Honeywell

LEVEL 6

SOFTWARE

GCOS 6 SORT/MERGE

SERIES 60 (LEVEL 6)

GCOS 6
SORT/MERGE

SUBJECT

Detailed Description of Series 60 (Level 6) GCOS 6 Sort/Merge

SOFTWARE SUPPORTED

This publication supports Release 0100 of the Series 60 (Level 6) GCOS 6 MOD 400 Operating System; see the Manual Directory of the latest *GCOS 6 MOD 400 System Concepts* manual (Order No. CB20) for information as to later releases supported by this manual.

This manual includes update pages issued as Addendum A in June 1978.

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Preface

This manual describes the GCOS 6 Sort/Merge. Unless stated otherwise, the term GCOS refers to the GCOS 6 software; the term Level 6 refers to the Series 60 (Level 6) hardware on which the software executes.

Section 1 summarizes the capabilities of the Sort and Merge programs.

Section 2 describes the Sort language, including the invoking SORT command and the Sort Description that particularizes the sort application.

Section 3 describes the Sort Report and error messages generated during execution of the Sort program.

Section 4 describes the Merge language.

Section 5 describes the Merge Report and error messages.

Section 6 describes the operating procedures for invoking Sort and Merge and submitting the Sort and Merge Descriptions. This section also includes sample sort and merge runs.

Section 7 explains sorting using subroutine calls.

Appendix A specifies Sort and Merge memory requirements.

Appendix B is the ASCII collating sequence.

Appendix C describes a debug mode.

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MANUAL DIRECTORY

The following publications comprise the GCOS 6 manual set. The Manual Directory in the latest *GCOS 6 MOD 400 Systems Concepts* manual (Order No. CB20) lists the current revision number and addenda (if any) for each manual in the set.

Order No.	*Manual Title*
CB01	*GCOS 6 Program Preparation*
CB02	*GCOS 6 Commands*
CB03	*GCOS 6 Communications Processing*
CB04	*GCOS 6 Sort/Merge*
CB05	*GCOS 6 Data File Organizations and Formats*
CB06	*GCOS 6 System Messages*
CB07	*GCOS 6 Assembly Language Reference*
CB08	*GCOS 6 System Service Macro Calls*
CB09	*GCOS 6 RPG Reference*
CB10	*GCOS 6 Intermediate COBOL Reference*
CB20	*GCOS 6 MOD 400 System Concepts*
CB21	*GCOS 6 MOD 400 Program Execution and Checkout*
CB22	*GCOS 6 MOD 400 Programmer's Guide*
CB23	*GCOS 6 MOD 400 System Building*
CB24	*GCOS 6 MOD 400 Operator's Guide*
CB25	*GCOS 6 MOD 400 FORTRAN Reference*
CB26	*GCOS 6 MOD 400 Entry-Level COBOL Reference*
CB27	*GCOS 6 MOD 400 Programmer's Pocket Guide*
CB28	*GCOS 6 MOD 400 Master Index*
CB30	*Remote Batch Facility User's Guide*
CB31	*Data Entry Facility User's Guide*
CB32	*Data Entry Facility Operator's Quick Reference Guide*
CB33	*Level 6/Level 6 File Transmission Facility User's Guide*
CB34	*Level 6/Level 62 File Transmission Facility User's Guide*
CB35	*Level 6/Level 64 (Native) File Transmission Facility User's Guide*
CB36	*Level 6/Level 66 File Transmission Facility User's Guide*
CB37	*Level 6/Series 200/2000 File Transmission Facility User's Guide*
CB38	*Level 6/BSC 2780/3780 File Transmission Facility User's Guide*
CB39	*Level 6/Level 64 (Emulator) File Transmission Facility User's Guide*
CB40	*IBM 2780/3780 Workstation Facility User's Guide*
CB41	*HASP Workstation Facility User's Guide*
CB42	*Level 66 Host Resident Facility User's Guide*
CB43	*Terminal Concentration Facility User's Guide*

In addition, the following documents provide general hardware information:

Order No.	*Manual Title*
AS22	*Honeywell Level 6 Minicomputer Handbook*
AT04	*Level 6 System and Peripherals Operation Manual*
AT97	*MLCP Programmer's Reference Manual*
FQ41	*Writable Control Store User's Guide*

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Section 1

Sort and Merge Capabilities

The Sort and Merge utility programs provide file sorting and file merging capabilities, respectively. Sort arranges records from an input file in an order based on the values of record key fields defined by the user, and places the ranked records in the specified output file. Merge combines the records of up to six sequentially ordered input files. Information supplied by the user defines the specific function to be performed. The general characteristics of Sort and Merge are summarized in this section.

Note:

A sorting function may also be invoked from COBOL, FORTRAN and assembly language programs (see Section 7).

SUMMARY OF FEATURES APPLICABLE TO BOTH SORT AND MERGE

Sort and Merge incorporate these features:

- Up to 16 key fields may be specified; they may be contiguous, separated, or overlapped. Keys may be specified as being in ascending or descending order according to the ASCII collating sequence.
- Key field data types may be any of the following:
  - — Character string.
  - — Single- or double-word signed binary.
  - — Unpacked decimal: unsigned or signed with the sign leading, trailing, or trailing overpunched.
  - — Packed decimal: unsigned or signed trailing.
- Record selection (i.e., the inclusion or exclusion of records as input to Sort or Merge) is based on record content only or on record content and a specified value.
- Compound record selection permits LOGICAL AND and/or INCLUSIVE OR relationships.
- Output records may be rearrangements of input record fields.
- Commands and statements may be entered through a terminal, card reader, or disk file.
- Input file(s) may have sequential, indexed, or relative organization. Output file must be on disk, and its organization must be sequential.
- The input and output files need not have the same record attributes.
- Records with duplicate keys may be deleted.
- A report comprising statistical information is directed to the console or a printer.

SUMMARY OF FEATURES APPLICABLE ONLY TO SORT

Sort incorporates the following features:

- Sort uses a disk work file; the work file may be permanent or temporary.
- The work file uses a minimal amount of disk file space; i.e., it is approximately 1.2 times the size required to support the output file.
- The input, output, and work files may reside on the same device.
- Records with duplicate key fields can be ordered on a first-in, first-out (FIFO) basis.
- The output record may consist of the input record address followed by the key fields or it may consist only of the input record address (i.e., the ADDROUT file).

SUMMARY OF FEATURES APPLICABLE ONLY TO MERGE

Merge incorporates the following features:

- Up to six sequentially ordered input files may be merged.
- A single input file may be used, thus providing a file restructuring capability.
- Input files need not have the same file or record attributes, except for the key and record selection fields.
- If duplicate records are found (i.e., they have the same key field), the records are written to the output file in the order in which the files containing them appear in the input file list; this is the Merge FIFO rule.

SYSTEM REQUIREMENTS

The minimum system requirements are:

- 8K words of memory for execution of Sort or Merge.
- One KSR-like device.
- Disk work file for Sort.
- Devices for supported input and output files.

GENERAL DESCRIPTION OF SORT AND MERGE

Sort and Merge are utility programs that execute under either an online task group or a batch task group in the operating system environment.

The command SORT or MERGE is submitted to the command processor to invoke Sort or Merge, respectively.

Sort and Merge Descriptions are submitted to the Sort and Merge programs respectively; they designate which files will be used by Sort/Merge and the keys on which sorting/merging are to be based.

RECORD KEYS

Sort arranges records from an input file according to the values of record key fields, and places the ranked records in the specified output file. Merge combines the records of up to six sequentially ordered input files. Up to 16 key fields within each record can be used in ranking the input records: 1 major key field and 15 minor key fields. Records are ordered first according to the major key; then all records containing the same major key are sorted/merged according to the minor keys in the sequence dictated by the Sort/Merge Description.

RECORD SELECTION

Records can be selected or omitted as input to Sort or Merge through record selection. Record selection may be based on the meeting of conditions defined by comparison operations between two fields within a record or between a field of a record and a specified value. The conditions for record selection are specified in INCL or OMIT statements, which are described later in this manual. A maximum of four conditions may be specified; they may be within a single statement or be interspersed among up to four statements.

RECORD ARRANGEMENT

The bytes of the input record(s) that will constitute the output records, and the order in which these bytes will occur can be specified for Sort and Merge. Up to 16 byte string descriptions may be specified.

KEY SORT OUTPUT

Sort output can consist of a field giving the input record address and be followed by the sort keys or it can consist only of the input record address.

REPORTS GENERATED BY SORT AND MERGE

Sort generates a Sort Report, containing statistical information on the sort operation; Merge generates a Merge Report containing statistical information on the Merge operation. The scope of the Sort or Merge Report is determined by the arguments specified in the invoking SORT or MERGE command.

FILES REQUIRED FOR SORT AND MERGE EXECUTION

Sort and Merge can accept records to be sorted or merged from the following input files that can be accessed sequentially: card files, labeled tape files, or disk files. Ranked output records are delivered to any previously created disk file that has a sequential or relative organization.

Sort requires a temporary or permanent disk work file. If the work file is temporary, it is created during execution of Sort and is deleted when execution of Sort terminates. If the work file is permanent, it must have been previously created on a single volume. (See "Preparing Files for Sort and Merge" in Section 6.)

Sort and Merge accept statements to specialize the application from a file designated in the invoking SORT or MERGE command, respectively, or by default, from the user-in file. During execution, Sort and Merge issue error messages to the error-out file and a Sort or Merge Report to the user-out file.

Section 2
Sort Language

The Sort program is invoked through specification of the SORT command. The SORT command provides information to specialize the Sort program for a particular execution, including identification of:

- The file containing the Sort Description.
- The amount of memory to be made available to Sort.
- An optional request for key sort output.

The SORT command is associated with a Sort Description, which contains additional information for specializing the Sort, including specification of:

- The input, output, and work files to be used by Sort.
- One or more key fields to be used in ranking records.
- The criteria to be used to determine which records of the input file will be sorted.
- The arrangement of the output record.

The SORT command and Sort Description are described in detail below, including format and language requirements and examples of usage. This section also presents examples of typical sort usage and related sort input streams.

SORT COMMAND

The SORT command invokes the Sort program. Any pathname specified in the SORT command can be either a full pathname or a relative pathname related to the current working directory. (Refer to the *System Concepts* manual for a description of the use of pathnames.)

The format of the SORT command is:

```
SORT [ctl_arg]
```

[ctl_arg]

Control arguments. Any or all of the following optional control arguments can be used:

-IN path

Specifies the name of the file containing the sort descriptors for this sort. If not specified, the user-in file is used.

$\left\{\begin{array}{l}\text{-SIZE n}\\ \text{-SZ n}\end{array}\right\}$

Indicates the number of 1024-word memory modules to be available to the sort. In a SAF system, the value of n can be from 8 to 56_{10}, inclusive. In a LAF system, n can be from 8 to 68_{10}, inclusive. An invalid value can cause an illegal memory error code to be displayed. If not specified, the default value is 8.

-PD

Indicates that a listing of the Sort Description is to be produced on the user-out file. (Only the first 71 characters of the line will be displayed.)

-FF

When duplicate records are encountered, order them on a first-in/first-out (FIFO) basis.

-DL

When duplicate records are encountered, delete all but one of them. If -FF has also been specified, all but the first occurrence of the duplicate will be deleted. If -FF has not been specified, the choice of which duplicate record is retained is arbitrary.

-AK

The output record will begin with a 4-byte input record address, followed by the sort keys, in the order in which they were specified.[1] If the output file is a BES file with a record size comprising more bytes than 4 plus the number of bytes in the sort keys, the remaining bytes are not specified.

-AD

The output record will be a 4-byte input record address. [1] If the output file is a BES file comprising more than four bytes, the remaining bytes are not specified.

Note:

Either -AK or -AD may be specified, but not both.

Example 1:

The SORT command and Sort Description are to be submitted in the command-in file. The sort program itself will be found according to your search rules (see command LIST SEARCH RULES (LSR) in the *Commands* manual). The amount of memory requested for Sort execution is 8K words. The invoking command is:

```
SORT
```

Example 2:

The Sort program is stored on volume MYAPPL; the Sort Description is in the file identified by the relative pathname SD1 related to the current working directory. The Sort Description is to be printed in the Sort Report. The amount of memory to be allocated to support Sort execution is 20K words. The invoking SORT command is:

```
^MYAPPL>SORT -IN SD1 -SZ 20 -PD
```

SORT DESCRIPTION

The Sort Description consists of the following statements, which supply information to specialize the Sort for a particular application:

- FILES statement: (Required) Specifies the input, output, and work files for the Sort application.
- INCL/OMIT statement(s): (Optional) Specify which records of the Sort input file will be processed.
- KEYS statement: (Required) Describes the key fields to be used for sorting records.
- ARRange statement: (Optional) Designates the placement of input record byte strings within the output record.

The Sort Description is required. The FILES statement must be first. If INCL or OMIT statement(s) are used, they must precede the KEYS and optional ARRange statements.

General language requirements for the Sort Description are given below, followed by format descriptions for each statement.

SYNTAX OF SORT DESCRIPTION

A Sort Description consists of a sequence of words organized into statements. Each statement must begin with a function keyword followed by a delimiting colon (for example, FILES: or KEYS:), and end with a semicolon. The body of each statement consists of one or more words. A statement can begin at any location on a line and may extend over more than one line. No limit exists on the number of statements (or portions of statements) per line.

In the Sort language, a *word* is any string of nondelimiter characters preceded by and terminated by a space, comma, horizontal tab, parenthesis, new line, or delimiter (a colon or semicolon). In addition, the delimiters (colon and semicolon) are themselves regarded as words. A pathname is considered to be one word, whether it is a full or relative pathname. A word in the

[1] This feature is supported only if the input file is relative or sequential. If the input file is relative, the address is a 4-byte relative record number. Otherwise, the address is a data management-defined simple key (see the "Keys" section in the *Data File Organizations and Formats* manual).

Sort Description cannot be divided between two lines or records (i.e., it cannot be started on one line or record and completed on the next line or record). Words of the Sort Description to be processed must be contained in the first 80 characters of a line.

Parentheses can be used to enclose any word or words in the statement to enhance readability.

Note:

In the statement format descriptions given below, where words are separated by a space, the space may be replaced with a comma.

NOTATIONAL SYMBOLS IN SORT DESCRIPTION

The following notational conventions are used in the format descriptions of statements:

Convention	**Meaning**
UPPERCASE CHARACTERS	Required word; must be used in the form specified.
lowercase characters	Symbolic name; must be replaced by user-supplied word or words.
Brackets [ ]	The item enclosed in the brackets is optional.
Braces { }	An enclosed entry must be selected.
Ellipses . . .	The immediately preceding portion of the format may be repeated one or more times.

COMMENTS IN SORT DESCRIPTION

Any string of characters that is preceded by and terminated by a slash (/) will be treated as a comment in the Sort Description. Comments cannot be inserted within a word of the Sort Description. If an incomplete comment is detected, an error message is issued and the Sort is terminated.

FILES STATEMENT (FOR SORT)

The FILES statement specifies the files to be processed by Sort. The pathnames specified in the FILES statement can be full pathnames or relative pathnames related to the current working directory.

The format of the FILES statement is:

```
FILES:-IF path,-OF  path[,-WF  path];
```

-IF path

Specifies the pathname of the file containing input records to be sorted. Required argument.

-OF path

Specifies the pathname of the output file. The output file must be a disk file created prior to execution of the Sort. Required argument.

-WF path

Defines the file to be used as a permanent work file by Sort. The work file must be a disk file created before Sort is executed. If this argument is not specified, Sort creates a temporary work file within the current working directory; the file is deleted when Sort terminates. Unless the file to be sorted is small, for performance reasons a permanent work file is recommended.
Optional argument.

Example 1:

The file INFILE contains records to be sorted; the file OUTREC is the file on which sorted records are to be written. These two files are on the same volume and are identified by relative pathnames related to the current working directory. The work file used by Sort is WORK2, which resides on the volume SRTWK. The FILES statement is:

```
FILES:-IF INFILE,-OF OUTREC,-WF  ^SRTWK>WORK2;
```

Example 2:

The single file ITSV23, containing input records, resides on the tape volume SRTI64; the tape is mounted on unit number 00. The output file OUTLIB resides on the disk volume Z10054. The Sort work file SWK01 is on the volume Z10193. The FILES statement is:

```
FILES: -IF  >SFD>MT900>SRT164>ITSV23
-OF  ^Z10054>OUTLIB,-WF  ^Z10193>SWK01;
```

INCL AND OMIT STATEMENTS (FOR SORT)

The INCL and OMIT statements cause input file records to be processed by Sort only if they meet certain condition(s). You can designate the criteria to be used by Sort for determining which record(s) *will* or *will not* be processed by specifying the INCL or OMIT statement, respectively. If INCL or OMIT is not specified, all input file records are processed.

Depending on which arguments are entered, two fields within a record are compared or a field is compared to a specified value. Within a single execution of Sort, either one to four INCL statements or one to four OMIT statements may be specified. Within a single sort, a maximum of four conditions may be specified; they may be within a single statement or be interspersed among up to four statements.

The order in which INCL or OMIT statements are specified determines the order in which records are tested. If a record meets all of the conditions specified in a single statement, it is not tested against the condition(s) specified in any subsequent statements. If the condition(s) are met, the specified record is processed (if INCL was used) or not processed (if OMIT) was used.

The format of the INCL and OMIT statements is:

$\left\{\begin{matrix}\text{INCL}\\ \text{OMIT}\end{matrix}\right\}$:criteria_description [AND criteria_description . . .];

The format of the criteria description is determined by the type of comparison being specified:

Comparing two fields within a record:

data_type(size),position$_1$,operator,position$_2$

Comparing a field to a specified value:

data_type(size),position$_1$, operator,'literal'

data_type

Data type of the key field is specified by a predefined code. See Table 2-1 later in this section for data types that can be used, and the code associated with each type. Required argument.

size

Size of the key field expressed as a decimal integer. The size is the number of data type units that constitute the field, excluding the unit that contains a separate sign. The units may be bit, four-bit, or byte elements. Any word separators, including parentheses, can be used with the integer representing size. (In the above format, parentheses have been inserted for readability.) Required argument.

position$_1$

Position of the beginning byte of the key field to which another key field or a literal value is being compared; the position is relative to the beginning of the record. Expressed as a decimal integer. The record is considered to be aligned on a byte boundary, with the first byte of the record being numbered 1. Required argument.

operator

Type of comparison that will be made between two specified fields or a specified field and a specified value; must be one of the following:

EQ - Equals
NE - Is not equal to
LT - Is less than

LE - Is less than or equal to
GT - Is greater than
GE - Is greater than or equal to

Required argument.

position $_2$

Position of the beginning byte of the key field that is being compared to the key field designated in position $_1$. The position is relative to the beginning of the record and is expressed as a decimal integer. The record is considered to be aligned on a byte boundary, with the first byte of the record being numbered 1. Optional argument.

literal

Alphanumeric character string constituting the value to which the key field designated in position $_1$ will be compared; must be delimited by single quotes. If the literal is a positive numeric value, a plus sign (+) need not be used.

Note:

A literal may span more than one line. If a literal begins at the beginning of a line or part of a literal is at the beginning of a line, that line may not begin with the characters QT, QUIT, or !S.

If a literal is to be compared to a character string, the literal must comprise the same number of characters as that field, including trailing blanks. (The number of characters is designated in the size argument.)

Note:

A single quote may be included as part of the character string literal by using two contiguous single quotes wherever a single quote is desired. For example, the literal DEPT. 'AA' is written 'DEPT. ''AA'''.

If a literal is to be compared to a field that is a numeric data type, the literal is converted to the appropriate numeric data type. If the literal is shorter than the size specified in the size argument, the converted literal is right-justified with leading zeros; if the literal is longer than the size specified, it is an error condition.

Within a single Sort Description, a maximum of 128 characters may be entered for all of the specified literals. Optional argument.

Example 1:

Statement with One Condition:

This statement requests that a character string (CHAR) comprising 5 units ((5)) that begins on the fourth byte of the record (4) be compared to the value ABCDE ('ABCDE'). If they are equal (EQ), the record *will* be processed (INCL) by Sort.

```
INCL:CHAR(5),4,EQ,'ABCDE';
```

Note that in this example commas are used as delimiters whereas in Example 2 spaces are used as delimiters.

Example 2:

Statement in which Two Conditions Must be Met:

In this statement, both of the specified conditions must be met (AND); otherwise, the record is not processed by Sort. A signed binary field (BIN) comprising 15 units ((15)) that begins on the fourth byte of the record (4) must be less than (LT) a field with the same attributes that begins on the tenth byte (10). The value of a signed decimal overpunch field (DEC) must be equal to (EQ) the value +26 ('26').

```
INCL:BIN(15) 4 LT 10 AND DEC(2) 15 EQ '26';
```

Note the mandatory use of single quote delimiters for the numeric literal.

Example 3:

Statements in which One or Two Conditions Must be Met:

Since the following conditions are *not* within a single statement separated by AND, the record is not processed (OMIT) if either of the specified conditions is met.

The first statement designates that a signed, packed decimal field (PDEC) comprising five units ((5)) that begins on the third byte of the record (3) be compared to the value -12345; if the PDEC field is greater than (GT) -12345, the record is *not* processed (OMIT) by Sort. If this condition is met, the second statement is not processed; otherwise, a signed decimal field with a trailing but separate sign (TDEC) comprising four units ((4)) that begins on the tenth byte of the record (10) is compared to the value 1024. If the TDEC field is less than (LT) 1024, the record is omitted (OMIT) from Sort processing.

```
OMIT:PDEC(5),3,GT,'-12345';
OMIT:TDEC(4),10,LT,'1024';
```

KEYS STATEMENT (FOR SORT)

The KEYS statement defines key fields in the input records to be used in sequencing the records in the output file. The statement consists of a series of 1 to 16 key descriptions, each of which specifies a single key field. The key descriptions must be specified in order, the first describing the major key and the last describing the least significant minor key. Key fields can be overlapping. In files with variable length records, the smallest record to be sorted must contain all the key fields. A record that does not contain all key fields will not be included in the sort. Each key description indicates whether the values for that key field are to be ranked in ascending or descending order.

Note:

If both KEYS and ARRange are specified, the key field(s) must be contained within the specified ARRange field (see "ARRange Statement (For Sort)" below).

The format of the KEYS statement is:

```
KEY[S]:key_description[,key_description . . . ];
```

Each key description has the following format:

```
data_type(size),position[,D]
```

data_type

Data type of the key field is specified by a predefined code. See Table 2-1 for data types that can be used, and the code associated with each type. Required argument.

size

Size of the key field expressed as a decimal integer. The size is the number of data type units that constitute the field, excluding the unit that contains a separate sign. The units may be bit, four-bit or byte elements.

Any word separators, including parentheses, can be used with the integer representing size. (In the above format, parentheses have been inserted for readability.) Required argument.

position

Position of the beginning byte of the specified key field, relative to the beginning of the record. Expressed as a decimal integer. The record is considered to be aligned on a byte boundary, with the first byte of the record being numbered 1. Required argument.

D

Descending order of values of the specified key field to be used in ranking the records. Optional argument. Default value is ascending order.

TABLE 2-1. KEY FIELD DATA TYPES

Data Type[a]	Code	Unit	Size	Space Occupied
Character string	CHAR	8-bit byte	1 to length of record	n bytes
Signed binary	BIN	1 bit	15 or 31	2 or 4 bytes
Signed decimal (units overpunched)	DEC	8-bit digit	1 to 31	n bytes
Signed decimal (trailing separate sign)	TDEC	8-bit digit	1 to 30	n+1 bytes
Signed decimal (leading separate sign)	LDEC	8-bit digit	1 to 30	n+1 bytes
Unsigned decimal	UDEC	8-bit digit	1 to 31	n bytes
Packed decimal (trailing sign)	PDEC	4-bit digit	1 to 30[b]	If n is even, (n+2)/2 If n is odd, (n+1)/2
Packed decimal (unsigned)	UPDEC	4-bit digit	1 to 30[b]	If n is even, n/2 If n is odd, (n+1)/2

[a] Data is not validated. Therefore, if a record contains invalid data, results are unspecified. Invalid data is data that does not conform to the data type specified in the KEYS statement.

[b] Packed decimal fields each must fully occupy an integral number of bytes and be byte-aligned. If padding is necessary, the first half-byte of the field must be 0000; this padding half-byte is optionally included in the size argument.

Example 1:

The following statement defines the two key fields according to which input records are to be sorted: a field consisting of the first seven bytes of the record, and one that comprises the 18th and 19th bytes of the record. The first key is to be arranged in ascending order, and the second key in descending order. (Note the free interchange of commas and spaces in the example.)

```
KEYS:CHAR(7),1  CHAR(2),18,D;
```

Example 2:

A file consists of six records labeled REC1-REC6. Each record is five bytes long. The following KEYS statement specifies that the records are to be sorted according to two key fields: the first byte of the record and the last byte of the record.

```
KEYS:CHAR(1),1,CHAR(1),5,D;
```

As shown below, the records are ranked in ascending order according to the value of the first byte (the major key); then records having identical major keys are arranged in descending order based on the value of the last byte (the minor key).

	Input Record					Output Record					Key Field
	Byte					Byte					Values
	1	2	3	4	5	1	2	3	4	5	
REC1	X	X	9	9	9	X	X	9	9	9	X9
REC2	Z	3	Z	5	1	X	Y	1	Z	3	X3
REC3	X	Y	1	Z	3	X	3	2	9	1	X1
REC4	X	3	2	9	1	Y	Y	4	X	4	Y4
REC5	Y	Y	4	X	4	Y	7	9	6	2	Y2
REC6	Y	7	9	6	2	Z	3	Z	5	1	Z1

Example 3:

The following example illustrates the specification of a signed decimal key field:

KEYS:DEC(5),20;

This indicates the field is signed decimal with trailing overpunch. The length of the field is five digits and starts on the 20th byte of the record. Five bytes of space are occupied.

Example 4:

This example illustrates a key field that is signed decimal with separate leading sign.

KEYS:LDEC(4),2,D;

The length of the field is four digits, starting on the second byte and occupying five bytes. The ordering sequence is descending.

Example 5:

This example shows the specification of a signed binary field:

KEYS:BIN(15),4;

The length of the field is 15 bits, starting on the fourth byte of the record and occupying two bytes.

Example 6:

In this example a signed, packed decimal key field is specified:

KEYS: PDEC(9),3;

The length specified is nine digits, starting on the third byte of the record and occupying five bytes.

ARRANGE STATEMENT (FOR SORT)

The ARRange statement specifies which bytes of the input record will be in the output record. This statement consists of one to 16 byte string descriptions, which may overlap. The order in which these descriptions are specified determines the placement of the strings in the output record. Each key field must be contained within a single byte string. A byte string may contain multiple key fields. The ARRange statement cannot be used if a key sort has been requested (i.e., the -AK or -AD argument was specified in the SORT command).

The format of the ARRange statement is:

ARR:(length),position[,(length),position . . .];

(length)

Number of bytes constituting the byte string.

position

Position within the input record of the beginning of the byte string; the first byte of the record is considered position 1.

Example 1:

The output record will comprise 29 bytes. The first five bytes of the output record will be taken from the input record, starting in position 10. The remainder of the output record will consist of 24 bytes, which begin in position 42 of the input record.

ARR:(5),10(24),42;

Example 2:

The output record will comprise 18 bytes. The first eight bytes will be taken from the input record, starting in position 27. The next 10 bytes of the output record will be taken from the input record, starting in position 24. Note that the bytes in positions 27 through 33 of the input record will occur twice in the output record because the byte string descriptions overlap.

ARR:(8),27,(10),24;

Example 3:

This example illustrates an ARRange statement used in conjunction with INCL and KEY statements.

The input file comprises the following records:

Byte	A	B	C	D
Record 1	4	Y	10	Z
Record 2	3	X	15	W
Record 3	7	Z	24	Z
Record 4	5	Y	14	N
Record 5	1	Y	11	Z

The statements specified are:

```
INCL:CHAR(1),2,EQ,'Y' AND CHAR(1),1,LT,'7';
KEY:CHAR(1),1,D;
ARR:(1),3,(1),2,(1),1;
```

The INCL statement has two conditions. The first condition specifies that the second byte of each record must be equal to Y; this condition eliminates records 2 and 3. The second condition specifies that the first byte of each remaining record must have a value less than 7; records 1, 4, and 5 also meet this condition.

The KEY statement designates that each record (records 1, 4, and 5) be sorted in descending order according to the first byte.

The results are:

Byte	A	B	C
Record 4	5	Y	14
Record 1	4	Y	10
Record 5	1	Y	11

The ARRange statement specifies that the bytes should be arranged as follows: byte that is in the third position should be in the first position, byte that is in the second position should stay where it is, and the byte that is in the first position should be in the third position. The resulting output file is:

Byte	C	B	A
Record 4	14	Y	5
Record 1	10	Y	4
Record 5	11	Y	1

TYPICAL SORT USAGE

The following two examples illustrate typical sort usage and related Sort input streams.

Example 1:

This example defines the SORT command and Sort Description to be specified to meet the following sorting requirement: Records in the file EMDATA on the volume EMPVOL are to be sorted by department number, and then by name under each department number. The layout of the key fields in the input record is shown below.

1 6	7 20	21 34	35
DEPT. NO.	LAST NAME	FIRST NAME	OTHER DATA

The ordered output records are to be written to the file EMFILE on the same volume. The work file to be used by Sort is WK7 on volume WKVOL.

In this example, 12K words of memory are requested for Sort execution. The following SORT command and Sort Description are to be read from a single file:

```
SORT -SZ 12
FILES: -IF  ^EMPVOL>EMDATA,-OF   ^EMPVOL>EMFILE
-WF ^WKVOL>WK7;
KEYS:CHAR(6),1,CHAR(14),7,CHAR(14),21;
QUIT
```

Example 2:

Records in the input file INDATA are to be sorted according to the following key fields in the record: bytes 8 through 13, 11 through 15, and 3 through 8 (the first byte of the record being numbered 1). Output records are to be written to the file PARAMS. Both files are identified by simple pathnames relative to the current working directory. The work file SWK is on the volume WKLIB.

The amount of memory requested for Sort execution is 8K words. The Sort Description, in the file SD on the volume WKLIB, is to be printed in the Sort Report. The following command invokes Sort:

```
SORT -IN  ^WKLIB>SD -PD
```

The Sort Description in the file SD is as follows:

```
FILES: -IF INDATA, -OF PARAMS, - WF ^WKLIB>SWK;
KEYS:CHAR(6), 8,CHAR(5), 11,CHAR(6), 3;
```

Example 3:

Records in the input file PAYROLL are to be sorted according to the following key fields: an unsigned packed decimal field comprising two bytes that has a value less than 2883, and a character string comprising 30 bytes. Output records are to be written to the file TAXES. Both files are identified by simple pathnames relative to the working directory. A temporary work file is to be used.

The amount of memory requested for Sort execution is 16K words. The Sort Description, which is in the file TXA on the volume ANNTAX, is to be printed in the Sort Report.

The following command invokes Sort:

```
SORT -SZ 16,-PD -IN  ^ANNTAX>TXA
```

The Sort Description in the file TXA is as follows:

```
FILES:-IF PAYROLL,-OF TAXES;
INCL:UPDEC(4),6,LT,'2883';
KEYS:UPDEC(4),6,CHAR(30),50;
```

Section 3

Reports and Messages Issued by Sort

Sort delivers a Sort Report to the user-out file on completion of the sorting process. In addition, Sort issues error messages, as appropriate, to the error-out file. The Sort Report and error messages are discussed in this section.

SORT REPORT

The Sort program always delivers a Sort Report to the user-out file unless Sort is terminated because of parameter diagnostic errors. The contents of the Sort Report are determined by the control arguments specified in the invoking SORT command.

BASIC SORT REPORT

If no control argument related to the contents of the Sort Report appears in the SORT command, the report issued by Sort is always a basic Sort Report. The basic Sort Report identifies the input and output files, provides statistical information on the records processed, and indicates whether error messages were issued during execution of the sort application. The items in the basic Sort Report (explained in Table 3-1 later in this section) are as follows:

```
SORT -version number -date/time linked
INPUT FILE: pathname
RECORDS READ nnnnnn
OUTPUT FILE: pathname
RECORDS WRITTEN nnnnnn
RECORDS DELETED nnnnnn
FATAL ERROR IN SORT          (Conditional message)
WARNING ERROR IN SORT        (Conditional message)
```

All items of the basic Sort Report are supplied whenever the Sort Report is printed, whether or not additional items are included.

EXPANDED SORT REPORT (INCLUDING SORT DESCRIPTION)

The optional control argument -PD can be specified in the invoking SORT command to extend the contents of the Sort Report. The argument -PD means "print Sort Description." If -PD is specified, the complete Sort Description as originally submitted is printed at the beginning of the Sort Report, followed by the other items of the Sort Report.

Table 3-1 illustrates the format of the expanded Sort Report which is delivered to the user-out file if the -PD option was specified in the SORT command. The pathnames cited in Table 3-1 are full pathnames, obtained after the files to which they refer are opened.

TABLE 3-1. FORMAT OF SORT REPORT (INCLUDING BASIC SORT REPORT AND SORT DESCRIPTION)

Sort Report Item	Comment
****SORT DESCRIPTION**** Sort Description statements	Each line of the Sort Description is entered exactly as originally submitted to Sort. (Included only if -PD specified in SORT command.)
Sort -version number -date/time linked	Header for main body of Sort Report. (Always included; part of basic Sort Report.)
INPUT FILE: pathname	Full pathname of input file as returned by the system. (Always included; part of basic Sort Report.)
RECORDS READ nnnnnn	Number of data records read from the Sort input file. (Always included; part of basic Sort Report.)
OUTPUT FILE: pathname	Full pathname of Sort output file as returned by the system. (Always included; part of basic Sort Report.)
RECORDS WRITTEN nnnnnn	Number of data records written to the output file. (Always included; part of basic Sort Report.)
RECORDS DELETED nnnnnn	Number of records deleted by the Sort program when the -DL argument is specified or due to record selection based on INCL or OMIT statements. (Always included; part of basic Sort Report.)
FATAL ERROR IN SORT	Written to the user-out file *only* if a fatal error message has been sent to the error-out file. (When issued, considered part of basic Sort Report.)
WARNING ERROR IN SORT	Written to the user-out file *only* if one or more warning error messages have been sent to the error-out file. This message is issued if the RECORD TOO SMALL error message was previously generated. (When issued, considered part of basic Sort Report.)

Example

A typical Sort Report delivered to the user-out file is shown below. The invoking SORT command for this sort application contains the control argument -PD.

```
**** SORT DESCRIPTION ****
FILES:-IF IOFILE -OF OUFILE -WF WKFILE;
KEYS:CHAR(6), 13 ;
SORT -version number -date/time linked
INPUT FILE:    ^ SORTVL>IOFILE
RECORDS READ 001000
OUTPUT FILE:    ^ SORTVL>OUFILE
RECORDS WRITTEN 001000
RECORDS DELETED 000000
```

ERROR MESSAGES ISSUED BY SORT

A complete list of error messages generated by Sort and delivered to the error-out file appears in the *System Messages* manual.

As soon as the Sort program is invoked, it begins to scan all elements of the SORT command and the Sort Description. If it detects an error, it issues an error message describing that error. Sort scans the entire Sort Description and issues error messages as appropriate. Sort then terminates if it detected one or more errors in the Sort Description.

For syntax errors, Sort generates an error message consisting of a coded number and the words PARAMETER SYNTAX ERROR. This message is followed by a secondary message that either identifies the error or presents a string of characters that can be interpreted as follows:

- First word of string indicates location of error
- Remaining words of string indicate words that Sort is unable to scan intelligently. All word separators are reduced to blanks.

Example:

The following KEYS statement is submitted:

```
KEYS:CHAR(A),4,CHAR(3),10,CHA(4),15;
```

The error messages Sort issues as a result of scanning this line are:

```
313121 PARAMETER SYNTAX ERROR
3131FF A 4
313121 PARAMETER SYNTAX ERROR
3131FF CHA 4 15
```

Section 4
Merge Language

The Merge program is invoked through specification of the MERGE command. The MERGE command provides information to specialize the Merge program for a particular execution, including identification of the file containing the Merge Description.

The Merge Description contains additional information for specializing the Merge, including specification of:

- The input and output files to be used by Merge
- One or more key fields to be used for merging records
- The criteria to be used to determine which records of the Merge input file(s) will be merged
- The record arrangement of the output file

The MERGE command and the statements that constitute the Merge Description are described in detail below. This section also includes examples of typical Merge usage.

MERGE COMMAND

The MERGE command invokes the Merge p, ogram. Any pathname specified in the MERGE command can be either a full pathname or a relative pathname related to the current working directory. (Refer to the *System Concepts* manual for a description of the use of pathnames in commands.)

The format of the MERGE command is:

```
MERGE [ctl_arg]
```

[ctl_arg]

Control arguments. Any or all of the following optional control arguments can be used:

-IN path

Specifies the name of the file containing the Merge Description for this merge. If not specified, the user-in file is used.

-PD

Indicates that a listing of the Merge Description is to be produced on the user-out file. (Only the first 71 characters of each line will be displayed.)

-DL

Designates that if Merge encounters records that have the same key, only the first record defined by the Merge FIFO rule is written to the output file (see the -IF path argument of "FILES Statement (For Merge)" later in this section).

Example 1:

The MERGE command and Merge Description are to be submitted in the command-in file. The Merge program will be found according to your search rules (see the LIST SEARCH RULES (LSR) command in the *Commands* manual). The invoking command is:

```
MERGE
```

Example 2:

The Merge program is stored on the volume MYAPPL; the Merge Description is identified by the relative pathname MD. If Merge encounters records that have the same key, only one of the records is written to the output file; the others are deleted. The invoking command is:

```
^MYAPPL>MERGE -IN MD -DL
```

MERGE DESCRIPTION

The Merge Description consists of the following statements, which supply information to specialize the Merge for a particular application:

- FILES statement: (Required) Specifies the input and output files for the Merge application.
- INCL/OMIT statement(s): (Optional) Specify which records of the Merge input file(s) will be processed.
- KEYS statement: (Required) Describes the input file fields to be used for merging files.
- ARRange statement: (Optional) Designates the placement of input record byte strings within the output record.

The Merge Description is required. The FILES statement must be first. If INCL or OMIT statements are used, they must precede the KEYS and optional ARRange statements. The syntax of the Merge Description is the same as that for the Sort Description (see "Syntax of Sort Description" and "Comments in Sort Description" in Section 2).

FILES STATEMENT (FOR MERGE)

The FILES statement specifies the pathnames of the input file(s) to be processed by Merge, and the output file. There may be one through six input files. Pathnames specified in the FILES statement can be full pathnames or relative pathnames related to the current working directory.

The format of the FILES statement is:

```
FILES:-IF  path[,path...],-OF  path;
```

-IF path

Specifies the pathname(s) of the input file(s) to be processed by Merge. Up to six input file pathnames may be specified. If duplicate records are found (i.e., they have the same key field), the records are written to the output file in the order in which the files containing them appear in the input file list. Required argument.

-OF path

Specifies the pathname of the output file. The output file must be a disk file created prior to execution of Merge. Required argument.

Example:

Three files to be merged reside on different volumes; the first file is relative to the current working directory. The output file resides on the same volume as the input file. The FILES statement is:

```
FILES:-IF BRANCH1,  ^DIST01>BRANCH2,
 ^DIST02>BRANCH3,-OF SUMM;
```

INCL AND OMIT STATEMENTS (FOR MERGE)

The INCL and OMIT statements cause input file records to be processed by Merge only if they meet certain condition(s). You can designate the criteria to be used by Merge for determining which record(s) will or will not be processed by specifying the INCL or OMIT statement, respectively. For a more detailed description of these statements, see "INCL and OMIT Statements (For Sort)" in Section 2.

The format of the INCL and OMIT statements is:

$$\left\{\begin{matrix}\text{INCL}\\ \text{OMIT}\end{matrix}\right\}\text{:criteria\_description}\left[\ \text{AND criteria\_description}\ldots\right];$$

The format of the criteria description is determined by the type of comparison being specified:

Comparing two fields within a record:

data_type(size),position$_1$, operator,position$_2$

Comparing a field to a specified value:

data_type(size),position $_1$,operator,'literal'

For descriptions of the arguments, see "INCL and OMIT Statements (For Sort)" in Section 2.

Example:

Four files are being merged. Records are included in the merging process only if they have the following characteristics: a character string comprising four bytes beginning on the 15th byte of the record is greater than an equivalent field starting on the sixth byte, and a 6-digit decimal field (overpunch sign) starting on the 40th byte has a value greater than -100. If the above conditions are not met, a record is included if it has a 4-digit signed packed decimal field with a padded half byte (all four bits are 0) starting on the 24th byte and is less than or equal to 16.

```
INCL:CHAR(4),15,GT,6 AND DEC(6),40,GT,'-100';
INCL:PDEC(4),24,LE,'16';
```

Note:

If the convention supporting byte-aligned packed decimal fields is followed (i.e., all four padding bits are 0), the second statement may be written as:
INCL:PDEC(5),24,LE,'16';

KEYS STATEMENT (FOR MERGE)

The KEYS statement describes the key fields of the input records to be used for merging records. The statement consists of a series of 1 to 16 key descriptions; each specifies a single key field. The key descriptions must be specified in order; the first describes the major key and the last describes the least significant minor key. Key fields can be overlapping. Each key description indicates whether the values for that key field are ranked in ascending or descending order.

The format of the KEYS statement is:

KEY[S]:key_description[,key_description . . .];

Each key description has the following format:

data_type(size),position[,D]

For descriptions of the arguments, see "KEYS Statement (For Sort)" in Section 2.

Example:

The following statement defines the two key fields to be used for merging records of the input files: a field consisting of the first seven bytes of the records, and one that comprises the 18th and 19th bytes of the record. The first key is arranged in ascending order, and the second key in descending order.

```
KEYS:CHAR(7),1  CHAR(2),18,D;
```

ARRANGE STATEMENT (FOR MERGE)

The ARRange statement specifies which bytes of the input record will be in the output record. This statement consists of one to 16 byte string descriptions, which may overlap. The order in which these descriptions are specified determines the placement of the strings in the output record. Each key field must be contained within a single byte string. A byte string may contain multiple key fields.

The format of the ARRange statement is:

ARR:(length),position[,(length),position . . .];

(length)

Number of bytes constituting the byte string.

position

Position within the input record of the beginning of the byte string; the first byte of the record is considered position 1.

Example:

The output record will comprise 29 bytes. The first five bytes of the output record will be taken from the input record, starting in position 10. The remainder of the output record will consist of 24 bytes, which begin in position 42 of the input record.

```
ARR:(5),10(24),42;
```

TYPICAL MERGE USAGE

The following examples illustrate typical Merge usage.

Example 1:

The files MASS, CONN, and PENN are to be merged. MASS and CONN reside on the same volume, which contains the current working directory. PENN is on the volume COR. The files are to be merged to an output file ALL, which is on the volume ULT. Two key fields describe the sequence of the records on the input files: a signed decimal field (with a trailing separate sign) that begins on the fifth byte and occupies seven bytes, and a character string that begins on the first byte and occupies only that byte.

Both the MERGE command and the Merge Description are in the command-in file.

```
MERGE
FILES:-IF MASS,CONN,  ^COR>PENN,-OF   ^ULT>ALL;
KEYS:TDEC(6),5,CHAR(1),1;
QT
```

Example 2:

The files STAN and LAUREL, which reside on different volumes, are to be merged into an output file whose simple pathname CHARLIE is relative to the current working directory. The input files are arranged in descending order according to a character string field.

Only records that have a binary field value less than 200 are to be merged. If records with equal key fields are encountered, only the first record defined by the Merge FIFO rule is written to the output file; the other records are deleted. For example, if duplicate records are found on STAN and LAUREL, the one in STAN is written to the output file.

The Merge Description is in the file MD on the volume CINAPP.

The invoking command is:

```
MERGE -IN   ^CINAPP>MD -DL
```

The Merge Description is:

```
FILES:-IF   ^PARM>STAN,   ^FOX>LAUREL,-OF CHARLIE;
INCL:BIN(15),20,LT,'200';
KEYS:CHAR(6),4,D;
```

Since the Merge Description is in the file ^CINAPP>MD, the word QUIT or QT is not required.

Example 3:

A single ordered file SOLD is to be restructured so that the output file DUAL only contains records in which each character string field is greater than or equal to AAABBB. The output record is to comprise four byte strings extracted from the associated input record.

The MERGE command and the Merge Description are in the command-in file.

```
MERGE
FILES:-IF  ^MYAPP>SOLD,-OF  ^YRAPP>DUAL;
INCL:CHAR(6),20,GE,'AAABBB';
KEYS:PDEC(3),6,CHAR(4),20,D;
ARR:(6),20,(10),6,(4),1,(8),40;
QT
```

Note that the key fields are contained within the byte string declarations for the ARRange statement.

Section 5

Reports and Messages Issued by Merge

Merge delivers a Merge Report to the user-out file on completion of the merging process. In addition, Merge issues error messages as appropriate, to the error-out file. The Merge Report and error messages are discussed in this section.

MERGE REPORT

The Merge program always delivers a Merge Report to the user-out file unless Merge is terminated because of parameter diagnostic errors. The contents of the Merge Report are determined by the control arguments specified in the invoking MERGE command.

BASIC MERGE REPORT

If no control argument related to the contents of the Merge Report appears in the MERGE command, the report issued by Merge always is a basic Merge Report. The basic Merge Report identifies the input and output files, provides statistical information on the records processed, and indicates whether error messages were issued during execution of the merge application. The items in the basic Merge Report (explained in Table 5-1 later in this section) are as follows:

```
MERGE   -version number   -date/time linked

INPUT FILE 1:  pathname
   .
   .
   .
INPUT FILE n:  pathname
OUTPUT FILE:  pathname
RECORDS READ 1:  nnnnnn
   .
   .
   .
RECORDS READ n:  nnnnnn
TOTAL READ:   nnnnnn
RECORDS WRITTEN:  nnnnnn
RECORDS DELETED:  nnnnnn
FATAL ERROR IN MERGE      (conditional message)
```

All items in the basic Merge Report are supplied whenever the Merge Report is printed, whether or not additional items are included.

EXPANDED MERGE REPORT (INCLUDING MERGE DESCRIPTION)

The optional control argument -PD can be specified in the invoking MERGE command to extend the contents of the Merge Report. The argument -PD means "print Merge Description." If -PD is specified, the complete Merge Description as originally submitted is printed at the beginning of the Merge Report, followed by the other items of the Merge Report.

Table 5-1 illustrates the format of the expanded Merge Report which is delivered to the user-out file if the -PD option was specified in the MERGE command. The pathnames cited in Table 5-1 are full pathnames, obtained after the files to which they refer are opened.

TABLE 5-1. FORMAT OF MERGE REPORT (INCLUDING BASIC MERGE REPORT AND MERGE DESCRIPTION)

Merge Report Item	Comment
****MERGE DESCRIPTION****	
Merge Description statements	Each line of the Merge Description is entered exactly as originally submitted to Merge. (Included only if -PD specified in MERGE command.)
MERGE -version number -date/time linked	Header for main body of Merge Report. (Always included; part of basic Merge Report.)
INPUT FILE n: pathname	Full pathname of input file n, as returned by the system. (Always included; part of basic Merge Report.)
OUTPUT FILE: pathname	Full pathname of Merge output file as returned by the system. (Always included; part of basic Merge Report.)
RECORDS READ n: nnnnnn	Number of records read from input file n. (Always included; part of basic Merge Report.)
TOTAL READ: nnnnnn	Total number of data records read from the Merge input files. (Always included; part of basic Merge Report.)
RECORDS WRITTEN: nnnnnn	Number of data records written to the output file. (Always included; part of basic Merge Report.)
RECORDS DELETED: nnnnnn	Number of records deleted by the Merge program. (Always included; part of basic Merge Report.)
FATAL ERROR IN MERGE	Written to user-out file only if a fatal error message has been sent to the error-out file. (When issued, considered part of basic Merge Report.)

Example

A typical expanded Merge Report delivered to the user-out file is shown below. The invoking MERGE command for this merge application contains the control argument -PD.

```
****MERGE DESCRIPTION****
FILES: -IF FIRST,SECOND,-OF RESULT;
KEYS: CHAR (6) 13;
MERGE  -version number  -date/time linked
INPUT FILE 1:   ^ COMB>FIRST
INPUT FILE 2:   ^ COMB>SECOND
OUTPUT FILE:    ^ COMB>RESULT
RECORDS READ 1: 000100
RECORDS READ 2: 000150
TOTAL READ:   000250
RECORDS WRITTEN: 000250
RECORDS DELETED: 000000
```

ERROR MESSAGES ISSUED BY MERGE

Merge scans the MERGE command and the Merge Description, as they are entered, and issues appropriate error messages, if any. If one or more errors are detected in the Merge Description, execution of Merge terminates.

For syntax errors, Merge generates an error message comprising a coded number and the words PARAMETER SYNTAX ERROR. For a description of parameter syntax errors, see "Error Messages Issued by Sort" in Section 3.

A complete list of error messages generated by Merge and delivered to the error-out file appears in the *System Messages* manual.

Section 6

Operating Procedures for Sort and Merge

This section describes the procedures for creating disk files for Sort and Merge, and preparing and submitting the commands and statements that invoke and particularize Sort and Merge for specific applications. Also included in this section are sample sort and merge runs.

PREPARING FILES FOR SORT AND MERGE

The Sort and Merge output files must have been created as disk files (on a storage module, cartridge disk, or diskette) before Sort or Merge execution, respectively. If a permanent file is to be used as the Sort work file, it too must be created before execution of Sort. The CREATE FILE (CF) command (described in the *Commands* manual) is normally used to create a disk file. Preparation and disposition of the work and output files are described below.

SORT WORK FILE

Sort requires a single-volume disk work file. To meet Sort requirements, it is recommended that the following be specified in the command that creates the work file:

```
CF path -SIZE n
```

The formula for determining the initial allocation size n of the file is as follows:

$$n = 1.2 * \frac{(\text{size of output file in sectors})}{s}$$

where s equals 4 for diskette or 2 for other disk devices. The value of n is rounded up.

During Sort execution, if the initial work file size allocation n is insufficient for the size of the file to be sorted, an attempt is made to expand the work file (see the -INC_SIZE argument of the CREATE FILE command in the *Commands* manual). If the file cannot be incremented, Sort is terminated.

Example:

The output file will occupy 822 sectors on a cartridge disk. The control interval size is 512 bytes. The size of the work file is calculated as follows:

$$n = 1.2 * \frac{822}{2}$$

$$= 493.2 \text{ or } 494 \text{ rounded up}$$

The command to create the work file is:

```
CF  ^VLSORT>WKSRT -SIZE 494
```

The work file, once created, can be considered a permanent work file. It can be used for any sort application for which it has sufficient capacity. However, it cannot be used by two Sort programs concurrently.

SORT AND MERGE OUTPUT FILES

Your requirements determine the characteristics of the Sort and Merge output files. The attributes of the output file may differ from those of the input file(s). The only restriction on output file organization is that it cannot be indexed. If the sequential file specified for output already contains records prior to execution of the Sort/Merge, these records are overwritten by Sort/Merge output. The output file must be created prior to the execution of Sort/Merge.

If the output records have a predefined size that differs from the size of the input records, the following occurs when the output record is written:

Record Size	Results
input<output	The input record contents are left justified; the remainder of the output record is set to spaces unless the output record type is variable.
input>output	The input record contents are left justified; truncation occurs as required.

DISPOSITION OF FILES

The shareability attribute of the work file is exclusive-use only. While the input and output files' shareability attribute is defaulted to exclusive-use only, this can be overridden by means of the GET command which is described in the *Commands* manual. Because input and output buffers are drawn from either the user's or the system's memory, depending on the shareability attribute of the respective files, the user normally assigns the same attribute to both files. If the attribute is exclusive-use only, buffers are drawn from the user's memory; otherwise, system memory is used.

The input file can be rewritten as the output file of the Sort.

The Sort input, output, and work files can reside on the same volume; however, for best performance, it is advisable to have the work file reside on a separate volume whenever possible. If the input file and output file do not reside on the same volume, the output volume need not be mounted when Sort is invoked; mounting can be deferred until the output file is needed. When the volume containing the input file is being used exclusively by Sort, the volume containing the output file can be mounted on the device from which the input volume has been demounted.

The Merge input and output files can reside on the same volume(s). All volumes must be simultaneously mounted.

SORT AND MERGE LOGICAL FILE NUMBERS

Logical file numbers (LFNs) for the Sort input, output, and work files are dynamically obtained from the system; similiarly, LFNs for the Merge input and output files are dynamically obtained from the system. Sort and Merge do not use reserved LFNs. Sort uses three user-available LFNs, whereas Merge requires two through seven user-available LFNs.

CREATING THE SORT AND MERGE DESCRIPTIONS

The Sort and Merge Descriptions can be entered interactively or stored in the user-in file.

The Editor can be used to create a Sort/Merge Description file on a disk volume. The name of the Description file is specified in the Editor write directive (W). When the Editor processes the quit directive (Q), it supplies an end-of-file indicator to the Description file. (For a description of the Editor, see the *Program Preparation* manual. Information on using the Editor appears in the *Programmer's Guide*.)

Termination of the Description must be indicated by specification of the single word QUIT (or QT) on a separate line, unless an end-of-file indicator appears at the end of the Description file.

INVOKING THE SORT AND MERGE PROGRAMS

To invoke the Sort or Merge program via the command processor, enter the SORT or MERGE command, respectively. The principal means of submitting these commands are:

1. Invoking Sort or Merge interactively: The SORT and MERGE commands can be submitted by hand through a terminal. During activation of the online task group under which Sort or Merge is to be executed, the terminal must be specified as the file from

which commands and your input are to be read. (See the *Commands* manual for a description of the ENTER GROUP REQUEST command, which causes an online task group to be activated.)

2. Invoking Sort or Merge from an EC file: The SORT or MERGE command can be stored in a file created by the Editor and identified by the pathname path.EC. When the pathname of the EC file is specified in an EXECUTION COMMAND (EC), the command is read and passed to the command processor for execution. (The EXECUTION COMMAND is described in the *Commands* manual.)
3. Invoking Sort or Merge from a batch command file: The SORT or MERGE command can be stored in a file from which the command processor reads its commands during execution of a batch task group. The pathname of the file must be specified in the in_path argument of the ENTER BATCH REQUEST (EBR) command that causes the batch task group to be executed. (The ENTER BATCH REQUEST command is defined in the *Commands* manual.)

SUBMITTING THE SORT AND MERGE DESCRIPTIONS

SPECIFYING SORT OR MERGE DESCRIPTION FILE IN -IN ARGUMENT OF SORT/MERGE COMMAND

The invoking SORT or MERGE command designates the file from which the Sort or Merge program will read the Sort or Merge Description, respectively. If the -IN path argument is specified in the SORT/MERGE command, the pathname in that argument identifies the file containing the Description.

SUBMITTING SORT OR MERGE DESCRIPTION WHEN -IN ARGUMENT OMITTED FROM SORT/MERGE COMMAND

If the invoking SORT/MERGE command does not include an -IN argument, the Sort/Merge Description is read from the file currently being used as the user-in file. The location of the current user-in file is related to the means used to submit the SORT/MERGE command (see "Invoking the Sort and Merge Programs" above). Listed below are various means by which the SORT and MERGE commands can be submitted to the system and the location of the current user-in file in each case.

1. SORT or MERGE command entered interactively: If the SORT or MERGE command without the -IN argument is entered by hand through a terminal, normally the Sort/Merge Description is also entered interactively through the terminal. (A description of the procedure for entering the Description interactively is given later in this section.)
2. SORT or MERGE command in EC file: If the SORT or MERGE command without the -IN argument is stored in and read from an EC file, the related description can be located in one of two places:
   a. In the EC file, following the SORT/MERGE command. The EC control directive &A must appear in the EC file, on a separate line preceding the SORT/MERGE command, so that the EC file can be substituted for the user-in file.
   b. In the current user-in file (in the online dimension, normally the user's terminal). The EC file must not contain the EC control directive &A on a line preceding the SORT/MERGE command.

   (For a description of the use of EC control directives with the EC file, see the EXECUTION COMMAND in the *Commands* manual.)
3. SORT or MERGE command in a batch command file: If the SORT or MERGE command without the -IN argument is stored in and read from a file whose pathname is specified in the in_path argument of the ENTER BATCH REQUEST (EBR) command, normally the Description is also stored in and read from that file.

PROCEDURE FOR ENTERING SORT OR MERGE DESCRIPTION INTERACTIVELY

To enter the Sort or Merge Description through a user's terminal, perform the following steps:

1. After being invoked, the Sort and Merge programs issue the following message on the terminal:

   $$\text{ENTER} \begin{Bmatrix}\text{SORT}\\ \text{MERGE}\end{Bmatrix} \text{DESCRIPTION}$$

   In response, enter the Sort or Merge Description manually, line by line.
2. At the completion of the Description, enter the characters QUIT (or QT) at the beginning of a separate line, to indicate termination of the Description.
3. As the Sort or Merge program processes each line of the Description, it issues an error message to the error-out file for each error in syntax or number of parameters that it detects. The program continues to request Description lines until it encounters the word QUIT (or QT). If the program detects no errors, it continues to execute. Otherwise, it returns to the command level.
4. If Sort or Merge terminates because of a fatal error, you can revise and resubmit the SORT or MERGE command and Sort/Merge Description.
5. Should an error occur during typing of the Description on the terminal, you can terminate Sort/Merge by typing !SΔ as the first characters on the next line. Once the program reads these characters, it suppresses subsequent error messages, causes the hexadecimal value FFFF to be supplied to register R1, and returns control to the command level.
6. When Sort or Merge is executing from an EC file and !SΔ is entered through the terminal to terminate the program, control is returned to the EC file. Normally, the next command is automatically read from that file. However, under certain conditions, control can be transferred from the EC file before the next command is read. For an exit from the EC file to occur before the end of the EC file, the EC control directive &IFΔ must exist in the EC file on the line immediately following the SORT or MERGE command. The following complete &IFΔ control directive must have been stored on that line:

   ```
   &IFΔ[EQUALSΔ&STATUSΔO]Δ&THENΔ&ELSEΔ&QUIT
   ```

   This directive causes the error status code in register R1 to be interrogated. The above control statement is interpreted as follows:

   > If the error status code is zero (0), continue with the next command or directive line; otherwise, quit.

   Because specifying !SΔ causes the error status code to contain a nonzero value, EC file execution is terminated. (The use of the &IFΔ control directive is described under the EXECUTION COMMAND in the *Commands* manual.)

SAMPLE SORT RUNS

The examples given below illustrate the input streams required to cause two sort runs to be executed. Included in each example is the resulting Sort Report. These examples assume that system startup has occurred and the appropriate online or batch task group under which Sort is to execute has been created and activated. Refer to the *System Building* manual for system startup procedures and to the *Commands* manual for commands required to create and activate task groups. Sample terminal sessions involving execution of programs appear in the *Programmer's Guide*.

Example 1:

The SORT command and the Sort Description are both to be entered through an interactive terminal. The amount of memory requested to support Sort execution is 16K words.

Files used by Sort include:

1. An input file on volume DSK011 referred to by the pathname ^DSK011>AC>PAY.

2. An output file on the same volume referred to by a pathname ^DSK011>TAXD>WAGE.
3. The Sort work file SRTWK on volume WDIR01.

Two record keys are to be used in sorting: a 10-character field beginning in the seventh byte of the record, and a two-character field beginning in the third byte. The latter key is to be sequenced in descending order.

The following terminal typeout shows the interactive dialog required to invoke and run the Sort program, and the resulting Sort Report. Entries supplied by the user are labeled (u) and those supplied by the system are labeled (s) in the margin to the left of the listing. (These labels do not appear on an actual listing.)

```
(u)  SORT -SIZE 16                                (Invoking SORT command)
(s)  ENTER SORT DESCRIPTION                       (System request for Sort Description statement)
(u)  FILES:-IF ^DSK011>AC>PAY                     (Sort Description statement)
     -OF ^DSK011>TAXD>WAGE -WF ^WDIR01>SRTWK;
(u)  KEYS:CHAR(10),7,CHAR(2),3,D;                 (Sort Description statement)
(u)  QUIT                                         (Terminate Sort Description)
(s)  SORT -version number -date/time linked       (Sort Report header)
(s)  INPUT FILE: ^DSK011>AC>PAY                   (Item of basic Sort Report)
(s)  RECORDS READ   2000                          (Item of basic Sort Report)
(s)  OUTPUT FILE: ^DSK011>TAXD>WAGE               (Item of basic Sort Report)
(s)  RECORDS WRITTEN: 2000                        (Item of basic Sort Report)
(s)  RECORDS DELETED: 0                           (Item of basic Sort Report)
```

Example 2:

In this example, the Editor is used to create a file (SRTDES) containing the Sort Description under the current working directory. Commands to invoke the Editor and Sort are submitted through a terminal. The resulting Sort Report, which includes a listing of the Sort Description statements, is to be printed on the terminal (designated as the user-out file).

The Sort work file (WKFILE) is under the current working directory. The input file (RECIN) and output file (RECOUT) are on the same volume (VOL234). Keys to be used in ranking the input records are as follows (the first byte of the record being numbered 1):

1. A 12-character field starting in byte 3
2. A 31-character field starting in byte 20 (to be sorted in descending order)
3. A five-character field starting in byte 6

The amount of memory to be allocated for Sort execution is 20K words.

The Editor directives required to create the Sort Description file are listed below, followed by the invoking SORT command, and the resulting Sort Report. (Refer to the *Program Preparation* manual for detailed information on the Editor.) The originator of each of the following entries is indicated in the left margin: (u) for user; (s) for system. (These labels do not appear on an actual listing.)

```
(u)  ED                                  (Invoking the Editor)
(u)  I                                   (Editor insert directive)
(u)  /SRTDES/                            (Comment line giving file name)
(u)  FILES:-IF ^VOL234>RECIN             (Sort Description statement)
     -OF ^VOL234>RECOUT -WF WKFILE;
(u)  KEYS:CHAR(12) 3,                    (Sort Description statement)
     CHAR(31) 20 D, CHAR(5) 6;
(u)  !F                                  (Terminate insert and enter Edit mode)
(u)  W SRTDES                            (Editor write directive naming the Sort Description file)
(u)  Q                                   (Quit; exit from Editor)
(u)  SORT -IN SRTDES -SZ 20 -PD          (Invoking SORT command)
(s)  ****SORT DESCRIPTION****            (Initial entry of Sort Report)
(s)  /SRTDES/
```

```
(s)  FILES:-IF ^VOL234>RECIN                  )
     -OF ^VOL234>RECOUT -WF WKFILE;           (  (Listing of Sort Description statements in Sort Report)
(s)  KEYS:CHAR (12) 3,                        (
     CHAR (31) 20 D, CHAR (5) 6;              )
(s)  SORT -version number -date/time linked      (Sort Report header)
(s)  INPUT FILE: ^VOL234>RECIN                   (Item of basic Sort Report)
(s)  RECORDS READ 500                            (Item of basic Sort Report)
(s)  OUTPUT FILE: ^VOL234>RECOUT                 (Item of basic  ort Report)
(s)  RECORDS WRITTEN: 500                        (Item of basic Sort Report)
(s)  RECORDS DELETED: 0                          (Item of basic Sort Report)
```

SAMPLE MERGE RUN

Example;

The MERGE command and the Merge Description both are to be entered through an interactive terminal. Files used by Merge include:

1. Input file on volume ZSVOLC referred to by the pathname ^ZSVOLC>APPLE.
2. Second input file on volume VL6469 referred to by the pathname ^VL6469>PEAR.
3. Output file on volume ZSVOLC referred to by the pathname ^ZSVOLC>PLUM.

The following single key is used to merge the two input files: a character string comprising six bytes starting on the first byte of the record.

The following terminal typeout shows the interactive dialog required to invoke and run the Merge program, and the resulting Merge Report.

```
MERGE
ENTER MERGE DESCRIPTION
FILES:-IF ^ZSVOLC>APPLE ^VL6469>PEAR -OF ^ZSVOLC>PLUM;
KEYS: CHAR 6 1;
QT
MERGE   -version number   -date/time linked
INPUT FILE 1: ^ZSVOLC>APPLE
INPUT FILE 2: ^VL6469>PEAR
OUTPUT FILE:    ^ZSVOLC>PLUM
RECORDS READ 01:000241
RECORDS READ 02:000137
TOTAL READ:000378
RECORDS WRITTEN: 000378
RECORDS DELETED: 000000
END MERGE
```

Section 7
Sorting Using Subroutine Calls

An application program may use a sequence of subroutine calls to sort records. To use these calls, link an interface module to your program, which may be written in COBOL, FORTRAN, or GCOS 6 assembly language. The sorting functions are performed by a dynamically loaded bound unit, SORTC. A call passes each record, and these records are sorted using a disk work file. After the calling program is notified that the sort has completed, call for the return of each record in sorted order. Prior to passing records to be sorted, call for the initialization of the sort by specifying the maximum amount of memory to be used, record and work file attributes, and the sort key fields. The disk work file may be temporary or permanent. The minimum memory requirement for Sort is 8K words.

Key fields have the following characteristics:

- Up to 16 key fields may be specified; they may be contiguous, separated, or overlapped.
- Keys may be sorted in ascending or descending order according to the ASCII collating sequence.
- Key field data types may be any of the following:
  - Character string
  - Single- or double-word signed binary
  - Unpacked decimal: unsigned or signed with the sign leading, trailing, or trailing over-punched
  - Packed decimal: unsigned or signed trailing

One major and up to 15 minor keys may be specified. Records are ordered first according to the major key; then all records containing the same major key are sorted according to the minor keys, in the sequence dictated by the sort description, which is described later in this section.

SORT SUBROUTINE CALLS

The function of each call is described briefly below; following are more detailed descriptions. Normally each function is required, except for abort sort. At the completion of each call, the subroutine is closed; i.e., control returns inline to the calling program immediately following the call.

- Initialize sort (ZSSRT) — Establishes the environment, according to the sort description, for the sorting process.
- Release record (ZSREL or ZSRELD) — Passes a record to Sort.
- Commence sort (ZSCOMM) — Performs the sorting process.
- Return record (ZSRET or ZSRETD) — Returns the next sorted record to the calling program.
- Abort sort (ZSEND) — Terminates execution of Sort prematurely, provided all records have not been returned.

SUBROUTINE CALL ARGUMENTS

DOPE VECTORS

Each subroutine call is associated with an argument list. Some arguments are passed using dope vectors. In the detailed descriptions of subroutine calls, it is indicated for each argument whether a dope vector is used.

The higher level programmer must be aware that the only types of data declarations that cause a dope vector to be used are:

- COBOL — An argument declared as elementary DISPLAY. (In COBOL it may be necessary to use an 01 level elementary REDEFINES to a group item that is to be referenced with a dope vector.)
- FORTRAN — An argument declared as CHARACTER.

If the application program using the sort subroutine calls is written in assembly language, the GCOS 6 standard calling sequence must be followed; i.e., arguments are passed through an argument list referenced by register B7. Depending on the form of data that is passed, the address pointers in the argument list either point directly to the data or to a dope vector, which in turn points to the data. The main intent of dope vectors is to permit data items that are not aligned on word boundaries to be passed. A dope vector consists of three contiguous words in the following format:

0 15

length of argument
byte offset of argument
word address of argument

The initialize Sort call requires that the sort description argument be passed with a dope vector. Consequently, the assembly language name used for the sort description argument must reference a dope vector that in turn points to the sort description. It is the assembly language programmer's responsibility to build the dope vector.

ARGUMENTS COMMON TO SORT SUBROUTINE CALLS

The first two arguments are the same for each of the five calls. The first argument specifies a work area within your program, and the second argument specifies the field used for storing the return code at the completion of a call. Both arguments are described in detail below.

work area (work_area)

This argument specifies the name of the work area declared within your program. During the execution of Sort, the work area must be available for the exclusive use of Sort. The work area must be word-aligned, and must occupy at least 21 words. It is *not* passed using a dope vector.

Throughout the sort, the work area retains the sort's context; therefore, the same argument value must be used for all calls associated with a specific sort. When a call is made to initialize the sort, the first word of the work area must be the binary equivalent of 4096. It is changed during the sort process, but it is reset to 4096 when the sort terminates.

report status (return_code)

This argument is the name of a 16-bit binary integer return code field used by Sort to report status to the caller. Unlike the work area argument, it is not necessary to specify the same argument value in all calls made during a sort. If the application program is written in COBOL, the status code should be declared as COMPUTATIONAL-1. If the program is written in FORTRAN, the status code should be declared as INTEGER. This argument is *not* passed using a dope vector.

INITIALIZE SORT CALL

The initialize sort function loads the Sort bound unit SORTC into memory, processes the sort description, opens a work file, obtains memory for Sort, and specializes the sort process.

The formats for the initialize Sort call are:

COBOL

```
    CALL "ZSSRT" USING work_area, return_code, sort_description
```

FORTRAN

```
    CALL ZSSRT (work_area,return_code,sort description)
```

Assembly language

```
    CALL ZSSRT,work_area,return_code,sort_description
```

work_area

Name of a work area within your program to be used by this sort. The work area must comprise a minimum of 21 words of memory; the first word must be initialized to the binary equivalent of 4096. (For a more detailed description, see "Arguments Common to Sort Subroutine Calls" earlier in this section.) This argument must *not* be passed with a dope vector. Required argument.

return_code

Name of the 16-bit binary integer return code field used by Sort to report status and errors. (For a more detailed description, see "Arguments Common to Sort Subroutine Calls" earlier in this section.) This argument must *not* be passed with a dope vector. Required argument.

sort_description

The sort description describes the key fields according to which records will be sorted, designates the amount of memory to be used by the sort, specifies the type and length of records to be sorted, and indicates whether the work file is temporary or permanent. This information must be specified as a character string. The meaning of each byte is described in Table 7-1; there are no default values.

Note:

If a value must be a specified number of digits, leading zeros are used, if necessary.

This argument *must* be passed with a dope vector. Required argument.

TABLE 7-1. SORT DESCRIPTION

Byte	Value	Meaning
0-1	dd	Size, in units of 1K of the memory to be used by the sort; expressed as two decimal digits (e.g., 16). Must be from 08 to 69 (see "Sort Subroutine Memory Usage" in Appendix A).
2	0	Reserved for sort use.
3-4		Work file indicator.
	00	Temporary work file is to be used.
	01-99	Preallocated permanent work file is to be used; the value specifies the logical file number of the permanent work file.
5		Record type.
	F	Fixed-length records (i.e., each record is the length specified in bytes 6 through 10).
	V	Variable-length records (i.e., the records vary in length up to the maximum given in bytes 6 through 10).
6-10	ddddd	Record length (in bytes); expressed as five digits.
11-12		Data type of the major key field (see Table 7-2 for detailed descriptions).
	CH	Character string.
	BN	Signed binary.
	DC	Signed decimal (units overpunched).
	TD	Signed decimal (trailing separate sign).
	LD	Signed decimal (leading separate sign).
	UD	Unsigned decimal.
	PD	Packed decimal (trailing sign).
	UP	Packed decimal (unsigned).
13-15	ddd	Space occupied, in bytes, by the major key field; expressed as three digits. To determine permitted space values, see the "Space Occupied" column of Table 7-2.
16-20	ddddd	Position of the beginning byte of the specified key field, relative to the beginning of the record; expressed as five digits. The record is considered to be aligned on a byte boundary, with the first byte of the record being numbered 1.
21		Order in which records will be ranked.
	A	Ascending order.
	D	Descending order.
22		Optional descriptions of up to 15 minor key fields; for each key field, specify the equivalence of bytes 11 through 21.
.		
.		
.		
n		The last *byte* of the sort description must be two blanks.

The key field descriptions must be in order; the first describes the major key, and the last describes the least significant minor key. Key fields can be overlapping. In files with variable length records, the smallest record to be sorted must contain all the key fields. A record that does not contain all key fields will not be included in the sort, and the calling program is notified that the record is too small. Each key description indicates whether the values for that key field are to be ranked in ascending or descending order.

TABLE 7-2. KEY FIELD DATA TYPES

Data Type[a]	Abbreviated Code	Unit	Size (n)[b]	Space Occupied[c]
Character string	CH	8-bit byte	1 to length of record	n bytes
Signed binary	BN	1-bit	15 or 31	2 or 4 bytes
Signed decimal (units overpunched)	DC	8-bit digit	1 to 31	n bytes
Signed decimal (trailing separate sign)	TD	8-bit digit	1 to 30	n+1 bytes
Signed decimal (leading separate sign)	LD	8-bit digit	1 to 30	n+1 bytes
Unsigned decimal	UD	8-bit digit	1 to 31	n bytes
Packed decimal (trailing sign)	PD	4-bit digit	1 to 30[d]	if n is even, (n+2)/2 if n is odd, (n+1)/2
Packed decimal (unsigned)	UP	4-bit digit	1 to 30[d]	if n is even, n/2 if n is odd, (n+1)/2

[a] Data is not validated. Therefore, if a record contains invalid data, results are unspecified. Invalid data is data that does not conform to the data type specified in bytes 11 and 12 of the sort description.

[b] The size is the number of data type units that constitute a field, excluding the unit that contains a separate sign.

[c] When the space occupied value is specified in the sort description, be sure to allow for the sign field.

[d] Packed decimal fields each must fully occupy an integral number of bytes and be byte-aligned. If padding is necessary, the first half byte of the field must be 0000; this is optionally included in the size field (i.e., bytes 13 through 15 of the sort description).

RELEASE RECORD CALL

The release record function releases a record so that it can be processed by Sort. The number of times this function is requested coincides with the number of records to be sorted; e.g., if 12 records are to be sorted, the release record function must be requested 12 times.

The formats for the release record call are:

COBOL

CALL $\left\{\begin{array}{l}\text{"ZSREL"}\\ \text{"ZSRELD"}\end{array}\right\}$ USING work_area, return_code, record_id[, record_length]

FORTRAN

CALL $\left\{\begin{array}{l}\text{ZSREL}\\ \text{ZSRELD}\end{array}\right\}$ (work_area,return_code,record_id[,record_length])

Assembly language

CALL $\left\{\begin{array}{l}\text{ZSREL}\\ \text{ZSRELD}\end{array}\right\}$,work_area,return_code,record_id[,record_length]

ZSREL

Indicates that the record is to be passed *without* a dope vector.

ZSRELD

Indicates that the record is to be passed *with* a dope vector.

work_area

Name of the work area used in the ZSSRT call. Required argument.

return_code

Name of the 16-bit binary integer return code field used by Sort to report status and errors. This argument must *not* be passed with a dope vector. Required argument.

record_id

Name of the area in which the record to be released is stored. If your declaration of this area requires that the argument be passed using a dope vector, then the call ZSRELD must be used; otherwise, the call ZSREL must be used. Required argument.

record_length

If record lengths are variable, assign to this argument the length of the record, in bytes. The size of the record length field is one word. In COBOL, the record length is declared COMPUTATIONAL-1. In FORTRAN, the record length is declared INTEGER. Optional argument.

COMMENCE SORT CALL

The commence sort function performs the sorting process after all records have been released to Sort.

The formats for the commence sort call are:

COBOL

CALL "ZSCOMM" USING work_area, return_code

FORTRAN

CALL ZSCOMM (work_area, return_code)

Assembly language

CALL ZSCOMM,work_area,return_code

work_area

Name of the work area used in the ZSSRT call. Required argument.

return_code

Name of the 16-bit binary integer return code field used by Sort to report status and errors. This argument must *not* be passed with a dope vector. Required argument.

RETURN RECORD CALL

The return record function returns the sorted records, one at a time, to the application program. Unless the abort sort function is used, the number of times the return record function is requested must coincide with the number of records released. Before the last record is returned, Sort closes the work file and the memory occupied by Sort is released.

The formats for the return record call are:

COBOL

CALL $\begin{Bmatrix}\text{"ZSRET"}\\ \text{"ZSRETD"}\end{Bmatrix}$ USING work_area, return_code, record_ar, record_length

FORTRAN

CALL $\begin{Bmatrix}\text{ZSRET}\\ \text{ZSRETD}\end{Bmatrix}$ (work_area,return_code,record _ar,record_length)

Assembly language

CALL $\begin{Bmatrix}\text{ZSRET}\\ \text{ZSRETD}\end{Bmatrix}$,work_area,return_code,record _ar,record_length

ZSRET

Indicates that the record area (specified in the record_ar argument) is to be passed *without* a dope vector.

ZSRETD

Indicates that the record area (specified in the record_ar argument) is to be passed *with* a dope vector.

work_area

Name of the work area used in the ZSSRT call. Required argument.

return_code

Name of the 16-bit binary integer return code field used by Sort to report status and errors. On a normal return of the last record, the value of the return code is the binary equivalence of 5. This argument must *not* be passed with a dope vector. Required argument.

record_ar

Name of the area into which the record will be returned. The record may be released to and returned to the same area (i.e., the name specified in this argument may be the same as the name specified in the record_id argument of the release record call). If your declaration of this area requires that the argument be passed using a dope vector, then the call ZSRETD must be used; otherwise, the call ZSRET must be used. Required argument.

record_length

Length of the record, in bytes, returned by Sort. The size of the record length field is one word. In COBOL, the record length is declared COMP-1. In FORTRAN, the record length is declared INTEGER. Required argument.

ABORT SORT CALL

The abort sort function may be used to terminate execution of Sort before all of the records have been returned. The system will perform functions normally done after the last record is returned; i.e., the work file is closed (and released if it is a temporary file), and the memory used by Sort is released.

The formats for the abort sort call are:

COBOL

```
CALL "ZSEND" USING work_area, return_code
```

FORTRAN

```
CALL ZSEND (work_area, return_code)
```

Assembly Language

```
CALL  ZSEND,work_area,return_code
```

work_area

Name of work area used in the ZSSRT call. Required argument.

return_code

Name of the 16-bit binary integer return code field used by Sort to report status and errors. This argument must *not* be passed with a dope vector. Required argument.

SEQUENCING OF SORT SUBROUTINE CALLS

Normally Sort functions are requested in the following order:

1. Initialize sort
2. Release record
3. Commence sort
4. Return record

The abort sort function may be requested at any point between sort initialization and the returnof the last record.

The release record call must be issued for each record to be sorted. The return record call mustbe executed for each sorted record to be returned.

Only certain sequences of calls are permitted:

Previous Call	Calls That May Follow
None	Initialize Sort
Initialize sort	Release record, commence sort, abort sort
Release record	Release record, commence sort, abort sort
Commence sort	Return record, abort sort
Return record	Return record, abort sort
Abort sort or return record	Initialize Sort

PROGRAM PREPARATION

LINKING REQUIREMENTS

The application program that contains the Sort subroutine calls must be explicitly linked to the interface module ZSINT.O.

Example 1:

In this example, the Linker is loaded, and the application module APP is linked to the interface module ZS_INT to form the bound unit BOUND.

```
LINKER BOUND
LINK APP,ZS_INT
MAP
QUIT
```

Example 2:

This example illustrates how to compile a COBOL application module CCB201 and link it to the interface module ZS_INT. In this example there is a request to change to the working directory identified by the pathname ^ SRTVL5>SETC210. The source module CCB201 is located within the working directory. The COBOL command includes the list data map option. The LINKER command designates that a bound unit named CCB201 will be created, LAF mode will be in effect, and Linker output will be produced on the printer. The directory ZCRT contains COBOL runtime routines. The interface module ZS_INT.O is located in SYSLIB2. In the following interactive dialog, entries supplied by the user are labeled (u) and those supplied by the system are labeled (s) in the margin to the left of the listing. (These labels do not appear on an actual listing.)

```
(u) CWD ^SRTVL5>SETC210
(s) RDY:
(u) COBOL CCB201  -LD  -COUT>SPD>LPT00
(s) COBOL 0201
(s) 0000 ERRORS
(s) END COMPILATION
(s) RDY:
(u) LINKER CCB201  -COUT>SPD>LPT00  -LAF
```

```
(s) LINKER 210  BU=CCB201   LINKED ON: 1977/11/02  1846:42.1  -LAF
(u) LIB ^ZSYS51>SYSLIB2>ZCRT;LIB2 ^ZSYS51>SYSLIB2;
(u) LINK CCB201,  ZS_INT;MAP;QT
(s) LAF OR SLIC ZSSRT.0  NT FND  )
(s) LAF OR SLIC ZSREL.0  NT FND  |
(s) LAF OR SLIC ZSCOMM.0  NT FND > THESE ERROR MESSAGES CAN BE IGNORED
(s) LAF OR SLIC ZSRET.0  NT FND  |
(s) LAF OR SLIC ZSEND.0  NT FND  )
(s) ROOT  CCB201
(s) LINK DONE
(s) RDY:
```

FILE REQUIREMENTS

Be sure that SORTC, the Sort bound unit, resides in a library that can be located via the system's search rules (see the LIST SEARCH RULES command (LSR) in the *Commands* manual).

Sort requires a temporary or permanent disk work file. The work file size must be approximately 1.2 times the size of the average record multiplied by the number of records to be sorted.

If a temporary work file is used, it is dynamically created on the volume containing the current working directory. It is released at the completion of the sort.

If the work file is permanent, the work file LFN must be associated with the work file pathname before the sort is initiated. When the sort is completed, the work file is removed by Sort via the REMOVE-FILE macro call, which is described in the *System Service Macro Calls* manual.

During execution, Sort issues error messages to the error-out file.

RETURN CODES AND ERROR MESSAGES

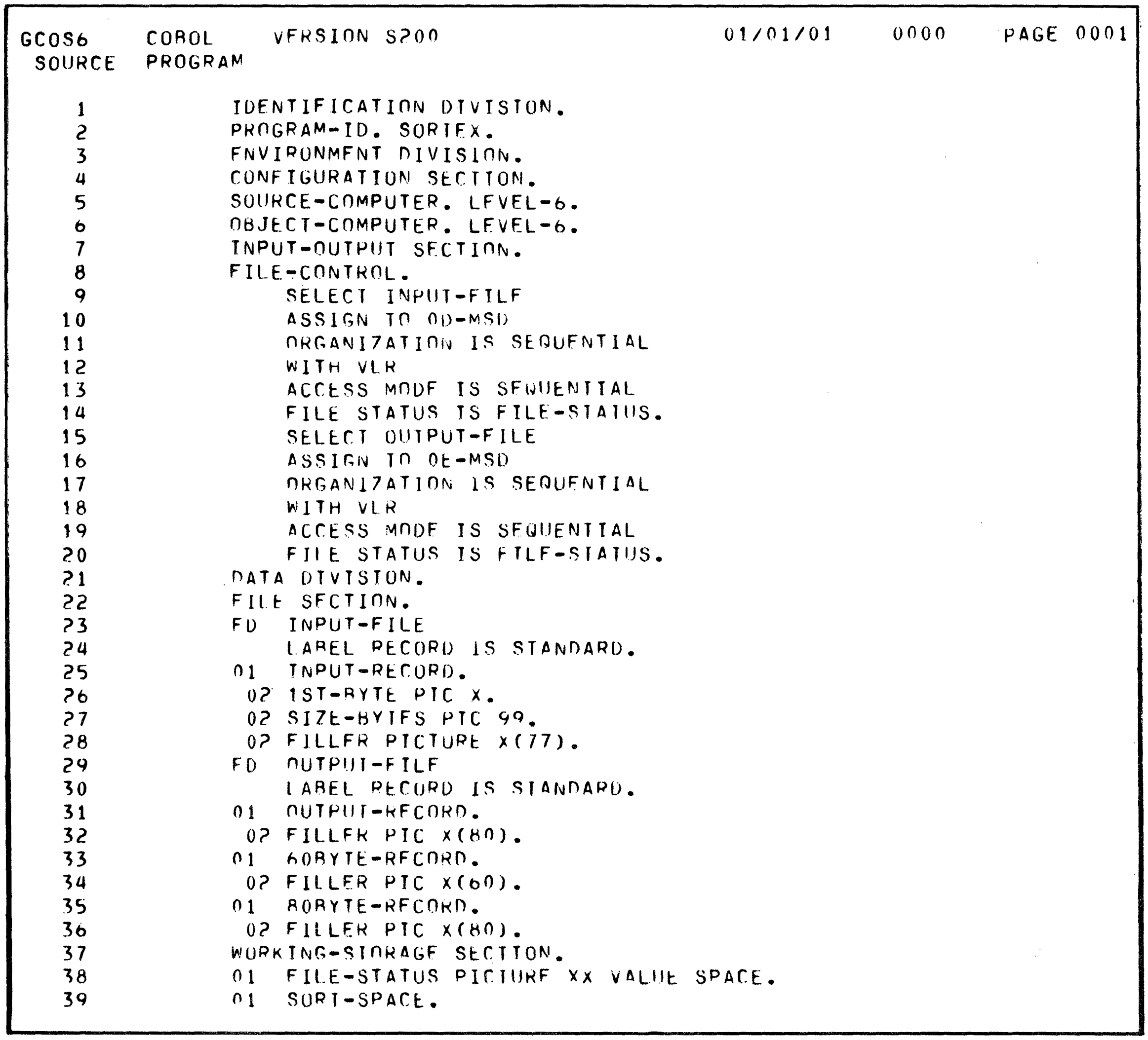
Return codes are issued as 16-bit binary integers to report status and errors. Return codes and their meanings are given below. Unless noted otherwise, an appropriate message also is issued to the error-out file. As indicated below, most return codes are associated with particular sort functions. Within a sort function, a return code may have more than one meaning.

Usage	Decimal Representation of Return Code	Meaning
General	0	Requested function has been performed successfully (no message is issued).
	1	System error.
	2	Error in call sequence.
Initialize sort	1	Work file not found.
		Open error on work file.
		Value or length inconsistency — rightmost key byte.
		Linkage error; Sort cannot be executed.
	2	Invalid argument.
Release record	1	Work file too small.
		Read error on work file.
		Write error on work file.
	3	Record too small (no message is issued).
	4	Record too large (no message is issued).
Commence sort	1	Read error on work file.
		Write error on work file.
		Linkage error; Sort cannot be executed.

Usage	Decimal Representation of Return Code	Meaning
Return record	1	Read error on work file.
		Write error on work file.
		Data gain sort error.
		Output records from sort are out of sequence.
		Data has been lost within sort.
		Close error on work file.
	5	Sort has been terminated. The last record has been returned by the current return call (no message is issued).
	6	The last record has been returned, but the sort has not been successfully terminated; e.g., close error on work file or failure to return the memory used by Sort.
Abort sort	1	Linkage error; Sort cannot be executed. Close error on work file.

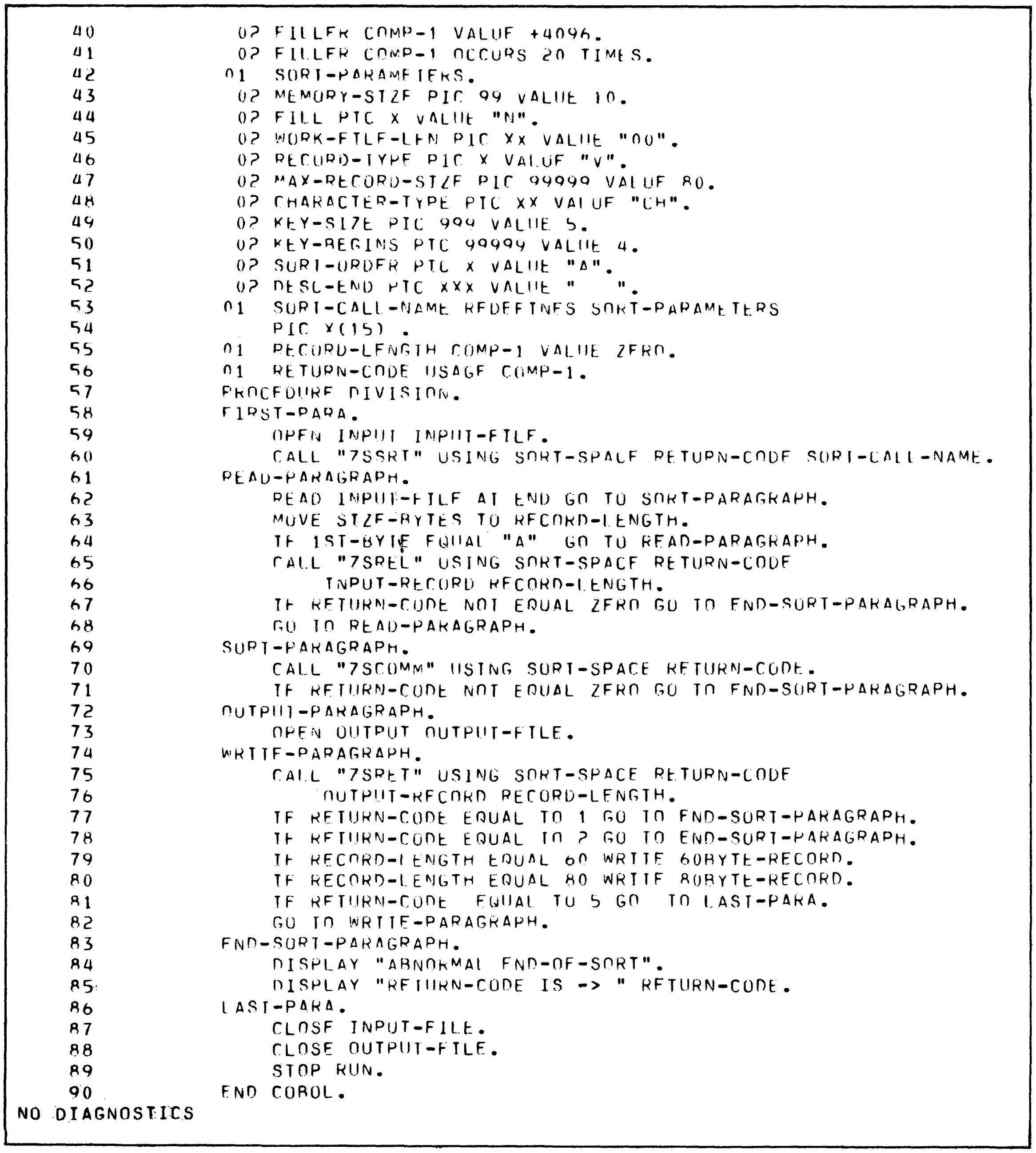
EXAMPLE OF SORTING USING SUBROUTINE CALLS

This example illustrates a COBOL source program that includes Sort subroutine calls.



```
GCOS6     COBOL     VERSION S200                          01/01/01     0000     PAGE 0001
 SOURCE   PROGRAM

               IDENTIFICATION DIVISION.
               PROGRAM-ID. SORTEX.
               ENVIRONMENT DIVISION.
               CONFIGURATION SECTION.
               SOURCE-COMPUTER. LEVEL-6.
               OBJECT-COMPUTER. LEVEL-6.
               INPUT-OUTPUT SECTION.
               FILE-CONTROL.
                   SELECT INPUT-FILE
                   ASSIGN TO OD-MSD
                   ORGANIZATION IS SEQUENTIAL
                   WITH VLR
                   ACCESS MODE IS SEQUENTIAL
                   FILE STATUS IS FILE-STATUS.
                   SELECT OUTPUT-FILE
                   ASSIGN TO OE-MSD
                   ORGANIZATION IS SEQUENTIAL
                   WITH VLR
                   ACCESS MODE IS SEQUENTIAL
                   FILE STATUS IS FILE-STATUS.
              DATA DIVISION.
              FILE SECTION.
              FD  INPUT-FILE
                  LABEL RECORD IS STANDARD.
              01  INPUT-RECORD.
               02 1ST-BYTE PIC X.
               02 SIZE-BYTES PIC 99.
               02 FILLER PICTURE X(77).
              FD  OUTPUT-FILE
                  LABEL RECORD IS STANDARD.
              01  OUTPUT-RECORD.
               02 FILLER PIC X(80).
              01  60BYTE-RECORD.
               02 FILLER PIC X(60).
              01  80BYTE-RECORD.
               02 FILLER PIC X(80).
              WORKING-STORAGE SECTION.
              01  FILE-STATUS PICTURE XX VALUE SPACE.
              01  SORT-SPACE.
```



```
       02 FILLER COMP-1 VALUE +4096.
       02 FILLER COMP-1 OCCURS 20 TIMES.
      01  SORT-PARAMETERS.
       02 MEMORY-SIZE PIC 99 VALUE 10.
       02 FILL PIC X VALUE "N".
       02 WORK-FILE-LEN PIC XX VALUE "00".
       02 RECORD-TYPE PIC X VALUE "V".
       02 MAX-RECORD-SIZE PIC 99999 VALUE 80.
       02 CHARACTER-TYPE PIC XX VALUE "CH".
       02 KEY-SIZE PIC 999 VALUE 5.
       02 KEY-BEGINS PIC 99999 VALUE 4.
       02 SORT-ORDER PIC X VALUE "A".
       02 DESC-END PIC XXX VALUE "   ".
      01  SORT-CALL-NAME REDEFINES SORT-PARAMETERS
          PIC X(15) .
      01  RECORD-LENGTH COMP-1 VALUE ZERO.
      01  RETURN-CODE USAGE COMP-1.
      PROCEDURE DIVISION.
      FIRST-PARA.
          OPEN INPUT INPUT-FILE.
          CALL "ZSSRT" USING SORT-SPACE RETURN-CODE SORT-CALL-NAME.
      READ-PARAGRAPH.
          READ INPUT-FILE AT END GO TO SORT-PARAGRAPH.
          MOVE SIZE-BYTES TO RECORD-LENGTH.
          IF 1ST-BYTE EQUAL "A"  GO TO READ-PARAGRAPH.
          CALL "ZSREL" USING SORT-SPACE RETURN-CODE
               INPUT-RECORD RECORD-LENGTH.
          IF RETURN-CODE NOT EQUAL ZERO GO TO END-SORT-PARAGRAPH.
          GO TO READ-PARAGRAPH.
      SORT-PARAGRAPH.
          CALL "ZSCOMM" USING SORT-SPACE RETURN-CODE.
          IF RETURN-CODE NOT EQUAL ZERO GO TO END-SORT-PARAGRAPH.
      OUTPUT-PARAGRAPH.
          OPEN OUTPUT OUTPUT-FILE.
      WRITE-PARAGRAPH.
          CALL "ZSRET" USING SORT-SPACE RETURN-CODE
               OUTPUT-RECORD RECORD-LENGTH.
          IF RETURN-CODE EQUAL TO 1 GO TO END-SORT-PARAGRAPH.
          IF RETURN-CODE EQUAL TO 2 GO TO END-SORT-PARAGRAPH.
          IF RECORD-LENGTH EQUAL 60 WRITE 60BYTE-RECORD.
          IF RECORD-LENGTH EQUAL 80 WRITE 80BYTE-RECORD.
          IF RETURN-CODE EQUAL TO 5 GO  TO LAST-PARA.
          GO TO WRITE-PARAGRAPH.
      END-SORT-PARAGRAPH.
          DISPLAY "ABNORMAL END-OF-SORT".
          DISPLAY "RETURN-CODE IS -> " RETURN-CODE.
      LAST-PARA.
          CLOSE INPUT-FILE.
          CLOSE OUTPUT-FILE.
          STOP RUN.
      END COBOL.
NO DIAGNOSTICS
```

Appendix A
Sort and Merge Memory Requirements

SORT MEMORY USAGE

Sort has the following memory requirements:

- Executable code: 4K words.
- Input buffer requirements: i words. For disk files to be used exclusively by Sort, i equals the control interval size; if the files are shareable, i equals 0. For tape, i equals the amount of data between interblock gaps.
- Task group overhead: 1K words.
- Work area of w words.

The totai Sort memory requirement(s) is calculated by the following:

$s = 5K + w + i$

Note:

The input buffer and part of the Sort work area are released before the output buffer is acquired. Therefore, the output buffer is not explicitly included in the above formulas. (See "Disposition of Files" in Section 6.)

The minimum requirement for w is given by the formula:

$$w = \frac{5(r + 14)}{2} \text{ words}$$

where r represents the maximum input record size (in bytes). If the record is variable in length, four bytes should be added to the value of r. Sort performance is enhanced by allowing w to be larger than the minimum.

When the ARRange statement is used, the minimum requirement for w is given by the formula:

$$w = \frac{5(a+14) + r}{2}$$

where a is the size, in bytes, of the arranged record, and r is the maximum input record size, in bytes.

The control argument -SIZE n (or -SZ n) in the SORT command specifies the maximum amount of memory to be allocated to the Sort to support the Sort executable code and the work area w, as follows:

$n = 4K + w$

If the value specified in the -SIZE argument results in a requirement for more memory than the amount of memory available in the memory pool associated with the task group, Sort will not be aborted provided sufficient memory is available for the Sort to be executed.

The recommended minimum value for -SIZE is 8. You may, if necessary, attempt to specify smaller values of memory size down to a lower minimum of 6; in this case, however, using the formula given under "Sort Work File" (see above) to calculate work file size may result in underestimation of the space required.

MERGE MEMORY USAGE

Merge has the following user memory requirements:

- Executable code: 5K words.
- Input file support: If the input files are not shareable, each input file requires the control interval size of the file (in words) plus 52 words; otherwise, no user memory is required.
- Output file support: If the output file is not sharable, it requires the control interval size (in words) plus 52 words of memory; otherwise, no user memory is required.
- Work area: The amount of memory required depends on whether there is an ARRange statement. In the following formulas,

  w = Work area
  n = Number of files to be merged
  i = Size of largest record to be merged
  r = Size of output record
  a = Size of the "arranged" record

  - No ARRange statement:
    - Fixed-length records, w = n(i)+r
    - Variable-length records, w = n(i+1) + (r+1)
  - ARRange statement included:

    w + n(a)+i+r
- Task overhead: 1K words.

SORT SUBROUTINE MEMORY USAGE

Sort requires a minimum of 8K words of memory more than that required by the application program. In the Sort Description of the initialize sort call, the size field specifies the amount of memory the sort will attempt to use: 4K is used by Sort subroutines, and the remainder is dynamically requested as a work area. The amount of memory actually obtained from the user's pool must be sufficient to support the sort. The minimum size of the work area (w) is determined by the following formula:

$$w = \frac{5(r+14)}{2} \text{ words}$$

r = Maximum input record size, in bytes.

Note:

If the record is variable in length, add 4 bytes to the value r.

If the work area is larger than the minimum required size, Sort performance is enhanced.

When determining a value for the size field, consider any increase in user memory requirements due to the actions of the application program after the sort has been initialized. For example, if you open a nonsharable output file between sort initialization and termination, the size value must be restricted so there is sufficient user memory space for necessary data management buffer and control structures.

SORT SUBROUTINE LRN'S

The user task group must be configured to include an extra LRN entry for the Sort.

Appendix B

ASCII Collating Sequence

Table B-1 gives the ASCII character collating sequence and the corresponding hexadecimal representation for each character.

TABLE B-1. ASCII COLLATING SEQUENCE

Order in Sequence	ASCII Character	Corresponding Hexadecimal Number	Order in Sequence	ASCII Character	Corresponding Hexadecimal Number
1	NUL	00	33	SP	20
(lowest)			34	!	21
2	SOH	01	35	”	22
3	STX	02	36	#	23
4	ETX	03	37	$	24
5	EOT	04	38	%	25
6	ENQ	05	39	&	26
7	ACK	06	40	’	27
8	BEL	07	41	(	28
9	BS	08	42	)	29
10	HT	09	43	*	2A
11	LF	0A	44	+	2B
12	VT	0B	45	,	2C
13	FF	0C	46	-	2D
14	CR	0D	47	.	2E
15	SO	0E	48	/	2F
16	SI	0F	49	0	30
17	DLE	10	50	1	31
18	DC1	11	51	2	32
19	DC2	12	52	3	33
20	DC3	13	53	4	34
21	DC4	14	54	5	35
22	NAK	15	55	6	36
23	SYN	16	56	7	37
24	ETB	17	57	8	38
25	CAN	18	58	9	39
26	EM	19	59	:	3A
27	SUB	1A	60	;	3B
28	ESC	1B	61	<	3C
29	FS	1C	62	=	3D
30	GS	1D	63	>	3E
31	RS	1E	64	?	3F
32	US	1F	65	@	40

TABLE B-1 (CONT). ASCII COLLATING SEQUENCE

Order in Sequence	ASCII Character	Corresponding Hexadecimal Number	Order in Sequence	ASCII Character	Corresponding Hexadecimal Number
66	A	41	98	a	61
67	B	42	99	b	62
68	C	43	100	c	63
69	D	44	101	d	64
70	E	45	102	e	65
71	F	46	103	f	66
72	G	47	104	g	67
73	H	48	105	h	68
74	I	49	106	i	69
75	J	4A	107	j	6A
76	K	4B	108	k	6B
77	L	4C	109	l	6C
78	M	4D	110	m	6D
79	N	4E	111	n	6E
80	O	4F	112	o	6F
81	P	50	113	p	70
82	Q	51	114	q	71
83	R	52	115	r	72
84	S	53	116	s	73
85	T	54	117	t	74
86	U	55	118	u	75
87	V	56	119	v	76
88	W	57	120	w	77
89	X	58	121	x	78
90	Y	59	122	y	79
91	Z	5A	123	z	7A
92	[	5B	124	{	7B
93	\	5C	125	¦	7C
94	]	5D	126	}	7D
95	∧	5E	127	~	7E
96	_	5F	128	DEL	7F
97	’	60	(highest)		

Appendix C
Debug Mode

EXECUTING THE SORT PROGRAM IN DEBUG MODE

To execute the Sort program in debug mode, specify the control argument -DB in the invoking SORT command. When Sort recognizes the debug mode request, it includes additional information on the internal operation of Sort in the Sort Report it issues to the user-out file.

All items in the full Sort Report are listed in Table C-1; this complete report is issued if both the -PD and -DB control arguments were included in the SORT command. Items that appear in the Sort Report because the debug option was specified are described in Table C-1. Items in Table C-1 that are not related to the debug mode of operation are described in Section 3, under "Sort Report."

TABLE C-1. FORMAT OF FULL SORT REPORT (INCLUDING DEBUG MODE ITEMS)

Sort Report Item	Comment[a]
**** SORT DESCRIPTION ****	Included only if -PD specified in SORT command.
Sort Description statements SORT -version number -date/time linked	Part of basic Sort Report.
INPUT FILE: pathname	Part of basic Sort Report.
START ASSIGN hhmm: ss.ttt	Starting time[b] of assignment phase (indicates the time immediately before assignment phase is called). Printing of time deferred until debug request is recognized by Sort. (Included only if debug mode requested in SORT command.)
START PRESRT hhmm:ss.ttt	Starting time[b] of Presort phase. (Included only if debug mode requested.)
STRING — ssssss x BEG — aaaaaa END — bbbbbb SWA — cccccc	This message is issued for each string written to the work file by Presort. Numbers are represented as follows: ssssss—String number. x—Sequence of string is N for normal, I for inverted. aaaaaa—Block or internal sort control interval number of first block in string. bbbbbb—Block number of last block in string. cccccc—Number of sort work file area. (Included only if debug mode requested.)
RECORDS READ nnnnnn	Part of basic Sort Report.
PRESORT RECORDS WRITTEN nnnnnn	Number of records written by the Presort to work file. (Included only if debug mode requested.)
PRESORT RECORDS DELETED nnnnnn	Number of records deleted by the Presort (e.g., records with duplicate keys when -DL argument is specified in the SORT command). (Included only if debug mode requested.)
PRESORT BLOCKS WRITTEN nnnnnn	Number of blocks written by the Presort to the work file. (Included only if debug mode requested.)
MERGE ORDER nnnnnn	Number of the merge order. (Included only if debug mode requested.)

TABLE C-1 (CONT). FORMAT OF FULL SORT REPORT (INCLUDING DEBUG MODE ITEMS)

Sort Report Item	Comment[a]
RECORDS IN PRESORT MEMORY nnnnnn	Number of records that can be stored in the presort record storage area. (Included only if debug mode requested.)
WORK BUFFER SIZE (BYTES) nnnnnn	Size of work file buffer in bytes. (Included only if debug mode requested.)
WORK BLOCK SIZE (BYTES) nnnnnn	Size of work file block in bytes. (Included only if debug mode requested.)
WORK RECORD SIZE (BYTES) nnnnnn	Size, in bytes, of record handled internally by Sort. (Included only if debug mode requested.)
INPUT RECORD SIZE (BYTES) nnnn	Size of input record in bytes. (Included only if debug mode requested.)
START MERGE hhmm:ss.ttt	Starting time[b] of the merge phase. (Included only if debug mode requested.)
OUTPUT FILE: pathname	Part of basic Sort Report.
RECORDS WRITTEN nnnnnn	Part of basic sort Report.
RECORDS DELETED nnnnnn	Part of basic Sort Report.
FATAL ERROR IN SORT	Issued *only* if fatal error message sent to error-out file. (When issued, considered part of basic Sort Report.)
WARNING ERROR IN SORT	Issued *only* if one or more warning error messages sent to error-out file. (When issued, considered part of basic Sort Report.)
END SORT hhmm:ss.ttt	Time[b] at which Sort terminates. (Included only if debug mode requested.)

[a] For detailed descriptions of items listed in this table that are *not* debug mode items, refer to Section 3, "Reports and Messages Issued by Sort."

[b] Time is expressed as follows:
hh—hours
mm—minutes
ss—seconds
ttt—thousandths of seconds

This time is taken from the system internal clock (see the SET DATE command in the *Commands* manual).

An example of a full Sort Report containing debug mode items and the Sort Description is given below.

Example:

In this example, the current working directory is SRT102. Sort is invoked as follows:

```
SORT -IN SRTDES -SZ 10 -PD -DB
```

Sort then reads the following Sort Description from the file SRTDES:

```
FILES:-IF  IDSF07  -OF  ODSF02  -WF  WDSF02;
KEYS:CHAR (8) 22, CHAR (6) 30,
CHAR (5) 99 D, CHAR (4) 36;
```

The resulting Sort Report, which includes debug mode items and a listing of the Sort Description, is given below.

```
**** SORT DESCRIPTION ****
FILES:  -IF  IDSF07  -OF  ODSF02  -WF  WDSF02;
KEYS:  CHAR (8) 22, CHAR (6) 30,
CHAR (5) 99 D, CHAR (4) 36;
SORT version number date/time linked
INPUT FILE:  ^SRTI02>IDSF07
START ASSIGN
START PRESRT
STRING-000001  N  BEG-000000  END-000027  SWA-000001
RECORDS READ  000357
PRESORT RECORDS WRITTEN  000357
PRESORT RECORDS DELETED  000000
PRESORT BLOCKS WRITTEN  000028
MERGE ORDER  000005
RECORDS IN PRESORT MEMORY  000071
WORK BUFFER SIZE (BYTES)  001548
WORK BLOCK SIZE (BYTES)  001664
WORK RECORD SIZE (BYTES)  000118
INPUT RECORD SIZE (BYTES)  000113
START MERGE
OUTPUT FILE:  ^SRTI02>ODSF02
RECORDS WRITTEN  000357
RECORDS DELETED  000000
END SORT
```

EXECUTING THE MERGE PROGRAM IN DEBUG MODE

To execute the Merge program in debug mode, the control argument -DB must be specified in the invoking MERGE command. If the -DB argument is specified, the Merge Report contains the items listed in Table C-2, as well as those in the basic Merge report (see Section 5).

TABLE C-2. ADDITIONAL ITEMS INCLUDED IN MERGE REPORT IF DEBUG MODE IS IN EFFECT

Merge Report Item	Comment
START ASSIGN hhmm:ss.ttt	Starting time[a] of assignment phase (indicates the time immediately before assignment phase is called). Printing of time deferred until debug request is recognized by Merge.
START MERGE hhmm:ss.ttt	Starting time[a] of the merge.
END MERGE hhmm:ss.ttt	Time[a] at which Merge terminates.

[a] Time is expressed as follows:
hh—Hours
mm—Minutes
ss—Seconds
ttt—Thousandths of seconds

This time is taken from the system internal clock (see the SET DATE command in the *Commands* manual).

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