File Number S360(Mod.20)-20
Form C24-9009-3

TPS

IBM Systems Reference Library

# IBM System/360 Model 20 Tape Programming System Operating Procedures

**Program Numbers:**

| | |
|---|---|
| 360U-UT-131-135 | Utility Programs |
| 360U-SL-142-147 and 155-156 | Service Programs |
| 360U-CL-157-159 | Control Programs |
| 360U-RG-148 | Report Program Generator |
| 360U-AS-149 | Assembler Program |
| 360U-SM-150 | Sort/Merge Program |
| 360U-IO-151 | Input/Output and Basic Monitor Macro Definitions |
| 360U-IO-152 | Input/Output Macro Definitions for the IBM 1419 and 1259 |
| 360U-CQ-154 | Input/Output Macro Definitions for the Binary Synchronous Communications Adapter |

This publication provides Model 20 operators with the information required to operate their systems using the Model 20 Tape Programming System (TPS).

Detailed information is given on (1) building a tape-resident system from IBM-supplied programs, (2) maintaining this system by means of IBM-supplied programs, (3) executing IBM-supplied and user-written programs under control of the tape-resident and card-resident systems of the TPS.

To derive the maximum benefit from this publication, the reader must be thoroughly familiar with the functions and operation of all components of his System/360 Model 20. The publications describing these components are listed in the SRL publication IBM System/360 Model 20, Bibliography, Form A26-3565.

Fourth Edition (March, 1969)

This is a major revision of, and obsoletes, C24-9009-2. The main changes are associated with the delivery of the IBM System/360 Model 20 Submodel 5, and with improvements and additions to IBM-supplied programs which are being made at the same time. Changes to the text, and small changes to illustrations, are indicated by a vertical line to the left of the change; changed or added illustrations are denoted by the symbol • to the left of the caption.

This edition applies to the following program version and modification levels of the IBM System/360 Model 20 Tape Programming System, and to all subsequent versions and modifications until otherwise indicated in new editions or Technical Newsletters.

| Program No. | V/M | Program No. | V/M |
|---|---|---|---|
| 360U-UT-131 | 3/0 | 360U-RG-148 | 3/0 |
| 360U-UT-132 | 3/0 | 360U-AS-149 | 3/0 |
| 360U-UT-133 | 3/0 | 360U-S/M-150 | 3/0 |
| 360U-UT-134 | 3/0 | 360U-I/C-151 | 4/0 |
| 360U-UT-135 | 2/2 | 360U-I/O-152 | 4/0 |
| 360U-SL-142 | 3/0 | 360U-CQ-154 | 1/1 |
| 360U-SL-143 | 3/0 | 360U-SL-155 | 1/0 |
| 360U-SL-144 | 3/0 | 360U-SL-156 | 1/0 |
| 360U-SL-145 | 3/0 | 360U-CL-157 | 1/0 |
| 360U-SL-146 | 3/0 | 360U-CL-158 | 1/0 |
| 360U-SL-147 | 3/0 | 360U-CL-159 | 1/0 |

Changes are continually made to the specifications herein; before using this publication in connection with the operation of IBM systems, consult the latest SRL Newsletter, Form N20-0361, for the editions that are applicable and current.

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A form for readers' comments is provided at the back of this publication. If the form has been removed, comments may be addressed to IBM Laboratory, Publications Dept., P.O. Box 24, Uithoorn, Netherlands.

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INTRODUCTION . . . . . 5
Terms and Abbreviations . . . . . 5
Prerequisites . . . . . 5
Summary of IBM-Supplied Programs . . . 5

INITIATION AND USE OF THE CARD-RESIDENT AND TAPE-RESIDENT SYSTEMS 8
The Card-Resident System . . . . . 8
The Card Initial Program Loader . . . 8
The Card Basic Monitor Program . . . . 8
The Card Job Control Program . . . . . 10
Preparation of a Card-Resident System Run . . . . . 11
Description of Output . . . . . 11
The Tape-Resident System . . . . . 13
The Tape Initial Program Loader . . . 13
The Tape Basic Monitor Program . . . . 14
The Tape Job Control Program . . . . . 14
Tape Error Statistics . . . . . 16
Preparation of a Tape-Resident System Run . . . . . 17
Executing Object Programs under Control of the Tape-Resident System . 18
Executing Object Programs Using the 1419/ 1259 IOCS Under Control of the Card-Resident or Tape-Resident System . 19

USE OF LANGUAGE TRANSLATORS AND OTHER IBM-SUPPLIED PROCESSING PROGRAMS . . . . 20
Using the TPS Report Program Generator . 20
I/O Device Assignments . . . . . 20
Control Statements . . . . . 21
User Subroutines . . . . . 23
Preparation of the System . . . . . 23
Programmed Halts . . . . . 25
Messages . . . . . 25
Description of Output . . . . . 25
Using the TPS Assembler Program . . . . 26
I/O Device Assignments . . . . . 26
Control Statements . . . . . 26
Preparation of the System . . . . . 27
Programmed Halts . . . . . 28
Messages . . . . . 28
Operator Intervention . . . . . 28
Description of Output . . . . . 29
Using the TPS Linkage Editor Program . . 30
I/O Device Assignments . . . . . 30
Job Control Statements . . . . . 30
Additional Input Statements . . . . . 30
Preparation of the System . . . . . 31
Programmed Halts . . . . . 31
Description of Output . . . . . 31
Using the TPS Sort/Merge Program . . . . 33
I/O Device Assignments . . . . . 33
Control Statements . . . . . 34
User Routines . . . . . 34
Preparation of the System . . . . . 35
Special Considerations for Multi-Volume Input and Output Files . 35
Programmed Halts . . . . . 36
Messages . . . . . 37
Description of Output . . . . . 37
Checkpoint and Restart Procedure . . . 37
Using the TPS Utility Programs . . . . . 38
I/O Device Assignments . . . . . 38
Control Statements . . . . . 38
User Routines . . . . . 39
Preparation of the System . . . . . 39
Programmed Halts . . . . . 41
Messages . . . . . 41
Description of Output . . . . . 41

CREATION AND MAINTENANCE OF SYSTEM TAPES . . . . . 42
Retrieving and Identifying programs stored on the IBM-Supplied Tape . . . . 42
Machine Requirements . . . . . 42
Program Package . . . . . 42
Operating procedures for the Distribution-Package Retrieval Program . . . . . 44
Identification of IBM-Supplied Programs . . . . . 46
Building the Initial System Tape from IBM-Supplied Programs (LDSYS run) . . . 47
Inserting IBM-Supplied Macros in the Macro Library (MMAINT run) . . . . . 49
Updating Model 20 TPS Programs from IBM-Supplied Program Modifications . . . 52
Copying a System Tape . . . . . 54
I/O Device Assignments . . . . . 54
Control Statements . . . . . 54
Preparation of the System . . . . . 54
Programmed Halts . . . . . 55
Description of Output . . . . . 55
Updating the Macro Library Section of a System Tape. . . . . 56
I/O Device Assignments . . . . . 56
Control Statements . . . . . 56
Preparation of the System . . . . . 57
Programmed Halts . . . . . 57
Messages . . . . . 57
Description of Output . . . . . 57
Updating the Program Library Section of a System Tape. . . . . 59
I/O Device Assignments . . . . . 59
Control Statements . . . . . 59
Preparation of the System . . . . . 60
Programmed Halts . . . . . 60
Description of Output . . . . . 60
Displaying Directories . . . . . 62
I/O Device Assignments . . . . . 62
Control Statements . . . . . 62
Preparation of the System . . . . . 62
Description of Output . . . . . 62
Using The Core-Image Service Program . . 63
I/O Device Assignments . . . . . 63
Control Statements . . . . . 63
Preparation of the System . . . . . 64
Programmed Halts . . . . . 64
Messages . . . . . 64
Description Of Output . . . . . 64
Using The Macro Service Program . . . . 66
I/O Device Assignments . . . . . 66

Control Statements . . . . . 66
Preparation of the System . . . . . 67
Programmed Halts . . . . . 67
Messages . . . . . 67
Description Of Output . . . . . 67
Building Additional System Tapes from IBM-Supplied and User-Written Programs . 68
Control Statements . . . . . 68
I/O Device Assignments . . . . . 68
Preparation of the System . . . . . 69
Error Halts . . . . . 70
Description of Output . . . . . 70

SAMPLE PROGRAMS . . . . . 71
Sample Program 1 . . . . . 71
Description of the Sample Deck . . . . 71
Operating Procedures . . . . . 75
Sample Program 2 . . . . . 80
Description of the Sample Deck . . . . 80
Operating Procedures . . . . . 84
Sample Program 3 . . . . . 87
Description of the Sample Deck . . . . 87
Operating Procedures . . . . . 90
Sample Program 4 . . . . . 93
Description Of The Sample Deck . . . . 93
Operating Procedures . . . . . 93
Sample Program 5 . . . . . 95
Description Of The Sample Deck . . . . 95
Machine Requirements . . . . . 95
Operating Procedures . . . . . 96
Manual Intervention (Slave Terminal only) . . . . . 98
Halts And Error Displays . . . . . 98
Sample Program 6 . . . . . .100
Description of the Sample Deck . . . .100
Machine Requirements . . . . . .100
Operating Procedures . . . . . .102
Halts and Error Displays . . . . . .103

PROGRAMMED-HALT DISPLAYS AND RESTART PROCEDURES . . . . . .105
Programmed Halts . . . . . .105
Non-Programmed Halts . . . . . .106
1419/1259 Halts and Error Displays . . .107
Restart Procedures . . . . . .110
Programmed-Halt Displays . . . . . .126

APPENDIX A. JOB CONTROL STATEMENTS . . .160
General Format Of Job Control Statements . . . . . .160
Order Of Input . . . . . .161
Functions And Format Of Job Control Statements . . . . . .161

APPENDIX B. MICRO PROGRAM LOAD PROCEDURES . . . . . .167

APPENDIX C. GLOSSARY . . . . . .168

INDEX . . . . . .172

This publication provides Model 20 operators with the information required to (1) build a tape-resident system from IBM-supplied programs, (2) maintain this system by means of IBM-supplied programs, (3) execute IBM-supplied and user-written programs under control of the tape-resident system, and (4) execute object programs under control of the card-resident system.

A tape-resident system is used to control the compilation, assembly, and execution of the user's problem programs and the execution of IBM-supplied programs. The principal features and advantages of a tape-resident system are: the program library facility, the macro library facility, batch job processing, selective phase loading, and automatic job-to-job transition.

The card-resident system provides for stacked-job processing with automatic job-to-job transition. It is used to control the building of a tape-resident system and the execution of object programs contained in punched cards. The card-resident system offers the advantage that all tape drives available can be used by the object program.

## TERMS AND ABBREVIATIONS

The meaning of the terms and abbreviations used in this publication is defined in Appendix C. Glossary.

## PREREQUISITES

Readers of this publication should be familiar with the functions and the operation of all components of their System/360 Model 20. The publications describing these components are listed in the Systems Reference Library publication IBM System/360 Model 20, Bibliography, Form A26-3565.

## SUMMARY OF IBM-SUPPLIED PROGRAMS

The programming support which IBM supplies to users of tape-resident systems comprises

- the Basic Assembler (tape versions)
- the Control programs of the card-resident system
- the Control programs of the tape-resident system
- the Service programs for the tape-resident system
- the TPS Report Program Generator
- the TPS Assembler program
- the TPS Sort/Merge program
- the TPS Utility programs
- Input/Output and Basic Monitor macro definitions.

A number of IBM-supplied programs are executed under control of the card-resident system, others under control of the tape-resident system, and some can be executed under control of either system. Those programs that are executed under control of the tape-resident system must be stored, together with the Basic Monitor program and the Job Control program of the tape-resident system, on a tape referred to as the system tape. The tape Basic Monitor is the first program on the system tape. It is followed by a program library, which contains the tape Job Control program and all other programs to be executed under control of the tape-resident system, and by an (optional) macro library, which contains the macro definitions.

A brief description of the functions of each IBM-supplied program is given below.

### Basic Assembler (Tape Versions)

The tape versions of the Basic Assembler are stand-alone programs used to assemble source programs written in the Basic Assembler language. The operating procedures for these programs are described in the SRL publication IBM System/360 Model 20, Card Programming Support, Basic Assembler (Tape Versions) Operating Procedures, Form C24-9011.

### Control Programs (Card and Tape)

The Control programs of the card and tape-resident systems are:

- The Initial Program Loader (IPL)
- The Basic Monitor program
- The Job Control program.

The card-resident IPL, Basic Monitor and Job Control programs are grouped together for distribution, the three being known

collectively as the card-resident control programs. For tape-resident systems, the IPL is a separate program, but the Basic Monitor and Job Control programs are coupled together for distribution purpose and known as the tape-resident control programs.

Initial Program Loader (IPL). The IPL is used to load the Basic Monitor program into main storage from cards or from the system tape, respectively.

Basic Monitor Program. The Basic Monitor is the main control program. The card Basic Monitor is used to control the loading and execution of object programs contained in punched cards. It is also used to control the building of a tape-resident system. The tape Basic Monitor controls the loading and execution of (1) programs contained in the program library of the tape-resident system, (2) executable object programs stored on tape in card-image format, and (3) executable object programs contained in punched cards.

The Job Control Program. The Job Control program is loaded into main storage by the Basic Monitor. It prepares each individual program for execution under control of the Basic Monitor. The Job Control program operates between jobs only. It is not in main storage during the execution of a program.

## Service Programs

The System Service programs comprise the Load System Tape program, the Copy System Tape program, the Linkage Editor program, and the Library Management programs.

TPS Load System Tape Program. The Load System Tape program is executed under control of the card-resident system. Its only function is to build a tape-resident control system.

TPS Copy System Tape Program. The Copy System Tape program is executed under control of the card-resident system. It is used to copy a system tape onto another tape (e.g., from a 7-track tape onto a 9-track tape or vice versa).

TPS Linkage Editor Program. The Linkage Editor program can be executed only under control of the tape-resident system. It combines separately assembled programs or phases into an integral program that can be executed under control of the Basic Monitor program. The Linkage Editor program also performs any required relocations.

The Linkage Editor program is used to process output of the Assembler program. It is not used in conjunction with the Report Program Generator.

TPS Library Management Programs. The Library Management programs are executed under control of the tape-resident system. They include the Maintenance and the Service programs for the program library and for the macro library, and the Display Service program.

- The Maintenance program for the program library (also referred to as Core-Image Maintenance program) adds programs or phases to the program library or deletes them from it. This program can also be used to replace the Basic Monitor program on the system tape.
- The Maintenance program for the macro library (also referred to as Macro Maintenance program) adds macro definitions to, or deletes macro definitions from, the macro library.
- The Service program for the program library (referred to as the Core-Image Service program) lists and/or punches the contents of the program library on the system tape.
- The Service program for the macro library (referred to as the Macro Service program) lists and/or punches the contents of the macro library.
- The Display Service program is used to print the contents of the core-image and/or macro directory of the user's tape-resident system.

## Other IBM-Supplied Programs

In addition to the System Control and Service programs, the following programs are available to users of the tape-resident system.

TPS Report Program Generator. The TPS Report Program Generator (RPG) translates source programs written in the RPG language into object programs. RPG programs are single-phase programs. They are not linked or relocated. Therefore, the Linkage Editor program is not used with RPG programs.

TPS Assembler Program and I/O and Basic Monitor Macro Definitions, including I/O Macro Definitions for the IBM 1419 and 1259 Magnetic Character Readers. The TPS Assembler program translates source programs written in the Assembler language into object programs. In conjunction with the Assembler program, IBM supplies macro definitions that can be used by this program. When an assembly is to be made, all macro definitions used must be contained in the macro library of the system tape. Programs written in the Assembler language may be single-phase or multi-phase programs. Separately assembled programs can be linked and/or relocated by the Linkage Editor program.

TPS Sort/Merge Program. The TPS Sort/Merge program performs two functions. It (1) sorts a single file, which must be stored on magnetic tape, to a user-specified sequence, and (2) merges from two to five sorted tape files into one sorted tape file. The merging facility can also be used to sequence-check and/or reblock a single file while copying it.

TPS Utility Programs. IBM supplies five Utility programs for Model 20 systems with magnetic tape equipment. Four of these Utility programs transfer data from one medium to another (from punched cards to magnetic tape, from one tape to another, from magnetic tape to punched cards, and from magnetic tape to a printer). The remaining Utility program prepares and writes standard IBM tape volume labels.

## THE CARD-RESIDENT SYSTEM

For a card-resident system, the card-resident Control programs are used. These programs, which must be contained in punched cards, are:

- the Initial Program Loader
- the Basic Monitor program
- the Job Control program.

The card-resident system can be used to execute IBM-supplied and user-written object programs contained in punched cards.

Executable user object programs are obtained as punched output from the:

1. TPS Report Program Generator,
2. TPS Assembler program (if object programs do not require linking and/or relocation),
3. TPS Linkage Editor program (if linking and/or relocation of assembled object programs was required).

The card-resident Control programs and the object programs form the skeleton of input for a card-resident system run.

### THE CARD INITIAL PROGRAM LOADER

To initiate a system run, the Initial Program Loader (IPL), preceded by a Clear Storage card, must be loaded into main storage from the reading device referred to as the loading unit. This loading unit is the 2501 Card Reader, or the 2520 Card Read-Punch, or the primary feed of the 2560 MFCM, whichever is attached.

During the loading and execution of the IPL program, a number of programmed halts may occur. The code displays associated with these halts and the appropriate restart procedures are described in the section Programmed-Halt Displays and Restart Procedures.

To load the card Job Control program, read the job control statements, and load problem programs into main storage, a card reading device must be assigned to SYSRDR. The IPL card deck in the loading unit must be followed by an ASSGN card for SYSRDR. For this purpose, an ASSGN card allocating SYSRDR to an IBM 2501 card reader is provided in the deck retrieved from the distribution tape (see Figure 2). If the user wishes to use a card-reading device other than the IBM 2501, this card must be replaced by one containing the correct specification. See the ASSGN Control Statement and Figure 50 in Appendix A.

### THE CARD BASIC MONITOR PROGRAM

The IPL program loads the card Basic Monitor program from the loading unit into main storage. Therefore, the Basic Monitor deck must be placed into the hopper of the loading unit, immediately behind the ASSGN card for SYSRDR.

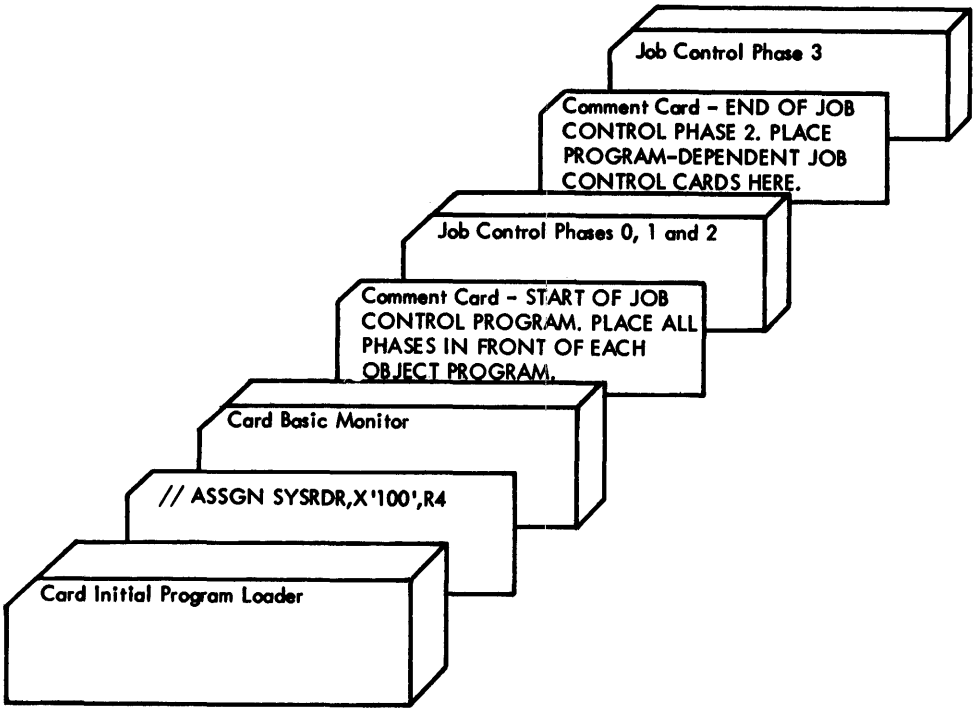
The Basic Monitor program contains the logical unit table, which consists of 22 logical unit blocks. Each logical unit block is used to associate a symbolic device address with a physical device address. The Basic Monitor contains standard assignments for a number of symbolic device addresses. The remaining symbolic device addresses are not assigned. Figure 1 shows the symbolic device addresses and the standard assignments.

| Symbolic Address | Physical Device Address |
|---|---|
| SYSRES* | not assigned |
| SYSRDR | not assigned |
| SYSIPT | 2501 Card Reader |
| SYSOPT | 2560 Secondary Feed |
| SYSLST | 1403 Printer |
| SYSLOG | 1403 Printer |
| SYS000* | 780 T2 |
| SYS001* | 781 T2 |
| SYS002* | 782 T2 |
| SYS003* | 783 T2 |
| SYS004* | 784 T2 |
| SYS005* | 785 T2 |
| SYS006 - SYS015* | not assigned |

* Only tape drives can be assigned to these symbolic device addresses

Figure 1. Symbolic Device Addresses and Standard Assignments in the Card Basic Monitor Program

The standard assignments for SYS000 through SYS005 are contained in the six REP cards (REP in cols. 2-4) included in the Basic Monitor deck, immediately preceding the END card. Columns 17 through 20 of these cards contain the tape-drive addresses 0780 through 0785. If some or all of these standard assignments are to be




●Figure 2. The Card-Resident Control Program Deck as Retrieved from the Distribution Tape

changed, the corresponding REP cards must be replaced by new REP cards containing the desired information in cols. 17-20.

Note 1: If REP cards are used for the assignment of 7-track tape drives or 9-track tape drives with compatibility feature, ASSGN cards (submitted to the Job Control program) must be used in addition to the correct REP cards to supply the appropriate specifications. (For a list of these specifications, see the description of the ASSGN control statement in Appendix A.)

Note 2: If the user's Model 20 system includes less than six tape drives and the standard assignments for some or all of these drives must be changed, the user need replace only those REP cards required to make the necessary changes. The remaining REP cards should be left, unchanged, in the Basic Monitor deck.

A loading routine in the Basic Monitor program is used to load object programs from SYSRDR into main storage. This routine is entered whenever a FETCH or EOJ macro instruction is encountered in a program. When the loading routine is entered through a FETCH macro instruction, the routine immediately loads the (physically) next program from SYSRDR into main storage. The execution of an EOJ macro instruction causes a programmed halt to occur before the next program is loaded.

The loading routine of the Basic Monitor program recognizes the following card types and performs the actions required for each type.

| Card Type | Action |
|---|---|
| TXT | The information in the card is loaded into main storage at the absolute address specified in the card. |
| END | The card is ignored if it does not contain a transfer address. If a transfer address is present, control is transferred to that address. |
| XFR | Control is transferred to the address specified in this card. |
| REP | Beginning at the address specified in the card, the contents of main storage are replaced with the information contained in the card. |

All other card types are ignored by the loading routine.

The Basic Monitor program also contains physical tape I/O and error routines. This group of routines is entered whenever an I/O operation in a program refers to a tape drive. The routines provide for a number of programmed halts. The code displays associated with these halts are identified by a 7 in the S-field of the E-S-T-R register panel on the CPU console. When a halt of this type occurs, the operator must in most cases display additional data (such as the CSW, the CCW, sense data, or register contents) to diagnose the error and determine the procedure to be followed.

The halt-code displays and the appropriate restart procedures for all programmed halts that the Basic Monitor program provides for are described in the section Programmed-Halt Displays and Restart Procedures.

## THE CARD JOB CONTROL PROGRAM

The Basic Monitor loads the Job Control program and the problem program(s) into main storage from the device assigned to SYSRDR. The Job Control program need be loaded only if Job Control functions (assignment of device addresses, insertion of the date, etc.) are required. Otherwise, the problem program can be loaded and executed under control of the Basic Monitor without a previous Job Control run. A Job Control run must always be made at system initiation time (i.e., before the first problem program is loaded and executed) to furnish the Basic Monitor program with the information required for all jobs (date, configuration, etc.).

In a stacked-job environment, it is advisable to have several Job Control decks, since each problem program that requires Job Control functions must be preceded by a Job Control deck. The functions performed by the Job Control program depend on the job control statements issued. The job control statements are punched into cards and read from the device assigned to SYSRDR. Job control statements may be issued for the following purposes:

- Indicating the beginning of a set of job control statements and specifying the name of the program to be executed (JOB).
- Inserting the date into the communication region of the Basic Monitor program in main storage (DATE).
- Altering the storage-capacity specification contained in the communication region of the Basic Monitor in main storage (CONFG).
- Updating an I/O device assignment of the Basic Monitor in main storage (ASSGN).
- Positioning a reel of tape by skipping the specified number of tape marks, starting from the present position, or by rewinding the tape to the load point (FILES).
- Specifying the name of a tape file to be processed and the symbolic address of the drive on which this file is mounted (VOL).
- Supplying tape-label information for the tape file to be processed (TPLAB).
- Setting user-program switch indicators in the communication region of the Basic Monitor program (UPSI).
- Initiating tape error statistics (OPTN).
- Initiating the listing of control statements, and error statistics if requested (LOG).
- Suppressing the listing of control statements, and error statistics if requested (NOLOG).
- Suspending system operation (PAUSE).
- Informing the Job Control program that the entire set of control statements has been read and control is to be returned to the Basic Monitor program (EXEC).

The cards containing the job control statements are normally prepared by the programmer. In some cases, however, the operator may have to prepare and insert such cards (e.g., DATE or ASSGN cards) to insure proper system operation. The formats of all job control statements are given in Appendix A.

Normally, the first statement of a set of job control statements is the JOB statement, and the last one is the EXEC statement. Only LOG, NOLOG, and PAUSE statements may precede a JOB statement. All other types of job control statements must appear between the JOB and EXEC statements as follows:

- A TPLAB control statement must immediately follow the associated VOL statement.
- If, in a set of job control statements, a FILES statement and an ASSGN statement refer to the same symbolic I/O device address, the FILES statement must follow the ASSGN statement.

- The CONFG statement, if required, must precede the first TPLAB statement for a job.
- All other job control statements may appear in any order between the JOB and EXEC statements.

The JOB statement and the EXEC statement are required in any set of job control statements. If it is intended to suspend system operation without terminating the system run, a PAUSE control statement must be issued. When the Job Control program encounters a PAUSE statement before it has read a JOB statement, it causes an immediate halt. In this case, the Job Control program expects a set of job control statements to be read as soon as system operation is resumed by pressing the Start key on the CPU console. When a PAUSE statement is encountered between a JOB and an EXEC statement, the Job Control program finishes reading the set of control statements issued and causes a system halt immediately before the loading of the program is to begin. In this case, the Basic Monitor expects to load the program associated with the set of job control statements as soon as system operation is resumed by pressing the Start key on the CPU console.

The programmed-halt codes that may be displayed during the execution of the Job Control program as well as the appropriate restart procedures are described in the section Programmed-Halt Displays and Restart Procedures.

## PREPARATION OF A CARD-RESIDENT SYSTEM RUN

The following steps must be taken to initiate a run of the card-resident system.

1. Place into the hopper of the loading unit (2501 if attached; otherwise, 2520 Card Read-Punch or primary feed of 2560 MFCM):
   a) the IPL deck,
   b) the appropriate ASSGN card for SYSRDR (behind the IPL deck),
   c) the Basic Monitor deck (behind the ASSGN card for SYSRDR).
2. Place into the hopper of the device assigned to SYSRDR:
   a) phases 00, 01 and 02 of the Job Control program deck
   b) the cards containing the job control statements (for system initiation and for the first job), and
   c) phase 03 of the Job Control program deck.

   Note: The job control statements must include a DATE statement.

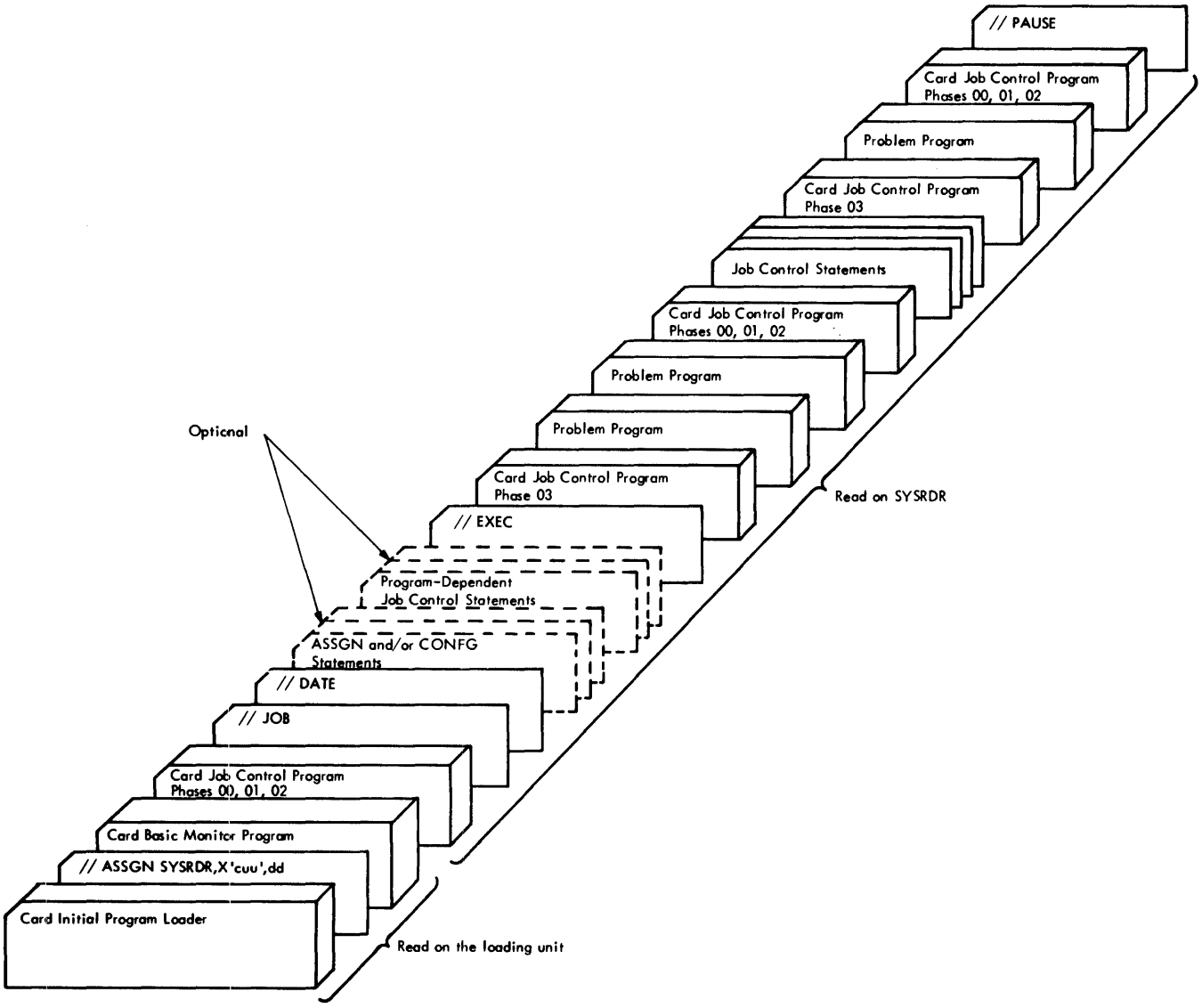
   d) the problem program deck (or several stacked decks with Job Control decks and job control cards where required).

   Note: A Job Control deck and job control cards are not required for second and subsequent programs in a job stream when the configuration and I/O-device assignments are the same and program-dependent job control statements are not used.
3. Press the Start key(s) of the loading unit and the device assigned to SYSRDR.
4. If the printer is to be used, prepare and start this device.
5. Prepare and start the I/O devices used by the first problem program to be executed.
6. Set the Register-Data/Address switches on the CPU console to an even main-storage address between hexadecimal 009C and the end-of-storage address minus hexadecimal 0052.
7. Set the Mode switch on the CPU console to PROCESS.
8. Press the Load key on the CPU console.

Figure 3 shows the arrangement of input for a card-resident system run.

## DESCRIPTION OF OUTPUT

The output obtained from object programs executed under control of the card-resident system depends entirely on the type of output specified in these programs and, therefore, must be identified with information supplied by the programmer.




●Figure 3. Arrangement of Input for a Card-Resident System Run

## THE TAPE-RESIDENT SYSTEM

Before any of the programs contained in the program library of the tape-resident system can be executed, a system run must be initiated; i.e., the tape Basic Monitor program must be loaded from the system tape into main storage. The loading of the Basic Monitor program is performed by the tape Initial Program Loader (IPL).

## THE TAPE INITIAL PROGRAM LOADER

If the tape Initial Program Loader is to be used, it must be contained in punched cards. The IPL deck is preceded by a Clear Storage card. The IPL program is loaded into main storage from the reading device referred to as the loading unit. This loading unit is the 2501 Card Reader or the 2520 Card Read-Punch or the primary feed of the 2560 MFCM, whichever is attached.

A number of programmed halts may occur during the loading and execution of the IPL program. The code displays associated with these halts and the appropriate restart procedures are described in the section Programmed-Halt Displays and Restart Procedures.

### ASSGN Cards for SYSRES and SYSRDR

The IPL program loads the tape Basic Monitor program into main storage from the system tape mounted on SYSRES. Since there is no standard assignment for SYSRES, an ASSGN card for this symbolic device address is required. (The tape drive assigned to SYSRES must be a 9-track drive). The ASSGN card must be placed directly behind the END card of the IPL program deck, and in front of the REP cards described in the following section.

If a card reading device other than that assigned in the tape Basic Monitor program is to be used as SYSRDR, an appropriate ASSGN card for SYSRDR must be placed behind the ASSGN card for SYSRES.

The ASSGN card(s) must be followed either by an end-of-file card (/* in columns 1 and 2) or by REP cards followed by an end-of-file card.

### REP Cards

Six REP cards (REP in cols. 2-4 ) and an end-of-file card (/* in cols. 1-2 ) follow the END card of the IPL program deck supplied by IBM. They are used to furnish the tape Basic Monitor in main storage with the unit numbers of the tape drives attached to the Model 20.

The REP cards supplied by IBM contain the physical device addresses 0780 through 0785 in columns 17-20, where 07 is the attachment point (valid for any magnetic tape drive), and 80 through 85 are the unit numbers to be inserted as standard numbers for six drives (maximum number of tape drives that can be attached to a Model 20).

The unit numbers (80-85) cannot be inserted or changed by ASSGN cards submitted to the Job Control program. If the unit numbers of the user's tape drives are not 80-85, they can be inserted or changed in one of the following ways:

1. by including ASSGN cards in the input deck for the Load System Tape program behind the tape Basic Monitor deck or, if the tape Basic Monitor is read from tape, behind the MONTR control card (see the sections Building the Initial System Tape from IBM-Supplied Programs and Building Additional System Tapes from IBM-Supplied and User-Written Programs);

2. by replacing the IBM-supplied REP cards behind the tape IPL deck with REP cards containing the unit numbers of the user's tape drives in columns 17-20.

In the first case (ASSGN cards submitted to LDSYS), the standard assignments of the tape Basic Monitor on the system tape are inserted. The REP cards behind the IPL deck may be removed to allow faster processing.

In the second case (REP cards submitted to the tape IPL), the standard assignments of the tape Basic Monitor in main storage are inserted or changed. The Basic Monitor program on the system tape is not affected.

Note 1: The REP cards indicate to the tape Basic Monitor only the attachment point and the unit numbers of the corresponding tape drives. Therefore, if 7-track tape drives or 9-track tape drives with compatibility feature are assigned by means of REP cards submitted to the IPL program, additional ASSGN statements (submitted to the Job Control program) must be used for the appropriate tape characteristics specifications. (For a list of these specifications, see the description of the ASSGN statement in Appendix A.)

Note 2: If less than six tape drives are attached and the standard assignments for some or all of these drives are to be inserted or changed by means of REP cards, the user need replace only those REP cards required to make the assignments for his tape drives. The remaining REP cards must be removed.

If the correct standard assignments for a particular Model 20 system were made by means of ASSGN statements at the time the system tape was built, and the unit numbers are different from those contained in the IBM-supplied REP cards, these REP cards must be removed from the IPL deck, so that the end-of-file card directly follows the ASSGN card for SYSRES (or that for SYSRDR, if present).

Through the use of REP cards in an IPL procedure, a system tape that has been created for a particular Model 20 system can be used on other systems with different tape-drive unit numbers. The system tape is not modified, since only the Basic Monitor program in main storage is affected.

## THE TAPE BASIC MONITOR PROGRAM

The tape Basic Monitor program is the main control program of the tape-resident system. It contains the logical unit table, which consists of 22 logical unit blocks. Each logical unit block is used to associate a symbolic device address with a physical device address. The tape Basic Monitor program supplied by IBM contains standard assignments for a number of symbolic device addresses. The remaining symbolic device addresses are not assigned. The standard assignments in the tape Basic Monitor are shown in Figure 4.

| Symbolic Address | Physical Device Address |
|---|---|
| SYSRES* | not assigned |
| SYSRDR | 2501 Card Reader |
| SYSIPT | 2501 Card Reader |
| SYSOPT | 2560 Secondary Feed |
| SYSLST | 1403 Printer |
| SYSLOG | 1403 Printer |
| SYS000 - SYS015* | not assigned |

* Only tape drives can be assigned to these symbolic device addresses.

Figure 4. Symbolic Device Addresses and Standard Assignments in the Tape Basic Monitor Program

When the Basic Monitor program has been read into main storage, and insertions or changes (if any) of standard assignments have been made by means of the IPL program, control is transferred to the loading routine of the Basic Monitor program. This routine loads the Job Control program and other programs from the program library into main storage. It is called initially by the IPL program and then either by the Job Control program or by a System Service or problem program that has just been executed.

The tape Basic Monitor program also contains physical tape I/O and error routines. This group of routines is entered whenever an I/O operation in the program that is being executed refers to a tape drive. The routines provide for a number of programmed halts. The code displays associated with these halts are identified by a 7 in the S-field of the E-S-T-R register panel on the CPU console. When a halt has been caused in the tape I/O and error routines, the operator can in most cases display additional data (such as the CSW, the CCW, sense data, or register contents) to diagnose the error and determine the procedure to be followed.

The halt code displays and the appropriate restart procedures for all programmed halts that the tape Basic Monitor program provides for are described in the section Programmed-Halt Displays and Restart Procedures.

## THE TAPE JOB CONTROL PROGRAM

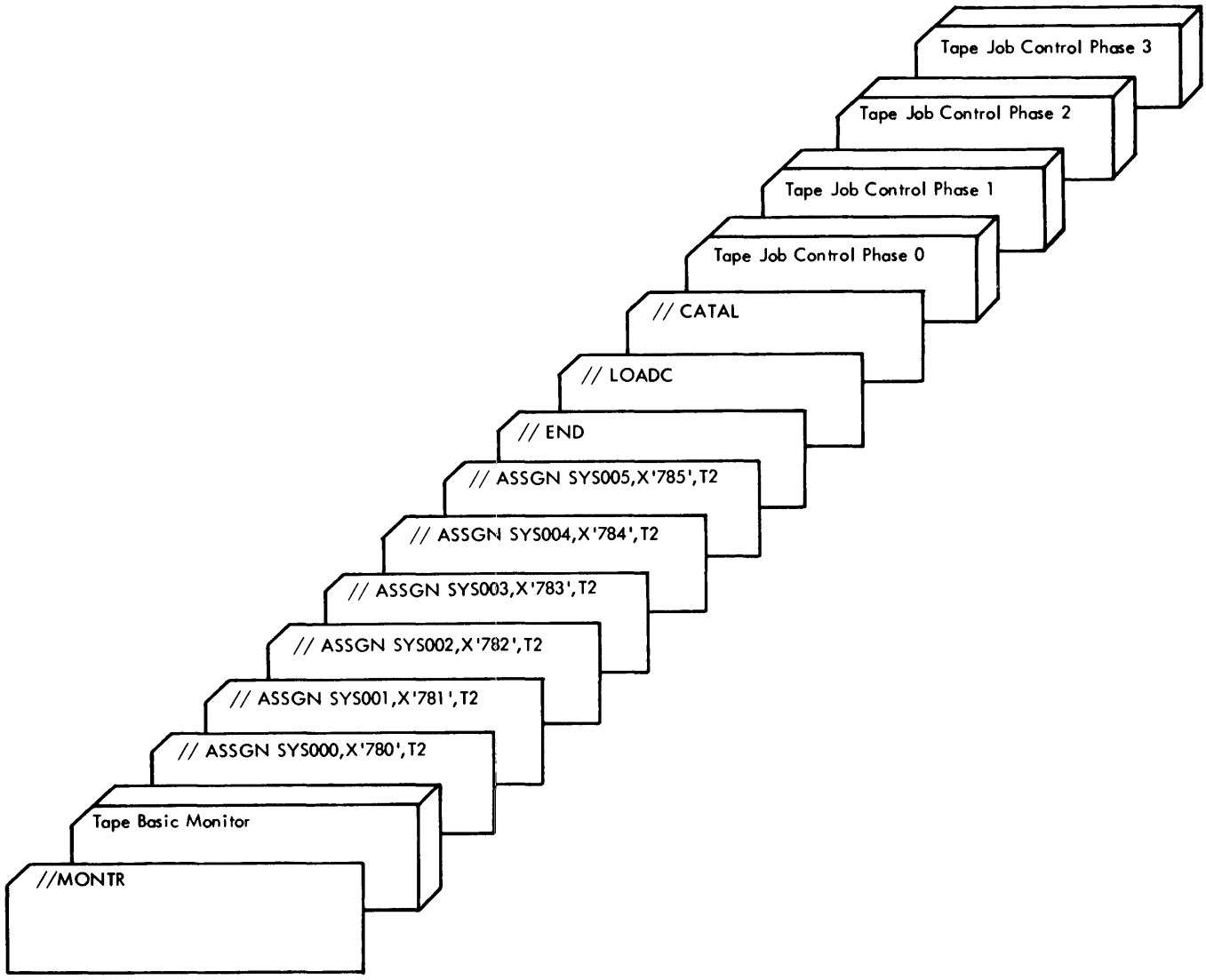
The Basic Monitor loads the Job Control program into storage both at system initiation time and before each program is loaded. The Job Control program processes the job control statements, which are read on the device assigned to SYSRDR. Job Control statements may be issued to the tape Job Control program for the following purposes:

- Indicating the beginning of a set of job control statements and specifying the name of the program to be executed next (JOB).
- Inserting the date into the communication region of the Basic Monitor program in main storage (DATE).
- Altering the storage-capacity specification contained in the communication region of the Basic Monitor in main storage (CONFG).
- Updating an I/O device assignment in the Basic Monitor in main storage (ASSGN).
- Positioning a reel of tape by skipping a specified number of tape marks, starting from the present position, or by rewinding to the load point (FILES).
- Specifying the name of a tape file to be processed and the symbolic address of the drive on which this file is mounted (VOL).
- Supplying tape label information (for later use) for the tape file to be processed (TPLAB).

- Setting user program switch indicators in the communication region of the Basic Monitor program (UPSI).
- Initiating tape error statistics (OPTN).
- Initiating the listing of control statements, and error statistics if requested (LOG).
- Suppressing the listing of control statements, and error statistics if requested (NOLOG).
- Suspending system operation (PAUSE).
- Informing the Job Control program that the entire set of control statements has been read and control is to be returned to the loading routine (EXEC).

The cards containing the job control statements are normally prepared by the programmer. In some cases, however, the operator may have to prepare and insert such cards (e.g., DATE or ASSGN cards) to insure proper system operation. The formats of all job control statements are given in Appendix A.

Normally, the first statement in a set of job control statements is the JOB state-




●Figure 5. The Tape-Resident Control Program Deck as Retrieved from the Distribution Tape if Output in Punched Cards is Specified

ment, and the last one is the EXEC statement. Only LOG, NOLOG, and PAUSE statements may precede a JOB statement. All other types of job control statements must appear between the JOB and EXEC statements as follows:

- The CONFG statement, if required, must precede the first TPLAB statement for a job.
- A TPLAB control statement must directly follow the associated VOL statement.
- If, in a set of job control statements, a FILES statement and an ASSGN statement refer to the same symbolic I/O address, the FILES statement must follow the ASSGN statement.
- All other job control statements may appear between the JOB and EXEC statements in any order.

The JOB statement and the EXEC statement are required in any set of job control statements. If it is intended to suspend system operation without terminating the system run, a PAUSE statement must be used. When the Job Control program encounters a PAUSE statement before it has read a JOB statement, it causes an immediate halt. In this case, the Job Control program expects a set of job control statements to be read as soon as system operation is resumed by pressing the Start key on the CPU console. When a PAUSE statement is encountered between a JOB and an EXEC statement, the Job Control program finishes reading the set of control statements issued and causes a system halt immediately before the loading of the program is to begin. In this case, the Basic Monitor expects to load the program associated with the set of job control statements as soon as system operation is resumed by pressing the Start key on the CPU console.

At system initiation time, a DATE control statement must be submitted to the Job Control program. If the storage capacity of the user's Model 20 system is other than 8K and a correct CONFG card has not been submitted to the Load System Tape program at the time the system tape was built, a CONFG card is also required. The use of any other job control statements depends on the requirements of the first job to be executed.

In the course of a system run, the Job Control program is loaded and executed whenever a program has reached the end-of-job. It reads the next set of job control statements from the device assigned to SYSRDR and sets up the system for the job to be executed next.

Execute-Loader Function

The loading routine loads the object program in card-image format from the device assigned to SYSIPT and causes its immediate execution. When a FETCH macro instruction is encountered in the program, the loading routine is re-entered and the next program phase is loaded from SYSIPT. When an EOJ macro instruction is encountered, control is returned to the loading routine of the Basic Monitor, which then loads the Job Control program, so that the system can be prepared for the next job.

Note: The operand LOADER in an EXEC statement is ignored if the preceding JOB statement contained the operands RPG,program-name.

The programmed-halt codes that may be displayed during the execution of the Job Control program as well as the appropriate restart procedures are described in the section Programmed-Halt Displays and Restart Procedures.

TAPE ERROR STATISTICS

Subject to the restrictions listed below, it is possible to determine the number of tape errors that occurred while the problem program was being executed.

Tape error statistics may be requested during Job Control time by means of the // OPTN control statement. If they are requested, the following information is collected for each physical unit used:

1. Successful requests - total number of successfully completed tape operations requested by the problem program.
2. Read errors - total number of read requests not successfully completed on the first attempt.
3. Unrecoverable read errors - total number of read requests not successfully completed after 100 attempts.
4. Noise records - records of less than 12 bytes in length.
5. Write errors - total number of write requests not successfully completed on the first attempt.
6. Erase gaps - repositioning and cleaning of the tape reel by the Basic Monitor program to correct write errors. An erase gap is initiated and counted every time a write error occurs.

To display tape and/or ESCA error statistics, the Job Control program must be reloaded after execution of the problem program.

Restrictions:

- The upper 280 bytes of main storage must be free. When submitting programs for

assembly, the user must ensure that this restriction is observed. The RPG program will free the upper 280 bytes for the generated object program if column 35 of the control card contains a 1-punch.

- Tape error statistics cannot be collected in IBM-supplied programs, except in the TPS Sort/Merge program and the TPS Utility programs TAPTAP, TAPPRT, TAPCAR and CARTAP.

## PREPARATION OF A TAPE-RESIDENT SYSTEM RUN

To initiate a run of the tape-resident system, the following steps must be taken by the operator (see also Figure 6):

1. Place into the hopper of the loading unit (2501 if attached; otherwise, 2520 Card Read-Punch or primary feed of 2560):

   a) the tape IPL deck up to and including the END card;

   b) the ASSGN card for SYSRES;

   c) an ASSGN card for SYSRDR (if required)

   d) the (corrected) REP cards (if the standard assignments have not been changed by means of the Load System Tape program);

   e) the end-of-file card (/* in cols. 1-2).

2. Mount the system tape on the drive assigned to SYSRES; press the Load-Rewind key and the Start key of the drive.

3. Place into the hopper of the device assigned to SYSRDR:

   a) the JCB card for the first job to be executed;

   b) a DATE card;

   c) a CONFG card (if the storage capacity is other than 8K and the specification in the Basic Monitor has not been corrected by means of the Load System Tape program);

   d) ASSGN cards for any 7-track tape drives or 9-track tape drives with compatibility feature that are to be assigned by the REP cards following the IPL deck;

   e) any job control cards required for the first job to be executed. (These job control cards must be terminated by an EXEC card).

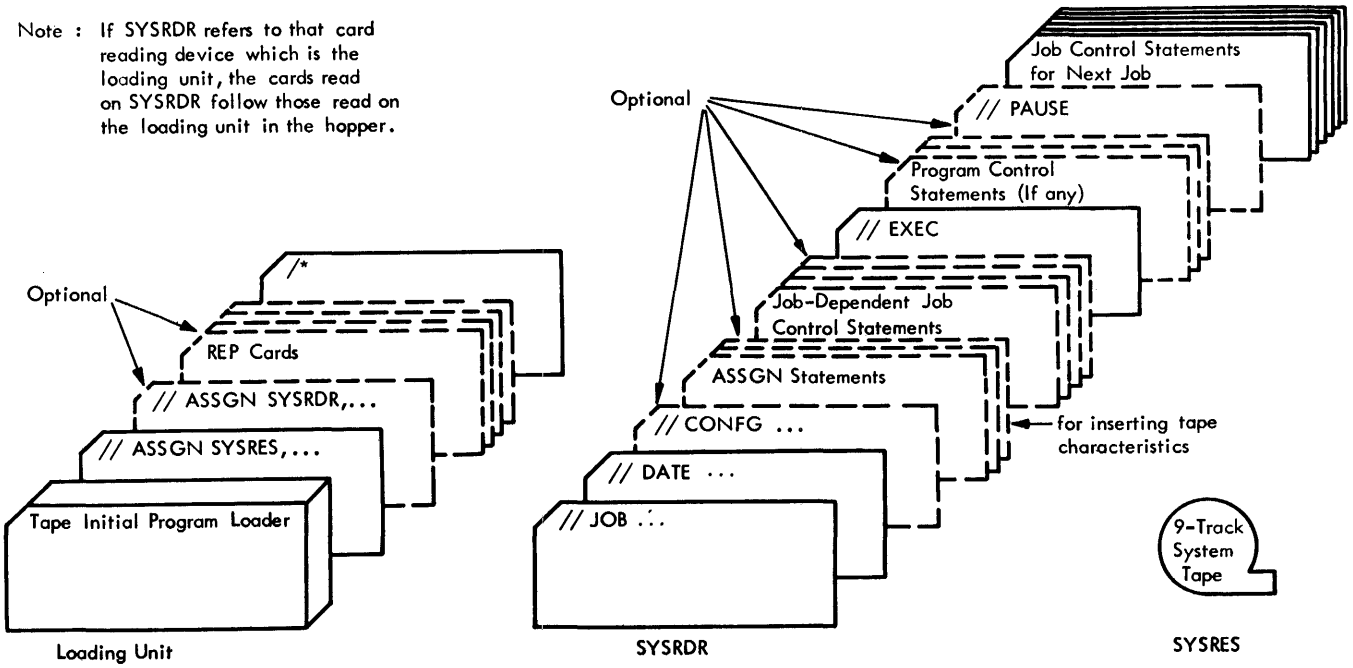



Figure 6. Arrangement of Input for a Tape-Resident System Run

4. Prepare the input/output devices required by the job to be executed. (Mount any required tapes and position them at load point, place any required card decks into the hoppers of the card devices used, install forms in the printer if it is to be used.)

5. Press the Start keys of all I/O devices used.

6. Set the Register-Data/Address switches on the CPU console to an even main-storage address between hexadecimal 009C and the end-of-storage address minus hexadecimal 0052.

7. Set the Mode switch on the CPU console to PROCESS.

8. Press the Load key on the CPU console.

Figure 6 shows the arrangement of input for a tape-resident system run.

## EXECUTING OBJECT PROGRAMS UNDER CONTROL OF THE TAPE-RESIDENT SYSTEM

Object programs can be executed under control of the tape-resident system if they are:

1. contained in the program library of the system tape, or

2. stored on tape in card-image format, or

3. contained in punched cards.

The methods to include user-written object programs in the program library of a system tape are described in the sections Building Additional System Tapes from IBM-Supplied and User-Written Programs and Updating the Program Library Section of a System Tape.

Executable object programs on tape (in card-image format) or in punched cards are obtained as tape output from one of the following programs:

1. The TPS Report Program Generator.

2. The TPS Assembler program (if object programs do not require linking and/or relocation).

3. The TPS Linkage Editor program (if linking and/or relocation of assembled object programs was required).

Before any object program can be executed, a tape-resident system run must be initiated. The appropriate procedure is described in the preceding section.

When the system run has been initiated, the operator must take the following steps to prepare the system for the execution of one or more object programs:

1. Place the set(s) of job control cards for the job(s) into the hopper of SYSRDR.

   Make sure that each set includes:

   a) a JOB statement with the name of the program or -- in case of a multi-phase program -- the name of the first program phase to be loaded,
   b) ASSGN statements for all symbolic I/O addresses used in the program (unless the assignments are already in effect through standard assignments or ASSGN statements issued for a previous job),
   c) an EXEC statement without an operand if the program is contained in the library, or with the operand LOADER if the program is either stored on tape in card-image format or contained in punched cards.

   Note: If the program is to be run in Overlap mode, the operand RWC must appear in the EXEC statement.

2. Prepare all I/O devices used by the program(s), i.e., mount and position any required tapes, place any required card decks into the appropriate hoppers, install forms in the printer if it is used.

3. If several jobs are to be run and preparation of I/O devices is required between jobs, place a PAUSE card in the set of job control cards for any job that requires preparation.

4. Press the Start keys of any required I/O devices that are not yet ready.

5. Press the Start key on the CPU console.

The halt codes that may be displayed owing to programmed halts in IBM-supplied programs, as well as the appropriate restart procedures, are described in the section Programmed-Halt Displays and Restart Procedures.

The codes and restart procedures for any user-programmed halts must be supplied by the programmer.

The output obtained from user-written object programs executed under control of the tape-resident system depends entirely on the types of output specified in these programs and, therefore, must be identified according to information supplied by the programmer.

## EXECUTING OBJECT PROGRAMS USING THE 1419/1259 IOCS UNDER CONTROL OF THE CARD-RESIDENT OR TAPE-RESIDENT SYSTEM

### 1419 System Preparation

When an object program uses the IBM 1419 Magnetic Character Reader, the following steps must be performed before the program is loaded:

1. Press the appropriate Validity-Check and Readout keys on the 1419.

   Note: Press only those keys which correspond to the fields specified in the program to be executed.

2. Press the Program-Sort key.

3. Place documents face-up, inscribed edge against the feed hopper guide, on the loading platform.

4. Set the batch numbering device (special feature) to its starting values.

5. Press the Start key of the 1419.

6. Set the Time-Sharing switch on the CPU to TIME-SHARING.

### 1419 Interruption

To interrupt the execution of a program, first press the Stop-Restore key of the 1419. When document feeding in the 1419 has stopped, press the Stop keys on the printer or the CPU.

To resume execution, first press the Start keys on the CPU and the printer, then the Start key of the 1419.

Unless the pocket light feature is used, the foot treadle may be pressed to temporarily stop the 1419 (e.g., to remove documents from a stacker).

### 1259 System Preparation

When an object program uses the IBM 1259 Magnetic Character Reader, the following steps must be performed before the program is loaded:

1. Press the appropriate Validity-Check and Readout keys on the 1259.

   Note: Press only those keys which correspond to the fields specified in the program to be executed.

2. Press the Reader-On-Line key.

3. Place documents to be processed on the loading platform, face-up, with the inscribed edge of the document towards the machine.

4. Press the Start key on the 1259.

5. Set the time-sharing switch on the CPU to TIME-SHARING.

### 1259 Interruption

Tc interrupt the execution of a program, first press the Stop key on the 1259 or the printer. When document feeding in the 1259 has stopped, press the Stop key on the CPU.

To resume execution, first press the Start keys on the CPU and the printer, then the Start key on the 1259.

The Stop key of the 1259 may be pressed tc stop the 1259 temporarily, e.g., to remove documents from a stacker.

### Halts and Error Displays

System-error halts which may occur because of malfunctions of the 1419 or 1259 are described under Programmed-Halt Displays and Restart Procedures.

Have you any comments or opinions about this manual that you would like to pass on? If so, why not fill in the reader's suggestion sheet and send it to us.....

## USING THE TPS REPORT PROGRAM GENERATOR

The TPS Report Program Generator (RPG) translates source programs written in the RPG language into executable object programs. If the RPG is to be used, it must be contained in the program library of the tape-resident system.

RPG source programs can be either compiled and executed in one job (compile-and-execute function) or compiled only. In the first case, the object program may, in addition to being executed immediately, be punched into cards or written onto tape before it is executed. In the latter case, the object program must be either punched into cards or written onto tape.

It is not possible to compile RPG programs with the read/compute, write/compute overlap feature of the Model 20. Therefore if the RPG source program is to be compiled only or compiled and executed in one job, this feature must not be specified in the RPG control card.

RPG object programs contained in punched cards can be:

1. executed under control of the card-resident system, or
2. used as card input to the Core-Image Maintenance (CMAINT) program, i.e., they can be included in the program library of the user's tape-resident system, or
3. executed under control of the tape-resident system by means of the execute-loader function, with SYSIPT assigned to a card reader.

RPG object programs stored on tape (in card-image format) can be:

1. executed under control of the tape-resident system by means of the execute-loader function, or
2. used as tape input to the CMAINT program; i.e., they can be included in the program library of the tape-resident system.

RPG object programs can also be included in the set of input phases (in cards or on tape) for the building of a tape-resident system. Refer to the appropriate sections of this publication for a description of the operating procedures.

### I/O DEVICE ASSIGNMENTS

The following symbolic I/O device addresses are used to prepare and perform an RPG compilation under control of the tape-resident system:

SYSRES -- Required. Assigned at IPL time. Refers to the 9-track tape drive on which the system tape is mounted.

SYSRDR -- Required. Refers to the card reading device used for reading the job control statements.

SYSIPT -- Required. Refers to the card reading device used for reading
a) the RPG control card,
b) the RPG source program.

SYSLOG -- Optional. Refers to the printer on which job control statements are listed.

SYSLST -- Optional. Refers to the printer on which an RPG listing is produced.

SYSOPT -- Optional if the compile-and-execute function is used. Required if a source program is to be compiled only. Refers to the card punching device or tape drive on which the object program is produced in punched cards or in card-image format, respectively.

SYS000 -- Required. Refers to the tape drive on which a compilation work tape is mounted.

SYS001 -- Optional. Refers to the tape drive on which a second compilation work tape is mounted.

Note 1: SYSOPT may refer to a tape drive only if two work tapes (on SYS000 and SYS001) are used.

Note 2: SYSRDR and SYSIPT may be assigned the same card reading device. SYSOPT and SYS000 may be assigned the same tape drive. The tape on SYSOPT is not rewound after an RPG compilation. Therefore, several object programs can be written on one tape.

However, the tape on SYS000 is rewound, so that only one object program can be written on the output tape if SYSOPT and SYS000 refer to the same tape drive.

CONTROL STATEMENTS

Job Control Statements

The following control statements must be issued to the Job Control program to set up the system for the execution of the Report Program Generator:

| | |
|---|---|
| // JOB RPG | Required if the source program is to be compiled only. |
| or | |
| // JOB RPG,program-name | Required if the compile-and-execute function is to be used (not to be used for programs in which RWC is specified). |
| // ASSGN | Required for any symbolic address whose device assignment in core storage is to be changed. |
| // EXEC | Required. |

If the compile-and-execute function is used, any job control statements required for the execution of the object program (e.g., ASSGN, FILES, VOL, or TPLAB statements ) must be submitted together with the job control statements required for compilation.

Note: The OPTN control statement must not be included in the job control statements for the TPS Report Program Generator.

RPG Control Card

The deck of input cards to the TPS Report Program Generator must be preceded by an RPG control card. This control card must be prepared by the programmer or operator according to the functions required of the RPG compiler. The RPG control card is read from the device assigned to SYSIPT.

The format of the RPG control card is as follows:

| Cols. | Contents | Meaning |
|---|---|---|
| 1-5 | any EBCDIC characters incl.blanks | Insignificant (may be used for sequence numbering, etc.). |
| 6 | H | Identifies the card as an RPG control card. |
| 7-9 | any EBCDIC characters incl.blanks | Insignificant. |
| 10 | P,C,or M | Object program is to be punched or written on SYSOPT. (It does not make any difference which of the three letters is used.) |
| | blank | Object program is not to be punched into cards or written on tape. |
| 11 | any EBCDIC character incl.blank | Insignificant. |
| 12-14 | blanks or 008 | Object program is to be executed on a Model 20 with a storage capacity of 8K. |
| | 012 | Object program is to be executed on a Model 20 with a storage capacity of 12K. |
| | 016 | Object program is to be executed on a Model 20 with a storage capacity of 16K. |
| | 024 | Object program is to be executed on a Model 20 Submodel 5 with a storage capacity of 24K. |
| | 032 | Object program is to be executed on a Model 20 Submodel 5 with a storage capacity of 32K. |
| 15 | blank | This column must be left blank. |
| 16 | I | If input-file and output-file cards are to be selected to a common stacker on the 2560, input cards are to be stacked first. |
| | O | If input-file and output-file cards are to be selected to a common stacker on the 2560, output cards are to be stacked first. |
| | blank | No common stacker, or stacking sequence insignificant. |
| 17 | 1 | The shillings portion of a sterling-currency input field is in the IBM format. |
| | 2 | The shillings portion of a sterling-currency input field is in the |

| | | |
|---|---|---|
| | | BSI format. |
| | blank | The input does not contain sterling-currency fields. |
| 18 | 1 | The pence portion of a sterling-currency input field is in the IBM format. |
| | 2 | The pence portion of a sterling-currency input field is in the BSI format. |
| | blank | The input does not contain sterling-currency fields. |
| 19 | 0 | The shillings portion of a sterling-currency output field is in the printer format. |
| | 1 | The shillings portion of a sterling-currency output field is in the IBM format. |
| | 2 | The shillings portion of a sterling-currency output field is in the BSI format. |
| | blank | The output does not contain sterling-currency fields. |
| 20 | 0 | The pence portion of a sterling-currency output field is in the printer format. |
| | 1 | The pence portion of a sterling-currency output field is in the IBM format. |
| | 2 | The pence portion of a sterling-currency output field is in the BSI format. |
| | blank | The output does not contain sterling-currency fields. |
| 21 | I | The Inverted-Print option is chosen (i.e., commas are used instead of decimal points). |
| | blank | The Inverted-Print feature is not to be used. |
| 22 | B | An additional input area for the 2501 is to be reserved in main storage. This may alternatively or additionally be specified in column 32 of the File Description specification. |
| | blank | An additional input area is not required. |
| 23-25 | 100 or blanks | 100 print positions are required during object program execution. |
| | 120 | 120 print positions are required during object program execution. |
| | 132 | 132 print positions are required during object program execution. |
| | 144 | 144 print positions are required during object program execution. |
| | | Note: The entries in these columns are used only if the file-description cards for the printer file do not contain block-length and record-length specifications. |
| 26 | T | User's translation table is to be read during compilation to translate, during the object run, alphameric fields for the purpose of altering the collating sequence. |
| | blank | Translation table is not to be read. |
| 27-30 | xxxx | Begin address of object program, in decimal notation (must be higher than 1663). If the read/compute, write/compute overlap feature is used (execution on a Submodel 5; W in col. 38 of the TPS RPG control card), the address must be 2100 or higher. |
| | blank | RPG assumes object program to begin at (decimal) address 1664 if the read/compute, write/compute overlap feature is not used, or at 2100 if the feature is used (execution on a Submodel 5 only; W in col. 38 of the TPS RPG control card). |
| 31 | 1 or blank | RPG is to use one work tape (SYS000) for compilation. |
| | 2 | RPG is to use two work tapes (SYS000 and SYS001) for compilation. |
| 32 | 1 | The OPEN routine of the object program may be overlaid with I/O areas. |
| | blank | The OPEN routine must |

| | | |
|---|---|---|
| | | not be overlaid with I/O areas.<br><br>Note: Column 32 must be left blank if:<br>a) the compile-and-execute function is used;<br>b) multi-reel files are to be processed by the object program;<br>c) the user's program contains subroutines for standard user-label processing. |
| 33 | 0 | Overlapped operation of upper and lower printer feeds (to increase execution speed). |
| | blank | Upper and lower printer-feed operation need not be overlapped (saves main storage). |
| 34 | B | Special look-up routine for sequential tables. |
| | any other EBCDIC character incl. blank | Insignificant. |
| 35 | 1 | During object time, tape error statistics will be requested by means of a // OPTN card.<br><br>Note: When the operand of the JOB control statement consists of RPG, program-name (compile-and-execute function), no tape error statistics can be requested. |
| | 0 or blank | During object time, no tape error statistics will be requested by means of a // OPTN card. |
| 36-37 | any EBCDIC characters incl.blanks | Insignificant. |
| 38 | W | The object program is to make use of the read/compute, write/compute overlap feature of the Submodel 5. |
| | blank | The object program is not to make use of the feature. |
| 39 | any EBCDIC character incl. blank | Insignificant. |
| 40 | N | No sign test will be performed on numeric fields of tape input files. |
| | blank | Sign test is performed on all numeric input fields. |
| 41-74 | any EBCDIC characters incl. blanks | Insignificant. |
| 75-80 | xxxxxx | These columns must contain the name (six characters) of the user's program. The first four characters of this name are punched or written, during compilation, into columns 73-76 of the object program records. All six characters appear in the PHASE statement of the object program and are used as the phase name if the program is included in the program library of the tape-resident system. |
| | blanks | If the columns are left blank, the program name is assumed to be RPGOBJ. |

## USER SUBROUTINES

The user's assembled subroutines for extending the calculating routines provided by the RPG or for processing standard user labels may be inserted in the RPG source deck.

The location of user subroutines and translation table in the RPG source deck is shown in Figure 7.

## PREPARATION OF THE SYSTEM

The operator must take the following steps to compile (or compile and execute in one job) programs written in the RPG language.

1. If the tape Basic Monitor is not yet in main storage, initiate the system run as described in the section Initiating a Tape-Resident System Run.
2. Place the cards containing the set of job control statements (including the job control statements required by the object program if the compile-and-execute function is used) into the hopper of SYSRDR.

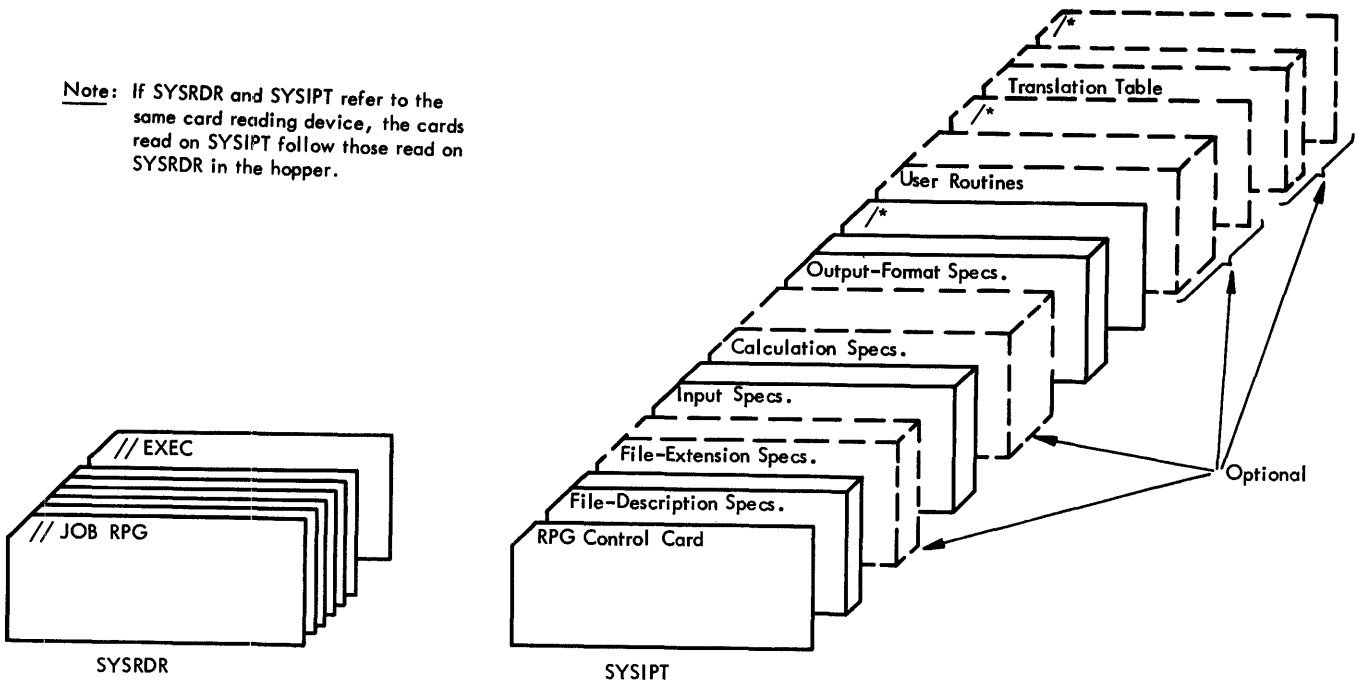



Figure 7. Arrangement of Input for an RPG Compilation

3. Place into the hopper of SYSIPT:
   a) the RPG control card;
   b) the source deck (RPG specifications cards), consisting of:
      - the file-description specifications cards, identified by an F in column 6 (one card for each file; at least one card is required);
      - the file-extension specifications cards, identified by an E in column 6 (optional; required if table files specified);
      - the input specifications cards, identified by an I in column 6 (specifications cards for alphabetic-sequence records must precede those for numeric-sequence records within each file);
      - the calculation specifications cards, identified by a C in column 6 (optional; if used, cards specifying detail calculations must precede those specifying total calculations);
      - the output-format specifications cards, identified by an O in column 6 (required; all heading specifications cards, followed by all detail specifications cards, followed by all total specifications cards for all files);
   c) an end-of-file card (/* in cols. 1-2, remaining cols. blank);
   d) the user's assembled subroutines (if any);
   e) an end-of-file card (if user subroutines are present);
   f) the translation table (if required) consisting of four cards identified by an S in column 6;
   g) an end-of-file card (if a translation table is present).

   Note: If SYSRDR and SYSIPT refer to the same card-reading device, the deck that is to be read from SYSIPT must immediately follow the EXEC card.

4. If the printer is assigned to SYSLST and/or SYSLOG, press the Reset key and the Start key of the printer.

5. Mount a work tape on the tape drive assigned to SYS000 and press the Load-Rewind key and the Start key of the drive.

6. If the use of a second work tape has been specified, mount a second work tape on the tape drive assigned to SYS-001 and press the Load-Rewind key and the Start key of the drive.

7. If the RPG object program is to be punched into cards, place blank cards into the hopper of the punching device assigned to SYSOPT.

8. If the RPG object program is to be written onto a tape, mount an appropri-

ate tape reel on the tape drive assigned to SYSOPT and press the Load-Rewind key and the Start key of the drive. (Note that the work tape on SYS000 may be used as output tape.)

9. Press the Start keys of any required I/O devices that are not yet ready.

10. Press the Start key on the CPU console.

Figure 7 shows the arrangement of input for an RPG compilation.

If the compile-and-execute function is used, a halt occurs and the halt code 1D01 is displayed in the E-S-T-R fields on the CPU console when the compilation of the RPG source program has been completed. The I/O devices required for execution of the compiled program must now be prepared and started. The tape drive(s) used for the work tape(s) during compilation may now be used for data files. If the object program requires card input, tables (if any) must precede card data files when both are read from the same device. Note that card data files must be terminated by an end-of-file card. However, an end-of-file card must not be placed behind a card table file. To initiate execution, press the Start key on the CPU console.

If the compilation is not to be followed by an execution, a halt does not occur and the next job is executed.

## PROGRAMMED HALTS

A number of programmed halts may occur during the compilation and execution of programs written in the RPG language. The halt-code displays and the associated restart procedures are described in the section Programmed-Halt Displays and Restart Procedures.

Several other halts can occur during the execution of RPG object programs. These halts occur when an arithmetic operation is performed on an invalid packed-decimal operand. They are identified by an operation code displayed in the U-L fields on the CPU console. The following codes may be displayed: DE, F8, F9, FA, FB, FC, or FD.

When one of these halts occurs, the job must be discontinued. The following steps must be taken to discontinue the job:

1. Prepare the I/O devices for the next job.

2. Set Data Switch 1 to position 3 to select the register to be altered.

3. Set the four Register-Data/Address switches to 00C2 (data to be entered into the selected register).

4. Set the Mode switch to ALTER REG.

5. Press the Start key on the CPU console.

6. The data entered into the register are displayed in the E-S-T-R registers. The number of the selected register is displayed as a four-bit binary number in the P register.

7. Set the Mode switch to PROCESS.

8. Press the Start key on the CPU console.

## MESSAGES

During the compilation of a program written in the RPG language, the RPG compiler causes a number of messages to be listed on the printer (SYSLST). Heading, diagnostic, and information messages may be printed. For a list of these messages and their meaning, refer to the SRL publication IBM System/360 Model 20, Disk and Tape Programming Systems, Report Program Generator, Form C24-9001.

## DESCRIPTION OF OUTPUT

The output obtained from an RPG compilation consists of:

- a program listing and printed messages if the printer has been assigned to SYSLST;
- the object program contained in punched cards if a card punching device has been assigned to SYSOPT;
- the object program deck on tape in card-image format if a tape drive has been assigned to SYSOPT.

If the compile-and-execute function is used, the output of the user's problem program is obtained in addition to the output of the compilation as described above (if the latter has been requested).

## USING THE TPS ASSEMBLER PROGRAM

The TPS Assembler program translates source programs written in the Assembler language into object programs. If the TPS Assembler program is to be used, it must be contained in the program library of the user's tape-resident system.

A number of Input/Output and Basic Monitor macro definitions are supplied by IBM. These macro definitions must be contained in the macro library of the user's tape-resident system if the corresponding macro instructions are used in source programs to be processed by the Assembler.

The source program to be assembled must be contained in punched cards. The object program produced by the Assembler can be either punched into cards or written onto tape. The object program may be executed immediately and/or included in the program library of a tape-resident system. However, if it requires linking and/or relocation, it must be processed by the Linkage Editor program before it can be executed and/or included in the program library. (See the appropriate sections of this publication).

The Assembler program produces a listing of the assembled program on the printer assigned to SYSLST. If this listing is not desired, or if only the listing but no object program is desired, the appropriate control statements must be used. (Refer to the subsequent section Control Statements.)

## I/O DEVICE ASSIGNMENTS

The following symbolic device addresses are used in preparing and performing the execution of the TPS Assembler program:

SYSRES -- Required. Assigned at IPL time.
Refers to the 9-track tape drive on which the system tape is mounted.

SYSRDR -- Required.
Refers to the card reading device on which the job control statements are read.

SYSIPT -- Required.
Refers to the card reading device on which the program control statements (if any), the Assembler source program cards, and an end-of-file card are read.

SYS000 -- Required.
Refers to the tape drive on which work tape 1 is mounted.

SYS001 -- Required.
Refers to the tape drive on which work tape 2 is mounted.

SYS002 -- Required if literals are to be processed.
Refers to the tape drive on which the literal tape is mounted.

SYSOPT -- Required if an object program is to be produced in cards or on tape.
Refers to the card punching device or tape drive on which the object program is to be produced.

SYSLST -- Required.
Refers to the printer on which the program listing and other information may be printed.

SYSLOG -- Optional.
Refers to the printer on which job control statements are listed.

Note: SYSRDR and SYSIPT may be assigned the same card reading device. SYSOPT and SYS002 may be assigned the same tape drive.

## CONTROL STATEMENTS

### Job Control Statements

The following job control statements are used to set up the system for the execution of the Assembler program.

| | |
|---|---|
| // JOB ASSEMB | Required. |
| // ASSGN | Required for any symbolic address whose device assignment in core storage is to be changed. |
| // EXEC | Required. |

Any other job control statements need be issued only if the corresponding functions are to be requested.

Note: The CPTN control statement must not be included in the job control statements for the TPS Assembler program.

### Program Control Statements

For the execution of the TPS Assembler program, program control statements are not required. However, the user has the option to request a certain function, or the suppression of a function of the Assembler, by means of an AOPTN control statement.

The name field of the AOPTN statement must be left blank.

The operation field contains the operation code AOPTN.

The operand field contains one or more of the following operands:

| Operand | Function Requested |
|---|---|
| ENTRY | An ENTRY statement is to be produced as the last record of the object program. (An ENTRY statement is required for the object program that is to be the last input program to the Linkage Editor.) |
| LITERAL | Literals are to be processed. (If this statement is not used, literals cannot be processed by the Assembler.) |
| NODECK | The object program is not to be punched into cards or written onto tape. |
| NOERR | The error listing is not to appear in the printed output. (The number of flagged statements is printed.) |
| NOESD | ESD (External Symbol Dictionary) records are not to be included in the object program and the printed output. (The object program cannot be processed by the Linkage Editor.) |
| NOLIST | A program listing is not to be produced. (The number of flagged statements is printed.) |
| NORLD | RLD (Relocation Dictionary) records are not to be included in the object program and the printed output. (The object program cannot be relocated.) |
| NOSYM | A symbol table is not to appear in the printed output. |

If, for one assembly, the user wishes to request several functions, he may do this by issuing

1. one AOPTN statement with several operands, or

2. several AOPTN statements with one or several operand(s) each.

If an AOPTN statement contains more than one operand, the operands must be separated from each other by a comma. An AOPTN statement must be completely contained in one card. Continuation cards are not permitted. If both NODECK and NOLIST are requested for an assembly, an error halt occurs.

Note: AOPTN statements are read on SYSIPT. They must precede the source statements.

PREPARATION OF THE SYSTEM

The following steps must be taken to prepare the system for the execution of the TPS Assembler program:

1. If the TPS Basic Monitor is not yet in main storage, initiate the system run as described in the section Initiating a Tape-Resident System Run.

2. Place the cards containing job control statements into the hopper of SYSRDR.

3. Place into the hopper of SYSIPT:
   a) the cards containing the AOPTN statements (if any),
   b) the source-program deck, concluded by an END card,
   c) an end-of-file card (/* in cols. 1-2).

   Note: If SYSRDR and SYSIPT have been assigned the same card reading device, the deck read on SYSIPT must be placed behind the job control-card deck in the hopper of the device.

4. Mount work tape 1 on the drive assigned to SYS000 and press the Load-Rewind key and the Start key of the drive.

5. Mount work tape 2 on the drive assigned to SYS001 and press the Load-Rewind key and the Start key of the drive.

6. If literals are to be processed (i.e., if an AOPTN LITERAL statement is present), mount a third work tape on the drive assigned to SYS002 and press the Load-Rewind key and the Start key of the drive.

7. If a card punching device has been assigned to SYSOPT, place blank cards into the hopper of the device.

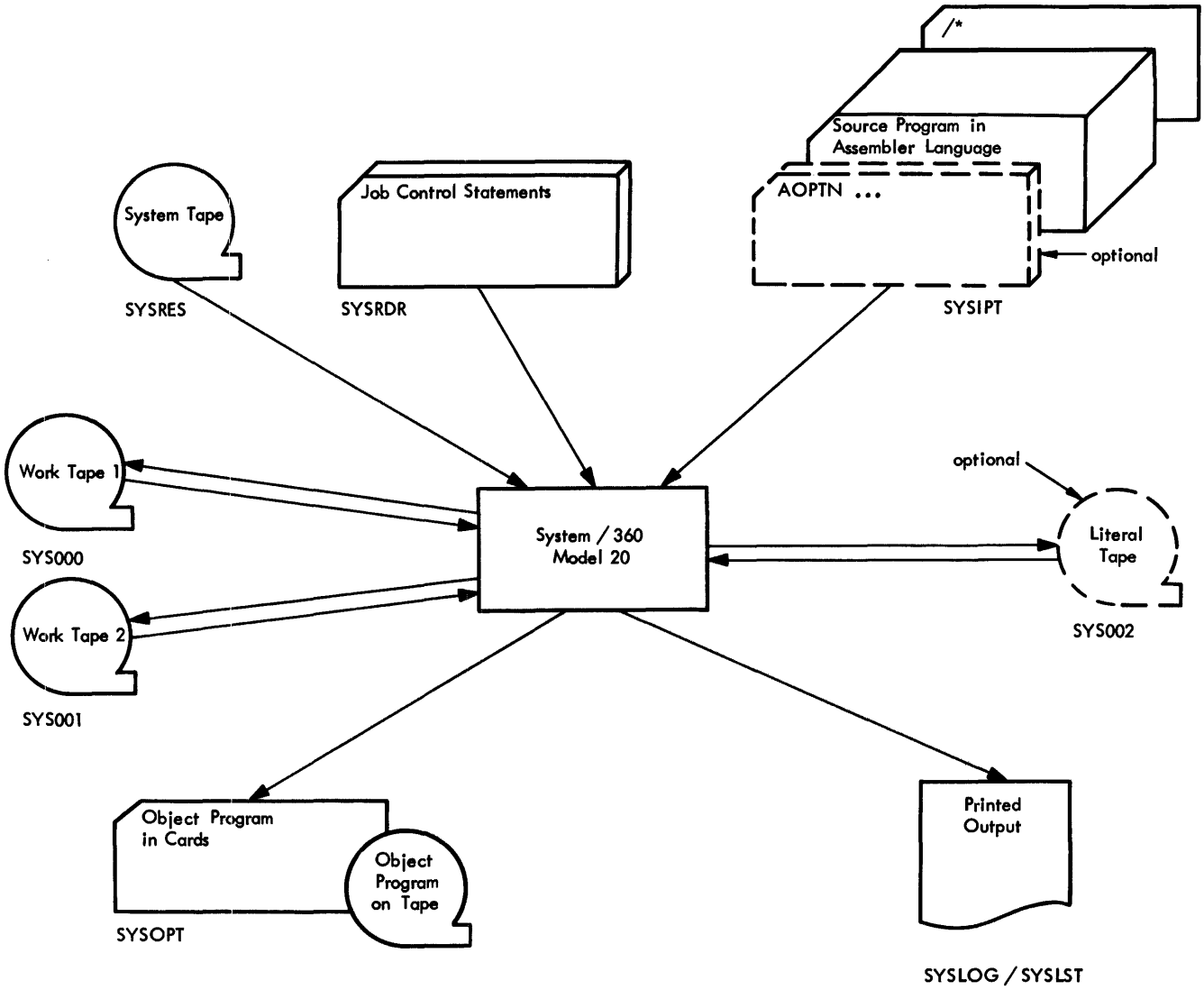
8. If a tape drive has been assigned to SYSOPT, mount an appropriate tape on the drive and press the Load-Rewind key and the Start key of the drive. (Note that the literal tape, if any, may be used as output tape.)

9. Install appropriate forms in the printer and press the Reset key and the Start key of the device.

10. Press the Start keys of all required I/O devices that are not yet ready.

11. Press the Start key on the CPU console.

Figure 8 shows the arrangement of input to, and output from, the TPS Assembler program.




Note : SYSRDR and SYSIPT may be assigned the same card reading device. In that case, the cards read on SYSIPT follow those read on SYSRDR in the hopper. SYSOPT and SYS002 may be assigned the same tape drive.

Figure 8. Arrangement of Input and Output of the Assembler Program

## PROGRAMMED HALTS

A number of programmed halts may occur during the loading and execution of the TPS Assembler program. The halt-code displays and the associated restart procedures are described in the section Programmed-Halt Displays and Restart Procedures.

## MESSAGES

The TPS Assembler causes a number of diagnostic and information messages to be listed on the printer assigned to SYSLST. For a list of these messages and their meaning, refer to the SRL publication IBM System/360 Model 20, Disk and Tape Programming Systems, Assembler Language, Form C24-9002.

## OPERATOR INTERVENTION

During macro generation, it is possible that the Assembler program enters a loop. To terminate the looping and continue processing, the operator must:

- press the Stop key on the CPU console,
- enter FF into location 00CE,
- press the Start key on the CPU console.

The macro generation during which the loop was entered is terminated, and the

message GENERATION TERMINATED BY OPERATOR'S INTERVENTION is printed. The assembly is continued.

DESCRIPTION OF OUTPUT

The output from the TPS Assembler program consists of:

- the object program contained in punched cards or on tape in card-image format, and/or
- printed output.

Object Program

The object program is obtained on the device assigned to SYSOPT unless an AOPTN statement with the operand NODECK was used.

The object program consists of:

1. reproduced records (resulting from REPRO instructions issued before the START statement);
2. ESD records for any External Symbol Dictionary items (except when NOESD was specified);
3. problem program records (TXT and XFR records, RLD records for any relocatable constants unless NORLD was specified, and reproduced records resulting from REPRO instructions issued after the START statement);
4. END statement;
5. ENTRY statement if ENTRY was specified.

Printed Output

Printed output is obtained on the printer (SYSLST), except when NOLIST was specified.

The output consists of:

1. the External Symbol Dictionary (unless NOESD was specified);
2. the listing of source and object statements;
3. the Relocation Dictionary (unless NORLD was specified);
4. the error listing (unless NOERR was specified);
5. one or more symbol tables (unless NOSYM was specified).

## USING THE TPS LINKAGE EDITOR PROGRAM

The TPS Linkage Editor program relocates assembled programs and/or combines separately assembled program sections into an integral program that can be executed under control of the card-resident or tape-resident system. The required linkages and relocations are performed on the basis of the ESD and RLD information produced by the Assembler program. If the Linkage Editor program is to be used, it must be contained in the program library of the user's tape-resident system.

The input to the Linkage Editor program can be contained in punched cards or stored on tape in card-image format. The output from the Linkage Editor program can be punched into cards or written onto tape in card-image format.

### I/O DEVICE ASSIGNMENTS

The following symbolic device addresses are used in preparing and performing the execution of the Linkage Editor program:

SYSRES -- Required. Assigned at IPL time. Refers to the 9-track tape drive on which the system tape is mounted.

SYSRDR -- Required. Refers to the card reading device on which job control statements are read.

SYSIPT -- Required. Refers to the card reading device or tape drive on which the input control section(s) is (are) read.

SYSOPT -- Required. Refers to the card punching device or tape drive on which the output phase(s) is (are) produced

SYS000 -- Required. Refers to the tape drive on which work tape 1 is mounted.

SYS001 -- Required. Refers to the tape drive on which work tape 2 is mounted.

SYSLST -- Optional. Refers to the printer on which output information and messages are listed.

SYSLOG -- Optional. Refers to the printer on which job control statements may be listed.

Note: SYSRDR and SYSIPT may be assigned the same card reading device.

### JOB CONTROL STATEMENTS

The following job control statements are used to set up the system for the execution of the Linkage Editor program:

| | |
|---|---|
| // JOB LNKEDT | Required. |
| // ASSGN | Required for any symbolic address whose device assignment in main storage is to be changed. |
| // EXEC | Required. |

Any other job control statements need be issued only if the corresponding functions are to be requested.

Note: The OPTN control statement must not be included in the job control statements for the TPS Linkage Editor program.

### ADDITIONAL INPUT STATEMENTS

The Linkage Editor program uses the following additional input statements:

| | |
|---|---|
| PHASE | Required. Used to indicate to the Linkage Editor program that a new phase is to begin. One or more PHASE statements may be present in the input. The first input record must be a PHASE statement. |
| ACTION | Optional. Used to indicate to the Linkage Editor program that any following XFR and END cards are to be duplicated (operand: DUP) or that the duplication of XFR and END cards is to be discontinued (operand: NODUP). |
| ENTRY | Required. Must be the last input record read on SYSIPT. |

The formats of the Linkage Editor input statements are described in detail in the SRL publication IBM System/360 Model 20, Tape Programming System, Control and Service Programs, Form C24-9000.

The PHASE and ENTRY statements may be produced by the Assembler program as a result of Assembler REPRO instructions and an AOPTN ENTRY statement, respectively. If they have not been produced, they must be prepared manually and included in the input read on SYSIPT.

The ACTION statement(s), if used, must be included where required in the input read on SYSIPT.

## PREPARATION OF THE SYSTEM

The following steps must be taken to prepare the system for the execution of the Linkage Editor program:

1. If the TPS Basic Monitor program is not yet in main storage, follow the procedure described in the section Initiating a Tape-Resident System Run.

2. Place the cards containing the job control statements into the hopper of the device assigned to SYSRDR. Press the Start key of the device.

3. If SYSIPT has been assigned a card reading device, place the input deck, headed by a PHASE card and concluded by an ENTRY card, into the hopper of the device. Press the Start key of the device.

   Note: If SYSIPT has been assigned the same device as SYSRDR, the deck read on SYSIPT must follow the last job control card in the hopper of SYSRDR.

4. If SYSIPT has been assigned a tape drive and the input tape is not mounted and positioned from a previous job, mount the input tape on the drive and press the Load-Rewind key and the Start key of the device.

5. Mount work tapes on the tape drives assigned to SYS000 and SYS001. Press the Load-Rewind keys and the Start keys of the devices.

6. If SYSOPT has been assigned a card punching device, place blank cards into the hopper and press the Start key of the device.

7. If SYSOPT has been assigned a tape drive, mount an appropriate output tape on the drive, and press the Load-Rewind key and the Start key of the device.

8. If the printer is to be used as SYSLOG and/or SYSLST, install appropriate forms, and press the Reset key and the Start key of the device.

9. Press the Start key on the CPU console.

Figure 9 shows the arrangement of input to and output from the Linkage Editor program.

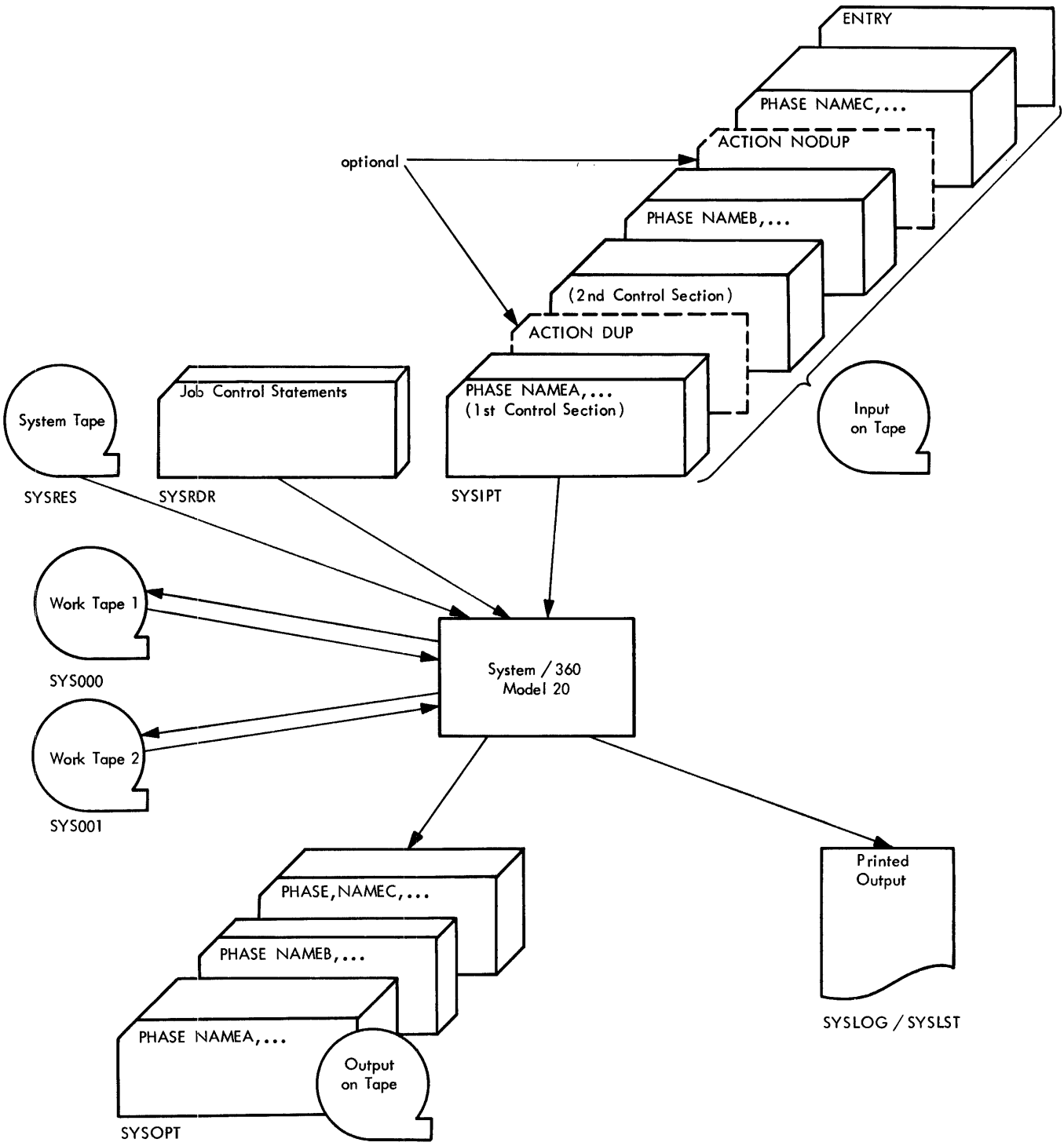
## PROGRAMMED HALTS

A number of programmed halts may occur during the loading and execution of the Linkage Editor program. The halt-code displays and the associated restart procedures are described in the section Programmed-Halt Displays and Restart Procedures.

## DESCRIPTION OF OUTPUT

The output obtained from the Linkage Editor program consists of one or more linked and/or relocated program phases contained in punched cards or stored on tape in card-image format.

If the printer was assigned to SYSLST, a printout of information concerning the output phases is also obtained.




Note : SYSRDR and SYSIPT may be assigned the same card reading device. In that case, the cards read on SYSIPT follow those read on SYSRDR in the hopper.

Figure 9. Arrangement of Input and Output of the Linkage Editor Program

## USING THE TPS SORT/MERGE PROGRAM

The TPS Sort/Merge program contained in card-image format on the tape supplied by IBM can be executed under control of either the card-resident or the tape-resident system. If it is to be executed under control of the card-resident system, it must be contained in punched cards. If it is to be executed under control of the tape-resident system, it must be included in the program library on the user's system tape.

The TPS Sort/Merge program consists of the following parts:

```
Assignment       -- phases 0-7
Internal Sorting -- phases 8-9
External Sorting -- phases 10-11
Merging          -- phases 12-13
```

Three types of job can be performed by means of the TPS Sort/Merge program:

1. A single input tape file can be sorted and written onto tape in a specified order.

2. Two to five sorted input tape files can be merged and written onto tape as one sorted file.

3. A single sorted tape file can be sequence-checked and/or reblocked while being copied.

## I/O DEVICE ASSIGNMENTS

The following symbolic I/O addresses are used in preparing and performing the execution of the TPS Sort/Merge program:

### 1. For Sort and Merge Runs:

SYSRES -- Required only for execution under control of the tape-resident system. Assigned at IPL time. Refers to the 9-track tape drive on which the user's system tape is mounted.

SYSRDR -- Required.
Refers to the card reading device used for reading the following:
(1) Execution under control of the card-resident system -- the Job Control program, the job control statements, the Sort/Merge program (including user routines, if present), and the Sort/Merge control statements.
(2) Execution under control of the tape-resident system -- the job control statements, the Sort/Merge control statements, and user routines, if present.

SYSLOG -- Required.
Refers to the printer on which control statements and diagnostic messages are to be listed.

### 2. For Sort Runs:

SYS000 -- Required.
Refers to the tape drive on which the primary output tape is mounted.

SYS001 -- Optional.
Refers to the tape drive on which an alternate output tape is mounted. (See the section Special Considerations for Multi-Volume Input and Output Files.)

SYS002 -- Required.
Refers to the tape drive on which the primary input tape is mounted.

SYS003 -- Optional.
Refers to the tape drive on which an alternate input tape is mounted. (See the section Special Considerations for Multi-Volume Input and Output Files.)

SYS004 -- Required.
Refers to the tape drive on which work tape 1 is mounted.

SYS005 -- Required.
Refers to the tape drive on which work tape 2 is mounted.

SYS006 -- Required.
Refers to the tape drive on which work tape 3 is mounted.

SYS007 -- Optional.
Refers to the tape drive on which work tape 4 is mounted.

SYS008 -- Optional.
Refers to the tape drive on which work tape 5 is mounted.

SYS009 -- Optional.
Refers to the tape drive on which work tape 6 is mounted.

Note: The following symbolic device addresses may be assigned the same tape drive:

```
SYS000 and SYS002,
SYS000 and SYS003,
SYS000 and SYS004,
SYS001 and SYS002,
SYS001 and SYS003,
SYS001 and SYS004,
SYS002 and the symbolic address for the
       last work tape,
```

SYS003 and the symbolic address for the last work tape.

If SYS002 or SYS003 refers to the same drive as the symbolic address for the last work tape, a halt occurs and the code 1C41 is displayed before any data is written on the input tape. This enables the user to save his input data and mount another tape on the drive.

In a tape-resident system run, the drive assigned to SYSRES must not be assigned to any other symbolic device address.

3. For Merge Runs:

SYS000 -- Required.
Refers to the tape drive on which the primary output tape is mounted.

SYS001 -- Optional.
Refers to the tape drive on which an alternate output tape is mounted. (See the section Special Considerations for Multi-Volume Input and Output Files.)

SYS002 -- Required.
Refers to the tape drive on which input tape 1 is mounted.

SYS003 -- Required except for sequence checking and/or reblocking only.
Refers to the tape drive on which input tape 2 is mounted.

SYS004 -- Optional. Refers to the tape drive on which input tape 3 is mounted.

SYS005 -- Optional. Refers to the tape drive on which input tape 4 is mounted.

SYS006 -- Optional. Refers to the tape drive on which input tape 5 is mounted.

## CONTROL STATEMENTS

### Job Control Statements

If the Sort/Merge program is to be executed under control of the card-resident system, job control statements need be issued only if functions of the Job Control program are required.

Whenever execution is to be controlled by the tape-resident system, job control statements must be issued.

The following job control statements are used in conjunction with the TPS Sort/Merge program:

| | |
|---|---|
| // JOB SORT | Required. |
| // ASSGN | Required for any symbolic address whose device assignment in main storage is to be changed. |
| // VOL | Required for each tape file on which standard label checking is to be performed. |
| // TPLAB | Required whenever a VOL statement is issued. |
| // EXEC | Required. |

Any other job control statements, such as OPTN, LOG, NOLOG, or FILES statements, may be included in the set if the corresponding functions are to be requested.

### Program Control Statements

The TPS Sort/Merge program requires the following control statements:

| | |
|---|---|
| SORT or MERGE | -- Required for a sorting or merging job, respectively. |
| RECORD | -- Required. |
| INPFIL | -- Optional. |
| OUTFIL | -- Optional. |
| OPTION | -- Optional. Required for Restart runs. |
| MODS | -- Optional. Used if user routines have been added. |
| END | -- Required. Must be the last statement. |

These statements are written by the programmer. The operator should ensure that all required statement cards are present.

## USER ROUTINES

If the user wishes to include his own routines, the assembled routines (including the END card) must be

a) inserted in the Sort/Merge program deck (see Figure 10) if the card-resident system is to be used; or

b) placed behind the Sort/Merge control cards in the hopper of SYSRDR if the tape-resident system is to be used. The tape error statistics option can be requested by including a // OPTN control statement during the preceding Job Control run (280 bytes of main storage will be used).

Note: If data cards are to be read by a user routine from the device assigned to SYSRDR, they must be placed behind that routine in the hopper. The user is responsible for recognizing the end of his data.

## PREPARATION OF THE SYSTEM

The following steps must be taken by the operator to prepare the system for the execution of the TPS Sort/Merge program.

### Card-Resident System

1. If the system run has not yet been initiated, follow the procedure described in the section The Card-Resident System.

2. Place into the hopper of SYSRDR:
   a) phases 00, 01 and 02 of the Job Control program;
   b) the cards containing the job control statements;
   c) phase 03 of the Job Control program;
   d) the deck containing phases 0 and 1 of the Sort/Merge program;
   e) the cards containing the program control statements for the Sort/Merge program;
   f) the deck containing phases 2-7 of the Sort/Merge program, followed by the user routines for the Assignment part, if any. (If data cards are to be read by these routines from the same device, they must follow the routines in the hopper);
   g) the deck containing phases 8 and 9 of the Sort/Merge program, followed by the user routines for the Internal Sorting part, if any. (If data cards are to be read by these routines from the same device, they must follow the routines in the hopper);
   h) the deck containing phases 10 and 11 of the Sort/Merge program, followed by the user routines for the External Sorting part, if any. (If data cards are to be read by these routines from the same device, they must follow the routines in the hopper);
   i) the deck containing phases 12 and 13 of the Sort/Merge program, followed by the user routines for the Merging part, if any. (If data cards are to be read by these routines from the same device, they must follow the routines in the hopper).

3. Place into the appropriate hopper any data cards to be read by user routines from a card reading device other than SYSRDR.

4. Press the Start key of each card reading device used.

5. Press the Reset key and the Start key of the printer.

6. Mount the required tapes on their drives and press the Load-Rewind key and the Start key of each drive used (except when tapes are positioned and ready from a previous job).

7. Press the Start key on the CPU console.

### Tape-Resident System

1. If the system run has not yet been initiated, follow the procedure described in the section The Tape-Resident System.

2. Place into the hopper of the reading device assigned to SYSRDR:
   a) the cards containing the job control statements,
   b) the cards containing the control statements for the Sort/Merge program,
   c) the assembled user routines (if any).

3. Place any data cards to be read by a user routine into the hopper of the appropriate device.

4. Press the Start key of each card reading device used.

5. Press the Reset key and the Start key of the printer.

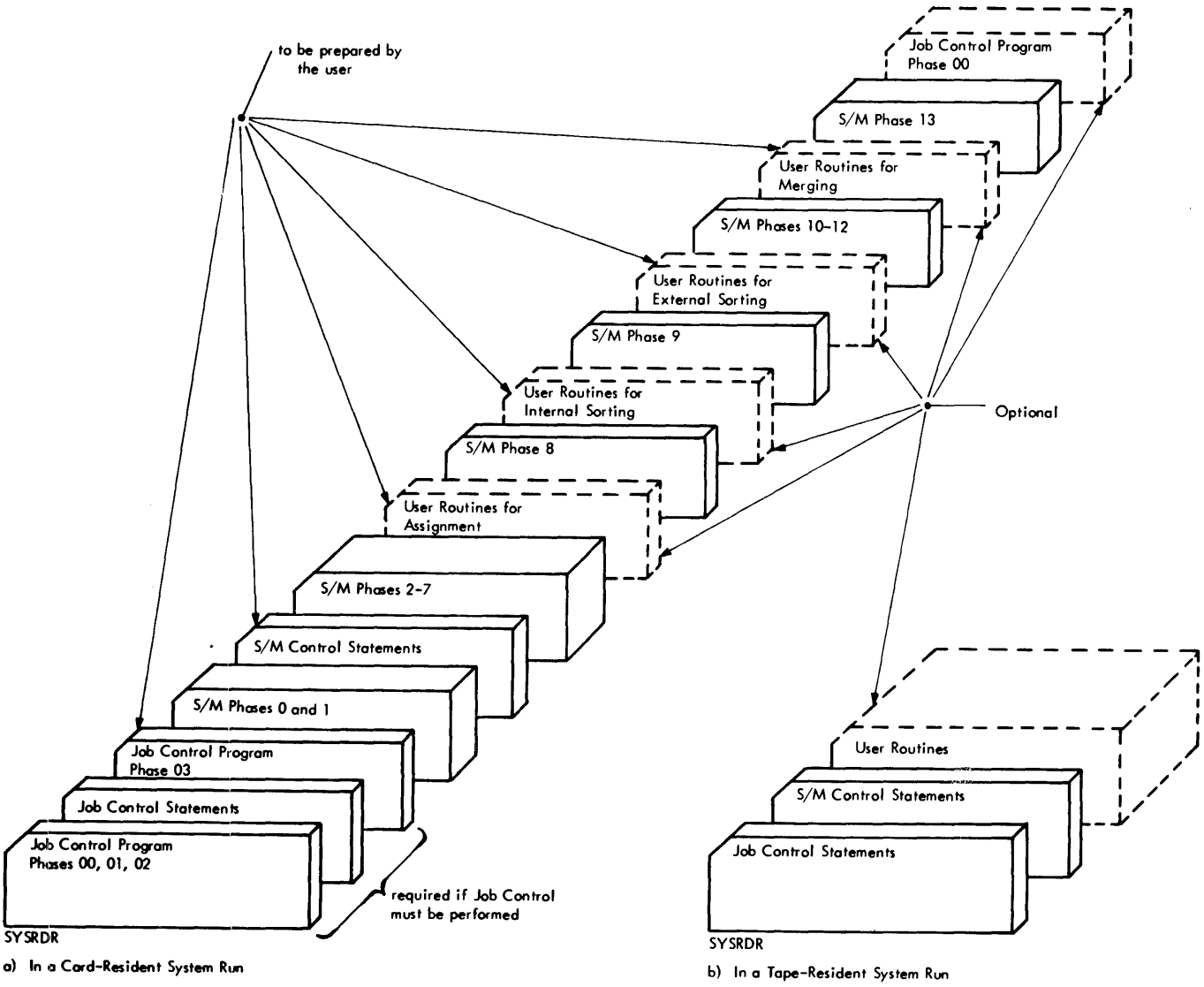
6. Mount the required tapes on their drives. Press the Load-Rewind key and the Start key of each drive used.

7. Press the Start key on the CPU console.

Figure 10 shows the arrangement of input decks for a sort/merge job under control of the card-resident system and the tape-resident system.

## SPECIAL CONSIDERATIONS FOR MULTI-VOLUME INPUT AND OUTPUT FILES

When alternate input or output devices have been specified and a volume on one drive has been completely read or written, the program checks whether the other drive is ready. If it is ready, processing continues without operator invention. If it is not ready, a programmed halt occurs. In this case, the halt code displayed on the CPU console identifies the cause of the halt and the appropriate restart procedure.




●Figure 10. Arrangement of Input Decks for the Execution of the Sort/Merge Program

When alternate input or output devices have not been specified, which is always the case for input to merge runs, a programmed halt occurs after a volume has been completely read or written. The halt code displayed on the CPU console identifies the cause of the halt and the appropriate restart procedure.

PROGRAMMED HALTS

A number of programmed halts may occur during the loading and execution of the Sort/Merge program. The halt-code displays and the associated restart procedures are described in the section Programmed-Halt Displays and Restart Procedures.

One non-programmed halt may occur during execution of the Sort/Merge program. This halt occurs when invalid packed-decimal or zoned-decimal data is encountered. The system halts, and the operation code "F8" is displayed in the U-I fields on the CPU console. In this case, the job must be discontinued. To discontinue the job,

- prepare the I/O devices for the next job,
- change the contents of register 3 to 00C2, and
- press the Start key on the CPU console to initiate the end-of-job routine.

MESSAGES

During execution, the Sort/Merge program causes a number of messages to be listed on the printer. Heading, diagnostic, and information messages may be printed.

The messages that may occur and their meaning are described in the SRL publication IBM System/360 Model 20, Disk and Tape Programming Systems, Tape Sort/Merge Program, Form C26-3804.

DESCRIPTION OF OUTPUT

The output of the TPS Sort/Merge program is produced on the tape drive assigned to SYS000 and, if an alternate output device is used, on the tape drive assigned to SYS001. For a sorting job as well as for a merging job, the output consists of one sorted file on one or more tape reels.

CHECKPOINT AND RESTART PROCEDURE

If the operand field of a SORT statement contains CKPT, the program periodically writes checkpoint records on the current (output) work tape during External Sorting. This option enables the user to

a) interrupt the sorting job at any time during External Sorting by pressing the Stop key on the CPU console,

b) restart the job later at the beginning of the pass during which it was interrupted.

External Sorting begins when the message **END OF PHASE 1** has been printed. It is completed when the message **END OF SORT** is printed.

The execution of the program cannot be interrupted and restarted in this manner during Assignment, Internal Sorting, or Merging.

A message is printed at the beginning of each external sorting level. The message printed is

LEVEL nnnn

where nnnn is the level number.

The number in the right-hand portion of the LEVEL message is updated at the beginning of each level. When the last level is to begin, the message printed is

LAST LEVEL

To restart the interrupted sorting job, perform the following steps:

1. If the card-resident system is to be used, place the Job Control program (if used) into the hopper of SYSRDR.

2. Submit any job control statements required to set up the system exactly as it was set up for the original job (the same VOL and TPLAB statements, ASSGN statements to make the same device assignments, and any other job control statements originally submitted). If the card-resident system is to be used, place the cards containing the job control statements between phase 02 and phase 03 of the job control program.

3. Remove the OPTION card (if any) from the deck containing the Sort/Merge control statements originally submitted. Insert an OPTION card that contains the (additional) operand RESTART=n. In this operand, n must be 1 if the original job was interrupted before the message LAST LEVEL was printed; n must be 2 if the job was interrupted after the message LAST LEVEL was printed.

4. If the card-resident system is used, place the program deck in its original arrangement behind the job control cards. If the tape-resident system is used, place the cards containing the Sort/Merge control statements as well as user routines (if any) behind the job control cards.

5. Place any data to be read by user routines in the appropriate hopper(s).

6. Press the Start key(s) of the card reading device(s) used.

7. Mount the tapes that were used in the original job on the appropriate drives. If the job was interrupted during execution of the last level and the output file is a multi-volume file, mount the first volume for the file on SYS000 and, if alternate output has been specified, the second volume for the file on SYS001.

8. Press the Load-Rewind key and the Start key of each tape drive used.

9. Press the Reset key and the Start key of the printer.

10. Press the Load key on the CPU console to restart the job.

Processing is bypassed until the beginning of the sorting level during which the original job was interrupted has been reached.

## USING THE TPS UTILITY PROGRAMS

The TPS Utility programs contained in card-image format on the tape supplied by IBM can be executed under control of either the card-resident or the tape-resident system. For execution under the card-resident system, they must be contained in punched cards. For execution under the tape-resident system, they must be included in the program library of the user's system tape.

Five Utility programs are supplied to the user:

1. the Tape-to-Tape Utility program,
2. the Tape-to-Card Utility program,
3. the Card-to-Tape Utility program,
4. the Tape-to-Printer Utility program,
5. the Initialize-Tape Utility program.

### I/O DEVICE ASSIGNMENTS

The following symbolic device addresses are used in preparing and performing the execution of a Utility program:

SYSRES -- Required only for execution under control of the tape-resident system. Assigned at IPL time. Refers to the 9-track tape drive on which the user's system tape is mounted.

SYSRDR -- Required. Refers to the card reading device used for reading the following:

1. Execution under control of the card-resident system -- the Job Control program (if required), the job control statements (if any), phase C of the Utility program to be executed, the program control statement(s), phases 1-4 of the Utility program, any user routines that may have been inserted (in the form of an integral assembled program), and the remainder of the Utility program.
2. Execution under control of the tape-resident system -- the job control statements, the program control statements, and user routines (if any) in the form of an integral assembled program.

SYSLOG -- Optional. Refers to the printer on which control statements are listed and messages are printed.

SYSIPT -- Required for file-to-file Utility programs only. Refers to the card reading device or tape drive used for reading the data to be transferred to another storage medium.

SYSOPT -- Required for all file-to-file Utility programs except the Tape-to-Printer program. Refers to the card punching device or tape drive on which the output file is produced.

SYSLST -- Required for the Tape-to-Printer Utility program. Refers to the printer which is used as output device.

SYS000 -- Required for the Initialize-Tape Utility program. Refers to the tape drive used as primary output device. For the Tape-to-Tape, Tape-to-Card, and Tape-to-Printer programs, SYS000 refers to the (optional) alternate input device.

SYS001 to SYS005 -- Optional for the Initialize-Tape Utility program. As many tape drives as are available (maximum 5) may be assigned as additional output devices. For the Tape-to-Tape and Card-to-Tape programs, SYS001 refers to the (optional) alternate output device.

Note: For the Card-to-Tape Utility program, SYSIPT may be assigned the same card reading device as SYSRDR.

### CONTROL STATEMENTS

#### Job Control Statements

If a Utility program is to be executed under control of the card-resident system, job control statements need be issued only if functions of the Job Control program are required.

Whenever execution is to be controlled by the tape-resident system, job control statements must be issued.

The following job control statements are used to set up the system for the execution of a Utility program:

// JOB program-name Required. Specifies the name of the Utility program.

| | |
|---|---|
| // ASSGN | Required for any symbolic address whose device assignment in main storage is to be changed. |
| // VOL | Required for any symbolic device on which standard label checking is to be performed. |
| // TPLAB | Required for standard label checking. Must follow the associated VOL statement. |
| // UPSI xxxxxxxx | Required if user routines are present and/or no tape mark option is used. Possible operands: |
| 1xxxxxxx | For user routines only. |
| xxxx1xxx | For no tape mark option only. |
| 1xxx1xxx | For both user routines and no tape mark option. |
| // EXEC | Required. |

Any other job control statements, such as DATE, OPTN, LOG, NOLOG, or FILES statements, need be issued only if the corresponding functions are to be requested.

Program Control Statements

The following program control statements are used with the file-to-file Utility programs:

| | |
|---|---|
| // U (Utility Modifier) | Optional. |
| // FS (Field-Select) | Optional. |
| // H (Print-Header) | Optional (for Tape-to-Printer Utility program only). |
| // END | Required. |

The following program control statements are used with the Initialize-Tape Utility program:

| | |
|---|---|
| // INITTP | Required. |
| VOL1 - VOL8 | Required if the operand CARD is specified in the INITTP statement. One to eight statements (called volume-label image statements) may be present for each output tape specified. |
| // END | Required after each set of volume-label image statements. |

USER ROUTINES

If the user wishes to include his own routines, the assembled routines (one integral program) must be:

a) inserted in the Utility program deck (see Figure 11) if the card-resident system is to be used; or

b) placed behind the program control cards in the hopper of SYSRDR if the tape-resident system is to be used.

The first two cards (Loader and Clear Storage cards) of the user's object deck must be removed. The last card (END card) remains in the deck.

The user must supply an UPSI control statement with the operand 1 (in the set of job control statements) if he includes his own routines.

The tape error statistics option can be requested by including a // OPTN control statement during the preceding Job Control run. (280 bytes of main storage will be used).

PREPARATION OF THE SYSTEM

The following steps must be taken to prepare the system for the execution of a Utility program.

Card-Resident System

1. If the system run has not yet been initiated, follow the procedure described in the section The Card-Resident System.

2. Place into the hopper of SYSRDR:
   a) the card Job Control program deck (if required);
   b) the cards containing the job control statements, if any, between phase 02 and phase 03 of the Job Control program;
   c) the deck containing phase 0 of the Utility program;
   d) the cards containing the program control statements for the Utility program;
   e) the deck containing phases 1-4 of the Utility program;
   f) user routines, if present;
   g) the remainder of the Utility-program deck.

3. If SYSIPT is a card reading device (Card-to-Tape only), place the data cards, terminated by an end-of-file card (/* in cols. 1-2), into the hopper of SYSIPT.

   Note: If SYSIPT is the same device as SYSRDR, remove phase 7 from the Utility-program deck in the hopper and place the data cards and the end-of-file card behind phase 6. Then, return phase 7 to the hopper.

4. If a tape drive has been assigned to SYSIPT, mount the input tape on the drive, and press the Load-Rewind key and the Start key of the drive.

5. If a tape drive has been assigned to SYSOPT, mount an output tape on the drive, and press the Load-Rewind key and the Start key of the drive.

6. If alternate input and/or output devices have been assigned, mount the tapes on the drives (SYS000 and SYS001, respectively, and press the Load-Rewind keys and the Start keys of the drives.

7. If the printer is to be used, install appropriate forms and press the Reset key and the Start key of the device.

8. For the Initialize-Tape program, mount the tape(s) to be initialized on the drive(s) assigned (SYS000 etc.), and press the Load-Rewind key(s) and the Start key(s) of the drive(s).

9. Press the Start keys of all required I/O units that are not yet ready.

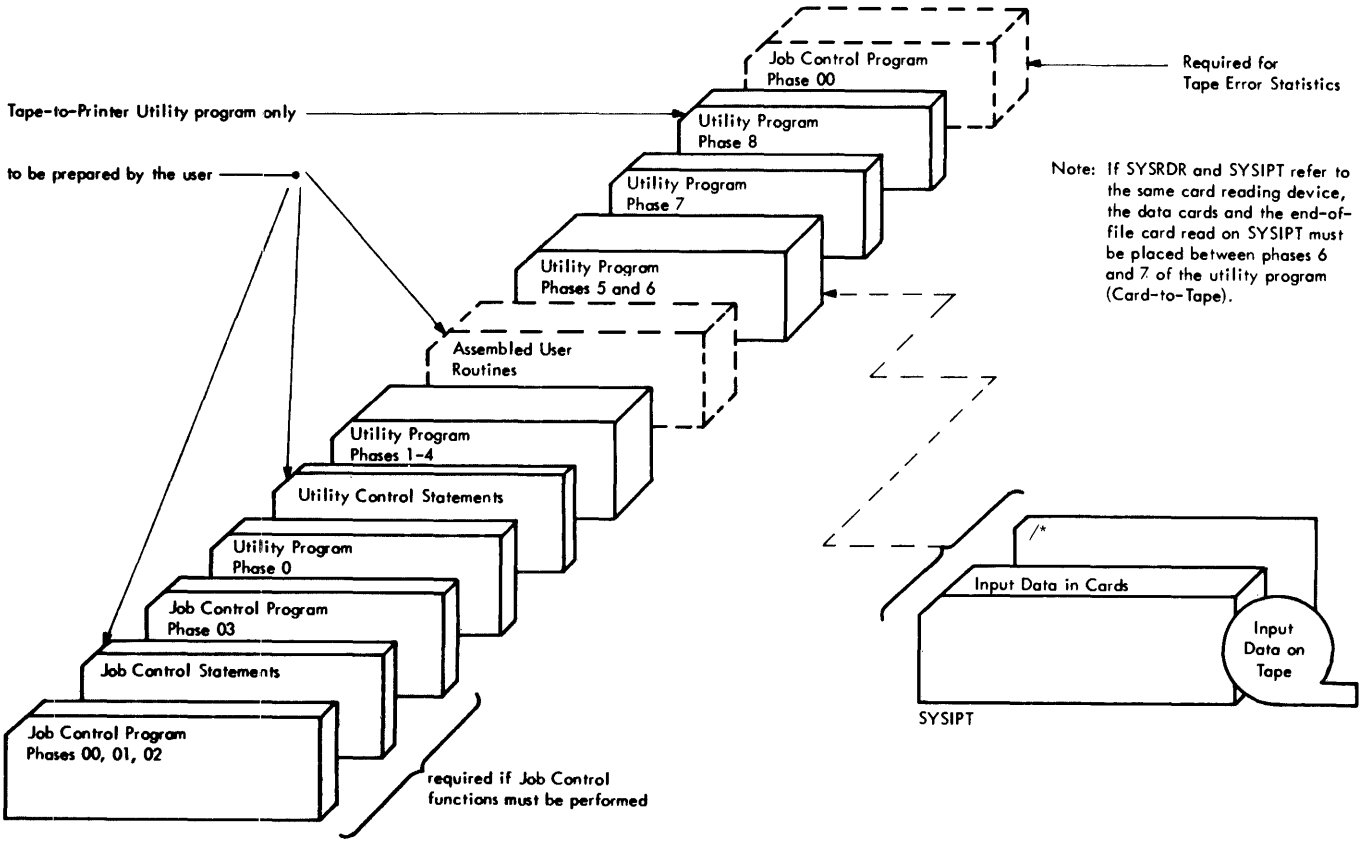
10. Press the Start key on the CPU console.

Figure 11 shows the arrangement of input for the execution of a Utility program under control of the card-resident system.

Tape-Resident System

1. If the system run has not yet been initiated, follow the procedure described in the section The Tape-Resident System.

2. Place into the hopper of SYSRDR:
   a) the cards containing the job control statements,
   b) the cards containing the program control statements for the Utility




● Figure 11. Arrangement of Input for the Execution of a Utility Program under Control of the Card-Resident System

program,
c) the deck containing the assembled user routines (if any).

3. If SYSIPT is a card reading device (Card-to-Tape only), place the data cards and an end-of-file card (/* in cols.1-2) into the hopper of SYSIPT.

   Note: If SYSIPT is the same device as SYSRDR, the data cards and the end-of-file card must follow the program control cards in the hopper of the device.

4. Perform steps 4 through 10 described in the preceding section Card-Resident System.

PROGRAMMED HALTS

A number of programmed halts may occur during the loading and execution of a Utility program. The halt codes displayed and the associated restart procedures are described in the section Programmed-Halt Displays and Restart Procedures.

MESSAGES

A number of messages are printed during the execution of each Utility program. Some of these messages are associated with a halt code and supply additional information on the cause of the halt. A complete list of the messages that may be printed and their meaning is contained in the SRL publication IBM System/360 Model 20, Disk and Tape Programming Systems, Tape Utility Programs, Form C26-3808.

DESCRIPTION OF OUTPUT

The output obtained from the Utility programs depends on the type of job performed. According to the Utility program that has been executed, the output is obtained in cards, on tape, or on the printer.

**Don't forget** the reader's suggestion sheet. By sending us your comments (complimentary or otherwise) you can help IBM produce better manuals for future readers.

## RETRIEVING AND IDENTIFYING PROGRAMS STORED ON THE IBM-SUPPLIED TAPE

The IBM-supplied package consists of a "bootstrap" card and a distribution tape. The Distribution-Package Retrieval program is the first program stored on the distribution tape and is used to retrieve the desired elements (i.e., programs, samples, macro definitions and control statements) from the tape. These can then be executed or - if copied onto tape - used as input to the Load System Tape and Macro Maintenance programs. The bootstrap card is used to load the Distribution-Package Retrieval program.

During Retrieval Program execution, the operator may skip the undesired elements stored on the distribution tape and may control the output of the program. The operator may also specify listing of the desired element, thereby suppressing any other output.

The following sections describe:

- the machine requirements for the execution of the Distribution-Package Retrieval program,
- the contents of the program package,
- the operating procedures for the Distribution-Package Retrieval program, and
- the identification of the program decks retrieved from the distribution tape.

### MACHINE REQUIREMENTS

The minimum machine requirements for the execution of the Distribution-Package Retrieval program are:

- 4096 bytes of main storage,
- one card reading device,
- one card punching device,
- one printer,
- one 2415 Magnetic Tape Unit (9-track drives, or 7-track drives with data conversion feature).

### PROGRAM PACKAGE

Each program, each macro definition, and each control statement on the distribution tape (with the exception of the Distribution-Package Retrieval program) is preceded by an 80-character header record in the following format:

| Cols. | Contents |
|---|---|
| 1-2 | $$ |
| 3 | Blank |
| 4-71 | Title and blanks |
| 72 | Classification:<br>X: punched out by the Distribution-Package Retrieval program<br>Y: punched out and copied onto tape by the Distribution-Package Retrieval program.<br>Z: copied onto tape by the Distribution-Package Retrieval program. The output may be changed by the user. |
| 73 | Identification |

The last record on the distribution tape is a header record that contains the characters EOJ in the program-title field.

Depending on the size of main storage and the number of available tape drives, the user has the following possibilities:

A. 4096 Bytes of Main Storage and a Minimum of Two Tape Drives

All programs to be run with this system must be copied into cards. These programs are:

1. Basic Assembler (Tape).
   With this program the user can assemble his own programs written in the Basic Assembler language (refer to SRL publication IBM System/360 Model 20, Card Programming Support, Basic Assembler (Tape Versions) Operating Procedures, Form C24-9011).

2. All tape Utility programs:
   TPS Tape-to-Tape Utility program
   TPS Tape-to-Card Utility program
   TPS Card-to-Tape Utility program
   TPS Tape-to-Printer Utility program
   TPS Initialize-Tape Utility program

   The programs must be run under control of the card-resident Control programs.

3. The Sample Program for the Basic Assembler (Tape)

4. Part of Sample Program 3 for the Utility programs (refer to the section Sample Programs in this publication).

B. 8192 Bytes of Main Storage and Two Tape Drives

In addition to the possibilities described above, the user can build a system tape consisting of the programs indicated by an asterisk in the listing of the contents of the distribution tape below. The programs that the user wishes to include in the system tape must first be punched from the distribution tape into cards. These program decks must be preceded by the Tape-Resident Control program as described in the section Building the Initial System Tape from IBM-Supplied Programs.

Furthermore, the user can execute the TPS Copy System Tape program and Sample programs 2 and 3. User programs may also be included on the system tape.

Note: The Initial Program Loader for the tape-resident system must also be punched from the distribution tape into cards.

C. 8192 Bytes of Main Storage and a Minimum of Four Tape Drives

In addition to the possibilities described under A and B, the user can copy all programs directly onto tape, with the exception of the X-classified programs. He can also execute all Sample programs.

Note: The Initial Program Loader for the tape-resident system must also be punched from the distribution tape into cards.

Contents of the Distribution Tape

The distribution tape contains the following programs, control statements, and macro definitions in the specified sequence:

| Seq. No. | Program | Classification |
|---|---|---|
| 1. | Distribution-Package Retrieval program. | - |
| 2. | TPS Initial Program Loader for Tape-Resident System. | X |
| 3. | TPS Copy System Tape program. | X |
| 4. | Basic Assembler (Tape) 4K. | X |
| 5. | Basic Assembler (Tape) 8K. | X |
| 6. | Sample for Basic Assembler (Tape). | X |
| 7. | TPS Sample 1 (Assembler). | X |
| 8. | TPS Sample 2 (RPG). | X |
| 9. | TPS Sample 3 (Utility and Sort/Merge). | X |
| 10. | TPS Sample 4 (IBM 1419 Magnetic Character Reader). | X |
| 11. | TPS Sample 5 (BSCA ICCS). | X |
| 12. | TPS Sample 6 (BSCA ICCS). | X |
| 13. | TPS Card-Resident Control programs (IPL, Basic Monitor, and Job Control). | X |
| 14. | TPS Load System Tape program. | X |
| *15. | TPS Tape-Resident Control programs. (Basic Monitor and Job Control) | Z |
| 16. | TPS Assembler program (Part 1). | Z |
| *17. | TPS Card-to-Tape Utility program. | Y |
| 18. | TPS Core-Image Maintenance program. | Z |
| 19. | TPS Core-Image Service program. | Z |
| 20. | TPS Directory Service program. | Z |
| *21. | TPS Initialize-Tape Utility program. | Y |
| 22. | TPS Linkage Editor program. | Z |
| 23. | TPS Macro Maintenance program. | Z |
| 24. | TPS Macro Service program. | Z |
| *25. | TPS Report Program Generator. | Z |
| 26. | TPS Sort/Merge program. | Y |
| *27. | TPS Tape-to-Card Utility program. | Y |
| *28. | TPS Tape-to-Printer Utility program. | Y |
| *29. | TPS Tape-to-Tape Utility program. | Y |

| | | |
|---|---|---|
| 30. | TPS Assembler program (Part 2). | Z |
| *31. | // END control statement. | Z |
| 32. | TPS Input/Output and Basic Monitor macro definitions, with interspersed // PRIOR and // CATAL statements, concluded by a // END control statement. | Z |
| 33. | Separate set of // PRIOR and // CATAL statements, concluded by a // END control statement. | X |
| 34. | TPS Input/Output macro definitions for the Binary Synchronous Communications Adapter, with interspersed // PRIOR and // CATAL statements, concluded by a // END control statement. | Z |
| 35. | Separate set of // PRIOR and // CATAL statements, concluded by a // END control statement. | Z |
| 36. | TPS Input/Output macro definitions for the IBM 1419 and 1259 Magnetic Character Readers, with interspersed // PRIOR and // CATAL statements, concluded by a // END control statement. | Z |
| 37. | Separate set of // PRIOR and // CATAL statements, concluded by // END control statement. | X |

## OPERATING PROCEDURES FOR THE DISTRIBUTION-PACKAGE RETRIEVAL PROGRAM

During execution, the Distribution-Package Retrieval program:

- prints all header records together with a message indicating the operator's output specification, and
- if specified, lists the selected element(s) (any other output is suppressed), or
- punches the selected element(s) of the distribution tape into cards, and/or writes the selected element(s) with a Y and Z classification onto the assigned output tape.

To execute the Distribution-Package Retrieval program, the following steps must be taken.

1. Mount the distribution tape on a 2415 tape drive. (9-track tapes must be mounted on 9-track drives; 7-track tapes must be mounted on 7-track drives. The data conversion feature is required when using 7-track tapes.)
2. Press the Load-Rewind key and the Start key of the drive on which the distribution tape is mounted.
3. Place the IBM-supplied bootstrap card and a blank card in the hopper of the reading device (2501 if attached; otherwise, 2520 Card Read-Punch or 2560, hopper 1).
4. If punched output is required, place blank cards in the hopper of the punching device. (Hopper 1 if 2560 is used.)
5. Press START on each card I/O device used.
6. Set the Register-Data/Address switches on the CPU console to 0E00.
7. Set the Mode switch on the CPU console to PROCESS.
8. Press LOAD on the CPU console.

Halt 0BF0 occurs after the bootstrap card has been read into main storage. Continue as follows:

9. Set the Mode switch on the CPU console to STOR ALTER.
10. Set the Data switches on the CPU console to the physical address of the tape drive on which the distribution tape is mounted (normally one of the numbers 80-85).
11. Set the Register-Data/Address switches to 00FC.
12. Press START on the CPU console.
13. Set the Mode switch to PROCESS.
14. Press START on the CPU console.

Halt 0BF2 occurs after the Distribution-Package Retrieval program has been read into main storage. Continue as follows:

15. Set the Mode switch to STOR ALTER.
16. Set the Register-Data/Address switches to 00FC.
17. Set the Data switches to
    20 if a 2520 is used for punching
    42 if a 1442 is used for punching
    60 if a 2560 is used for punching

FF if listing is desired and other output is to be suppressed.

18. Press START on the CPU console.

19. Operator decision:
Perform this step only if selected elements are to be copied onto tape. Otherwise, bypass step 19 and continue with step 20.

    a) Mount an output tape on a 2415 tape drive. (9-track tapes must be mounted on 9-track drives; 7-track tapes must be mounted on 7-track drives. The data conversion feature is required when using 7-track tapes.)

    b) Set the Register-Data/Address switches to 00FD.

    c) Set the Data switches to the functional characteristics of the output tape as follows:

        C0 -- 1600 bytes/inch 9-track
        C8 -- 800 bytes/inch 9-track
        10 -- 200 bytes/inch 7-track with data conversion
        50 -- 556 bytes/inch 7-track with data conversion
        90 -- 800 bytes/inch 7-track with data conversion

    d) Press START on the CPU console.

    e) Set the Register-Data/Address switches to 00FE.

    f) Set the Data switches to the physical address of the tape drive on which the output tape is mounted (normally one of the numbers 80-85).

    g) Press START on the CPU console.

20. Set the Mode switch to PROCESS.

21. Press START on the CPU console.

The Distribution-Package Retrieval program prints the header of the next element (i.e., program, sample, macro definition, or control statement) stored on the distribution tape and then halts.

Halt 0BF7 occurs. Continue as follows:

22. Remove the previously punched deck (if any) from the stacker for marking.

23. Operator decision:
Bypass step 23 and continue with step 24 if normal output of the element last announced by the printer is desired.

Normal form of output: X-class elements are punched, Y-class elements are punched and copied onto the output tape, Z-class elements are copied onto the output tape. If no output tape is assigned, Y- and Z-elements are punched.

Other forms of output or skipping of the element last announced by the printer can be selected as described below.

    a) Set the Mode switch to STOR ALTER.

    b) Set the Register-Data/Address switches to one of these values:

        00FB: The element last announced by the printer is skipped.

        Y- and Z-elements only (specification ignored for X-elements):
        00F8: The Y- or Z-element last announced by the printer is punched only.
        00F9: The Y-element last announced by the printer is copied onto tape only.
        00FA: The Z-element last announced by the printer is punched and copied onto tape.

    c) Set the Data switches to a value other than FF.

    d) Press START on the CPU console.

    e) Set the Mode switch to PROCESS.

24. Press START on the CPU console.

Retrieval of the selected element begins in the specified form. "PRINTED","SKIPPED", "PUNCHED","COPIED ", or "PUNCH, COPY" is printed beneath the announcement to indicate the form of output.

Halt 0BF7 occurs to signal completed retrieval. The next element stored on the distribution tape has been announced by the printer.

25. If further elements are to be retrieved, start again with step 22 of the procedure described above.

"$$ EOJ" is announced by the printer after the last element has been retrieved from the distribution tape.

Halts

Any halts that occur during the loading and execution of the program are described, together with the appropriate restart procedures, in the section Programmed-Halt Displays and Restart Procedures.

| Program Title | Program Name | Program Identification |
|---|---|---|
| Basic Assembler (Tape) 4K | -- | A |
| Basic Assembler (Tape) 8K | -- | A |
| TPS Card-Resident Control programs | | B |
| TPS Initial Program Loader for Tape-Resident System | -- | E |
| TPS Tape-Resident Control programs | -- | F |
| TPS Load System Tape program | LDSYS | H |
| TPS Core-Image Maintenance program | CMAINT | I |
| TPS Macro Maintenance program | MMAINT | J |
| TPS Copy System Tape program | CPSYS | K |
| TPS Directory Service program | DSERV | L |
| TPS Core-Image Service program | CSERV | M |
| TPS Linkage Editor program | LNKEDT | N |
| TPS Assembler program | ASSEMB | O |
| TPS Input/Output and Basic Monitor macro definitions | -- | P |
| TPS Macro Service program | MSERV | Q |
| TPS Input/Output macro definitions for the IBM 1419 and 1259 | -- | Y |
| TPS Input/Output macro definitions for the Binary Synchronous Communications Adapter | -- | Z |
| TPS Report Program Generator | RPG | R |
| TPS Sort/Merge program | SORT | S |
| TPS Tape-to-Tape Utility program | TAPTAP | T |
| TPS Tape-to-Card Utility program | TAPCAR | U |
| TPS Card-to-Tape Utility program | CARTAP | V |
| TPS Tape-to-Printer Utility program | TAPPRT | W |
| TPS Initialize-Tape Utility program | INITTP | X |
| Sample for Basic Assembler (Tape) | -- | A |
| TPS Sample 1 | -- | O |
| TPS Sample 2 | -- | R |
| TPS Sample 3 | -- | S,V,W,or X |
| TPS Sample 4 (1419 IOCS) | -- | Y |
| TPS Sample 5 (BSCA IOCS) | -- | Z |
| TPS Sample 6 (BSCA IOCS) | -- | Z |

●Figure 12. Summary of IBM-Supplied Programs

Output of the Distribution-Package Retrieval Program

- a listing of all headers together with their output specifications, and
- listings of all elements selected to be listed, or
- card decks containing the elements selected to be punched, and, if step 19 is to be performed,
- a tape containing the Y- and Z-elements selected to be copied in 80-character unblocked format.

## IDENTIFICATION OF IBM-SUPPLIED PROGRAMS

Columns 73 through 80 of the IBM-supplied program cards contain the following information that enables the user to identify and separate the decks punched by the Distribution-Package Retrieval program.

Identification of the cards will be easier if they are first interpreted.

Col. 73 -- Program identification (see Figure 12).
Cols. 74-75 -- Phase number within program, macro-definition number, or sample card-group number (starting with 90).
Col. 76 -- 2 (identification for TPS).
Cols. 77-79 -- Consecutive card number within phase, macro definition, or sample card group (leading zeros are punched).
Col. 80 -- Reserved for insertions.

Figure 12 is a summary of the full titles, names, and identifications of the programs supplied by IBM.

In the card-resident Control programs, the Initial Program Loader, the Basic Monitor, and phases of the Job Control program are separated by an ASSGN and two comments cards as shown in Figure 2.

## BUILDING THE INITIAL SYSTEM TAPE FROM IBM-SUPPLIED PROGRAMS (LDSYS RUN)

The following steps must be taken to build a system tape from programs obtained as output from the Distribution-Package Retrieval program.

1. Place the card IPL deck, an ASSGN card for SYSRDR and the card Basic Monitor deck in the hopper of the loading unit. (The tape unit numbers in the REP cards of the Basic Monitor deck may have to be changed to the numbers of the drives actually attached.)

2. Place in the hopper of SYSRDR:

   a) phase 00, 01 and 02 of the card Job Control program deck

   b) cards containing the following job control statements:

```
// JOB    LDSYS
// DATE
// ASSGN  SYSIPT   (if not 2501)
// ASSGN  SYSOPT   (tape drive)
// ASSGN  SYS000   (if tape characteristics have to be added to the standard assignment)
// EXEC
```

   c) phase 03 of the card Job Control program deck

   d) the Load System Tape program deck

3. If input for the LDSYS run is in punched cards, the tape-resident Control programs (sequence number 15) must also have been punched into cards during execution of the Distribution-Package Retrieval program. Follow either procedure (a) or procedure (b) below.

   If input for the LDSYS run is from magnetic tape, follow procedure (c).

   (a) If SYSIPT refers to the same card-reading device as SYSRDR:

      i. Insert into the deck containing the tape-resident Control programs any new or replacement ASSGN and/or CONFG cards required to change the standard entries in the tape Basic Monitor program to the actual configuration of the Model 20 system. (these cards must be placed immediately after the Basic Monitor program -- see Figure 5).

      ii. Place into the hopper of the card-reading device:

         - the deck containing the tape-resident Control programs
         - the deck containing the user-selected programs (sequence numbers 15 to 29) to be included on the system tape, in the same order as they were punched by the Distribution Package Retrieval program
         - a // END control card (to be prepared by the user).

   (b) If SYSIPT refers to a card-reading device other than that assigned to SYSRDR:

      i. Place into the hopper of SYSRDR:

         - the // MONTR card from the tape-resident Control program deck (to be prepared by the user)
         - any ASSGN and/or CONFG cards required either to change the standard entries in the tape Basic Monitor program to the actual configuration of the Model 20 system or to insert tape-drive assignments
         - a // END control card (to be prepared by the user).

      ii. Place into the hopper of SYSIPT:

         - the remainder of the deck containing the tape-resident Control programs
         - the deck containing the user-selected programs (sequence numbers 16 to 30) to be included on the system tape, in the same order as they were punched by the Distribution Package Retrieval program
         - a // END control card (to be prepared by the user).

(c) If SYSIPT refers to a tape drive:

i. Place into the hopper of SYSRDR:

- a // MONTR control card (to be prepared by the user)
- any ASSGN and/or CONFG cards required either to change the standard entries in the tape Basic Monitor program to the actual configuration of the Model 20 system, or to insert tape-drive assignments
- a // END control card (to be prepared by the user).

ii. Mount on the drive assigned to SYSIPT the tape written by the Distribution Package Retrieval program. Press the Load-Rewind key and the Start key of this drive. (The tape written by the Distribution-Package Retrieval program should contain the TPS tape-resident Control programs -- sequence number 15.)

4. Mount an output tape on the drive assigned to SYSOPT; press the Load-Rewind key and the Start key of the drive.

5. Mount a work tape on the drive assigned to SYS000 (standard assignment); press the Load-Rewind key and the Start key of the drive.

6. Press the Start keys of the required I/O units that are not yet ready.

7. Set the Mode switch on the CPU console to PROCESS.

8. Set the Register-Data/Address switches on the CPU console to an even main-storage address between hexadecimal 009C and the end-of-storage address minus hexadecimal 0052.

9. Press the Load key on the CPU console.

Upon completion of the Load System Tape program run, a system halt occurs and the code 0B20 is displayed in the E-S-T-R fields on the CPU console.

The tape on the drive assigned to SYSOPT is now the system tape and includes the programs selected by the user, but not the macro definitions.

If IBM-supplied macro definitions are to be included on the system tape, do not rewind the tape on the drive assigned to SYSIPT in the LDSYS run.

## INSERTING IBM-SUPPLIED MACROS IN THE MACRO LIBRARY (MMAINT RUN)

The framework for a macro library is created during the LDSYS run. Macro definitions can, however, only be added to, or deleted from, the library by means of the MMAINT (Macro Maintenance) program. Therefore, if the system is to include a macro library, the MMAINT program must be included on the tape at retrieval time.

This section describes the procedure for using the MMAINT program to include IBM-supplied macros in the library. It is also applicable when these macros are to be updated from modifications supplied by IBM.

Further notes on the macro library, together with details of the procedures for deleting unwanted items and for adding user-written macro definitions will be found in the section Updating the Macro Library Section of a System Tape.

The macro definitions supplied by IBM are contained on the distribution tape in three files:

1. TPS Input/Output and Basic Monitor macro definitions
2. TPS Input/Output macro definitions for the Binary Synchronous Communications Adapter
3. TPS Input/Output macro definitions for the IBM 1419 and 1259 Magnetic Character Readers.

Any or all of these files (depending on the user's requirements) are retrieved from the distribution tape during the retrieval run.

These files are now on the tape drive assigned to SYSIPT in the LDSYS run. Each file is preceded by a tape mark. On completion of the LDSYS run, the tape is positioned just before the first tape mark.

If only the Input/Output and Basic Monitor macro definitions are to be used, one MMAINT run will be sufficient. If the system also includes the BSCA and/or a Magnetic Character Reader (1419 or 1259), two or three additional MMAINT runs will be required to insert the macro definitions for these devices into the library.

The steps to be performed for each additional run follow the same pattern, as described below.

1. Remove the file-protection ring from the system tape (on the drive assigned to SYSOPT in the previous run), remount the tape on the drive, and press the Load-Rewind key and the Start key of the drive.
2. Place in the hopper of the loading unit:
   a) the tape IPL deck up to and including the END card;
   b) an ASSGN card assigning the drive on which the system tape is mounted to SYSRES (this is the drive that was assigned to SYSOPT in the LDSYS or previous MMAINT run(s));
   c) an ASSGN card for SYSRDR (if a device other than the assigned one is to be used);
   d) the (corrected) REP cards (unless the correct assignments were inserted in the tape Basic Monitor by means of the LDSYS program);
   e) the end-of-file card (/* in cols. 1-2).
3. Place cards containing the following job control statements in the hopper of SYSRDR:

```
// JOB   MMAINT
// DATE
// ASSGN SYSIPT      (same device as during LDSYS or previous MMAINT run(s)
// FILES SYSIPT,1    (used only if SYSIPT refers to a tape drive)
// ASSGN SYSOPT      (tape drive)
// ASSGN SYS000      (tape drive: required unless assignment was made during LDSYS)
// ASSGN SYSLST,UA   (required if the macro definitions are not to be listed)
// CONFG             Required if more than 8K bytes of main storage are available. (Allows faster processing).
// EXEC
```

4. a) If SYSIPT refers to the same card reading device as SYSRDR:
   - remove the separate control-card deck (PRIOR and CATAL cards) from the output deck produced by the Distribution-Package Retrieval program;

- place the deck of macro definitions produced by the Distribution-Package Retrieval program (beginning with a PRIOR card and a CATAL card, containing interpersed PRIOR and CATAL cards, and terminated by a // END control card) in the hopper of the device, behind the EXEC card.

b) If SYSIPT refers to a card reading device other than that assigned to SYSRDR:

- place the separate control-card deck produced by the Distribution-Package Retrieval program in the hopper of SYSRDR, behind the EXEC card;

- place the deck of macro definitions, terminated by the // END card, in the hopper of SYSIPT. (The interpersed PRIOR and CATAL cards in the deck are ignored by the MMAINT program).

c) If SYSIPT refers to a tape drive, place the separate control-card deck produced by the Distribution-Package Retrieval program in the hopper of SYSRDR. The input tape on which the macro definitions are stored is still mounted on SYSIPT from the LDSYS or previous MMAINT run(s);

5. If SYS000 refers to the same tape drive as in the preceding LDSYS or MMAINT run, the work tape is still mounted and positioned.
If a different drive is used as SYS000, mount a work tape on the drive; press the Load-Rewind key and the Start key of the drive.

6. Mount an output tape on the drive assigned to SYSOPT; press the Load-Rewind key and the Start key of the drive.

7. If the printer (SYSLST) is used to list the macro definitions, press the Reset key and the Start key of the printer.

8. Press the Start keys of any required I/O units that are not yet ready.

9. Press the Load key on the CPU console.

After the IPL procedure, the MMAINT program is read into storage and executed. A number of programmed halts may occur during processing. The halt codes displayed and the appropriate restart procedures are described in the section Programmed-Halt Displays and Restart Procedures.

On completion of the MMAINT run, the system halts, and code 0D10 is displayed in the E-S-T-R registers on the CPU console.

The system tape, which now includes a macro library, is on the drive assigned to SYSOP1.

If more macro definitions (i.e., those for the 1419/1259 and/or for the BSCA) are to be included, additional MMAINT runs should be executed. Repeat steps 1 through 9 described above, but note that SYSOPT from the previous run becomes SYSRES in the next run: SYSRES from the previous run can be assigned to SYSOPT in the next run.

Figure 13 is an example of the tape handling to be carried out when a system tape is being created for a system with four tape drives, and when all three files of IBM-supplied macro definitions are required. If the 1419/1259 macro definitions, but not those for BSCA IOCS are to be included in the macro library, the second MMAINT run represents the tape-drive handling for inclusion of the 1419/1259 macro definitions.

GENERATION OF A SYSTEM TAPE

| | 80 | 81 | 82 | 83 |
|---|---|---|---|---|
| Standard assignments | SYS000 | SYS001 | SYS002 | SYS003 |
| 1. Retrieval run (Bootstrap card) | | | Worktape (=Output) | Distribution Tape |
| | | | Ring Off | Remove |
| 2. LDSYS run Building the Initial System tape (without IOCS) | Worktape (=SYS000) | Worktape[1] (=SYSOPT) | SYSIPT | |
| | | Ring Off | Do not rewind | |
| 3. 1st MMAINT run Creation of macro library, includes I/O and Basic Monitor macro definitions. | SYS000 | SYSRES | SYSIPT | Worktape[2] (=SYSOPT) |
| | | Ring On | Do not rewind | Ring Off |
| 4. 2nd MMAINT run Includes BSCA macro definitions | SYS000 | SYSOPT[3] | SYSIPT | SYSRES |
| | | Ring Off | Do not rewind | Ring On |
| 5. 3rd MMAINT run Includes 1419/1259 macro definitions | SYS000 | SYSRES | SYSIPT | SYSOPT[4] |

[1] System tape, without macro library
[2] System tape, including I/O and Basic Monitor macros
[3] System tape, including I/O and Basic Monitor, and BSCA IOCS macros
[4] System tape, including I/O and Basic Monitor, BSCA, and 1419/1259 IOCS macros

Figure 13. Example of the Tape-Drive Handling Needed to Build a System Tape

## UPDATING MODEL 20 TPS PROGRAMS FROM IBM-SUPPLIED PROGRAM MODIFICATIONS

When maintenance of the Model 20 Tape Programming System is to be performed, the revised elements are supplied on a tape reel (or in cards). The retrieval of the elements from such a distribution tape is performed in the same way as for initial retrieval.

The distribution tape may contain the following items:

| Item | | Classification |
|---|---|---|
| 1. | Distribution-Package Retrieval program. | -- |
| 2. | Any modified program phases or programs for sequence numbers 2 to 13 of the initial distribution tape. | X |
| 3. | The modified Tape-Resident Control programs | Z |
| 4. | Any modified program phases or programs for sequence numbers 16 to 30 of the initial distribution tape. | identical to the initial release |

If item 4 is present:

| | | |
|---|---|---|
| 5. | /* control statement | Z |
| 6. | // END control statement | X |
| 7. | Separate set of // CATAL statements, concluded by the // END statement. | X |
| 8. | Any modified Input/Output and/or Basic Monitor macro definitions, with interspersed // PRIOR and // CATAL statements, concluded by a // END control statement. | Z |

If item 8 is present:

| | | |
|---|---|---|
| 9. | Separate set of // PRIOR and // CATAL statements, concluded by a // END control statement. | X |
| 10. | Any modified Input/Output macro definitions for the Binary Synchronous Communications Adapter, with interspersed // PRIOR and // CATAL statements, concluded by a // END control statement. | Z |

If item 10 is present:

| | | |
|---|---|---|
| 11. | Separate set of // PRIOR and // CATAL statements, concluded by a // END control statement. | X |
| 12. | Any modified Input/Output macro definitions for the IBM 1419 and 1259 Magnetic Character Readers, with interspersed // PRIOR and // CATAL statements, concluded by a // END control statement. | Z |

If item 12 is present:

| | | |
|---|---|---|
| 13. | Separate set of // PRIOR and // CATAL statements, concluded by a // END control statement. | X |

Updating of the initially distributed Model 20 TPS programs is described in the following paragraphs.

### Updating of Programs Under Item 2 of the Distribution Tape

All programs are card-resident. Replace the corresponding card decks.

### Updating of Programs under Items 3 and 4 of the Distribution Tape

If the CMAINT program cannot be used on the available machine configuration, the master deck used for initial system generation must be updated by replacing the corresponding programs and/or phases. The new system can be built as described in the section Building the Initial System Tape from IBM-supplied Programs.

When the CMAINT program can be used on the available machine configuration, updating of the existing system tape is performed as described in the section Updating the Program Library Section of a System Tape.

The tape described in step 19 of the section Operating Procedures for the Distribution-Package Retrieval Program may be used as input to the CMAINT program. All control statements for the CMAINT program except the // MONTR and // END control statements for the TPS Basic Monitor program are made available under items 5, 6, and 7 of the distribution tape. These items are to be used under the following conditions:

- If SYSIPT refers to a tape drive or a card reader other than that assigned to SYSRDR, item 7 of the distribution tape provides the complete set of // CATAL and // END statements. The /* control statement of item 5 must be placed behind the last phase selected by the user.

- If SYSIPT refers to the same card reader as SYSRDR, insertion of // CATAL statements is not required since every phase retrieved is already preceded by a // CATAL control statement. However, the last card of the deck must be the // END statement and can be retrieved from item 6 of the distribution tape.

Figure 15 shows the arrangement of the input to the CMAINT program. By placing ASSGN and CONFG control statements behind the Basic Monitor program, and before the first END statement, standard device assignments and the storage-capacity specification can be changed when the Basic Monitor program is replaced.

### Updating of Macro Definitions under Items 8, 10, and 12 of the Distribution Tape

Updating of the macro definitions is identical to the procedure described in the section Inserting IBM-Supplied Macros in the Macro Library.

## COPYING A SYSTEM TAPE

The user may wish to copy a system tape mainly for one of the following reasons:

1. to create an extra system tape, so that the information on the currently used system tape is not lost if the tape becomes unusable;

2. to copy a 7-track system tape, which cannot be used to control a system run, onto a 9-track tape.

The IBM-supplied Copy System Tape (CPSYS) program may be used to copy:

- a 9-track tape onto a 9-track tape,
- a 7-track tape onto a 9-track tape,
- a 9-track tape onto a 7-track tape,
- a 7-track tape onto a 7-track tape.

The CPSYS program is executed under control of the card-resident system. If it is to be used, it must be contained in punched cards.

## I/O DEVICE ASSIGNMENTS

The following symbolic device addresses are used when the CPSYS program is to be executed.

SYSRDR -- Required. Refers to the card reading device on which the Job Control program (if required), job control statements (if any), and the CPSYS program are read.

SYSIPT -- Required. Refers to the tape drive on which the system tape that is to be copied onto another tape is mounted.

SYSOPT -- Required. Refers to the tape drive on which the tape is mounted that is to become a copy of the system tape on SYSIPT.

SYSLOG -- Optional. Refers to the printer on which job control statements are listed.

## CONTROL STATEMENTS

If a Job Control run is required (e.g., for I/O device assignment), the following job control statements must be issued to set up the system for the execution of the CPSYS program:

```
// JOB CPSYS
// EXEC
```

The use of any other job control statements depends on the job control functions requested.

Note: The CPTN control statement must not be included in the job control statements for the CPSYS program.

The CPSYS program does not require program control statements.

## PREPARATION OF THE SYSTEM

The following steps must be taken to execute the CPSYS program under control of the card-resident system.

1. If the card Basic Monitor program is not yet in main storage, follow the procedure described in the section The Card-Resident System.

2. If a Job Control run is required, place the following cards into the hopper of the device assigned to SYSRDR:

   a) phases 00, 01 and 02 of the Job Control program deck,
   b) the cards containing the job control statements, and
   c) phase 03 of the Job Control program deck.

3. Place the CPSYS program deck into the hopper of the device assigned to SYSRDR (immediately behind phase 02 of the Job Control program deck). Press the Start key of the device.

4. Mount the system tape to be copied on the tape drive assigned to SYSIPT; press the Load-Rewind key and the Start key of the drive.

5. Mount the reel of tape onto which the system tape is to be copied on the tape drive assigned to SYSOPT, press the Load-Rewind key and the Start key of the drive.

6. If the printer is to be used for listing job control statements, press the Reset key and the Start key of this device.

7. Press the Start key on the CPU console.

PROGRAMMED HALTS

A number of programmed halts may occur during the loading and execution of the CPSYS program. The halt codes displayed and the associated restart procedures are described in the section Programmed-Halt Displays and Restart Procedures.

DESCRIPTION OF OUTPUT

The output from the CPSYS program is a copy of the system tape, obtained on the tape drive assigned to SYSOPT. The system tape on SYSIPT remains intact.

## UPDATING THE MACRO LIBRARY SECTION OF A SYSTEM TAPE.

If the user wishes to use any macro instructions other than those provided by IBM in his source program, he writes his own macro definitions and includes them in the macro library of his tape-resident system.

Macro definitions that are to be included in the macro library can be contained either in punched cards or on magnetic tape in card-image format.

Any macro definitions that are contained in the macro library but are no longer required by the user can be deleted from the library.

The Macro Maintenance (MMAINT) program provides for the inclusion of IBM-supplied and user-written macro definitions in the macro library and for the deletion of macro definitions that are no longer required. This program must be included in the program library of the user's tape-resident system if the latter is to contain a macro library. The operating procedures for adding user-written macro definitions to, or deleting macro definitions from the macro library, by means of the MMAINT program, are described in the sections that follow. The procedure for inserting IBM-supplied macros into a macro library is detailed in the section Inserting IBM-Supplied Macros in the Macro Library.

### I/O DEVICE ASSIGNMENTS

The following symbolic device addresses are used in preparing and performing the execution of the MMAINT program:

SYSRES -- Required. Assigned at IPL time. Refers to the 9-track tape drive on which the system tape is mounted.

SYSRDR -- Required. Refers to the card reading device on which job control statements and MMAINT control statements are read.

SYSIPT -- Required if macro definitions are to be included in the library. Refers to the card reading device or tape drive on which the macro definitions are read.

SYSOPT -- Required. Refers to the tape drive on which the new system tape (with the updated macro library) is created.

SYS000 -- Required. Refers to the tape drive on which a work tape is mounted.

SYSLST -- Optional. Refers to the printer on which the macro definitions that are to be included in the library are listed. The printer is also used to list diagnostic and information messages.

SYSLOG -- Optional. Refers to the printer on which control statements are listed.

Note: SYSRDR and SYSIPT may be assigned the same card reading device.

### CONTROL STATEMENTS

#### Job Control Statements

The following job control statements are used to set up the system for the execution of the MMAINT program.

| | |
|---|---|
| // JOB MMAINT | Required. |
| // ASSGN | Required for any symbolic address whose device assignment in core storage is to be changed. |
| // CONFG | Required if more than 8K bytes of main storage are available and if the configuration has not already been specified in this run. (Allows faster processing). |
| // EXEC | Required. |

Any other job control statements need be issued only if the corresponding functions are to be requested.

Note: The OPTN control statement must not be included in the job control statements for the MMAINT program.

#### Program Control Statements

The MMAINT program requires the following control statements:

| | |
|---|---|
| // PRIOR n | Required. Must precede each set of DELET and/or CATAL statements referring to one priority section. |
| // CATAL | Required for each macro definition to be included in the macro library. |
| // DELET macro<br>or<br>// DELET ALL | Required for deleting one macro definition (or all macro definitions) contained in a priority section. |

// END — Required. Must be the last program control statement issued.

The operand n in a PRIOR statement can be 1 through 4. Up to four PRIOR statements may be contained in a set of MMAINT control statements. If more than one card containing a PRIOR statement is present, the cards must be arranged in ascending order by n.

The DELET and CATAL control statements (and the associated input) for each priority section must be in alphabetical order by the operation codes of the macro instructions to which they refer. This is illustrated in the example below.

```
// PRIOR 1
// DELET BEXIT
// CATAL (refers to DIVID)
// CATAL (refers to MOVEZ)
// DELET MULT
// CATAL (refers to TEST)
```

If a DELET statement with the operand ALL is issued for a priority section, the card containing this statement must be placed immediately behind the PRIOR card for that section.

## PREPARATION OF THE SYSTEM

The following steps must be taken to prepare the system for the execution of the MMAINT program.

1. If the system run has not yet been initiated, follow the procedure described in the section The Tape-Resident System.
2. Place into the hopper of the device assigned to SYSRDR:
   a) the cards containing the job control statements,
   b) the cards containing the program control statements for the MMAINT program.
3. If a card-reading device has been assigned to SYSIPT, place into the hopper of this device the card deck containing the macro definitions to be included in the library (each macro definition is headed by a MACRO statement and terminated by a MEND statement);
   Note: If SYSIPT has been assigned the same card reading device as SYSRDR, each macro definition to be included in the library must follow the corresponding CATAL card.
4. If a tape drive has been assigned to SYSIPT, mount the reel of tape that contains the macro definitions to be included in the library, and press the Load-Rewind key and the Start key of the tape drive.
5. Mount the reel of tape that is to accomodate the updated system tape on the tape drive assigned to SYSOPT, and press the Load-Rewind key and the Start key of the drive.
6. Mount a work tape on the drive assigned to SYS000, and press the Load-Rewind key and the Start key of the drive.
7. If the printer has been assigned to SYSLST and/or SYSLOG, press the Reset key and the Start key of the printer.
8. Press the Start keys of any required I/O devices that are not yet ready.
9. Press the Start key on the CPU console.

Figure 14 shows the arrangement of input to and output from the MMAINT program.

## PROGRAMMED HALTS

A number of programmed halts may occur during the loading and execution of the MMAINT program.

The halt-code displays and the associated restart procedures are described in the section Programmed-Halt Displays and Restart Procedures.

## MESSAGES

A number of diagnostic messages may be printed on the printer assigned to SYSLST during the execution of the MMAINT program.

A list of these messages and their meaning is contained in the SRL publication IFM System/360 Model 20, Disk and Tape Programming Systems, Assembler Language, Form C24-9002.

## DESCRIPTION OF OUTPUT

The output from the MMAINT program is the updated system tape on the tape drive assigned to SYSOPT. If a printer was assigned to SYSLST, a listing of the included macro definitions (in source format), together with any required messages, is produced.

Note: The updated system tape should be file-protected.

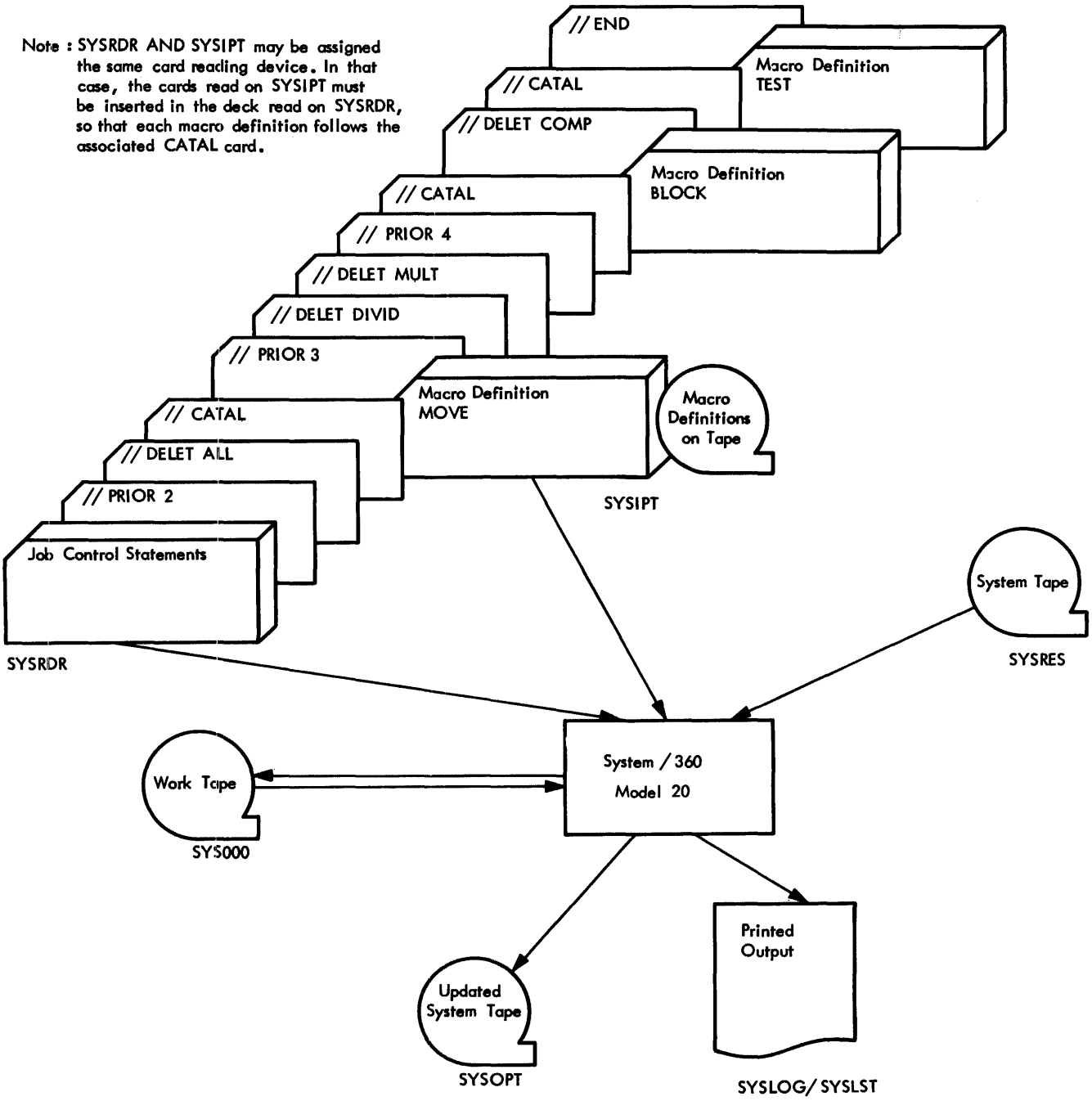



Figure 14. Arrangement of Input and Output of the MMAINT Program

## UPDATING THE PROGRAM LIBRARY SECTION OF A SYSTEM TAPE.

The program library of a tape-resident system can be updated; i.e., program phases can be included in, or deleted from, the library. Both IBM-supplied and user-written program phases may be included or deleted.

The updating is performed by an IBM-supplied service program referred to as the Core-Image Maintenance (CMAINT) program. If this program is to be used, it must be contained in the program library of the user's tape-resident system.

A program phase can be either a complete single-phase program or a phase of a multi-phase program. A phase may have up to 9 subphases. The program phases to be included in the library can be:

1. phases of IBM-supplied programs;
2. phases obtained as output from the TPS Report Program Generator;
3. phases obtained as output from the TPS Assembler program (if they do not require linking and/or relocation);
4. phases obtained as output from the TPS Linkage Editor program (if the output from the Assembler program required linking and/or relocation).
5. phases obtained as output from the TPS Core-Image Service program.

The input phases may be contained either in punched cards or on tape in card-image format.

The Core-Image Maintenance program can also be used to replace the tape Basic Monitor program on the system tape, although this program is not contained in the program library.

### I/O DEVICE ASSIGNMENTS

The following symbolic device addresses are used in preparing and performing the execution of the CMAINT program:

SYSRES -- Required. Assigned at IPL time. Refers to the 9-track tape drive on which the system tape is mounted.

SYSRDR -- Required. Refers to the card reading device on which the cards containing the control statements are read.

SYSIPT -- Required if the Basic Monitor is to be replaced or phases are to be included in the library. Refers to the card-reading device or tape drive on which the Basic Monitor and/or the phases, terminated by an end-of-file card, are read.

SYSOPT -- Required. Refers to the tape drive on which the new system tape (with the updated program library) is created.

SYS000 -- Required. Refers to the tape drive on which a work tape is mounted.

SYSLOG -- Optional. Refers to the printer on which control statements are listed.

Note: SYSRDR and SYSIPT may be assigned the same card reading device.

### CONTROL STATEMENTS

#### Job Control Statements

The following job control statements are used to set up the system for the execution of the CMAINT program:

| | |
|---|---|
| // JOB CMAINT | Required. |
| // ASSGN | Required for any symbolic address whose device assignment in main storage must be changed. |
| // EXEC | Required. |

Any other job control statements need be issued only if the corresponding functions are required.

Note: The OPTN control statement must not be included in the job control statements for the CMAINT program.

#### Program Control Statements

The CMAINT program requires the following control statements:

| | |
|---|---|
| // MONTR | Required only if the tape Basic Monitor program is to be replaced. If it is used, it must be the first control statement. |
| // CATAL | Required for each phase to be included in the program library. |

| | |
|---|---|
| // DELET phase-name | Required for each phase to be deleted from the program library. |
| // END | Required. Must be the last program control statement issued. (If the tape Basic Monitor program is to be replaced, another END control statement is required to indicate the end of that program.) |

The CATAL and DELET control cards (and the associated input phases) must be arranged in alphabetical order by the names of the phases to be included in, or deleted from, the program library.

Note: If the Job Control program is to be replaced, the phase and the associated CATAL control card must precede all other library phases and CATAL or DELET control cards, respectively. The Job Control phase must not be deleted by means of a DELET statement.

## PREPARATION OF THE SYSTEM

The following steps must be taken to prepare the system for the execution of the CMAINT program.

1. If the system run has not yet been initiated, follow the procedure described in the section The Tape-Resident System.

2. Place into the hopper of the device assigned to SYSRDR:
   a) the cards containing the job control statements;
   b) the cards containing the program control statements for the CMAINT program.

3. If a card reading device has been assigned to SYSIPT, place into the hopper of this device the card deck containing the Basic Monitor program (if it is to be replaced) and/or the program phases to be included in the library (each phase is headed by a PHASE statement) and the end-of-file card.

   Note: If SYSIPT has been assigned the same card reading device as SYSRDR, the Basic Monitor deck (if any) must be placed between the MCNTR control card and the first END control card, and each program phase to be included in the library must follow the corresponding CATAL card.

4. If a tape drive has been assigned to SYSIPT and the reel of tape that contains the input phases is not mounted from a previous job, mount the reel on the drive and position SYSIPT by pressing the Load-Rewind key and the start key of the drive.

5. Mount the reel of tape that is to accommodate the updated tape-resident system on the tape drive assigned to SYSOPT, and press the Load-Rewind key and the Start key of the drive.

6. Mount a work tape on the tape drive assigned to SYS000, and press the Load-Rewind key and the Start key of the drive.

7. If control statements are to be listed, press the Reset key and the Start key of the printer (SYSLOG).

8. Press the Start keys of any required I/O devices that are not yet ready.

9. Press the Start key on the CPU console.

Figure 15 shows the arrangement of input to and output from the CMAINT program.

## PROGRAMMED HALTS

A number of programmed halts may occur during the loading and execution of the CMAINT program. The halt-code displays and the associated restart procedures are described in the section Programmed-Halt Displays and Restart Procedures.

## DESCRIPTION OF OUTPUT

The output from the CMAINT program is the updated system tape on the tape drive assigned to SYSOPT. The old tape-resident system (on SYSRES) remains intact and can immediately be used to perform further jobs.

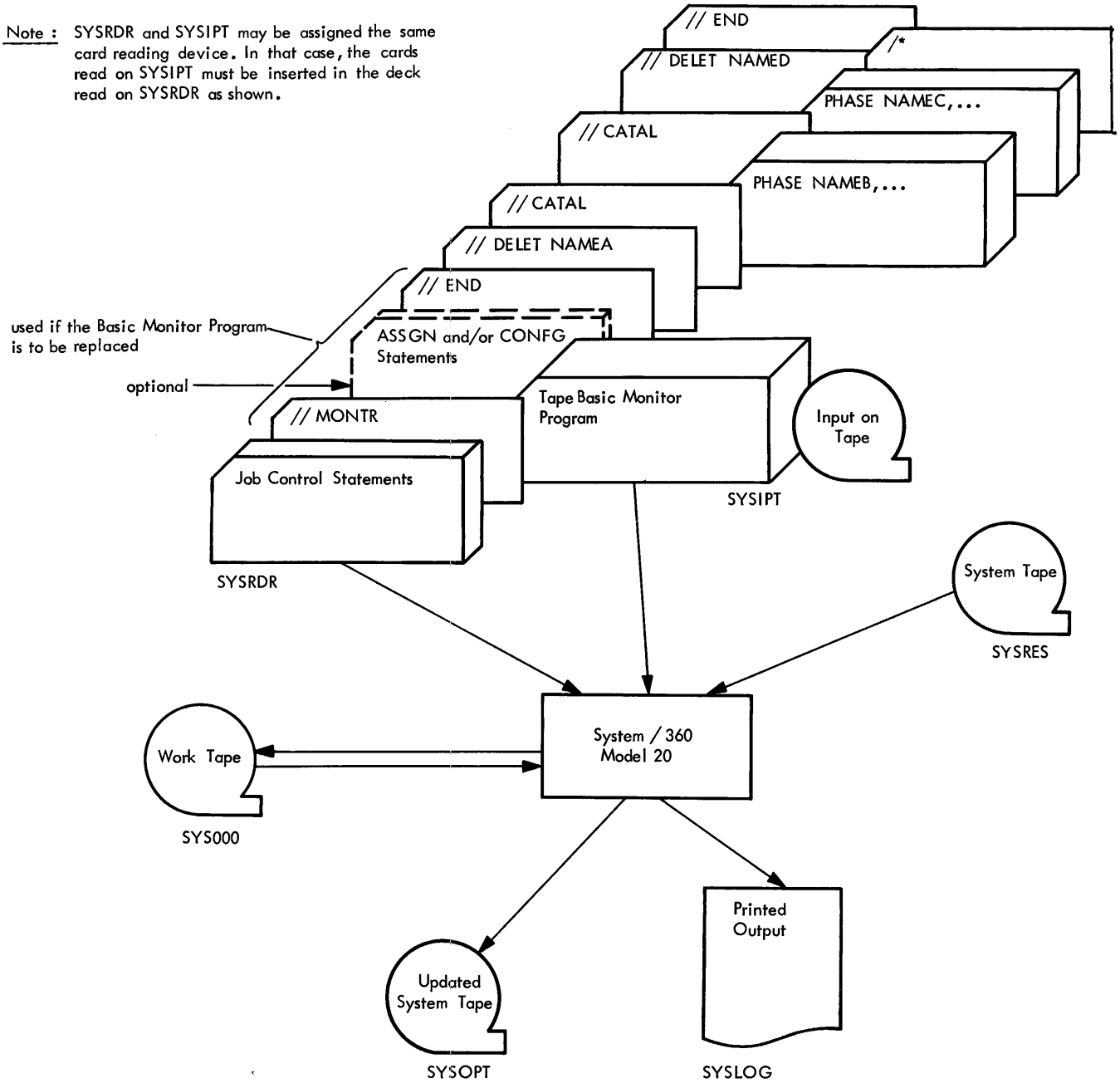



Figure 15. Arrangement of Input and Output of the CMAINT Program

## DISPLAYING DIRECTORIES

Both the program library and the macro library of a system tape contain entries that form a directory to their contents. These directories, which are referred to as the core-image directory and the macro directory, respectively, can be listed on the printer by means of the IBM-supplied Directory Service (DSERV) program, thus affording a survey of the contents of each library at any time.

If the DSERV program is to be used, it must be contained in the program library of the tape-resident system.

Either one or both of the directories may be displayed in one job.

## I/O DEVICE ASSIGNMENTS

The following symbolic device addresses are used in preparing and performing the execution of the DSERV program:

SYSRES -- Required. Assigned at IPL time. Refers to the 9-track tape drive on which the system tape is mounted.

SYSRDR -- Required. Refers to the card reading device on which control cards are read.

SYSLST -- Required. Refers to the printer on which the directories are listed.

SYSLOG -- Optional. Refers to the printer on which control statements are listed.

## CONTROL STATEMENTS

### Job Control Statements

The following job control statements are used to set up the system for the execution of the DSERV program.

| | |
|---|---|
| // JOB DSERV | Required. |
| // ASSGN | Required for any symbolic address whose device assignment in main storage is to be changed. |
| // EXEC | Required. |

Any other job control statements need be issued only if the corresponding functions are to be requested.

Note: The OPTN control statement must not be included in the job control statements for the DSERV program.

### Program Control Statements

The following control statements are used to supply information to the DSERV program.

| | |
|---|---|
| // DSPLY CD | Required if the core-image directory is to be displayed. |
| // DSPLY MD | Required if the macro directory is to be displayed. |
| // DSPLY CD,MD<br>or<br>// DSPLY MD,CD<br>or<br>// DSPLY ALL | Required if both directories are to be displayed. |
| // END | Required. Must be the last program control statement. |

Note: Only one DSPLY control statement is used.

## PREPARATION OF THE SYSTEM

The following steps must be taken to prepare the system for the execution of the DSERV program.

1. If the TPS Basic Monitor program is not yet in main storage, follow the procedure described in the section The Tape-Resident System.
2. Place into the hopper of the device assigned to SYSRDR:
   a) the cards containing the job control statements,
   b) the cards containing the program control statements for the DSERV program.

   Press the Start key of the device.
3. Install forms in the printer; press the Reset key and the Start key of the device.
4. Press the Start key on the CPU console.

## DESCRIPTION OF OUTPUT

The output from the DSERV program is a list of the entries contained in the directory (or directories) specified in the DSPLY control statement.

## USING THE CORE-IMAGE SERVICE PROGRAM

The Core-Image Service program (CSERV) enables the user to check some or all of the programs or program phases contained in the core-image library of his system tape. It also enables him to extract (i.e., punch out) some or all of the contents of the library for such purposes as making corrections or creating back-up.

The program is used to print, in hexadecimal notation, one, several or all program phases from the library, and/or to punch the phases into TXT and END cards. It can also be used to print and/or punch the Tape-Resident Basic Monitor program, which is not contained in the program library.

Output from the CSERV program may be used as input to the Core-Image Maintenance program or to the Load System Tape program.

The CSERV program must be contained in the core-image library of the user's tape-resident system if it is to be used.

## I/O DEVICE ASSIGNMENTS

The following symbolic device addresses are used in preparing and performing the execution of the CSERV program:

SYSRES -- Required. Assigned at IPL time. Refers to the tape drive on which the system tape is mounted.

SYSRDR -- Required. Refers to the card reading device on which job control statements and CSERV control statements are read.

SYS000 -- Required. Refers to the tape drive on which a work tape is mounted.

SYSOPT -- Required if program phases are to be punched into cards. Refers to the card punching device on which the output is to be produced.

SYSLST -- Required if program phases are to be printed. Refers to the printer on which the printed output is to be produced.

SYSLOG -- Optional. Refers to the printer on which control statements, messages, and information on the extracted phases may be printed.

## CONTROL STATEMENTS

### Job Control Statements

The following job control statements are used to set up the system for the execution of the CSERV program.

| | |
|---|---|
| // JOB CSERV | Required. |
| // DATE | Required if the execution of the CSERV program is the first job in a system run. |
| // ASSGN | Required for any symbolic address whose device assignment in main storage is to be changed. |
| // EXEC | Required. |

Any other job control statements (such as FILES or LOG statements) need be issued only if the corresponding functions are required.

The job control statements are read on the device assigned to SYSRDR.

### Program Control Statements

The following program control statements are used to supply information to the CSERV program.

| | |
|---|---|
| // DSPLY phase-name | Required if the program phase whose name appears in the operand field is to be printed. |
| // DSPLY ALL | Required if all program phases contained in the core-image library are to be printed. |
| // DSPLY nnnnnn.ALL | Required if all program phases whose names begin with a character combination identical to that preceding the period in the operand field are to be printed. |
| // DSPLY and // MONTR | Required if the tape Basic Monitor program is to be printed. |
| // PUNCH phase-name | Required if the program phase whose name appears in the operand field is to be punched. |

| | |
|---|---|
| // PUNCH ALL | Required if all program phases contained in the core-image library are to be punched. |
| // PUNCH nnnnnn.ALL | Required if all program phases whose names begin with a character combination identical to that preceding the period in the operand field are to be printed. |
| // PUNCH , | Required if the tape Basic Monitor program is to be punched. |

and

| | |
|---|---|
| // MONTR | |
| // END | Required. Must be the last program control statement. |

As many DSPLY and PUNCH statements as desired may be submitted to the CSERV program in any order.

The program control statements for the CSERV program are read on the device assigned to SYSRDR.

## PREPARATION OF THE SYSTEM

The operator must take the following steps to prepare the system for the execution of the CSERV program.

1. If the system run has not yet been initiated, follow the procedure described in the section The Tape-Resident System.
2. Place into the hopper of SYSRDR:
   - the cards containing the job control statements
   - the cards containing the program control statements.
3. Press the Start key of the device assigned to SYSRDR.
4. If the printer is to be used as SYSLST and/or SYSLOG, prepare and start this device.
5. If a card punching device has been assigned to SYSOPT, place blank cards in the hopper of the device and press the Start key.
6. Mount a work tape on the drive assigned to SYS000. Press the Load-Rewind key and the Start key of this drive.
7. Press the Start key on the CPU console (or the Load key if the execution of the CSERV program is the first job in the system run).

## PROGRAMMED HALTS

A number of programmed halts may occur during the loading and execution of the TPS Core Image Service program. The halt-code displays and the associated restart procedures are described in the section Programmed Halt Displays and Restart Procedures.

## MESSAGES

A number of messages may be printed during execution of the CSERV program. They are printed on either SYSLOG or SYSLST (depending on the kind of message).

## DESCRIPTION OF OUTPUT

The output from the CSERV program consists of:

- printed output, and/or
- output in cards.

### Printed Output

Each phase for which printing has been requested by a DSPLY card is listed on the printer. The listing includes:

- information from the header record for the phase (and any subphases), and
- a hexadecimal print-out of the phase (and any subphases).

### Output in Cards

If a card-punching device has been assigned to SYSOPT, the output requested by means of PUNCH statements comprises the following cards.

a) For the Basic Monitor program:

```
// MONTR
ESD card
TXT cards
END card
// END
// LOADC
```

b) For Library phases:

```
// CATAL (used by the Core-Image Main-
         tenance program)
PHASE card
TXT cards
END card
TXT cards (for any sub-phase)
END card
```

c) At the end of the output file:

```
// END
```

All output cards except those for the Basic Monitor contain identifying information in columns 73 to 79. The identification consists of the first character and the last two characters of the phase name (or, if the name has less than three characters, the name and blank/s), the sub-phase number (0 to 9), and a serial number.

The cards for the Basic Monitor have the letters MNTR in columns 73 to 76, and a serial number in columns 77 - 79.

## USING THE MACRO SERVICE PROGRAM

The Macro Service program (MSERV) enables the user to check individual macro definitions or the complete contents of the macro library on his system tape. It also enables him to punch out some or all of the contents of the library for such purposes as making corrections or creating backup.

The program is used to print one, several, or all of the macro definitions from the library, the listing being in the same form (i.e. one card per line) as the original cards, and/or to punch the macro definitions into cards.

Output from the MSERV program may be used as input to the Macro Maintenance program.

## I/O DEVICE ASSIGNMENTS

The following symbolic device addresses are used in preparing and performing the execution of the MSERV program:

SYSRES -- Required. Assigned at IPL time. Refers to the tape drive on which the system tape is mounted.

SYSRDR -- Required. Refers to the card reading device on which job control statements and MSERV control statements are read.

SYS000 -- Required. Refers to the tape drive on which a work tape is mounted.

SYSOPT -- Required if macro definitions are to be punched into cards. Refers to the card punching device on which the output is to be produced.

SYSLST -- Required if macro definitions are to be printed. Refers to the printer on which the printed output is to be produced.

SYSLOG -- Optional. Refers to the printer on which control statements, messages, and information on the extracted macro definitions may be printed.

## CONTROL STATEMENTS

### Job Control Statements

The following job control statements are used to set up the system for execution of the MSERV program.

| | | |
|---|---|---|
| // JOB | MSERV | Required. |
| // DATE | | Required if the execution of the MSERV program is the first job in a system run. |
| // ASSGN | | Required for any symbolic address whose device assignment in main storage is to be changed. |
| // EXEC | | Required. |

Any other job control statements (such as FILES or LOG statements) need be issued only if the corresponding functions are required.

The job control statements are read on the device assigned to SYSRDR.

### Program Control Statements

The following program control statements are used to supply information to the MSERV program.

| | | |
|---|---|---|
| // DSPLY | macro-name | Required if the macro definition whose name appears in the operand field is to be printed. |
| // DSPLY | ALL | Required if all macro definitions in the macro library are to be printed. |
| // PUNCH | macro-name | Required if the macro definition whose name appears in the operand field is to be punched. |
| // PUNCH | ALL | Required if all macro definitions in the macro library are to be punched. |
| // DSPCH | macro-name | Required if the macro definition whose name appears in the operand field is to be both printed and punched. |
| // DSPCH | ALL | Required if all macro definitions in the macro library are to be both printed and punched. |
| // END | | Required. Must be the last program control statement. |

As many DSPLY, PUNCH and/or DSPCH statements as desired may be submitted to the MSERV program, in any order.

The program control statements for the MSERV program are read on the device assigned to SYSRDR.

## PREPARATION OF THE SYSTEM

The operator must take the following steps to prepare the system for the execution of the MSERV program.

1. If the system run has not already been initiated, follow the procedure described in the section The Tape-Resident System.

2. Place into the hopper of SYSRDR:

   - the cards containing the job control statements
   - the cards containing the program control statements.

3. Press the Start key of the device assigned to SYSRDR.

4. If the printer is to be used as SYSLST and/or SYSLOG, prepare and start this device.

5. If a card punching device has been assigned to SYSOPT, place blank cards in the hopper of the device and press the Start key.

6. Mount a work tape on the drive assigned to SYS000. Press the Load-Rewind key and the Start key of this drive.

7. Press the Start key on the CPU console (or the Load key if execution of the MSERV program is the first job in the system run).

## PROGRAMMED HALTS

A number of programmed halts may occur during the loading and execution of the MSERV program. The halt-code displays and the associated restart procedures are described in the section Programmed Halt Displays and Restart Procedures.

## MESSAGES

A number of messages may be printed during execution of the MSERV program. These messages are printed on either SYSLOG or SYSLST (depending on the kind of message).

## DESCRIPTION OF OUTPUT

The output from the MSERV program consists of:

- printed output, and/or

- output in cards.

The output generated by the DSPLY statement is the same as that generated by the PUNCH statement except for the fact that DSPLY is used to produce a print file and PUNCH a card file. The output of DSPCH is both a card file and a print file.

As the Macro Maintenance (MMAINT) program converts the format of the model and conditional-assembly statements of a macro definition into an internal format for the TPS Assembler at the time they are put onto the system tape, it is not possible to reproduce exactly the same format as that of the original cards. The comments for MMAINT and the original card numbers are lost, and MSERV has to create new card numbers. However, the original symbolic parameters and the sequence symbols will be the same. As a result, it is possible to insert new model and conditional-assembly statements into the card deck produced as output from MSERV and to put the revised macro definition back into the library by means of MMAINT.

The output of MSERV consists of:

```
CATAL
MACRO

prototype statement

model and conditional-assembly
statements

    MEND
```

At the end of the output file there will be a // END card.

The cards will have an identification and a sequence number as follows:

Columns 73 - 75 macro identification consisting of the first character and the last two characters of the macro name.

Columns 76 - 79 sequence number.

The first macro definition of each priority section to be punched will be preceded by a PRIOR control statement referring to that priority section.

## BUILDING ADDITIONAL SYSTEM TAPES FROM IBM-SUPPLIED AND USER-WRITTEN PROGRAMS

In addition to the initial system tape, which is built from IBM-supplied programs exclusively, the user may build other system tapes that are tailored to his requirements. He builds these additional systems from his own object programs and from IBM-supplied programs. Additional system tapes are built by means of the Load System Tape program, which must be contained in punched cards and executed under control of the card-resident system. Each system tape, regardless of whether it is built from IBM-supplied programs only or from a combination of IBM-supplied and user-written programs, must include the tape Basic Monitor program and a program library containing the tape Job Control program.

The programs or program phases to be included in a tape-resident system (i.e., the input to the Load System program) can be either contained in punched cards or stored on magnetic tape in card-image format. Program decks of IBM-supplied programs that are to be included in the system are obtained from the tape supplied by IBM by means of the Distribution-Package Retrieval program. The user's object programs are obtained as punched output from one of the following:

1. The TPS Report Program Generator.
2. The TPS Assembler program (if object programs do not require linking and/or relocation).
3. The TPS Linkage Editor program (if linking and/or relocation of assembled object programs was required).
4. The TPS Core-Image Service program.

The tape Basic Monitor program must be the first program on every system tape.

The programs or program phases to be included in the program library of a system tape must be arranged as follows:

1. Job Control program.
2. Other IBM-supplied and user-written programs in alphabetical order by program (phase) names.

## CONTROL STATEMENTS

### Job Control Statements

If a Job Control run is required, the following job control statements must be issued to the card Job Control program to set up the system for the loading and execution of the Load System Tape program:

```
// JOB LDSYS
// EXEC
```

The use of any other job control cards depends on the Job Control functions required (e.g., the listing of control statements or I/O device assignments).

Note: The OPTN control statement must not be included in the job control statements for the LDSYS program.

### Program Control Statements

The following control statements are required to supply information to the Load System Tape program:

```
// MONTR
// END
// LOADC
// END
```

The cards containing these control statements are normally supplied by the programmer. The operator must ensure that they are present and that they are located in the proper place. If the input to the Load System Tape program is on tape, the LOADC control statement and the second END control statement must also be stored on the input tape, in card-image format (see Figure 14).

## I/O DEVICE ASSIGNMENTS

The following symbolic I/O device addresses are used in preparing and performing the execution of the LDSYS program:

SYSRDR -- Required. Refers to the card reading device for reading:

1. the Job Control program (if required),
2. job control statements (if any),
3. the Load System Tape program,
4. the MONTR control statement,
5. any ASSGN and/or CONFG control statements used to insert or change standard assignments and/or change the storage capacity specification in the tape Basic Monitor program, and

6. an END control statement.

SYSIPT -- Required. Refers to the card reading device or tape drive used for reading:

1. the tape Basic Monitor program,
2. the LOADC control statement,
3. the input programs and/or program phases, and
4. an END control statement.

SYSOPT -- Required. Refers to the tape drive on which the reel to accommodate the tape-resident system is mounted.

SYS000 -- Required. Refers to the tape drive on which a work tape is mounted.

Note: SYSRDR and SYSIPT may be assigned the same card reading device.

PREPARATION OF THE SYSTEM

The following steps must be taken by the operator to execute the Load System Tape program under control of the card-resident system.

1. If the system run has not yet been initiated, follow the procedure described in the section The Card-Resident System.

2. If a Job Control run is required, place the Job Control program deck and the job control cards (between phase 02 and phase 03 of the Job Control program deck) into the hopper of the device assigned to SYSRDR.

3. Place the Load System Tape program deck, followed by the MONTR control card, into the hopper of the device assigned to SYSRDR (behind the EXEC control card).

4. If SYSIPT has been assigned the same card reading device as SYSRDR,

   - place the tape Basic Monitor deck into the hopper of the device, behind the MONTR control card;
   - place any ASSGN and/or CONFG cards behind the tape Basic Monitor deck;
   - place an END control card behind the last card in the hopper (ASSGN or CONFG card or, if no such cards are used, last card of the tape Basic Monitor deck);
   - place the input phases, preceded by the LOADC control card and followed by another END control card, into the hopper of the device, behind the first END card.

   If SYSIPT has been assigned a card reading device other than that assigned to SYSRDR,

   - place into the hopper of SYSRDR, behind the MONTR control card, any ASSGN and/or CONFG cards used for modifying the tape Basic Monitor program, followed by an END control card;
   - place into the hopper of SYSIPT, in the order indicated, the tape Basic Monitor deck, the LOADC control card, the input phases, and an END control card.

   If SYSIPT has been assigned a tape drive,

   - place into the hopper of SYSRDR, behind the MONTR control card, any ASSGN and/or CONFG cards used for modifying the tape Basic Monitor program, followed by an END card;
   - mount on the tape drive assigned to SYSIPT the tape reel on which the tape Basic Monitor program, the LOADC control statement, the input phases, and the END control statement are stored in card-image format; press the Load-Rewind key and the Start key of the drive.

5. Mount on the tape drive assigned to SYSOPT the reel of tape which is to accommodate the tape-resident system; press the Load-Rewind key and the Start key of the drive.

6. Mount a work tape on the tape drive assigned to SYS000; press the Load-Rewind key and the Start key of the drive.

7. Press the Start keys of all required I/O devices that are not yet ready.

8. Press the Start key on the CPU console.

The Job Control program (if used) is now loaded into main storage, and the job control statements (if any) are processed to set up the system for the execution of the Load System Tape program. Then, the Load System Tape program is loaded into main storage and executed.

Figure 16 shows the arrangement of input for the building of a tape-resident system.

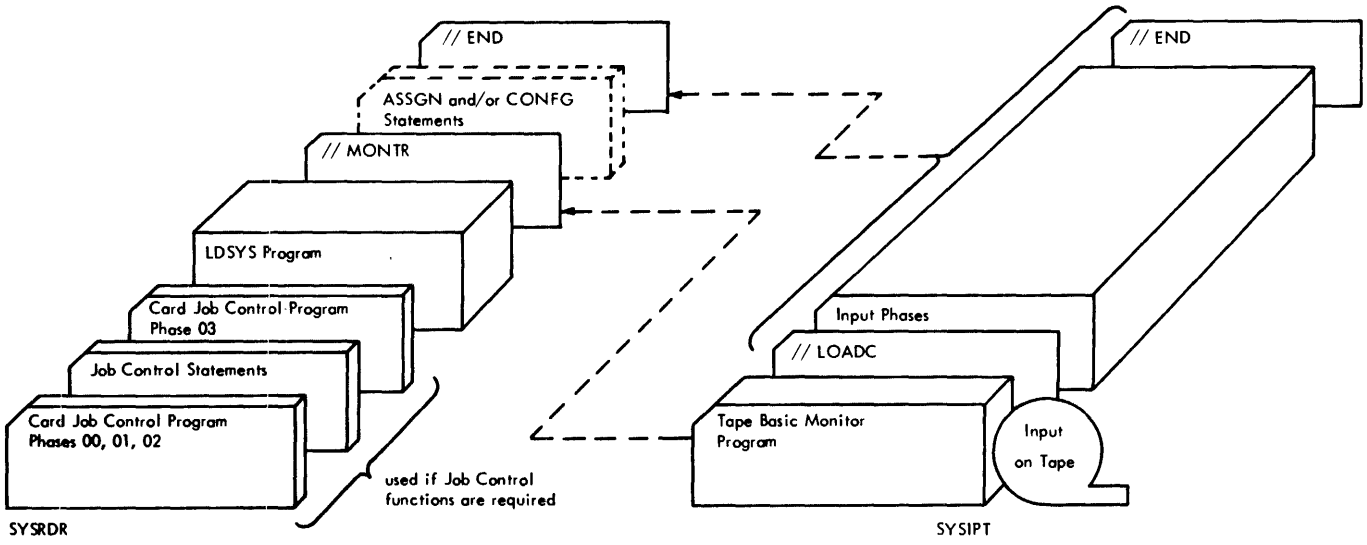
ERROR HALTS

A number of programmed halts may occur during the loading and execution of the Load System Tape program. The halt codes displayed and the appropriate restart procedures are described in the section Programmed-Halt Displays and Restart Procedures.

DESCRIPTION OF OUTPUT

The output of the Load System Tape program is an operable tape-resident system on the tape mounted on the drive assigned to SYSCPT.

Note: The system tape should be file-protected.




Note: SYSRDR and SYSIPT may be assigned the same card reading device. In that case, the cards read on SYSIPT must be placed in the deck read on SYSRDR as indicated by the broken lines.

●Figure 16. Arrangement of Input for the Execution of the LDSYS Program

In addition to the Basic Assembler sample program, which is described in the SRL publication IBM System/360 Model 20, Card Programming Support, Basic Assembler (Tape Versions) Operating Procedures, Form C24-9011, six sample programs for the Tape Programming System are provided in card-image format on the tape supplied by IBM. The sample decks are obtained by means of the Distribution-Package Retrieval Program.

In the following descriptions, in cases where a sample program consists of several parts, it is assumed that the sample program is executed in one continuous run.

## SAMPLE PROGRAM 1

The first sample program is designed to demonstrate:

- the use of the Assembler program,
- the use of the macro library,
- the execution of object programs under control of the card-resident system,
- the execution of object programs stored on tape in card-image format under control of the tape-resident system (execute-loader function),
- the use of the Core-Image Maintenance program,
- the execution of object programs contained in the program library of the tape-resident system.

### DESCRIPTION OF THE SAMPLE DECK

The sample-program cards are identified by the letter O in column 73.

The deck consists of nine card groups, which are identified by different digits in card columns 74-75 (see list below).

Card column 76 contains a 2 (identification for TPS).

Card columns 77-79 contain consecutive card numbers, which begin with 001 for each card group. Sample deck 1 consists of the following card groups:

| Columns 74 | 75 | Description |
|---|---|---|
| 9 | 0 | Job control cards for execution of the Assembler program with output in punched cards. |
| 9 | 1 | Source program in Assembler language. |
| 9 | 2 | Job control cards for execution of the assembled sample program (in cards) under control of the card-resident system. |
| 9 | 3 | Job control cards for execution of the Assembler program with output on tape. |
| 9 | 4 | Job control cards for execution of the assembled sample program (on tape in card-image format) under control of the tape-resident system. |
| 9 | 5 | Job control cards and program control cards for execution of the CMAINT program. |
| 9 | 6 | Job control cards for execution of the assembled sample program (contained in the program library) under control of the tape-resident system. |
| 9 | 7 | Job control cards for execution of the Initialize-Tape program. |
| 9 | 8 | Program control cards for the Initialize-Tape program. |

Figures 17 through 24 show the card groups of Sample Program 1.

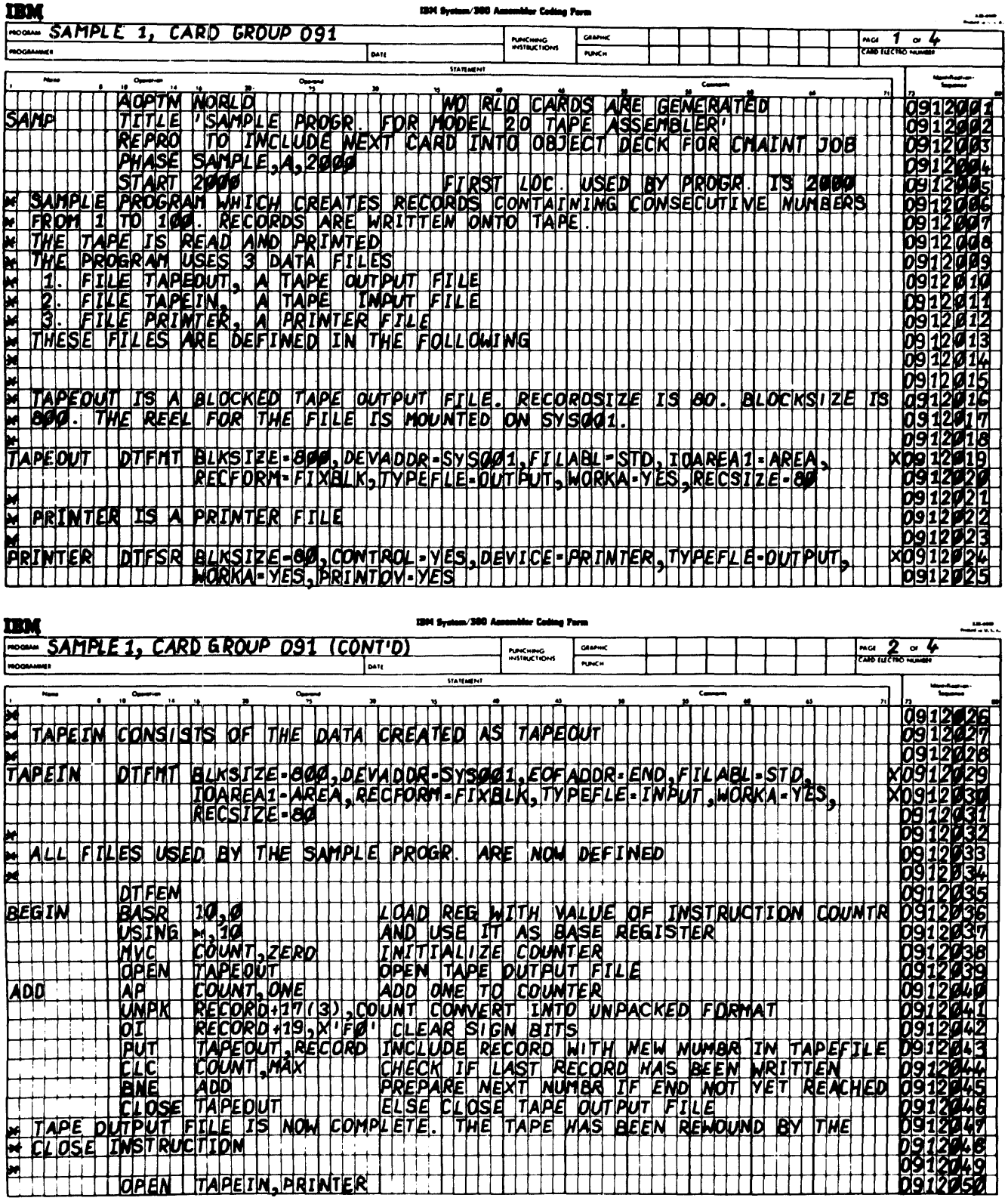
IBM System/360 Assembler Coding Form

PROGRAM SAMPLE 1, CARD GROUP 090 | PUNCHING INSTRUCTIONS | GRAPHIC | PUNCH | PAGE 1 OF 1 | CARD ELECTRO NUMBER

PROGRAMMER | DATE

| Name | Operation | Operand | Comments | Identification-Sequence |
|---|---|---|---|---|
| // | ASSGN | SYSRES,X'732',T2 | PLACE THIS CARD IN THE IPL DECK | 09020001 |
| // | ASSGN | SYSRDR,X'100',R4 | 2501 CARD READER | 09020002 |
| // | LOG | | PRINT JOB CONTROL CARDS | 09020003 |
| // | JOB | ASSEMBLER | ASSEMBLY WITH OUTPUT IN CARDS | 09020004 |
| // | DATE | 65002 | JANUARY 2,1963 | 09020005 |
| // | ASSGN | SYSIPT,X'100',R4 | 2501 CARD READER | 09020006 |
| // | ASSGN | SYSOPT,X'200',R7 | 2560 SECONDARY FEED | 09020007 |
| // | ASSGN | SYS000,X'780',T2 | 9-TRACK DRIVE FOR WORK TAPE 1 | 09020008 |
| // | ASSGN | SYS001,X'781',T2 | 9-TRACK DRIVE FOR WORK TAPE 2 | 09020009 |
| // | EXEC | | EXECUTE ASSEMBLER PROGRAM | 09020010 |

Figure 17. Job Control Statements for Assembly with Output in Cards



IBM — IBM System/360 Assembler Coding Form

PROGRAM: SAMPLE 1, CARD GROUP 091 — PAGE 1 OF 4

```
         AOPTN NORLD                    NO RLD CARDS ARE GENERATED
SAMP     TITLE 'SAMPLE PROGR. FOR MODEL 20 TAPE ASSEMBLER'
         REPRO  TO INCLUDE NEXT CARD INTO OBJECT DECK FOR CMAINT JOB
         PHASE SAMPLE,A,2000
         START 2000                     FIRST LOC. USED BY PROGR. IS 2000
* SAMPLE PROGRAM WHICH CREATES RECORDS CONTAINING CONSECUTIVE NUMBERS
* FROM 1 TO 100. RECORDS ARE WRITTEN ONTO TAPE.
* THE TAPE IS READ AND PRINTED
* THE PROGRAM USES 3 DATA FILES
*  1. FILE TAPEOUT, A TAPE OUTPUT FILE
*  2. FILE TAPEIN,  A TAPE  INPUT FILE
*  3. FILE PRINTER, A PRINTER FILE
* THESE FILES ARE DEFINED IN THE FOLLOWING
*
*
* TAPEOUT IS A BLOCKED TAPE OUTPUT FILE. RECORDSIZE IS 80. BLOCKSIZE IS
* 800. THE REEL FOR THE FILE IS MOUNTED ON SYS001.
*
TAPEOUT  DTFMT BLKSIZE=800,DEVADDR=SYS001,FILABL=STD,IOAREA1=AREA,      X
               RECFORM=FIXBLK,TYPEFLE=OUTPUT,WORKA=YES,RECSIZE=80
*
* PRINTER IS A PRINTER FILE
*
PRINTER  DTFSR BLKSIZE=80,CONTROL=YES,DEVICE=PRINTER,TYPEFLE=OUTPUT,     X
               WORKA=YES,PRINTOV=YES
```

IBM — IBM System/360 Assembler Coding Form

PROGRAM: SAMPLE 1, CARD GROUP 091 (CONT'D) — PAGE 2 OF 4

```
*
* TAPEIN CONSISTS OF THE DATA CREATED AS TAPEOUT
*
TAPEIN   DTFMT BLKSIZE=800,DEVADDR=SYS001,EOFADDR=END,FILABL=STD,        X
               IOAREA1=AREA,RECFORM=FIXBLK,TYPEFLE=INPUT,WORKA=YES,      X
               RECSIZE=80
*
* ALL FILES USED BY THE SAMPLE PROGR. ARE NOW DEFINED
*
         DTFEN
BEGIN    BASR  10,0            LOAD REG WITH VALUE OF INSTRUCTION COUNTR
         USING *,10            AND USE IT AS BASE REGISTER
         MVC   COUNT,ZERO      INITIALIZE COUNTER
         OPEN  TAPEOUT         OPEN TAPE OUTPUT FILE
ADD      AP    COUNT,ONE       ADD ONE TO COUNTER
         UNPK  RECORD+17(3),COUNT CONVERT INTO UNPACKED FORMAT
         OI    RECORD+19,X'F0' CLEAR SIGN BITS
         PUT   TAPEOUT,RECORD  INCLUDE RECORD WITH NEW NUMBR IN TAPEFILE
         CLC   COUNT,MAX       CHECK IF LAST RECORD HAS BEEN WRITTEN
         BNE   ADD             PREPARE NEXT NUMBR IF END NOT YET REACHED
         CLOSE TAPEOUT         ELSE CLOSE TAPE OUTPUT FILE
* TAPE OUTPUT FILE IS NOW COMPLETE. THE TAPE HAS BEEN REWOUND BY THE
* CLOSE INSTRUCTION
*
         OPEN  TAPEIN,PRINTER
```

Figure 18. Source Statements, Part 1 of 2

IBM System/360 Assembler Coding Form

PROGRAM SAMPLE 1, CARD GROUP 091 (CONT'D) | PUNCHING INSTRUCTIONS | GRAPHIC | PUNCH | PAGE 3 OF 4 | CARD ELECTRO NUMBER

PROGRAMMER | DATE

STATEMENT

| Name | Operation | Operand | Comments | Identification-Sequence |
|---|---|---|---|---|
| | CNTRL | PRINTER,SK,1 | RESTORE CARRIAGE | 09120051 |
| READIN | GET | TAPEIN,AREAPR | BRING NEXT REC. FROM TAPEFILE INTO WORKAR | 09120052 |
| | PUT | PRINTER,AREAPR | PRINT THIS RECORD | 09120053 |
| | PRTOV | PRINTER,12 | TEST CHANNEL 12 | 09120054 |
| | B | READIN | REPEAT | 09120055 |
| * | | | | 09120056 |
| * EOF ROUTINE IS ENTERED WHEN TRAILER LABELS HAVE BEEN PROCESSED BY THE | | | | 09120057 |
| * IOCS | | | | 09120058 |
| * | | | | 09120059 |
| END | CNTRL | PRINTER,SK,1 | RESTORE CARRIAGE | 09120060 |
| | PUT | PRINTER,MESSAGE | PRINT END MESSAGE | 09120061 |
| | CNTRL | PRINTER,SK,1 | | 09120062 |
| | CLOSE | PRINTER,TAPEIN | | 09120063 |
| | EOJ | , | TRANSFER CONTROL TO EOJ ROUT. OF MONITOR | 09120064 |
| * | | | | 09120065 |
| * CONSTANTS AND AREAS | | | | 09120066 |
| * | | | | 09120067 |
| COUNT | DS | CL2 | AREA USED TO INCREMENT RECORD NUMBER | 09120068 |
| ZERO | DC | PL2'0' | ZERO TO INITIALIZE COUNTER | 09120069 |
| ONE | DC | PL2'1' | | 09120070 |
| MAX | DC | PL2'100' | HIGHEST RECORD NUMBER | 09120071 |
| RECORD | DC | CL32'SAMPLE RECORD NO' | TEXT FOR RECORD. RECORD NUMBER | 09120072 |
| | DC | CL32' ' | IS INSERTED BY PROGRAM. | 09120073 |
| | DC | CL16' ' | | 09120074 |
| AREA | DS | CL256 | I/O AREA FOR TAPEOUT AND TAPEIN FILES | 09120075 |

IBM System/360 Assembler Coding Form

PROGRAM SAMPLE 1, CARD GROUP 091 (CONT'D) | PUNCHING INSTRUCTIONS | GRAPHIC | PUNCH | PAGE 4 OF 4 | CARD ELECTRO NUMBER

PROGRAMMER | DATE

STATEMENT

| Name | Operation | Operand | Comments | Identification-Sequence |
|---|---|---|---|---|
| | DS | CL256 | | 09120076 |
| | DS | CL256 | | 09120077 |
| | DS | CL32 | | 09120078 |
| AREAPR | DS | CL80 | WORKAREA FOR PRINTER AND TAPEIN FILES | 09120079 |
| MESSAGE | DC | CL32' END OF SAMPLE PROGRAM' | | 09120080 |
| | DC | CL32' ' | | 09120081 |
| | DC | CL16' ' | | 09120082 |
| | END | BEGIN | | 09120083 |
| /* | | | | 09120084 |

Figure 18. Source Statements, Part 2 of 2

IBM System 360 Assembler Coding Form

PROGRAM SAMPLE 1, CARD GROUP 092 | PUNCHING INSTRUCTIONS | GRAPHIC | PUNCH | PAGE 1 OF 1 | CARD ELECTRO NUMBER

PROGRAMMER | DATE

STATEMENT

| Name | Operation | Operand | Comments | Identification-Sequence |
|---|---|---|---|---|
| // | LOG | | PRINT JOB CONTROL CARDS | 00220001 |
| // | JOB | SAMPLE | EXECUTION UNDER CARD CONTROL | 00220002 |
| // | DATE | 68002 | JANUARY 2, 1968 | 00220003 |
| // | ASSGN | SYS001,X'781',T2 | 9-TRACK DRIVE FOR WORK TAPE | 00220004 |
| // | VOL | SYS001,TAPEOUT | LABEL INFORMATION OUTPUT | 00220005 |
| // | TPLAB | 'SAMPLE PROGRAM 000001000100001000100 68002 68002' | | 00220006 |
| // | VOL | SYS001,TAPEIN | LABEL INFORMATION INPUT | 00220007 |
| // | TPLAB | 'SAMPLE PROGRAM 000001000100001000100 68002 68002' | | 00220008 |
| // | EXEC | | EXECUTE SAMPLE PROGRAM | 00220009 |

Figure 19. Job Control Statements For Execution under Control of the Card-Resident System

IBM System 360 Assembler Coding Form

PROGRAM SAMPLE 1, CARD GROUP 093 | PUNCHING INSTRUCTIONS | GRAPHIC | PUNCH | PAGE 1 OF 1 | CARD ELECTRO NUMBER

PROGRAMMER | DATE

| Name | Operation | Operand | Comments | Identification-Sequence |
|---|---|---|---|---|
| // | LOG | | PRINT JOB CONTROL CARDS | 09320001 |
| // | JOB ASSEMBLER | | ASSEMBLY WITH OUTPUT ON TAPE | 09320002 |
| // | DATE 68002 | | JANUARY 2, 1968 | 09320003 |
| // | ASSGN SYSIPT,X'100',R | | 2501 CARD READER | 09320004 |
| // | ASSGN SYSOPT,X'783',T2 | | 9-TRACK DRIVE FOR OUTPUT TAPE | 09320005 |
| // | ASSGN SYS000,X'780',T2 | | 9-TRACK DRIVE FOR WORK TAPE 1 | 09320006 |
| // | ASSGN SYS001,X'781',T2 | | 9-TRACK DRIVE FOR WORK TAPE 2 | 09320007 |
| // | EXEC | | EXECUTE ASSEMBLER PROGRAM | 09320008 |

Figure 20. Job Control Statements for Assembly with Output on Tape

IBM System 360 Assembler Coding Form

PROGRAM SAMPLE 1, CARD GROUP 094 | PUNCHING INSTRUCTIONS | GRAPHIC | PUNCH | PAGE 1 OF 1 | CARD ELECTRO NUMBER

PROGRAMMER | DATE

| Name | Operation | Operand | Comments | Identification-Sequence |
|---|---|---|---|---|
| // | JOB SAMPLE | | EXECUTE UNDER TAPE CONTROL | 09420001 |
| // | ASSGN SYSIPT,X'783',T2 | | DRIVE FOR TAPE WITH OBJECT PR | 09420002 |
| // | FILES SYSIPT,REW | | LOAD-REWIND SYSOPT 093 | 09420003 |
| // | VOL SYS001,TAPEOUT | | LABEL INFORMATION OUTPUT | 09420004 |
| // | TPLAB 'SAMPLE PROGRAM | 0000010000100001000100 68002 68002' | | 09420005 |
| // | VOL SYS001,TAPEIN | | LABEL INFORMATION INPUT | 09420006 |
| // | TPLAB 'SAMPLE PROGRAM | 0000010000100001000100 68002 68002' | | 09420007 |
| // | EXEC LOADER | | EXECUTE SAMPLE PROGRAM | 09420008 |

●Figure 21. Job Control Statements for Execution by means of Execute-Loader Function

IBM System 360 Assembler Coding Form

PROGRAM SAMPLE 1, CARD GROUP 095 | PUNCHING INSTRUCTIONS | GRAPHIC | PUNCH | PAGE 1 OF 1 | CARD ELECTRO NUMBER

PROGRAMMER | DATE

| Name | Operation | Operand | Comments | Identification-Sequence |
|---|---|---|---|---|
| // | JOB CMAINT | | INCLUDE SAMPLE PROG. IN LIBRARY | 09520001 |
| // | ASSGN SYSIPT,X'783',T2 | | DRIVE FOR TAPE WITH OBJECT PR. | 09520002 |
| // | FILES SYSIPT,REW | | | 09520003 |
| // | ASSGN SYS000,X'780',T2 | | DRIVE FOR WORK TAPE | 09520004 |
| // | ASSGN SYSOPT,X'781',T2 | | DRIVE FOR UPDATED SYSTEM TAPE | 09520005 |
| // | EXEC | | EXECUTE CMAINT PROGRAM | 09520006 |
| // | CATAL | | PROGRAM CONTROL CARDS FOR IN- | 09520007 |
| // | END | | CLUDING SAMPLE PROG. | 09520008 |

●Figure 22. Job Control and Program Control Statements for Core-Image Maintenance

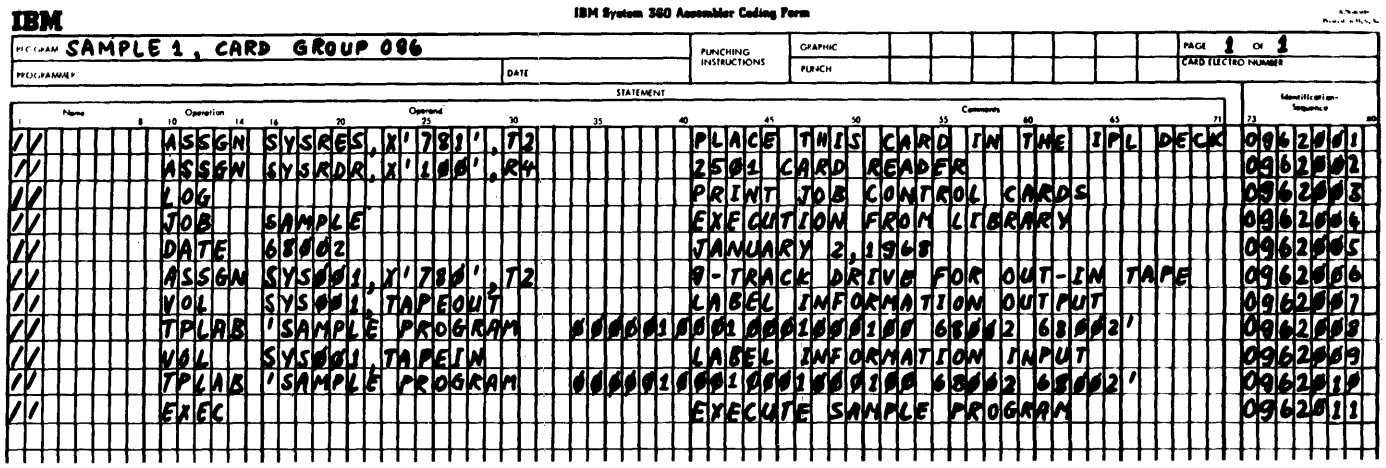



Figure 23. Job Control Statements for Execution from Core-Image Library

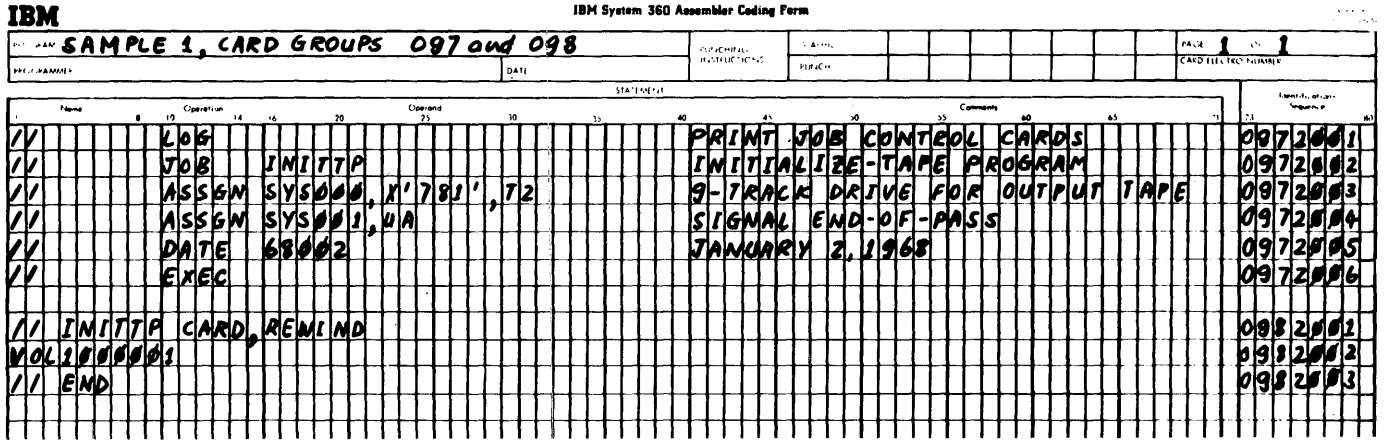



Figure 24. Job Control and Program Control Statements for Initialize-Tape Program

## OPERATING PROCEDURES

The sample deck supplied by IBM is designed for Model 20 systems with a storage capacity of 8192 bytes and the following I/O devices:

- an IBM 2501 Card Reader,
- an IBM 2560 MFCM,
- an IBM 1403 Printer,
- an IBM 2415 Magnetic Tape Unit, Model 2, 3, 5, or 6 (9-track drives with unit numbers 80, 81, 82, 83).

If the user's Model 20 system has a different I/O configuration or different tape unit numbers, the ASSGN cards in the sets of job control cards and/or the REP cards supplied with the control programs (card Basic Monitor and tape IPL, respectively) must be changed accordingly.

### Assembly with Output in Cards

The following steps must be taken to assemble the source program and obtain the executable object program in punched cards.

1. Mount the system tape (containing the TPS Assembler program and the macro library with the Basic Monitor and IOCS macro definitions) on the tape drive assigned to SYSRES (see ASSGN card in group 090). Press the Load-Rewind key and the Start key of the device.
2. Mount work tapes on the tape drives assigned to SYS000 and SYS001 (see ASSGN cards in group 090). Press the Load-Rewind keys and Start keys of the drives.
3. Remove the ASSGN cards for SYSRES and SYSRDR from card group 090 and place them in the IPL deck, in front of the REP cards (if used) and the end-of-file card. Place this card deck into the

hopper of the loading unit (2501 in the example).

4. Place card group 090 (job control cards) into the hopper of SYSRDR (2501 in the example).

5. Place card group 091 (sample source program) into the hopper of SYSIPT (2501 in the example). Press the Start key of the device.

6. Place blank cards into the hopper of SYSOPT (2560 secondary feed in the example) and press the Start key of the device.

7. Install forms in the printer (1403 in the example) and press the Reset key and the Start key of the device.

8. Set the Register-Data/Address switches on the CPU console to an even core storage address between hexadecimal 009C and the end-of-storage address minus hexadecimal 0052.

9. Set the Mode switch on the CPU console to PROCESS.

10. Press the Load key on the CPU console.

A sample of the Assembler listing obtained on the printer is shown in Figure 25.

The object program, contained in punched cards, is obtained on SYSOPT. The system then halts and code 01D0 is displayed.

## Execution Under Control of the Card-Resident System

The execution of the sample program requires a tape on the drive assigned to SYS001 (see ASSGN card in group 092). This tape must contain a volume label with the volume serial number 000001.

The following steps must be taken to write this label on tape by means of the Initialize-Tape Utility program.

1. The system tape (containing the Initialize-Tape Utility program) remains on the tape drive assigned to SYSRES from the previous run.

2. The tape on the drive assigned to SYS-000 (see ASSGN card in group 097) is already positioned at the load point from the previous run.

3. Place the tape IPL deck (containing ASSGN cards for SYSRES and SYSRDR from the previous run) into the hopper of the loading unit (2501 in the example).

4. Place group 097 (job control statements) and card group 098 (program control statements) into the hopper of SYSRDR (2501 in the example), and press the Start key of the device.

5. Set the Register-Data/Address switches on the CPU console to an even main storage address between hexadecimal 009C and the end-of-storage address minus hexadecimal 0052.

6. Set the Mode switch on the CPU console to PROCESS.

7. Press the Load key on the CPU console.

After the volume label has been written onto tape, the system halts and code 01D0 is displayed.

The following steps must be taken to execute the object program obtained as card output from the Assembler under control of the card-resident system.

1. Place the card IPL deck into the hopper of the loading unit (2501 in the example).

2. Prepare the appropriate ASSGN card for SYSRDR and place it behind the IPL deck.

3. Place the card Basic Monitor deck into the hopper of the loading unit.

4. Place the following cards into the hopper of SYSRDR:

   - phases 00, 01 and 02 of the Job Control program deck,
   - card group 092 (job control cards), and
   - phase 03 of the Job Control program.

5. Place the sample object deck into the hopper of SYSRDR.

6. Press the Start key(s) of the card reading device(s) used.

7. Press the Reset key and the Start key of the printer.

8. The initialized tape is mounted on the tape drive assigned to SYS001 (see ASSGN card in group 092) and positioned at the load point, from the previous run.

9. Set the Register-Data/Address switches on the CPU console to an even main storage address between hexadecimal 009C and the end-of-storage address minus hexadecimal 0052.

10. Set the Mode switch on the CPU console to PROCESS.

11. Press the Load key on the CPU console.

A list of job control statements is obtained on the printer.

The sample program creates 100 data records and writes them onto the tape. It then reads the records from the tape and lists them on the printer.

When the execution is completed, the system halts and the code 0B20 is displayed.

If the next job is to be executed, the initialized tape, which is mounted on the drive assigned to SYS001, must be unloaded and kept for later use.

Assembly with Output on Tape and Execution by Means of Execute-Loader Function

The following steps must be taken to assemble the sample source program with output on tape and to execute the program from this tape (two stacked jobs).

1. The system tape (containing the TPS Assembler program and the macro library with Basic Monitor and IOCS macro definitions) remains on the tape drive assigned to SYSRES from the previous run.

2. Mount an appropriate output tape on the drive assigned to SYSOPT (see ASSGN card in group 093). Press the Load-Rewind key and the Start key of the drive.

3. Mount work tapes on the drives assigned to SYS000 and SYS001 (see ASSGN cards in group 093.) Press the Load-Rewind keys and the Start keys of the drives.

4. Place the tape IPL deck (containing ASSGN cards for SYSRES and SYSRDR from the previous runs) into the hopper of the loading unit (2501 in the example).

5. Place card group 093 (job control cards for assembly) into the hopper of SYSRDR (2501 in the example).

6. Place card group 091 (sample source program) into the hopper of SYSIPT (2501 in the example).

7. Place card group 094 (job control cards for execution) into the hopper of SYSRDR.

8. Press the Start key(s) of the card reading device(s) used.

9. Press the Reset key and the Start key of the printer.

10. Set the Register-Data/Address switches on the CPU console to an even main storage address between hexadecimal 009C and the end-of-storage address minus hexadecimal 0052.

11. Set the Mode switch on the CPU console to PROCESS.

12. Press the Load key on the CPU console.

The Assembler listing (Figure 25) is obtained on the printer. The object program is written onto the tape mounted on SYSOPT.

When the assembly has been completed, the Job Control program is called. The Job Control program reads the job control statements for execution and loads the object program into storage from the tape.

Execution begins with label checking on SYS001, and since the Assembler work tape is still mounted on this drive, a system halt occurs and the code 0E0A is displayed.

To resume operation, take the following steps:

1. Remove the tape reel from SYS001.

2. Mount the initialized tape with volume serial number 000001 on the tape drive, and press the Load-Rewind key and the Start key of the drive.

3. Enter FF into location 00CE.

4. Press the Start key on the CPU console.

Label checking is now performed on the tape, and the sample program is executed. The list of records is produced on the printer. The system halts and code 01D0 is displayed.

If the next job is to be executed immediately, the initialized tape (on the drive assigned to SYS001) must be unloaded and kept for later use.

Assembly with Output on Tape, Core-Image Maintenance, and Execution from the Program Library

The following steps must be taken to assemble the sample source program with output on tape, include the object program in the program library, load the program from the library and execute it.

1. The system tape (containing the TPS Assembler program, the CMAINT program, and the macro definitions) remains on

the tape drive assigned to SYSRES from the previous run.

2. Mount an output tape (for the assembly) on the tape drive assigned to SYSOPT (see ASSGN card group 093). Press the Load-Rewind key and the Start key of the drive.

3. Mount work tapes on the drives assigned to SYS000 and SYS001 (see ASSGN cards in group 093). Press the Load-Rewind keys and the Start keys of the drives.

4. Place the tape IPL deck (containing ASSGN cards for SYSRES and SYSRDR from previous runs) into the hopper of the loading unit (2501 in the example).

5. Place card group 093 (job control cards for assembly) into the hopper of SYSRDR (2501 in the example).

6. Place card group 091 (sample source program) into the hopper of SYSIPT (2501 in the example).

7. Place card group 095 (control cards for CMAINT) into the hopper of SYSRDR.

8. Press the Start key(s) of the card device(s) used.

9. Press the Reset key and the Start key of the printer.

10. Set the Register-Data/Address switches on the CPU console to an even main storage address between hexadecimal 009C and the end-of-storage address minus hexadecimal 0052.

11. Set the Mode switch on the CPU console to PROCESS.

12. Press the Load key on the CPU console.

The Assembler program is executed first. A listing (Figure 25) is obtained on the printer, and the object program is produced on the tape drive assigned to SYSOPT in card group 093. The Job Control program is called into storage. It reads the job control cards for CMAINT and loads the CMAINT program. The CMAINT program is executed, and the updated system tape (containing the sample object program) is produced on the drive assigned to SYSOPT in card group 095. The system halts and code 01D0 is displayed.

To prepare the execution of the sample program contained in the program library of the new system tape, perform the following steps:

1. Remove the updated system tape from SYSOPT (see ASSGN card in group 095) and remove the file-protection ring. (The read-write head must be raised in order to change the status of the file-protection). Re-mount the reel on the drive, press the Load-Rewind key and the Start key of the drive.

2. Remove the tape reel from SYS001 (see ASSGN card in group 096) and mount the initialized tape with volume serial number 000001 on the drive. Press the Load-Rewind key and the Start key of the device.

3. Remove the ASSGN cards for SYSRES and SYSRDR from card group C96 and place them in the IPL deck, in front of the REP cards (if used) and the end-of-file card. Place this deck into the hopper of the loading unit (2501 in the example).

4. Place card group 096 (control cards for execution) into the hopper of SYSRDR (2501 in the example).

5. Press the Start key of the card reading device.

6. Set the Register-Data/Address switches on the CPU console to an even main storage address between hexadecimal 009C and the end-of-storage address minus hexadecimal 0052.

7. Set the Mode switch on the CPU console to PROCESS.

8. Press the Load key on the CPU console.

The IPL procedure is performed, and the drive on which the updated system tape is mounted is assigned to SYSRES. The sample object program is loaded into storage from the program library and is then executed. The output is obtained on the printer.

After execution of the sample program, the system halts and code 01D0 is displayed tc indicate the completion of Sample Program 1.

```
SAMP   SAMPLE PROGR. FOR MODEL 20 TAPE ASSEMBLER                                12/31/67  PAGE  002

LOCATN  OBJECT CODE  ADDR1 ADDR2 STMT    SOURCE STATEMENT                        TPS AS V/M 2/0

                             0003          REPRO  TO INCLUDE NEXT CARD INTO OBJECT DECK FOR CHAINT JOB    0912003
                             0004          PHASE SAMPLE,A,2000                                            0912004
0700                         0005          START 2000              FIRST LOC. USED BY PROGR. IS 2000      0912005
                             0006 * SAMPLE PROGRAM WHICH CREATES RECORDS CONTAINING CONSECUTIVE NUMBERS    0912006
                             0007 * FROM 1 TO 100. RECORDS ARE WRITTEN ONTO TAPE.                         0912007
                             0008 * THE TAPE IS READ AND PRINTED                                          0912008
                             0009 * THE PROGRAM USES 3 DATA FILES                                         0912009
                             0010 *  1. FILE TAPEOUT, A TAPE OUTPUT FILE                                  0912010
                             0011 *  2.  FILE TAPEIN,  A TAPE  INPUT FILE                                 0912011
                             0012 *  3.  FILE PRINTER, A PRINTER FILE                                     0912012
                             0013 * THESE FILES ARE DEFINED IN THE FOLLOWING                             0912013
                             0014 *                                                                       0912014
                             0015 *                                                                       0912015
                             0016 * TAPEOUT IS A BLOCKED TAPE OUTPUT FILE. RECORDSIZE IS 80. BLOCKSIZE IS 0912016
                             0017 *  900.  THE REEL FOR THE FILE IS MOUNTED ON SYS001.                    0912017
                             0018 *                                                                       0912018
                             0019 TAPEOUT  DTFMT BLKSIZE=800,DEVADDR=SYS001,FILABL=STD,IOAREA1=AREA,     X0912019
                             0020                BECFORM=FIXBLK,TYPEFLE=OUTPUT,WORKA=YES,RECSIZE=80       0912020
                             0021*         DTFMM                                                          DTFMT003
                             0022**                                                                       DTFMM001
                             0023** MOD 20 TPS IOCS VERSION 02 MOD-LEVEL 00                               DTFMM002
                             0024**                                                                       DTFMM003
                             0025** THIS MACRO PERFORMS THE DIAGN. AND CREATES THE DTFBLK FOR ALL TPFILES DTFMT005
0700                         0026*         DS    0H                                                       DTFMT389
0700                         0027*         USING *,15                                                     DTFMT390
0700 0700                    0028*TAPEOUT  DC    Y(TAPEOUT)                                               DTFMT391 002
0702 0707                    0029*         DC    X'0707' REW OPTION COMMAND BYTES (REWIND)                DTFMT396 002
0704 0000                    0030*ICCB001  DC    H'0' CCB INT. LINK                                       DTFMT400 002
0706 0040                    0031*         DC    B'0000000001000000' CCB COMMUNICATION INFO               DTFMT402 002
0708 000E                    0032*         DC    Y(14) CCB LOGICAL UNIT DISPLACEMENT                      DTFMT412 002
070A 07E2                    0033*         DC    Y(ICZW001) ADDRESS OF SET MODE CCW                       DTFMT413 002
070C 10                      0034*         DC    B'00010000' FILE STATUS                                  DTFMT416 002
070D 80                      0035*         DC    B'10000000' FILE CHARACT.                                DTFMT424 002
070E 0000                    0036*         DC    Y(0) NOT USED                                            DTFMT428 002
0710 0000                    0037*         DC    Y(0) LOG UNIT DISP. FOR ALTTAPE                          DTFMT441 002
                             0038** DEFINE SET MODE CCW.COMMAND BYTE IS INSERTED AT OBJ. TIME FROM PUB     DTFMT442
0712 03                      0039*ICZW001  DC    XL1'3' COMMAND BYTE  'NOP'                               DTFMT443 002
0713 80                      0040*         DC    XL1'80' FLAG BYTE ( CHAIN BIT ON)                        DTFMT444 002
0714 0100                    0041*         DC    H'256' CONSTANT,REPLACING UNUSED ADDR OF I/OAREA         DTFMT450 002
0716 0320                    0042*ICNT001  DC    H'800' CONSTANT,REPLACING UNUSED LENGTHCOUNT             DTFMT452 002
0718 01                      0043*ICCW001  DC    XL1'1' COMMAND CODE 'WRITE'                              DTFMT463 002
0719 00                      0044*         DC    XL1'0' FLAGS                                             DTFMT464 002
071A 1280                    0045*         DC    Y(AREA) START ADDRESS OF I/O AREA                        DTFMT469 002
071C 0320                    0046*         DC    Y(800) LENGTH COUNT                                      DTFMT475 002
071E 0000000C                0047*IBCT001  DC    PL4'0' PACKED BLOCK COUNT                                DTFMT477 002
0722 0000                    0048*         DC    Y(0) NOT USED                                            DTFMT479 002
0724 E3C1D7C5D6E4E3          0049*         DC    CL7'TAPEOUT' FILENAME                                    DTFMT483 002
072C 0000                    0050*         DC    Y(0) SPECIFIES FIRST DTFMT BLOCK                         DTFMT485 002
072E                         0051*INI      EQU   *-10                                                     DTFMT490
072E                         0052*         DS    CL46 AREA TO SAVE LABEL INFO                             DTFMT491
075C                         0053*         DS    0H                                                       DTFMT492
075C 48F0                    0054*TAPEOUTP DC    X'48F0' LH 15,ADDR OF DTF BLOCK                          DTFMT518 003
075E 07D0                    0055*         DC    Y(TAPEOUT) ENTRY FOR PUT                                 DTFMT519 003
0760 D201 F08C E000 085C 0000 0056*         MVC   IMOV001(2),0(14) INSERT ADDR OF WORKAREA                 DTFMT521 003
0766 4AE0 F110       0810    0057*         AH    14,IC02001 CALCULATE AND                                 DTFMT522 003
076A 40E0 F086       0886    0058*         STH   14,IRET001+2 SAVE RETURN ADDR                            DTFMT525 003
                             0059*TAPEOUT  DTFND ,800,,,SYS001,,,STD,AREA,,,,FORWARD,FIXBLK,80,,YES,OUTPU&DTFMT540
                             0060*         T,,YES,                                                        DTFMT540
                             0061** THIS MACRO HANDLES TAPE OUTPUT FILES,FIX LENGTH BLOCKED, 1I/O,WORKA   DTFND001
076E 48E0 F118       08E8    0062*IENT001  LH    14,IRPT001 GET RECORDPOINTER                             DTFND002 003
0772 9140 F007       07D7    0063*         TM    ICCB001+3,X'40' WAIT FOR                                 DTFND003 003
0776 4780 F072       0842    0064*         BZ    *-4 I/O  COMPLETION                                      DTFND004 003
077A D201 F01C F112 07EC 08E2 0065*         MVC   ICCW001+4(2),IBLK001 INITIALIZE BLOCKLENGTHCOUNT         DTFND005 003
0780 9101 F006       07D6    0066*         TM    ICCB001+2,X'01' TEST IF UNIT EXCEPTION                   DTFND006 003
0784 4710 F08A       088A    0067*         BO    IEOV001 YES                                              DTFND007 003
0788                         0068*IMOVE001 EQU   *                                                        DTFND008
078C                         0069*IMOV001  EQU   *+4 ADDRESS OF WORKAREA                                   DTFND011
0788 D24F E000 0000 0000 0000 0070*         MVC   0(80,14),0(0) MOVE RECORD FROM WORKA TO I/OAREA          DTFND012 003
078E 4AE0 F114       08E4    0071*         AH    14,IRECC01 UPDATE RECORDPOINTER                          DTFND037 003
0792 40E0 F118       08E8    0072*         STH   14,IRPT001                                               DTFND038 004
0796 49E0 F116       08E6    0073*IBFT001  CH    14,IEOB001 END OF BLOCK  TEST                            DTFND039 004
079A 4770 F084       0884    0074*         BNE   IRET001 IF NOT,RETURN IN-LINE                            DTFND040 004
079E 4DE0                    0075*IREA001  DC    X'4DE0' ELSE WRITE BLOCK                                 DTFND041 004
07A0 0E06                    0076*         DC    Y(IPIOCS) BAS 14,IPIOCS                                  DTFND042 004
07A2 07D4                    0077*         DC    Y(ICCB001)                                               DTFND043 004
07A4 FA30 F01E F11A 07EF 08EA 0078*         AP    IBCT001,IP01001 INCREASE BLOCKCOUNT                      DTFND045 004
07AA D201 F118 F01A 08E8 07EA 0079*         MVC   IRPT001,ICCW001+2 INITIALIZE RECORDPOINTER               DTFND047 004
07B0 4700 F0EE       08EE    0080*ISWJ001  BC    0,IRES001 SWITCH FOR TRUNC RTN.                          DTFND048 004
07B4 47F0 0000       0000    0081*IRET001  B     0 EXIT IN-LINE                                           DTFND049 004
07B8 083E                    0082*IADR001  DC    Y(IENT001) DEFINE RETURN ADDR FOR EOV CONDITION          DTFND050 004
07BA 48E0 F088       0888    0083*IEOV001  LH    14,IADR001 GET RETURNADDRESS  FOR EOV CONDITION          DTFND051 004
07BE 94FE F006       07D6    0084*         NI    ICCB001+2,X'FE' CLEAR UNIT EXCEPTION BIT                 DTFND052 004
07C2 48F0                    0085*TAPEOUTF DC    X'48F0' LH  15,FILENAME   ,LOAD BASEREG.                 DTFND053 004
07C4 07D0                    0086*         DC    Y(TAPEOUT) ENTRY POINT FOR FEOV                          DTFND054 004
07C6 94FF F00C       000C    0087*         NI    12(15),X'FF' SET EOF/EOV SWITCH IN DTF BLOCK TO EOV      DTFND055 004
07CA 92F0                    0088*TAPEOUTC DC    X'92F0' MVI IISW+1,X'F0'   ENTRY POINT FOR CLOSE         DTFND056 004
07CC 08C3                    0089*         DC    Y(IISW001+1) SET SWITCH TO EXIT TO GEN.CLOSE RTN.        DTFND057 005
07CE 48F0                    0090*TAPEOUTT DC    X'48F0' ENTRY POINT FOR TRUNC                            DTFND058 005
07D0 07D0                    0091*         DC    Y(TAPEOUT) LH 15,FILENAME   ,LOAD BASEREG.               DTFND059 005
07D2 40E0 F0F8       08C8    0092*         STH   14,IRTN001+2 SAVE RETURN ADDRESS                         DTFND060 005
07D6 48E0 F118       08E8    0093*         LH    14,IRPT001 CALCULATE                                     DTFND061 005
07DA 4BE0 F01A       07EA    0094*         SH    14,ICCW001+2 CURRENT BLOCKLENGTH                         DTFND062 005
07DE 4780 F0F2       08C2    0095*         BE    IISW001 I/O AREA IS EMPTY                                DTFND063 005
07E2 40E0 F01C       07EC    0096*         STH   14,ICCW001+4 INSERT CURRENT BLKLENGTH INTO COUNT          DTFND064 005
07E6 92F0 F0B1       0881    0097*         MVI   ISWJ001+1,X'F0' SET RETURN SWITCH                        DTFND065 005
07EA 47F0 F09E       086E    0098*         B     IREA001 WRITE                                            DTFND066 005
07EE 9200 F0B1       0881    0099*IRES001  MVI   ISWJ001+1,X'00' RESET  SWITCH   TO NOP                   DTFND067 005
07F2 4700 F0FA       08CA    0100*IISW001  BC    0,ICSE001 EXIT SWITCH FOR FEOV AND CLOSE ENTRY           DTFND068 005
07F6 47F0 F0B4       0884    0101*IRTN001  B     IRET001 EXIT FOR TRUNC ENTRY                             DTFND069 005
07FA 9400 F0F3       08C3    0102*ICSE001  NI    IISW001+1,0 RESET FEOV/CLOSE EXIT SWITCH                 DTFND070 005
07FE 48E0 F0F8       08C8    0103*         LH    14,IRTN001+2 GET RETURN ADDRESS                          DTFND071 005
0802 47F0                    0104*         DC    X'47F0' BC 15,ITACLOSE                                   DTFND072 005
0804 1160                    0105*         DC    Y(ITACLOSE) EXIT FOR FEOV/CLOSE TO GEN.CLOSE RTN.        DTFND073 006
0806 48F0                    0106*TAPEOUTO DC    X'48F0' ENTRY POINT FOR OPEN                             DTFND074 006
0808 07D0                    0107*         DC    Y(TAPEOUT) LH 15,FILENAME   ,LOAD BASEREG.               DTFND075 006
080A 47F0                    0108*         DC    X'47F0' BRANCH TO                                        DTFND076 006
080C 0F6C                    0109*         DC    Y(ITAOPEN) GENERAL TAPE OPEN ROUTINE                     DTFND077 006
080E                         0110*ISVE001  DS    H                                                        DTFND078
0810 0002                    0111*IC02001  DC    H'2'                                                     DTFND079 007
0812 0320                    0112*IBLK001  DC    H'800'                                                   DTFND080 007
0814 0050                    0113*IREC001  DC    H'80' RECORDSIZE                                         DTFND081 007
0816 1500                    0114*IEOB001  DC    Y(AREA+800)                                              DTFND085 007
```

Figure 25. Sample of the Assembler Listing

## SAMPLE PROGRAM 2

The second sample program is designed to demonstrate the use of the TPS Report Program Generator.

In this sample program, a commission report is to be prepared from invoice summary cards (Figure 26). The cards are in sequence by salesman number. The commission amount is calculated on the invoice amount. The percentage of commission depends on the invoice amount:

10% commission for invoice amounts up to $10,000.

12% commission for invoice amounts above $10,000.

The commission is calculated for each card read. The result is printed, together with other data from the card. The total commission amount for each salesman is accumulated and printed. The total amount of commission is accumulated and printed at the end of the report.

## DESCRIPTION OF THE SAMPLE DECK

Sample deck 2 consists of three card groups, with the following identifications:

| Columns 73 74 75 | Description |
|---|---|
| R 9 0 | Job control cards for compile-and-execute function and output of object program in cards. |
| - - - | RPG control card and source program in RPG language (identified by the letters SACO in cols. 76-79). |
| R 9 1 | Data cards |

In addition, card groups R90 and R91 contain a 2 in column 76 (identification for TPS) and consecutive card numbers in cclumns 77-79, beginning with 001 for each group.

Figures 27-29 show the card groups of Sample Program 2.

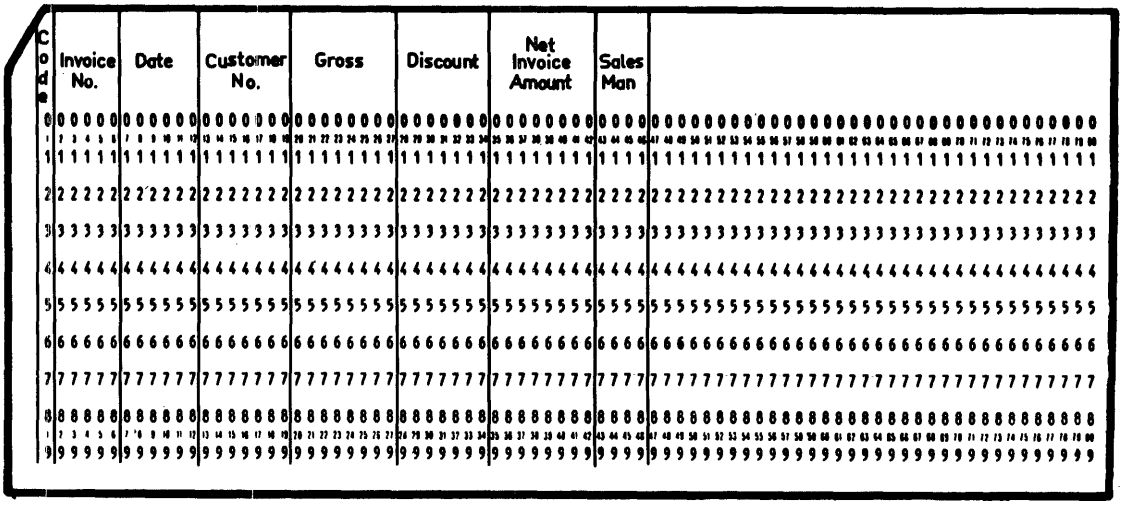



Figure 26. Input Card for Sales Commission Report

IBM System 360 Assembler Coding Form

PROGRAM SAMPLE 2, CARD GROUP R90 | PUNCHING INSTRUCTIONS | GRAPHIC | PUNCH | PAGE 1 OF 1 | CARD ELECTRO NUMBER
PROGRAMMER | DATE

| Name | Operation | Operand | Comments | Identification-Sequence |
|---|---|---|---|---|
| // | ASSGN | SYSRES,X'780',T2 | PLACE THIS CARD IN THE IPL DECK | R90200001 |
| // | ASSGN | SYSRDR,X'100',R4 | PLACE THIS CARD IN THE IPL DECK | R90200002 |
| // | LOG | | PRINT JOB CONTROL CARDS | R90200003 |
| // | JOB | RPG,SACO | COMPILE AND EXECUTE SAMPLE PROG | R90200004 |
| // | DATE | 68002 | JANUARY 2, 1968 | R90200005 |
| // | ASSGN | SYSIPT,X'100',R4 | 2501 CARD READER | R90200006 |
| // | ASSGN | SYSOPT,X'300',P2 | PUNCH FOR PRODUCING OBJECT PROG | R90200007 |
| // | ASSGN | SYS000,X'781',T2 | 9-TRACK DRIVE FOR WORK TAPE | R90200008 |
| // | EXEC | | EXECUTE SAMPLE PROGRAM | R90200009 |

Figure 27. Job Control Statements for Compile-and-Execute Function

IBM System/360 Assembler Coding Form

PROGRAM SAMPLE 2, CARD GROUP SACO | PUNCHING INSTRUCTIONS | GRAPHIC | PUNCH | PAGE 1 OF 5 | CARD ELECTRO NUMBER
PROGRAMMER | DATE

| Name | Operation | Operand | Comments | Identification-Sequence |
|---|---|---|---|---|
| H | P | 120 | RPG CONTROL CARD | SACO |

● Figure 28. Source Statements, Part 1 of 5

IBM

INTERNATIONAL BUSINESS MACHINES CORPORATION

**REPORT PROGRAM GENERATOR FILE DESCRIPTION SPECIFICATIONS**

IBM System 360

Form X24-3347-3
Printed in U.S.A.

Date

Program SAMPLE 2, CARD GROUP SACO

Programmer

Punching Instruction: Graphic | Punch

Page 02

Program Identification SACO

| Line | Form Type | Filename | File Type | File Designation | End of File | Sequence | File Format | Block Length | Record Length | L/R | Mode of Processing | Length of Key Field or of Record Address Field | Record Address Type | Type of File Organization | Overflow Indicator | Key Field Starting Location | Extension Code E/L | Device | Symbolic Device | Labels (S, N, or E) | Name of Label Exit | Extent Exit for DAM | A | File Addition | No. Tracks for Cylinder Overflows | No. of Extents | Tape Rewind |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | I/O/C | P/S/C/R/T | E | A/D | F/V | | | | | K/I | I/D/T | | | | | | | | | | | | | | N/U |
| 01 | 0 | INPUT | I | P | | | | | | | | | | | | | | READ01 | | | | | | | | | |
| 02 | 0 | PRINT | O | | | | | | | | | | | | | | | PRINTER | | | | | | | | | |
| 03 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 04 | | | | | | | | | | | | | | | | | | | | | | | | | | | |

● Figure 28. Source Statements, Part 2 of 5

**IBM**

INTERNATIONAL BUSINESS MACHINES CORPORATION

**REPORT PROGRAM GENERATOR INPUT SPECIFICATIONS**

IBM System/360

Form X24-3350-1
Printed in U. S. A.

Date _____

Program SAMPLE 2, CARD GROUP SACO

Programmer _____

Punching Instruction: Graphic / Punch

Page 03

Program Identification: SACO

| Line | Form Type | Filename | Sequence | Number (1-N) | Option (/OI) | Resulting Indicator | Record Identification Codes: 1 Position | 1 Not (N) | 1 C/Z/D | 1 Character | 2 Position | 2 Not (N) | 2 C/Z/D | 2 Character | 3 Position | 3 Not (N) | 3 C/Z/D | 3 Character | Stacker Select | Packed (P) | Field Location: From | Field Location: To | Decimal Positions | Field Name | Control Level (L1-L9) | Matching Fields or Chaining Fields | Field-Record Relation | Field Indicators: Plus | Field Indicators: Minus | Field Indicators: Zero or Blank | Sterling Sign Position |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 010 | I | INPUT | AA | | | 11 | 1 | | C | 5 | | | | | | | | | | | | | | | | | | | | | |
| 020 | I | | | | | | | | | | | | | | | | | | | | 2 | 6 | | INVOIC | | | | | | | |
| 030 | I | | | | | | | | | | | | | | | | | | | | 13 | 190 | | CUST | | | | | | | |
| 040 | I | | | | | | | | | | | | | | | | | | | | 35 | 422 | | IVCAMT | | | | | | | |
| 050 | I | | | | | | | | | | | | | | | | | | | | 43 | 46 | | SALESM | L1 | | | | | | |

Figure 28. Source Statements, Part 3 of 5

**IBM**

INTERNATIONAL BUSINESS MACHINES CORPORATION

**REPORT PROGRAM GENERATOR CALCULATION SPECIFICATIONS**

IBM System 360

Form X24-3351-1
Printed in U. S. A.

Date

Program SAMPLE 2, CARD GROUP SACO

Programmer

Punching Instruction: Graphic / Punch

Page 04

Program Identification: SACO

| Line | Form Type | Control Level (L0-L9, LR) | Indicators: Not | Indicators: And Not | Indicators: And Not | Factor 1 | Operation | Factor 2 | Result Field | Field Length | Decimal Positions | Half Adjust (H) | Resulting Indicators: Plus | Resulting Indicators: Minus | Resulting Indicators: Zero or Blank | Compare: High 1 > 2 | Compare: Low 1 < 2 | Compare: Equal 1 = 2 | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 010 | C | | 11 | | | IVCAMT | COMP | 10000.00 | | | | | 22 | | | | | | |
| 020 | C | | 22 | 11 | | IVCAMT | MULT | 0.12 | COMM | 9 | 2 | H | | | | | | | |
| 030 | C | | N22 | 11 | | IVCAMT | MULT | 0.10 | COMM | | | H | | | | | | | |
| 040 | C | | 11 | | | COMM | ADD | SUM | SUM | 10 | 2 | | | | | | | | |
| 050 | C | L1 | | | | SUM | ADD | FINTOT | FINTOT | 11 | 2 | | | | | | | | |

Figure 28. Source Statements, Part 4 of 5

IBM

INTERNATIONAL BUSINESS MACHINES CORPORATION

## REPORT PROGRAM GENERATOR OUTPUT-FORMAT SPECIFICATIONS

IBM System/360

Form X24-3282-1
Printed in U.S.A.

Date _____

Program SAMPLE 2, CARD GROUP SACO

Programmer _____

Punching Instruction: Graphic / Punch

Page 05

Program Identification: SACO

| Line | Form Type | Filename | Type (H/D/T) | Space: Stacker Select | Space: Before | Space: After | Skip: Before | Skip: After | Output Indicators: And/Not | Output Indicators: And/Not | Output Indicators: And/Not | Field Name | Zero Suppress (Z) | Blank After (B) | End Position in Output Record | Packed Field (P) | Constant or Edit Word | Sterling Sign Position |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 010 | O | PRINT | H | | | 3 | 01 | | 0 | FNL | 1 | | | | | | | |
| 020 | O | | R | | | | | | L | 1 | | | | | | | | |
| 030 | O | | | | | | | | | | | | | | 72 | | 'COMMISSION' | |
| 040 | O | | | | | | | | | | | | | | 59 | | 'PERC' | |
| 050 | O | | | | | | | | | | | | | | 51 | | 'AMOUNT' | |
| 060 | O | | | | | | | | | | | | | | 42 | | 'INVOICE' | |
| 070 | O | | | | | | | | | | | | | | 34 | | 'CUST' | |
| 080 | O | | | | | | | | | | | | | | 28 | | 'SALESMAN' | |
| 090 | O | | D | | 2 | | | | 1 | 1 | | | | | | | | |
| 100 | O | | | | | | | | | | | COMM | | | 72 | | ' Ø. ' | |
| 110 | O | | | | | | | | N | 22 | | | | | 59 | | '10%' | |
| 120 | O | | | | | | | | 2 | 2 | | | | | 59 | | '12%' | |
| 130 | O | | | | | | | | | | | IVCAMT | | | 53 | | ' Ø. ' | |
| 140 | O | | | | | | | | | | | INVOIC | | | 41 | | | |
| 150 | O | | | | | | | | | | | CUST | Z | | 34 | | | |
| 160 | O | | | | | | | | L | 1 | | SALESM | | | 26 | | | |
| 170 | O | | T | | 21 | | | | L | 1 | | | | | | | | |
| 180 | O | | | | | | | | | | | | | | 56 | | 'TOTAL' | |
| 190 | O | | | | | | | | | | | SUM | | B | 72 | | ' Ø. ' | |
| 200 | O | | T | | | | 01 | | L | R | | | | | | | | |
| 210 | O | | | | | | | | | | | | | | 56 | | 'FINAL TOTAL' | |
| 220 | O | | | | | | | | | | | FINTOT | | | 72 | | ' Ø. ' | |

Figure 28. Source Statements, Part 5 of 5

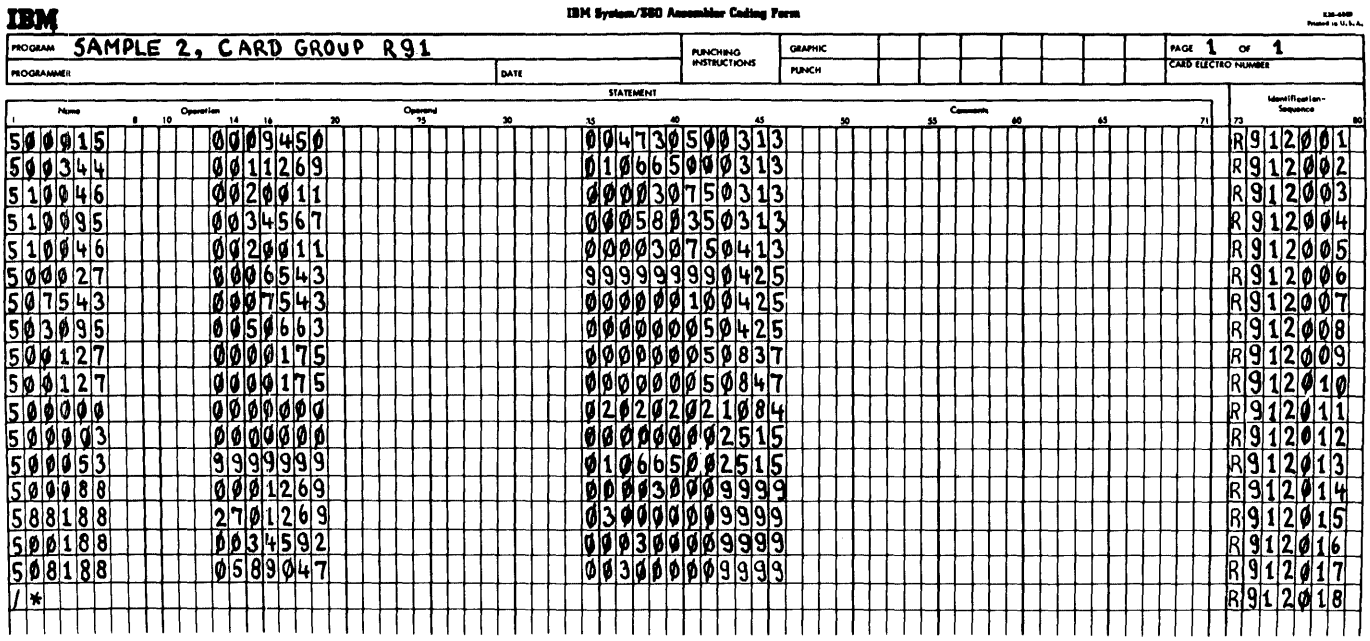



Figure 29. Data Cards

## OPERATING PROCEDURES

The sample deck supplied by IBM is designed for Model 20 systems with a storage capacity of 8192 bytes and the following I/O devices:

- an IBM 2501 Card Reader,
- an IBM 1442 Card Punch,
- an IBM 1403 Printer,
- an IBM 2415 Magnetic Tape Unit, any model (9-track drives with unit numbers 80 and 81).

If the user's Model 20 system has a different I/O configuration or different tape unit numbers, the job control cards and/or the REP cards supplied with the tape IPL must be changed accordingly.

The following steps must be taken to compile the source program, execute it immediately after compilation, and obtain the object program in punched cards.

1. Mount the system tape (containing the TPS Report Program Generator) on the tape drive assigned to SYSRES (see ASSGN card in group R90). Press the Load-Rewind key and the Start key of the drive.
2. Mount a work tape on the tape drive assigned to SYS000 (see ASSGN card in group R90). Press the Load-Rewind key and the Start key of the drive.
3. Remove the ASSGN cards for SYSRES and SYSRDR from card group R90 and place them in the IPL deck, in front of the REP cards (if used) and the end-of-file card. Place this deck into the hopper of the loading unit (2501 in the example).
4. Place card group R90 (job control cards) into the hopper of SYSRDR (2501 in the example).
5. Place the card group identified by the letters SACO in cols. 76-79 (RPG control card and sample source program) into the hopper of SYSIPT (2501 in the example).
6. Place card group R91 (data cards) into the hopper of the 2501. (If a 2501 is not available and the data cards are to be read on a different device, the file description specifications must be changed accordingly.)
7. Place blank cards into the hopper of SYSOPT (1442 in the example).
8. Press the Start keys of the card I/O devices used.
9. Install forms in the printer (1403 in the example) and press the Reset key and the Start key of the device.

10. Set the Register-Data/Address switches on the CPU console to an even main storage address between hexadecimal 009C and the end-of-storage address minus hexadecimal 0052.

11. Set the Mode switch on the CPU console to PROCESS.

12. Press the Load key on the CPU console.

The RPG listing, part of which is shown in Figure 30, is obtained on the printer. The object program deck is produced on the 1442.

Upon completion of the compilation, a system halt occurs and the code 1D01 is displayed. To initiate the execution of the sample program, press the Start key on the CPU console.

The output from the sample program is the printed report shown in Figure 31.

The object deck obtained on SYSOPT may be used to execute the sample program under control of the card-resident system or include it in the program library of the system tape.

```
MOD 20 TPS RPG  VERSION 2   MOD-LEVEL 0                                                    12/31/67

                H   P            120          RPG CONTROL CARD                                SACO

     1 01010 FINPUT   IP                          READ01                                      SACO
     2 01020 FPRINT   O                           PRINTER                                     SACO


     3 02010 IINPUT   AA  11   1 C5                                                           SACO
     4 02020 I                                          2   6 INVOIC                           SACO
     5 02030 I                                         13  190CUST                             SACO
     6 02040 I                                         35  422IVCAMT                           SACO
     7 02050 I                                         43  46 SALESML1                         SACO


     8 03010 C    11       IVCAMT    COMP 10000.00            22                               SACO
     9 03020 C    22 11    IVCAMT    MULT 0.12      COMM    92H                               SACO
    10 03030 C   N22 11    IVCAMT    MULT 0.10      COMM      H                               SACO
    11 03040 C    11       COMM      ADD  SUM       SUM    102                                SACO
    12 03050 CL1           SUM       ADD  FINTOT    FINTOT 112                                SACO


    13 04010 OPRINT   H  301   OFNL1                                                          SACO
    14 04020 O        OR       L1                                                            SACO
    15 04030 O                                      72 'COMMISSION'                           SACO
    16 04040 O                                      59 'PERC'                                 SACO
    17 04050 O                                      51 'AMOUNT'                               SACO
    18 04060 O                                      42 'INVOICE'                              SACO
    19 04070 O                                      34 'CUST'                                 SACO
    20 04080 O                                      28 'SALESMAN'                             SACO
    21 04090 O         D  2     11                                                            SACO
    22 04100 O                          COMM        72 '    ,  0.  '                          SACO
    23 04110 O                 N22                  59 '10('                                  SACO
    24 04120 O                  22                  59 '12('                                  SACO
    25 04130 O                          IVCAMT      53 '    ,  0.  '                          SACO
    26 04140 O                          INVOIC      41                                        SACO
    27 04150 O                          CUST  Z     34                                        SACO
    28 04160 O                  L1      SALESM      26                                        SACO
    29 04170 O         T 21     L1                                                            SACO
    30 04180 O                                      56 'TOTAL'                                SACO
    31 04190 O                          SUM    B    72 '      ,  0.  '                        SACO
    32 04200 O         T   01   LR                                                            SACO
    33 04210 O                                      56 'FINAL TOTAL'                          SACO
    34 04220 O                          FINTOT      72 '       ,  0.  '                       SACO
```

Figure 30. Sample of RPG Listing

| SALESMAN | CUST | INVOICE | AMOUNT | PERC | COMMISSION |
|---|---|---|---|---|---|
| 0313 | 9450 | 00015 | 4,730.50 | 10 | 473.05 |
| | 11269 | 00344 | 10,665.00 | 12 | 1,279.80 |
| | 20011 | 10046 | 30.75 | 10 | 3.08 |
| | 34567 | 10095 | 580.35 | 10 | 58.04 |
| | | | TOTAL | | 1,813.97 |

| SALESMAN | CUST | INVOICE | AMOUNT | PERC | COMMISSION |
|---|---|---|---|---|---|
| 0413 | 20011 | 10046 | 30.75 | 10 | 3.08 |
| | | | TOTAL | | 3.08 |

| SALESMAN | CUST | INVOICE | AMOUNT | PERC | COMMISSION |
|---|---|---|---|---|---|
| 0425 | 6543 | 00027 | 999,999.99 | 12 | 120,000.00 |
| | 7543 | 07543 | .10 | 10 | .01 |
| | 50663 | 03095 | .05 | 10 | .01 |
| | | | TOTAL | | 120,000.02 |

| SALESMAN | CUST | INVOICE | AMOUNT | PERC | COMMISSION |
|---|---|---|---|---|---|
| 0837 | 175 | 00127 | .05 | 10 | .01 |
| | | | TOTAL | | .01 |

Figure 31. Output of Sample Program 2, Part 1 of 2

| SALESMAN | CUST | INVOICE | AMOUNT | PERC | COMMISSION |
|---|---|---|---|---|---|
| 0847 | 175 | 00127 | .05 | 10 | .01 |
| | | | TOTAL | | .01 |

| SALESMAN | CUST | INVOICE | AMOUNT | PERC | COMMISSION |
|---|---|---|---|---|---|
| 1084 | | 00000 | 20,202.02 | 12 | 2,424.24 |
| | | | TOTAL | | 2,424.24 |

| SALESMAN | CUST | INVOICE | AMOUNT | PERC | COMMISSION |
|---|---|---|---|---|---|
| 2515 | | 00003 | .00 | 10 | .00 |
| | 9999999 | 00053 | 10,665.00 | 12 | 1,279.80 |
| | | | TOTAL | | 1,279.80 |

| SALESMAN | CUST | INVOICE | AMOUNT | PERC | COMMISSION |
|---|---|---|---|---|---|
| 9999 | 1269 | 00088 | 30.00 | 10 | 3.00 |
| | 2701269 | 88188 | 30,000.00 | 12 | 3,600.00 |
| | 34592 | 00188 | 300.00 | 10 | 30.00 |
| | 589047 | 08188 | 3,000.00 | 10 | 300.00 |
| | | | TOTAL | | 3,933.00 |
| | | | FINAL TOTAL | | 129,454.13 |

Figure 31. Output of Sample Program 2, Part 2 of 2

## SAMPLE PROGRAM 3

The third sample program is designed to demonstrate:

- the use of the Utility programs,
- the use of the Sort/Merge program.

With the sample deck supplied by IBM, the following jobs can be performed:

1. Initialize-Tape job,
2. Card-to-Tape job,
3. Tape-to-Printer job (unsorted records),
4. Sort job,
5. Tape-to-Printer job (sorted records).

## DESCRIPTION OF THE SAMPLE DECK

The sample-program cards (eleven groups) are identified by a letter in column 73 and two digits in columns 74-75. (See list below.)

Card column 76 contains a 2 (identification for TPS).

Card columns 77-79 contain consecutive card numbers, which begin with 001 for each card group.

Sample deck 3 consists of the following card groups:

| Columns 73 | 74 | 75 | Description |
|---|---|---|---|
| X | 9 | 0 | Job control cards for Initialize-Tape job |
| X | 9 | 1 | Program control card for Initialize-Tape Program |
| V | 9 | 0 | Job control cards for Card-to-Tape job |
| V | 9 | 1 | Program control cards for Card-to-Tape job |
| V | 9 | 2 | Data cards |
| W | 9 | 0 | Job control cards for Tape-to-Printer job (unsorted records) |
| W | 9 | 1 | Program control cards for Tape-to-Printer job (unsorted records) |
| S | 9 | 0 | Job control cards for Sort job |
| S | 9 | 1 | Program control cards for Sort job |
| W | 9 | 2 | Job control cards for Tape-to-Printer job (sorted records) |
| W | 9 | 3 | Program control cards for Tape-to-Printer job (sorted records) |

Figures 32-37 show the card groups of Sample Program 3.

IBM System/360 Assembler Coding Form

PROGRAM SAMPLE 3, CARD GROUPS X90 and X91 | PUNCHING INSTRUCTIONS | GRAPHIC | PAGE 1 OF 1
PROGRAMMER | DATE | PUNCH | CARD ELECTRO NUMBER

| Name | Operation | Operand | Comments | Identification-Sequence |
|---|---|---|---|---|
| // | ASSGN | SYSRES,X'786',T2 | PLACE THIS CARD IN THE IPL DECK | X9002001 |
| // | ASSGN | SYSRDR,X'2E0',R6 | 2560 PRIMARY HOPPER | X9002002 |
| // | LOG | | PRLMT JOB CONTROL CARDS | X9002003 |
| // | JOB | INITTP | INITIALIZE-TAPE PROGRAM | X9002004 |
| // | DATE | 68002 | JANUARY 2, 1968 | X9002005 |
| // | CONFG | 4 | 4K CORE STORAGE | X9002006 |
| // | ASSGN | SYS000,X'781',T2 | 9-TRACK DRIVE FOR OUTPUT TAPE | X9002007 |
| // | ASSGN | SYS001,UA | SIGNAL END-OF-PASS | X9002008 |
| // | EXEC | | | X9002009 |
| // | INITTP REWIND,SERIAL=(123456),CODE=(OWNER NAME) | | | X9112001 |

Figure 32. Job Control and Program Control Statements for Initialize-Tape Job

IBM System 360 Assembler Coding Form

PROGRAM SAMPLE 3, CARD GROUPS V90 and V91 | PUNCHING INSTRUCTIONS | GRAPHIC | PUNCH | PAGE 1 OF 1 | CARD ELECTRO NUMBER

PROGRAMMER | DATE

STATEMENT

| Name | Operation | Operand | Comments | Identification-Sequence |
|---|---|---|---|---|
| // | LOG | | PRINT JOB CONTROL CARDS | V90 2001 |
| // | JOB | CARTAP | CARD-TO-TAPE PROGRAM | V90 2002 |
| // | DATE | 68002 | JANUARY 2, 1968 | V90 2003 |
| // | CONFG | 4 | 4K CORE STORAGE | V90 2004 |
| // | ASSGN | SYSOPT,X'181',T2 | 9-TRACK DRIVE FOR OUTPUT TAPE | V90 2005 |
| // | ASSGN | SYS001,UA | UNASSIGN ALTERNATE OUTPUT TAPE | V90 2006 |
| // | VOL | SYSOPT,UOUT | LABEL INFORMATION FOR OUTPUT | V90 2007 |
| // | TPLAB | '.USER.FILE.IDENT.123456 | 000101 68002 68002' | V90 2008 |
| // | ASSGN | SYSIPT,X'200',R7 | 2560 SECONDARY HOPPER | V90 2009 |
| // | EXEC | | | V90 2010 |
| // | UCT | TR,FF,A=(80,80),B=(80,400),OR | | V91 2001 |
| // | END | | | V91 2002 |

Figure 33. Job Control and Program Control Statements for Card-to-Tape Job

IBM System/360 Assembler Coding Form

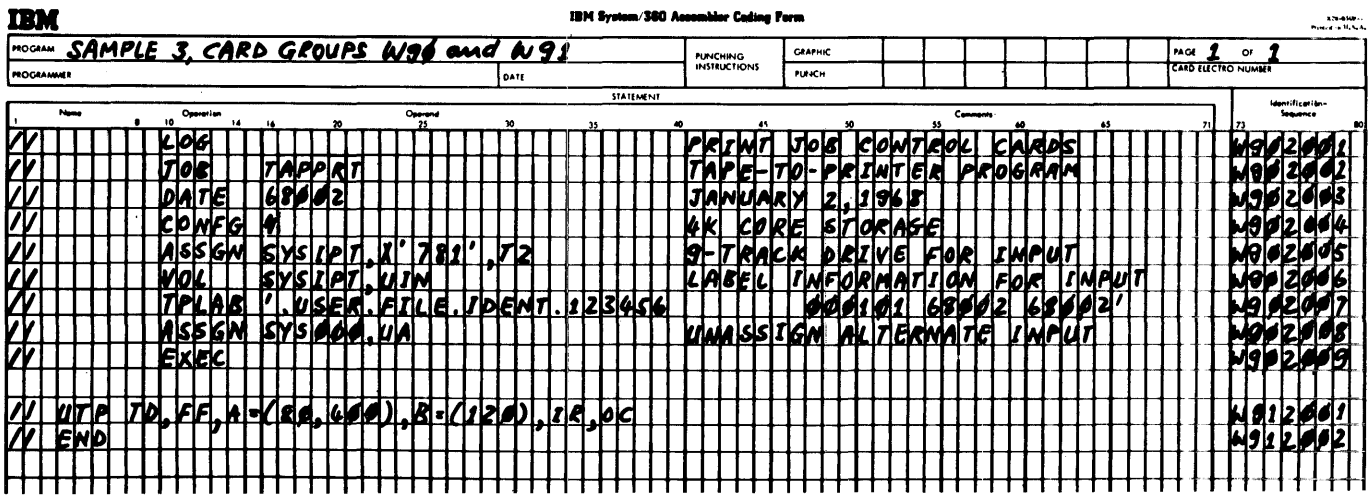
PROGRAM SAMPLE 3, CARD GROUP V92 | PUNCHING INSTRUCTIONS | GRAPHIC | PUNCH | PAGE OF | CARD ELECTRO NUMBER

PROGRAMMER | DATE

STATEMENT

| Name | Operation | Operand | Comments | Identification-Sequence |
|---|---|---|---|---|
| ABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789ABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789 | | | | V92 2001 |
| BCDEFGHIJKLMNOPQRSTUVWXYZ0123456789ABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789A | | | | V92 2001 |
| | | | A TOTAL OF 36 DATA CARDS ARE USED. THE FIRST | |
| | | | CARD CONTAINS THE LETTERS A-Z AND THE DIGITS | |
| | | | 0-9 IN COLS. 1-36, AND AGAIN IN COLS. 37-72. | |
| | | | EACH FOLLOWING CARD CONTAINS THE SAME INFORMA- | |
| | | | TION AS THE PRECEDING ONE, OFFSET ONE COLUMN | |
| | | | TO THE LEFT. THE FIRST CHARACTER OF THE PRE- | |
| | | | CEDING CARD APPEARS IN COL. 72 | |
| 9ABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789ABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789 | | | | V92 2036 |
| /* | | | | V92 2037 |

Figure 34. Data Cards



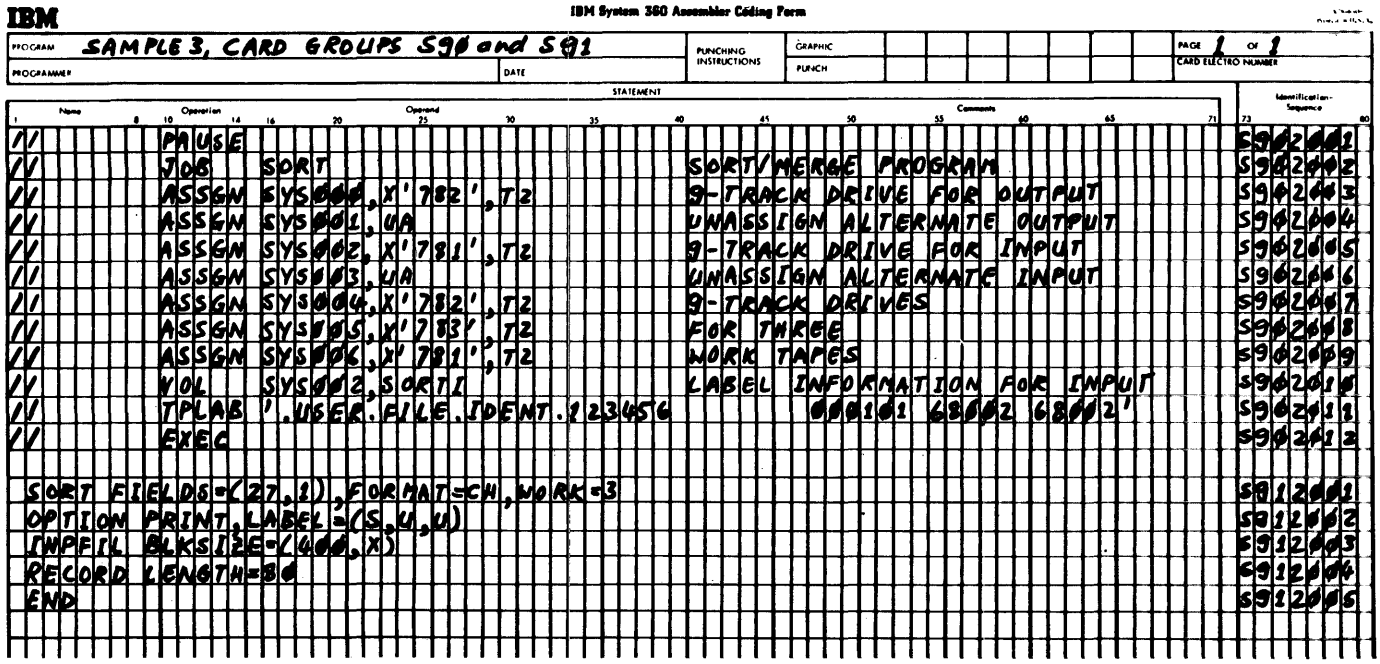
IBM System/360 Assembler Coding Form

PROGRAM: SAMPLE 3, CARD GROUPS W90 and W91 | PROGRAMMER | DATE | PUNCHING INSTRUCTIONS | GRAPHIC | PUNCH | PAGE 1 OF 1 | CARD ELECTRO NUMBER

STATEMENT

| Name | Operation | Operand | Comments | Identification-Sequence |
|---|---|---|---|---|
| // | LOG | | PRINT JOB CONTROL CARDS | W9002001 |
| // | JOB | TAPPRT | TAPE-TO-PRINTER PROGRAM | W9002002 |
| // | DATE | 68002 | JANUARY 2, 1968 | W9002003 |
| // | CONFG | 4 | 4K CORE STORAGE | W9002004 |
| // | ASSGN | SYSIPT,X'781',T2 | 9-TRACK DRIVE FOR INPUT | W9002005 |
| // | VOL | SYSIPT,UIN | LABEL INFORMATION FOR INPUT | W9002006 |
| // | TPLAB | '.USER.FILE.IDENT.123456 | 000101 68002 68002' | W9002007 |
| // | ASSGN | SYS000,UA | UNASSIGN ALTERNATE INPUT | W9002008 |
| // | EXEC | | | W9002009 |
| // | UTP TO,FF,A=(RB,600),B=(120),IR,OC | | | W9012001 |
| // | END | | | W9012002 |

Figure 35. Job Control and Program Control Statements for Tape-to-Printer Job (Unsorted Records)



IBM System 360 Assembler Coding Form

PROGRAM: SAMPLE 3, CARD GROUPS S90 and S91 | PROGRAMMER | DATE | PUNCHING INSTRUCTIONS | GRAPHIC | PUNCH | PAGE 1 OF 1 | CARD ELECTRO NUMBER

STATEMENT

| Name | Operation | Operand | Comments | Identification-Sequence |
|---|---|---|---|---|
| // | PAUSE | | | S9002001 |
| // | JOB | SORT | SORT/MERGE PROGRAM | S9002002 |
| // | ASSGN | SYS000,X'782',T2 | 9-TRACK DRIVE FOR OUTPUT | S9002003 |
| // | ASSGN | SYS001,UA | UNASSIGN ALTERNATE OUTPUT | S9002004 |
| // | ASSGN | SYS002,X'781',T2 | 9-TRACK DRIVE FOR INPUT | S9002005 |
| // | ASSGN | SYS003,UA | UNASSIGN ALTERNATE INPUT | S9002006 |
| // | ASSGN | SYS004,X'782',T2 | 9-TRACK DRIVES | S9002007 |
| // | ASSGN | SYS005,X'783',T2 | FOR THREE | S9002008 |
| // | ASSGN | SYS006,X'781',T2 | WORK TAPES | S9002009 |
| // | VOL | SYS002,SORTI | LABEL INFORMATION FOR INPUT | S9002010 |
| // | TPLAB | '.USER.FILE.IDENT.123456 | 000101 68002 68002' | S9002011 |
| // | EXEC | | | S9002012 |
| | SORT FIELDS=(27,1),FORMAT=CH,WORK=3 | | | S9012001 |
| | OPTION PRINT,LABEL=(S,U,U) | | | S9012002 |
| | INPFIL BLKSIZE=(400,X) | | | S9012003 |
| | RECORD LENGTH=80 | | | S9012004 |
| | END | | | S9012005 |

Figure 36. Job Control and Program Control Statements for Sort Job

IBM System/360 Assembler Coding Form

PROGRAM: SAMPLE 3, CARD GROUPS W92 AND W93 | PUNCHING INSTRUCTIONS | GRAPHIC | PUNCH | PAGE OF | CARD ELECTRO NUMBER

PROGRAMMER | DATE

STATEMENT

| Name | Operation | Operand | Comments | Identification-Sequence |
|---|---|---|---|---|
| // | JOB TAPPRT | | TAPE-TO-PRINTER PROGRAM | W92Ø01 |
| // | ASSGN SYSIPT,X'782',T2 | | 9-TRACK DRIVE FOR INPUT | W92Ø02 |
| // | ASSGN SYSØØØ,UA | | NO ALTERNATE INPUT | W92Ø03 |
| // | EXEC | | | W92Ø04 |
| // | UTP TD,FF,A=(8Ø,4ØØ),B=(12Ø),OC | | | W93Ø01 |
| // | END | | | W93Ø02 |

Figure 37. Job Control and Program Control Statements for Tape-to-Printer Job (Sorted Records)

OPERATING PROCEDURES

The sample deck supplied by IBM is designed for Model 20 systems with:

a) a storage capacity of 4096 bytes and the following I/O devices:
   an IBM 2560 MFCM,
   an IBM 1403 Printer,
   an IBM 2415 Magnetic Tape Unit Model 1 or 4 (9-track drives with unit numbers 80 and 81);

b) a minimum storage capacity of 8192 bytes and the following I/O devices:
   an IBM 2560 MFCM,
   an IBM 1403 Printer,
   an IBM 2415 Magnetic Tape Unit, any model, (9-track drives with unit numbers starting at 80).

Operating Procedure (4K)

The following is a description of the operating procedure for a configuration as described under (a) above.

If the sample jobs are to be executed with a different I/O configuration, the ASSGN statements and the other job control statements of the sample programs must be changed according to the I/O characteristics.

If the physical addresses of the user's tape drive differ from the standard assignments (780-785), the REP cards at the end of the Monitor deck must be changed accordingly. (See the description of the REP cards in the SRL publication IBM System/360 Model 20, Tape Programming System, Control and Service Programs, Form C24-9000.)

Initialize-Tape Run

1. Mount a tape on the drive assigned to SYS000 (see ASSGN card in group X90). Press the Load-Rewind key and the Start key of the drive.

2. Place the following cards into the hopper of the loading unit (2560 primary hopper in the example):
   - the card IPL deck,
   - the ASSGN card for SYSRDR (see group X90), and
   - the Basic Monitor card deck.

3. Place the following cards into the hopper of SYSRDR:
   - phases 00, 01 and 02 of the Job Control program deck,
   - card group X90 (job control statements -- excluding the ASSGN card for SYSRES),
   - phase 03 of the Job Control program deck,
   - the Initialize-Tape Utility program deck, and
   - card group X91 (program control statement).

4. Press the Start key of the device.

5. Press the Reset key and the Start key of the printer assigned to SYSLOG.

6. Set the Address switches on the CPU console to 009C.

7. Press the Load key on the CPU console.

A standard volume label will be written on the tape mounted on drive SYS000. The tape will be rewound so that the card-to-tape job can be run next. The system halts and code 0B20 is displayed.

Card-to-Tape Run

1. The labeled tape (mounted on the drive assigned to SYSOPT--see ASSGN card in group V90) is positioned at the load point and ready, from the previous run.

2. Place the following cards into the hopper of the loading unit (2560 primary hopper in the example):

   - the card IPL deck,
   - the ASSGN card for SYSRDR (see card group X90), and
   - the Basic Monitor card deck.

3. Place the following cards into the hopper of SYSRDR:

   - phases 00, 01 and 02 of the Job Control program deck,
   - card group V90 (job control statements),
   - phase 03 of the Job Control program deck,
   - phase 00 of the Card-to-Tape Utility program deck,
   - card group V91 (program control statements), and
   - the remainder of the Card-to-Tape Utility program.

4. Place card group V92 (data cards) and an end-of-file card into the hopper of SYSIPT (see ASSGN card in group V90).

5. Press the Start key of the device used.

6. Press the Reset key and the Start key of the printer.

7. Set the Address switches on the CPU console to 009C.

8. Press the Load key on the CPU console.

9. After halt 0C2F is displayed, press the start key on the CPU console.

The card file is blocked with five records in a block and written on the tape mounted on drive SYSOPT. The tape will be rewound so that the tape-to-printer job can be run next. The system halts and code 0B20 is displayed.

Tape-to-Printer Run

1. The tape to be printed (mounted on the drive assigned to SYSIPT--see ASSGN card in group W90) is positioned at the load point and ready, from the previous run.

2. Place the following cards into the hopper of the loading unit (2560 primary hopper in the example):

   - the card IPL deck,
   - the ASSGN card for SYSRDR (see card group X90), and
   - the Basic Monitor card deck.

3. Place the following cards into the hopper of SYSRDR:

   - phases 00, 01 and 02 of the Job Control program deck,
   - card group W90 (job control statements),
   - phase 03 of the Job Control program deck,
   - phase 00 of the Tape-to-Printer Utility program deck,
   - card group W91 (program control statements), and
   - the remainder of the Tape-to-Printer Utility program deck.

4. Press the Start key of the device.

5. Press the Reset key and the Start key of the printer.

6. Set the Address switches on the CPU console to 009C.

7. Press the Load key on the CPU console.

The tape file written by the card-to-tape utility program is printed out using the display option of the tape-to-printer utility. The five records in each block are identified by the indicators on the left side of the printed output. The tape will be rewound. The system halts and code 0B20 is displayed.

Operating Procedure (8K)

The following is a description of the operating procedure for Model 20 systems with a minimum storage capacity of 8192 bytes and the following I/O devices:

- an IBM 2560 MFCM
- an IBM 1403 Printer
- an IBM 2415 Magnetic Tape Unit, any model, (9-track drives with unit numbers starting at 80).

If the user's Model 20 system has a different I/O configuration or different tape unit numbers, the ASSGN cards in the sets of job control cards and/or the REP cards supplied with the tape IPL must be changed.

If the user's Model 20 system includes two tape drives only, the last two sample jobs (sorting of records and printing of sorted records) cannot be performed.

The following steps must be taken to perform the five (stacked) sample jobs:

1. Mount the system tape (containing the Utility programs and, if the Sort job is to be performed, the Sort/Merge program) on the tape drive assigned to SYSRES (see ASSGN card in group X90). Press the Load-Rewind key and the Start key of the device.

2. Mount a blank tape on the tape drive assigned to SYS000 in card group X90, and press the Load-Rewind key and the Start key of the drive.

3. Remove the ASSGN cards for SYSRES and SYSRDR from card group X90 and place them in the IPL deck, in front of the REP cards (if used) and the end-of-file card. Place this deck into the hopper of the loading unit (2560 primary feed in the example).

4. Remove the CONFG cards from card groups X90, V90, and W90. (These cards are used in a card-resident system run.)

5. Place card groups X90-V91 and W90-W91, in the sequence shown in the above list, into the hopper of SYSRDR (2560 primary feed in the example).

6. If the Sort job is to be performed, place card groups S90-W93 into the hopper of SYSRDR, behind group W91.

7. Place card group V92 (data cards) and an end-of-file card into the hopper of SYSIPT (2560 secondary feed in the example).

8. Press the Start key of the card device used.

9. Install forms in the printer, and press the Reset key and the Start key of the device.

10. Set the Register-Data/Address switches on the CPU console to an even main storage address between hexadecimal 009C and the end-of-storage address minus hexadecimal 0052.

11. Set the Mode switch on the CPU console to PROCESS.

12. Press the Load key on the CPU console.

A volume label is written on the tape mounted on SYS000. Then, the data is read from the cards and written onto the tape. In the third job, the data is read from the tape and listed on the printer.

If the Model 20 system has two tape drives, the sample run is completed. If the system has four or six tape drives, a PAUSE card is read after the third job, and the code 0B40 is displayed. Perform the following steps:

1. Mount an unlabeled output tape on the drive assigned to SYS000 in card group S90 (job control cards for Sort job).

2. Mount an unlabeled work tape on the drive assigned to SYS005 in card group S90.

3. Press the Load-Rewind keys and the Start keys of the drives.

4. Press the Start key on the CPU console. After halts 1C0A and 1C41 are displayed (warning messages), press the Start key on the CPU console.

The data is read from the labeled tape, sorted by the contents of column 27, and written onto the unlabeled output tape. Then, the sorted records are read from the tape and listed on the printer. Code 01D0 is displayed, completing the sample-program run.

## SAMPLE PROGRAM 4

Sample program 4 for the IBM System/360 Model 20, Input/Output Macro Definitions for the IBM 1419 is designed to perform:

- an assembly of a source program with macro instructions for the IBM 1419 included,
- the reading of banking documents on an IBM 1419,
- pocket selection of documents as described in the SRL publication IBM System/360 Model 20, Disk and Tape Programming Systems, Input/Output Control System for the IBM 1419 and 1259 Magnetic Character Reader, Form C33-6001, section Programming Example,
- printing of the contents of certain document fields on a 1403 printer.

## DESCRIPTION OF THE SAMPLE DECK

The sample program cards are identified by the letter Y in column 73. Card column 76 contains a 2. The deck consists of:

- two Job Control cards identified by punches 90 in columns 74 and 75,
- the source program containing macro instructions for the IBM 1419, identified by punches 91 in columns 74 and 75.

Card columns 77 to 79 contain consecutive numbers which begin with 001 for both card groups.

## OPERATING PROCEDURES

The sample deck supplied by IBM is designed for Model 20 systems with a storage capacity of at least 8192 bytes and the following I/O devices:

- A card reading device to be assigned by the user,
- An IBM 1419 Magnetic Character Reader,
- An IBM 1403 Printer

Moreover, the configuration requirements of the TPS Assembler program are to be met. Since the object program is to be punched, a card punching device is required.

The following steps should be followed to assemble the source program and obtain the executable object program in punched cards.

1. Place the Tape IPL program deck into the hopper of the loading unit.
2. Assign tape units and card reader by punching appropriate ASSGN statements and inserting them in the IPL deck, in front of the REP cards (if used) and the end-of-file card.
3. Mount the system tape (containing the TPS Assembler program and the macro library with Basic Monitor and I/O Macro Definitions with the Macro Definitions for the IBM 1419 included) on the tape drive assigned to SYSRES. Press the Load-Rewind key and the Start key on the device.
4. Place the Job Control cards (identified by punches Y90 in columns 73-75) with a // DATE card and ASSGN cards for SYSIPT, SYSOPT, SYSIST, SYS000, and SYS001 to be punched by the user and to be inserted after the // JOB card into the hopper of the card reader assigned to SYSRDR.
5. Place the card group identified by Y91 in columns 73 to 75 (sample source program) in the hopper of the unit assigned to SYSIPT. Press the Start key of this device.
6. Place blank cards in the hopper of the unit assigned to SYSOPT and press the Start key of this device.
7. Mount work tapes on the tape drives assigned to SYS000 and SYS001. Press the Load-Rewind and Start keys of these drives.
8. Install forms on the printer and press the Reset key and the Start key of the printer.
9. Set the Register-Data/Address switches on the CPU console to an even main storage address between hexadecimal 009C and the end-of-storage address minus hexadecimal 0052.
10. Set the Mode switch on the CPU console to PROCESS.
11. Press the Load key on the CPU console.

The object program contained in punched cards is obtained from the unit assigned to SYSOPT.

Execution of the Object Program under Control of the Card-Resident System

The following steps must be taken to execute the object program obtained as card output from the Assembler program under control of the Card-Resident System.

1. Place the card IPL deck in the hopper of the loading unit.
2. Assign a card reader to SYSRDR by punching the appropriate ASSGN card and inserting this card behind the IPL deck.
3. Place the card Basic Monitor deck into the hopper of the loading unit.
4. Place into the hopper of SYSRDR:
   - phases 00, 01 and 02 of the Job Control program deck
   - a // JOB card (to be prepared by the user)
   - a // DATE card (to be prepared by the user)
   - an ASSGN card for SYSLST (to be prepared by the user)
   - phase 03 of the Job Control program deck
   - the sample program object deck.
5. Press the Start key on the card reading device
6. Press the Reset and Start keys on the printer.
7. Press the amount and transit routing Validity-Check and Read-Out keys on the IBM 1419. Only these two Validity-Check keys should be pressed.
8. Press the Program-Sort key on the IBM 1419.
9. Feed sample banking documents into the hopper of the IBM 1419. These documents should be prepared according to the description in the SRL publication IBM System/360 Model 20, Disk and Tape Programming Systems, Input/Output Control System for the IBM 1419 and 1259 Magnetic Character Readers, Form C33-6001, section Programming Example.
10. Press the Reset, Restore, and Start keys of the IBM 1419.
11. Set the Time-Sharing switch on the CPU to TIME SHARING.
12. Set the Mode switch on the CPU to PROCESS.
13. Set the Register-Data/Address switch on the CPU console to an even main storage address between hexadecimal 009C and the end of storage minus hexadecimal 0052.
14. Press the Load key on the CPU console.

The sample program causes the IBM 1419 to read and pocket-select documents as described in the above referenced SRL publication.

The IBM 1403 printer lists the contents of the amount and transit routing fields and the number of the pocket into which documents are selected.

After 50 documents have been read, the amount totals are printed, a programmed halt occurs, and the code 0B20 is displayed on the CPU console.

Note: The sample program can be modified to run on a system that includes the 1259. (For details of the program modifications, see the SRL publication IBM System/360 Model 20, Disk and Tape Programming Systems, Input/Output Control System for the IBM 1419 and 1259 Magnetic Character Readers, Form C33-6001). The operating procedure described above may be used to run the sample program if the 1259 keys corresponding to the 1419 keys listed above are pressed as directed.

## SAMPLE PROGRAM 5

Sample program 5 illustrates the use of the Model 20 BSCA IOCS for a non-switched, point-to-point line configuration with no leading graphics and no limited conversational mode. The sample program is split into two separate, self-contained parts:

- the "master" program, which transmits data read from cards, and
- the "slave" program, which punches the transmitted data into cards.

## DESCRIPTION OF THE SAMPLE DECK

The two parts of the sample program deck are identified as follows:

| Columns 73 74 75 | Description |
|---|---|
| Z 9 0 | Master program |
| Z 9 1 | Slave program |

Card column 76 contains a 2 (identification for TPS).

## MACHINE REQUIREMENTS

### Assembly

The sample programs with the BSCA IOCS routines have been designed for assembly on Model 20 systems with a main-storage capacity of 16,384 bytes and the following I/O configuration:

- An IBM 2501 Card Reader
- An IBM 2520 Card Punch
- An IBM 2415 Magnetic Tape Unit with three tape drives
- An IBM 1403 or 2203 Printer.

If the user's Model 20 has a different main-storage capacity or I/O configuration, the job-control cards (statements 1 to 9 in Figure 38) must be changed accordingly.

IBM System/360 Assembler Coding Form — X28-6509-3 U M050 Printed in U.S.A.

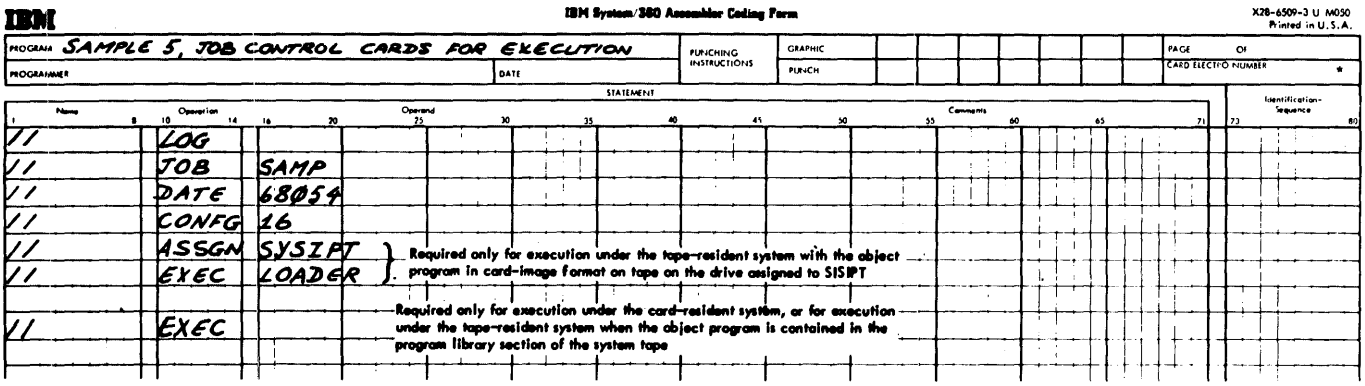
PROGRAM: SAMPLE 5, CARD GROUP Z90 — PUNCHING INSTRUCTIONS — GRAPHIC — PUNCH — PAGE — OF — CARD ELECTRO NUMBER

PROGRAMMER — DATE

STATEMENT

| Name | Operation | Operand | Comments | Identification-Sequence |
|---|---|---|---|---|
| // | LOG | | | Z902001 |
| // | JOB | ASSEMBLER | | Z902002 |
| // | DATE | 68057 | | Z902003 |
| // | ASSGN | SYSIPT,X'100',R4 | | Z902004 |
| // | ASSGN | SYS000,X'781',T2,X'C8' | | Z902005 |
| // | ASSGN | SYS001,X'782',T2,X'C8' | | Z902006 |
| // | ASSGN | SYSOPT,X'200',R5 | | Z902007 |
| // | CONFG | 16 | | Z902008 |
| // | EXEC | | | Z902009 |
| | AOPTN | NORLD | | Z902010 |
| ********** | ********** | ********** | ********** | Z902011 |
| * | | | | Z902012 |
| * MASTER | SAMPLE | PROGRAM - DTF STATEMENTS | | Z902013 |
| * | | | | Z902014 |
| | START | X'1000' | | Z902015 |
| * | | | | Z902016 |
| BSCA | DTFBT | CONFIG=PTP,MODE=TR,CONT=PRIME,RETRY=5,CICPT=CIOP, | | BZ902017 |
| | | TECB=TECB | | Z902018 |
| * | | | | Z902019 |
| INPT | DTFSR | DEVICE=READ01,TYPEFLE=INPUT,WORKA=YES,EOFADDR=FINI, | | CZ902020 |
| | | IOAREA1=CR01,BLKSIZE=80 | | Z902021 |
| * | | | | Z902022 |
| PRNT | DTFSR | DEVICE=PRINTER,TYPEFLE=OUTPUT,WORKA=YES,BLKSIZE=30 | | Z902023 |
| | DTFEN | | | Z902024 |

●Figure 38. Job Control and DTF Statements supplied for Assembly of the (Master) Sample Program




●Figure 39. Job Control Cards Required for Execution of the Sample Program

Execution

The sample programs have been designed for execution on systems with the following I/O devices:

a) For the master program:

- An IBM 2501 Card Reader
- An IBM 1403 or 2203 Printer
- The Binary Synchronous Communications Adapter (Feature No. 2074)

b) For the slave program:

- An IBM 2520 Card Punch
- An IBM 1403 or 2203 Printer
- The Binary Synchronous Communications Adapter (Feature No. 2074).

If the user's I/O configuration differs from that shown above, the DTFSR cards in the source sample program(s) (see Figure 38) must be changed.

It is assumed that 16,384 bytes of main storage are available for execution; if the user's Model 20 has a different storage capacity, the appropriate job-control card (statement 4 in Figure 39) must be changed.

OPERATING PROCEDURES

Assembly

The following steps must be taken to assemble the master or the slave source program and obtain the object program in the required form:

1. Place into the hopper of the loading unit:
   (a) the tape IPL deck up to and including the END card.
   (b) an ASSGN card for SYSRES (prepared by the user)
   (c) an ASSGN card for SYSRDR (prepared by the user) if SYSRDR is not the IBM 2501 Card Reader
   (d) the end-of-file card (/* in columns 1 and 2).
2. Mount the system tape on the drive assigned to SYSRES and press the Load-Rewind key and the Start key of the drive.
3. Mount work tapes on the drives assigned to SYS000 and SYS001. Press the Load-Rewind keys and the Start keys of these drives.
4. If the object program is to be put onto tape in card-image format for subsequent execution under control of the tape-resident system, perform the additional steps (a) and (b) below. Otherwise, (if output in cards is required) continue with step 5.
   a) Change the ASSGN SYSCPT card (statement 7 of Figure 38).
   b) Mount an output tape on the drive assigned to SYSCPT and press the Load-Rewind key and the Start key of the drive.
5. Place the job-control cards (statements 1 to 9 in Figure 38) into the hopper of the card reader assigned to SYSRDR. Press the Start key of this device.
6. Place the sample source program into the hopper of the device assigned to

SYSIPT. Press the Start key of this device.

7. Prepare and start the printer.

8. Set the Register-Data/Address switches on the CPU console to 009C.

9. Set the Mode switch on the CPU console to PROCESS.

10. Press the Load key on the CPU console.

The object program, either contained in punched cards or (if step 4 has been carried out) on tape in card-image format, is obtained from the unit assigned to SYSOPT.

Execution under Control of the Card-Resident System

The following steps must be taken to execute the object program obtained as card output from the assembler program, under control of the card-resident system:

1. Place the card IPL deck into the hopper of the loading unit.

2. Punch an ASSGN card for SYSRDR and place it behind the card IPL deck.

3. Place the following into the hopper of the card reader assigned to SYSRDR:

   (a) Phases 00, 01 and 02 of the job-control program deck.

   (b) The job-control cards shown in Figure 39. (These cards must be prepared by the user).

   (c) Phase 03 of the job-control program deck.

   (d) The sample program object deck (excluding, for the master program, the data cards and the end-of-file card).

4. For the master program only: Place into the hopper of the device specified in the DTFSR statement (statement number 20 in Figure 38) the data cards and the end-of-file card.

5. For the master program:
   Press the Start key on the card reader.
   For the slave program:
   Press the Start key on the card punch.

6. Press the Reset key and the Start key on the printer.

7. Press the Load key on the CPU console.

Execution under Control of the Tape-Resident System

Execution under control of the tape-resident system can be carried out if the object program is either:

- stored on tape in card-image format,

or

- contained in the program library of the system tape.

The procedure for obtaining the source program on tape in card-image format as output from the assembler program is described under step 4 of the instructions for assembly of the sample program.

If it is desired to have the sample program (master or slave) on the system tape, the object program obtained as output from the assembler program (either on tape or in cards) must be added to the program library section of the system tape by means of the CMAINT program. The procedure for doing this is described in the section Updating the Program Library Section of the System Tape.

The following steps must be taken to execute the object program:

1. Place into the hopper of the loading unit:

   (a) the tape IPL deck up to and including the END card.

   (b) an ASSGN card for SYSRES (prepared by the user).

   (c) an ASSGN card for SYSRDR (prepared by the user) if SYSRDR is not the IBM 2501 Card Reader.

   (d) the end-of-file card (/* in columns 1 and 2).

2. Mount the system tape on the drive assigned to SYSRES; press the Load-Rewind key and the Start key of this drive.

3. If the object program is stored on tape in card-image format, mount this tape on the drive assigned to SYSIPT; press the Load-Rewind key and the Start key of this drive.

4. Place into the hopper of the device assigned to SYSRDR the job-control cards shown in Figure 39. These cards must be prepared by the user.

5. For the master program only: Place into the hopper of the device specified

in the DTFSR statement (statement number 20 in Figure 36) the data cards and the end-of-file card.

6. For the master program:

   Press the Start key on the card reader.

   For the slave program:

   Press the Start key on the card punch.

7. Press the Reset key and the Start key on the printer.

8. Press the Load key on the CPU console.

The slave program should, if possible, be loaded just before the master program. If the master program is loaded before the slave, the slave must be loaded within the next three minutes, otherwise there will be a halt with E-S-T-R display 0553 on the console of the master CPU. If this happens, the master program must be loaded again.

After all the data cards have been read and transmitted, a programmed halt occurs and code 0F10 is displayed on the consoles of both the master and the slave CPUs.

## MANUAL INTERVENTION (SLAVE TERMINAL ONLY)

If the operator at the slave terminal wishes to suspend operation, he must:

1. Set the Register-Data/Address switches on the CPU console to the address of the SAK byte. This address is obtained from the assembly listing of the slave program.

2. Set the Data switch to a value other than zero.

3. Set the Mode switch to STOR ALTER.

4. Press the Start key on the CPU console to set the SAK byte to the value indicated by the Data switch.

5. Set the Mode switch to PROCESS.

6. Press the Start key on the CPU console. This will cause a halt, with E-S-T-R display 0F20 on the console at the slave terminal and 0F30 on the console at the master terminal.

To resume operation, the operator at the slave terminal must press the Start key on the CPU console.

When the operator at the master terminal receives the 0F30 display, he should communicate with the operator at the slave terminal, or wait a prearranged time and then press START on his console to resume operation.

## HALTS AND ERROR DISPLAYS

In addition to the standard BSCA IOCS halts, there are a number of other halts that may occur during execution of the master and slave sample programs. These halts, together with the restart procedures are shown in Figure 40.

| Master | Slave | Halt code ESIR | Restart Procedure | Remarks |
|---|---|---|---|---|
| X | X | 0 0 4 0 | Press START on the CPU to continue the job. | |
| X | X | 0 0 5 0 | | |
| X | | 0 0 5 1 | | |
| X | X | 0 0 5 2 | | |
| X | X | 0 0 5 4 | | |
| | X | 0 0 6 4 | | |
| | X | 0 0 6 6 | | |
| X | X | 0 5 4 1 | Press START on the CPU to discontinue the job. | |
| X | X | 0 5 4 3 | No restart procedure. | |
| X | | 0 5 5 3 | No restart procedure. | |
| | X | 0 5 6 3 | No restart procedure. | |
| X | X | 0 F 1 0 | No restart procedure. | Normal program end |
| | X | 0 F 2 0 | Press START on the CPU to continue the job. | Slave operator has interrupted the job. |
| X | | 0 F 3 0 | Communicate with operator of slave station or press START on the CPU after a prearranged time to resume operation. | |

● Figure 40. Programmed-Halt Displays and Restart Procedures Associated with Sample Program 5 for the Binary Synchronous Communications Adapter

## SAMPLE PROGRAM 6

Sample program 6 illustrates the use of the Model 20 BSCA IOCS in a switched configuration using the ITB feature. The sample program is split into two separate, self-contained parts:

- the "master" program, which transmits data read from cards, and
- the "slave" program, which punches the transmitted data into cards.

## DESCRIPTION OF THE SAMPLE DECK

The two parts of the sample program deck are identified as follows:

| Columns | | | Description |
|---|---|---|---|
| 73 | 74 | 75 | |
| Z | 9 | 2 | Master program |
| Z | 9 | 3 | Slave program |

Column 76 contains a 2 (identification for TPS).

## MACHINE REQUIREMENTS

### Assembly

The sample program with the BSCA IOCS routines have been designed for assembly on Model 20 systems with a main-storage capacity of 16,384 bytes and the following I/O configuration:

- An IBM 2501 Card Reader
- An IBM 2520 Card Punch
- An IBM 2415 Magnetic Tape Unit with three tape drives
- An IBM 1403 or 2203 Printer

If the user's Model 20 has a different main-storage capacity or I/C configuration, the job-control cards (statements 1 to 9 in Figure 41) must be changed accordingly.

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PROGRAM SAMPLE 6, CARD GROUP Z92 — PUNCHING INSTRUCTIONS — GRAPHIC — PUNCH — PAGE — OF — CARD ELECTRO NUMBER

PROGRAMMER — DATE

STATEMENT

| Name | Operation | Operand | Comments | Identification-Sequence |
|---|---|---|---|---|
| // | LOG | | | Z922001 |
| // | JOB | ASSEMBLER | | Z922002 |
| // | DATE | 68057 | | Z922003 |
| // | ASSGN | SYSIPT,X'100',R4 | | Z922004 |
| // | ASSGN | SYS000,X'781',T2,X'C8' | | Z922005 |
| // | ASSGN | SYS001,X'782',T2,X'C8' | | Z922006 |
| // | ASSGN | SYSOPT,X'200',R5 | | Z922007 |
| // | CONFG | 16 | | Z922008 |
| // | EXEC | | | Z922009 |
| | AOPTN | WORLD | | Z922010 |
| MAST | START | X'1300' | | Z922011 |
| * | THE DTF STATEMENTS ARE PART OF THE SOURCE | | | Z922012 |
| * | PROGRAM. THEY RESULT, AT ASSEMBLY TIME, IN | | | Z922013 |
| * | THE INSERTION OF THE NECESSARY IOCS AND BSCA | | | Z922014 |
| * | IOCS ROUTINES INTO THE SAMPLE SOURCE PROGRAM. | | | Z922015 |
| * | | | | Z922016 |
| * | DTF STATEMENTS FOR IOCS AND BSCA IOCS FILES | | | Z922017 |
| * | | | | Z922018 |
| BSCA | DTFBT | | | X Z922019 |
| | | CONFIG=SW, | | X Z922020 |
| | | CONT=PRIME, | | X Z922021 |
| | | MODE=TR, | | X Z922022 |
| | | CIOPT=BSAR, | | X Z922023 |
| | | TECB=TECB, | | X Z922024 |

Figure 41. Job Control and DTF statements supplied for Assembly of the (Master) Sample Program (Part 1 of 2)

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PROGRAM SAMPLE 6, CARD GROUP 292 (CONT'D) — PUNCHING INSTRUCTIONS — GRAPHIC — PUNCH — PAGE — OF — CARD ELECTRO NUMBER

PROGRAMMER — DATE

| Name | Operation | Operand | Comments | Identification-Sequence |
|---|---|---|---|---|
| | | AUTCALL=YES, | | X2922025 |
| | | CALL=SIW, | | X2922026 |
| | | ITBMODE=YES, | | X2922027 |
| | | ITBRTMN=PARTL, | | X2922028 |
| | | TRANSP=YES, | | X2922029 |
| | | LGRAPH=YES, | | X2922030 |
| | | RETRY=5 | | 2922031 |
| PRNT | DTFSR | | | P2922032 |
| | | DEVICE=PRINTER, | | P2922033 |
| | | TYPEFLE=OUTPUT, | | P2922034 |
| | | WORKA=YES, | | P2922035 |
| | | BLKSIZE=29 | | 2922036 |
| CRD | DTFSR | | | C2922037 |
| | | DEVICE=READ01, | | C2922038 |
| | | TYPEFLE=INPUT, | | C2922039 |
| | | WORKA=YES, | | C2922040 |
| | | EOFADDR=FINI, | | C2922041 |
| | | IOAREA1=CR01, | | C2922042 |
| | | BLKSIZE=40 | | 2922043 |
| | DTFEN | | | 2922044 |

● Figure 41. Job Control and DTF statements supplied for Assembly of the (Master) Sample Program (Part 2 of 2)

IBM System 360 Assembler Coding Form — X28-6509-3 U M050 Printed in U.S.A.

PROGRAM SAMPLE 6, JOB CONTROL CARDS FOR EXECUTION — PUNCHING INSTRUCTIONS — GRAPHIC — PUNCH — PAGE — OF — CARD ELECTRO NUMBER

PROGRAMMER — DATE

| Name | Operation | Operand | Comments | Identification-Sequence |
|---|---|---|---|---|
| // | LOG | | | |
| // | JOB | SAMP | | |
| // | DATE | 68054 | | |
| // | CONFG | 16 | } Required only for execution under the tape-resident system with the object program in card-image format on tape on the drive assigned to SYSIPT | |
| // | EXEC | LOADER | | |
| // | EXEC | | Required only for execution under the card-resident system, or for execution under the tape-resident system when the object program is contained in the program library section of the system tape | |

● Figure 42. Job Control Cards Required for Execution of the Sample Program

Execution

The sample programs have been designed for execution on systems with the following I/O devices:

a) For the master program:

- The Binary Synchronous Communications Adapter (Feature No. 2074) equipped with Automatic Calling (Autodial) (Feature No. 1315), Intermediate Block Checking (Feature No. 4700), and Full Transparency Text Mode (Feature No. 4100).
- An IBM 2501 Card Reader
- An IBM 1403 or 2203 Printer

b) For the slave program:

- The Binary Synchronous Communications Adapter (Feature No. 2074) equipped with Intermediate Block Checking (Feature No. 4700) and Full Transparency Text Mode (Feature No. 4100).

- An IBM 2520 Card Punch
- An IBM 1403 or 2203 Printer

If the user's I/O configuration differs from that shown above, the DTFSR cards in the source sample program(s) (see Figure 41) must be changed.

It is assumed that 16,384 bytes of main storage are available for execution; if the user's Model 20 has different storage capacity, the appropriate job-control card (statement 4 in Figure 42) must be changed.

## OPERATING PROCEDURES

### Assembly

The following steps must be taken to assemble the master or the slave source program and obtain the object program in the required form:

1. For the master program only: Remove card Z922339 from the master source deck and replace it with a card containing the length of the slave station telephone number. Remove card Z922340 from the master source deck and replace it with a card containing the slave telephone number itself.

2. Place into the hopper of the loading unit:
   a) the tape IPL deck up to and including the END card
   b) an ASSGN card for SYSRES (prepared by the user)
   c) an ASSGN card for SYSRDR (prepared by the user) if SYSRDR is not the IBM 2501 Card Reader
   d) the end-of-file card (/* in columns 1 and 2).

3. Mount the system tape on the drive assigned to SYSRES and press the Load-Rewind key and the Start key of the drive.

4. Mount work tapes on the drives assigned to SYS000 and SYS001. Press the Load-Rewind keys and Start keys of these drives.

5. If an object program is to be put onto tape in card-image format for subsequent execution under control of the tape-resident system, perform the additional steps (a) and (b) below. Otherwise, (if output on cards is required) continue with step 6.
   a) Change the ASSGN SYSOPT card (statement 7 of Figure 41)
   b) Mount an output tape on the drive assigned to SYSOPT and press the Load-Rewind key and the Start key of the drive.

6. Place the job-control cards (statements 1 to 9 in Figure 41) into the hopper of the card reader assigned to SYSRDR. Press the Start key of this device.

7. Place the sample source program into the hopper of the device assigned to SYSIPT. Press the Start key of this device.

8. Prepare and start the printer.

9. Set the Register-Data/Address switches on the CPU console to 009C.

10. Set the Mode switch on the CPU console to PROCESS.

11. Press the Load key on the CPU console.

The object program, either contained in punched cards or (if step 5 has been carried out) on tape in card-image format, is obtained from the unit assigned to SYSOPT.

### Execution under Control of the Card-Resident System

The following steps must be taken to execute the object program, obtained as card output from the assembler program, under control of the card-resident system:

1. Place the card IPL deck into the hopper of the loading unit.

2. Punch an ASSGN card for SYSRDR and place it behind the card IPL deck.

3. Place the following into the hopper of the card reader assigned to SYSRDR:
   (a) Phases 00 and 01 of the job-control program deck.
   (b) The job control cards shown in Figure 41. (These cards must be prepared by the user).
   (c) Phase 02 of the Job Control program deck.
   (d) The sample program object deck (including, for the master program, the data cards and the end-of-file card).

4. For the master program:
   Press the Start key on the card reader.
   For the slave program:
   Press the Start key on the card punch.

5. Press the Reset key and the Start key on the printer.

6. Press the Load key on the CPU console.

Execution under Control of the Tape-Resident System.

Execution under control of the tape-resident system can be carried out if the object program is either:

- stored on tape in card-image format, or
- contained in the program library of the system tape.

The procedure for obtaining the source program on tape in card-image format as output from the Assembler program is described under step 4 of the instructions for assembly of the sample program.

If it is desired to have the sample program (master or slave) on the system tape, the object program obtained as output from the Assembler program (either on tape or in cards) must be added to the program library section of the system tape by means of the CMAINT program. The procedure for doing this is described in the section Updating the Program Library Section of the System Tape.

The following steps must be taken to execute the object program:

1. Place into the hopper of the loading unit:
   (a) the tape IPL deck up to and including the END card.
   (b) an ASSGN card for SYSRES (prepared by the user).
   (c) an ASSGN card for SYSRDR (prepared by the user) if SYSRDR is not the IBM 2501 Card Reader.
   (d) the end-of-file card (/* in columns 1 and 2).
2. Mount the system tape on the drive assigned to SYSRES; press the Load-Rewind key and the Start key of this drive.
3. Place into the hopper of the device assigned to SYSRDR the job control cards shown in Figure 41. These cards must be prepared by the user.
4. For the master program:
   Press the Start key on the card reader.
   For the slave program:
   Press the Start key on the card punch.
5. Press the Reset key and the Start key on the printer.
6. Press the Load key on the CPU console.

The slave program should, if possible, be loaded just before the master program.

After all the data cards have been read and transmitted, a programmed halt occurs.

HALTS AND ERROR DISPLAYS

In addition to the standard BSCA IOCS halts, there are a number of other halts that may occur during execution of the master and slave programs. These halts, together with the restart procedures, are shown in Figure 43.

| Master | Slave | Halt code ESTR | Restart Procedure | Cause |
|---|---|---|---|---|
| X | X | 0011 | Press START to discontinue the job | End of program |
| X | | 0025 | Press START to discontinue the job via HPR0011 | Improper ID-ACK received for WRITE CONNECT |
| X | X | 0040 | Press START to discontinue the job via HPR0011 | ABORT RCVD (error-free) |
| X | X | 0041 | Press START to discontinue the job via HPR0011 | ABORT SENT/RCVD and macro in error (second-level abort) |
| X | X | 0043 | Press START to discontinue the job via HPR0011 | Abort during ending macro |
| X | | 00AB | Press START to discontinue the job via HPR0011 | Unexpected outcome during execution of Master Program* |
| | X | 00FF | Press START to discontinue the job via HPR0011 | Unexpected outcome during execution of Slave Program** |

* One of the following error messages will be printed:

| | |
|---|---|
| "BSCA ERROR - NCODE xx, LOG" | (gives normal code setting and logical error byte setting) |
| "BSCA ERROR - SENSE xx" | (gives sense byte setting) |
| "BSCA ERROR - NCODE xx UNEXP" | (gives normal code setting) |
| "BSCA ERROR - NCODE xx ITB 7" | (gives normal code setting after seven retransmission tries) |

** One of the following error messages will be printed:

| | |
|---|---|
| "BSCA ERROR - COMPL xx LOG xx" | (gives completion code and logical error byte setting) |
| "BSCA ERROR - SENSE xx" | (gives sense byte setting) |
| "BSCA ERROR - COMPL xx" | (gives completion code) |
| "BSCA ERROR - COMPL xx ITB 7" | (gives completion code setting after seven requests for receiving an error-free block have failed) |
| "BSCA ERROR - RECORD COUNT" | (expected record count not equal to received record count) |

●Figure 43. Programmed-Halt Displays and Restart Procedures Associated with Sample Program 6 for the Binary Synchronous Communications Adapter

## PROGRAMMED HALTS

Whenever a programmed halt occurs, the U-L fields on the CPU console contain the code 99.

In most cases, processing can be resumed by following the described restart procedure. If the normal restart procedure fails, press the System Reset key on the CPU and restart (reload) the interrupted program. If at this point it is still impossible to resume successful operation, the attention of an IBM customer engineer is required. For a Model 20, Submodel 5 installation, try to restore the micro program before calling a customer engineer. (Refer to Appendix B. Micro Program Load Procedures.)

The section Programmed-Halt Displays contains a list of all programmed-halt codes that may be displayed in the E-S-T-R fields on the CPU console during the execution of IBM-supplied programs.

Wherever possible, a brief restart procedure is given in the list of halt codes for quick reference. Where this has not been possible due to the length of the procedure, or where additional information is required to clarify the brief restart procedure in the list, a reference number is given in the rightmost column of the list. This number corresponds to a number in the section Restart Procedures, where the appropriate information can be found.

In the section Restart Procedures and in the list of Programmed-Halt Displays, codes, data, and addresses of storage locations are given in hexadecimal notation. General register numbers are given in decimal notation.

Two types of programmed halts may occur: device-dependent halts and program-dependent halts. From the code displayed, the user can determine the type of halt that occurred, and the device or program to which it pertains. Figure 44 shows the codes used for device-dependent halts, and Figure 45 those used for program-dependent halts.

| Display E S T R | Device |
|---|---|
| 0 1 x x | 2501 |
| 0 2 x x | 2560, 2520 |
| 0 3 x x | 1442 |
| 0 4 x x | 1403, 2203 |
| 0 5 x x | BSCA |
| 0 6 x x | 1419, 1259 |
| 0 7 x x | 2415 |

Figure 44. Device-Dependent Halts

| Display E-S-T-R | Program |
|---|---|
| 0 5 x x | BSCA IOCS |
| 0 A 0 X | All programs |
| 0 B 0 x | IPL |
| 0 B 1 x | IPL |
| 0 B 2 x | Basic Monitor |
| 0 B 3 x | Basic Monitor |
| 0 B 4 x | Job Control |
| 0 B 5 x | Error Statistics |
| 0 B F x | Distribution-Package Retrieval |
| 0 C x x | Utility |
| 0 D x x | RPG Object |
| 0 E x x | I/O macros and RPG I/O Routines |
| 1 A x x | Assembler |
| 1 B 0 x | Load System Tape |
| 1 B 1 X | Load System Tape |
| 1 B 2 x | Linkage Editor |
| 1 B 3 x | Linkage Editor |
| 1 B 4 x | Core-Image Maintenance |
| 1 B 5 x | Core-Image Maintenance |
| 1 B 6 x | Macro Maintenance |
| 1 B 7 x | Macro Maintenance |
| 1 B 8 x | Directory Service |
| 1 B A x | Copy System Tape |
| 1 B D x | Core-Image Service/Macro Service |
| 1 B E x | Core-Image Service/Macro Service |
| 1 C x x | Sort/Merge |
| 1 D x x | RPG Compiler |

●Figure 45. Program-Dependent Halts

When a program-dependent halt has been caused by an error during a tape operation, it is sometimes necessary to identify the tape drive concerned. In these cases, the displacement of the affected logical unit block (symbolic device address) from the beginning of the logical unit table is contained in register 13, in hexadecimal notation. Figure 46 shows the arrangement of logical unit blocks in the table, and the displacement of each block.

| Position | Symbolic Address | Displacement* |
|---|---|---|
| 1 | SYSRES | 00 |
| 2 | SYSRDR | 02 |
| 3 | SYSIPT | 04 |
| 4 | SYSOPT | 06 |
| 5 | SYSLST | 08 |
| 6 | SYSLOG | 0A |
| 7 | SYS000 | 0C |
| 8 | SYS001 | 0E |
| 9 | SYS002 | 10 |
| 10 | SYS003 | 12 |
| 11 | SYS004 | 14 |
| 12 | SYS005 | 16 |
| 13 | SYS006 | 18 |
| 14 | SYS007 | 1A |
| 15 | SYS008 | 1C |
| 16 | SYS009 | 1E |
| 17 | SYS010 | 20 |
| 18 | SYS011 | 22 |
| 19 | SYS012 | 24 |
| 20 | SYS013 | 26 |
| 21 | SYS014 | 28 |
| 22 | SYS015 | 2A |

* in hexadecimal notation

Figure 46. Arrangement of Logical Unit Table, and Displacement of Logical Unit Blocks

During the execution of RPG object programs, a number of halts may occur that are not associated with any halt codes shown in the list. These halts occur when an arithmetic operation is performed on an invalid packed-decimal operand. The operation code of the instruction that led to the halt is then displayed in the U-L fields. (For more details, see the section Using the TPS Report Program Generator.)

NON-PROGRAMMED HALTS

In addition to programmed halts, the following non-programmed halts (machine stops) may occur during the execution of IBM-supplied or user-written programs:

1. A CPU process check -- indicated by the Process indicator on the CPU console.
2. A machine check on the 2520 Read/Punch or on the 2560 MFCM -- indicated by the Machine Check light on the affected unit.
3. A specification error (programming error stop) -- indicated by a nonzero I-field on the CPU console.

After a CPU process check or a machine check on the 2520 or 2560, no restart procedure can be used. If it is not possible to resume successful operation after pressing the System Reset key on the CPU and reloading the interrupted program, the attention of an IBM customer engineer is normally required. For information about correcting a specification error refer to the SRL publication IBM System/360 Model 20, Functional Characteristics, Form A26-5847. A specification error can only be corrected by the programmer.

When a machine stop occurs on a Submodel 5 and all attempts to resume operation fail, try to restore the micro program before calling a customer engineer. (Refer to Appendix B. Micro Program Load Procedures).

## 1419/1259 HALTS AND ERROR DISPLAYS

In addition to the halts described in the section Programmed-Halt Displays, certain conditions may occur on the IBM 1419/1259 that do not lead to a programmed halt, but cause a 1419 or 1259 stop while the IOCS stays in a wait loop. These conditions are summarized in figures 47 and 48. A detailed description and the appropriate restart procedures are given below.

| Procedure | Identification | | | | | |
|---|---|---|---|---|---|---|
| | Left-Feed Light | Start-Key Light | Film Light | Endorse-Stop Indicator | Stop Restore | Advance-Check Stop Indicator |
| 1 | ON | ON | | | | |
| 2 | | | ON | | | |
| 3 | | | | ON | ON | |
| 4 | | | | | ON | ON |
| 5 | | | | | | |
| 6 | Unrecoverable I/O Error | | | | | |

● Figure 47. Summary of 1419 Halts and Error Displays

### 1419 Halts and Error Displays

1. The Left-Feed light and the Start-Key light are on -- one or more documents may be jammed at the end of the document path.

   Procedure:

   - Clear the path.
   - Place the documents that have been read into the correct pockets. Return all other documents to the hopper. Place any mutilated documents into the reject pocket.
   - Press the 1419 Stop-Restore key.
   - Press the 1419 Start key.

2. The Film light is on.

   Procedure:

   - Eliminate the condition that caused the 1419 stop.
   - Distribute the documents as described above.
   - Press the Start key of the 1419.

3. The Endorse-Stop indicator and the Stop-Restore key light are on.

   Procedure:

   - Check the last few documents processed for proper endorsement.
   - Press the Stop-Restore key and the Start key of the 1419.

4. The Advance-Check-Stop indicator and the Stop-Restore key light are on. This condition can occur only if the Batch Numbering feature is installed and the Advance-Check switch is in the ON position. The stop is caused by a failure to advance the numbering device.

   Procedure:

   - Press the Stop-Restore key and the Start key of the 1419.

5. No error lights are set for the following conditions:

   a) Full pocket

   b) Empty feed hopper

   c) Hopper-feed failure.

   d) 1419 is not operational.

   Procedure:

- Eliminate the condition that caused the stop.
- Press the Start key of the 1419.

6. An unrecoverable I/O error may occur, or it may become necessary to terminate the job because of a program or other, error. Recovery is possible only if the program being executed was assembled with the ERREXIT detail entry specified in the DTFPD reader file-definition statement.

Procedure:

- Press the Stop keys on the 1419 and the CPU.
- Set the PSW (alter register 3) to the address of the instruction labeled I6ERROR (obtained from the Assembler listing of the program).
- Press the Start key on the CPU.

When the IOCS error recovery is complete, control is passed to the user's error exit routine.

| | Identification | | | | | |
|---|---|---|---|---|---|---|
| Procedure | Transport Light | Stacker-Command Light | Feed Light | Stacker Light | Short-Document Light | Document-Gap Light |
| 1 | ON | | | | | |
| 2 | | ON | | | | |
| 3 | | | ON | | | |
| 4 | | | | ON | | |
| 5 | | | | | ON | |
| 6 | | | | | | ON |
| 7 | Unrecoverable I/O Error | | | | | |

●Figure 48. Summary of 1259 Halt and Error Displays

1259 Halts and Error Displays

1. The Transport light is on -- one or more documents may be jammed in the document feed path.

   Procedure:

   - Press the Stop key on the CPU.
   - Enter a hexadecimal value other than 00 into location CE.
   - Press the Start key on the CPU.
   - Halt 0602 occurs. Follow the procedure described later in this section.

2. The Stacker-Command light is on -- the user has failed to issue a stacker-selection command in time for a document to be directed to the designated pocket.

   This condition may also be caused by dirty photo cells or multilated documents.

   Procedure:

   - Press the Start key on the 1259.

3. The Feed light is on -- either the feed hopper is empty or a jam has occurred at the separator-retard rollers.
   Procedure:

   - Correct the condition and press the start key on the 1259.

4. The Stacker light is on -- one or more stacker pockets are full.

   Procedure:

   - Remove documents from the full stacker pocket(s).

- Press the Start key of the 1259.

5. The Short-Document light is on -- a short or folded document is in the feeder area.

   Procedure:

   - Remove the document and press the Start key on the 1259.

6. The Document-Gap light is on -- the gap between documents is too short.

   Procedure:

   - Tighten the separator-retard rollers and press the Start key on the 1259.

7. An unrecoverable I/O error may occur, or it may become necessary to terminate the job because of a program or other, error. Recovery is possible only if the program being executed was assembled with the ERREXIT detail entry specified in the DTFPD reader file-definition statement.

   Procedure:

   - Press the Stop keys on the 1259 and the CPU.
   - Set the PSW (alter register 3) to the address of the instruction labeled I6ERROR (obtained from the Assembler listing of the program).
   - Press the Start key on the CPU.

   When the IOCS error recovery is complete, control is passed to the user's error exit routine.

## RESTART PROCEDURES

In this section (Restart Procedures) and in the list of Programmed-Halt Displays, codes, data, and addresses of storage locations are given in hexadecimal notation. General register numbers are given in decimal notation.

| 1 | The halt indicates one of the following conditions.

a) The hopper is empty.
- Place cards into the empty hopper.
- Press the Start key of the affected unit.
- Press the Start key on the CPU console.

b) The hopper is not empty. In this case, the affected unit has not been started.
- Press the Start key of the affected unit.
- Press the Start key on the CPU console.

| 2 | The halt indicates one of the following conditions.

a) The hopper is empty and there are still cards to be processed.
- Place cards into the empty hopper.
- Press the Start key of the affected unit.
- Press the Start key on the CPU console.

b) The hopper is empty and there are no more cards to be processed. The card that was the last one in the hopper has not yet been processed. Therefore, the system must be restarted.
- Press the Start key of the affected unit.
- Press the Start key on the CPU console.

c) The hopper is not empty. In this case, the affected unit has not been started.
- Press the Start key of the affected unit.
- Press the Start key on the CPU console.

| 3 | The stacker is full, or the cover is open, or the chip-box is full or mispositioned (punching devices only), or the print-line selector is not locked (2560 only).
- Correct the error condition.
- Press the Start key of the affected unit.
- Press the Start key on the CPU console.

| 4 | The read instruction that led to the error halt is re-executed upon restart.
- Remove the input deck from the hopper.
- Press the NPRO key.
- Remove the last two cards from the stacker and place them in front of the input deck.
- Check the card that is now the first card of the input deck (i.e., the card that caused the error) and correct it if necessary.
- Return the input deck to the hopper.
- Press the Start key of the affected unit.
- Press the Start key on the CPU console.

| 5 | The error that caused the halt is irrecoverable.
- Re-initiate the system run, beginning with the IPL procedure.

| 6 | The punch instruction that led to the error halt and, if the affected unit is a 2520 card read-punch, the preceding read instruction, are re-executed upon restart.
If the device is used for punching only, follow restart procedure 10. Otherwise, perform the following steps.
- Mark the last card in the stacker (stacker 2 for any model of the 2520).
- Remove the hopper deck.
- Press the NPRO key and place the cards ejected by the NPRO in front of the hopper deck.
- Remove the marked card, which is the card that caused the error, from the stacker and check it. If it does not contain any entries originating from earlier processing, discard it and place a blank card in front of the hopper deck. If the card does contain such entries, transfer these entries to a blank card manually, discard the marked card, and place the newly prepared card in front of the hopper deck.
- The second card in the hopper deck (behind the blank or newly prepared card) may have been misread. Check

this card and correct it if necessary.
- Return the hopper deck to the hopper.
- Press the Start key of the affected unit.
- Press the Start key on the CPU console.

7 The read instruction that led to the error halt is re-executed upon restart.

- Remove the input deck from the primary hopper.
- If the secondary hopper is also used, remove the input deck from the secondary hopper.
- Press the NPRO key.
- Remove the last three cards from stacker 1 and place them in front of the input deck for the primary hopper.
- Check the card that is now the first card of the input deck for the primary hopper (i.e., the card that caused the error) and correct it if necessary.
- If the secondary hopper is also used, remove the last card from stacker 5 and place it into the secondary hopper.
- Return the input deck(s) to the hopper(s).
- Press the Start key of the 2560.
- Press the Start key on the CPU console.

8 The read instruction that led to the error halt is re-executed upon restart.

- Remove the input deck from the secondary hopper.
- If the primary hopper is also used, remove the input deck from the primary hopper.
- Press the NPRO key.
- Remove the last two cards from stacker 5 and place them in front of the input deck for the secondary hopper.
- Check the card that is now the first card of the input deck for the secondary hopper (i.e., the card that caused the error) and correct it if necessary.
- If the primary hopper is also used, remove the last two cards from stacker 1 and place them into the primary hopper.
- Return the input deck(s) to the hopper(s).
- Press the Start key of the 2560.
- Press the Start key on the CPU console.

9
- Remove the deck from the affected hopper.
- Check the first card of the hopper deck (i.e., the card that caused the check).
- Repair this card or replace it by a duplicate.
- Return the hopper deck to the hopper.
- Press the start key of the affected unit.
- Press the start key on the CPU console.

10 The punch instruction that led to the error halt is re-executed upon restart.

- The mispunched card is the last card in the stacker (stacker 2 for the 2520). Remove this card from the stacker and discard it.
- Press the Start key on the CPU console.

11 The punch instruction that led to this error halt is re-executed upon restart.

- Mark the last card in stacker 1.
- Press the Start key on the CPU console.
- Remove and discard the mispunched card, i.e., the card stacked immediately behind the marked card in stacker 1.

12 The punch instruction that led to the error halt is re-executed upon restart.

- Mark the last card in stacker 5.
- Press the Start key on the CPU console.
- Remove and discard the mispunched card, i.e., the card stacked immediately behind the marked card in stacker 5.

13
- Remove the hopper deck and open the cover.
- Mark the card that is either immediately before or in the read station.
- Manually clear the feed path and close the cover.
- Press the NPRO key to turn off the Feed-Check light.
- Place the marked card and any cards that followed it in the feed path in front of the hopper deck.
- Place the cards that preceded the marked card in the feed path into

the stacker, in the correct order.
- Duplicate and replace any damaged cards.
- Return the hopper deck to the hopper.
- Press the Start key of the 2501.
- Press the Start key on the CPU console.

14 The read instruction that led to the error halt is re-executed upon restart.

- Remove the hopper deck and open the cover.
- Mark the card that is either in or immediately beyond the read station. (This is the card that caused the read error.)
- Manually clear the feed path and close the cover.
- Press the NPRO key to turn off the Feed-Check light.
- Check the marked card and correct it if required.
- Place the marked card and any cards that followed it in the feed path in front of the hopper deck.
- Place the cards that preceded the marked card in the feed path into the appropriate stacker, in the correct order.
- Duplicate and replace any damaged cards.
- Return the hopper deck to the hopper.
- Press the Start key of the affected unit.
- Press the Start key on the CPU console.

15 The punch instruction (and the preceding read instruction if the unit is also used for reading) that led to the error halt is re-executed upon restart.

- Remove the hopper deck and open the cover.
- Mark the card that is located immediately beyond the punch station. (This card may already be in the stacker.)
- Manually clear the feed path and close the cover.
- Press the NPRO key to turn off the Feed-Check light.
- Place the marked card and all other cards removed from the feed path in front of the hopper deck, in the proper order.
- Check the marked card. If it does not contain any entries originating from earlier processing, replace it with a blank card. If it does contain such entries, transfer these entries to a blank card manually, and replace the marked card with the newly prepared card.
- If the affected unit is a 2520 card read-punch, check the second card of the hopper deck, which may have been misread, and correct it if necessary.
- Duplicate and replace any damaged cards.
- Return the hopper deck to the hopper.
- Press the Start key of the affected unit.
- Press the Start key on the CPU console.

16
- Remove the hopper deck and open the cover.
- Manually clear the feed path and close the cover.
- Press the NPRO key to turn off the Feed-Check light.
- Place the card removed from the pre-punch station into stacker 1 if the halt code is 0211, and into stacker 2 if the halt code is 0212.
- Place the card removed from the pre-read station into the hopper.
- Duplicate and replace any damaged cards.
- Return the hopper deck to the hopper.
- Press the Start key of the 2520.
- Press the Start key on the CPU console.

17
- Remove the hopper deck and open the cover.
- Mark the card that is either immediately before or in the punch station.
- Manually clear the feed path and close the cover.
- Press the NPRO key to turn off the Feed-Check light.
- Place the marked card and any cards that followed it in the feed path in front of the hopper deck.
- Place the cards that preceded the marked card in the feed path into the appropriate stacker, in the proper order.
- Duplicate and replace any damaged cards.
- Return the hopper deck to the hopper.
- Press the Start key of the affected unit.
- Press the Start key on the CPU console.

18
- Remove the hopper deck and open the cover.
- Mark the following cards:

card A (which should be in the pre-read station);
card B (which should be in the pre-punch station);
card C (which should be the last card in stacker 1 if the halt code is 0231, or the last card in stacker 2 if the halt code is 0232).
The cards may be mispositioned. If they are, try to locate them by means of card numbers or other identifiers.

- Manually clear the feed path and close the cover.
- Press the NPRO key to turn off the Feed-Check light.
- Check card C. If it contains entries originating from earlier processing, transfer these entries to a blank card manually and place the newly prepared card into the hopper. If card C does not contain any such entries, place a blank card into the hopper. Discard card C.
- Place card B and card A in front of the hopper deck, so that card B is the first card of the deck.
- Duplicate and replace any damaged cards.
- Return the hopper deck to the hopper.
- Press the Start key of the 2520.
- Press the Start key on the CPU console.

19 The read instruction that led to the error halt is re-executed upon restart.

- Remove the primary-hopper deck.
- If the secondary hopper is also used, remove the secondary-hopper deck.
- Open the cover.
- Mark that card from the primary hopper which is either immediately beyond or in the read station.
- Manually clear the feed path and close the cover.
- Press the NPRO key to turn off the Feed-Check light.
- Place the marked card and the two cards from the primary hopper that followed it in the feed path in front of the primary-hopper deck.
- If the secondary hopper is also used, place the card from the secondary hopper that was located before the read station in front of the secondary-hopper deck.
- Stack any other cards removed from the feed path as required.
- Check the marked card, which may have been misread, and correct it if necessary.
- Duplicate and replace any damaged cards.
- Return the hopper deck(s) to the hopper(s).
- Press the Start key of the 2560.
- Press the Start key on the CPU console.

20 The read instruction that led to the error halt is re-executed upon restart.

- Remove the secondary-hopper deck.
- If the primary hopper is also used, remove the primary-hopper deck.
- Open the cover.
- Mark the card from the secondary hopper that is either immediately beyond or in the read station.
- Manually clear the feed path and close the cover.
- Press the NPRO key to turn off the Feed-Check light.
- Place the marked card and the card from the secondary hopper that followed it in the feed path in front of the secondary-hopper deck.
- If the primary hopper is also used, place the two cards from that hopper that were located before the read station in front of the primary-hopper deck.
- Stack any other cards removed from the feed path as required.
- Check the marked card, which may have been misread, and correct it if necessary.
- Duplicate and replace any damaged cards.
- Return the hopper deck(s) to the hopper(s).
- Press the Start key of the 2560.
- Press the Start key on the CPU console.

21 The punch instruction that led to the error halt is re-executed upon restart.

- Remove the hopper deck and open the cover.
- Manually clear the feed path and close the cover.
- Press the NPRO key to turn off the Feed-Check light.
- Discard all blank cards removed from the feed path.
- Stack any punched cards removed from the feed path as required.
- If the halt code is 02D4 or 03D4, remove and discard the last card stacked. (This card may have been mispunched.)
- Duplicate and replace any damaged cards.
- Return the hopper deck to the hopper.

- Press the Start key of the affected unit.
- Press the Start key on the CPU console.

22 The punch instruction that led to the error halt is re-executed upon restart.

- Remove the primary-hopper deck.
- If the secondary-hopper is also used, remove the secondary hopper deck.
- Open the cover.
- Manually clear the feed path and close the cover.
- Press the NPRO key to turn off the Feed-Check light.
- Discard any blank cards removed from the feed path.
- Place the punched cards removed from the feed path and originating from the primary hopper into stacker 1, in the proper order.
- If the halt code is 02D4, remove the last card from stacker 1 and discard it.
- If the secondary hopper is also used, place the punched cards removed from the feed path and originating from the secondary hopper into stacker 5, in the proper order. Then remove the last card from stacker 5 and place it into the secondary hopper.
- Duplicate and replace any damaged cards.
- Return the hopper deck(s) to the hopper(s).
- Press the Start key of the 2560.
- Press the Start key on the CPU console.

23 The punch instruction that led to the error halt is re-executed upon restart.

- Remove the secondary-hopper deck.
- If the primary hopper is also used, remove the primary-hopper deck.
- Open the cover.
- Manually clear the feed path and close the cover.
- Press the NPRO key to turn off the Feed-Check light.
- Discard any blank cards removed from the feed path.
- Place the punched cards removed from the feed path and originating from the secondary hopper into stacker 5, in the correct order.
- If the halt code is 02D5, remove the last card from stacker 5 and discard it.
- If the primary hopper is also used, place the punched cards removed from the feed path and originating from the primary hopper into stacker 1, in the proper order. Then remove the last two cards from stacker 1 and place them into the primary hopper.
- Duplicate and replace any damaged cards.
- Return the hopper deck(s) to the hopper(s).
- Press the Start key of the 2560.
- Press the Start key on the CPU console.

24
- Remove the hopper deck(s) and open the cover.
- Manually clear the feed path and close the cover.
- Press the NPRO key to turn off the Feed-Check light.
- Discard any blank cards removed from the feed path.
- Place the punched cards removed from the feed path (primary feed for the 2560) into the appropriate stacker (stacker 1 for the 2560), in the proper order.
- If the affected unit is a 2560 and the secondary hopper is also used, place the punched cards removed from the feed path and originating from the secondary hopper into stacker 5, in the proper order. Then remove the last card from stacker 5 and place it into the secondary hopper.
- Duplicate and replace any damaged cards.
- Return the hopper deck(s) to the hopper(s).
- Press the Start key of the affected unit.
- Press the Start key on the CPU console.

25
- Remove the secondary-hopper deck.
- If the primary hopper is also used, remove the primary-hopper deck.
- Open the cover.
- Manually clear the feed path and close the cover.
- Press the NPRO key to turn off the Feed-Check light.
- Discard any blank cards removed from the feed path.
- Place the punched cards removed from the feed path and originating from the secondary hopper into stacker 5, in the proper order.
- Place the punched cards removed from the feed path and originating from the primary hopper into stacker 1, in the proper order. Then remove the last two cards from stacker 1 and place them into the primary hopper.

- Duplicate and replace any damaged cards.
- Return the hopper deck(s) to the hopper(s).
- Press the Start key of the 2560.
- Press the Start key on the CPU console.

26
- Check the attached 1403 or 2203 printer and, if an error condition exists, correct the condition. (For the error conditions that may occur and the corrective action required, refer to the pertinent SRL publications.)
- Press the Start key of the printer.
- Press the Start key on the CPU console.

27 The print operation cannot be repeated to correct the error.
- Mark the misprinted line or correct it manually.
- Press the Start key of the printer.
- Press the Start key on the CPU console.

28 The read instruction preceding the error halt is re-executed upon restart.
- Remove the hopper deck.
- Press the NPRO key.
- Place the last two cards stacked in front of the hopper deck.
- Correct the first card of the hopper deck. (This is the card containing the error.)
- Return the hopper deck to the hopper.
- Press the Start key of the affected unit.
- Press the Start key on the CPU console.

29 The two read instructions preceding the halt are re-executed upon restart.
- Remove the hopper deck.
- Press the NPRO key.
- Remove the last three cards from the stacker and place them in front of the hopper deck.
- Correct the first card of the hopper deck. (This is the card containing the error).
- Return the hopper deck to the hopper.
- Press the Start key of the 2501.
- Press the Start key on the CPU console.

30 Proceed as described in restart procedure 6. (Correct the card that follows the marked card. This card contains the format error.)

31 Proceed as described in restart procedure 15. (Correct the card that follows the marked card. This card contains the format error).

32
- Remove the hopper deck from the hopper (primary hopper for the 2560.)
- If the affected unit is a 2560 and the secondary hopper is also used, remove the secondary-hopper deck.
- Press the NPRO key.
- If the affected unit is a 2560, remove the last three cards from stacker 1 and place them in front of the primary-hopper deck.
- If the affected unit is a 2520, remove the last two cards from the stacker and place them in front of the hopper deck.
- Replace the card that is now the first card of the hopper deck (primary-hopper deck for the 2560) with a blank card.
- If the affected unit is a 2560 and the secondary hopper is also used, remove the last card from stacker 5 and place it into the secondary hopper.
- Return the hopper deck(s) to the hopper(s).
- Press the Start key of the affected unit.
- Press the Start key on the CPU console.

33
- Remove the deck from the secondary hopper.
- If the primary hopper is also used, remove the deck from the primary hopper.
- Press the NPRO key.
- Remove the last two cards from stacker 5 and place them in front of the secondary-hopper deck.
- Replace the card that is now the first card of the secondary-hopper deck with a blank card.
- If the primary hopper is also used, remove the last two cards from stacker 1 and place them into the primary hopper.
- Return the hopper deck(s) to the hopper(s).
- Press the Start key of the 2560.
- Press the Start key on the CPU console.

|34| This halt code indicates one of the following conditions.

a) A check occurred during object program execution.
   - Empty both hoppers and all stackers.
   - Press the NPRO key.
   - Mark the last card in stacker 1.
   - Place 6 blank cards into the primary hopper.
   - Press the Start key of the 2560.
   - Press the Start key on the CPU console.

   Operation is resumed, and an information card is punched which contains relevant details for restart procedure 36. (See Figure 49 for the format of the information card.) If the halt was preceded by a punch-card or write-card instruction, the instruction(s) is (are) re-executed and 1 or 2 correction cards are produced. If a halt occurs during the punching of the information and correction cards, follow the appropriate restart procedure, which is indicated by the halt code. If no error condition occurs, the system halts and the code 0202 is displayed when the information and correction cards have been punched.
   - When 0202 is displayed in the E-S-T-R fields of the register panel, perform restart procedure 36.

b) A check occurred after resuming operation within this restart procedure (see (a) above).
   - Empty the primary hopper and press the NPRO key.
   - Remove and discard all cards following the marked card in stacker 1.
   - Continue with step 4 under (a) above (step 4 is marked by double bullets).

|35| This halt indicates one of the following conditions.

a) A feed check (possibly combined with other type(s) of error) occurred during object program execution.
   - Empty both hoppers and all stackers.
   - Open the cover.
   - Manually clear the feed path and close the cover.
   - Press the NPRO key to turn off the Feed-Check light.
   - Stack all cards removed from the feed path (cards from the primary hopper into stacker 1, cards from the secondary hopper into stacker 5), and check the stacking sequence.
   - Duplicate and replace any damaged cards.
   - Mark the last card in stacker 1.
   - Continue with step 4 of restart procedure 34a (step 4 is marked by double bullets).

b) A feed check occurred after resuming operation within restart procedure 34.
   - Empty the primary hopper and open the cover.
   - Manually clear the feed path and close the cover.
   - Press the NPRO key to turn off the Feed-Check light.
   - Discard all cards removed from the feed path and all cards following the marked card in stacker 1.
   - Continue with step 4 of restart procedure 34a (step 4 is marked by double bullets).

|36| This halt indicates one of the following conditions.

a) Restart 34 has been completed successfully and the system is ready for restart 36. (Upon restart 36, object program execution is resumed.)
   - Empty the primary hopper.
   - Press the NPRO key.
   - Remove all cards following the marked card from stacker 1. Discard any blank cards. The card immediately behind the marked card is the information card. The format of this card is shown in Figure 37. The information card may be followed by 1 or 2 correction cards.
   - If a rewritten correction card was stacked behind the information card, look for the last card written before the halt occurred. This card is either the card that is now the first card in the stacker specified in column 6 of the information card or the last card of the deck removed from the stacker specified in column 8 of the information card. Check whether this card contains entries originating from earlier processing. If this is the case, manually transfer these entries to the rewritten correction card. Replace the last card written with the correction

card.
- Starting with the marked card, remove from stacker 1 the number of cards specified in column 9 of the information card and place them in front of the primary-hopper deck.
- Starting with the last card stacked, remove from stacker 5 the number of cards specified in column 10 of the information card and place them in front of the secondary-hopper deck.
- Remove all cards (if any) from the stackers and place them behind the appropriate stacker decks.
- If a repunched correction card was stacked behind the information card, look for the last card punched before the halt occurred. This card is now the first card of the hopper deck specified in column 3 of the information card. Check whether this card contains entries originating from earlier processing. If this is the case, manually transfer these entries to the repunched correction card. Replace the last card punched with the correction card.
- If column 1 of the information card does not contain a 1-punch, look for the card that caused the preceding error halt. If column 3 of the information card contains 1, the error halt was caused by the card that is now the second one in the primary-hopper deck. If column 3 of the information card contains 2, the error halt was caused by the card that is now the second one in the secondary-hopper deck. If necessary, correct the card that caused the check.
- Return the hopper decks to the hoppers and the stacker decks to the stackers.
- Press the Start key of the 2560.
- Press the Start key on the CPU console.
- Discard the information card and any replaced cards.

b) A check occurred upon restart 36a.
- Empty both hoppers and stackers 1 and 5.
- If the Feed-Check light is off, press the NPRO key.
- If the Feed-Check light is on, open the cover, manually clear the feed path, close the cover, and press the NPRO key to turn off the Feed-Check light.
- Duplicate and replace any damaged cards.
- Place all cards removed during feed-path clearing or ejected by the NPRO in front of their hopper decks, in the proper order.
- Return the hopper decks to the hoppers and the stacker decks to the stackers.
- Press the Start key of the 2560.
- Press the Start key on the CPU console.

37 The punch instruction that led to the halt was a dummy-punch instruction required to move an END or XFR card through the punch station. The instruction is not re-executed upon restart.

- Remove the hopper deck(s).
- Press the NPRO key.
- If the secondary hopper is also used, remove the last card from stacker 5 and place it into the secondary hopper.
- Remove all cards that follow the END or XFR card from stacker 1 and place them into the primary hopper.
- Return the hopper deck(s) to the hopper(s).
- Press the Start key of the 2560.
- Press the Start key on the CPU console.

38 The punch instruction that led to the halt was a dummy-punch instruction required to move an END or XFR card through the punch station. The instruction is not re-executed upon restart.

- Remove the hopper deck(s).
- Open the cover.
- Manually clear the feed path.
- Press the NPRO key to turn off the Feed-Check light.
- Place the cards removed from the feed path and originating from the primary hopper into stacker 1 and the cards (if any) originating from the secondary hopper into stacker 5; check the stacking sequence.
- If the secondary hopper is also used, remove the last card from stacker 5 and place it into the secondary hopper.

| Column | Contents | Indication |
|---|---|---|
| 1 | blank | read or feed error |
| | 1 | punch error |
| | 2 | read-format error, primary feed |
| | 3 | read-format error, secondary feed |
| | 4 | punch-format error, primary feed |
| | 5 | punch-format error, secondary feed |
| | 6 | punch in EOF card, primary feed |
| | 7 | punch in EOF card, secondary feed |
| 2 | blank | -- |
| 3[1] | 1 | error occurred during operation in primary feed |
| | 2 | error occurred during operation in secondary feed |
| 4 | blank | -- |
| 5[2] | * | the hopper of origin and the stacker for the card located at the pre-print station or at the punch station when the halt occurred |
| 6[2] | * | the hopper of origin and the stacker for the card located at the print station when the halt occurred |
| 7 | * | the hopper of origin and the stacker for the last card stacked |
| 8 | * | the hopper of origin and the stacker for the next-to-last card stacked |
| 9 | 0 or 2 or 3 or 4 | number of "run-out" cards to be returned to the primary hopper |
| 10 | 0 or 1 or 2 or 3 | number of "run-out" cards to be returned to the secondary hopper |

*blank = no card located in this position
12-0-9-n = from primary hopper to stacker n
12-8-n = from secondary hopper to stacker n
(n may be any one of the digits 1 through 5)

1 For output files only (additional 12-punch in column 3): If the Feed-Check light was on when halt code 0201 was displayed because a card did not properly register at the punch station, punching was suppressed. In this case, check which feed was involved and increase by 1 the number of cards to be returned to the corresponding hopper.

2 Normally, either column 5 or column 6 contains information. If both columns contain information, no accurate restart procedures can be guaranteed.

Figure 49. Format of the Information Card Punched by the 2560 During Restart 34

- Remove all cards that follow the END or XFR card from stacker 1 and place them into the primary hopper.
- Duplicate and replace any damaged cards.
- Return the hopper deck(s) to the hopper(s).
- Press the Start key of the 2560.
- Press the Start key on the CPU console.

[39] The punch instruction that led to the halt was a dummy-punch instruction required to move an END or XFR card through the punch station. The instruction is not re-executed upon restart.

- Remove the hopper deck.
- Press the NPRO key.
- Remove all cards that follow the END or XFR card from stacker 1 and place them into the hopper.
- Return the hopper deck to the hopper.
- Press the Start key of the 2520.
- Press the Start key on the CPU console.

[40] The punch instruction that led to the halt was a dummy-punch instruction required to move an END or XFR card through the punch station. The instruction is not re-executed upon restart.

- Remove the hopper deck.
- Open the cover.
- Manually clear the feed path.
- Press the NPRO key to turn off the Feed-Check light.
- Place the cards removed from the feed path into stacker 1, in the proper order.
- Remove all cards that follow the END or XFR card from stacker 1 and place them into the hopper.
- Duplicate and replace any damaged cards.
- Return the hopper deck to the hopper.
- Press the Start key of the 2520.
- Press the Start key on the CPU console.

[41] The punch instruction that led to the halt was a dummy-punch instruction required to move an END or XFR card through the punch station. The instruction is not re-executed upon restart.

- Remove the hopper deck(s).
- Press the NPRO key.
- If the primary hopper is also used, remove the last 2 cards from stacker 1 and place them into the primary hopper.
- Remove all cards that follow the END or XFR card from stacker 5 and place them into the secondary hopper.
- Return the hopper deck(s) to the hopper(s).
- Press the Start key of the 2560.
- Press the Start key on the CPU console.

[42] The punch instruction that led to the halt was a dummy-punch instruction required to move an END or XFR card through the punch station. The instruction is not re-executed upon restart.

- Remove the hopper deck(s).
- Open the cover
- Manually clear the feed path.
- Press the NPRO key to turn off the feed-check light.
- Place the cards removed from the feed path and originating from the secondary hopper into stacker 5 and the cards (if any) originating from the primary hopper into stacker 1; check the stacking sequence.
- If the primary hopper is also used, remove the last 2 cards from stacker 1 and place them into the primary hopper.
- Remove all cards that follow the END or XFR card from hopper 5 and place them into the secondary hopper.
- Duplicate and replace any damaged cards.
- Return the hopper deck(s) to the hopper(s).
- Press the Start key of the 2560.
- Press the Start key on the CPU console.

[43]
- Display location 9C, which contains the address of the tape drive concerned.
- Check whether this drive is attached to the I/O channel. If the drive is attached, the tape control unit is not ready (either the power is off, or the unit has been switched to off-line CE operation).
  If the drive is not attached, i.e., the address displayed is not associated with any of the tape drives included in the user's Model 20 system, the pertinent contents of the Basic Monitor in main storage are invalid. This can have two causes: either the REP cards for

the Basic Monitor contained invalid addresses, or a problem program changed the contents of the Basic Monitor area. In any case, the job must be discontinued.
- Press the Start key on the CPU console to initiate the end-of-job routine.

|44|
- Have the hardware analyzed by an IBM customer engineer. When this analysis has been made, the job must be discontinued.
- Press the Start key on the CPU console to initiate the end-of-job routine.

|45| Display locations A0 and A1, which contain the address of the CCW containing the error.
If the address displayed is that of a location within the Basic Monitor area, part of the Basic Monitor has been destroyed by a problem program. In this case, a new system run (starting with the IPL procedure) must be initiated. If the address displayed indicates a location within the problem program, the job must be discontinued. Press the Start key on the CPU console to initiate the end-of-job routine.

|46| The condition cannot be corrected. If it is desired to further identify the halt, the following steps may be taken.

- Display location 9C, which contains the address of the tape drive concerned.
- Display locations A0 and A1, which contain the address of the CCW.
- Display the first byte of the CCW, which contains the command code. If the command code is 04 (sense), no sense data has been stored. If the command code is not 04, locations D0 through D5 (sense data) may be displayed.

Discontinue the job by pressing the Start key on the CPU console to initiate the end-of-job routine.

|47| If the halt follows an operator-choice halt and the cause of the latter was considered a disaster condition, no further diagnosing is required. Otherwise, perform the following steps to identify the cause of the halt.

- Display location 9C, which contains the address of the tape drive concerned.
- Display location D0 (sense byte 0). If bit 3 (equipment check), and/or bit 5 (overrun), and/or bit 6 (word count zero) of this byte are on, the cause of the halt is a hardware malfunction. In this case, have the hardware analyzed by an IBM customer engineer. Otherwise, continue with the following step.
- Display locations A0 and A1, which contain the address of the CCW. Display the command code (1st byte of the CCW). If the command code is 27 (backspace block), 2F (backspace file), or 0C (read backward), display location D1 (sense byte 1) and check bit 4 (load-point bit). If this bit is on, the error halt was caused by a backspace or read-backward operation that led to or was attempted at load-point. In this case, display location 9D (unit status) and inspect bit 5 (device-end bit) to determine whether the operation was attempted at load-point or led to load-point (on = to load point, off = at load point).
  If the command code is not 27, 2F, or 0C, or if the load-point bit is off, continue with the following step.
- Display location D0 (sense byte 0) and check bit 4 (data check). If the bit is on, the halt was caused by an irrecoverable read error (during the execution of a read or read-backward command) that could not be handled by the problem program. If the bit is off, the tape drive or the tape control unit left ready status during the execution of a command because (1) the power dropped, or (2) the reset key of the drive was pressed, or (3) an operation was not terminated before the physical end of the tape was reached (read or forward-space-block operation into a completely erased tape, or forward-space-file operation on a tape that does not contain a tape mark between the starting point of the operation and the physical end of the tape).
- Having identified the cause of the halt, discontinue the job by pressing the Start key on the CPU console to initiate the end-of-job routine.

|48| Perform the following steps to identify the cause of the halt.

- Display location 9C, which contains the address of the tape drive concerned.
- Display location D0 (sense byte 0).

- Inspect bit 1 (intervention required). If this bit is on, the tape drive addressed is not attached to the control unit.
- Display location D1 (sense byte 1).
- Inspect bit 7 (not capable). If this bit is on, an attempt has been made to read, on a tape drive (one of the Models 4 through 6) without the NRZI compatibility feature, a tape written in the NRZI mode.
- Display location D0 (sense byte 0).
- Inspect bit 4 (data check). If this bit is on, a write error has occurred.
- If bits 1 and 4 were found to be off, inspect bit 2 (bus-out check). If this bit is on, a bus-out check (not corrected after 3 repeated attempts) has occurred. This is a channel hardware failure, which should be analyzed by an IBM customer engineer. For further identification, location 9D (unit status) may be displayed to find out whether the error occurred during initial selection or during data transfer.
- If bit 2 of sense byte 0 is also off, bit 0 (command reject) must be on. Display locations A0 and A1 to find the address of the CCW. Display the first byte of the CCW, which contains the command code. If the command code is 01 (write), 1F (write tapemark), or 17 (erase), an attempt has been made to write on, or erase, a file-protected tape volume. In this case, bit 6 in location D1 (file-protected) is also on.
- If the command code is not 01, 1F, or 17, an attempt has been made to set a tape control unit with 7-track compatibility feature to "data converter on" although the unit does not have the data conversion feature.

If the error condition cannot be corrected manually, the job must be discontinued. Press the Start key on the CPU console to initiate the end-of-job routine.
If the condition has been corrected or another repetition sequence is desired, manually enter into location CE (operator-communication byte) any non-zero binary value and press the Start key on the CPU console to resume operation.

**|49|**
- Display general register 13, which contains the displacement of the symbolic device address that was not assigned or misassigned, counted from the beginning of the logical unit table in the Basic Monitor.
- Display general register 15, which contains the address of the command control block.
- Give this information to the programmer to enable him to correct the program.
- Discontinue the job by pressing the Start key on the CPU console. This initiates the end-of-job routine.

**|50|**
- Display location 9C, which contains the address of the tape drive concerned.
- Put this drive into ready status.
- Press the Start key on the CPU console to continue processing.

**|51|**
- Correct the error condition and reinitiate the system run, beginning with the IPL procedure.

**|52|**

a) The incorrect card was read on a 2501 or a 2520 card Read-Punch.
- Remove the input deck from the hopper.
- Press the NPRO key.
- Remove the last two cards from the stacker and place them in front of the input deck.
- Check the card that is now the first card of the input deck (i.e., the card that caused the error) and correct it if necessary.
- Return the input deck to the hopper.
- Press the Start key of the affected unit.
- Press the Start key on the CPU console.

b) The incorrect card was read on the 2560 primary feed.
- Remove the input deck from the primary hopper.
- If the secondary hopper is also used, remove the input deck from the secondary hopper.
- Press the NPRO key.
- Remove the last three cards from stacker 1 and place them in front of the input deck for the primary hopper.
- Check the card that is now the first card of the input deck for the primary hopper (i.e., the card that caused the error) and correct it if necessary.
- If the secondary hopper is also used, remove the last card from stacker 5 and place it into the secondary hopper.
- Return the input deck(s) to the hopper(s).
- Press the Start key of the 2560.

- Press the Start key on the CPU console.

c) The incorrect card was read on the 2560 secondary feed.
   - Remove the input deck from the secondary hopper.
   - If the primary hopper is also used, remove the input deck from the primary hopper.
   - Press the NPRO key.
   - Remove the last two cards from stacker 5 and place them in front of the input deck for the secondary hopper.
   - Check the card that is now the first card of the input deck for the secondary hopper (i.e., the card that caused the error) and correct it if necessary.
   - If the primary hopper is also used, remove the card(s) ejected by the NPRO from stacker 1 and place it (them) into the primary hopper.
   - Return the input deck(s) to the hopper(s).
   - Press the Start key of the 2560.
   - Press the Start key on the CPU console.

Note: When the program is running under control of a card-resident system, the job control statements must precede phase 02 of the Job Control program deck.

If the incorrect card is a loader card, place the control cards in front of phase 02 of the Job Control program deck, before returning the input deck(s) to the hopper(s).

53
- Remove the hopper deck(s).
- Press the NPRO key.
- Set up the I/O devices for the next job.
- Press the Start keys of all I/O devices to be used.
- Press the Start key on the CPU console.

54 Both JOB cards are ignored.
- Remove the input deck from the hopper of SYSRDR.
- If SYSRDR refers to the primary or secondary feed of a 2560 and the other feed is also used, remove the other hopper deck, too.
- Press the NPRO key.
- Remove the job control cards read during this Job Control run (i.e., all cards up to, and including, the first of the two JOB cards read) from the stacker of SYSRDR (stacker 1 for 2560 primary feed, stacker 5 for 2560 secondary feed).
- Place the JOB card and all other job control cards required for the next job into the hopper of SYSRDR.
- Make sure that the last control card is an EXEC card.
- Check the first cards of the input deck previously removed from the hopper. If they are object program cards, return the input deck to the hopper. If they are job control cards for the next-but-one job, (which can be the case only when the tape-resident Job Control program is being executed), check whether the JOB card is missing. If so, the second JCE card read is probably for this job. Place this JOB card and all job control cards that followed it in the stacker into the hopper of the device assigned to SYSRDR and return the input deck to the hopper.
- If the device is a 2560 and the other feed is also used, return the cards ejected from that feed by the NPRO to the hopper, and return the hopper deck to the hopper.
- Press the Start key of the device.
- Press the Start key on the CPU console to resume operation.

55 If it is desired to discontinue the job,
- prepare the I/O devices for the next job and
- press the Start key on the CPU console to initiate the end-of-job routine.

If it is desired to continue the job, take the following steps:
- Remove the hopper deck from the affected device.
- If the device is the 2560 primary or secondary feed and the other feed is also used, remove the deck from the other hopper.
- Press the NPRO key of the device.
- a) If the device is a 2501 and an additional input area has not been specified in the RPG control card (i.e., col. 22 is blank), remove the last two cards from the stacker.
  b) If the device is a 2501 and an additional input area has been specified in the RPG control card (i.e., col. 22 contains a E), remove the last three cards from the stacker.
  c) If the device is a 2520 Card Read-Punch, remove the last two cards stacked.
  d) If the device is the 2560 primary feed, remove the last three cards from stacker 1.
  e) If the device is the 2560 secon-

dary feed, remove the last two cards from stacker 5.

- Place the cards removed from the stacker in front of the hopper deck, in the proper sequence. (Refer to the RPG listing or a list prepared by the programmer.)
- Check the card that is now the last card in the appropriate stacker.
- Use the RPG listing or the list prepared by the programmer to determine the next mandatory card type that is to follow the last card in the appropriate stacker.
- Check whether the first card of the hopper deck is a card of this type. If this is not the case, take the following steps:
  a) If one or more cards of the required type follow later in the hopper deck, remove the card(s) preceding it (or them). The removed card(s) cannot be processed during the current job.
  b) If the required card type is missing, prepare the specified card(s) of this type and insert it (or them) into the hopper deck, in the proper sequence. Remove any cards(s) that precede the newly prepared card(s) in the hopper deck. The removed card(s) cannot be processed during the current job.
- If the affected device is the 2560 primary or secondary feed and the other feed is also used, remove the card(s) ejected by the NPRO from the stacker of the other feed and place it (or them) in front of the corresponding hopper deck.
- Return the hopper deck(s) to the hopper(s).
- Press the Start key of the affected device.
- Enter FF into location 00CE.
- Press the Start key on the CPU console to continue processing.

|56| If it is desired to discontinue the job,

- prepare the I/O devices for the next job and
- press the Start key on the CPU console to initiate the end-of-job routine.

If it is desired to continue the job, take the following steps:

- Remove the hopper deck from the affected device.
- If the device is the 2560 primary or secondary feed and the other feed is also used, remove the deck from the other hopper.
- Press the NPRO key of the device.
- a) If the device is a 2501 and an additional input area has not been specified in the RPG control card (i.e., col. 22 is blank), remove the last two cards from the stacker.
  b) If the device is a 2501 and an additional input area has been specified in the RPG control card (i.e., col. 22 contains a B), remove the last three cards from the stacker.
  c) If the device is a 2520 Card Read-Punch, remove the last two cards stacked.
  d) If the device is the 2560 primary feed, remove the last three cards from stacker 1.
  e) If the device is the 2560 secondary feed, remove the last two cards from stacker 5.
- Insert the cards removed from the stacker into the hopper deck, in the proper sequence by matching fields.
- Check the matching field of the last card in the stacker against that of the first card of the hopper deck. If the card of the hopper deck is not in the specified sequence with respect to the stacked card, remove this card from the hopper deck.
- Repeat the preceding step until the first card of the hopper deck is in sequence with the last card in the stacker. (The removed card(s) cannot be processed during the current job.)
- If the affected device is the 2560 primary or secondary feed and the other feed is also used, remove the card(s) ejected by the NPRO from the stacker of the other feed and place it (or them) in front of the corresponding hopper deck.
- Return the hopper deck(s) to the hopper(s).
- Press the Start key of the affected device.
- Enter FF into location 00CE.
- Press the Start key on the CPU console to continue processing.

|57|

- Display register 13, which contains the displacement of the affected symbolic device address (logical unit block) from the beginning of the logical unit table, and identify the tape drive concerned.
- Display register 15, which contains the address of the corresponding DTF block. The DTF block contains information which may assist the programmer in locating the error (e.g., the accumulated block count in bytes 30-33, and the residual count in bytes 4-5). The structure of the DTF block is described in

detail in the SRL publication IBM System/360 Model 20, Tape Programming System, Input/Output Control System, Form C24-9003.

58 • Display register 13, which contains the displacement of the affected symbolic device address (logical unit block) from the beginning of the logical unit table, and identify the tape drive concerned.

59 Document feeding in the IBM 1419 has stopped. One of the following has occurred:

Sort-Check Halt - 1419 Sort-Check indicator and Stop-Restore key are illuminated.

More than one or none of the stacker chute blades have been activated for a document passing the selector station. Document feeding stops, and the remaining documents in the document path are read, stacker selected, processed, and printed. The error document is directed to the reject pocket.

- Remove the error document from the reject pocket.
- Follow the installation procedures to identify the error document and place the error document into the correct pocket.
- Press the 1419 Stop-Restore key.
- Press the 1419 Start key.
- Press the Start key on the CPU console.

Jam Halt - Left-Feed and/or Right-Feed, and Stop-Restore key lights are on (1419). Transport light is on (1259).

- Follow the installation procedure to determine which of the documents have been read.
- Place the documents that have been read into the correct pockets. Return all other documents to the hopper in the proper order. Place any mutilated documents into the reject pocket.
- Press the Stop-Restore key on the 1419.
- Press the Start key on the 1419.
- Press the Start key on the CPU.

If it is desired to discontinue the job:

- Enter a hexadecimal value other than '00' in the communication byte (location X'00CE').
- Press the Start key on the CPU Console to initiate the end-of-job routine.

60 • Remove the input deck from the hopper
- Press the NPRC key
- Remove the last two cards from the stacker and place them in front of the input deck.
- Place the USER routine in front of the input deck.
- Return the input deck to the hopper
- Press the Start keys on the affected units
- Press the Start key on the CPU console.

61 Too many follow-up documents were encountered after a disengage instruction, because the input buffer became full.

- Press the Stop key on the Magnetic Character Reader.
- Press the Start key on the CPU to continue processing.
- If this halt occurs frequently, call in an IBM Customer Engineer.

62 A 1419 I/O error has occurred. Several unread documents may be in the reject pocket.

- Stop the 1419.
- Start the CPU and allow the user program to print all the documents that have been read.
- Return all rejected, unread documents to the feed hopper.
- Start the 1419 to continue processing.
- If the user program specified ERREXIT in the 1419 file-definition statement, the job can be discontinued using the error exit option.

63 • Check that the power to the Modem is on and that the connection to the BSCA has been made properly.
- Check that the BSCA is ready.
- If the Autocall feature is used, make sure that the receiver is on the hook and that the Autocall unit has power on.
- Set the Register-Data/Address switch to the address 00CE.
- Set the Data switch to a value other than zero.
- Set the Mode switch to STOR ALTER.
- Press START on the CPU to set the CE byte to the value indicated by the Data switch.
- Set the Mode switch to PROCESS.
- Press START on the CPU.

If the program does not continue and error code 0501 is displayed again,

the job must be discontinued (after communicating with the operator of the remote terminal).

64 Operator choice:
a) Follow the appropriate procedure as indicated for halt code 02D2.
b) Follow the appropriate procedure as indicated for halt code 02D2, but enter a value other than 00 into location CE before pressing the Start key on the CPU console. The cards will then not be read (i.e., checked for "all blanks") before they are punched.

65 Operator choice:
a) Follow the appropriate procedure as indicated for halt code 02D3.
b) Follow the appropriate procedure as indicated for halt code 02D3, but enter a value other than 00 into location CE before pressing the Start key on the CPU console. The cards will then not be read (i.e., checked for "all blanks") before they are punched.

66 Operator choice:
a) Follow the appropriate procedure as indicated for halt code 02D4.
b) Follow the appropriate procedure as indicated for halt code 02D4, but enter a value other than 00 into location CE before pressing the Start key on the CPU console. No more cards will then be punched during the job.

67 Operator choice:
a) Follow the appropriate procedure as indicated for halt code 02D5.
b) Follow the appropriate procedure as indicated for halt code 02D5, but enter a value other than 00 into location CE before pressing the Start key on the CPU console. No more cards will then be punched during the job.

68 Operator choice:
a) Follow the appropriate procedure as indicated for halt code 03D4.
b) Follow the appropriate procedure as indicated for halt code 03D4, but enter a value other than 00 into location CE before pressing the Start key on the CPU console. No more cards will then be punched during the job.

69 Operator choice:
a) Press the Start key on the CPU console. The line will be reprinted.
b) Enter FF into location CE and press the Start key on the CPU console. The line will not be reprinted.
c) Enter a value other than 00 or FF into location CE and press the Start key on the CPU console. Any misprinted line will now be reprinted once without a halt occurring before reprinting. Reprinted lines will be marked.

70 a) Press the Start key on the CPU console to continue processing. The card that caused the halt is selected to a separate stacker.
b) Enter a value other than 00 into location CE and press the Start key on the CPU console. Depending on the type of error (read check or punch check), no more cards will be read (i.e., checked for "all blanks") or punched, respectively.

PROGRAMMED-HALT DISPLAYS

| Code Displayed ESTR | Cause | Additional Identification | Ref.No. |
|---|---|---|---|
| 0100 | 2501 not ready | Attention and Feed-Check lights off | 1 |
| | | Only attention light on | 3 |
| | | Feed-Check light on | 13 |
| 0101 | Read error (and possibly additional feed check) on 2501 | Feed-Check light off | 4 |
| | | Feed-Check light on | 14 |
| 0110 | Read-format error on 2501 (one I/O area specified) | Feed-Check light off | 28 |
| 0111 | Read-format error on 2501 (two I/O areas specified) | Feed-Check light off | 29 |
| 011C | Card read error during IPL | Feed-Check light off | 5 |
| 01D0 | 2501 not ready | Attention and Feed-Check lights off | 2 |
| | | Only attention light on | 3 |
| | | Feed-Check light on | 13 |
| 01D1 or 01D2 | Read error (and possibly additional feed check) on 2501 | Feed-Check light off | 4 |
| | | Feed-Check light on | 14 |
| 0200 | Unit with device address 2 (2560 MFCM, 2520 card read-punch or 2520 card punch) not ready | Attention and Feed-Check (and, if 2560, Hopper-check) lights off | 1 |
| | | Only attention light on | 3 |
| | | Feed-Check light on | 24 |
| | | Hopper-Check light on | 9 |
| 0201 | Punch error (and possibly additional feed check) on 2520 card punch or any check on 2560 MFCM | 2520: Feed-Check light off | 6 |
| | | 2520: Feed-Check light on | 15 |
| | | 2560: Feed-Check light off | 34 |
| | | 2560: Feed-Check light on | 35 |
| 0202 | 2560 ready for second restart | | 36 |
| 0205 or 0206 | Punch error (and possibly additional feed check) on 2520 card read-punch | Feed-Check light off | 6 |
| | | Feed-Check light on | 15 |
| 0209 or 020A | Read error (and possibly additional feed check) on 2520 card read-punch | Feed-Check light off | 4 |
| | | Feed-Check light on | 14 |
| 020D or 020E | Read error and punch error (and possibly additional feed check) on 2520 card read-punch | Feed-Check light off | 6 |
| | | Feed-Check light on | 15 |
| 0211 or 0212 | Feed check prevents read operation on 2520 card read-punch | Feed-Check light on | 16 |
| 0220 | Feed-check on 2520 card punch | Feed-Check light on | 17 |

| Code Displayed ESTR | Cause | Additional Identification | Ref.No. |
|---|---|---|---|
| 0221 or 0222 | Feed-check prevents punch operation on 2520 card read-punch | No card in pre-read station (hopper-check)<br>Card in pre-read station | 9<br>17 |
| 0231 or 0232 | Feed check occurred during punch operation on 2520 card read-punch | Feed-Check light on | 18 |
| 0235 or 0236 | Punch error prevents read operation on 2520 card read-punch | Feed-Check light off | 6 |
| 0241 or 0242 | Punch-format error on 2520 card read-punch | Feed-Check light off | 28 |
| 0281 or 0282 | Read-format error on 2520 card read-punch | Feed-Check light off | 28 |
| 0285 or 0286 | Punch error and additional read-format error on 2520 card read-punch | Feed-Check light off<br>Feed-Check light on | 30<br>31 |
| 02B2 | Read error and/or feed check on 2560 primary feed or 2520 card read-punch | Feed-Check light off<br>Feed-Check light on | 70<br>64 |
| 02B3 | Read error and/or feed check on 2560 secondary feed | Feed-Check light off<br>Feed-Check light on | 70<br>65 |
| 02B4 | Punch error and/or feed check on 2560 primary feed or 2520 card read-punch or 2520 card punch | Feed-Check light off<br>Feed-Check light on | 70<br>66 |
| 02B5 | Punch error and/or feed check on 2560 secondary feed | Feed-Check light off<br>Feed-Check light on | 70<br>67 |
| 02C1 | Feed check prevents read or punch operation on 2520 card read-punch or card punch | Feed-Check light on | 17 |
| 02C3 | Feed check prevents read operation on 2520 card read-punch | Feed-Check light on | 17 |
| 02C5 | Read error and/or feed check on 2520 card read-punch | Feed-Check light off<br>Feed-Check light on | 4<br>14 |
| 02C7 | Punch error and/or read error and/or feed check on 2520 card read-punch or 2520 card punch | Feed-Check light off<br>Feed-Check light on | 6<br>15 |
| 02D0 | Unit with device address 2 (2560, 2520 card read-punch or 2520 card punch) not ready | Attention and Feed-Check (and, if 2560, Hopper-check) lights off<br>Only Attention light on<br>Feed-Check light on<br>Hopper-Check light on | 2<br>3<br>24<br>9 |

| Code Displayed ESTR | Cause | Additional Identification | Ref.No. |
|---|---|---|---|
| 02D2 | Read and/or feed check on 2560 primary feed or 2520 card read-punch | 2560: Feed-Check light off<br>2560: Feed-Check light on<br>2520: Feed-Check light off<br>2520: Feed-Check light on | 7<br>19<br>4<br>14 |
| 02D3 | Read error and/or feed check on 2560 secondary feed | Feed-Check light off<br>Feed-Check light on | 8<br>20 |
| 02D4 | Punch error and/or feed check on 2560 primary feed or 2520 card read-punch or 2520 card punch | 2560: Feed-Check light off<br>2560: Feed-Check light on<br>2520: Feed-Check light off<br>2520: Feed-Check light on | 11<br>22<br>10<br>21 |
| 02D5 | Punch error and/or feed check on 2560 secondary feed | Feed-Check light off<br>Feed-Check light on | 12<br>23 |
| 02D6 | 2560 primary feed or 2520 card read-punch or 2520 card punch not ready | Attention and Feed-Check lights off (and, if 2560, Hopper-Check light off)<br>Only attention light on<br>Feed-Check light on<br>Hopper-Check light on | 1<br>3<br>24<br>9 |
| 02D7 | 2560 secondary feed not ready | Attention, Feed-Check and Hopper-Check lights off<br>Only attention light on<br>Feed-Check light on<br>Hopper-Check light on | 1<br>3<br>25<br>9 |
| 02D8 | No blank card found for punching on 2560 primary feed or 2520 card read-punch | | 32 |
| 02D9 | No blank card found for punching on 2560 secondary feed | | 33 |
| 02DA | Feed check on 2560 primary feed or 2520 card read-punch | 2560: Feed-Check light on<br>2520: Feed-Check light on | 22<br>21 |
| 02DB | Feed check on 2560 secondary feed | Feed-Check light on | 23 |
| 02DC | Punch and/or feed check on 2560 primary feed or 2520 card read-punch | 2560: Feed-Check light off<br>2560: Feed-Check light on<br>2520: Feed check light off<br>2520: Feed-Check light on | 37<br>38<br>39<br>40 |
| 02DD | Punch and/or feed check on 2560 secondary feed | Feed-Check light off<br>Feed-Check light on | 41<br>42 |
| 0300 | 1442 not ready | Attention and Check lights off<br>Only attention light on<br>Feed-Check light on | 1<br>3<br>17 |
| 0301 | Punch error and/or feed check on 1442 | Feed-Check light off<br>Feed-Check light on | 6<br>15 |
| 0320 | Feed check on 1442 | Feed-Check light on | 17 |

| Code Displayed ESTR | Cause | Additional Identification | Ref.No. |
|---|---|---|---|
| 03B4 | Punch error and/or feed check on 1442 | | 68 |
| 03D4 | Punch error and/or feed check on 1442 | Feed-Check light off<br>Feed-Check light on | 10<br>21 |
| 03D6 | 1442 not ready | Attention and Feed-Check lights off<br>Only Attention light on<br>Feed-Check light on | 1<br>3<br>24 |
| 0400 | Printer not ready | | 26 |
| 0401 | Print error | | 27 |
| 04B1 | Print error (with reprint) | | 69 |

| Code ESTR | Cause | Restart | Ref.No. |
|---|---|---|---|
| 0501 | Condition code = 3; XIC instruction rejected (BSCA) | Follow procedure 63 | 63 |
| 0581 | OPEN macro not issued or another initial macro issued before transmission is finished (BSCA) | Press START on CPU to discontinue the job | 53 |
| 0582 | A non-initial macro has been issued without the preceding initial macro or (in CONFIG=SW) connection not established (BSCA) | | |
| 0583 | Condition code = 1 after an execution try (in CONFIG=SW) or condition code = 3 and sense byte not set to X'40' (BSCA) | | |
| 0584 | Two WRITE RVI macros issued immediately after each other or two RVI sequences received in succession (BSCA) | | |
| 0585 | Previous macro not completed (BSCA) | | |
| 0586 | A WRITE has been issued immediately after a READ receiving a message which did not end with ETX (MODE=TAT only) (BSCA) | | |
| 0587 | A WRITE has been issued immediately after a WRITE which resulted in a message response (MODE = TAT only) (BSCA) | | |
| 0588 | Invalid third operand in macro (BSCA) | | |
| 058A | Number of leading graphic characters greater than 7 or (in CONFIG=SW only) the number of ID characters is greater than 15 | | |
| 058B | Not enough space in CIOAREA for the expected message (BSCA) | | |
| 058C | Erroneous or missing start-of-message sequence in outgoing message (BSCA) | | |
| 058D | Erroneous or missing end-of-message sequence in outgoing message or given message length does not correspond to real message length (BSCA) | | |
| 058E | The user-defined CIOAREA is equal to or less than 0 bytes or exceeds 4095 bytes (BSCA) | | |
| 0590 | Variable-length records, transparency, and ITB used concurrently (BSCA) | | |
| 0593 | ABORT requested issued when another ABORT request has already been cataloged (BSCA) | | |
| 0595 | The byte count for the telephone number to be used by AUTOCALL is 0 (BSCA) | | |

| Code Displayed ESTR | Cause | Additional Identification | Ref.No. |
|---|---|---|---|
| 0600 | 1419 or 1259 Magnetic Character Reader not ready | Restart: Press the start keys on the 1419 or 1259 and on the CPU | |
| 0601 | A GET for the Magnetic Character Reader, or a PUT for the printer, has been issued without a prior OPEN. | Press start on the CPU to discontinue the job. | |
| 0602 | Jam or sort check in the 1419 or 1259 | | 59 |
| 0603 | Buffer overrun for the 1419 or 1259 | | 61 |
| 0604 | 1419 I/O error | | 62 |

| Code Displayed ESTR | Cause | Ref.No. |
|---|---|---|
| 0701 | Device not operational.<br>(I/O operation requested on a tape drive not attached to I/O channel) | 43 |
| 0702 | Hardware malfunction.<br>Tape I/O operation resulted in interface control check or channel data check. The checks are caused by a channel or control unit malfunction, which should not occur during normal operation. An interface control check can occur at the time an XIO instruction is executed or at interrupt time. A channel data check can occur only during the execution of an XIO instruction. In both cases, the XIO instruction may have been issued as a result of a request for I/O either in the problem program or within the error recovery routine in the Basic Monitor. | 44 |
| 0703 | Channel programming error.<br>The physical tape I/O and error routines attempted to execute an invalid command or command chain. The corresponding XIO instruction may have been issued as a result of a request for I/O either in the problem program or in the error recovery routine.<br>The halt is caused by one of the following conditions:<br>a) The device address in the specified physical unit block is zero;<br>b) the command code in the CCW has four low-order zero bits;<br>c) the length count of a read, read-backward, write, or sense command is zero;<br>d) the CCW contains an invalid data address (protected area or outside available storage), or the data address becomes invalid at a point during the execution of a read, read-backward, write, or sense command (i.e., while data is being transferred);<br>e) the command chain begins with a transfer-in-channel command or has two successive transfer-in-channel commands. | 45 |

| Code Displayed ESTR | Cause | Ref.No. |
|---|---|---|
| 0704 | Error within corrective action.<br>A unit-check condition occurred when an attempt was made in the error recovery routine to execute a sense command or a space-block command. | 46 |
| 0705 | Disaster condition.<br>During execution of the tape error recovery routine, one of the following non-correctable conditions has been encountered:<br>a) A data error that occurred during the execution of a read or read-backward command has not been corrected after 99 repeated attempts (including 9 tape-cleaning sequences), and the problem program does not provide for handling a read error.<br>b) The execution of a read-backward, backspace-block, or backspace-file command led to load point or was attempted at load point.<br>c) During execution of a command, the tape device concerned or the tape control unit left ready status (power dropped, or the Reset key was pressed, or the tape ran off the left-hand reel).<br>d) An equipment-check, overrun, or word-count-zero condition occurred.<br>e) An operator-choice condition had ocurred before this disaster halt, and the operator had considered it a disaster condition. | 47 |
| 0706 | Operator-choice condition.<br>During execution of the tape error recovery routine, a condition occurred that requires an operator decision. This condition is one of the following:<br>a) A write error in a write or write-tapemark operation has not been corrected after 3 repeated attempts.<br>b) The tape drive addressed is not attached to the tape control unit.<br>c) A write, write-tapemark, or erase operation has been attempted on a file-protected tape volume.<br>d) An attempt has been made to set a tape control unit with 7-track compatibility feature to "data converter on" although the unit does not have the data conversion feature.<br>e) A bus-out-check condition has not been corrected after 3 repeated attempts.<br>f) An attempt has been made, on a tape drive (one of the Models 4 through 6) without the NRZI compatibility feature, to read a tape written in the NRZI mode. | 48 |
| 0707 | Symbolic device address not assigned or not assigned to a tape drive. | 49 |
| 0708 | Device not ready.<br>I/O operation requested on a tape drive that is not ready. | |
| 0710 | Tape drive on which the system tape is mounted is not operational during tape IPL. | 51 |
| 0711 | Tape read error during tape IPL. Press START on the CPU to re-execute IPL. If the error occurs repeatedly, create a new system tape. | |

| Code ESTR | Cause | Restart | Ref.No. |
|---|---|---|---|
| 0B01 | Control statement other than ASSGN follows IPL. | Repeat the IPL procedure using the correct control statement. | |
| 0B02 | ASSGN statement following IPL is not for SYSRDR. | | |
| 0B03 | Incorrect 'cuu' specification in ASSGN statement. | | |
| 0B04 | Incorrect 'dd' specification in ASSGN statement. | | |
| 0B11 | IPL is not followed by a control statement. | | |
| 0B12 | Tape IPL is followed by a control statement other than ASSGN. | | |
| 0B13 | 1st operand or separator (,) of ASSGN statement is incorrect. | | |
| 0B14 | 2nd operand or separator (,) of ASSGN statement is incorrect. | | |
| 0B15 | 3rd operand or separator (,) or delimiter (blank) of ASSGN statement is incorrect. | | |
| 0B16 | 4th operand or delimiter (blank) of ASSGN statement is incorrect. | | |
| 0B17 | Tape drive for system tape is 7-track or not ready, or not file-protected. The mounted reel either is not the system tape or it contains records of wrong length. | Correct the error condition and repeat the IPL procedure. | |
| 0B18 | Basic Monitor does not contain unit number specified in ASSGN statement. | Repeat the IPL procedure using a set of correct REP cards. | |
| 0B19 | End-of-file card missing, or cards other than ASSGN SYSRDR or REP cards between ASSGN SYSRES card and end-of-file card. | Repeat the IPL procedure using the required cards in the correct sequence. | |
| 0B1A | Unit number in REP card is zero. | Correct the REP card(s) and repeat the IPL procedure. | |
| 0B20 | End-of-job halt. | Prepare the next job(s). Press START on CPU. | |
| 0B30 | Phase not found. Name of phase to be loaded next is not in core-image directory. (Error in JCB statement or error in FETCH macro instruction of problem program.) | If error in JCB statement, correct and re-insert JCB card, then press START on CPU to continue processing. If error in FETCH macro instruction, discontinue the job. Note: This halt may also occur after an error halt in the Assembler, CMAINT, MMAINT, or DSERV program. In this case, a new IPL procedure is required. | 52 |

| Code ESTR | Cause | Restart | Ref.No. |
|---|---|---|---|
| 0B31 | Hardware malfunction or system tape mispositioned. | Re-initiate the system run (IPL). | |
| 0B3A | Load address for the program on the system tape to be loaded is too low for execution in overlap mode (lower than 2100) | Change control cards -- either insert correct address or remove the overlap specification. Assembly must be performed again. | |
| 0B3B | Load address on the TXT card when the LOADER function is specified is lower than:<br>2000 for non-overlap mode and tape input OR<br>2100 for non-overlap mode and card input OR<br>2400 for overlap mode and tape input OR<br>2500 for overlap mode and card input. | Press START on the CPU console to discontinue the job. | |
| 0B40 | PAUSE statement has been encountered. | Set up job(s) as described. Press START to resume operation. | |
| 0B41 | 1st operand or separator (,) or delimiter (blank) of control statement is incorrect. | | 52 |
| 0B42 | 2nd operand or separator (,) or delimiter (blank) of control statement is incorrect. | | |
| 0B43 | 3rd operand or separator (,) or delimiter (blank) of control statement is incorrect. | | |
| 0B44 | 4th operand or delimiter (blank) of control statement is incorrect. | | |
| 0B45 | Tape unit number specified in ASSGN statement is not in Basic Monitor. | | |
| 0B46 | JOB statement is missing. | Follow procedure 52, but place a JOB card in the hopper of SYSRDR before returning the input deck. | 52 |
| 0B47 | Two successive JOB statements have been encountered, i.e., no EXEC statement has been encountered between two JOB statements. | | 54 |
| 0B48 | The card just read did not contain a control statement. | | 52 |
| 0B49 | Control statement contains invalid operation code, or TPLAB statement is not preceded by VOL statement. | | |

| Code ESTR | Cause | Restart | Ref.No. |
|---|---|---|---|
| 0B4A | DATE statement is missing. | An EXEC statement has been encountered. Follow procedure 52, but place a DATE card in the hopper of SYSRDR before returning the input deck. | 52 |
| 0B4B | TPLAB statement is missing or not in the correct place. | Discontinue the job. | 53 |
| 0B4C | TPLAB statement is incorrect. | Discontinue the job. | 53 |
| 0B4D | Label-information area in main storage is full. (CONFG card incorrect or too many TPLAB statements for the available storage capacity.) Or: a CONFG card is read in after the processing of at least one TPLAB statement. | Discontinue the job. | 53 |
| 0B4E | SYSIPT has not been assigned a tape drive, or convert feature is off (ignored when SYSIPT is assigned to a tape drive) | Insert a correct ASSGN card for SYSIPT and an EXEC ICALER card in the hopper of SYSRDR and continue processing. | 52 |
| 0B4F | On SYSIPT, a tape mark has been encountered where not expected, or a record of incorrect length has been read. | Discontinue the job. | 53 |
| 0B64 | Device assigned as SYSRDR is not attached | Repeat the IPL procedure using the proper ASSGN statement for SYSRDR | |
| 0B7A | Overlap has been specified for a machine without the overlap feature | Press START on the CPU console to discontinue the job. | 53 |
| 0B7B | A system program has been specified to run in the overlap mode | Operator choice:<br>a) Press START on the CPU console to continue in non-overlap mode.<br>b) Enter FF into location CE and press START on the CPU console to discontinue the job. | |
| 0B7C | Error statistics were requested but are not allowed with this job. | Press the Start key on the CPU console to enable normal execution of the job. Error statistics will not be initiated. | |
| 0B7D | Error statistics about the preceding job are requested, but a LOG control statement is missing. | When error statistics are not required, press the Start key on the CPU console to continue the job.<br>When error statistics are required enter hexadecimal FF into location 00CE to permit printing of the error statistics. Then press the Start key on the CPU console to continue the job.<br>(Check if appropriate paper is on the SYSLOG printer). | |

| Code ESTR | Cause | Restart | Ref.No. |
|---|---|---|---|
| 0BF0 | Bootstrap card has been loaded. | Continue with step 9 of the operating procedure for the Distribution-Package Retrieval program. | |
| 0BF2 | Distribution-Package Retrieval program has been loaded. | Continue with step 15 of the operating procedure for the Distribution-Package Retrieval program. | |
| 0BF4 | A 9-track distribution tape is mounted on a 7-track tape drive; or the tape drive addressed in step 10 of the Distribution-Package Retrieval program is not ready or not attached to the system; or the tape reel mounted on this drive does not contain the distribution tape. | Terminate program execution and start from the beginning. | |
| 0BF5 | Tape characteristics specification incorrect, or the same tape drive specified for input and output tapes. | Repeat from step 19b of the operating procedure for the Distribution-Package Retrieval program. | |
| 0BF6 | End-of-reel condition on output tape. | Repeat the job from the beginning, using a longer tape. | |
| 0BF7 | Next element on distribution tape has been announced by the printer. | Continue with step 22 of the operating procedure for the Distribution-Package Retrieval program. | |
| 0BFF | Last element stored on the Distribution tape has been retrieved. | | |
| 0C01 | END statement incorrect or missing (last-card condition was detected on SYSRDR, or a card with a 12-2-9 punch in column 1 was read), or format specifications were not followed, or a control statement other than UM, FS, or END (or H1 or H2 for the Tape-to-Printer program) was read. (An error message is printed.) | Discontinue the job. | 53 |
| 0C02 | The number of field-selects (and header statements for Tape-to-Printer program) or field-select coding necessary to perform the requested field selection exceeds storage capacity. | | |
| 0C03 | Incorrect specification in utility-modifier statement, field-select statement, or job control statement; or ASSGN, VOL, and/or TPLAB statements missing; or storage capacity not sufficient to assign specified I/O areas. | | |

| Code ESTR | Cause | Restart | Ref.No. |
|---|---|---|---|
| 0C1A | Data loss or overlay (warning). | Operator choice:<br>a) Press START on CPU to continue processing.<br>b) Enter FF into location CE and press START on CPU to discontinue the job. | 53 |
| 0C24 | Input block on current volume was read with an irrecoverable data error. | Press START on CPU to bypass block and continue processing. | |
| 0C25 | Input block on the current volume either exceeds the specified input block size, or -- for fixed-length records -- is not a multiple of the input record length. There is no data error. | | |
| 0C26 | A combination of the conditions that cause halts 0C24 and 0C25. | | |
| 0C2F | The available storage capacity is too small for processing multi-volume output files. | Operator choice:<br>a) Press START on CPU to continue processing.<br>b) Enter FF into location CE and press START on CPU to discontinue the job. | 53 |
| 0C30 | Improper data entered in location CE. | Enter correct data and press START on CPU to continue processing. | |
| 0C31 | Additional input is expected. | Operator choice:<br>a) Mount new reel and press START on CPU to continue processing.<br>b) Enter FF into location CE and press START on CPU to continue processing with ECF condition. | |
| 0C32 | Tape mark read instead of standard volume label on input tape when standard labels have been specified. | Operator choice:<br>a) Mount correct reel and press START on CPU to continue processing.<br>b) Enter FF into location CE and press START to discontinue the job. | 53 |
| 0C33 | First record on input tape is not a standard volume label when standard labels have been specified. | Operator choice:<br>a) Mount correct reel and press START on CPU to continue processing.<br>b) Enter 0F into location CE and press START on CPU to continue processing.<br>c) Enter FF into location CE and press START on CPU to discontinue the job. | 53 |

| Code ESTR | Cause | Restart | Ref.No. |
|---|---|---|---|
| 0C34 | Volume serial number in standard volume label on input tape does not correspond to file serial number in TPLAB control statement. | Operator choice:<br>a) Press START on CPU to continue processing. (User labels are processed.)<br>b) Mount correct reel, enter 0F into location CE, and press START on CPU to continue processing.<br>c) Enter FF into location CE and press START on CPU to discontinue the job. | 53 |
| 0C35 | Tape mark encountered before reading standard header label on input tape, or end-of-data sensed on multi-file input tape (tape mispositioned). | Operator choice:<br>a) Mount correct reel and press START on CPU to continue processing.<br>b) Enter 0F into location CE and press START on CPU to continue processing.<br>c) Enter FF into location CE and press START on CPU to discontinue the job. | 53 |
| 0C36 | Standard header label not found on input tape when standard labels have been specified. | | |
| 0C37 | File identification and/or file serial number in standard header label of input tape do not correspond to information in TPLAB control statement. | Operator choice:<br>a) Press START on CPU to continue processing.<br>b) Mount correct reel, enter 0F into location CE, and press START on CPU to continue processing.<br>c) Enter FF into location CE and press START on CPU to discontinue the job. | 53 |
| 0C38 | Volume sequence number in standard header label does not correspond to information in TPLAB control statement. | | |
| 0C39 | Information other than file identification, file serial number, and volume sequence number in standard header label does not correspond to information in TPLAB control statement. | | |
| 0C3A | Illegal user header label read on an input tape. | | |
| 0C3C | Tape mark encountered before reading standard trailer label on input tape. | Operator choice:<br>a) Press START on CPU to continue processing with EOF condition.<br>b) Mount new reel, enter 0F into location CE, and press START on CPU to continue processing.<br>c) Enter FF into location CE and press START on CPU to discontinue the job. | 53 |
| 0C3D | Standard trailer label not found on input tape when standard labels have been specified. | | |
| 0C3E | Block count in standard trailer label does not equal number of blocks read from an input tape. | Operator choice:<br>a) Press START on CPU to continue processing.<br>b) Enter FF into location CE and press START on CPU to discontinue the job. | 53 |
| 0C3F | Illegal user trailer label read on an input tape. | | |
| 0C51 | Additional output tape required. | Mount new reel and press START on CPU to continue processing. | |

| Code ESTR | Cause | Restart | Ref. No. |
|---|---|---|---|
| 0C52 | Tape mark read instead of standard volume label on output tape when standard labels have been specified, or multi-file volume was positioned incorrectly by use of a FILES statement. | Operator choice:<br>a) Mount correct reel and press START on CPU to continue processing.<br>b) Enter FF into location CE and press START on CPU to discontinue the job. | 53 |
| 0C53 | First record of output tape is not a standard volume label when standard labels have been specified. | Operator choice:<br>a) Mount correct reel and press START on CPU to continue processing.<br>b) Enter 0F into location CE and press START on CPU to continue processing.<br>c) Enter FF into location CE and press START on CPU to discontinue the job. | 53 |
| 0C54 | Volume serial number in standard volume label on output tape does not correspond to file serial number in TPLAB control statement. | Operator choice:<br>a) Press START on CPU to continue processing.<br>b) Mount correct reel, enter 0F into location CE, and press START on CPU to continue processing.<br>c) Enter FF into location CE and press START on CPU to discontinue the job. | 53 |
| 0C57 | File identification and/or file serial number in standard trailer label on output tape do not correspond to information in TPLAB control statement. | | |
| 0C5B | Output tape has not expired. | | |
| 0CD1 | A new pass is about to start. | Press START on CPU to continue processing. | |
| 0CD7 | An OPTN TES statement was encountered for the Initialize Tape Utility program. | Press START on CPU to discontinue the job. | 53 |
| 0CD8 | No VOLx cards found after INITTP | | |
| 0CD9 | An operand detected more than once on an INITTP control statement. | | |
| 0CDA | First control statement read is not INITTP, or is INITTP but contains invalid operand(s). | Press START on CPU to discontinue the job. | 53 |
| 0CDB | SYS000 not assigned. | | |
| 0CDC | Utility-modifier statement does not contain SERIAL when the CARD option is not specified. | | |
| 0CDD | The beginning serial number or the code was not indicated or incorrect in the utility-modifier statement with the CARD option not specified. | | |
| 0CDE | CODE has not been entered with the CARD option not specified. | | |
| 0CDF | A card that did not contain a VOLx or END statement has been read. | | |

| Code ESTR | Cause | Restart | Ref.No. |
|---|---|---|---|
| 0D01 | The input data file read on the 2501 contains a record which, according to the input specifications, is incorrect or out of sequence. | | 55 |
| 0D02 | The input data file read on the 2560 primary feed contains a record which, according to the input specifications, is incorrect or out of sequence. | | |
| 0D03 | The input data file read on the 2560 secondary feed contains a record which, according to the input specifications, is incorrect or out of sequence. | | |
| 0D07 | The input data file read on a 2415 tape drive contains a record which, according to the input specifications, is incorrect or out of sequence. | Operator choice:<br>a) Press START on CPU to discontinue the job.<br>b) Enter FF into location CE and press START on CPU to continue processing | 57 |
| 0D0F | User-programmed halt provided by means of halt indicator H2. | Operator choice:<br>a) Press START on CPU to continue the job.<br>b) Enter FF into location CE and press START on CPU to discontinue the job. | 53 |
| 0D10 | Input of tables is completed. | Press START on CPU to continue processing. | |
| 0D11 | Data processing is completed and output of tables is to follow. | | |
| 0D12 | The number of table records read from a card reading device is lower than the number specified in the source program. | Press START on CPU to discontinue the job. | 53 |
| 0D13 | The number of table records read from a tape drive is lower than the number specified in the source program. | | |
| 0D14 | A reflective marker has been encountered while a table is being written on tape. | | 53 |
| 0D21<br>0D22<br>0D23<br>0D27 | 2501<br>2560,2520<br>1442<br>2415<br>End-of-file condition occurred, but one or more records required according to sequence specifications have not been read. | Operator choice:<br>a) Press START on CPU to discontinue the job.<br>b) Enter FF into location CE and press START on CPU to continue processing with end-of-file condition.<br>c) For stop no. 0D21, 0D22, 0D23, continuation of the job is possible as indicated under Restart 55, provided a value other than FF or 00 is entered into location CE. | 53 |
| 0D30 | Error statistics are not specified in column 35 of the RPG control card, but an OPTN TES card is present. | Press START on CPU to discontinue the job. | 53 |

| Code ESTR | Cause | Restart | Ref.No. |
|---|---|---|---|
| 0DF0 | User-programmed halt provided by means of halt indicator H1 | Operator choice:<br>a) Press START on CPU to continue the job.<br>b) Enter FF into location CE and press START to discontinue the job | |
| 0DF1 | The matching field specified in the input specifications is out of sequence in the input file read on the 2501 when two or three input files are being read. | | 56 |
| 0DF2 | The matching field specified in the input specifications is out of sequence in the input file read on the 2560 primary feed when two or three input files are being read. | | |
| 0DF3 | The matching field specified in the input specifications is out of sequence in the input file read on the 2560 secondary feed when two or three input files are being read. | | |
| 0DF7 | The matching field specified in the input specifications is out of sequence in the input file read on a 2415 tape drive when two or three input files are being read. | Operator choice:<br>a) Press START on CPU to discontinue the job.<br>b) Enter FF into location CE and press START on CPU to continue processing. | 57<br>53 |
| 0DFF | User-programmed halt provided by means of halt indicators H1 and H2. | Operator choice:<br>a) Press START on CPU to continue the job.<br>b) Enter FF into location CE and press START on CPU to discontinue processing. | |
| 0E01 | Record of incorrect length has been read, and neither WLRERR=name nor ERROPT=parameter is specified in the pertinent DTFMT statement. | Press START on CPU to discontinue the job. | 57<br>53 |
| 0E02 | Block count in standard trailer label does not equal the number of blocks read from an input tape. | Operator choice:<br>a) Press START on CPU to discontinue the job.<br>b) Enter FF into location CE and press START on CPU to continue processing. | 57<br>53 |
| 0E03 | End-of-volume condition on input or output file, and no alternate drive specified. | Operator choice:<br>a) Press START on CPU to discontinue the job.<br>b) Mount new reel, enter FF into location CE, and press START on CPU to continue processing. | 57<br>53 |

| Code ESTR | Cause | Restart | Ref. No. |
|---|---|---|---|
| 0E04 | During read-backward, an end-of-file condition has been reached but no header label is encountered although standard labels have been specified. | Operator choice:<br>a) Press START on CPU to discontinue the job.<br>b) Enter FF into location CE and press START on CPU to continue processing.<br>(0E04: label processing is bypassed. 0E05: user labels can be processed.) | 57<br>53 |
| 0E05 | Information other than the file serial number, file sequence number, or volume sequence number in the standard header label does not correspond to information in TPLAB statement. | | |
| 0E06 | File serial number in standard header label does not correspond to information in TPLAB statement. | Operator choice:<br>a) Press START on CPU to discontinue the job.<br>b) Mount correct reel, enter FF into location CE, and press START on CPU to continue processing. | 57<br>53 |
| 0E07 | Volume sequence number in standard header label does not correspond to information in TPLAB statement or updated volume sequence number of multi-volume file, respectively. | | |
| 0E08 | Standard-labeled input file is to be read on a multi-file reel, and the reel is positioned beyond the desired file. | Operator choice:<br>a) Press START on CPU to discontinue the job.<br>b) Manually position the tape, enter FF into location CE, and press START on CPU to continue processing. | 57<br>53 |
| 0E09 | No volume label read on input tape although standard labels have been specified. | Operator choice:<br>a) Press START on CPU to discontinue the job.<br>b) Enter FF into location CE and press START on CPU to continue processing. (Header labels are processed.) | 57<br>53 |
| 0E0A | No volume label read on output tape although standard labels have been specified. | Operator choice:<br>a) Press START on CPU to discontinue the job.<br>b) Mount correct reel, enter FF into location CE, and press START on CPU to continue processing. | 57<br>53 |
| 0E0B | No standard header label read on input tape although standard labels have been specified, or the specified file is not contained in a multi-file volume. In the latter case, a restart is not possible. | Operator choice:<br>a) Press START on CPU to discontinue the job.<br>b) Enter FF into location CE and press START on CPU to continue processing. | 57<br>53 |
| 0E0C | Output tape is not at load point when standard labels have been specified, and no preceding standard trailer label is found. | Press START on CPU to discontinue the job. | 57<br>53 |
| 0E0D | First record is not a tape mark when read-backward is specified. | | |
| 0E0E | Standard trailer label does not correspond to information in TPLAB statement when read-backward is specified. | Operator choice:<br>a) Press START on CPU to discontinue the job.<br>b) Enter FF into location CE, and press START on CPU to continue processing. | 57<br>53 |

| Code ESTR | Cause | Restart | Ref.No. |
|---|---|---|---|
| 0E0F | No TPLAB information has been found for a file in the label-information area. | Press START on CPU to discontinue the job. | 57 53 |
| 0E10 | Too many TPLAB statements have been read for the current program; or CONFG statement is incorrect for the current program. | | |
| 0E11 | Output tape is not at load point, and file serial number of preceding trailer label does not correspond to information in TPLAB statement. | Operator choice:<br>a) Press START on CPU to discontinue the job.<br>b) Enter FF into location CE and press START on CPU to continue processing. | 57 53 |
| 0E12 | Output tape has not expired. | Operator choice:<br>a) Press START on CPU to discontinue the job.<br>b) Enter 0F into location CE and press START on CPU to continue processing with mounted reel.<br>c) Mount correct reel, enter FF into location CE, and press START on CPU to continue processing. | 57 53 |
| 0E13 | Volume serial number in standard volume label does not correspond to file serial number in TPLAB statement. | | |
| 0E14 | For an input file, no trailer label has been read after the tape mark although standard labels have been specified. | Operator choice:<br>a) Press START on CPU to discontinue the job.<br>b) Enter 0F into location CE and press START on CPU to continue processing with end-of-file condition.<br>c) Enter FF into location CE and press START on CPU to continue processing with end-of-volume condition. | 57 53 |
| 0E15 | Required tape drive has not been assigned. | Press START on CPU to discontinue the job. | 53 |
| 0E1A | Read/compute write/compute overlap feature has been specified with the EXEC RWC statement, but no DTFBG RWC=YES was issued during generation. | Press START on CPU to discontinue the job. | 53 |
| 0E1B | DTFBG=YES has been specified during generation but no EXEC RWC statement was issued. | | |
| 0E9A | Read/compute write/compute overlap feature was specified by RWC in EXEC statement, but RPG control card has a blank in col. 38. | | |
| 0E9B | Read/compute write/compute overlap feature was not specified in the EXEC statement, but RPG control card has a W in col. 38. | | |

| Code ESTR | Cause | Restart | Ref. No. |
|---|---|---|---|
| 0EA0 | Permanent tape read error. | Operator choice:<br>a) Press START on CPU to discontinue the job.<br>b) Enter FF into location CE and press START on CPU to continue processing. | 57<br>53 |
| 0EB1 | When fixed-length records are specified, the length of a block read is not an integer multiple of the specified record length, or greater than the specified block length. | | |
| 0EB2 | When variable-length records are specified, the length of a block read is not equal to the block length indicated in the block header, or greater than the maximum block length specified. | | |
| 0EC1 | When variable-length records are specified, the record length is 0. | Press START on CPU to discontinue the job. | 57<br>53 |
| 0EC2 | When variable-length records are specified, the record length is greater than the maximum record length specified. | | |
| 0ED0 | Next reel of file cannot be opened since the OPEN routine has been overlaid. | Press START on CPU to discontinue the job. | 53 |
| 1A01 | END card of input deck is not followed by an end-of-file card. | Press START on CPU to continue processing. Check whether the card read after END card belongs to next job, and if so, return it to the hopper. | |
| 1A02 | END card of input deck is missing. | Follow procedure 53. (Check whether cards for the next job have been ejected by the NPRO, and if so, return them to their hopper decks.) | 53 |
| 1A03 | Both NOLIST and NODECK have been specified in AOPTN statement(s). | Press START on CPU to discontinue the job. | 53 |
| 1A04 | System tape is incomplete or damaged. | Press START on CPU to discontinue the job. (If the error occurs repeatedly, a new system tape must be created.) | 53 |
| 1A05 | Last card of input deck may have been punched by mistake on 2520 Card Read-Punch or 2560. | Press START on CPU to continue processing. Check last card stacked. If it has been punched, replace it by a correct card. | |
| 1A06 | Card following END card of input deck has been misread and cannot be identified. | Press START on CPU to continue processing. Check whether the card read after END card belongs to next job, and if so, return it to the hopper. | |
| 1A1F | Macro definition not found in library. | Press START on CPU to discontinue the job. (If the error occurs repeatedly, a new system tape must be created.) | 53 |

| Code ESTR | Cause | Restart | Ref.No. |
|---|---|---|---|
| 1ABA | Card punching device assigned to SYSOPT is not attached to the Model 20. | Press START on CPU to continue processing. (The object program is not punched out.) | |
| 1ABB | SYSIPT was in "not operational" condition when it was attempted to eject the last card into the stacker. | Press START on CPU to continue processing. Empty the hopper(s) of the device assigned to SYSIPT and press NPRC. Return any cards following the last card to the hopper(s). Return the hopper decks. | |
| 1AC0<br>1AC1<br>1AC2<br>1ACA<br>1ACB | SYS000<br>SYS001<br>SYS002<br>SYSOPT<br>SYSIPT | Incorrect assignment. No physical device assigned to required symbolic device address, or tape drive assigned to SYSIPT, or "data converter off" specified for 7-track drive. | Press START on CPU to discontinue the job. | 53 |
| 1ACE | SYSLST | Conflicting assignment. SYSLST is unassigned while AOPTN NOLIST is not specified. | | |
| 1AD0<br>1AD1<br>1AD2<br>1ADA | SYS000<br>SYS001<br>SYS002<br>SYSOPT | Tape drive has been assigned to more than one symbolic device address used (other than SYS002 and SYSOPT). | | |
| 1AE0<br>1AE1<br>1AE2<br>1AEA | SYS000<br>SYS001<br>SYS002<br>SYSOPT | End of reel has been reached during write operation. | | |
| 1AF0<br>1AF1<br>1AF2<br>1AFF | SYS000<br>SYS001<br>SYS002<br>SYSRES | Error condition during read operation (incorrect-length record, tape mark where not expected, wrong block number, etc.) due to damaged tape. | | |
| 1B00 | The same tape drive assigned to more than one symbolic device address used, or no device assigned to required symbolic device address, or "data converter off" specified for 7-track tape drive. | | | |
| 1B01 | Tape Basic Monitor is incorrect. | | | |
| 1B02 | Control statement read on SYSRDR is not ASSGN, CONFG, or END statement. | Correct the card containing the statement and continue processing. | 52 |
| 1B03 | Control statement on SYSIPT misplaced or incorrect. | Press START on CPU to discontinue the job. | 53 |
| 1B04 | 1st operand or separator (,) of ASSGN statement is incorrect. | Correct the card containing the statement and continue processing. | 52 |
| 1B05 | 2nd operand or separator (,) of ASSGN statement is incorrect. | | |

| Code ESTR | Cause | Restart | Ref.No. |
|---|---|---|---|
| 1B06 | 3rd operand or separator (,) or delimiter (blank) of ASSGN statement is incorrect. | Correct the card containing the statement and continued processing. | 52 |
| 1B07 | 4th operand or delimiter (blank) of ASSGN statement is incorrect. | | |
| 1B08 | ASSGN statements for tape Basic Monitor specify more than 6 physical tape-drive addresses. | Press START on CPU to continue processing. (The excess ASSGN statements are ignored.) | |
| 1B09 | CONFG statement for tape Basic Monitor is incorrect. | Correct the card containing the statement and continue processing. | 52 |
| 1B0A | PHASE statement for Job Control program is missing or misplaced. | Press START on CPU to discontinue the job. | 53 |
| 1B0B | PHASE statement is incorrect or phases are out of sequence. | | |
| 1B0C | Load address for text in TXT or REP card is lower than load address of phase or higher than 32,767. | | |
| 1B0D | Phase/subphase consists of less than 24 bytes or SYSEOJ is the only input phase. | | |
| 1B0E | Load address of phase or subphase is lower than end address of Basic Monitor. | | |
| 1B0F | Phase has more than 9 subphases. | | |
| 1B10 | Two consecutive XFR or END cards have been read. | Warning only. Press START on CPU to continue processing. (The second XFR or END card is ignored.) | |
| 1B11 | Tape mark has been encountered on SYSIPT. | Operator choice:<br>a) Press START on CPU to continue processing with same reel.<br>b) Mount new reel and press START on CPU to continue processing. | |
| 1B12 | Specification in REP card is not hexadecimal. | Press START on CPU to discontinue the job. | 53 |
| 1B13 | Error statistics specified and not possible with LDSYS. | | |
| 1B21 | The name used in an Assembler ENTRY statement is the same as that used in a preceding Assembler ENTRY statement. | | |
| 1B22 | A phase name is the same as the name of a control section or the name used in an Assembler ENTRY or EXTRN statement. | | |
| 1B23 | The name used in an Assembler ENTRY statement is the same as that of a preceding control section. | | |

| Code ESTR | Cause | Restart | Ref.No. |
|---|---|---|---|
| 1B24 | The name of a control section is the same as that of a preceding control section. | Press START on CPU to discontinue the job. | 53 |
| 1B25 | An ESID number is multiply defined within one control section. | | |
| 1B26 | Too many phase, control section, ENTRY, and/or EXTRN names have been used for the specified storage capacity. | | |
| 1B27 | An ESID number that is not defined in the control section has been referenced in an RLD, TXT, REP, END, or XFR record. | | |
| 1B28 | An ESID number in an RLD, TXT, REP, END, or XFR record has been defined in the control section, but does not refer to the Section Definition entry for this section. | | |
| 1B29 | A TXT record pertaining to a previously processed phase has been encountered. | | |
| 1B2A | The name used in a Section Definition entry is the same as the name used in an Assembler ENTRY statement in a preceding control section. | | |
| 1B2B | ACTION control statement contains invalid operand. | Press START on CPU to continue processing (Statement is ignored.) | |
| 1B2C | The (optional) name in an ENTRY control statement has not been defined as the name of a phase or control section or as the name used in an Assembler ENTRY statement. | Press START on CPU to discontinue the job. | 53 |
| 1B2D | 1st operand of PHASE statement is incorrect. | | |
| 1B2E | 2nd operand of PHASE statement is incorrect. | | |
| 1B2F | 3rd operand of PHASE statement is incorrect. | | |
| 1B30 | 4th operand of PHASE statement is incorrect or not previously defined. | Press START on CPU to discontinue the job. | 53 |
| 1B31 | No device assigned to required symbolic address(es), or the same tape drive assigned to more than one symbolic address used, or incorrect device type(s) assigned. | | |
| 1B32 | Symbolic transfer address in an END or XFR record has not been defined previously. | | |

| Code ESTR | Cause | Restart | Ref.No. |
|---|---|---|---|
| 1B33 | Tape mark has been read on SYSIPT. | Operator choice:<br>a) Press START on CPU to continue processing with same reel.<br>b) Mount new reel and press START on CPU to continue processing. | |
| 1B34 | Input records are out of sequence. | Press START on CPU to discontinue the job. | 53 |
| 1B35 | First card column contains character other than blank or 12-2-9, or -- if blank -- card is not a PHASE, ACTION, or ENTRY card. | Press START on CPU to continue processing. (The card is ignored.) | |
| 1B36 | REP card contains an incorrect specification. | Press START on CPU to discontinue the job. | 53 |
| 1B37 | Load address calculated from PHASE statement is higher than 32,767. | | |
| 1B38 | 1st input statement is not a PHASE statement. | | |
| 1B39 | No TXT cards present for last phase. | | |
| 1B40 | End of reel reached on SYS000 or SYSOPT. | | |
| 1B41 | During read operation, tape mark encountered where not expected, or record of incorrect length read. | Press START on CPU to discontinue the job. | 58<br>53 |
| 1B42 | Tape on SYS000 is mispositioned. (Hardware malfunction.) | Press START on CPU to discontinue the job. | 53 |
| 1B43 | The same tape drive assigned to more than one symbolic device address used, or no device assigned to required symbolic device address, or "data converter off" specified for 7-track tape drive. | | |
| 1B44 | Name field of control statement contains incorrect specification, or, if SYSIPT and SYSRDR refer to the same device, PHASE statement is not preceded by a control statement. | Follow procedure 52 and correct or insert the control statement before returning the hopper deck to the hopper. | 52 |
| 1B45 | Control statement contains invalid operation code. | | |
| 1B46 | 1st operand or separator (,) or delimiter (blank) of control statement is incorrect. | | |
| 1B47 | 2nd operand or separator (,) of control statement is incorrect. | | |
| 1B48 | 3rd operand or separator (,) or delimiter (blank) is incorrect. | | |
| 1B49 | 4th operand or delimiter (blank) is incorrect. | | |

| Code ESTR | Cause | Restart | Ref.No. |
|---|---|---|---|
| 1B4A | Two consecutive XFR or END cards have been read, or a CATAL statement is encountered after an end-of-file card has been read on SYSIPT. | Press START on CPU to continue processing. (The second XFR or END card or the CATAL statement, respectively, is ignored.) | |
| 1B4B | PHASE statement is not followed by REP, TXT, XFR, or END cards. | Press START on CPU to discontinue the job. | 53 |
| 1B4C | CATAL statement is encountered when tape mark has been read on SYSIPT. | Operator choice:<br>a) Press START on CPU to discontinue the job.<br>b) Enter 0F into location CE and press START on CPU to continue processing. (The CATAL statement is ignored.)<br>c) If the tape on SYSIPT contains additional input, leave it on the drive. If further input is stored on another tape, mount that tape on SYSIPT. Enter FF into location CE and press START on CPU to continue processing. | 53 |
| 1B4D | Phase SYSEOJ is to be included (replaced) and is not the first phase in the input stream, or SYSEOJ has been read as operand in a DELET statement. | Press START on CPU to discontinue the job. | 53 |
| 1B4E | Input phase or DELET statement out of sequence. | | |
| 1B4F | PHASE statement contains invalid operands, or load address of a phase is lower than end address of Basic Monitor area, or column 1 of PHASE statement is not blank. | | |
| 1B50 | PHASE statement contains phase name with illegal characters, or phase name consists of more than 6 characters. | Press the START on CPU to discontinue the job. | 53 |
| 1B51 | Load address in TXT or REP card is lower than load address of phase. | | |
| 1B52 | Load address of last byte in TXT or REP card is higher than 32,767. | | |
| 1B53 | Phase or subphase consists of less than 24 bytes. | | |
| 1B54 | Phase to be deleted not found in library. | Press START on CPU to continue processing. (DELET statement is ignored.) | |
| 1B55 | PHASE statement not found where expected. | Press START on CPU to continue processing. (Warning only.) | |

| Code ESTR | Cause | Restart | Ref. No. |
|---|---|---|---|
| 1B56 | Phase has more than 9 subphases. | Press START on CPU to discontinue the job. | 53 |
| 1B57 | MONTR statement encountered is not the first control statement, or two MONTR statements have been encountered. | | |
| 1B58 | Tape Basic Monitor is incorrect. | | |
| 1B59 | ASSGN statements for tape Basic Monitor specify more than 6 physical tape-drive addresses. | Press START on CPU to continue processing. (The excess ASSGN statements are ignored.) | |
| 1B5A | REP card contains invalid hexadecimal character(s). | Press START on CPU to discontinue the job. | 53 |
| 1B60 | 1st control statement is not a PRIOR statement. | | 52 |
| 1B61 | Statement read is not a control statement. | | |
| 1B62 | Control statement contains invalid operation code. | | |
| 1B63 | PRIOR control statement contains invalid operand. | Operator choice:<br>a) Press START on CPU to discontinue the job.<br>b) Enter FF into location CE and press START on CPU to continue processing. (The incorrect card is ignored. A correct one may be inserted as described in procedure 52.) | 53<br>(52) |
| 1B64 | PRIOR statement is out of sequence. | | |
| 1B65 | DELET control statement contains invalid operation code. | | |
| 1B66 | DELET statement with operand ALL is not preceded by a PRIOR statement. | | |
| 1B67 | DELET control statement or input macro definition out of sequence. | Operator choice:<br>a) Press START on CPU to discontinue the job.<br>b) Enter FF into location CE and press START on CPU to continue processing. (The DELET statement is ignored or the macro definition is skipped.) | 53 |
| 1B68 | Element in control statement (operation code or operand) is missing or extends beyond column 71. | Operator choice:<br>a) Press START on CPU to discontinue the job.<br>b) Enter FF into location CE and press START on CPU to continue processing. (The incorrect statement is ignored. A correct one may be inserted as described in procedure 52.) | 53<br>(52) |
| 1B69 | During write operation on SYS000 or SYSOPT, end of reel is encountered. | Operator choice:<br>a) Press START on CPU to discontinue the job.<br>b) Enter FF into location CE and press START to continue processing. (Only a few records can be written on the tape.) | 58<br>53 |

| Code ESTR | Cause | Restart | Ref.No. |
|---|---|---|---|
| 1B6B | Tape mark has been read on SYSIPT at the beginning of a CATAL procedure. | Operator choice:<br>a) Press START on CPU to discontinue the job.<br>b) Enter 0F into location CE and press START on CPU to continue processing. (The next control statement is read. It should be DELET or END. No more macro definitions should be read on SYSIPT.)<br>c) Enter FF into location CE and press START on CPU to continue processing. (The tape mark is ignored. It is also possible to mount a new input tape before pressing START.) | 53 |
| 1B6C | Invalid MACRO statement has been read on SYSIPT. | If SYSIPT is a tape drive, enter FF into location CE and press START on CPU to continue processing. (The macro definition is skipped.)<br>If SYSIPT is a card reading device, operator choice:<br>a) Correct MACRO statement as described in procedure 52. (The macro definition is processed.)<br>b) Enter FF into location CE and press START on CPU to continue processing. (The macro definition is skipped.) | 52 |
| 1B6D | Record of incorrect length has been read on tape, or tape read error occurred. | Press START on CPU to discontinue the job. | 58<br>53 |
| 1B6E | Macro definition to be deleted has not been found in library. | Operator choice:<br>a) Press START on CPU to discontinue the job.<br>b) Enter FF into location CE and press START on CPU to continue processing. (The DELET request is ignored.) | 53 |
| 1B6F | Tape mark encountered within macro definition on SYSIPT. | Press START on CPU to discontinue the job. | 53 |
| 1B70 | No MEND statement found when skipping a macro definition because of a previous error. | | |
| 1B71 | Invalid prototype statement has been read on SYSIPT. | Operator choice:<br>a) Press START on CPU to discontinue the job.<br>b) Enter FF into location CE and press START on CPU to continue processing. (The macro definition is skipped.) | 53 |

| Code ESTR | Cause | Restart | Ref.No. |
|---|---|---|---|
| 1B72 | Control statement has been encountered while reading a macro definition on SYSIPT. | Operator choice:<br>a) Press START on CPU to discontinue the job.<br>b) Enter FF into location CE and press START on CPU to continue processing. (The control statement is ignored and the macro definition is processed.) | 53 |
| 1B79 | No device assigned to SYSRDR. | Press START on CPU to discontinue the job. | 53 |
| 1B7A | Improper SYSOPT assignment:<br>a) no device assigned,<br>b) device assigned is not a tape drive,<br>c) tape characteristics specification for 7-track drive is not "data converter on". | | |
| 1B7B | Improper SYS000 assignment:<br>a) no device assigned,<br>b) device assigned is not a tape drive,<br>c) tape characteristics specification for 7-track drive is not "data converter on". | | |
| 1B7C | Improper SYSIPT assignment:<br>a) no device assigned,<br>b) 7-track drive assigned, and tape characteristics specification is not "data converter on". | | |
| 1B7D | SYSOPT has been assigned the same drive as SYSRES. | | |
| 1B7E | SYS000 has been assigned the same drive as SYSRES or SYSOPT. | | |
| 1B7F | SYSIPT has been assigned the same drive as SYSRES, or SYSOPT, or SYS000. | | |
| 1B80 | The printer has not been assigned to SYSLST. | | |
| 1B81 | Name field of control statement contains improper specification. | Correct the statement and continue processing. | 52 |
| 1B82 | Control statement contains invalid operation code, or does not contain any operation code. | | |
| 1B83 | DSPLY control statement contains invalid operand(s). | | |
| 1B84 | Column 72 of control statement is not blank. | | |
| 1B85 | Directory entry for Job Control has not been found at beginning of library. | Press START on CPU to discontinue the job. (System tape is damaged or incorrect.) | 53 |

| Code ESTR | Cause | Restart | Ref.No. |
|---|---|---|---|
| 1BA0 | End of reel reached on SYSOPT. | Press START on CPU to discontinue the job. | 53 |
| 1BA1 | During read operation on SYSIPT, tape mark encountered where not expected. | | |
| 1BA2 | Record of incorrect length read on SYSIPT. | | |
| 1BA3 | No tape drive assigned to SYSIPT and/or SYSOPT, or the same drive assigned to SYSIPT and SYSOPT, or "data converter off" specified for a 7-track drive. | Press START on CPU to discontinue the job. | 53 |
| 1BA4 | Error statistics specified and not possible with CPSYS | | |
| 1BD0 | Control statement is incorrect, or sequence of control statements is invalid. | If a control statement is incorrect, correct it following procedure 52. If the sequence is invalid, all statements that are out of sequence must be returned to the hopper and re-read. | 52 |
| 1BD1 | SYSOPT or SYSLST not assigned when required. | Press START on the CPU to continue processing. (The corresponding PUNCH, DSPLY or DSPCH statement is ignored. To avoid further halts, remove all following PUNCH, DSPLY or DSPCH cards, respectively.) | |
| 1BD2 | Card punching device assigned to SYSOPT is not attached when required. | | |
| 1BD3 | Device assigned to SYSRDR is not attached to the system. | Carry out a new IPL procedure. | |
| 1BD4 | Printer assigned to SYSLST is not attached when required. | Press START on the CPU to continue processing. (The corresponding DSPLY or DSPCH statement is ignored. To avoid further halts, remove all following DSPLY and/or DSPCH statements.) | |
| 1BE0 | Read error on SYSRES. (Incorrect length record, tape mark where not expected, wrong block number, damaged tape, etc.) | Press START on the CPU to discontinue the job. | |
| 1BE1 | Read error on SYS000 | | |

| Code ESTR | Cause | Restart | Ref.No. |
|---|---|---|---|
| 1BE2 | Tape read error on SYSRES. | Operator choice:<br>a) Press START on the CPU to discontinue the job.<br>b) Enter FF into location CE and press START on the CPU to continue processing. (The misread block is put out as read. The next block or part of it may also be incorrect.)<br>c) Enter a value other than 00 or FF into location CE and press START on the CPU to continue processing. (The current PUNCH, DSPLY, or DSPCH operation is terminated, and the next control statement is read.) | |
| 1BE3 | Reflective marker encountered on SYS000 during execution of a write command. | Press START on the CPU to discontinue the job. | |
| 1BE4 | SYS000 improperly assigned. | | |
| 1BE5 | SYSRDR improperly assigned. | | |
| 1C00 | END control statement missing, or more than 15 Sort/Merge control statements issued. | | |
| 1C01 | Sort/Merge specification errors have been detected. | | |
| 1C02 | Maximum file size has been exceeded during Internal Sorting (end-of-reel condition detected on work tape). | | |
| 1C03 | Maximum file size has been exceeded during External Sorting (end-of-reel condition detected on work tape). | | |
| 1C04 | During external sorting: tape read error or record with incorrect length on tape | Press START on CPU to discontinue the job. | 58<br>53 |
| 1C05 | Tape mark detected on work tape during read-backward (may be due to incorrect tape-drive assignment for Restart run). | Press START on CPU to discontinue the job. | 53 |
| 1C06 | Data found to be out of sequence. (In a Sort run, this halt may be due to a hardware malfunction.) | | |

| Code ESTR | Cause | Restart | Ref.No. |
|---|---|---|---|
| 1C0A | Pause for verifying assumptions. | If the assumptions are correct, press START on CPU to continue processing.<br>If the assumptions are not correct, enter FF into location CE and press START on CPU to discontinue the job. | 53 |
| 1C0B | Unreadable data or block of incorrect length found on tape. | Operator choice:<br>a) Press START on CPU to continue processing. (The block is bypassed.)<br>b) Enter FF into location CE and press START on CPU to discontinue the job. | 58<br>53 |
| 1C0C | Checkpoint record has not been found. | Press START on CPU to discontinue the job. | 53 |
| 1C0D | Input tape contains a record which is longer than the specified L1 or shorter than the specified L4 when variable-length records have been specified. | Display register 9 (address of record). Display record-length field.<br>Operator choice:<br>a) Press START on CPU to continue processing. (Record is bypassed.)<br>b) Enter FF into location CE and press START on CPU to discontinue the job. | 53 |
| 1C30 | Incorrect information entered into location CE. | Enter correct information into location CE and press START on CPU to resume operation. | |
| 1C31 | Further input is expected. | Operator choice:<br>a) Mount new reel and press START on CPU to continue processing.<br>b) Enter FF into location CE and press START on CPU to continue processing with end-of-file condition. | 58 |
| 1C32 | Tape mark has been read instead of standard volume label on input tape when standard labels are specified. | Operator choice:<br>a) Mount correct tape and press START on CPU to continue processing.<br>b) Enter FF into location CE and press START on CPU to discontinue the job. | 58<br>53 |
| 1C33 | First record of input tape is not a standard volume label when standard labels are specified. | Operator choice:<br>a) Mount correct reel and press START on CPU to continue processing.<br>b) Enter 0F into location CE and press START on CPU to continue processing. (The tape is accepted.)<br>c) Enter FF into location CE and press START on CPU to discontinue the job. | 58<br>53 |

| Code ESTR | Cause | Restart | Ref.No. |
|---|---|---|---|
| 1C34 | Volume serial number in standard volume label on input tape does not correspond to file serial number in TPLAB control statement. | Operator choice:<br>a) Press START on CPU to continue processing. (User labels are processed.)<br>b) Mount correct reel, enter 0F into location CE, and press START on CPU to continue processing.<br>c) Enter FF into location CE and press START on CPU to discontinue the job. | 58<br><br><br><br><br><br>53 |
| 1C35 | Tape mark has been encountered instead of standard header label on input tape. | Operator choice:<br>a) Mount correct reel and press START on CPU to continue processing.<br>b) Enter 0F into location CE and press START on CPU to continue processing. (The tape is accepted.)<br>c) Enter FF into location CE and press START on CPU to discontinue the job. | 58<br><br><br><br><br>53 |
| 1C36 | Standard header label has not been found on input tape when standard labels are specified. | | |
| 1C37 | File identification and/or file serial number in standard header label do not correspond to information in TPLAB control statement. | Operator choice:<br>a) Press START on CPU to continue processing. (The tape is accepted.)<br>b) Mount correct reel, enter 0F into location CE, and press START on CPU to continue processing.<br>c) Enter FF into location CE and press START to discontinue the job. | 58<br><br><br><br><br>53 |
| 1C38 | Volume sequence number in standard header label does not correspond to information in TPLAB control statement. | | |
| 1C39 | Information other than the file identification, file serial number, and volume sequence number in the standard header label does not correspond to information in TPLAB control statement. | | |
| 1C3A | Invalid standard user header label has been read on input tape. (First three characters are not UHL.) | | |
| 1C3C | Tape mark has been encountered instead of standard trailer label on input tape. | Operator choice:<br>a) Press START on CPU to continue processing with EOF condition.<br>b) Mount new reel, enter 0F into location CE, and press START on CPU to continue processing.<br>c) Enter FF into location CE and press START on CPU to discontinue the job. | 58<br><br><br><br><br>53 |
| 1C3D | Standard trailer label has not been found on input tape when standard labels were specified. | | |
| 1C3E | Block count in standard trailer label does not equal number of blocks read from input tape. | Operator choice:<br>a) Press START on CPU to continue processing.<br>b) Enter FF into location CE and press START on CPU to discontinue the job. | 58<br><br><br>53 |
| 1C3F | Invalid standard user trailer label has been read on input tape. (First three characters are not UTL.) | | |

| Code ESTR | Cause | Restart | Ref. No. |
|---|---|---|---|
| 1C41 | Last work tape has been assigned the same drive as an input tape. (Warning only.) | Mount an appropriate tape on drive and press START on CPU to continue processing. | 58 |
| 1C42 | Tape mark has been read instead of standard volume label on work tape when standard labels are specified. | Operator choice:<br>a) Mount correct reel and press START on CPU to continue processing.<br>b) Enter FF into location CE and press START on CPU to discontinue the job. | 58<br>53 |
| 1C43 | First record of work tape is not a standard volume label when standard labels are specified. | Operator choice:<br>a) Mount correct reel and press START on CPU to continue processing.<br>b) Enter 0F into location CE and press START on CPU to continue processing. (The tape is accepted.)<br>c) Enter FF into location CE and press START on CPU to discontinue the job. | 58<br>53 |
| 1C45 | Tape mark has been encountered instead of standard header label on work tape. | | |
| 1C46 | Standard header label has not been found on work tape when standard labels are specified. | | |
| 1C4A | Invalid standard user header label has been read on work tape. (First three characters are not UHL.) | Operator choice:<br>a) Press START on CPU to continue processing. (The tape is accepted.)<br>b) Mount correct reel, enter 0F into location CE, and press START on CPU to continue processing.<br>c) Enter FF into location CE and press START on CPU to discontinue the job. | 58<br>53 |
| 1C4B | Work tape has not expired. | | |
| 1C50 | An output-tape file and a work-tape file have the same tape-drive specification. | Operator choice:<br>a) Press START on CPU to continue processing. (The work tape is accepted as output tape.<br>b) Mount correct reel and press START on CPU to continue processing. | |
| 1C51 | Additional output tape is required. | Mount correct tape and press START on CPU to continue processing. | 58 |
| 1C52 | Tape mark has been read instead of standard volume label on output tape when standard labels are specified. | Operator choice:<br>a) Mount correct reel and press START on CPU to continue processing.<br>b) Enter FF into location CE and press START on CPU to discontinue the job. | 58<br>53 |

| Code ESTR | Cause | Restart | Ref.No. |
|---|---|---|---|
| 1C53 | First record of output tape is not a standard volume label when standard labels are specified. | Operator choice:<br>a) Mount correct reel and press START on CPU to continue processing.<br>b) Enter 0F into location CE and press START on CPU to continue processing. (The tape is accepted.)<br>c) Enter FF into location CE and press START on CPU to discontinue the job. | 58<br><br><br><br><br>53 |
| 1C54 | Volume serial number in standard volume label on output tape does not correspond to file serial number in TPLAB control statement. | Operator choice:<br>a) Press START on CPU to continue processing. (The tape is accepted.)<br>b) Mount correct reel, enter 0F into location CE, and press START on CPU to continue processing.<br>c) Enter FF into location CE and press START on CPU to discontinue the job. | 58<br><br><br><br>53 |
| 1C56 | Output tape is not at load point when standard labels are specified, and no preceding trailer label has been found. | Operator choice:<br>a) Mount correct reel and press START on CPU to continue processing.<br>b) Enter FF into location CE and press START on CPU to discontinue the job. | 58<br><br>53 |
| 1C57 | Output tape is not at load point, and file serial number of preceding trailer label does not correspond to information in TPLAB control statement. | Operator choice:<br>a) Press START on CPU to continue processing. (The tape is accepted.)<br>b) Mount correct reel, enter 0F into location CE, and press START on CPU to continue processing.<br>c) Enter FF into location CE and press START on CPU to discontinue the job. | 58<br><br><br><br><br>53 |
| 1C5B | Output tape has not expired. | | |
| 1C5C | MODS statement specified, but no user routine present. | | 60 |
| 1D01 | End of RPG compilation. | Prepare the I/C devices required by the object program and press START on CPU to initiate execution. | |

| Code ESTR | Cause | Restart | Ref. No. |
|---|---|---|---|
| 1D02 | Irrecoverable error. Caused by main-storage overflow during generation, or object program too large for available main-storage capacity as specified in cols. 12 - 14 of RPG control card, or RPG control card missing or incorrect, or errors in source deck. | Press START on CPU to discontinue the job. | 53 |
| 1D03 | Conflicting tape-drive assignments. (SYSRES, SYS000, and SYS001 must be different tape drives; SYSOPT, if tape drive, must not be the same drive as SYSRES or SYS001), or required tape drive not assigned, or SYSIPT is not a card reading device, or a 7-track tape drive is assigned to SYS000 or SYS001 and the conversion feature is not on. | | |
| 1D11 | Permanent read error on SYS000. | | |
| 1D12 | Permanent read error on SYS001. | | |
| 1D21 | Unit exception on SYS000. (During read operation, tape mark encountered where not expected. During write operation, end of reel sensed.) | | |
| 1D22 | Unit exception on SYS001. (During read operation, tape mark encountered where not expected. During write operation, end of reel sensed.) | Press START on CPU to discontinue the job. | 53 |

# APPENDIX A. JOB CONTROL STATEMENTS

The job control statements are submitted to the Job Control program to request functions of this program.

The formats and functions of the job control statements used with the Model 20 Tape Programming System are described below.

The following notation is used in the format description:

1. Upper case words or letters must appear in the control statement exactly as given in the description of the format.

2. Lower case words or letters represent information to be supplied by the programmer or operator. Their meaning is described in the text immediately following the format description.

## GENERAL FORMAT OF JOB CONTROL STATEMENTS

Any job control statement contains
- a name,
- an operation code,
- one or more operands (if required),
- comments (optional).

### Name

All job control statements are identified by two slashes (//) in columns 1 and 2 (name field), followed by at least one blank column.

### Operation Code

The type of control statement is defined by the operation code. The codes and their meaning are summarized in Figure 50. The operation code determines which function of the Job Control program is requested. The last character of the code must be followed by at least one blank.

### Operands

Most of the job control statements require some additional information (operands). If a control statement contains more than one operand, each operand is separated from the following one by a comma. The last character of an operand (or group of operands) must be followed by at least one blank.

### Comments

Comments may be used in any of the job control statements. At least one blank column must separate the operand(s) or, if the statement does not contain any operands, the operation code, from the comments.

| Operation Code | Function |
|---|---|
| ASSGN | inserts, changes, or deletes I/O device assignment in logical unit table |
| CONFG | places storage-capacity specification into communication region |
| DATE | places date into communication region |
| EXEC | indicates end of a set of job control statements and returns control to loading routine |
| FILES | positions tape reel by skipping specified number of tape marks or by rewinding |
| JOB | is required in every set of job control statements and specifies name of program |
| LOG | causes listing of job control statements and error statistics on SYSLOG |
| NOLOG | causes the listing of job control statements and error statistics to be discontinued |
| OPTN | causes initiation of error statistics |
| PAUSE | causes system halt |
| TPLAB | supplies tape label information for individual file |
| UPSI | changes setting of UPSI byte in communication region |
| VOL | specifies name of tape file to be processed; specifies the symbolic adress of the tape drive on which this file is mounted |

Figure 50. Summary of Job Control Statements

Note: The information (including possible comments) contained in a job control statement must not extend beyond column 71.

ORDER OF INPUT

Job control statements are read on a device whose symbolic address is SYSRDR. Normally, the first statement of a set of job control statements for a particular job is a JOB statement. Only the PAUSE, LOG, and NOLOG statements may precede a JOB statement. The last statement of a set of job control statements must be an EXEC statement.

Except where noted, the remaining control statements of a set may be arranged in any order between the JOB and EXEC statements.

FUNCTIONS AND FORMAT OF JOB CONTROL STATEMENTS

The function and format of each type of job control statement is described in detail in the following sections.

ASSGN Control Statement

The ASSGN control statement is used to assign an actual I/O device address to a specific symbolic I/O device address. It is also used to "unassign" a symbolic I/O device address, i.e., remove an entry from the logical unit table.

The ASSGN control statement has one of the following formats:

| Name | Op.Code | Operands |
|---|---|---|
| // | ASSGN | SYSxxx,X'cuu',dd |
| // | ASSGN | SYSxxx,X'cuu',dd,X'ss' |
| // | ASSGN | SYSxxx,UA |

SYSxxx
This operand specifies the symbolic I/O device address to which an actual device address is to be assigned, or which is to be unassigned.
The symbolic device addresses used are listed in Figure 51, in the order in which they appear in the logical unit table.

X'cuu'
This operand specifies the actual I/O device address in hexadecimal notation: c is the attachment-point specification, uu is the unit-number specification. The following specifications are used.

c
1 -- 2501 Card Reader
2 -- 2560 MFCM, or
2520 Card Read-Punch, or
2520 Card Punch
3 -- 1442 Card Punch
4 -- 1403 Printer or
2203 Printer
7 -- 2415 Magnetic Tape Drive

uu
00 -- all I/O devices other than magnetic tape drives
01 to FF -- magnetic tape drives
Note: Only the numbers of the drives attached should be used.

| Symbolic Address | Device Type |
|---|---|
| SYSRES | tape drive |
| SYSRDR | card reading device |
| SYSIPT | card reading device or tape drive |
| SYSOPT | card punching device or tape drive |
| SYSLST | printer |
| SYSLOG | printer |
| SYS000 to SYS015 | tape drives |

Figure 51. Summary of Symbolic I/O Device Addresses

dd
This operand is the device-type specification. The specifications used are listed in Figure 52.

X'ss'
This operand is the characteristics specification for magnetic tape drives. It is required for (1) 7-track magnetic tape drives and (2) 9-track magnetic tape drives with compatibility feature. The operand must be omitted when 9-track magnetic tape drives without compatibility feature are to be assigned. The characteristics specifications for 7-track tape drives are summarized in Figure 53.

| dd | Device Specified |
|---|---|
| L1 | 1403 Printer |
| L3 | 2203 Printer |
| P2 | 1442 Card Punch |
| P3 | 2520 Card Punch |
| R4 | 2501 Card Reader |
| R5 | 2520 Card Read Punch |
| R6 | 2560 MFCM, Primary Feed |
| R7 | 2560 MFCM, Secondary Feed |
| T1 | 2415, 7-Track Tape Drive |
| T2 | 2415, 9-Track Tape Drive |

Figure 52. Summary of Device-Type Specifications (dd)

The characteristics specifications for 9-track tape drives with compatibility feature are:

X'C0' -- 1600 bytes/inch
X'C8' -- 800 bytes/inch

Note: In the course of a system run, a number of ASSGN statements may be issued to assign the same physical tape drive to various symbolic device addresses. In this case, the tape characteristics specifications contained in the last ASSGN statement read for the (physical) drive are valid for all symbolic device addresses to which the drive is assigned at that time.

UA
This operand is used to unassign a symbolic device address.

Note: An ASSGN statement for SYSRES may be submitted only to the tape IPL program. An ASSGN statement for SYSRDR must be submitted to the card IPL program, and may be submitted to the tape IPL and tape Job Control programs. It must not be submitted to the card Job Control program.

## CONFG Control Statement

The CONFG control statement is used to place the storage-capacity specification into the communication region of the Basic Monitor program in main storage. The CONFG control statement has the following format:

| ss | Specifies | | | |
|---|---|---|---|---|
| | Bytes/Inch | Parity | Translate Feature | Convert Feature |
| 10 | 200 | odd | off | on |
| 20 | | even | off | off |
| 28 | | even | on | off |
| 30 | | odd | off | off |
| 38 | | odd | on | off |
| 50 | 556 | odd | off | on |
| 60 | | even | off | off |
| 68 | | even | on | off |
| 70 | | odd | off | off |
| 78 | | odd | on | off |
| 90 | 800 | odd | off | on |
| A0 | | even | off | off |
| A8 | | even | on | off |
| B0 | | odd | off | off |
| B8 | | odd | on | off |

Figure 53. Summary of 7-Track Tape-Characteristics Specifications for use in ASSGN Statements

| Name | Op.Code | Operands |
|---|---|---|
| // | CONFG | xx |

xx
This operand represents the main-storage capacity. It may be:

4
or
04 - 4096 bytes
8
or
08 - 8192 bytes
12 - 12,288 bytes
16 - 16,384 bytes
24 - 24,576 bytes
32 - 32,768 bytes

For example, to define a Model 20 with a main-storage capacity of 8192 bytes, the CONFG statement is:

```
// CONFG 8
```

Note: The communication region of the Basic Monitor program contains a standard storage-capacity specification for 8192 bytes. Therefore, the CONFG control statement is required only if the storage capacity of the user's Model 20 is other than 8K.

## DATE Control Statement

The DATE control statement is used to place the date into the communication region of the Basic Monitor program in main storage.

The DATE control statement has the following format:

| Name | Op.Code | Operands |
|---|---|---|
| // | DATE | yyddd |

yyddd
This operand is the date specification, where yy represents the rightmost two digits of the year, and ddd represents the three-digit number of the day in the year (ddd may be any of the numbers 001 through 366).
For example, the date September 1, 1966, would be specified as 66244. The Job Control program converts this date specification and places it in the date field of the communication region in the form 090166244.

Note: The DATE control statement need be submitted only once after the Basic Monitor program has been loaded. Prior to the execution of a program, the Job Control program checks whether the communication region contains the date.

EXEC Control Statement

The EXEC control statement indicates to the Job Control program that the reading of a set of job control statements has been completed and that control is to be returned to the loading routine (in the Basic Monitor program if no operand is specified, in the tape Job Control program if the operand LOADER is specified).

The EXEC control statement has one of the following formats:

| Name | Op.Code | Operands |
|---|---|---|
| // | EXEC | |
| // | EXEC | [RWC], [LOADER] |

The first type of EXEC statement does not contain an operand. This type is used to delimit any set of job control statements issued to the card or the tape Job Control program. The statement // EXEC causes the Job Control program to return control to the Basic Monitor program. The load address of the next program phase must not be below main-storage position 067E (hexadecimal).

The second type of EXEC statement contains one or both of the symbols LOADER and RWC in the operand field.

The statement // EXEC LOADER causes the Job Control program to transfer control to a loader routine, which is located at the end of the Basic Monitor area in main storage. The function of this loader routine is to load a program from the magnetic tape drive (the program must be in card-image format), or from the card device, assigned to SYSIPT. Any FETCH macro instruction contained in the object program thus loaded causes the loading of the physically next program phase from SYSIPT. When an EOJ macro instruction is encountered in the program, control is returned to the Basic Monitor program. The symbol LOADER may only appear in the operand field when the tape Job Control program is used. The load address of the next program phase must not be below main-storage position 07D0 (hexadecimal) if the device assigned to SYSIPT is a tape drive. If this device is not a tape drive, the first available main-storage position is 64 (hexadecimal) bytes higher. If // JOB RPG, name is specified the operand LOADER will be ignored.

The statement // EXEC RWC causes the Job Control program to change the mode of the Basic Monitor from non-overlap to overlap. This statement can be issued for both card and tape Job Control programs. The load address of the next program phase must not be below main-storage position 0834 (hexadecimal).

When the EXEC statement contains both the symbols LOADER and RWC (in either order) in the operand field, the Job Control program changes the mode of the Basic Monitor from non-overlap to overlap, and transfers control to the loader routine discussed above. The load address of the next program phase should not be below main-storage position 0960 (hexadecimal) if the device assigned to SYSIPT is a tape drive. If this device is not a tape drive, the first available main-storage position is 64 (hexadecimal) bytes higher.

Note: Each set of job control statements must be delimited by an EXEC control statement.

FILES Control Statement

The FILES control statement is used to position a reel of magnetic tape, either by skipping a specified number of tape marks or by rewinding the tape to the load point.

The FILES control statement has one of the following formats:

| Name | Op. Code | Operand |
|---|---|---|
| // | FILES | SYSxxx,n |
| // | FILES | SYSxxx,REW |

SYSxxx
This operand specifies the symbolic address of the tape drive on which the tape is mounted. (For a list of symbolic addresses, see the description of the ASSGN statement.)

n
This operand specifies the number of tape marks to be skipped. It may be any one of the numbers 1 through 999. The number of tape marks to be skipped (n) is counted from the present position of the tape and may be any one of the numbers 1 through 999. It must take into account the tape marks associated with the labels, as well as the file tape marks.

REW
This operand specifies that the tape is to be rewound to the load point.

Note: If, in a set of job control statements, a FILES control statement and an ASSGN control statement refer to the same symbolic I/O address, the FILES statement must follow the ASSGN statement.

## JOB Control Statement

The JOB control statement indicates to the Job Control program that a set of job control statements follows. It is used to place the name of the program to be executed next into the communication region of the Basic Monitor program in main storage.

The JOB control statement has one of the following formats:

| Name | Op.Code | Operands |
|---|---|---|
| // | JOB | program-name |
| // | JOB | RPG,program-name |

JOB control statements of the first format can be submitted either to the card Job Control program or to the tape Job Control program. When submitted to the tape Job Control program, the operand program-name specifies the name of the object program, included in the core-image library, to be executed next. The card Job Control program checks whether the operand is present, but ignores it and loads the physically next program.

JOB control statements of the second format are submitted to the tape Job Control program. In this format, the operand program-name specifies the name of a source program written in the RPG language which is to be first compiled and then executed immediately (i.e., without an intermediate Job Control run).

In both formats of the JOB control statement, the program name is not restricted in length. However, if the length exceeds six characters, only the leftmost six characters are recognized.

Note: Normally, the JOB statement is the first statement of a set of job control statements. Only LOG, NOLOG, and PAUSE statements may precede the JOB statement.

## LOG Control Statement

The LOG control statement is used to instruct the Job Control program to list the job control statements on the printer assigned to SYSLOG. It also causes the listing of tape error statistics on SYSLOG if generated by an OPTN control statement, provided the Job Control program is reloaded after execution of the problem program. If a BSCA job on which error statistics were collected has been run, the LOG control statement also causes listing of BSCA error statistics. The LOG control statement is the first statement that is listed. Listing is continued in the following Job Control runs until a NOLOG statement is encountered.

The LOG control statement has the following format:

| Name | Op.Code | Operands |
|---|---|---|
| // | LOG | |

Note 1: A LOG control statement may precede the JOB statement in a set of job control statements.

Note 2: A LOG control statement is ignored if the printer is not assigned to SYSLOG.

Note 3: If the job for which the LOG statement is issued is the first job after IPL, or if NOLOG was specified during the previous job, the first LOG control statement in a set of control statements causes the printer to skip to a new page.

## NOLOG Control Statement

The NOLOG control statement is used to instruct the Job Control program to discontinue the listing of job control statements on SYSLOG. The NOLOG control statement is the last statement that is listed.

Note: When tape and/or BSCA error statistics are collected and a NOLOG control statement is in force, a programmed halt occurs. The operator can then decide whether or not error statistics are to be printed.

The NOLOG control statement has the following format:

| Name | Op.Code | Operands |
|---|---|---|
| // | NOLOG | |

Note: A NOLOG control statement may precede the JOB statement in a set of job control statements.

OPTN Control Statement

The OPTN control statement is used to initiate tape error statistics.

The OPTN control statement has the following format:

| Name | Op.Code | Operands |
|---|---|---|
| // | OPTN | TES |

TES
Tape error statistics are to be initiated.

Note 1: Error statistics will only be listed on the printer when a LOG statement is issued and the Job Control program is reloaded after execution of the problem program.

Note 2: Error statistics are not permitted with the following IBM-supplied programs:

- The language translators (Assembler and RPG) during generation time.
- The service programs (Linkage Editor, Load System Tape, Copy System Tape, Directory Service, Core-Image Maintenance, Macro Maintenance, Core-Image Service, and Macro Service).
- The Initialize Tape utility program.

The Job Control program will perform a check to prevent the initiation of error statistics with these programs.

PAUSE Control Statement

The PAUSE control statement is used to instruct the Job Control program to interrupt processing.

The PAUSE control statement has the following format:

| Name | Op.Code | Operands |
|---|---|---|
| // | PAUSE | |

Note: A PAUSE control statement may be placed before the JOB statement and/or between the JOB statement and the EXEC statement in a set of job control statements. A PAUSE control statement issued before the JOB statement causes an immediate system halt. A PAUSE control statement issued between the JOB statement and the EXEC statement causes a system halt after the reading of the set of control statements has been completed (i.e., immediately before the loading of the associated program). In either case, processing can be resumed by pressing the Start key on the CPU console.

TPLAB Control Statement

The TPLAB control statement is used to supply file label information for label processing.

The TPLAB control statement has the following format:

| Name | Op.Code | Operands |
|---|---|---|
| // | TPLAB | 'label-information' |

'label-information'
This operand consists of fields 3 through 10 of the standard IBM tape file label, enclosed in apostrophes. (The format of this label is described in Appendix B of the SRL publication IBM System/360 Model 20, Tape Programming System, Control and Service Programs, Form C24-9000.) The file-label fields must be contiguous in the operand of the TPLAB statement. They are not separated by commas. The operand requires 51 columns (49 columns of information, enclosed in apostrophes).

Note: The TPLAB control statement must immediately follow the associated VOL control statement.

UPSI Control Statement

The UPSI control statement is used to set user program switch indicators in the UPSI byte of the communication region.

The UPSI control statement has the following format:

| Name | Op.Code | Operands |
|---|---|---|
| // | UPSI | xxxxxxxx |

xxxxxxxx
In this operand, x can be either 1 or any other EBCDIC character (c) except

blank. The eight characters represent the eight bits of the UPSI byte. A specification of 1 means that the corresponding bit is to be set on. A specification of c (any EBCDIC character except 1 or blank) indicates that the status of the corresponding bit is not to be changed. Trailing c's need not be specified (e.g., the specifications 1cc11ccc and 1cc11 are equivalent).

VOL Control Statement

The VOL control statement is required when standard IBM tape labels are to be checked or written.

The VOL control statement has the following format:

| Name | Op.Code | Operands |
|---|---|---|
| // | VOL | SYSxxx,file-name |

SYSxxx
This operand specifies the symbolic address of the magnetic tape drive on which the reel containing the file to be processed is mounted. (For a list of symbolic addresses, see the description of the ASSGN statement.)

file-name
This operand specifies the name of the file to be processed. This name may be 1 to 7 characters in length. It must be identical to the file name used in the pertinent program.

On a Model 20 Submodel 5, the micro program in main storage may be destroyed when any of the following conditions occurs:

1. Process Check -- the system halts and the Process indicator on the CPU is turned on.
2. Machine Check on the 2520 or 2560 -- the system halts and the Machine Check indicator on the affected unit is turned on.
3. Unrecoverable I/O error -- the system halts and a programmed-halt code is displayed in the E-S-T-R fields of the CPU console. All programmed-halt codes are listed in the section Programmed-Halt Displays.

If a halt caused by any of these three conditions occur on a Model 20 Submodel 5 and operation cannot be resumed, the micro program must be reloaded. This is done by performing the following steps:

1. Press the I/O Check-Reset key on the CPU and reset all check lights on the attached I/O devices.
2. Set the Register Data/Address switches on the CPU console.
3. Set the Mode switch on the CPU to CPL.
4. Place the micro-program card deck (supplied by the IBM customer engineer) in the hopper of the loading unit of the 2501 or 2520 or in the primary feed of the 2560.
5. Press the Load key on the CPU console.

If the micro program has been successfully loaded, the U-L and E-S-T-R fields on the CPU console will contain all zeros. If an error occurred during the loading process, a code will be displayed in the U-I fields on the CPU console. The code displays that can be handled without the aid of an IBM customer engineer are listed below.

| Code Displayed U L | Cause | Restart |
|---|---|---|
| 0 0 | Successful load. | Set Mode switch on CPU to PROCESS |
| 0 1 | Read error and/or feed check. | Restart the micro program load procedure. |
| 0 2 | Card missing or out of sequence. | Check the card sequence in columns 73-80. (If the sequence error was caused by a break in the numeric sequence, a card is out of sequence; if it was caused by a break in the alphabetic sequence, a section is out of sequence) Correct the sequence error and restart the load procedure. If a card is missing, call the IBM customer engineer. |
| 0 3 | Section out of sequence. | |

# APPENDIX C. GLOSSARY

Allocate: To assign storage locations or areas of storage for specific routines, portions of routines, constants, data, etc.

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

Assembler: A program that prepares an object language program by producing absolute or relocatable machine code from a machine-oriented source program of statements containing symbolic operation codes and symbolic operands.

Assembler Language: A symbolic language (used to write source programs) which enables the programmer to use all machine functions as if he were coding in machine language.

b: The symbol for a blank space.

Base Address: A given address from which an effective address is derived by combination with a relative address. (See Displacement)

Basic Monitor: The main control program. Available in a card, a tape, and a disk version. Resident in main storage when control required. Loads programs into main storage and causes their execution.

Binary Digit: The smallest unit of information. It can have either of the two binary values zero or one.

Bit: See Binary Digit.

Block (records):
1. (v.t.) To group records for the purpose of conserving storage space or increasing the efficiency of access or processing.
2. (n.) A physical record so constituted, or a portion of a telecommunications message defined to be a unit of data transmission.

BSCA: Binary Synchronous Communications Adapter.

Buffer (Program Input/Output): A portion of main storage into which data is read, or from which it is written.

Byte: The basic unit of information in System/360. Every byte consists of eight bits, each having a value of zero or one.

Card-Resident System: Consists of the card control programs Basic Monitor, Job Control, and Initial Program Loader. Used for the execution of object programs contained in punched cards.

Character: One of a set of elementary signals which may include decimal digits 0 through 9, the letters A through Z, punctuation marks and any other symbols acceptable to a computer for reading, writing, or storing.

Checkpoint: A point in a program about which sufficient information is stored to permit restarting the problem from that point.

CMAINT: Core-Image Maintenance Program.

Communication Region: An area of the (Basic) Monitor. Contains data, storage-capacity specification, UPSI byte, user areas 1 and 2, program-name area, and various control bits used by the system. Provides for inter-program and intra-program communication.

Compiler: A program which translates a program written in a problem-oriented (RPG, PL/I, etc.) language into object code.

Control Field: A group of contiguous bytes that are within a data record. The sort or merge of the records is based on the collating sequence as applied to these bytes.

Control Statement: Any of the statements in the input to a specific job that define the requirements of the job, its options, or control its actions.

Control Program: A set of programs which provide the management functions necessary for continuous operation of a computing system.

Copy System Tape Program: A TPS Service program contained in punched cards. Copies user's tape-resident system from one tape onto another.

Core-Image Directory: A directory to the program (core-image) library. Each directory entry contains information about a program phase and its location in the library.

Core-Image Library: An external-storage area containing the Job Control program, other IBM-supplied programs (except the [Basic] Monitor), and user problem

programs. Permits retrieval of programs and/or phases by the (Basic) Monitor.

Core-Image Maintenance Program: A System Service program. Updates the core-image library and directory. Is used to add and/or replace and/or delete phases and the (Basic) Monitor.

Core-Image Service Program: A system service program that permits the printing and/or punching of one or more entries of the core-image library.

CPSYS: Copy System Tape Program.

CSERV: Core-Image Service Program.

Data File: A collection of related records treated as a unit and consisting of data in one of several prescribed arrangements and described by control information to which the system has access.

Default Value: The operand specification assumed by a program when the value is omitted.

Directory Entry: A unit in the core-image or macro directory. (Phase header or macro identifier.)

Directory Service Program: A System Service program. Causes printing of the core-image and/or macro directory and/or system directory.

Displacement: A value, or an expression representing a value, which is added to a base address to obtain the effective address.

Display Service Program: See Directory Service Program.

DSERV: Directory Service Program.

EBCDIC: (Extended Binary Coded Decimal Interchange Code) A specific set of eight-bit codes standard throughout System/360.

ECF Card: End-of-file card which terminates a logical set of input data. (/*b in columns 1-3.)

File: See Data File.

Fixed-Length Record: A record having the same length as all other records with which it is logically or physically associated.

Halfword: Two adjacent bytes where the left byte is on a halfword boundary.

Halfword Boundary: Even-numbered byte position in main storage, coincident with the left byte of a halfword.

Hexadecimal: A number system using the equivalent of the decimal number 16 as a base. The values 0-15 are represented by the digits 0-9 and the alphabetic characters A-F.

Initialize: To set counters, switches, and addresses to zero or other starting values at the beginning of, or at prescribed points in, a computer routine.

Initial Program Loader (IPL): A System Control program. Loads (Basic) Monitor into main storage. Required for the initialization of the system.

I/O (Input/Output): Input or output, or both.

I/O Area: An area (portion) of main storage into which data is read or from which data is written. I/O means Input/Output.

IPL: Initial Program Loader.

Job Control Program: A System Control program. Called into main storage between jobs and provides for automatic job-to-job transition. Processes control statements in the input stream that identify a job or define its requirements and options.

Job Control Statement: Any one of the control statements in the input stream that identifies a job or defines its requirements and options.

K Bytes: 1024 bytes. For example: nK = n x 1024 bytes.

Label: A physical identification record on magnetic tape or disk. See Tape Labels.

LDSYS: Load System Program.

Library Management Programs: Collective term for five system Service programs: Core-Image Maintenance, Macro Maintenance, Core-Image Service, Macro Service, and Directory Service.

Linkage Editor: A system Service program. Relocates programs or phases and links separately assembled programs or phases.

Load System Program: A Service program that creates a tape or disk-resident system from card input.

Logical Record: A record identified from the standpoint of its content, function, and use rather than its physical attributes. It is meaningful with respect to the information it contains. (Contrasted with Physical Record.)

Logical Unit Table: A feature of the (Basic) Monitor. It has logical unit blocks, each of which refers to one specific symbolic I/O address. These symbolic addresses are related to physical I/O device addresses by means of ASSGN control statements.

Macro Directory: An area of the macro library section of a system. The TPS version has four priority sections, each of which contains the identifiers for the macro definitions contained in the corresponding section of the macro library. Is used with programs written in the Assembler language. Macro directory can be listed on a printer by means of the Directory Service program.

Macro Identifier: An entry in the macro directory that identifies and points to the corresponding macro definition in the macro library.

Macro Instruction: A macro instruction is a statement that is used in a source program and replaced by a specific sequence of machine instructions in the associated object program.

Macro Library (Tape): An area of the macro library section of the system tape. Has four priority sections, each of which contains the macro definitions required by the macro instructions in user programs.

Macro Maintenance Program: A system Service program. Updates the macro library and directory. Is used to add and/or delete macro definitions.

Macro Service Program: A system service program that permits the printing and/or punching of one or more macro definitions from the macro library.

MMAINT: Macro Maintenance Program.

Mnemonic: A contraction or abbreviation whose characters are suggestive of the full expression.

MSERV: Macro Service Program.

Multi-Reel Tape File: A file stored on more than one tape reel.

Multi-Volume Tape File: See Multi-Reel Tape File.

Operand: The representation of a value that must be supplied to define a selective function to the program.

Phase: A portion of a program executed as one main-storage load. The smallest addressable unit in the core-image library of a tape or disk-resident system. May be output of Assembler, RPG or Linkage Editor program.

Physical Record: A record identified from the standpoint of the manner or form in which it is stored and retrieved; that is, one that is meaningful with respect to access. (Contrasted with Logical Record.)

Physical Unit Table: A feature of the (Basic) Monitor. It has several physical unit blocks, each of which contains a physical device address. Pointers to these entries are inserted into the logical unit table by means of ASSGN control statements.

Priority Level: Classifies macro definitions by frequency of usage in TPS. Four levels are used in the macro library section of the tape resident system.

Priority Section: An area of the TPS macro directory or library. Each priority section is assigned to a specific priority level.

Read/Compute, Write/Compute: A feature of the IBM System/360 Model 20 Submodel 5 that permits data transfer to or from I/O units to be overlapped with processing.

Reblock: To change the format of a file so that a different number of logical records comprises one physical record. See Block.

Record: A general term for any unit of data that is distinct from all others when considered in a particular context.

Report Program Generator (RPG): A program which constructs reports or report-writing programs in accordance with input specifications of the data file and of the desired report.

RWC Feature: See Read/Compute, Write/Compute.

Statement: A meaningful expression or generalized instruction in a source language.

Subphase: A part of a program in the core-image library. Must be provided with a phase name that is identical in the first four characters with the name of the main phase.

Symbolic I/O Address: A symbol used in IBM-supplied and user-written programs to refer to an I/O device (e.g., SYSRES, SYSIPT, SYS005). This address is related to an actual address by means of the logical unit table.

SYSIPT: System Input Unit.

SYSOPT: System Cutput Unit.

System Tape: The reel of magnetic tape on which the user's tape-resident system is located.

Tape Error Statistics: An optional function of the (Basic) Monitor that collects and lists tape operating characteristics.

Tape Labels: Special records at the beginning and end of tape files. There are volume, header, and trailer labels. They are used to identify the reel of tape and the file they precede. They also contain certain housekeeping information.

Tape Mark: A special symbol that can be read from, or written on, magnetic tape. Used to indicate the end of a file or file segment, and to segregate the labels from data.

Tape-Resident System: (Also referred to as "user's tape-resident system.") Contains the Basic Monitor program, the Job Control program, and may contain any IBM-supplied and/or user-written programs and/or macro definitions. Consists of three sections: Monitor section, program library section, and macro library section. Is created and updated by means of maintenance programs.

Unblock: (v.t.) To change the format of a file so that a physical record comprises only one logical record. See Block.

UPSI: User Program Switch Indicators.

User Program Switch Indicators: A field of one byte within the communication region of the (Basic) Monitor program. Specified bits (switches) may be set by means of the UPSI control statement and tested in user's programs.

Variable-Length Records: Logical records in a file in which the number of bytes in each record is not a fixed value, but may vary within prescribed limits.

INDEX


ACTION statement . . . . . 30
AOPTN statement. . . . . 26
Assembler program . . . . . 26
  control statements . . . . . 26
  end-of-file card . . . . . 27
  function . . . . . 6
  I/O device assignments . . . . . 26
  input. . . . . 27
  messages . . . . . 28
  operator intervention. . . . . 28
  output . . . . . 29
  preparation of system run. . . . . 27
  programmed halts . . . . . 28
  sample program . . . . . 71
ASSGN control statement. . . . . 161
Assignment of SYSRDR . . . . . 161
  card-resident system . . . . . 8
  tape-resident system . . . . . 13
Assignment of SYSRES . . . . . 13,161

Basic Assembler (tape versions). . . . . 5
Basic Monitor program, function. . . . . 6
Bootstrap card . . . . . 42
BSCA
  error statistics . . . . . 164
  sample program . . . . . 95,100
Building system tapes
  example of tape handling . . . . . 51
  LDSYS run. . . . . 47
  MMAINT run . . . . . 49

Card Basic Monitor program . . . . . 8
Card Initial Program Loader. . . . . 8
Card Job Control program . . . . . 10
Card-resident system . . . . . 8
  assignment of SYSRDR . . . . . 8
  Clear Storage card . . . . . 8
  executing object programs. . . . . 8
  input. . . . . 8,12
  loading unit . . . . . 8
  output . . . . . 11
  preparation of system run. . . . . 11
  sample program . . . . . 71
  1419/1259 IOCS . . . . . 19
CATAL statement
  Core-Image Maintenance program . . . 59
  Macro Maintenance program. . . . . 56
Checkpoint and restart procedures
  (Sort/Merge program) . . . . . 37
Clear Storage card
  card-resident system . . . . . 8
  tape-resident system . . . . . 13
CMAINT (see also Core-Image Maintenance
  program). . . . . 59
CONFG control statement. . . . . 162
Control programs (card and tape) . . . . 5
Control statements
  for Assembler program. . . . . 26
  for Copy System Tape program . . . . 54
  for Core-Image Maintenance program . 59
  for Core-Image Service program . . . 63
  for Directory Service program. . . . 62
  for Linkage Editor program . . . . . 30
  for Load System Tape program . . . . 47
  for Macro Maintenance program. . . . 56
  for Report Program Generator . . . . 21
  for Sort/Merge program . . . . . 34
  for Utility programs . . . . . 38
Copy System Tape program . . . . . 54
  control statements . . . . . 54
  I/O device assignments . . . . . 54
  input. . . . . 54
  output . . . . . 55
  preparation of system run. . . . . 54
  programmed halts . . . . . 55
Copying a system tape. . . . . 54
Core-Image Maintenance program . . . . . 59
  control statements . . . . . 59
  I/O device assignments . . . . . 59
  input. . . . . 54
  output . . . . . 60
  preparation of system. . . . . 60
  programmed halts . . . . . 60
  sample program . . . . . 71
Core-Image Service program . . . . . 63
  control statements . . . . . 63
  I/O device assignments . . . . . 63
  input. . . . . 63
  messages . . . . . 64
  output . . . . . 64
  preparation of system run. . . . . 64
  programmed halts . . . . . 64
CPSYS (see also Copy System Tape
  program). . . . . 54
Creating the macro library . . . . . 49
CSERV (see also Core-Image Service
  program). . . . . 63

DATE control statement . . . . . 162
DELET statement
  Core-Image maintenance Program . . . 60
  Macro Maintenance program. . . . . 56
Device-dependent halts . . . . . 105
Device-type specifications . . . . . 162
Directory Service program . . . . . 62
  control statements . . . . . 62
  I/O device assignments . . . . . 62
  input. . . . . 62
  output . . . . . 62
  preparation of system run. . . . . 62
Displacement of logical unit blocks. . 106
Displaying directories . . . . . 62
Distribution tape . . . . . 42
  contents . . . . . 43
Distribution-Package Retrieval program . 42
  machine req. . . . . 42
  operating proc.. . . . . 44
  output . . . . . 46
  program package. . . . . 42
DSERV (see also Directory Service
  program). . . . . 62

DSPCH statement . . . . . 66
DSPLY statement
  Core-Image Service program . . . . . 63
  Directory Service program. . . . . 62
  Macro Service program. . . . . 66

END statement
  Core-Image Maintenance program . . . 60
  Core-Image Service program . . . . . 64
  Directory Service program. . . . . 62
  Load System Tape program . . . . 47,48
  Macro Maintenance program. . . . . 57
  Macro Service program. . . . . 66
  Sort/Merge program . . . . . 34
  Utility programs . . . . . 39
End-of-file card
  Assembler program. . . . . 27
  Core-Image Maintenance program . . . 59
  Report Program Generator . . . . . 24
  tape-resident system run . . . . . 13
  Utility programs . . . . . 40
ENTRY statement. . . . . 30
Error statistics
  BSCA . . . . . 164
  restrictions . . . . . 16
  tape . . . . . 16,165
EXEC control statement . . . . . 163
Execute-Loader function. . . . . 16
Executing object programs
  card-resident system . . . . . 8
  sample . . . . . 71
  tape-resident system . . . . . 18
  using 1419/1259 IOCS . . . . . 19

Field-Select statement . . . . . 39
FILES control statement. . . . . 163
Format of job control statements . . . 160

Glossary . . . . . 168

Halts, see Programmed-halt displays
Header records on distribution tape. . . 42

I/O device assignments
  for Assembler program. . . . . 26
  for Copy System Tape program . . . . 54
  for Core-Image Maintenance prog. . . 59
  for Core-Image Service program . . . 63
  for Directory Service program. . . . 62
  for Linkage Editor program . . . . . 30
  for Load System Tape program . . . . 68
  for Macro Maintenance program. . . . 56
  for Report Program Generator . . . . 20
  for Sort/Merge program . . . . . 33
  for Utility programs . . . . . 38
IBM-supplied programs
  description. . . . . 5
  identification . . . . . 46
  names. . . . . 46
  retrieval. . . . . 42
  summary. . . . . 46
Identification of IBM-supplied programs. 46
Initial Program Loader (IPL) . . . . . 6

INITTP statement . . . . . 39
INPFIL statement . . . . . 34
Input
  Assembler program. . . . . 28
  card-resident system . . . . . 8,12
  Copy System Tape program . . . . . 54
  Core-Image Maintenance program . . . 61
  Core-Image Service program . . . . . 64
  Directory Service program. . . . . 62
  Linkage Editor program . . . . . 31
  Load System Tape program . . . . . 70
  Macro Maintenance program. . . . . 56
  Macro Service program. . . . . 67
  Report Program Generator . . . . . 24
  Sort/Merge program . . . . . 35
  tape-resident system . . . . . 17
  Utility programs . . . . . 39
IPL (see also Initial Program Loader). . 6

Job Control program, function. . . . . 6
JOB control statement. . . . . 164
Job control statements
  card Job Control program . . . . . 10
  general format . . . . . 160
  order of input . . . . . 161
  summary. . . . . 160
  tape Job Control program . . . . . 14

LDSYS (see also Load System Tape
  program). . . . . 47,68
Linkage Editor program . . . . . 30
  control statements . . . . . 30
  function . . . . . 6
  I/O device assignments . . . . . 30
  output . . . . . 31
  preparation of system run. . . . . 31
  programmed halts . . . . . 31
LNKEDT (see also Linkage Editor program) 30
Load System Tape program . . . . . 47
  building additional tapes. . . . . 68
  building initial tapes . . . . . 47
LOADC statement. . . . . 68
Loading unit
  card-resident system . . . . . 8
  tape-resident system . . . . . 13
LOG control statement. . . . . 164
Logical unit block displacement. . . . 106
Logical unit table . . . . . 106
  card Basic Monitor . . . . . 8
  tape Basic Monitor . . . . . 14

Macro library, sample program. . . . . 71
Macro Maintenance program . . . . . 49,56
  control statements . . . . . 56
  I/O device assignments . . . . . 56
  input. . . . . 56
  messages . . . . . 57
  output . . . . . 57
  preparation of system run. . . . . 57
  programmed halts . . . . . 57
Macro Service program . . . . . 66
  control statements . . . . . 66
  I/O device assignments . . . . . 66
  input. . . . . 67
  messages . . . . . 67

output . . . . . 67
preparation of system run. . . . . 67
programmed halts . . . . . 67
MERGE statement. . . . . 34,34
Micro program load procedures. . . . . 167
MMAINT (see also Macro Maintenance program). . . . . 49,56
MODS statement . . . . . 34
MONTR statement
Core-Image Maintenance program . . . 59
Core-Image Service program . . . . . 63
Load System Tape program . . . . . 68
MSERV (see also Macro Service program) . 66

Names of IBM-supplied programs . . . . . 46
NOLOG control statement. . . . . 164
Non-programmed halts . . . . . 106
RPG. . . . . 25
Sort/Merge program . . . . . 36

OPTION statement . . . . . 34
OPTN control statement . . . . . 165
OUTFIL statement . . . . . 34
Output
Assembler program. . . . . 29
card-resident system . . . . . 11
Copy System Tape program . . . . . 55
Core-Image Maintenance program . . . 60
Core-Image Service program . . . . . 64
Directory Service program. . . . . 62
Distribution-Package Retrieval prgrm 46
Linkage Editor program . . . . . 31
Macro Maintenance program. . . . . 57
Macro Service program. . . . . 67
Report Program Generator . . . . . 25
Sort/Merge program . . . . . 37
tape-resident system . . . . . 18
Utility programs . . . . . 41

PAUSE control statement. . . . . 165
PHASE statement. . . . . 30
Preparation of system run
Assembler program. . . . . 27
card-resident system . . . . . 11
Copy System Tape program . . . . . 54
Core-Image Maintenance prgrm . . . . 60
Core-Image Service program . . . . . 64
Directory Service program. . . . . 62
Linkage Editor program . . . . . 31
Load System Tape program . . . . . 69
Macro Maintenance program. . . . . 57
Macro Service program. . . . . 67
Report Program Generator . . . . . 23
Sort/Merge program . . . . . 35
tape-resident system . . . . . 17
Utility programs . . . . . 39
Print-Header statement . . . . . 39
PRIOR statement. . . . . 56
Program-dependent halts. . . . . 105
Programmed-halt displays . . . . . 105,126
PUNCH statement
Core-Image Service program . . . . . 63
Macro Service program. . . . . 66

RECORD statement . . . . . 34
REP cards
card Basic Monitor . . . . . 8
tape Basic Monitor . . . . . 13
Report Program Generator . . . . . 20
control card . . . . . 21
control statements . . . . . 21
end-of-file card . . . . . 24
function . . . . . 6
I/O device assignments . . . . . 20
input. . . . . 23
messages . . . . . 25
output . . . . . 25
preparation of system run. . . . . 23
programmed halts . . . . . 25
sample program . . . . . 80
user routines. . . . . 23
Restart procedures . . . . . 105,110
Retrieval program. . . . . 42
RPG (see also Report Program Generator). 20
RPG control card . . . . . 21

Sample program
Assembler program. . . . . 71
BSCA . . . . . 95,100
card-resident system . . . . . 71
Core-Image Maintenance program . . . 71
Report Program Generator . . . . . 80
Sort/Merge program . . . . . 87
tape-resident system . . . . . 71
use of macro library . . . . . 71
Utility programs . . . . . 87
1419 IOCS. . . . . 93
Sample Program, 1419 IOCS. . . . . 93
Service programs, summary. . . . . 6
SORT statement . . . . . 34
Sort/Merge program . . . . . 33
checkpoint and restart procedure . . 37
control statements . . . . . 34
function . . . . . 7
I/O device assignments . . . . . 33
messages . . . . . 37
multi-volume I/O files . . . . . 35
output . . . . . 37
preparation of system run. . . . . 35
programmed halts . . . . . 36
sample program . . . . . 87
user routines. . . . . 34
Standard assignments
card Basic Monitor . . . . . 8
tape Basic Monitor . . . . . 14
Summary
device-type specifications . . . . 162
IBM-supplied programs. . . . . 46
job control statements . . . . . 160
Service programs . . . . . 6
symbolic I/O device addresses. . . 161
tape-characteristics specifications 162
1259 halts and error displays. . . 108
1419 halts and error displays. . . 107
Symbolic I/O device addresses . . . . 162
card Basic Monitor . . . . . 8
summary. . . . . 161
tape Basic Monitor . . . . . 14
SYSRDR
card-resident system . . . . . 8
tape-resident system . . . . . 13

SYSRES . . . . . 13
System tapes
building additional tapes. . . . . 68
copying. . . . . 54
creating the initial tape. . . . . 47
creation and maintenance . . . . . 42
inserting macros . . . . . 49
updating the macro library . . . . . 56
updating the program library . . . . 59

Tape Basic Monitor program . . . . . 14
Tape error statistics
description. . . . . 16
initiation . . . . . 15,165
listing. . . . . 164
restrictions . . . . . 16
Tape Initial Program Loader. . . . . 13
Tape Job Control program . . . . . 14
Tape-characteristics specifications. . 162
Tape-resident system . . . . . 13
assignment of SYSRDR . . . . . 13
assignment of SYSRES . . . . . 13
Clear Storage card . . . . . 13
executing object programs. . . . . 18
initiating a system run. . . . . 13
input. . . . . 17
loading unit . . . . . 13
output . . . . . 18
preparation of system run. . . . . 17
sample program . . . . . 71
1419/1259 IOCS . . . . . 19
TPLAB control statement. . . . . 165

Updating the macro library . . . . . 56
Updating the program library . . . . . 59
Updating TPS programs from IBM-supplied
program modific . . . . . 52
UPSI control statement . . . . . 165
User routines
with RPG . . . . . 23
with Sort/Merge program. . . . . 39
with Utility programs. . . . . 39
Utility programs . . . . . 38
control statements . . . . . 38
function . . . . . 7
I/O device assignments . . . . . 38
input. . . . . 39
messages . . . . . 41
output . . . . . 41
preparation of system run. . . . . 39
programmed halts . . . . . 41
sample program . . . . . 87
user routines. . . . . 39
Utility-Modifier statement . . . . . 39

VOL control statement. . . . . 166
VOLx statement . . . . . 39

1419 IOCS, sample program. . . . . 93
1419/1259 Halts and error displays . . 107
1419/1259 IOCS . . . . . 19

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