



PRODUCT SPECIFICATION

REV LTR	REVISION ISSUE DATE	APPROVED BY	REVISIONS
A	10/25/78	<i>J. Hale</i>	Original Release - Mark 8.0 Level
B	10/4/79	<i>J. Hale</i>	<p>Changes for MARK 9.0 Release</p> <p>2-4 Updated <in.part> and <out.part>. Deleted <max>.</p> <p>2-7 Updated FILE IN <file name> (DISK 80 MULTI PURGE). Deleted "If any input or output file is specified as variable, all input and output files must be variable" from NOTE.</p> <p>2-7 } Added "Attributes for output files" sentence to NOTE 4. 2-8 }</p> <p>2-8 Added NOTE 6.</p> <p>4-4 Deleted "INCORRECT VARIABLE PART".</p> <p>F-1 Deleted VARIABLE from attributes. Added "Output files specified" paragraph.</p>
C	12/13/79	<i>J. Hale</i>	<p>Changes for MARK 9.0 Release</p> <p>4-2 Deleted "- DROP CONTROL has been specified with a TAGSORT" from "CONFLICTING SPECIFICATIONS".</p> <p>4-3 Added "DROP CONTROL REDUNDANT DURING TAGSORT - IGNORED" and explanation.</p> <p>4-10 Added "NEEDS AT LEAST <X> BITS MORE DYNAMIC MEMORY" and explanation.</p> <p>D-1 Added "default size for dynamic memory" paragraph, example, and "X is the exact amount" paragraph in DYNAMIC MEMORY USAGE section.</p>

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INTRODUCTION

Sort/Utility will perform all of the functions of IBM's \$DSORT program. Specifications may be given in free format, as in the SORT language, or in the fixed field format of \$DSORT.

A selected subset of the input records may be processed. Records of an input file may be included or excluded from sort processing depending on selected conditions.

The format and contents of the output records may differ from the input appearance. Fields in a record may be rearranged or excluded. Characters may be forced into chosen positions. Selected fields may be summed together to provide user processing during the sort run.

Different record formats may be specified within the same output file. Selected criteria will determine the arrangement and selection of fields in a record, and there may be numerous sets of criteria for one output file.

The order of the output file may be controlled by the user. Records may be sorted in ascending or descending order. The normal collating sequence can be altered to allow the ordinal value of a character to be controlled.

In addition, Sort/Utility has the ability to handle right or left signed, packed or unpacked fields. Character or numeric type data may be specified. Also, zone or digit portions of characters may be used.

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FREE FORMAT SPECIFICATIONS

This section of the document discusses the use of free format specifications. The free format syntax is given initially, with abbreviation definitions immediately following. Examples of each type of free format statement are also given. Those statements preceded by the symbol ">" are combined into a sample execution of SORT/UTILITY. The equivalent fixed format syntax is given in the final example.

The free format syntax has some extensions to the capabilities allowable in fixed format. Character constants are restricted only by record size in free format. The unsigned numeric, UN, packed data type exists only in free format. The ZIP, RESTART, TIMING and STABLE options exist only in free format syntax.

The TEACH option will produce equivalent free format specifications to any given input specifications. It is designed to aid in converting fixed format to free format syntax.

There is no specific restriction on the number of Record and Field type statements that may be specified. The limiting factor is the amount of dynamic memory available, as this is where the information is stored.

The entire input record size is used for interpreting free format input; therefore, there must be no sequence numbers in the input file specifications.

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SPECIAL OPTIONS

(May be specified only once)

NOPRINT don't print, must be the first token
 FILE IN [<name>] (<in.part>[<close.type.in>])... name & attributes
 OUT [<name>] (<out.part>[<close.type.out>]) 1-16 INs & 1 OUT
 COLLATE { FILE (<name>) name of external collate file
 { (<collate constant>) } collating sequence to be used
 ZIP "<lit>" zipped at EOJ

CONTROL SPECIFICATIONS

(May be specified only once, with the exception of "FIXED" and ":",")

:	rest of line contains a comment
NOSORT	don't sort
DROP CONTROL	don't keep control fields in output records
CONTROL <int>	maximum key field length
TEACH [(<name>)]	print the free format equivalent, and optionally save on disk
ME[mory] <int>	dynamic memory to be used in bytes
SUMMARIZE	add summarydata fields of duplicate records
RESTART [<int>]	make restartable or restart job number <int>
TAGSORT	output is a tagfile of 8-digit packed decimals
STABLE	duplicate records retain input order
FIXED [<int>] **	Read all or next <int> cards as fixed format
SYNTAX	check spec cards for syntax only
TIMING	print VSORT timing report

**Must be the only specification appearing on its input record

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RECORD TYPE SPECIFICATIONS

(Record selection and record type definition)

```
INCLUDE [( <disp> [EQL*] "<lit>" [ <length> ] [ <type> ] ) [ AND ] ... ] ...
DELETE      [ NEQ ] 2 <hex> 2      1*      UA*      [ OR* ]
            [ LSS ] # <num> #
            [ GTR ] <disp>
            [ LEQ ]
            [ GEQ ]
```

* Denotes default value

FIELD SPECIFICATIONS

(Output record description of each record type)

```
KEY ( <disp> <length> [ <order> ] [ <type> ] ) ...
                                     A*      UA*
FORCEKEY [ REMAPS ] ( [ <disp> <const> ] <const> [ <order> ] [ UA* ] ) ...
                                                    A*      [ ALPHA ]
                                                    [ ZONE ]
                                                    [ DIGIT ]

DATA ( <disp> <length> [ <type> ] ) ...
                                     UA*
FORCEDATA ( <const> ) ...

SUMMARYDATA ( <disp> <length> [ <type> ] [ <overflow length> ] ) ...
                                                    UA*
OVERFLOW [ ( <const> [ <const> ] ) ]
```

* Denotes default value

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ABBREVIATIONS AND EXPLANATIONS

<in.part> = (<har> <rsz> [<rpb>] [MULTI])

(DISK DEFAULT)

<out.part> = (<har> <rsz> [<rpb>] [MULTI])

(DISK DEFAULT)

<name> = a file name according to MCP file naming conventions,
 except left and right parentheses must be in quotes

<disp> and <length> = integer bytes such that displacement
 plus length is less than 8192

<const> = "<lit>" or 2<hex>2

<collate constant> = "<lit>" or 2[(<hexpair>)]<hexpair>[-<hexpair>]2

<hexpair> = a pair of single <hex> characters

<type> = ALPHA*, UA*, NUMERIC, UN, SA, RSA, SN, RSN, ZONE, or DIGIT

<order> = ASCENDING or A, DESCENDING or D

<lit> = any EBCDIC character(s). Two adjacent quotes denote one quote.

<hex> = any character(s) 0-9 and A-F

<int> = any unsigned integer

<num> = any signed integer

<rsz> = record size in bytes

<har> = hardware: DISK (<disk.part>), PACK (<disk.part>),
 TAPE [(<tape.part>)], CARD, CARDS or PRINTER

<disk.part> = disk attributes: <records per area> [<number of areas>]

<tape.part> = tape attribute: O, ODD, E, or EVEN; implies 7 track

<rpb> = records per block

<overflow length> = field length + overflow length in bytes

<close.type.in> = PURGE

<close.type.out> = RELEASE (not disk)

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EXAMPLES

">" The right arrow denotes statements used in the sample SORT job found in the EXAMPLE at the end of this section.

Header Type Cards

NOPRINT

Requests that no listing of the input cards be generated. If this instruction is left out a listing will be generated. If an error is found the specification cards and errors are listed from that point on.

NOSORT

Do not sort the file, just create the output file as specified. If this instruction is left out, a sort is performed.

DROP CONTROL

This requests that the key fields, (i.e., fields specified with the KEY and FORCEKEY statements), be dropped from the output records. If this instruction is not given, the key fields will be included in the output file records.

>CONTROL 6

The maximum control field length of any record type is specified as 6 bytes.

TEACH

Print the free format equivalent of the input specifications.

TEACH (<filename1>)

Print the free format equivalent of the input specifications and save them on disk as file <filename1>.

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>MEMORY 12000

The default memory for the sort phase is 8,000 bytes. Any integer specified, greater than 8,000, will be used as the memory size. In this instance, 12,000 bytes of memory will be used.

ME <integer>

Same as MEMORY.

>SUMMARIZE

Perform a sort summarizing the SUMMARYDATA fields. SUMMARYDATA fields occurring in records with duplicate control fields will be added together.

RESTART

Restart information is kept.

RESTART 2080

Restart the job with parent job number 2080.

TAGSORT

Create a tag file of relative record numbers, 4 bytes per record.

STABLE

Records with duplicate keys are output in the same order in which they were input.

ZIP "EX DMPALL"

The command is ZIP-ped to the MCP at the end of the job. Before terminating, SORT/UTILITY will ZIP "EX DMPALL" string.

FIXED

The rest of the input is in fixed format.

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FIXED 5

The next five cards of input are in fixed format.

FILE IN <file name1> (TAPE (ODD) 10) IN (TAPE 10) IN <file name3>
 (TAPE 10 PURGE) OUT <filename4> (TAPE 10)

Specifies that there are three input files and one output file on tape, with record sizes of 10 bytes. The third input file, <file name3>, is to be closed purge. The second input file will be unlabeled. The first input file, <file name1>, has odd parity implying a 7-track tape.

FILE IN <file name1> (DISK (20) 80 MULTI PURGE)

One input file is specified. It is on disk with a record size of 80 bytes. It is a multiple pack file and the file is to be closed purge. No output file attributes are specified.

>FILE OUT <file name1> (DISK DEFAULT) IN <file name2> (DISK DEFAULT)

One input file on disk and one output file on disk are specified. Their file attributes will default to the file header's attributes.

FILE OUT <file name1> (DISK (50 75) 80)

No input files are specified. One output file on disk with a record size of 80 bytes is specified. There are 50 records per area with a maximum of 75 areas.

NOTES:

1. Specifying an output file to be closed purge is not valid.
2. The order of the IN and OUT parts of the FILE statement is not restricted.
3. File names follow standard B1800/B1700 file naming conventions, except that left and right parenthesis must be in quotes.
4. The file statement is optional. File equates specified at execution time will override file statement specifications. Missing attributes will be given SDL defaults unless the file is on disk. In this case the attributes will come from the disk file header. The SDL defaults will be taken from the FBP of a file with the

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internal name of "DEFAULT". Attributes for output files described as DISK DEFAULT will come from the first input file if it resides on disk. Otherwise, attribute assignment is identical to that described above. (See File Attribute Assignment Precedence.)

5. One to sixteen input files are allowable in SORT/UTILITY. In order for SORT/UTILITY to recognize that a file is to be included in a SORT/UTILITY execution, either the name field, FPB.NAMES, or the hardware type field, FPB.HDWR, must be altered in the files corresponding FPB. The internal file names for these files are: INPUT, INPUT2, INPUT3....INPUT16.
6. Non-disk input files are copied and locked on the system pack.

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Record Type Cards

INCLUDE (1 "2")

If the value of the data beginning in byte position 1 of length one byte and type unsigned alpha is equal to the constant "2" of the same type and length, include this record in the sort. Therefore, the first record would be included and the second would not.

INCLUDE (1 LSS 40)

If the value of the data beginning in byte position 1 with a length of one byte is less than the data beginning in byte position 40 with the same length, include this record in the sort. Both fields are defined to be unsigned alpha. Since neither a "2" or a "3" is less than "0" neither record would be included.

INCLUDE (5 NEQ "BB" 2)

Sort all records that do not contain the constant "BB" in byte position 5 for length 2 where the constant and the comparison field are of type unsigned alpha (the default). Therefore, both records would be sorted.

INCLUDE (13 GTR 17 4 UN)

If the value of the data beginning in digit position 13 of length 2 bytes (4 digits) and type unsigned numeric is greater than the value of the data beginning in digit position 17 with the same length and type, include this record in the sort. Therefore, since 200322 is greater than 200012 and 200022 both records would be included in the sort.

INCLUDE (51 EQL #-228# 4 RSN)

Sort all records containing -228 beginning in digit position 51 for length 2 bytes (4 digits) where -228 and the comparison field are of type right signed numeric, denoting packed specification. The number will be converted to a packed format. Both records contain -228 in digit position 51 in packed, right signed numeric format. Therefore, both records are included in the sort.

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>INCLUDE (30 LEQ #2452# 5 RSA)

Sort all records with a value less than or equal to the number 2452 in byte position 30 for length 5 bytes. The constant 2452 and the comparison field are of type right signed alpha, denoting unpacked specification. The length is computed in 8 bit bytes. The sign in this example is assumed to be positive and will be added on the right. Both positive 2452 and negative 2453 are less than or equal to positive 2452 and both records will be included in the sort.

INCLUDE (51 GEQ 22802 4 RSN) AND (40 GEQ "000001" 6 UA)

If the value of the field beginning in position 51 of length 2 bytes (4 digits) and type right signed numeric is greater than or equal to -228, and the value of the field beginning in position 40 of length 6 bytes and type unsigned alpha is greater than or equal to the string "000001", then include the record in the sort. Both conditions must be satisfied to qualify a record for sorting. The constant 22802 denotes the actual contents of the data field. In this example, both records will be included in the sort as they both satisfy the two conditions specified.

INCLUDE (30 EQL 2F5F22 5 RSA) OR (35 EQL "LAST" 5)

If the value of the field beginning in byte position 30 of length 5 bytes and type signed alpha is equal to 52, (right-justified, zero filled), or if the value of the field beginning in byte position 35 of length 5 bytes and type unsigned alpha is equal to "LAST", (left-justified, blank filled), then include the record in the sort. One of these two conditions must be satisfied if a record is to be included in the sort. In this example, neither record will be included in the sort as neither record contains the value 52 in positions 30 through 34, or the string "LAST" in positions 35 through 39.

NOTES:

1. The word "AND" in this context denotes a continued condition. The word "OR" denotes a new condition. If all conditions are true when an "OR" is reached, the current record is assumed to belong to the current group. If a false condition occurs when an "AND" is reached, the "AND" statements are skipped and processing continues with the next "OR" statement.
2. A time savings can be realized if INCLUDE statements can be organized into "groups". A "group" consists of any consecutive INCLUDE statements that have like displacement, length, type, have a relation of equal,

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("EQL"), and refer to a constant for factor-2. They must not be connected by "AND"s.

DELETE

The format for DELETE is the same as for INCLUDE.

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Field Type Cards

>KEY (35 5)

This key field begins in byte position 35 of the input file. It is 5 bytes in length and unsigned alpha type. It is to be sorted in ascending order. In this example the first record would sort before the second record since "FIRST" is of lower value than "SECND".

KEY (35 5 D)

This key field begins in byte position 35 of the input file. It is of length 5 bytes and type unsigned alpha. It is to be sorted in descending, D, order. In this example the second record would sort before the first record, since "SECND" is of higher value than "FIRST".

KEY (30 5 A RSA)

This key field begins in byte position 30 of the input file. It is of length 5 bytes and type right signed alpha. It is to be sorted in ascending, A, order. Therefore, the second record will sort before the first record since -2453 is of less value than 2452.

KEY (51 4 D RSN) (35 5)

There are two key fields. The first key begins in digit position 51 of the input file. It is 2 bytes (4 digits) in length and of type right signed numeric. It is to be sorted in descending order. The second key begins in byte position 35 of the input file. It is of length 5 bytes and type unsigned alpha. It is to be sorted in ascending order. Therefore, since the value of the field beginning in digit position 51 is the same (-228) in both records, the second key then further determines the order of the records. In this case the first record will sort first, as "FIRST" is of less value than "SECND".

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FORCEKEY statements always define one byte of the output record.

FORCEKEY ("A")

Unconditionally, the character "A" is placed into the next byte position in the output record. It forms a new key field one byte in length, to be sorted in ascending order.

>FORCEKEY (1 2F22 "A" ALPHA)

If the character in byte position 1 of the input record is equal to a "2" (2F22), place an "A" in the next byte position in the output record. Otherwise, since the key is sorted in ascending (default) order, 2FF2 is placed in this position. A descending key would cause 2002 to be supplied. Thus, the first record would cause an "A" to be placed in its corresponding output record. The second record would cause 2FF2 to be entered.

FORCEKEY (1 "2" "A" A ALPHA) REMAPS (2 "0" "B" A ZONE) REMAPS ("C" A)

In this case, each condition applies to the same byte position in the output record which is the next position. If the character in byte position 1 of the input record is equal to "2" then place an "A" in the output record. If it is not equal to "2", and if the zone portion (leftmost 4 bits) of the character in position 2 of the input record is equal to the zone portion of the character "0" (2F2), place a "B" in this position of the output record. If neither of these first conditions are true, place a "C" in the output record. Thus, the first record would cause an "A" to be output and the second record would cause a "B" to be output. In every case the resulting key will be sorted in ascending order.

FORCEKEY (1 "2" "A" D) REMAPS (2 "0" "B" D DIGIT) (5 "A" "Z" UA)

The first two conditions described in this "FORCEKEY" statement pertain to the same byte position in the output file record. The third condition pertains to the next byte due to the lack of the word "REMAPS". If the character in byte position 1 of the input record is equal to a "2" then place an "A" into the current byte position of the output record. If it is not a "2", and if the digit portion (rightmost 4 bits) of the character in position 2 of the input record is equal to the digit portion of the character "0" (202) place a "B" in this position of the output record. Otherwise, 2002 will be entered since the key is to be sorted in descending order.

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The third condition causes the current output record position to be updated by one byte. It states that if the character in byte position 5 of the input record is an "A" place a "Z" in the new position of the input record. Otherwise, 2002 is entered as described above.

Therefore, the first record causes an "A" and a "Z" to be placed in its corresponding output record. The second record causes a "B" and a "Z" to be output.

>FORCEKEY REMAPS (1 "2" "A" ALPHA) REMAPS (1 2F02 2C22 ALPHA)
 REMAPS ("C")

The word "REMAPS" states that all force character conditions apply to the preceding specified key output position. Therefore, this statement must follow a "KEY" or a "FORCEKEY" statement. The first condition states that if the character in byte position 1 of the input file record is equal to "2", then "A" is put in the last byte position specified in the previous key statement. Condition two states that if the character beginning in digit position 1 of the input file record is equal to "0" (2F02), then a "B" (2C22) is put in the same position in the output record. The third condition states that if neither of the previous conditions is true, a "C" is placed in this same position of the output file record. This field will be sorted in ascending order (the default).

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DATA (1 6)

One output record field is described. The data field beginning in byte position 1 of the input record with length 6 bytes and type unsigned alpha is to begin in the next position of the output record and given the same length and type.

>DATA (7 4 ZONE)

One output record field is described. The data field beginning in byte position 7 of the input record with length 4 bytes and type ZONE is to begin in the next position of the output record and given the same length and type. The field is prefilled with 2402's and only the zones are moved.

DATA (49 2 SN) (11 14 DIGIT)

Two output record fields are described here. The data field beginning in digit position 49 of the input record with length 1 byte (2 digits) and type signed numeric, is to be placed in the next byte of the output record and assigned a type of signed numeric. The data field beginning in byte position 11 of the input record with length 14 bytes and type digit, is to begin in the next position of the output record and given the same length and type. The field is prefilled with 2F02's and only the digits are moved.

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>FORCEDATA ("4")

The use of FORCEDATA implies that an unconditional force to the next output byte position is to be performed. One unconditional force is specified. The constant "4" of type unsigned alpha is to be moved to the next output record byte position.

FORCEDATA ("4") (2C12)

In this case, the constant "4", of type unsigned alpha, is to be placed in the next output record byte position. The constant "A" (2C12) of type unsigned alpha is to be placed in the next output record byte position following the "4".

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SUMMARYDATA (1 4)

The field beginning in byte position 1 of the input record, with length 4 bytes and type unsigned alpha is to be summarized (added together) during a summary sort. The maximum size allowed for the output field is 4 bytes. There will be no duplicate keys in the output file. During SORTR type of sort, the field will not be summarized and will thus be treated as a DATA specification. During an ADDRUT sort the field is ignored.

>SUMMARYDATA (13 4 SN)

The field beginning in byte digit position 13 of the input record, with length 2 bytes (4 digits) and type signed numeric, is to be summarized during a summary sort. The maximum size allowed for the output field is 2 bytes. There will be no duplicate keys in the output file. During a SORTR type of sort, the field will not be summarized and will thus be treated as a DATA specification. During an ADDRUT sort this field is ignored.

SUMMARYDATA (51 4 SN 8)

The field beginning in digit position 51 of the input record with length 2 bytes (4 digits) and type signed numeric is to be summarized during a summary sort. The maximum size allowed for the output field is 4 bytes (8 digits). There will be no duplicate keys in the output file. During a SORTR type of sort, the field is not summarized and will be treated as a DATA specification. During an ADDRUT sort these fields are ignored.

SUMMARYDATA (51 4 SN 8) (1 4)

Same as the above examples, though two SUMMARYDATA fields are specified here.

NOTES:

1. In a summary sort, the SUMMARYDATA fields must be in the same position for all record types. The fields do not have to refer to the same position in the input file.
2. The first record type description containing summary specifications defines the summary format for all included records of any type. It is recommended that all record type descriptions contain summary specifications

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if one of them does. If a record type description does not contain summary specifications, the data specification should align the data for summarization.

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OVERFLOW

If overflow occurs in any SUMMARYDATA field, the next byte position in the output record will contain an "*". If no fields overflow, a blank will be placed in this position.

OVERFLOW ("0")

If overflow occurs in any SUMMARYDATA field, the next byte position in the output record will contain the constant "0". If no fields overflow, a blank will be placed in this position.

>OVERFLOW ("*" "N")

If overflow occurs in any SUMMARYDATA field, the next byte position in the output record will contain an "*". If no fields overflow, "N" will be placed in this position.

OVERFLOW (2D62 "N")

If overflow occurs in any SUMMARYDATA field, the next byte position in the output record will contain the constant "0", (ie. 2D62). If no fields overflow, "N" will be placed in this position.

NOTES:

1. Only one overflow indicator may be defined for all record types.

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EXAMPLE

Input Data

```
1.....5.....10.....15.....20.....25.....30.....35
2 0 4 4 A A           T H I S I S T H E F I R S T /           0 2 4 5 2 F
F2F OF 4F 4C1C100320001E3C8C9E2C9E2E3C8C5C6C9D9E2E361228D005OF OF 2F 4F 5F 2C6
```

```
36.....40.....45.....50
```

```
I R S T 0 0 0 0 0 1
```

(first record)

```
C9D9E2E3F OF OF OF OF OF 1000003000F
```

```
1.....5.....10.....15.....20.....25.....30.....35
3 0 3 2 A A           T H I S I S T H E S E C O N D           0 2 4 5 L S
F3F OF 3F 2C1C100320002E3C8C9E2C9E2E3C8C5E2C5C3D6D5C4228D004OF OF 2F 4F 5D 3E2
```

```
36.....40.....45.....50
```

```
E C N D 0 0 0 0 0 2
```

(second record)

```
C5C3D5C4F OF OF OF OF OF 2000003001D
```

Sort/Utility Language

```
FILE OUT <file name1> (DISK DEFAULT) IN <file name2> (DISK DEFAULT)
MEMORY 12000
CONTROL 6
SUMMARIZE
INCLUDE(30 LEQ #2452# 5 RSA)
KEY (35 5)
FORCEKEY REMAPS (1 "2" "A" ALPHA) REMAPS (1 2F02 2C22 ALPHA)
  REMAPS ("C")
  (1 2F22 "A" ALPHA)
DATA (7 4 ZONE)
FORCEDATA ("4")
SUMMARYDATA (13 4 SN)
OVERFLOW ("*" "N")
```


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Fixed Format Equivalent

	1	1	2	2	3
345.....	0.....	5.....	0.....	5.....	0..
000HSORTSRS		6A			14

010I U 30 34LECO2452

070FNC	35	39
080FFC		12AX
090FFC		10BX
100FFC		CX
110FFC		12A
120FDZ	7	10
130FDV		4
140FSP	7	8
150FSV		*N

Resulting Output Records

1.....	5.....	10.....	15
F I R S A A		4	N
C6C9D9E2C1C100300000F40032D5			

(first record)

1.....	5.....	10.....	15
S E C N C		4	N
E2C5C3D5C3FF00300000F40032D5			

(second record)

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FIXED FORMAT SPECIFICATIONS

This section of the document discusses the various types of disk sort specifications that are allowed in fixed format. The column number appears at the left-hand side of the page and the description of the function of that column follows. Where a fixed format entry is restricted in combination with other entries, a statement of the restrictions occurs. The EXAMPLE at the end of Section 2 uses some fixed format specifications.

There is no specific restriction on the number of Record and Field type statements that may be specified. The limiting factor is the amount of dynamic memory available, as this is where the information is stored.

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COLUMN SUMMARY - HEADER SPECIFICATIONS

COLUMNS	ENTRIES	EXPLANATION
1-5	00000	Page and line number
6	H	Header line identification
7-12	SORTA	Addrout sort job
	SORTR	Tag along sort job
	SORTRS	Summary tag along sort job
13-17	1-511	Longest control field
18	A	Records sorted in ascending order
	D	Records sorted in descending order
19	L	All signs on are on left of field
	Blank	All signs are on right of field
20	Blank	First input file will not be closed PURGE
	P	First input file will be closed PURGE
21-25	Blank	Not used
26	Blank	Use standard collating sequence
	S	Use alternate collating sequence
27	Blank	Not used
28	Blank	Keep control fields in output records in tag along sort jobs
	X	Drop control fields from output records in tag along sort jobs
29-32	1-8191	Length of output records in tag along sort jobs
35-39	0-99999	Additional storage size to execute the sort, above 8K

Table 3.1 Summary of Header Specifications

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Required and optional entries for header-type specifications are discussed in the subsection below. This discussion follows the format described in the first paragraph of this section.

COL(S) HEADER-TYPE: FUNCTION AND DESCRIPTION

- 1-2 **Page Number:** The first part of a five-digit page and line sequence number. If the sequence numbers given are in descending order, a warning will be issued.
- 3-5 **Line Number:** The second part of the five-digit sequence number. If the sequence numbers given are in descending order, a warning will be issued.
- 6 **Line Type:** Column 6 of the header line contains an "H" to identify this line.
- 7-12 **Type of Job:** The type of disk sort required is specified in these columns. SORTA means addroot (TAGSORT) sort. SORTR means tag-along (DISK SORT) sort. SORTRS means a summary tag-along (DISK SORT) sort.
- 13-17 **Field Total:** A description of the control field with the greatest length. The length, in characters or bytes, must not exceed 511. It is determined by adding together the lengths of the control fields (N, O, or F in column 7) for each type of record. When each type has been separately totaled, the largest (longest) is specified in these columns. The number must be right-justified in the column field provided on the coding form.
- 18 **Order:** Indicates the sequential order, ascending or descending, in which the records are to be sorted. The entry is either A for ascending or D for descending.
- 19 **Signed Fields:** This column determines whether fields will be right or left signed. An L in this column specifies all signs will be on the left of the field; if the column is left blank all signs will be on the right of the field.

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COL(S)HEADER-TYPE: FUNCTION AND DESCRIPTION

20 File Close: This column is left blank if the first input file is not to be closed purge. A P indicates the first input file will be closed purge.

21-25 Blank: Not used for disk sort processing.

26 Collating Sequence: This column is left blank if the standard EBCDIC collating sequence is desired. An S in this column indicates that an alternate collating sequence, which must be specified through an ALTSEQ statement, is to be used.

If an alternate collating sequence is desired, column 8 in the record type specifications must not contain a P or a U which would indicate that the fields described are packed or unpacked.

28 Tag-along Output: This column applies to tag-along output only. It indicates whether or not the program should drop control fields from the sorted output records. The column is left blank if the control fields should not be dropped. An X in this column indicates that the control fields should be dropped.

Control fields are normally dropped if opposite control fields or an alternate collating sequence are used. Furthermore, users must specify these control fields twice (once as control fields and once as data fields) if opposite control fields or an alternate collating sequence are being used. Specifying the same field as a data field means that the program does not change the field since data fields are not involved in the sorting process.

29-32 Tag Record Lengths: When a tag-along sort is specified (SORTR or SORTRS), this field is used to specify the length of the output records written in the final sorted file. The length specified depends on whether the user has dropped control fields or not. If control fields are dropped, length includes only the data fields. If they are not, the length must be a sum of both control fields and data fields. In either case, the sum of the control and the data fields must not exceed the maximum record lengths of 8191 bytes.

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COL(S)

HEADER-TYPE: FUNCTION AND DESCRIPTION

35-39 Sort Additional Memory: The number specified here will
be added to 8K.

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COLUMN SUMMARY - RECORD SPECIFICATIONS

COLUMNS	ENTRIES	EXPLANATION
1-5	00000 - 99999	Page and line number
6	I	Include line
	O	Omit line
7	A	AND line
	O	OR line
	Blank	First line of a set of I or O type
	*	Comment line
8	C	Use both zone & digit char. portions
	Z	Use only zone portion of 1-char fld
	D	Use only digit portion of characters
	P	Signed packed decimal data
	U	Signed unpacked decimal data
9-12	1-8191	Factor-1 - beginning position (blank if field length one)
13-16	1-8191	Factor-1 - ending position
17-18	EQ	Factor-1 must = factor-2
	NE	Factor-1 must not = factor-2
	LT	Factor-1 must be < than factor-2
	GT	Factor-1 must be > than factor-2
	LE	Factor-1 must be < = to factor-2
	GE	Factor-1 must be > = to factor-2
19	C	Factor-2 is a constant
	F	Factor-2 - another field in record
20-23	1-8191	Factor-2 - beginning position
24-27	1-8191	Factor-2 - ending position
20-39	Character	Factor-2 constant - any characters
40-72	Character	Comments

Table 3.2 Summary of Record Type Specifications

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COL(S) RECORD-TYPE: FUNCTION AND DESCRIPTION

1-2 Page Number: The first part of a five-digit page and line sequence number. If the sequence numbers given are in descending order, a warning will be issued.

3-5 Line Number: The second part of the five-digit sequence number. If the sequence numbers given are in descending order, a warning will be issued.

6 Line Type: Column 6 must contain either I for include or O for omit. The value I may be either include or include-all, depending on whether or not columns 7-39 (record description) are blank. If record-type lines are used, the specifications must contain at least one include or include all; otherwise, no records will be sorted.

Include: specifies which records are to be included in the sort, according to the particular records fields that are described in columns 7-39.

Include-all: tells the sort program to sort all records that have not been described by any preceding include or omit lines. Only one include-all can be used per job, and it must be the last record-type line for that job.

Omit: identifies what records are not to be sorted. Omit lines are not required and are normally followed by an include-all line which tells the program to sort all records not described by omit lines.

Sets: There are two types of sets: include sets and omit sets. An include set identifies one or more record types that should be included in the sort. An omit set identifies one or more record types that should be omitted from the sort. Sorting by sets presumes that all the records have at least one distinguishing characteristic in common. The rules for sorting by sets are as follows:

1. All include sets must end with a field-description line.
2. Omit sets never have field-description lines.
3. Every omit set must be followed by an include set.
4. The last set must be an include set.

NOTE: A time savings can be realized if Include statements can be organized into "groups". A "group"

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COL(S) RECORD-TYPE: FUNCTION AND DESCRIPTION

consists of any consecutive include statements that have like displacement, length, type, have a relation of equal (EQ), and refer to a constant for factor-2. They must not be joined by "AND"s.

7 Continuation or Comment: Column 7 indicates the line's relationship to the preceding line for the specification of include and omit sets or indicates that this is a comment line. Column 7 should contain one of the following entries:

Blank The column is left blank if it is the first of a set of include (I) or omit (O) lines or is a single include or omit line.

A Stands for AND in relation to the previous include or omit line.

O Stands for OR in relation to the previous include or omit line, i.e., a different record type than the previous line, but the control field specifications are the same for both.

* Identifies this line as a comment line which does not affect the sort in any way. The line is allowed purely for documentation. Comments are printed only if column 27 of the header line contains a zero or a blank.

8 Interpretation: Specifies whether the data in the specified field is to be compared as character values or as numeric values during compare operations. When the field contains alphanumeric data, C, Z, or D must be specified. When the field contains signed numeric data, P or U must be specified. If an alternate collating sequence is used, a packed or unpacked field may not be used in an include or omit record-type specification. Summaries of this information are presented in tables 3.3 and 3.4.

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```

*****
* Entry * Compare Operation *
* (col 8) *
*****
* * *
* C * Use both zone and digit *
* * * portion of the characters *
*****
* * *
* N * Unsigned packed numeric *
* * * data *
*****
* * *
* Z * Use only the zone portion *
* * * of the characters *
*****
* * *
* D * Use only digit portion *
* * * of the characters *
*****
* * *
* P * Numeric data is packed *
* * * (see note below). *
*****
* * *
* U * Numeric data is unpacked *
* * * (see note below) *
*****

```

Table 3.3 Interpretation Entries

Note: U and P are not allowed when an alternate collating sequence has been specified in conjunction with include or omit record-type statements.

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```

*****
*Format of      * Entry *      Definition      * Considerations *
*Numeric Data * (col 8) *
*****
*
*
*Unsigned      *      D *      Number does not * Absolute values of*
*              *      *      * have a sign. Both * the numbers are *
*              *      *      * the zone and digit* used. All zone *
*              *      *      * portions are      * portions are      *
*              *      *      * stored.           * stored as 2F2    *
*****
*
*              *      *      * Packed: Number   * Sign control      *
*              *      *      * always carries a * (see note below) *
*              *      *      * sign. Only the   * digit portions are*
*              *      *      * P                * stored.           *
*              *      *      *
*              *      *      *
*Signed       *      *      *
*              *      *      *
*              *      *      * Unpacked: Number * Sign control      *
*              *      *      * always carries a * (see note below) *
*              *      *      * sign. Both the   * zone and the digit*
*              *      *      * U                * portions are      *
*              *      *      *                  * stored.           *
*              *      *      *
*              *      *      *
*****
    
```

Table 3.4 Format of Numeric Data

Notes:

1. The sign controls the comparison. For example, -3 is less than zero and +5 is more than -6.
2. Before comparing numeric data, disk sort converts any leading blanks to zeros.

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COL(S) RECORD-TYPE: FUNCTION AND DESCRIPTION

9-16 Factor-1 Location: Columns 9-12 identify where the factor-1 field begins in the record. Columns 13-16 identify where it ends.

Note: Factor-1 is the data being compared in the record-type statements. Factor-2 is the data Factor-1 is compared against.

The length of the field cannot exceed the length of the record being sorted. For example, an 80-column record may have a maximum factor-1 entry of 80.

Entries are right-justified in columns 9-12 and 13-16 for beginning and ending columns, respectively. When a length of one character is involved, columns 9-12 are left blank and the single record position is entered in the field 13-16.

17-18 Relation: The relationship between factor-1 and factor-2 must be specified and must be one of the standard relational operators listed below. If an alternate collating sequence is used, both factor-1 and factor-2 are modified before the comparison is made.

The relationship must be one of the following:

EQ (Factor-1 must be equal to factor-2.)

NE (Factor-1 is not equal to factor-2.)

LT (Factor-1 is less than factor-2.)

GT (Factor-1 is greater than factor-2.)

LE (Factor-1 is less than or equal to factor-2.)

GE (Factor-1 is greater than or equal to factor-2.)

19 Field or Constant: Identifies whether factor-2, the field factor-1 is to be compared to, is a constant or a field. When a C is entered, columns 20-39 are used to define the constant. When an F is entered, columns 20-27 are used to identify the location of the factor-2 field within the record.

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COL(S) RECORD-TYPE: FUNCTION AND DESCRIPTION

20-27 Factor-2 Field: Factor-2 must be the same length as factor-1 and must be located within the same record. Similar to factor-1 declarations, the starting position of the field is declared (right-justified) in columns 20-23 and the ending position is declared (right-justified) in columns 24-27. One-character fields are described with an entry in the ending-column half of the field only.

20-39 Factor-2 Constant: When factor-2 is a constant, the constant is entered in columns 20-39. Note that the length of the constant must be the same as the length of factor-1, for a valid comparison. The constant may be declared as any valid EBCDIC character, or string of characters. Alphabetic or alphanumeric constants are left-justified within the field.

Numeric constants must be right-justified within the field length specified in factor-1 (within twice the field length if factor-1 is a packed number), with leading zeros or blanks. For example, a 5-position factor-1 that is being compared to the numeric constant "123" must be declared as "00123" or " 123" since the two fields must be the same length. In this example, "123" is right-justified in a 5-position field.

Signed constants: If factor-1 is a packed number, the last digit in the constant must be its sign (+ or -). If factor-1 is an unpacked negative number, the last character in the constant must be one that indicates both the numeric value of the last digit and the negative sign for the entire constant. See Table 3.4.5.

40-72 Comments: These columns are available for any comments that the user wishes to make. Comments have no effect on the program's operation.

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Coding Negative Unpacked Constants		
If last digit in constant is	Character used	Hexadecimal Equivalent
0	J	2D02
1	J	2D12
2	K	2D22
3	L	2D32
4	M	2D42
5	N	2D52
6	O	2D62
7	P	2D72
8	Q	2D82
9	R	2D92

Table 3.4.5 Coding Negative Unpacked Constants

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COLUMN SUMMARY - FIELD SPECIFICATIONS

COLUMNS	CONTENTS	EXPLANATION
1-5	00002 - 99999	Page and line number
6	F	Field specification line
7	N	Normal control field
	O	Opposite control field
	F	Forced control field
	D	Data field
	S	Summary data field
	*	Comment line
8	P	Signed packed decimal data
	U	Signed unpacked decimal data
	C	Field uses zone & digit chars
	Z	Uses zone portion of 1-char field
	D	Uses digit portion of characters
	V	Forces data character into field
9-12	1-8191	Starting position of field (blank if field length one)
13-16	1-8191	End position of field in record
17	Any nonblank	Forced field conditional char
18	Any nonblank	Forced field substitute char
19	Blank	Forced field not a continuation of the preceding line
	Not blank	Forced field continuation
20-22	1-999	Summary overflow field length
23-39	Not used	Not used
40-72	Any text	Comments - characters

Table 3.5 Summary of Field Description Specifications

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COL(S) FIELD-TYPE: FUNCTION AND DESCRIPTION

Output records from a disk sort are formatted (arranged) according to the instructions of the sort's field-description specifications. This subsection defines the proper syntax for those fields.

- 1-2 Page Number: The first part of a five-digit page and line sequence number. If the sequence numbers given are in descending order, a warning will be issued.
- 3-5 Line Number: The second part of the five-digit sequence number. If the sequence numbers given are in descending order, a warning will be issued.
- 6 Line Type: Column 6 of the field line contains a preprinted F to identify this line. Addroot sorts (SORTA) use field lines describing control specifications only. The field lines used by tag-along sorts (SORTR) and summary tag-along sorts (SORTRS) may be either control fields (used to sort the records) or actual data fields. In addition, field lines for summary tag-along sorts describe the fields that the program is expected to summarize.
- 7 Field Type or Comments: Entries in this column are chosen from the table below:

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```

*****
* Entry * Specifies: *
* (col 7) * *
*****
* * *
* * *
* D * This is a data field. It is used for tag-along *
* * (SORTR, SORTS) sorts only. If a D entry is used *
* * during an addrout sort, it is treated as a *
* * comment line. *
* * *
*****
* * *
* N * A normal control field. Sort this field so that *
* * data from the field is in the sequence specified *
* * in column 18 of the header line. *
* * *
*****
* * *
* O * This is an opposite control field. Sort this *
* * field so that the data from the field is in the *
* * sequence opposite that specified in column 18 *
* * of the header line. *
* * *
*****
* * *
* F * This is a forced control field which specifies *
* * that the control field should be modified *
* * according to the entries in columns 9-19. *
* * *
*****
* * *
* S * This is a summary data field. It is used for *
* * summary tag-along sorts (SORTRS) only. If an S *
* * is entered during an addrout sort, the line is *
* * treated like a comment line. If an S is entered *
* * during a tag-along sort, the fields are treated *
* * as normal data fields. *
* * *
*****
* * *
* * * This is a comment line. *
* * *
*****

```

Table 3.6 Interpretation Entries

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COL(S) FIELD-TYPE: FUNCTION AND DESCRIPTION

7 Data Fields: (D in Column 7). Data fields apply to tag-along (SORTR, SORTRS) sorts only. They are fields that users wish to have included in the output records. Control field lines must be declared before data fields within include sets.

When a file has more than one type of record, the following conditions apply:

- * The number of data fields do not have to be the same for all record types.
- * The total lengths of all the data fields do not have to be the same for all record types. Disk sort places blanks to the right of shorter data fields so that all total lengths are equal.

Control Fields: (N, O, or F in column 7). These fields determine the sorted sequence of the output file. They apply to all three types of sorts; SORTR, SORTRS, SORTA.

Opposite Control Fields: indicates that the control field is to be sorted in opposite order from that specified in the header line. For example, if the header line has established ascending order as the order for this field, a 0 specifies descending for this control field.

If the file contains different record types, all of which have an opposite control field in the same record position, the column 8 entry must be one of the following: all Ds, all Cs, all Zs, or any combination of Cs and Zs. Any other combinations produce unpredictable results.

Packed or Unpacked Control Fields: Control fields are changed while building the work record to allow proper sorting of signed fields. Therefore, control field information must be dropped by entering an X in column 28 of the header line. If users wish to maintain the original control field data in the output record, they must repeat the control information as a data field.

Forced Control Fields: (F in column 7). These fields are implemented in three modes: Conditional, Force-all, and Unconditional.

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COL(S) FIELD-TYPE: FUNCTION AND DESCRIPTION

Forced control fields affect the work and output records only. The proper syntax for these modes is found in the discussion of columns 17-19 below, and in Appendix B, FORCED-FIELD SORTING PROCEDURES.

Forced Control Fields are defined according to the following conventions:

- * Only one character may be contained in a forced control field.
- * The force may be either conditional or unconditional.
- * A force-all line must be preceded by a conditional force line.

When a file has more than one type of record:

- * The number of control fields does not have to be the same for all record types.
- * The total lengths of the control fields do not have to be the same for all record types.

When records with duplicate control fields (records with all the control fields equal) are sorted, the order in which they are output cannot be guaranteed to be the same as the order in which they appear in the input file, i.e., the sort is not stable.

Summary Data Fields: An S in column 7 defines a summary data field. Summary data fields may be defined for all three types of sorts, but the fields are added together (summarized) only in summary sorts. In tag-along sorts (SORTR), summary fields are treated as normal data fields. In addrout sorts (SORTA), summary fields are treated as comments.

In a summary sort, the summary data fields in the work and output records for individual record types must always be in the same position. The fields do not have to be in the same position in the input records.

The first include set that contains summary specifications defines the summary format for all included records of any set. It is recommended that all include sets contain summary specifications if one of

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COL(S) FIELD-TYPE: FUNCTION AND DESCRIPTION

them does. If an include set does not contain summary specifications, the data specification should align the data for summarization.

- 8 Interpretation: Specifies whether the data in the specified field is to be compared as character values or as hexadecimal values during compare operations. When the field contains alphanumeric data, C, Z, or D must be specified. When the field contains signed numeric data, P or U must be specified. If an alternate collating sequence is used, a packed or unpacked factor-1 may not be used. When the field contains a V, a data character is forced into the data field. A summary of this information is presented in table 3.4.

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```

*****
* Entry * Compare Operation *
* (col 8) *
*****
* * *
* C * Use both zone and digit *
* * * portions of the characters *
*****
* * *
* N * Unsigned packed numeric *
* * * data *
*****
* * *
* Z * Use only the zone portions *
* * * of the characters *
*****
* * *
* D * Use only digit portions *
* * * of the characters *
*****
* * *
* P * Numeric data is packed *
* * * (see note below). *
*****
* * *
* U * Numeric data is unpacked *
* * * (see note below). *
*****
* * *
* V * Force one data character *
* * * into the data field. *
*****
    
```

Table 3.7 Interpretation Entries

Note: U and P are not allowed when an alternate collating sequence has been specified (S in column 26 of the header record).

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Table 3.8 shows possible combinations of columns 7 and 8.

```

*****
* Col. 7 * Col. 8 *
*****
* N or 0 * C *
* * * Z *
* * * D *
* * * P *
* * * U *
*****
* F * C(1) *
* * * Z(1) *
* * * D(1) *
*****
* D * C *
* * * Z *
* * * D *
* * * P *
* * * U *
* * * V *
*****
* S * C *
* * * Z *
* * * D *
* * * P *
* * * U *
* * * V *
*****

```

(1) For an unconditional force and a force-all line, column 8 must contain a C.

Table 3.8. Possible Combinations of Columns 7-8.

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COL(S) FIELD-TYPE: FUNCTION AND DESCRIPTION

9-16 **Field Location:** Identifies the input record positions that contain the record fields. Columns 9-12 (from) specify the starting position of a field; columns 13-16 the ending position of the field. The order in which the fields are described determines the precedence of the control fields and the format of the output record.

Entries must be right-justified, ending in columns 12 and 16 respectively. One-character fields require a right-justified entry in columns 13-16 only.

17 **Conditionally Forced Character:** An entry in this column is only required when a conditional force is desired (see column 7 or Appendix B for further discussion of Forced-Field Sorting procedures). The entry tells the disk sort program which character in the control field is to be replaced by the character in column 18.

If a control field contains one of several characters that are to be replaced with separate forced characters, an entry in column 19 must be contained in all the forced-field lines except the first. See column 19 for instructions.

18 **Forced Character:** This column contains the forced character when a forced control-field sort has been specified; otherwise it is blank. The character either replaces the control field character specified in column 17 or it adds a new character to the control field for sorted output record(s) only. Note that all the restrictions for a valid forced-control-field sort (see discussion on column 7) apply to this entry.

Note: See Appendix B for further discussion on Forced-Field Sorting Procedures.

19 **Forced Field: Multiple Replacements:** If a control field in an input record may contain any one of several characters and forced-character replacements for more than one character are desired, a separate line is used to define each possible character and the forced character with which it is to be replaced. Note that column 19 must be blank for the first field statement in

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COL(S) FIELD-TYPE: FUNCION AND DESCRIPTION

an include set.

Coding: Multiple Replacement

1. Define the control field in columns 13-16.
2. Enter the first character to be replaced in column 17.
3. Enter the character which replaces it in columns 18.
4. Enter the next character to be replaced in column 17 of the next line.
5. Enter the character which replaces it in column 18 of the same line.
6. Enter any character except blank (2402) in column 19 of the same line. This specification informs disk sort that the line refers to the same control field in the work record as the preceding line.
7. Repeat steps 4, 5, and 6 for any other characters to be replaced.

Note: if column 19 were left blank, each line would define a new position in the work and output records.

Note: if the input records are being sorted in ascending order (A in column 18 of the header line), a 2FF2 is placed into the work record before any characters are forced. If descending order, a 2002 is placed into the work record before any characters are forced. Therefore, if a force character is not found, the hexadecimal characters (2FF2 or 2002) are left unchanged in the work record.

20-22 **Overflow Field Length Entry:** These columns are used only by a Summary Tag-Along, SORTRS, sort to eliminate the possibility of an overflow condition by increasing the length of the summary data field to allow for any anticipated overflow.

The overflow field length entry should reflect the sum of the summary data field length and the anticipated overflow length. The entry must be right-justified in

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COL(S) FIELD-TYPE: FUNCTION AND DESCRIPTION

column 22 and cannot exceed the maximum field length.
Columns 20-22 are ignored by a FSZ and an FSV since these
fields can be only one byte long.

23-29 Blank: These columns are not used and should be left
blank.

40-72 Comments: These columns are available for any comments
that the user wishes to make. Comments have no effect on
the program's operation.

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MESSAGES

This section covers error and warning messages generated by SORT/UTILITY. Error messages will halt further processing of SORT/UTILITY; warning messages are informational only.

Both error and warning messages will be printed on SORT/UTILITY's output (LINE) file. If the NOPRINT option has been specified, a listing will be generated only if there are errors or warnings. If program switch 1 is set to 1 (SW1=1), any occurring errors or warnings will be printed to an ERROR.LINE file, along with the associated text.

Error and warning messages associated with a specific line will immediately follow that line. Messages associated with a record type, such as "INCLUDE/DELETE MISSING FROM PREVIOUS RECORD TYPE", follow that record type description. The remaining error or warning messages refer to all the input specifications, such as the warning "DIFFERENT CONTROL FIELD LENGTHS: ACTUAL <INT1> SPECIFIED <INT2>". These messages will occur at the end of the SORT/UTILITY listing.

ERROR MESSAGES

"A DISPLACEMENT EXCEEDS MAX INPUT RECORD SIZE OF <INT1> BYTES"

A displacement specified in a fixed or free format statement is larger than the maximum record size of the specified input files (denoted here by <INT1>).

"BLOCKING IS NOT AN EVEN MULTIPLE"

In this free format FILE statement, the number of records per area specified for the current file is not a multiple of the number of records per block specified.

"CONFLICTING BLOCKING"

In this free format FILE statement, the records per area specified is greater than or equal to the specified records per block.

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"CONFLICTING LENGTHS"

In the current fixed format INCLUDE statement, the field length described in columns 9-16 conflicts with the field length described in columns 20-27.

"CONFLICTING SPECIFICATIONS"

Header statements or free format FILE statements contain one of the following errors:

- conflicting types of sorts have been specified, such as TAGSORT and SUMMARIZE
- DISK DEFAULT has been specified in the FILE statement along with a records per area part

"CONTROL FIELD LENGTH IS GREATER THAN 511 BYTES"

The maximum key length of 511 bytes has been exceeded in one of the following ways:

- The sum of the control fields of the previous record type exceeds 511 bytes
- The number indicated as the maximum key size in the fixed format header card, columns 13-17, or the free format CONTROL statement is greater than 511

"CONTROL FIELDS MUST PRECEDE DATA"

Control fields have been found following data fields within the current record type.

"DATA NAME INVALID IN THIS CONTEXT"

A word composed of alphabetic characters was found outside of statement context. It is not a reserved word. This error will occur only once until a reserved word is found, signifying statement context is to be resumed.

"DIRECTION OF REMAPPED KEY IS NOT THE SAME"

In the current free format FORCEKEY statement, the direction, ascending or descending, is not the same as that of the key or FORCEKEY it remaps.

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"DISK DEFAULT ONLY"

Only the attributes of a disk file can be defaulted in a free format FILE statement.

"DROP CONTROL REDUNDANT DURING TAGSORT - IGNORED"

Both TAGSORT and DROP CONTROL imply that key fields be excluded from output file records. DROP CONTROL will be programatically ignored if both are specified.

"EXTRA FILE IN OR OUT"

In the current free format FILE statement, more than 16 input files or one output file have been specified.

"EXTRA LEFT PARENTHESIS"

In the current free format FILE statement, an extra left parenthesis has been found.

"FORCEKEY REMAPS MUST FOLLOW KEY OR FORCEKEY"

Only a KEY (FM or FO) or FORCEKEY (FF) field can be remapped (anything but blank in column 19) by another FORCEKEY field.

"INCLUDE/DELETE MISSING FROM PREVIOUS RECORD TYPE"

Previous data or control fields were described before the current INCLUDE or DELETE statement, and they were not preceded by an INCLUDE or DELETE statement.

"INCLUDE MUST FOLLOW DELETE"

The last DELETE statement of a record type must be followed by an INCLUDE statement.

"INCORRECT RECORD SIZE"

In the free format FILE statement, the record size specified for the current file is described to be zero or greater than 8191 bytes.

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"INPUT RECORD IS DEFINED TO BE GREATER THAN 8191 BYTES"

The displacements, lengths, or displacements plus lengths given in the record and field type statements describe input record positions greater than 8191 bytes.

"INVALID CARD TYPE"

Column 6 of the current fixed format card does not contain an "H", "I", "O", OR "F", nor is this an "ALTSEQ" card.

"INVALID COLLATE STATEMENT"

Processing of the current free format COLLATE statement has been terminated due to one of the following errors:

- more than 256 items have been specified to be collated
- could not find ending quote or 2-sign of a literal
- delimiter other than a quote or 2-sign found
- missing left parenthesis

"INVALID CONSTANT"

The numeric constant of the current free format statement contains non-numeric integers.

"INVALID CONTROL STATEMENT"

No number has been given to represent the maximum sum of the control fields.

"INVALID DATA STATEMENT"

Processing of the current free format DATA statement has been terminated due to one of the following errors:

- the statement is incomplete, length or displacement missing
- the displacement or length given is zero

"INVALID DATA TYPE"

Column 8 of the current fixed format record or field type statement does not contain a "Z", "D", "P", "C", "U" or "V".

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"INVALID DEVICE"

The free format FILE statement has one of the following errors:

- device type is either missing or not equal to one of the following: DISK, PACK, CARD, CARDS, TAPE or PRINTER
- the current input file's device type has been specified as PRINTER

"INVALID DISPLACEMENT"

A displacement was expected, but one of the following conditions was found:

- the item is non-numeric
- the item is zero
- in fixed format only:
 - an ending displacement is blank
 - an ending displacement is of smaller value than a starting displacement

"INVALID DROP CONTROL STATEMENT"

The expected word "CONTROL" is missing.

"INVALID FIELD TYPE"

In the current fixed format Field statement, column 7 does not contain a "0", "N", "F", "D" or "S".

"INVALID FILE NAME"

The file name in the current free format File statement was invalid for one of the following reasons:

- file name found does not follow standard B1800/B1700 file naming conventions
- left and right parentheses must be in quotes

"INVALID FILE STATEMENT"

Processing of the FILE statement has been terminated due to its incompleteness (see syntax for explanation of non-optional parameters).

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"INVALID FIXED STATEMENT"

A non-numeric token was found following the word "FIXED". Only the word "FIXED" or "FIXED" followed by a number should be present on this record.

"INVALID FORCEDATA STATEMENT"

Processing of the current free format FORCEDATA statement has been terminated due to one of the following reasons:

- expected left parenthesis is missing
- constant not found

"INVALID FORCEKEY STATEMENT"

Processing of the current free format FORCEKEY statement has been terminated due to one of the following reasons:

- expected left parenthesis is missing
- displacement given is zero
- displacement is given but not followed by two constants

"INVALID INCLUDE/DELETE STATEMENT"

Processing of the current free format INCLUDE/DELETE statement has been terminated due to one of the following reasons:

- an "AND" or "OR" was specified but no further specifications followed
- expected left parenthesis is missing
- two displacements, or one displacement and one delimited constant are missing
- non-numeric token found when expected numeric displacement
- "DELETE" is specified followed by no further specifications
- displacement or length given is zero

"INVALID KEY STATEMENT"

Processing of the current free format KEY statement has been terminated due to one of the following reasons:

- expected left parenthesis is missing
- displacement or length given is zero

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"INVALID LENGTH"

In a free format KEY, DATA or SUMMARYDATA statement, a length was expected where a non-numeric token was found.

"INVALID LITERAL"

If the error message is referring to a free format COLLATE statement, then the error is due to one of the following:

- duplicate specification of collated characters
- hex pair of integers required to specify a character, or position was not found
- dash or left parenthesis followed by another dash or left parenthesis
- dash, left parenthesis, or valid hexadecimal character expected but not found
- beginning value of range is equal to ending value

If the error message is referring to a free format INCLUDE/DELETE statement, then the error is due to the following:

- ending delimiter of constant not found on current record

If the error message is referring to a free format FORCEKEY, FORCEDATA or OVERFLOW statement, the error is due to one of the following:

- delimiter other than quote or 2-sign found
- ending delimiter of constant not found on current record
- constant specified describes more than one byte of data

"INVALID MEMORY STATEMENT"

No number or a number less than 8000 was given following the word "MEMORY" or "ME".

"INVALID OVERFLOW STATEMENT"

Processing of the current free format OVERFLOW statement has been terminated. No token or a token other than quote or 2-sign was found following a left parenthesis.

"INVALID PARITY PART"

Processing of the FILE statement has been terminated. No token or a token other than "E", "EVEN", "O" or "ODD" was found following a left parenthesis.

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"INVALID RECORDS PER BLOCK"

Processing of the FILE statement has been terminated. The number of records per block was specified as zero.

"INVALID RELATION"

In the current fixed format record type statement, columns 17-18 do not contain "EQ", "NE", "LT", "GT", "LE" OR "GE".

"INVALID RELATION FOR ZONE"

In the current fixed format Record type statement, column 8 contains a "Z", indicating a zone type field; therefore, columns 17-18 may only contain "EQ" or "NE", indicating "equal to" or "not equal to" relations.

"INVALID SUMMARYDATA STATEMENT"

Processing of the current SUMMARYDATA statement has been terminated due to one of the following reasons:

- expected left parenthesis is missing
- displacement or length are not given
- displacement or length are zero

"INVALID TYPE COMBINATION"

In the current fixed format Field Type statement one of the following errors occur:

- column 7 contains "N" or "O" and column 8 contains a "V"
- column 7 contains an "F" and column 8 contains "P", "U" or "V"

"INVALID ZIP STATEMENT"

Processing of the ZIP statement has been terminated due to one of the following reasons:

- delimiting beginning quote not found
- message is longer than 256 characters

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"MINIMUM TAPE RECORD SIZE ALLOWABLE IS 8 BYTES"

In the free format FILE statement, the hardware type has been specified as tape and the specified record size is less than 8 bytes.

"MISSING ENDING QUOTE"

Ending quote was not found before the end of the current record. In the case of a ZIP statement, an ending quote was not found before the end of the CARDS file.

"MISSING LEFT PARENTHESIS"

In the current free format Record or Field type statement, a left parenthesis was expected and not found.

"MISSING RECORD SIZE"

In the free format FILE statement, a numeric token representing record size was expected following hardware type but not found. Record size must be given unless DISK DEFAULT is specified.

"MISSING RECORDS PER AREA PART"

In the free format FILE statement, DISK or PACK was specified as the hardware type followed by a left parenthesis, indicating a records per area and optionally a number of areas specification to follow. Either no token or a non-numeric token was found.

"MISSING RIGHT PARENTHESIS"

A right parenthesis was expected to terminate the previous statement. No tokens were found and all other specifications for this statement were optional.

"MULTIPLE FILES ON DISK ONLY"

In the free format FILE statement, MULTI was specified with other than a DISK or PACK hardware type. Multi-pack files are only defined for DISK or PACK.

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"MUST HAVE CONTROL FIELDS"

No valid KEY ("FN" or "FD" Col. 6-7) or FORCEKEY ("FF" Col. 6-7) type statements have been found in the previous record type.

"MUST HAVE DATA FIELDS WHEN DROPPING CONTROL"

DROP CONTROL has been specified in the header cards. No valid DATA or FORCEDATA ("D" Col. 7) or SUMMARYDATA ("S" Col. 7) fields have been defined in the previous record type.

"NEEDS AT LEAST <X> BITS MORE DYNAMIC MEMORY"

Memory requirements for buffers, keys, etc (see DYNAMIC MEMORY USAGE, page D-1) exceed the default value of 32000 bits.

"NO CLOSE RELEASE OF DISK FILES"

In the free format FILE statement, RELEASE was specified with a hardware type of DISK or PACK. Close release is only defined for non-disk files.

"NO INPUT FILE SPECIFIED"

The FPB values for hardware type and file name have not been altered, with a FILE statement or file equates, from their initial values of SPO and null, respectively, in any of the input file FPB'S.

"NO INPUT SPECIFICATIONS"

No valid statements were found in the CARDS file.

"NO MORE HEADER CARDS ALLOWED"

All header type statements must occur before all record or field type statements in the CARDS file.

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"NO NAME"

The word FILE was specified in the COLLATE statement indicating a file would follow. No tokens or a left parenthesis were found, however.

"NOT A NUMBER"

If the error refers to a free format statement:

- A numeric token was expected following the words "CONTROL", "MEMORY" or "ME" but none was found.

If the error refers to a fixed format statement:

- A numeric token was expected but not found in the header card in columns 13-17, indicating maximum control key length, or columns 29-32, indicating maximum output record length.

"NOT HEXADECIMAL VALUE"

A hexadecimal number was expected, delimited by a-signs. Integers found were other than "0123456789ABCDEF".

"NUMBER IS TOO BIG"

The number found is larger than expected. The limits used are as follows:

- maximum number of areas allowable is 105
- all numbers must be less than 8 integers long, except constants

"ONE FIXED HEADER CARD"

More than one fixed header card, "H" in column 6, has been found.

"OUTPUT RECORD IS DEFINED TO BE GREATER THAN 8191 BYTES"

The maximum output record length of 8191 bytes has been exceeded in one of the following ways:

- the number indicated as the maximum output record size in the fixed format header card, column 29-32, is greater than 8191 bytes
- the sum of the data and control field type cards (data only if drop control has been specified) of the previous record type exceeds 8191 bytes

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"OVERFLOW INDICATORS ARE NOT THE SAME"

In a summary sort, only one OVERFLOW indicator may be described. It must be the same (same output record position, same literals) every time it is defined.

"PREVIOUS INCLUDE ALL ENCOUNTERED"

Once an INCLUDE ALL has been described, no other INCLUDE or DELETE statements (record type statements) are allowable.

"PURGE INPUT FILES ONLY"

PURGE has been specified as the output file's close type. Close purge may only be performed on an input file.

"RELEASE ON OUTPUT ONLY"

RELEASE has been specified as an input file's close type. Close release may only be performed on the output file.

"SIGN NOT ALLOWED"

The constant delimited by number signs (#), or specified in fixed format contains the sign symbol, + or -, but has a type of ALPHA, ZONE, DIGIT, UA, C, Z or D (unsigned type).

"SPECIFIED TWICE"

The only type of statements that may be specified more than once are: FIXED, INCLUDE, DELETE, KEY, FORCEKEY, DATA, FORCEDATA, SUMMARYDATA and OVERFLOW.

"TAGSORT INVALID FOR MULTIPLE FILE INPUT"

The word "TAGSORT", in free format, or "SORTA", in fixed format, has been specified with more than one input file. Relative record pointers would not be meaningful.

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"UNLABELED DISK FILE"

No file name was given, either with a file statement or file equate, to the input disk file being defined.

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WARNING MESSAGES

"ALTERNATE COLLATING SEQUENCE ASSUMED"

In the fixed format header card, column 26 does not contain an "S" or a blank. An alternate collating sequence will be expected.

"CHARACTER CONSTANT LENGTH TRUNCATED TO 20 CHARACTERS"

In the current fixed format INCLUDE/DELETE statement, the length specified in columns 9-16 is greater than 20 bytes and a constant has been specified. The length will be truncated to 20 bytes.

"CONFLICTING OVERFLOW FIELDS - FORCEDATA (FDV) ASSUMED"

In a summary sort, only one OVERFLOW indicator may be described. The OVERFLOW indicator last described differed, either in output record position or indicated literal, from the first OVERFLOW indicator described in the input specifications. This field will be altered to describe a FORCEDATA field.

"CONSTANT AND FIELD LENGTHS DIFFER"

In the current free format INCLUDE or DELETE statement, the length of the constant specified is different than the given field length.

"CONSTANT FROM FREE FORMAT INPUT WILL BE TRUNCATED"

An INCLUDE or DELETE statement is being interpreted to free format syntax due to the TEACH command. It contains a constant greater than 20 characters in length. This indicates the statement was specified in free format originally. The constant will be truncated to 20 characters.

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"DIFFERENT CONTROL FIELD LENGTHS: ACTUAL <INT1> SPECIFIED <INT2>"

The control field length specified in the fixed or free format header statements differs from the actual maximum sum of the control fields described for any record type. The values in bytes for these figures are given in this warning message, (denoted here by <INT1> and <INT2>).

"DIFFERENT OUTPUT RECORD SIZES: ACTUAL <INT1> SPECIFIED <INT2>"

The output record size specified in the fixed format header statement or the free format FILE statement, differs from the actual maximum output record size described by the field type statements of each record type. The values in bytes for these figures are given in the warning message, (denoted here by <INT1> and <INT2>).

"DROP CONTROL ASSUMED - COLUMN 28 NOT X"

In the fixed format header card, column 28 does not contain an "X" or a blank. Control fields will be dropped from the output file.

"INPUT FILE <FILE NAME> MISSING"

An open was attempted on the disk file specified in this statement, (denoted here as <FILE NAME>), but the file was not found on disk.

"INVALID CONTINUATION - OR ASSUMED"

In the current fixed format INCLUDE or DELETE statement ("I" or "D" Column 6), column 7 does not contain either an "A", "O", "*" or a blank. The current INCLUDE/DELETE statement will be "OR"ed with the previous INCLUDE/DELETE.

"INVALID FACTOR-2 TYPE - CONSTANT ASSUMED"

In the current fixed format INCLUDE/DELETE statement, column 19 does not contain a "C" or "F" indicating constant or field, respectively. It will be assumed that FACTOR-2 will be described with a constant.

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"INVALID OVERFLOW LENGTH"

In the current fixed or free format summary statement, the overflow length given is less than the field length indicated. The field length will be used as the output length for this field.

"INVALID SORT TYPE - ASSUMED TO BE SORTR"

In the fixed format header card, columns 7-12 do not contain either "SORTR", "SORTRS" or "SORTA" left justified. "SORTR", a tag-along sort, is assumed.

"MORE THAN ONE OVERFLOW FIELD (FSV) - FORCEDATA (FDV) ASSUMED"

More than one overflow field ("FSV" column 6-8) has been described in the current record type description. It will be altered to describe a FORCEDATA ("FDV" column 6-8) field.

"NO VALID ALTSEQ STATEMENTS FOUND"

The fixed format header card contained an "S" in column 26 indicating an alternate collate statement is to be specified. No fixed or free format collate statement was found.

"NUMBER OF SUMMARY FIELDS IS INCONSISTENT"

A different number of SUMMARYDATA fields ("FS" column 6-7) has been described in the current record type than was defined in the first record type description containing SUMMARYDATA or OVERFLOW fields ("FSV" column 6-8).

"RECORD SIZE ALTERED DUE TO TAGSORT - 4 BYTES"

The maximum sum of the key and data fields (data only if drop control is specified) is not equal to 4 bytes. The output record size will be 4 bytes and will contain the relative record pointers to the sorted file.

"SEQUENCE NUMBERS ARE OUT OF ORDER"

The current fixed format sequence number given in columns 1-5 is less than or equal to the previous sequence number. The order of the input cards will not be altered.

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"SHOULD DROP CONTROL FIELDS DUE TO ALTERED DATA"

The input specifications contain one of the following:

- control fields to be sorted in descending order
- control fields defined to be of signed type
- an alternate collating sequence

Any of these conditions will cause the control fields to contain altered data. Control fields should be dropped from the output file.

"SIGNED FIELD USED WITH COLLATE - ALPHA ASSUMED"

In the current fixed or free format INCLUDE/DELETE statement, the type specified is signed, i.e., SA, SN, RSN, RSA, P or U. Collating cannot be performed on a signed field. The type will be changed to unsigned alpha.

"SUMMARY FIELD IS INCONSISTENT"

The previous SUMMARYDATA field ("FS" column 6-7) differs from its corresponding SUMMARYDATA field in the first record type description containing SUMMARYDATA or OVERFLDW fields ("FSV" column 6-8). Either the output record positions or the specified literals differ.

"TOO FEW FIXED CARDS"

A number was specified in the FIXED statement indicating that number of fixed format records would follow. An END-OF-FILE condition was found before that number was reached.

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SEQUENCE SPECIFICATIONS

ALTERNATE COLLATING SEQUENCE

To change the standard collating sequence, an "S" is coded in column 26 of the header specification and "ALTSEQ" is coded in the first six positions. As many ALTSEQ statements as needed may be used; each statement must begin with ALTSEQ and can contain a maximum of 96 positions.

NOTE: Do not use a packed or unpacked factor-1 in an include or omit record type specification (P or U in column 8) if the alternate collating sequence is specified.

CODING RULES

- 1) ALTSEQ is placed in the first six positions to indicate to disk sort that the standard collating sequence is being altered.

```

1 2 3 4 5 6
-----
|A|L|T|I|S|E|I|Q|I| | | | | | | | | |
-----

```

- 2) The next two positions are left blank.

```

1 2 3 4 5 6 7 8
-----
|A|L|T|I|S|E|I|Q|I|b|I|b|I| | | | | | | | | | (b = blank)
-----

```

- 3) Enter the hex equivalent of the character being taken out of normal sequence.

```

1 2 3 4 5 6 7 8 9 10
-----
|A|L|T|I|S|E|I|Q|I| |h|n|I| | | | | | | | | | (hn = hex number)
-----

```


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INPUT ORDER

Input to indicate use of the alternate collating sequence must be in the following order:

Sequence Specifications

- a. Header line
- b. ALTSEQ statements
- c. **
- d. Record type lines as required
- e. Field description lines as required

NOTES: A character being moved into a sequence position assigned to another character will occupy the same position and are considered equal (see ALTSEQ Statements, Example 1). If the characters are not to be equal, the character that normally occupies the position must also be moved (see ALTSEQ Statements, Example 2).

ALTSEQ statements can change:

1. Factor-1 and factor-2
2. Normal and opposite control fields
3. Control field characters before they are replaced or added to by forced fields

ALTSEQ statements cannot change:

1. Data fields in records
2. Forced control field characters

SAMPLE ALTSEQ STATEMENTS

Example 1: To change the sequence of one character:

ALTSEQ	ALTSEQ 40F0
Statements	**

Explanation: Blank (40) is moved to the position in the collating sequence occupied by zero (F0). Blanks and zeros are, therefore, considered equal.

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Example 2: To change the sequence of several characters:

ALTSEQ ALTSEQ 5BC8C8C9C9D1
Statements **

Explanation: 5BC8 moves \$ (5B) to the position occupied
 by H (C8).
 C8C9 moves H (C8) to the position occupied
 by I (C9).
 C9D1 moves I (C9) to the position occupied
 by J (D1).
 The \$ is inserted between G and H as follows:
 A,B,C,D,E,F,G,\$,H,I (I and J occupy the
 same position)

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FORCED-FIELD SORTING PROCEDURES

Defining a Conditional Force Character

1. Fill in columns 1-6 as they would normally be filled in.
2. Put an F in column 7.
3. Define the position of the control field for the input record in columns 13-16.
4. Enter the character that is to be replaced in column 17.
5. Enter the character that is to replace it in column 18.

Defining a Force-All Character

1. Fill in columns 1-6 as they would normally be filled in.
2. Put an F in column 7.
3. Put the character which replaces the control field in column 18.
4. Enter the character that is to be replaced in column 19. (The character entered in column 19 informs the disk sort that the line is a continuation of the preceding line.)
5. Leave columns 9-17 blank.

If a force-all line is not placed after a conditional force line and the sort program does not find the specified characters in the control field of the input record, the program

- * Replaces the control field character with 2FF2 if ascending sequence is specified in the header line.
- * Replaces the control field character with 2002 if descending sequence is specified in the header line.

Defining an Unconditional Force Character

1. Fill in columns 1-6 as they would normally be filled in.
2. Put an F in column 7.

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3. Put the character which replaces the control field in columns 18.
4. Leave columns 9-17 blank.

Specifying an Overflow Indicator Field

1. Fill in columns 1-6 as they would normally be filled in.
2. Put an S in column 7.
3. Put a V in column 8.
4. Enter a character in column 17 if replacement with an asterisk (*) is not desired. If overflow occurs in any summary data field in the record, the initial value of the overflow field is replaced by the character in column 17.
5. Enter a character in column 18. If none of the summary data fields overflow, the overflow field will contain the character specified in column 18.

NOTE: Only one overflow indicator may be defined for all record types.

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SAMPLE JOBS

SAMPLE JOB ONE

<header type> CONTROL 10
 <record type> INCLUDE (69 LEQ 40 6 DIGIT)
 <field type> KEY (7 4 A UA) (1 6 A UA)
 DATA (11 14 UA) (28 2 UA) (30 5)
 (46 5) (69 6) (81 6) (87 5)
 (92 5) (75 6)

SAMPLE JOB TWO

<header type> TAGSORT
 CONTROL 10
 <field type> KEY (7 4 UA) (1 6 DIGIT)

SAMPLE JOB THREE

<header type> DROP CONTROL
 CONTROL 7
 <record type> INCLUDE (7 LEQ "0130" 4 DIGIT) AND
 (7 GEQ "0126" 4 DIGIT)
 <field type> KEY (7 4 UA) (97 3 D DIGIT)
 DATA (1 6) (7 4) (97 3) (106 6)

SAMPLE JOB FOUR

<header type> CONTROL 13
 <record type> INCLUDE (1 EQL "R" UA)
 <field type> FORCEKEY ("1")
 KEY (6 6 DIGIT)
 DATA (2 4) (12 5) (17 6) (23 5)
 <record type> INCLUDE (1 EQL "I" UA)
 <field type> FORCEKEY ("2")

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KEY (2 6 DIGIT) (28 6 DIGIT)
 DATA (8 5) (13 7) (20 8) (34 1) (35 5)

<record type>

INCLUDE (1 EQL "A" UA)

<field type>

FORCEKEY ("3")
 KEY (2 6 DIGIT)
 DATA (8 1) (9 5) (24 4) (18 6)

SAMPLE JOB FIVE

<header type>

SUMMARIZE
 CONTROL 6

<record type>

INCLUDE (1 EQL "A" UA)

<field type>

KEY (2 6 UA)

SAMPLE JOB SIX

<header type>

SUMMARIZE
 CONTROL 7

<record type>

INCLUDE (1 EQL "I" UA)

<field type>

KEY (13 7 UA)
 FORCEDATA (" ") ("#")
 SUMMARYDATA (40 3 DIGIT)
 FORCEDATA (" ") ("\$")
 SUMMARYDATA (43 8 RSA)
 OVERFLOW (X)

SAMPLE JOB SEVEN

<header type>

DROP CONTROL
 CONTROL 8

<record type>

DELETE (23 EQL "X")
 INCLUDE

<field type>

KEY (15 8 RSA)
 DATA (1 23 UA)

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SAMPLE JOE EIGHT

FILE INVENTORY (DISK DEFAULT) INVYR04 (TAPE 111 10) INVYR03
 (TAPE 111 10) INVYR02 (TAPE 111 10) INVYR01
 (TAPE 111 10) OUTPUT (DISK DEFAULT)

<header type> CONTROL 13

<record type> INCLUDE (7 EQL "0126" 4 DIGIT) AND
 (87 EQL "00023" 5 DIGIT) OR
 (7 EQL "0126" 4 DIGIT) AND
 (87 EQL "C00108" 6 DIGIT) OR
 (7 EQL "0126" 4 DIGIT) AND
 (87 EQL "C1120" 5 DIGIT)

<field type> KEY (104 2 A UA) (87 5) (1 6 DIGIT)
 DATA (7 4) (97 3) (106 6)

SAMPLE JOE NINE

<header type> CONTROL 6

<record type> INCLUDE (44 EQL "+" DIGIT) AND
 (87 LEG "1" RSN) AND :Displacement is
 :specified in half
 :bytes
 (87 GTR "0" RSN) AND :Displacement is
 :specified in half
 :bytes
 (45 EQL "2" ZONE) AND
 (45 EQL "8" DIGIT)

<field type> KEY (1 6 DIGIT)
 DATA (7 105 UA)

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DATA STRUCTURES

DYNAMIC MEMORY USAGE

Dynamic memory is allocated from two stacks which run together. Permanent memory spaces are at low address (the beginning of dynamic memory) locations. Temporary spaces are allocated from the limit register down and each piece has an associated length field of 16 bits. This allows temporary chunks to be returned either one at a time in a LIFO manner or all at once. Returned areas are zero filled.

Permanent space is used for ID.KEYS, F.KEYS and the collate table. Temporary memory is used for record buffers, temporary constants and all short duration items.

The default size for dynamic memory is 32000 bits and is sufficient for most runs. Should this prove insufficient, however, SORT/UTILITY will terminate after displaying the message:

NEEDS AT LEAST <X> BITS MORE DYNAMIC MEMORY.

X is the exact amount of additional memory required for that one specific allocation to succeed. A future run given $32000 + X$ will successfully process beyond that point but subsequent allocations may halt SORT/UTILITY again.

Since dynamic memory usage in SORT/UTILITY is dynamic, and pieces are returned and retrieved often, no exact figure can be calculated for the total required.

LINKED DATA STRUCTURES

A linked list structure is created internally by SORT/UTILITY and stored in permanent dynamic memory. It is created from the input specifications and used in processing the work and output files. The linked list is made up of "KEYS". There are two types of keys: the ID.KEY which holds all information needed to describe an INCLUDE/DELETE type statement and the F.KEY which holds all information needed to describe a field type statement (i.e., KEY, FORCEKEY, DATA, FORCEDATA, SUMMARYDATA, or OVERFLOW).

There are various chains running through the linked list (see figure D-1). The primary chain links are ID.KEY and F.KEY entries. The head of this chain is called ID.HEAD. ID.HEAD points to the first ID.KEY. All ID.KEY's are linked together by

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the field ID.LINK. The ID.F.LINK field of each ID.KEY links F.KEYS to their associated ID.KEY's. That is, all ID.KEY's describing INCLUDE/DELETE statements of the same record type have the same ID.F.LINK pointer. This ID.F.LINK pointer points to the first F.KEY describing a field statement for this record type. F.KEY's of a record type are linked by the F.LINK field. A value of -1 indicates the end of a linked list.

The summary keys chain is initially pointed to by the pointer S.HEAD. This chain is made up of F.KEY entries describing SUMMARYDATA statements of the first record type description containing SUMMARYDATA or OVERFLOW statements. These are the SUMMARYDATA statements that define any summarizing to be performed.

The OI.PTR field points to an F.KEY describing an OVERFLOW statement, if there is one. This statement must also be defined in the first record type description containing summary information. If both S.HEAD and OI.PTR have a value of -1, there are no SUMMARYDATA or OVERFLOW statements in the input specifications.

At a minimum, there will be one ID.KEY and one F.KEY entry in this linked list structure. One extra ID.KEY entry will exist which will not represent an INCLUDE/DELETE statement, unless the last INCLUDE/DELETE was an INCLUDE ALL statement or an implied INCLUDE ALL situation existed. In other words, if there are no INCLUDE or DELETE statements in the input specifications, there will be only one ID.KEY entry in the linked list representing an INCLUDE ALL. If the last INCLUDE/DELETE was an INCLUDE ALL statement, the number of ID.KEY entries will equal the number of INCLUDE/DELETE statements. In all other cases there will be one more ID.KEY entry than INCLUDE/DELETE statements, and the extra will be the last ID.KEY.

The last ID.KEY entry of the list will only point to F.KEY entries (by way of its ID.F.LINK field) if it represents an INCLUDE ALL situation or statement.

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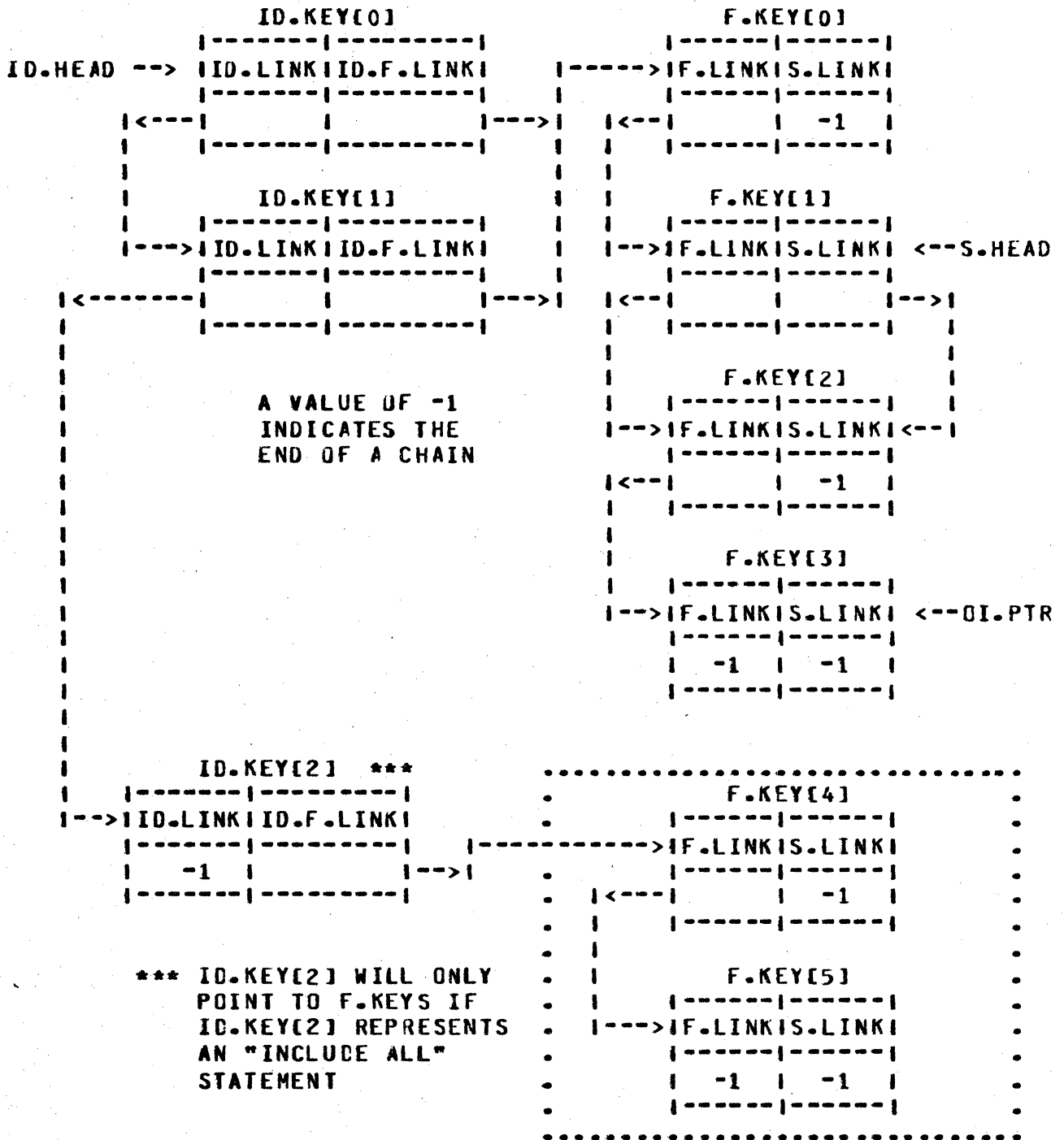


Figure D-1: INTERNAL KEYS CHAIN AFTER SYNTAX PHASE

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RECORD PROCESSING

IAGSORT

Work records are built with keys on the right and relative record pointers on the left. Relative record pointers are eight decimal digits, 4 bytes, long. SORT is called with the work file as input and the output file as output. The keys are truncated when the output file is written because its record size is four characters. No output pass is done.

RECORD

Work records are built with input file number, relative record pointer, record type key pointer, and keys. SORT is called with input and output file of WORK. An output pass uses information from the work records to create the output records by tagsearching the original input records.

SUMMARY

Processing is the same as a record sort except during the output pass. The key of each work record is compared to the next. When they are equal, the summary fields are added together. An output record is written when they are not equal.

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FILE ATTRIBUTE ASSIGNMENT PRECEDENCE

File equates specified at execution time will override file statement specifications for the following attributes:

RECORD SIZE
RECORDS PER BLOCK
BLOCKS PER AREA
AREAS
NAME
HARDWARE

The file statement will override for the following attributes:

CODE TYPE
PARITY
MULTI PACK

Missing attributes, those not specified by file equates or a FILE statement, will be given SDL defaults unless the file is on disk. If the file is on disk, the attributes will come from the disk file header. The SDL defaults will be taken from the FPB of a file with the internal name of "DEFAULT".

Output files specified as DISK DEFAULT will get default attributes from the first input file if it resides on disk. Otherwise, assignment rules are identical to those described above.

If the file is to be included in SORT/UTILITY's input data, either the name field, `FBP.NAMES`, or the hardware field, `FBP.HCWR`, must be altered in an input file's FPB.

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RESTART PROCEDURES

If the statement "RESTART" is specified in the input specifications, the SORT/UTILITY run will be made "restartable". This allows the user to restart the job at various points in case of an abnormal terminate. A SORT/UTILITY run is restarted by specifying "RESTART" followed by the abnormally terminated SORT/UTILITY's job number.

A SORT/UTILITY run is divided as follows:

FIRST PASS	SYNTAX ANALYSIS INPUT FILE VERIFICATIONS GENERATION OF WORK FILE
	SORT
SECOND PASS: (last pass)	GENERATION OF OUTPUT FILE

If the SORT/UTILITY run has been specified as restartable, and the program abnormally terminates before the end of the first pass, the restarted job will resume at the beginning of the first pass.

If the job abnormally terminates during the SORT phase, the restarted job will RESTART the SORT phase, skipping everything in the first pass except the syntax analysis.

If the SORT/UTILITY run abnormally terminates in the last pass, the restarted job will resume at the beginning of the last pass, skipping everything before that except the syntax analysis. The syntax analysis will always be performed.

When a job is being restarted, it is also being made restartable.

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PROGRAM SWITCHES

- SW0=1 Causes the specifications (usually a CARDS file) to be read from the accept queue. A blank accept terminates the input.
- SW1=1 If errors are detected in the specifications, they will be written to the ERROR.LINE file.
- SW2=1 This switch setting makes the SORT restartable, and, if the last 24 bits of the program switches are not zero, a restart of the specified job number is effected. This cannot be used when debugging.
- SW3 Debugging
- =1 Trace (print) all of the conditional halts to the LINE file.
 - =2 Print all tokens found by GET.TOKEN.
 - =4 Print contents of keys and FPB's when they are accessed.
 - =8 Allows halting at a sequence number specified in the rightmost 24 bits of all the program switches. Combinations of values may be used.

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COMPILING

SORT/UTILITY specifications can be compiled in the same manner as the SORT program. The object file generated can then be executed to initiate a SORT/UTILITY run using the compiled specifications. The statement required is:

```
CO <object file name> [WITH] SORT/UTILITY [LI] [SA] ;  
[SY]  
  
FI CARDS NAME <input specifications file name> ;
```

NOTES: 1. Brackets, [], denote an optional item.
2. See the Software Operational Guide syntax for the COMPILE statement.

File equates can be used with the generated object file to alter input or output file specifications. Program switches can be used to specify RESTART when using this compiling method (see Appendix H on Program Switches).

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