assembler 50  
 CMSLIB ddname 51,60  
 COBOL (see problem-oriented languages)  
 compatibility with Assembler F 10  
 COND parameter 96  
 conditional assembly statements in listing  
     (see ALOGIC option, MLOGIC option)  
 conventions for linking 49  
 COPY instruction 50  
 creating a CMS object file 53  
 creating a module (CMS) 60  
 cross reference listing 41-43

## D

- data sets, assembler 88-90
  - SYSGO 89,90
  - SYSIN 88,90
  - SYSLIB 88,90
  - SYSPRINT 87,88,90
  - SYSPUNCH 89,90
  - SYSTEM 89,90
  - SYSUT1, SYSUT2, SYSUT3 89,90
- data set characteristics, assembler 90
- DD statements, overriding 32-33
- DECK option 21
  - under CMS 55
- default values for assembler options 16
- diagnostic messages
  - CMS 63-66
  - explanations 94-157
  - in listing 44-45
  - special data set for (see SYSTEM listing)
  - suppressing (see FLAG option)
  - on terminal (see SYSTEM listing)
- diagnostics 44-45
- DISK option
  - under CMS 55
- DOS option 23
- dynamic invocation of assembler 86,22
- dynamic invocation of IBM-supplied program 48

## E

- EDIT command (CMS) 52
- effective address 39
- END card, object module 83
- END instruction to specify entry point 47
- entry point 47
- error messages (see diagnostic messages)
- ESD (see external symbol dictionary)
- ESD card 81
- ESD option 19
  - under CMS 54
- ESDID (external symbol dictionary identification number) 37,41
- example of assembler language program 73-80
- examples of cataloged procedures 14-16,32-34
- EXEC statement, overriding parts of 32
- execution of user program 10
- external symbol dictionary 36-37

## F

- file defaults (CMS), overriding 51
- file definitions for CMS ddname, defaults for 51-52
- FILEDEF in (CMS) 51-52
  - default for 51-52
- file processed by assembler under CMS 58

- FLAG option 19
  - under CMS 55
- FORTTRAN (see problem-oriented languages)

## H

- High-level language (see problem-oriented languages)

## I

- IEBUPDTE utility program 49
- INCLUDE command,
  - to execute more than one file 59
- input to the assembler, CMS 50
- inner macro instructions, listing of (see MCALL option; MLOGIC option)
- input to the assembler 9

## J

- JCL (job control language) 12
  - job 12
  - job control language 12
  - job control statements for assembler jobs 14-33
  - job step 12

## L

- LIBMAC option 20,94
  - under CMS 54
- library macro definitions
  - adding to library 50
  - errors in 44-45
    - (see also LIBMAC option)
  - listing of (see LIBMAC option)
- library maintenance, macro 49
- LINECNT option 23
- LINECOUNT option 19
  - under CMS 55
- LINK macro 70
- linkage conventions 46
- linkage editor
  - choosing entry point 47
  - examples 32,33
  - purpose 10
- linkage registers 46
- linking with modules produced by other language translators 47
- linking with IBM-supplied programs 48
- LIST option 19
  - under CMS 54
- listing control options 19-20
- listing control options (CMS) 53,54
- LISTING ddname 51,61
- LISTING file,
  - created by assembler 57
- literal cross reference listing 43
- literals in listing 38,43

LOAD command (CMS) 51  
 to load text file 59  
 load module 10  
 load module modification - entry point  
 restatement 47  
 LOAD option 23  
 loader  
 example of use 15-16  
 purpose 10  
 location counter in listing 39  
 LRECL for assembler data sets 90

## M

machine language code in listing 39  
 macro definitions, library (see library  
 macro definitions)  
 macro instructions in listing, inner (see  
 MCALL option; MLOGIC option)  
 macro library 49  
 (see also SYSLIB)  
 MCALL option 19  
 under CMS 54  
 messages (see diagnostic messages,  
 statistics)  
 messages identifier number 45,94  
 message text 45,94  
 MLOGIC option 19,95  
 under CMS 54  
 MNOTE message 19  
 MNOTE option  
 under CMS 55

## N

Name of assembler 17  
 NOALIGN option 22  
 under CMS 56  
 NOALOGIC option 19  
 under CMS 54  
 NODECK option 21  
 under CMS 55  
 NOESD option 19  
 under CMS 54  
 NOLIBMAC option 20  
 under CMS 54  
 NOLIST option 19  
 under CMS 54  
 NOMCALL option 19  
 under CMS 54  
 NOMLOGIC option 19  
 under CMS 54  
 NONUMBER option 21  
 under CMS 56  
 NOOBJECT option 21  
 under CMS 55  
 NOPRINT option (CMS) 55  
 NORENT option 22  
 under CMS 56  
 NORLD option 20  
 under CMS 54  
 NOSTMT option 21,91  
 under CMS 56

NOTERMINAL option 21,91  
 under CMS 55  
 NOTEST option 21  
 NOXREF option 20  
 under CMS 55  
 NOYFLAG option 19  
 under CMS 55  
 NUM option 21  
 NUMBER option 21,91  
 under CMS 55

## O

OBJ option 21  
 object code in listing 39  
 object deck output 81-85  
 END 83  
 ESD 81  
 RLD 82-83  
 SYM 83-85  
 TXT 82  
 object module  
 definition 9  
 records of 81-85  
 object module, CMS 51  
 object module linkage 47  
 OBJECT option 21  
 under CMS 55  
 options, assembler (see assembler options)  
 options in listing 45  
 output control options 21  
 output control options (CMS) 53,55  
 output from assembler 9  
 output from assembler, CMS 51  
 overriding parts of cataloged  
 procedures 32-33

## P

page size, assembler listing (see LINECOUNT  
 option)  
 passing parameters to your program  
 (CMS) 59  
 PARM field  
 (see also assembler options)  
 acquiring information in 48  
 coding rules 17-18  
 overriding in cataloged  
 procedures 17,32  
 performance, influencing (see assembler  
 speed and capacity)  
 PL/I (see problem-oriented languages)  
 PRINT instruction 38,39  
 PRINT option  
 under CMS 55  
 problem-oriented languages, linking  
 with 47  
 procedures, cataloged (see cataloged  
 procedures)  
 program design 46  
 program listing (see assembler listing)  
 PUNCH ddname 51,61

## R

RECFM for assembler data sets 90  
recurring errors 96  
reenterability check 22  
register usage under CMS 59  
relocatable constants 40  
relocation dictionary 40  
RENT option 22  
    under CMS 56  
return code 96  
RLD (see relocation dictionary)  
RLD card 82-83  
RLD option 20  
    under CMS 54

## S

Sample program 73-80  
Save area 46  
Saving registers 46  
Severity code 96,45  
source and machine language statements in  
    listing 38-39  
source module 9  
source statement in listing 38-39  
START command (CMS) 51  
    to begin execution under CMS 59  
statement number 39,45,94  
statistics listing 44-45  
step 12  
storage requirements, virtual 89  
SMT option 21,91  
    under CMS 56  
SYM card 83-85  
symbol cross reference listing 42-43  
SYS1.MACLIB 49,88  
SYSGO data set 99,90  
SYSIN data set 88,90  
SYSLIB data set 88,90  
SYSPARM option  
    under CMS 56-57  
SYSPRINT data set 87,98,90  
SYSPUNCH data set 89,90  
SYSTEM data set 89,90  
SYSTEM ddname 61  
SYSTEM listing 91-93  
SYSTEM options 21  
SYSTEM options (CMS) 53,55-56  
SYSUT1, SYSUT2, SYSUT3 data set 88,90

## T

TERM option 21  
TERMINAL option 21,91  
    under CMS 55  
terminal output (see SYSTEM listing)  
TEST option 21  
    under CMS 55  
TEXT ddname 51,61  
TEXT file (CMS) 51  
    created by assembly 57  
Time Sharing Option 91  
TSO (see Time Sharing Option)  
TXT card 82

## U

use of assembler cataloged  
    procedures 13-15,32-33  
using SYSPARM under CMS 56-57  
utility data sets 88,90  
    (see also BUFSIZE option)

## V

virtual storage requirements 89  
virtual storage requirements under CMS 61

## W

work space, assembler 22,89  
WORKSIZE option 20

## X

XCTL macro 86  
XREF option 20  
    under CMS 55

## Y

YFLAG option 19  
    under CMS 55



IBM CORPORATION  
1970-1971  
PUBLISHED BY THE  
INTERNATIONAL BUSINESS  
MACHINES CORPORATION  
ARMONK, N.Y. 10504  
© 1970 IBM CORPORATION  
ALL RIGHTS RESERVED





