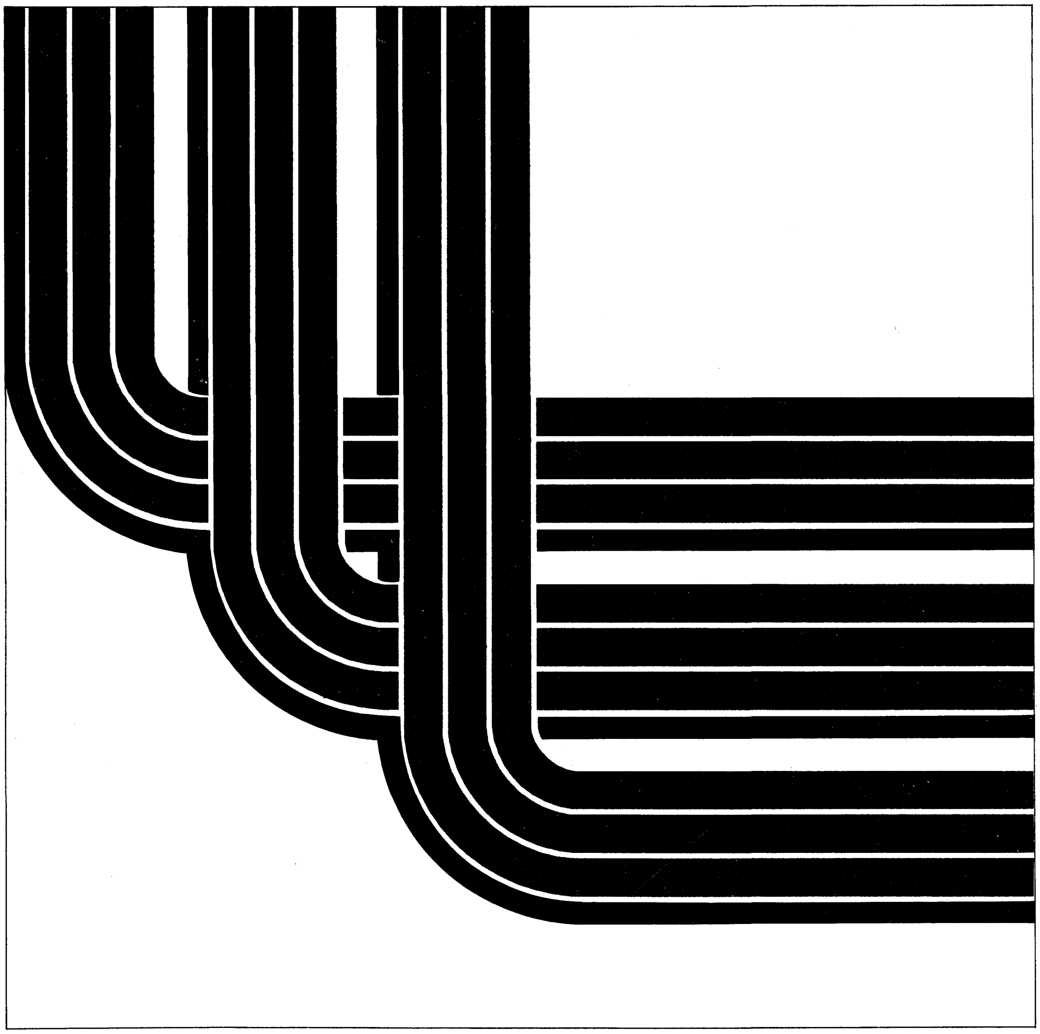
Application System/400™

SC09-1363-00

Utilities: Sort User's Guide and Reference

Version 2



Application Development

Application System/400™

SC09-1363-00

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Note!

Before using this information and the product it supports, be sure to read the general information under "Notices" on page vii.

First Edition (May 1991)

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About This Manual

This manual describes the Application System/400* (AS/400*) Sort utility, which is a function of the Operating System/400* (OS/400*) system. It contains a general description of the Sort utility, specific descriptions with examples, and detailed reference information. This book tells you how to use the Sort utility to select records from existing files, sort and reformat them, and then store the result. Topics covered also include copying records, merging records from several files, summing data in the selected records, and sorting double-byte character set (DBCS) data.

You may need to refer to other IBM manuals for more specific information about a particular topic. The *Publications Guide*, GC41-9678 provides information on all the manuals in the AS/400 library.

For a list of related publications, see the "Bibliography" on page 161.

Who Should Use This Manual

This manual, the *Utilities: Sort User's Guide and Reference*, SC09-1363, is written for programmers who wish to design and code Sort jobs, and for the system operators who may run these jobs.

To use this manual effectively, you must know how to use your work station, understand and use messages, and have a general knowledge of the AS/400 system.

If you are not familiar with your work station, refer to the specific manual for your work station.

If you are new to the AS/400 system, and have no knowledge of how it works, use the *New User's Guide*, SC41-8211.

Part 1. User's Guide

Part 1 contains the information you need to use the Sort utility, presented in the order in which you would normally use it. The first chapter contains a general description of Sort, while Chapters 2 to 6 describe individual functions and provide examples.

The following topics are covered:

- Chapter 1, "Introduction"
- Chapter 2, "Sorting Records from a Single File"
- Chapter 3, "Sorting Records from Several Files"
- Chapter 4, "Sorting Records from a Single File to Produce a Record Address File"
- Chapter 5, "Sorting Records from a File and Producing Totals"
- Chapter 6, "Copying and Merging Records from Several Files into One."

Chapter 1. Introduction

This chapter contains a general description of the Sort utility and of what you should know when you use it. It covers:

- The functions of the Sort utility
- How to use the Sort utility
- How to enter the Sort specifications
- The contents of the source file in which you enter the specifications
- How to process the specifications
- Related concepts for using the Sort utility
- How to know if your sort program runs successfully.

The Sort utility provides a large range of sorting and reformatting possibilities; to copy and merge files; or to add information, sum data, and reference existing records in other files.

General Description

Use the Sort utility to sort and reformat records. You work with Control Language (CL) commands to enter and then process the appropriate instructions. With Sort, you can:

- ***Sort records from one file*** (called the input file) ***and store the result in a single physical output file***. This output file is called a physical file because it contains the actual records that were sorted. You can also divide the input records into fields, and reformat (select and rearrange) those fields in the output records.

  See Chapter 2, "Sorting Records from a Single File," for examples.

- ***Sort records from several input files and store the result in a single physical output file***. You can also divide the input records into fields and reformat them in the output records.

  See Chapter 3, "Sorting Records from Several Files," for examples.

- ***Sort records from a single input file and store the result in a single record address (RA) output file***. This output file does not contain the actual records that were sorted; rather, it contains a sorted list of addresses of the records in the original input file. This has the advantage of keeping the sorted result up to date for changes to previously existing records. However, if you add or delete records from the input file, the RA file does not have the addresses for the new records, and will still contain the addresses of the old records.

  See Chapter 4, "Sorting Records from a Single File to Produce a Record Address File," for examples.

- ***Produce an output file containing totals***, rather than sorted or reformatted records.

  See Chapter 5, "Sorting Records from a File and Producing Totals," for examples.

- ***Copy and merge*** records from several files into one file.

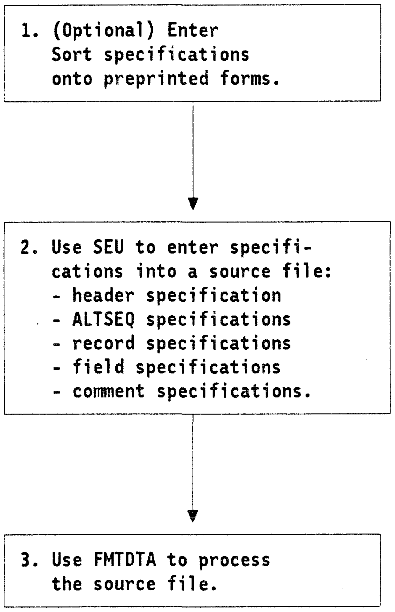
  See Chapter 6, "Copying and Merging Records from Several Files into One," for examples.

How to Use Sort

Perform the following steps:

1. Fill in the appropriate Sort specifications manually on preprinted forms. (This step is optional. You can begin directly with step 2.)
2. Use the Source Entry Utility (SEU) to enter the specifications into a source file.
3. Use the Format Data (FMTDTA) command to process the specifications. You do this by entering the CL command, FMTDTA, followed by the appropriate options.

Figure 1 shows these steps and also gives the order of the specifications in the source file. Figure 2 on page 5 shows what happens when you use the FMTDTA command to process a source file.



1. (Optional) Enter Sort specifications onto preprinted forms.

2. Use SEU to enter specifications into a source file:
   - header specification
   - ALTSEQ specifications
   - record specifications
   - field specifications
   - comment specifications.

3. Use FMTDTA to process the source file.

Figure 1. Steps in Using Sort

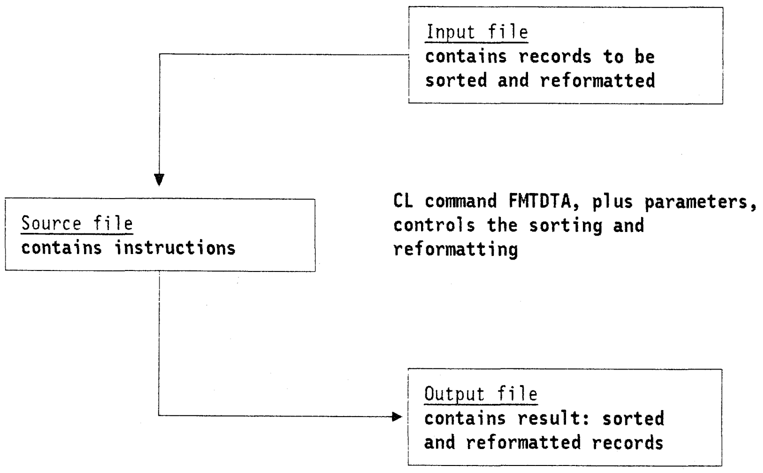

Input file
contains records to be sorted and reformatted
Source file
contains instructions
CL command FMTDTA, plus parameters, controls the sorting and reformatting
Output file
contains result: sorted and reformatted records

Figure 2. The Sort Process: What Happens in Step 3 of Figure 1-1

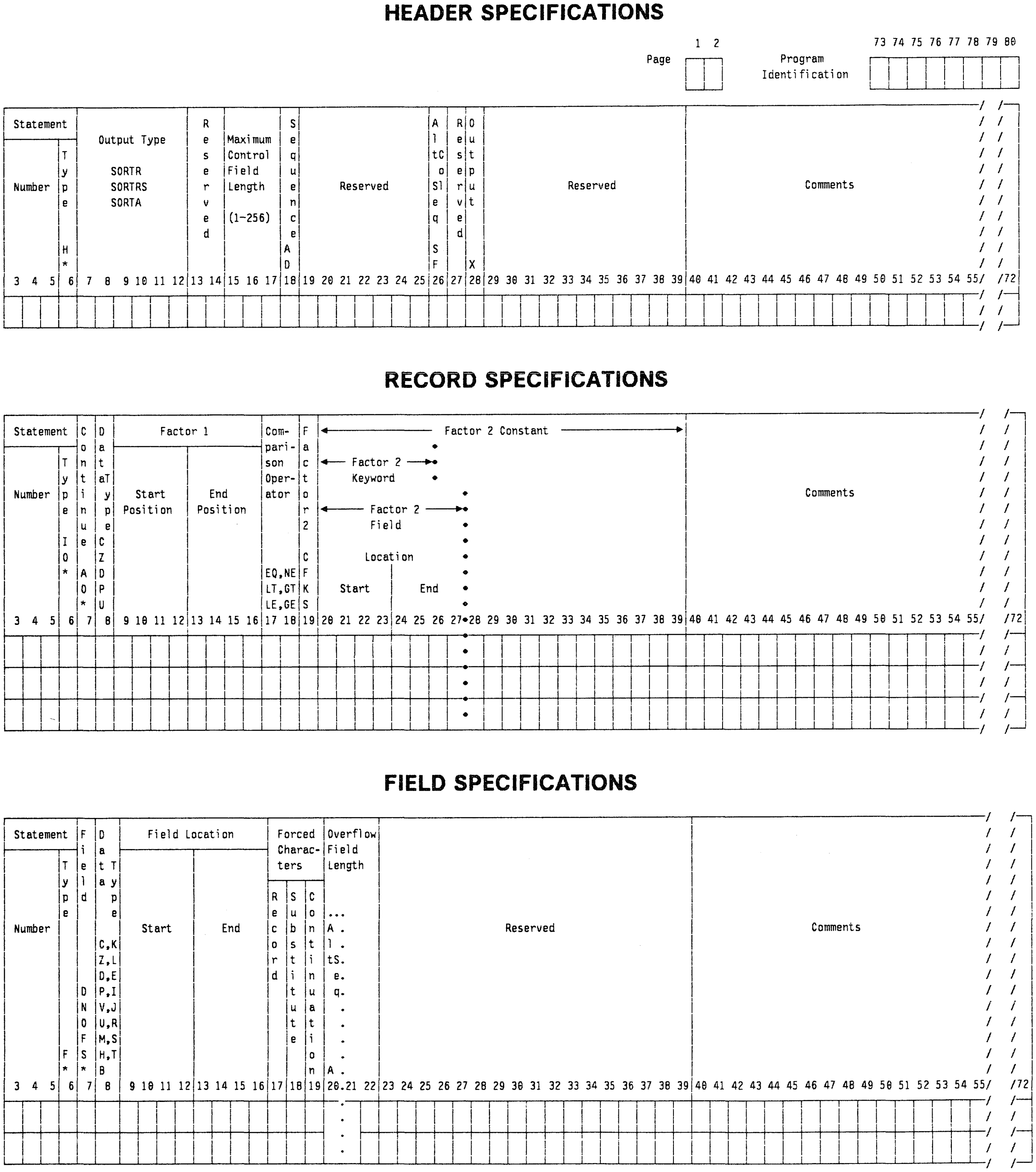
Entering the Sort Specifications

There are two ways to enter Sort specifications:

- Complete the appropriate specifications forms and submit them to be keyed into the system.
- Use the Source Entry Utility to enter the specifications directly.

Specifications Forms

The three Sort specifications forms are shown in Figure 3 on page 6 and are followed by a description of how to complete them.



HEADER SPECIFICATIONS

Page (1 2) □□ Program Identification (73 74 75 76 77 78 79 80) □□□□□□□□

Statement Number	Type H *	Output Type SORTR SORTRS SORTA	Reserved	Maximum Control Field Length (1-256)	Sequence A D	Reserved	Alt Col Seq S F	Reserved	Output X	Reserved	Comments
3 4 5	6	7 8 9 10 11 12	13 14	15 16 17	18	19 20 21 22 23 24 25	26	27	28	29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72

RECORD SPECIFICATIONS

Statement Number	Type I O *	Continue A O *	Data Type C Z D P U	Factor 1 Start Position	Factor 1 End Position	Comparison Operator EQ,NE LT,GT LE,GE	Factor 2 C F K S	Factor 2 Constant • Factor 2 Keyword • Factor 2 Field Location Start	End		Comments
3 4 5	6	7	8	9 10 11 12	13 14 15 16	17 18	19	20 21 22 23	24 25 26 27	•28 29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72

FIELD SPECIFICATIONS

Statement Number	Type F *	Field D N O F S *	Data Type C,K Z,L D,E P,I V,J U,R M,S H,T B	Field Location Start	Field Location End	Forced Characters Record	Forced Characters Substitute	Forced Characters Continuation A	Overflow Field Length ... A . l . tS. e. q. . . . . A .	Reserved	Comments
3 4 5	6	7	8	9 10 11 12	13 14 15 16	17	18	19	20.21 22	23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72

Figure 3. Sort Specification Forms

When completing the fields in these specifications, all entries must be right-justified in the spaces provided, unless otherwise indicated in the description. If you enter anything that is not right-justified, the system pads your entry with zeros. Entering a 1 that is not right-justified, for example, could be interpreted as a 10 or a 100, depending on where you place it in the field.

Entering Specifications Interactively

Use the Source Entry Utility (SEU) to enter source statements. Enter the specifications for a particular sort job into a member of a source file with SEU.

SEU is accessed through the CL command STRSEU. The *Application Development Tools: Source Entry Utility User's Guide and Reference* describes how to use the Source Entry Utility.

Contents of the Source File

The sort specifications you enter are stored in a member of a source file. The types of specifications and the rules regarding the sequence in which they must appear are described below.

Types of Specifications

There are five types of Sort specifications you can use to describe what you want sorted and how:

- The ***header specification*** describes general information such as output file type and collating sequence used. There must be only one for each sort job. Chapter 8, "The Header Specification," describes all the possible entries.
- The ***ALTSEQ specifications*** are optional. If you want a collating sequence other than the standard one, use these specifications to describe your alternative collating sequence. Appendix C, "Standard and Alternative Collating Sequences" describes the standard EBCDIC collating sequences and how to code ALTSEQ specifications.
- The ***record specifications*** identify the input records you want to include or exclude from the sort. Chapter 9, "Record Specifications," describes all the possible entries.
- The ***field specifications*** identify the control fields and the data fields on the input record that you want included in the output record. Chapter 10, "Field Specifications," describes all the possible entries.
- The ***comment specification*** allows you to place comment entries throughout your sort program to make its purpose and process clearer for yourself and other users. There is no special form for a comment specification: entering an asterisk into column 6 or 7 of any of the specifications automatically identifies the specification as a comment. Chapter 11, "The Comment Specification," provides details.

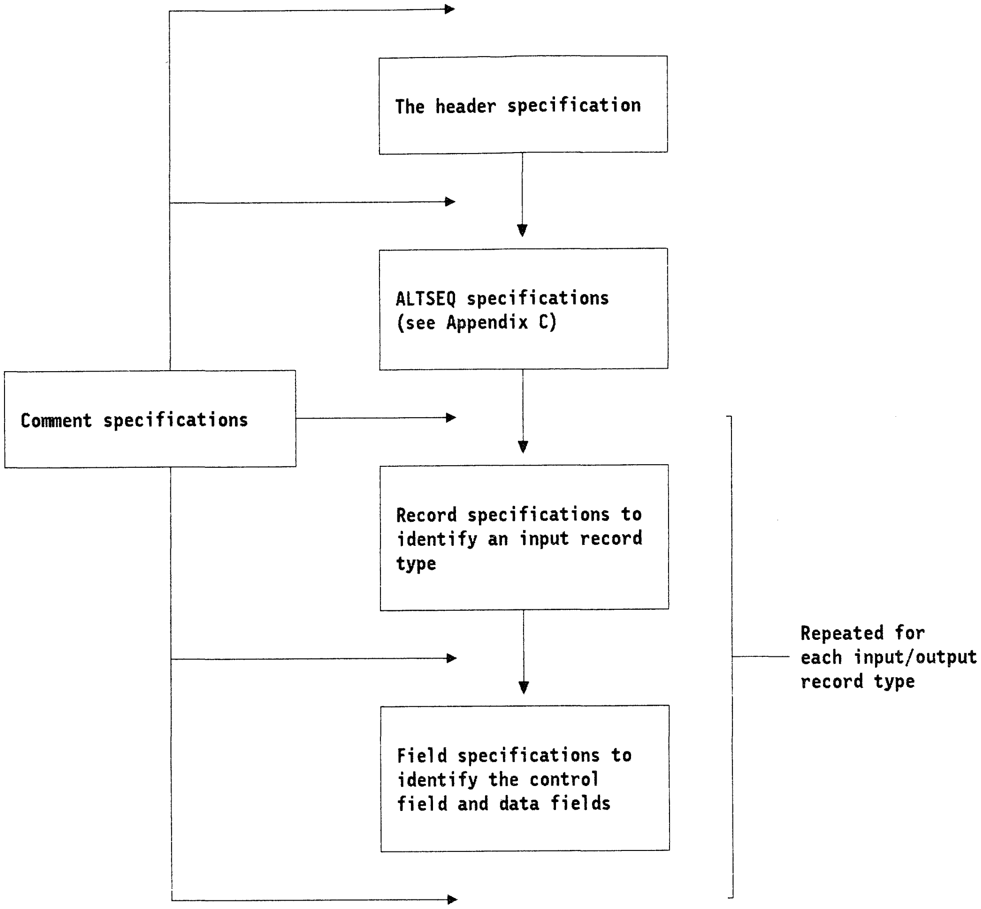

The header specification
ALTSEQ specifications (see Appendix C)
Comment specifications
Record specifications to identify an input record type
Field specifications to identify the control field and data fields
Repeated for each input/output record type

Figure 4. Order in Which You Should Store Sort Specifications in the Source File. You may insert comment specifications where they are most useful.

Sequencing the Specifications

The Sort utility orders the specifications by occurrence in the source member. This order, shown in Figure 4, is:

1. The header specification.
2. ALTSEQ specifications, if any. (These specifications are optional.)
3. One or more record specifications.
4. One or more field specifications for each record specification. Follow the record specification by the field specifications that pertain to it.

Repeat steps 3 and 4 for each input/output record type desired.

The Purpose of Record and Field Specifications

Together, record and field specifications determine the records to be sorted, the sorting order, and the information that will be written to the output file.

If all input records are to be sorted in the same way, no record specifications need to be entered: the field specifications are entered by themselves and apply to all input records. A sort program could thus consist of only two specifications: a header specification, and a field specification to define the control field. When run, all input records would be sorted according to the data in the control field.

Record Types

Record specifications define which records are to be selected from an input file. At least one record specification (each grouping is called a ***set***) is needed to define a type of record.

Entering the first of a series of record specifications signals the start of a new record type. Any difference in the way an input record is to be selected or an output record is to be organized is considered a new record type, and requires a new set of record specifications. There are two main differences:

- **Input record type.** Differences in the criteria by which input records are to be selected. You enter a set of record specifications to identify each set of criteria.
- **Output record type.** Differences in the field specifications for an input record type. You must precede each set of field specifications by the appropriate record specifications, even if those record specifications are the same as the set previously entered.

Selecting Control and Data Fields—Building the Output Record

Each set of record specifications is followed by a series of field specifications. The field specifications select the fields from the input records and specify if and how they are to be changed. These input fields can either be data fields, or can become part of the control field. One or more field specifications may be needed for each field.

The order of the field specifications in the source file determines the order of the fields in the output records. For example, to move a field from the end of the input record to the beginning of the output record, place its field specification first in the source file, before any other. This way, you can select any portion of the input record, change it, and place its data anywhere in the output record.

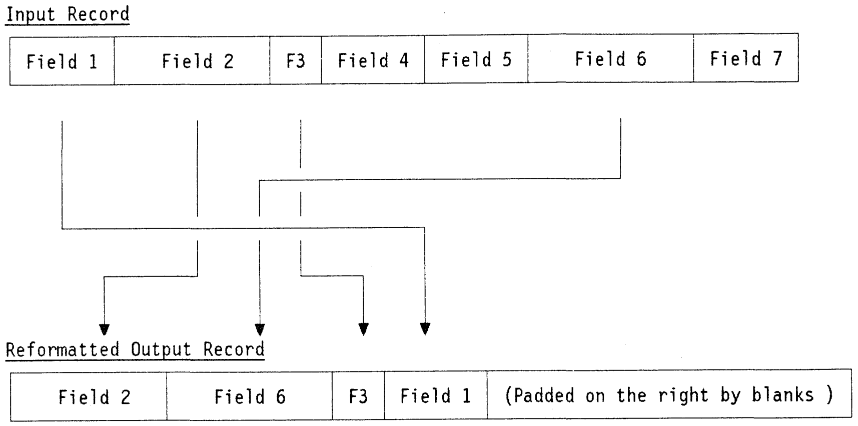


Figure 5. An Example of How Sort Builds an Output Record. The output record is padded on the right by blanks to make its length equal to the output file.

Building the Control Field

The control field is specified like any other field; however, its contents control the sorting. For example, to sort a series of input records in ascending order, Sort orders them by the contents of their control fields so that records whose control field contents begin with an 'A' would precede those whose control field contents begin with a 'B'.

Construct one control field for each sort job. For different input record types, however, you can combine different elements from the input record into the one control field. (The next section, "Using FMTDTA to Process the Specifications" on page 11, describes how the Sort utility uses the control field to sort input records.)

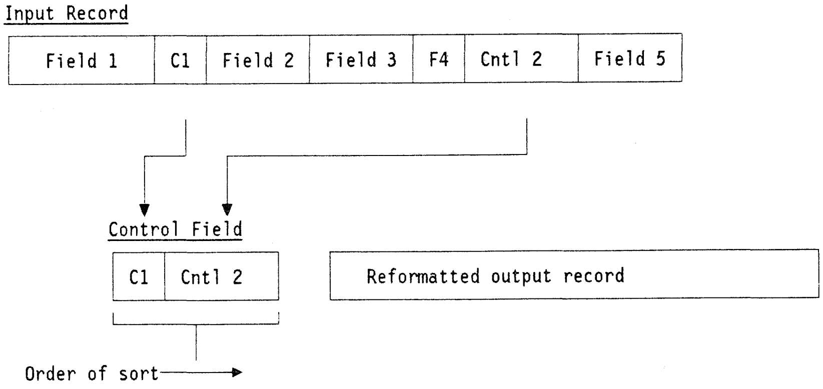


Figure 6. An Example of How Sort Builds a Control Field. The control field is then used as a key to sort the reformatted output record.

The Data Description

Field specifications allow you to completely restructure input records and build output records, and sort them in any way you choose. To enable you to do this, the Sort utility ignores the data description already associated with the files it processes. It treats both input and output files as unformatted strings of bytes; the length of the string is determined by the record length.

As part of the sort specifications, therefore, you must define the input fields and the output fields, and specify their start and end positions. Sort then divides the data in the files according to these specifications, and sorts and reformats the input records accordingly.

Ensure that the lengths of the fields you specify match the data in the file. For example, if positions 5 to 10 contain a date and positions 11 to 32 contain a name, the start and end positions of your fields will probably be 5, 10, 11, and 32.

Using FMTDTA to Process the Specifications

Once the specifications for a particular job have been entered in a source file, use the FMTDTA command and its parameters to run Sort. Refer to Chapter 7, "The Format Data (FMTDTA) Command," for a complete description of how to use this command.

Note: Running a sort job never changes your input files unless you specify the input file as the output file.

As a Line Command

Enter the command followed by the name of the file containing the records to be sorted (input file), and the name of the file to contain the sorted records (output file). For example:

```
FMTDTA INFILE((FILE1)) OUTFILE(FILE2)
```

where FILE1 is the input file, and FILE2 is the output file.

Because no source file is identified here, the system assumes the source specifications are stored in the first member of the default file, QFMTSRC, found in the library list. Because no libraries or members have been specified for input or output files, the system automatically defaults to the current library and the first member of each file. If you want to specify another library or member, enter the name of each in the following way:

```
FMTDTA INFILE((LIBRAR1/FILE1)) OUTFILE(FILE2 MEMB3)
         SRCFILE(LIBRAR2/FILE3)
```

Here, the input records are taken from the first member of file FILE1 in library LIBRAR1, and the output records are put into member MEMB3 of file FILE2 in the current library. The source specifications are taken from the first member in file FILE3 in library LIBRAR2.

To specify a member in the source file, add another parameter to the FMTDTA command. For example, to specify member MEM2 in the source file, enter:

```
FMTDTA INFILE((LIBRAR1/FILE1)) OUTFILE(FILE2 MEMB3)
          SRCFILE(LIBRAR2/FILE3) SRCMBR(MEM2)
```

From Screen Displays

To enter FMTDTA and its parameters from a prompt display, change the values on the FMTDTA screen that apply to your particular case and press Enter to run the command. Chapter 7, "The Format Data (FMTDTA) Command," describes this method.

What Happens when You Use the FMTDTA Command

The following section provides a general description of processing:

1. ***Select records***. The FMTDTA command first processes the information in the header specification, and copies each input file into a work area in main storage. Only those records that are identified by the selection criteria on the record specifications will be copied.

   Be aware that once the records matching one record type are selected, they are no longer accessible for further selection. Thus, the number of input records available for processing decreases with the specification of each new record type. This method of selection can be regarded as a limitation, but it also means that, by arranging your record types carefully, you can maximize the sort process by entering a minimum number of specifications.

2. ***Reformat records***. The utility then restructures each input record according to the data field specifications for the record type. It takes sections of the input record, then changes and repositions them to create the output record.

3. ***Putting together the control field***. For each record type, you can specify one or more elements (from the input record) to make up the entire control field. The total length of all these elements must not exceed the length entered in columns 15 through 17 of the header specification.

4. ***Sort records***. The output records, stored in their own separate work area, are sorted according to the collating sequence specified and according to the contents of the control field.

   The control field is used as a key. Its size is determined by the entry in columns 15 through 17 of the header specification. The data that is placed in this control field during the reformatting process is determined by the control field specifications, and can be formatted differently for each record type.

5. ***Store records***. The result is stored in a physical file.

If no record or field specifications are entered, FMTDTA does no sorting or reformatting, and the process becomes one of copying and merging records from one or more input files into an output file.

The Sort utility does not require unique control fields. If duplicate control field values are found in the input records, those records will appear in a group in the output file, in the same order that they were found in the input file.

Related Concepts

The following concepts are useful in understanding how the Sort utility works.

Files and Work Areas

Sort can work with files on diskettes, disks, and databases. The following files and work areas are used:

- ***Up to 8 input files***. The input files can be any combination of physical, logical, or diskette unit files.
- ***One source file***. This file contains the specification statements.
- ***Work area***. A work area is automatically built and deleted by the Sort utility during the processing of sort requests. It is not needed or created for copy-only requests.
- ***One output file***. The output file is an existing physical file.
- ***One print file***. This file contains a listing of the source file with any errors and/or messages.

Input Files

The input files used by the Sort utility must follow these rules:

- Normal AS/400 security is in effect for all input files. The user using the utility must have use and read authority for the input files.
- The Sort utility defaults to a shared-read lock on the input file. If you want to restrict other users' access to the input file while the utility is running, you must override the locked state with the CL command Allocate Object (ALCOBJ). You must issue this command before FMTDTA. The Deallocate Object (DLCOBJ) command can be used to return files to their original locked state.
- You must provide the name of the input file in the FMTDTA command, as described in Chapter 7, "The Format Data (FMTDTA) Command." The utility can be directed to a different file with a suitable override command.
- All input files are opened for sequential processing only. This means that for database files:
  - physical files or nonkeyed logical file records are read in arrival sequence
  - keyed logical file records are read in key sequence.
- Multiple input files are processed in the order specified in the FMTDTA command.
- All input record lengths should be equal. If they are different lengths, the shorter records may be padded on the right with data from previous longer records.
- If a device file is specified as the input file, the record length defined for the input records should not exceed the physical limitations of the device specified. If the record length does exceed the physical limitation of the specified device, undesirable results can occur.

- The record format information given in the specifications is not checked against the system data description associated with each input file, except for record length considerations.
- The Sort utility can process, as input files, both regular input files and other source files (those with the file type *SRC). Be aware that data management adds 12 bytes of sequence information and data to the front of every record in a source file. Thus, when using such a file as input, the actual data you may want to sort begins at byte 13.

Output File

The following rules apply to the file containing the output produced by the Sort utility:

- You must create the output file and member before running the Sort utility. The utility checks for the presence of this file and member; if neither exists, an error message is issued.

  Note: The output file in the database can have either a keyed or an arrival sequence access path. Depending on the specified application, a keyed access path to the output file may be redundant, and can cause the Sort utility to run more slowly.
- The sum of the field lengths specified for each record in the output file should be consistent with the record length of the output file. If the reformatted record length is less than the output file record length, the file will contain left-justified data and will be padded on the right with blanks. If the reformatted record length is greater than the output file record length, the output record will be truncated (on the right) to the file record length.
- The data description of the output file, though not used by the Sort utility, becomes the data management view of the output data. The string of data constructed by the utility should correspond to this associated data description.
- Normal AS/400 security is enforced for the output file. You must have the proper authority to clear and write into the file and member.
- The Sort utility defaults to a shared-update lock on the output file. If you want to restrict other users' access to the output file while the utility is running, you must override the locked state with the ALCOBJ command. This command must be issued before the FMTDTA. The DLCOBJ command can be used to return the output file to its prior locked state.
- The names of the output file and member are specified by FMTDTA. The utility opens this file name and member, although you can use an override command to redirect the output to a different file.

Note: The same physical database file and member name can be specified for both the output file and one of the input files. Here, the output data is written over the input data. The Sort utility clears the output file member so that it contains no records before output is written to the file (except for copy-only requests). If a major failure occurs between clearing the file member and writing the resequenced data records to the file member, your input data (and your sorted data) will be lost. Thus, make sure that this file member has adequate backup.

Work Area

Sort internally creates a work area to accommodate the input records and codes generated during the sorting process. The work area resides in a temporary work library, and is only accessible to the program that is being run. The area is automatically deleted at the end of the job.

Copying the input records into a work area and then working with only the copied records allows several programs to use the same input files at the same time. This is also the reason the input files are not altered by the Sort utility.

The work area is not created for copy-only requests.

Source File

The sort specifications are considered to be source input, and must therefore come from a source file (either a database or a diskette unit file). The name of the source file from which the sort specification set comes is specified as a parameter to the FMTDTA command. If the specified name is not a source file, an error condition occurs. You can use an override command to redirect the utility to another source file.

Print File

If the *PRT or *DUMP options of FMTDTA are selected, a print file can be identified to store information about the sort job. All the print data is directed to this file. The file that is specified must already exist before running Sort; otherwise, an error condition occurs.

If a print file is not specified, print output is sent to QSYSPRT, the system print file by default.

Input and Output Record Format

Any file that is used as input or output by the Sort utility can have a detailed record format description associated with it. This description specifies detailed field-level information, which is used by data management in performing field-level manipulations. This information is not used by the Sort utility, and does not affect the processing of the sort specifications.

The Sort utility receives a string of bytes as input from data management, and sends a string of bytes back to data management for placement in the output file. The field-level view used for processing by the Sort utility is defined by start and end positions in the specifications.

This field-level view is used only by the Sort utility, and does not have to match the one used by data management. However, inconsistencies can occur if the two views are not compatible; for example, if only half of a data field is selected by the Sort utility, only half of the original field will appear in the output record. Also, if a field that was originally defined to data management as a *character field* is specified by the Sort utility as a *numeric field*, the output may not be as you expected.

Limitations on the Number of Records for Copy-Only Requests

The Sort utility can copy an unlimited number of records, provided enough storage is available.

Although the Sort utility does generate tables during a copy-only request, the storage these tables occupy is insignificant in comparison to the amount of auxiliary storage available for the output file. To determine the approximate number of records you can copy, subtract 100 000 bytes from the amount of auxiliary storage you have available for your output file, and divide the remainder by the length of the records you are copying.

Limitations on the Number of Records for Sort Requests

The number of records that can be processed by a sort (as opposed to a copy-only) request is also restricted by the amount of auxiliary storage available. For sort requests, this amount must be sufficient to hold both the output file and the work area constructed during sorting.

1. ***Determine the length of the work records*** that occupy the work area for a sort request by adding together the following:

   - The length of the output record
   - The total length of the control field elements that the Sort utility uses
   - The value 4 for the 4-byte binary relative record number that the utility supplies for each work record.

   For sort requests that produce record address (RA) files as output, only the last two items in this list are included in the record that is transferred to the work area.

2. ***Determine the number of records in the work area.***

   The number of records in the work area is equal to the number of output records in the output file. Both are determined by the number of records selected (using either select or omit record specifications) from the input file. If no select or omit specifications exist, all the input records are present in the work area and in the output file. (For RA output, the actual data is not present; instead, there is a record address entry for each input record.)

3. ***Multiply the work record length by the number of work records*** in the work area to determine how much work area storage is needed for the work records.

4. ***To this, add two million bytes*** to determine the total work area space needed by the Sort utility.

   For example, if you have determined that there are 5 000 work records that are each 150 bytes long, the total storage required for the work records is 750 000 bytes. The work area would then require 2 750 000 bytes of storage (750 000 plus 2 million). If you determine that there are 30 000 work records that are each 500 bytes long, the storage required for the work records is 15 million bytes. The utility would then require 17 million bytes of storage.

5. ***Add the storage required for the output file*** to determine the total amount of storage required to resequence the specified number of input records.

Tracking Any Problems

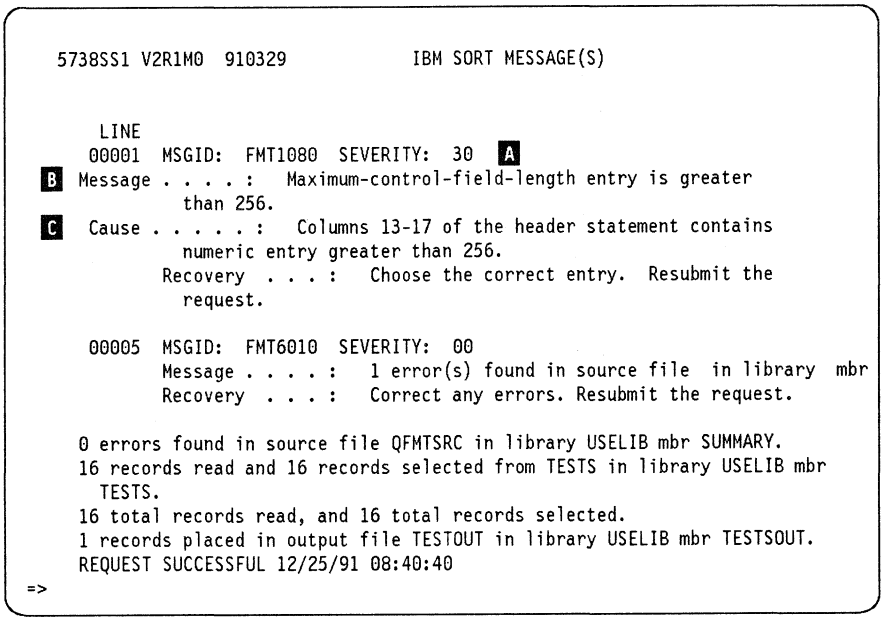
When the processing of a sort job ends, the system sets a return code. If the job was successful, the return code is set to 0; if it was not successful, the code is set to 2.

Use this value to check the status of a sort job and to direct the system to perform certain tasks based on the result. To access the return code value, use the CL command RTVJOBA and its appropriate parameters. The *Programming: Control Language Reference* manual contains information about this command.

Message and Help Information

When you work with the Sort utility, the system responds to your commands by processing them and also by providing messages. These messages are displayed on your screen or sent to a printer.

Each message contains a minimum of three parts:



```
  5738SS1 V2R1M0  910329           IBM SORT MESSAGE(S)


      LINE
     00001  MSGID:  FMT1080  SEVERITY:  30  A
 B  Message . . . . :   Maximum-control-field-length entry is greater
              than 256.
 C   Cause . . . . . :   Columns 13-17 of the header statement contains
              numeric entry greater than 256.
            Recovery  . . . :   Choose the correct entry.  Resubmit the
              request.

     00005  MSGID:  FMT6010  SEVERITY:  00
            Message . . . . :   1 error(s) found in source file  in library  mbr
            Recovery  . . . :   Correct any errors. Resubmit the request.

    0 errors found in source file QFMTSRC in library USELIB mbr SUMMARY.
    16 records read and 16 records selected from TESTS in library USELIB mbr
      TESTS.
    16 total records read, and 16 total records selected.
    1 records placed in output file TESTOUT in library USELIB mbr TESTSOUT.
    REQUEST SUCCESSFUL 12/25/91 08:40:40
=>
```

Figure 7. A Sample Screen Display of Sort Messages

A A number indicating the seriousness of the error.

Severity **Meaning**

00 ***Informational:*** The message is for your information only; no error has been detected and no reply is necessary. It suggests that a function is either in progress or reached a normal, successful completion.

10 ***Warning:*** A potential error condition exists. A function may have been only partially completed; for example, some items in a list may have succeeded while others have failed. Or, the program may have taken a default to fill in missing input, and the default chosen may not have been valid. Thus, the results of the operation may be different from what you intended, and the program cannot determine if they are valid.

20 ***Error:*** A definite error has been detected, but it is one for which automatic recovery procedures have probably been applied and for which processing has continued. A default may have been used to replace erroneous input. The results of the operation may not be valid.

30 ***Severe error:*** The error detected is too serious for automatic recovery, and no defaults are possible. If the error was in source data, the entire input record was skipped. If it occurred while the program was running, it will lead to an *abnormal end of program or function* (severity code 40) condition. The results of the operation are not valid.

40 ***Abnormal end of program or function:*** The running of the program has actually stopped, either because it was unable to handle invalid data or because the user has canceled it.

B The text you see online or on a listing, giving a brief (generally one-sentence) description of the problem.

C The text you see online when you press Help from the screen with the message displayed. It will be printed on your listing if you specify `*SECLVL` in your run-time options. (The default for this option is `*NOSECLVL`.) This text contains an expanded description of the message, and a section detailing the correct user response.

Displaying and Printing Messages

To display or print a particular message or messages, use the `DSPMSGD` command. This command is described in the *Programming: Control Language Reference* manual. The library name for your product is `QSYS`, and the file names are `QFMTMSG` and `QFMTTXT`.

Error messages fall into two basic categories:

- *Error messages,* to inform you of an error situation as the system was running your command
- *Informational messages,* to provide you with information about the processing and/or its result.

When a message is displayed, one or more of the following can occur:

- The message is displayed (called "first-level text")
- A blinking cursor is repositioned at the input field in error
- The input field in error is highlighted in reverse image
- The keyboard is locked; that is, pressing any keyboard key has no result
- An alarm (beep) sounds.

Correcting the Error

If you know how to correct the error from the information provided in the error message, press the Error Reset key, enter the corrected information, and continue your work.

If the error message is not sufficient for you to decide how to handle the error, press the Help key. This displays additional information about the error, and describes how to correct it.

Note: Running a sort job can cause messages that are not part of the Sort utility to be displayed. In such cases, press Help to obtain further information, and then refer to the appropriate user's manual, if necessary.

Control Language Command Help

For more information about a command, use one of the following procedures:

- Type the command, with or without parameters, on any command line and press F4 (Prompt). The prompt display for that command is displayed. From here you can press Help for more information about the command and its parameters.
- Choose a menu selection that prompts you for parameter values before a command is run, and press Help on the prompt display.

Chapter 2. Sorting Records from a Single File

The Sort utility can sort records selected from a single file and produce a copy of the records that reflects the new order (see Figure 8). It can also reformat (select, change, or rearrange) fields within each record.

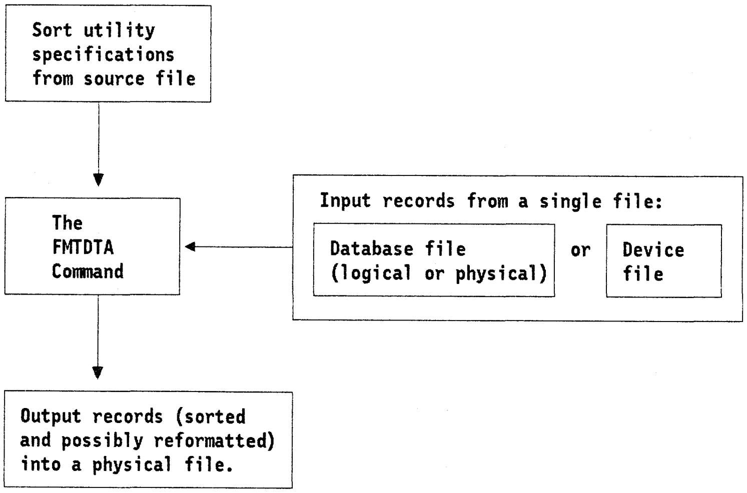

Sort utility specifications from source file
The FMTDTA Command
Input records from a single file:
Database file (logical or physical)
or
Device file
Output records (sorted and possibly reformatted) into a physical file.

Figure 8. Sorting and Reformatting a Single File into One Physical File

The output is a physical file in the database, meaning that it contains a sorted and reformatted copy of the actual input records.

When sorting a single file to produce a physical output file, note the following:

- The output type on the header specification must be SORTR.
- The maximum control field length must be greater than zero.
- Field specifications must be entered to define the control field.
- You need not enter a separate field specification for each input field you want to appear in the output record. If there are to be no changes in their order or content, you can enter just one field specification that treats the entire input record as a single output field.
- The INFILE parameter of the FMTDTA command has only one value, because only one input file is being specified.

Examples

The following examples extract records from a single input file.

Example 1. Sorting a File with a Single Input Record Type

This example takes the records from a file (INVENTRY) and puts the sorted output records into a physical file (NEWORD). The fields that are identified by the sort specifications correspond to those that were originally defined for the records.

The Sort utility looks for only one type of input record. Records are selected by comparing the INSTOCK field (columns 69 through 74) with the REORDER field (columns 40 through 45) of the input record. If the INSTOCK field is less than the REORDER field, the record is selected for sorting and included in the output file.

The records are sorted in ascending order based on the control field. The control field is composed of the input fields TYPENO (columns 1 and 2) and ITEMNO (columns 3 through 8).

The output records are to contain six rearranged data fields, one of which is the control field. Note that once the control field is used for sorting, if it is to be included in the output record it is treated as a data field.

Entering the Specifications

Enter the following header, record, and field specifications. (Only those columns that are specific to this example are described below.)

HEADER SPECIFICATIONS

Page (1 2) □□ Program Identification (73 74 75 76 77 78 79 80) □□□□□□□□

Statement Number	Type H *	Output Type SORTR SORTRS SORTA	Reserved	Maximum Control Field Length (1-256)	Sequence A D	Reserved	Alt Col Seq S F	Reserved	Output X	Reserved	Comments
3 4 5	6	7 8 9 10 11 12	13 14	15 16 17	18	19 20 21 22 23 24 25	26	27	28	29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72
	H	S O R T R		0 0 8	A						

Columns	Entry	Explanation
7-12	SORTR	This is a regular sort; the output is to be a physical file.
15-17	8	The maximum control field length is 8 characters.
18	A	The output records are to be sorted in ascending order (A before B, 1 before 2, and so on). For the ordering of numbers relative to upper- and lowercase characters and special characters, refer to the collating sequences in Appendix C, "Standard and Alternative Collating Sequences."
26	No entry	The Sort utility defaults to the standard collating sequence.
28	No entry	The default is to include the control field in the output record.

RECORD SPECIFICATIONS

Statement	Type	Continue	Data Type	Factor 1		Comparison Operator	Factor 2	Factor 2 Constant			Comments
Number	I O *	A O *	C Z D P U	Start Position	End Position	EQ,NE LT,GT LE,GE	C F K S	Factor 2 Keyword Factor 2 Field Location Start	End		
3 4 5	6	7	8	9 10 11 12	13 14 15 16	17 18	19	20 21 22 23	24 25 26 27	28 29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72
	I		U	6 9	7 4	L T	F	4 0	4 5		

Columns	Entry	Explanation
6	I	The input records that meet the conditions specified are to be included in the output.
7	No entry	The first of the set of record specifications that is to define this type of record.
8	U	The data in the Factor 1 and Factor 2 fields of each input record is to be interpreted as numeric, and in unpacked format. This means that each digit will be represented by 8 bits. The lower 4 bits (digit portion) identify the digit, while the higher 4 bits (zone portion) represent the sign (plus or minus) for the entire number. Note that by specifying this type of data, you are limiting the length of the Factor 1 and Factor 2 fields to 192 bits (I6 digits) or less.
9-12	69	The Factor 1 field begins in column 69 of the input record.
13-16	74	The Factor 1 field ends in column 74 of the input record. This selects the data from the INSTOCK field, corresponding to the original data definition for the input records.
17-18	LT	The data in the Factor 1 field must be less than the data in the Factor 2 field for the input record to be selected for sorting. The comparison is to be based on the collating sequence specified in the header specification, which here is the standard collating sequence.
19	F	The data in the Factor 2 field is to be the data taken from the input record field, as specified in columns 20 through 27.
20-23	40	The Factor 2 field begins in column 40 of the input record.
24-27	45	The Factor 2 field ends in column 45 of the input record. This selects the data from the REORDER field, corresponding to the original data definition for the input records.

FIELD SPECIFICATIONS

Statement		Field	Data Type	Field Location		Forced Characters			Overflow Field Length	Reserved	Comments
Number	Type F *	D N O F S *	C,K Z,L D,E P,I V,J U,R M,S H,T B	Start @	End	Record	Substitute	Continuation	... A . l . tS. e. q. . . . . A .		
3 4 5	6	7	8	9 10 11 12	13 14 15 16	17	18	19	20.21 22	23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72
	F	N	C	1	2				•		TYPENO FIELD
	F	N	C	3	8				•		ITEMNO FIELD
									•		

These two specifications establish the two elements of the control field. The contents of the first specification are:

Columns	Entry	Explanation
7	N	This element is to be treated as normal. This means that the unchanged data from the input record is to be used, and that the sort sequence for this element (or part of the control field) is that specified in the header specification (ascending).
8	C	The system looks at the data in this field as character data. Each group of 8 bits is assumed to represent a character, which can be a letter of the alphabet, a symbol, or a digit.
9-12	1	This element of the control field is to begin in column 1 of the input record.
13-16	2	The element is to end in column 2 of the input record. This selects the data from the TYPENO field, corresponding to the original data definition for the input records.
40-72	Comments	Identifies the name of the field selected.

The second field specification defines the second element of the control field, called ITEMNO in the input record. Sort regards both elements as a single string of control characters, and begins the sort with the character farthest to the left.

FIELD SPECIFICATIONS

Statement				Field Location		Forced Charac- ters			Overflow Field Length	Reserved	Comments
Number	Type F *	Field D N O F S *	Data Type C,K Z,L D,E P,I V,J U,R M,S H,T B	Start	End	Record	Substitute	Continuation	... A . 1 . tS. e. q. . . . . A .		
3 4 5	6	7	8	9 10 11 12	13 14 15 16	17	18	19	20.21 22	23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72
	F	D	C	30	34				•		COST FIELD
	F	D	C	28	29				•		UNIT FIELD
	F	D	C	46	50				•		QTY FIELD
	F	D	C	86	91				•		DATE FIELD
	F	D	C	95	100				•		ORDERNO FIELD
									•		

These five specifications define five data fields to be taken from each input record. The contents of the first specification are:

Columns	Entry	Explanation
7	D	The field is to be treated as a data field, meaning that the unchanged data from the input record is to be transferred to the output record.
8	C	The system looks at the data in this field as character data. Each group of 8 bits is assumed to represent a character, which can be a letter of the alphabet, a symbol, or a digit.
9-12	30	This data field begins in column 30 of the input record.
13-16	34	This control field ends in column 34 of the input record. This selects the data from the COST field, corresponding to the original data definition for the input records.
40-72	Comments	Identifies the name of the field selected as a data field from the input record.

The field specification is followed by four more specifications, each defining a new data field (UNIT, QTY, DATE, and ORDERNO) corresponding to the original data description for the input records. Notice the order in which these fields are entered into the source file, represented by the number in columns 3 through 5. This is the order in which they will be put into the output record, **not** the order in which they occur in the input record.

Processing These Specifications

An example of the FMTDTA command used to process these statements is given below:

Specified on FMTDTA Command	Explanation
FMTDTA INFILE((PROD/INVENTRY MONDAY))+	The input records are to be taken from member MONDAY of database file INVENTRY in library PROD.
OUTFILE(PROD/NEWORD MONDAY)+	The output records are to be put into member MONDAY of file NEWORD in library PROD.

The specifications are automatically taken from the first member of file QFMTSRC *(default source file) in the library list.*

The OPTION parameter defaults to *CHK, *PR , *NODUMP, and *NOSECLVL.

The plus sign (+) shown for continuations is not required if the FMTDTA *command is entered from a display station.*

Example 2. Sorting Two Types of Records from the Input File

Example 2 also takes records from a single file and puts the sorted output records into a physical file; this time however, two types of input records are selected for sorting: those with IM in columns 79 through 80 of the input record, and those with IQ in columns 79 through 80. This distinction corresponds to two record types, ITEMASTER and QTRSALES, as originally defined by the record data description for the input file.

There is an additional condition placed on the second record type: only the QTRSALES records containing dates greater than or equal to October 7, 1989, are to be included in the sort.

For ITEMNO records, the ITEMNO, DESC, SUPPLY, and SUPPADR fields are to be included in the output record. For QTRSALES records, the ITEMNO, QTRTOTAL, OUTLISTS, and DATE fields are to be included in the output record.

Both record types are to be sorted in ascending order in the output file based on the control field ITEMNO. QTRSALES records that have the same ITEMNO are arranged in descending order based on the control field QTRTOTAL. The two record types are merged in the output file. The first record will be the ITEMASTER record with the lowest ITEMNO, and following it will be the QTRSALES record with the same ITEMNO. If more than one QTRSALES record has the same ITEMNO, the records will be arranged in descending order based on the QRTOTAL field.

Entering the Specifications

To sort this file, enter the following header, record, and field specifications. (Only those columns that are important to this example are described below.)

HEADER SPECIFICATIONS

Page (1 2) □□ Program Identification (73 74 75 76 77 78 79 80) □□□□□□□□

Statement Number	Type H*	Output Type SORTR SORTRS SORTA	Reserved	Maximum Control Field Length (1-256)	Sequence A D	Reserved	Alt Col Seq S F	Reserved	Output X	Reserved	Comments
3 4 5	6	7 8 9 10 11 12	13 14	15 16 17	18	19 20 21 22 23 24 25	26	27	28	29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72
	H	SORTR		11	A				X		

Columns	Entry	Explanation
7-12	SORTR	This is a regular sort: the output is to be a physical file.
15-17	11	The maximum control field length is 11 characters. This is the sum of the two input fields, ITEMNO and QTRTOTAL, that are combined to form the control field.
18	A	The output records are to be sorted in ascending order (A before B, 1 before 2, and so on). For the ordering of numbers relative to upper- and lowercase characters and special characters, refer to the collating sequences in Appendix C, “Standard and Alternative Collating Sequences.”
26	No entry	The Sort utility defaults to the standard collating sequence.
28	X	The control fields are not to be included in the output record.

RECORD SPECIFICATIONS

Statement Number 3 4 5	Type I O * 6	Continue A O * 7	Data Type C Z D P U 8	Factor 1 Start Position 9 10 11 12	Factor 1 End Position 13 14 15 16	Comparison Operator EQ,NE LT,GT LE,GE 17 18	Factor 2 C F K S 19	Factor 2 Constant Factor 2 Keyword Factor 2 Field Location Start End 20 21 22 23 24 25 26 27•28 29 30 31 32 33 34 35 36 37 38 39	Comments 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57/ /72
	I		C	79	80	EQ	C	IM	INCLUDE ITEMASTER
	*								RECORD COL79=I
	*								AND COL80=M

Columns	Entry	Explanation
6	I	The input records that meet the conditions specified in this set of input record specifications are to be included in the output.
7	No entry	The first of the set of record specifications that is to define this type of record.
8	C	The data in the Factor 1 and Factor 2 fields of each input record is to be interpreted as character data. Each group of 8 bits represents a character.
9-12	79	The Factor 1 field begins in column 79 of the input record.
13-16	80	The Factor 1 field ends in column 80 of the input record. This selects the data from the ITEMASTER field, corresponding to the original data definition for the input records.
17-18	EQ	The data in the Factor 1 field must be equal to the data in the Factor 2 field for the input record to be selected for sorting.
19	C	The data in the Factor 2 field is to be the constant specified in columns 20 through 39 of this record specification.
20-39	IM	The constant value of the Factor 2 field is IM. The IM in columns 79 through 80 of the input record identifies this record as an ITEMASTER record.
40-72	Comments	Identifies the specified columns.

The record specification is followed by two comment specifications, identified by the asterisk in column 6.

FIELD SPECIFICATIONS

Statement Number	Type F *	Field D N O F S *	Data Type C,K Z,L D,E P,I V,J U,R M,S H,T B	Field Location Start	Field Location End	Forced Characters Record	Forced Characters Substitute	Forced Characters Continuation	Overflow Field Length ... A. 1. tS. e. q. . . . . A.	Reserved	Comments
3 4 5	6	7	8	9 10 11 12	13 14 15 16	17	18	19	20.21 22	23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72
	F	N	C	1	6				•		ITEMNO IS THE
	*								•		CONTROL FIELD
									•		

This specification establishes a control field for this record type:

Columns	Entry	Explanation
7	N	The control field is to be treated as a normal control field. This means that the unchanged data from the input record is to be used, and that the sort sequence is to be that specified in the header specification (ascending).
8	C	The system looks at the data in this control field as character data. Each group of 8 bits is assumed to represent a character, which can be a letter of the alphabet, a symbol, or a digit.
9-12	1	This control field begins in column 1 of the input record.
13-16	6	This control field ends in column 6 of the input record. This selects the data from the ITEMNO field, corresponding to the original data definition for the input records.
40-72	Comments	Identifies the name of the field selected as control field from the input record.

FIELD SPECIFICATIONS

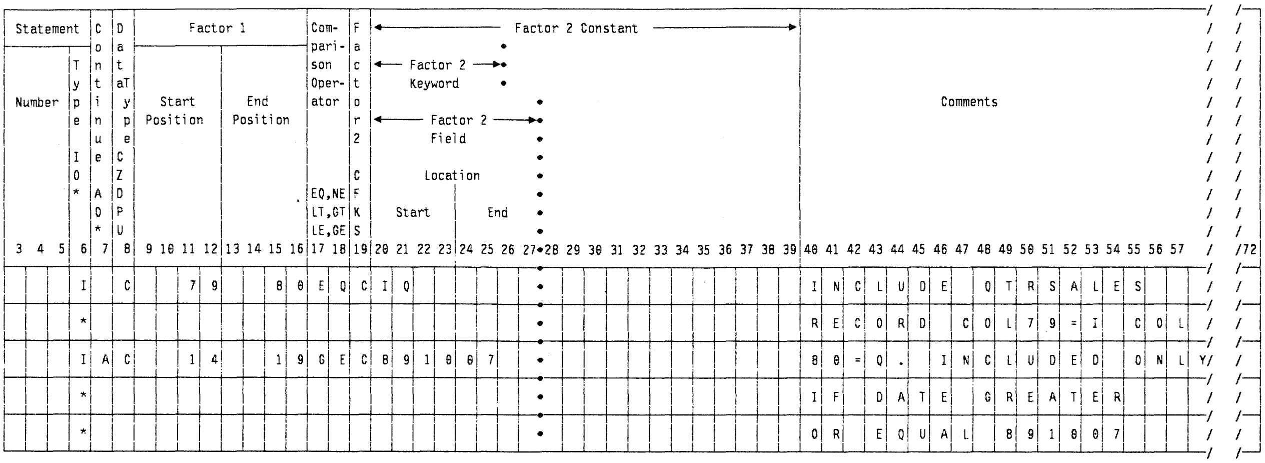
Statement Number 3 4 5	Type 6 (F *)	Field Type 7 (D N O F S *)	Data Type 8 (C,K Z,L D,E P,I V,J U,R M,S H,T B)	Field Location Start 9 10 11 12	Field Location End 13 14 15 16	Forced Characters Record 17	Forced Characters Substitute 18	Forced Characters Continuation 19	Overflow Field Length 20.21 22	Reserved 23-39	Comments 40-55	/72
	F	D	C	1	6						ITEMNO FIELD	
	F	D	C	30	49						DESC FIELD	
	F	D	C	50	55						SUPPLY FIELD	
	F	D	C	56	78						SUPPADDR FIELD	

These four specifications define four data fields to be taken from each input record of this type. The contents of the first specification are:

Columns	Entry	Explanation
7	D	The field is to be treated as a data field, meaning that the unchanged data from the input record is to be transferred to the output record.
8	C	The system looks at the data in this field as character data. Each group of 8 bits is assumed to represent a character, which can be a letter of the alphabet, a symbol, or a digit.
9-12	1	This data field begins in column 1 of the input record.
13-16	6	This control field ends in column 6 of the input record. This selects the data from the ITEMNO field, corresponding to the original data definition for the input records. This is also the same as the control field used for sorting. The data is used separately to control the sort and then respecified as data. This allows more flexibility. Control data can be altered before being used as a control; regular data can be repositioned in the output record.
40-72	Comments	Identifies the name of the field selected as a data field from the input record.

The field specification is followed by three more specifications, each defining a new data field (DESC, SUPPLY, and SUPPADR, respectively), corresponding to the original data description for the input records. Notice the order in which these fields are entered into the source file, represented by the sequence number in columns 3 through 5. This is the order in which they will be put into the output record.

RECORD SPECIFICATIONS


Statement
Number
Type
Continue
I O *
A O *
Data Type
C Z D P U
Factor 1
Start Position
End Position
Comparison Operator
EQ,NE LT,GT LE,GE
Factor 2
C F K S
Factor 2 Constant
Factor 2 Keyword
Factor 2 Field
Location
Start
End
Comments
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 72

```
     I C  79  80EQCIQ                  INCLUDE QTRSALES
     *                                 RECORD COL79=I COL
     IAC  14  19GEC891007              80=Q. INCLUDED ONLY
     *                                 IF DATE GREATER
     *                                 OR EQUAL 891007
```

This set of record specifications defines a new record type. The record specifications are interspersed with comment specifications to help explain the input record selection criteria. The column entries for the first record specification in the set are:

Columns	Entry	Explanation
6	I	The input records that meet the conditions specified in this set of input record specifications are to be included in the output.
7	No entry	This specification is the first of the set of record specifications that is to define this type of record.
8	C	The data in the Factor 1 and Factor 2 fields of each input record is to be interpreted as character data. Each group of 8 bits represents a character.
9-12	79	The Factor 1 field begins in column 79 of the input record.
13-16	80	The Factor 1 field ends in column 80 of the input record.
17-18	EQ	The data in the Factor 1 field must be equal to the data in the Factor 2 field for the input record to be selected for sorting.
19	C	The data in the Factor 2 field is to be the constant specified in columns 20 through 39 of this record specification.
20-39	IQ	The constant value of the Factor 2 field is IQ. The IQ in columns 79 through 80 of the input record identifies this record as a QTRSALES record.
40-72	Comments	Identifies the specified columns.

This is followed by a comment specification and another record specification.

The second record specification in the set puts an additional condition on each input record before that record is selected for sorting. The significant column entries are:

Columns	Entry	Explanation
7	A	This specification adds another condition to the previous record specification.
8	C	The data in the Factor 1 and Factor 2 fields of each input record is to be interpreted as character data. Each group of 8 bits represents a character.
9-12	14	The Factor 1 field begins in column 14 of the input record.
13-16	19	The Factor 1 field ends in column 19 of the input record. This corresponds to the DATE field of the input record, as defined by the existing data description for the record.
17-18	GE	The data in the Factor 1 field must be greater than or equal to the data in the Factor 2 field for the input record to be selected for sorting.
19	C	The data in the Factor 2 field is to be the constant specified in columns 20 through 39 of this record specification.
20-39	891014	This is the constant value of the Factor 2 field, representing October 7, 1989.
40-72	Comments	Identifies the specified columns.

FIELD SPECIFICATIONS

Statement					Field Location		Forced Characters			Overflow Field Length	Reserved	Comments
Number		Type F *	Field D N O F S *	Data Type C,K Z,L D,E P,I V,J U,R M,S H,T B	Start	End	Record	Substitute	Continuation	... A. 1. tS. e. q. . . . . A.		
3 4 5		6	7	8	9 10 11 12	13 14 15 16	17	18	19	20.21 22	23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 /72
		F	N	C	1	6				•		ITEMNO IS NORMAL
		F	O	U	25	29				•		(ASCENDING)
		*								•		QTRTOTAL IS OPPOSITE

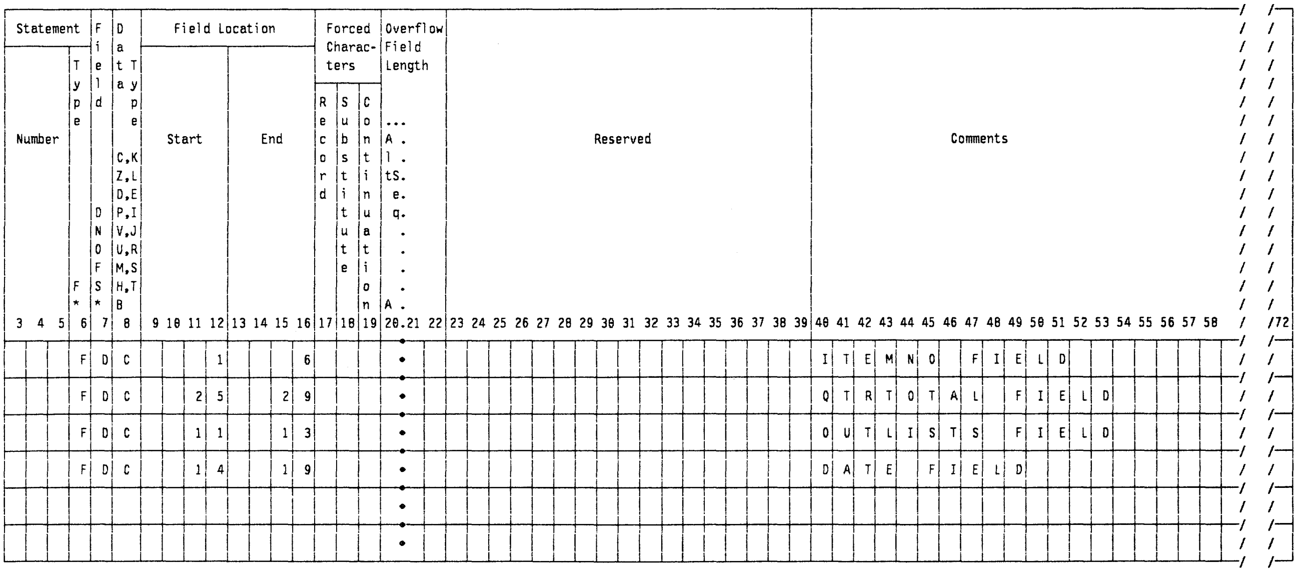
These two specifications establish the control field for this record type. The contents of the first specification define the first part of the control field, and are:

Columns	Entry	Explanation
7	N	The control field data is to be treated as a normal control field. This means that the unchanged data from the input record is to be used, and that the sort sequence is to be that specified in the header specification (ascending).
8	C	The system looks at the data as character data. Each group of 8 bits is assumed to represent a character, which can be a letter of the alphabet, a symbol, or a digit.
9-12	1	This control field data begins in column 1 of the input record.
13-16	6	This control field data ends in column 6 of the input record. This selects the data from the ITEMNO field, corresponding to the original data definition for the input records.
40-72	Comments	Identifies the name of the field selected as control field from the input record.

The second field specification defines another field (QTRTOTAL) from the input record, which will become the second part of the control field. Sort will regard both control fields as a single string of control characters, and will begin the sort with the character farthest to the left. The significant column entries are:

Columns	Entry	Explanation
7	0	The control field is to be treated as an opposite control field. This means that the input records are to be sorted so the data in the QTRTOTAL field ends in a sequence opposite to that specified in the header specification.
8	U	The data in this control field is to be interpreted as numeric data in unpacked format. This means that each digit is to be represented by 8 bits; the lower 4 bits identify the digit and the higher four (zone portion) represent the sign (plus or minus) of the entire number.
9-12	25	This control field data begins in column 25 of the input record.
13-16	29	This control field data ends in column 29 of the input record
40-72	Comments	Identifies the name of the field selected as control field from the input record.

FIELD SPECIFICATIONS



Statement Number	Type	Field	Data Type	Field Location Start	Field Location End	Forced Characters Record	Forced Characters Substitute	Forced Characters Continuation	Overflow Field Length	Reserved	Comments
	F *	D N O F S *	C,K Z,L D,E P,I V,J U,R M,S H,T B						... A . l . tS. e. q. . . . . A .		
3 4 5	6	7	8	9 10 11 12	13 14 15 16	17	18	19	20.21 22	23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 / /72
	F	D	C	1	6				.		ITEMNO FIELD
	F	D	C	25	29				.		QTRTOTAL FIELD
	F	D	C	11	13				.		OUTLISTS FIELD
	F	D	C	14	19				.		DATE FIELD
									.		
									.		

These four specifications define four data fields to be taken from each input record. The data fields are specified in the same way as the previous record type. Because the header specification omitted the control fields from the output record, the two control field elements are respecified here as the first two data fields of the output record.

Processing These Specifications

The FMTDTA command that could be used to process the specification is:

Specified on FMTDTA Command	Explanation
FMTDTA INFILE((PROD/SALEHIST))+	The input records are to be taken from the first member of file SALEHIST in library PROD.
OUTFILE(PROD/ITEMSALE)+	The output records are to be put into the first member of file ITEMSALE in library PROD.

The specifications are automatically taken from the first member of file QFMTSRC *(default source file) in the library list.*

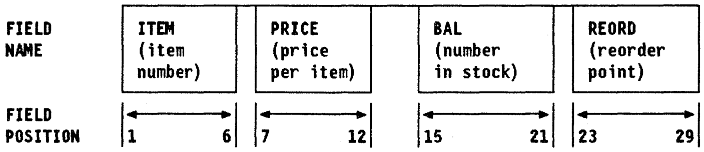
The OPTION parameter defaults to *CHK, *PRT, *NODUMP, and *NOSECLVL.

The plus sign (+) shown for continuations is not required if the FMTDTA *command is entered from a display station.*

Example 3. Reformatting Records—1

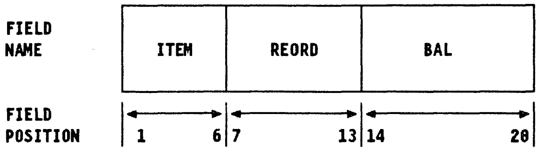
The order in which you select the input fields to be processed determines the order in which they will appear in the output records. Suppose you have an input record that looks like this:

INPUT RECORD



You want your output record, however, to look like this:

OUTPUT RECORD

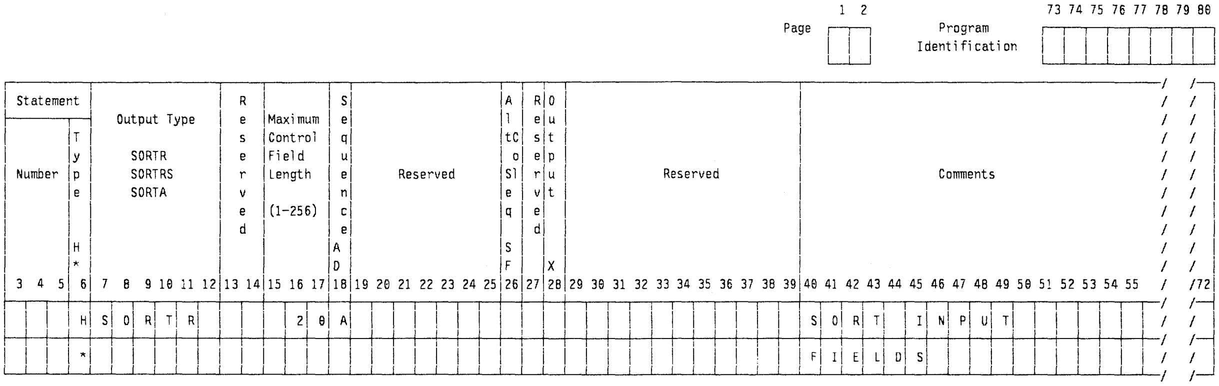


You also want to reorder all the records by item number.

Entering the Specifications

To sort this file, enter the following header, record, and field specifications. (Only those columns that are important to this example are described.)

HEADER SPECIFICATIONS



Page 1 2 · Program Identification 73 74 75 76 77 78 79 80

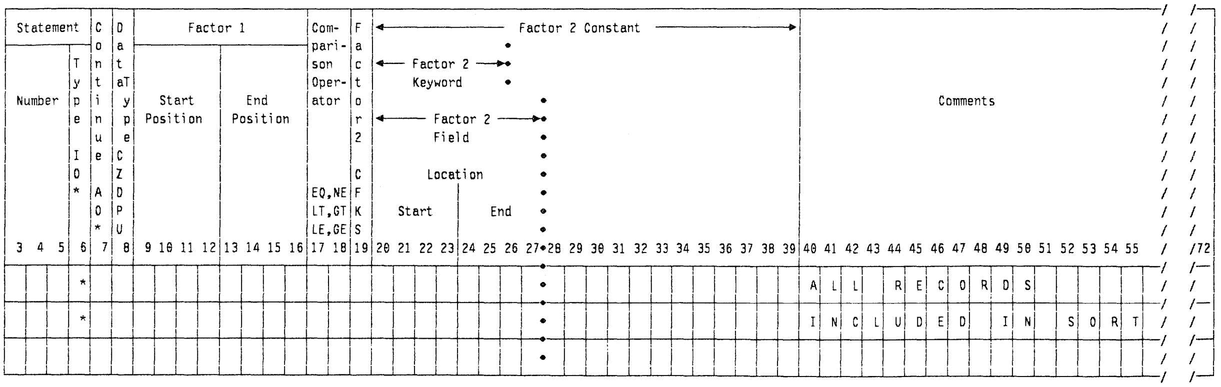
Statement Number 3 4 5	Type H * 6	Output Type SORTR SORTRS SORTA 7 8 9 10 11 12	Reserved 13 14	Maximum Control Field Length (1-256) 15 16 17	Sequence A D 18	Reserved 19 20 21 22 23 24 25	Alt Seq S F 26	Reserved 27	Output X 28	Reserved 29 30 31 32 33 34 35 36 37 38 39	Comments 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 … 72
	H	SORTR		28	A						SORT INPUT
	*										FIELDS

This is a standard header specification for a Sort job, similar to that entered for the previous examples. The significant column entry, here, is:

Columns	Entry	Explanation
28	No entry	The control field will be included in the output record.

This means that the unchanged data from the input record is to be used, and that the sort sequence is specified in the header specification (ascending). A blank in column 28 will include the control field in the output record.

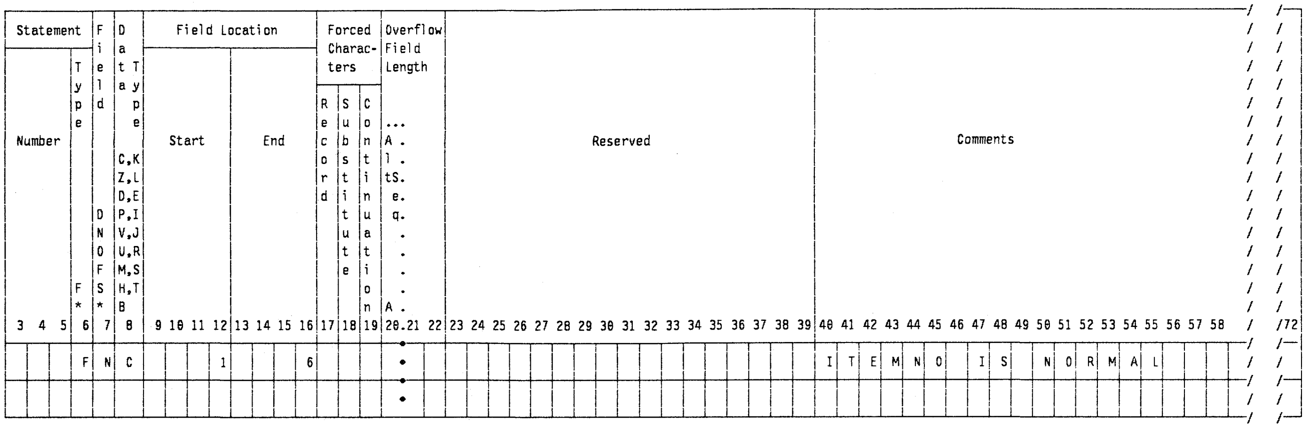
RECORD SPECIFICATIONS



Statement Number 3 4 5	Type I O * 6	Continue A O * 7	Data Type C Z D P U 8	Factor 1 Start Position 9 10 11 12	Factor 1 End Position 13 14 15 16	Comparison Operator EQ,NE LT,GT LE,GE 17 18	Factor 2 C F K S 19	Factor 2 Constant / Keyword / Field Location Start 20 21 22 23	End 24 25 26 27	28 29 30 31 32 33 34 35 36 37 38 39	Comments 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 … 72
	*										ALL RECORDS
	*										INCLUDED IN SORT

Because all input records are to be processed, no record specifications need to be entered, as indicated by the above comment specifications.

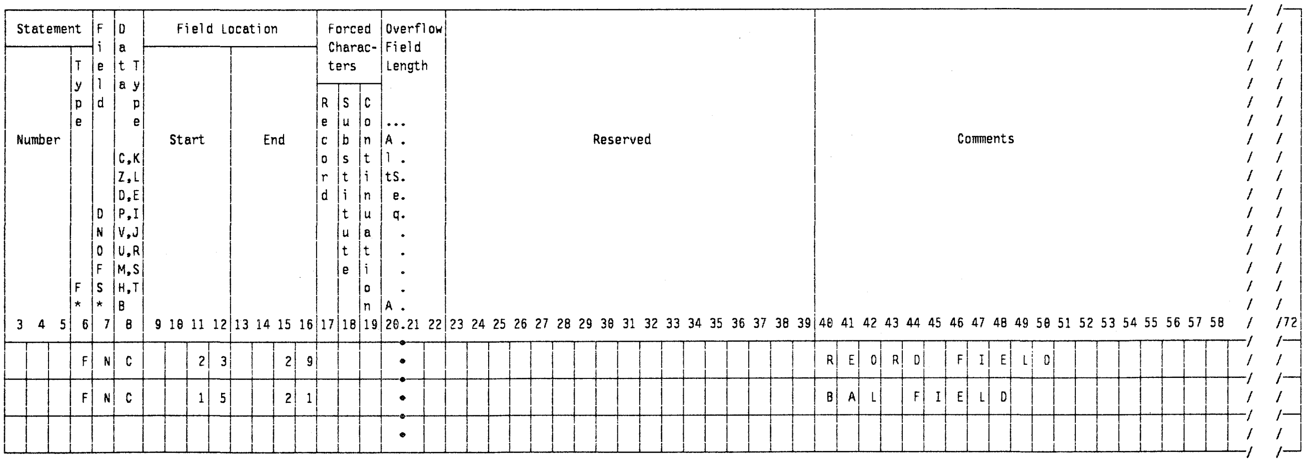
FIELD SPECIFICATIONS



Statement Number (3 4 5)	Type (6) F *	Field (7) D N O F S *	Data Type (8) C,K Z,L D,E P,I V,J U,R M,S H,T B	Field Location Start (9 10 11 12)	Field Location End (13 14 15 16)	Forced Characters Record (17)	Forced Characters Substitute (18)	Forced Characters Continuation (19)	Overflow Field Length ...A.1.tS.e.q....A. (20.21 22)	Reserved (23–39)	Comments (40–58)	/72
	F	N	C	1	6				•		ITEMNO IS NORMAL	
									•			

This is the specification that defines the control field as ITEM from the input record. The control field is to be included in the output record and, because it is the first field specified, it will be the first field in the output record and will automatically occupy columns 1 to 6.

FIELD SPECIFICATIONS



Statement Number (3 4 5)	Type (6) F *	Field (7) D N O F S *	Data Type (8) C,K Z,L D,E P,I V,J U,R M,S H,T B	Field Location Start (9 10 11 12)	Field Location End (13 14 15 16)	Forced Characters Record (17)	Forced Characters Substitute (18)	Forced Characters Continuation (19)	Overflow Field Length ...A.1.tS.e.q....A. (20.21 22)	Reserved (23–39)	Comments (40–58)	/72
	F	N	C	23	29				•		REORD FIELD	
	F	N	C	15	21				•		BAL FIELD	
									•			

The control field specification is then followed by two more field specifications, one identifying the field REORD, and the other identifying the field BAL from the input record.

Processing These Specifications

You can process these specifications by entering the FMTDTA command as described in “Example 2. Sorting Two Types of Records from the Input File” on page 26. Because the source records are no longer in the default file, you must also enter values for the SRCFILE and SRCMBR parameters of the command as shown below.

Specified on FMTDTA Command	Explanation
FMTDTA INFILE((PROD/SALEHIST))+	The input records are to be taken from the first member of file SALEHIST in library PROD.
OUTFILE(PROD/ITEMSALE)+	The output records are to be put into the first member of file ITEMSALE in library PROD.
SRCFILE(TEST/EXAMPLE)+ SRCMBR(EXAMPLE3)+	The reformat specifications are taken from member EXAMPLE3 in database file EXAMPLE, which is in library TEST.

The OPTION parameters default to *CHK, *PRT, *NODUMP, and *NOSECLVL.

The plus sign (+) shown for continuations is not required if the FMTDTA *command is entered from a display station.*

Example 4. Reformatting Records—2

In this example, you want the one-character field in position 20 of your input record to be in the first position of the output record. To do this, add the following field specification to the source file in the previous example:

HEADER SPECIFICATIONS

Page 1 2 □□   Program Identification 73 74 75 76 77 78 79 80 □□□□□□□□

Statement Number	Type H *	Output Type SORTR SORTRS SORTA	Reserved	Maximum Control Field Length (1-256)	Sequence A D	Reserved	Alt Col Seq S F	Reserved	Output X	Reserved	Comments
3 4 5	6	7 8 9 10 11 12	13 14	15 16 17	18	19 20 21 22 23 24 25	26	27	28	29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 / /72
	H	SORTR		21	A						SORT INPUT
	*										FIELDS

FIELD SPECIFICATIONS

Statement				Field Location		Forced Characters			Overflow Field Length		
Number	Type F *	Field D N O F S *	Data Type C,K Z,L D,E P,I V,J U,R M,S H,T B	Start	End	Record	Substitute	Continuation	... A . l . tS. e. q. . . . . A .	Reserved	Comments
3 4 5	6	7	8	9 10 11 12	13 14 15 16	17	18	19	20.21 22	23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 /72
	F	N	C	20	20				.		SINGLE-CHAR FIELD
									.		

Because of the sequence number, the control field specification (ITEM field) follows this data field specification. As a result, the control field is positioned in columns 2 through 7, after the one-character data field in the output record.

You then process the source file by using the FMTDTA command as in “Example 3. Reformatting Records — 1” on page 35.

Chapter 3. Sorting Records from Several Files

The Sort utility can sort records selected from multiple physical, logical, or device files, and produce a copy of the records that reflects the new order. (See Figure 9.) It can also rearrange the fields within each record.

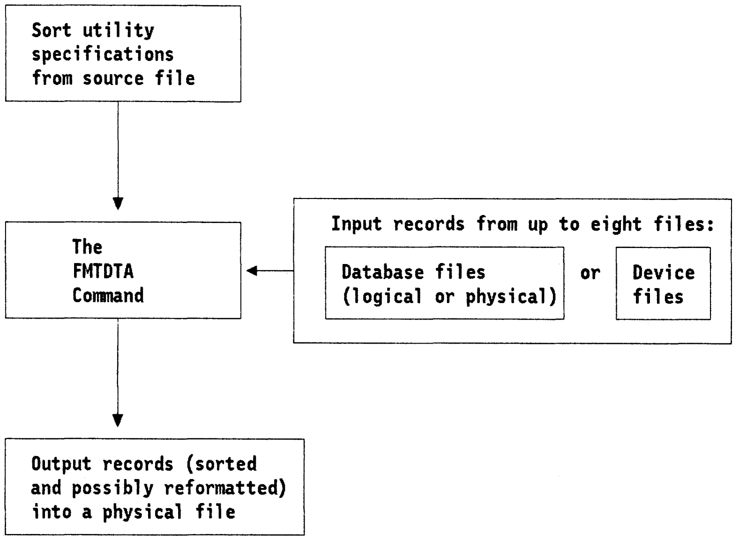

Sort utility specifications from source file
The FMTDTA Command
Input records from up to eight files:
Database files (logical or physical)
or
Device files
Output records (sorted and possibly reformatted) into a physical file

Figure 9. Sorting and Reformatting Several Files into One

Up to eight input files can be specified. The utility processes the files in the order in which they are entered in the FMTDTA command. The output is a physical file in the database, meaning that it contains a sorted and reformatted copy of the actual input records.

When sorting multiple input files to produce a physical output file, note the following:

- The output type on the header specification must be SORTR.
- The maximum control field length must be greater than zero.
- Field specifications must be entered to define the control field.
- You need not enter a separate field specification for each input field you wish to appear in the output record. If there are to be no changes in their order or content, you can treat the entire input record as one output field.
- The INFILE parameter of the FMTDTA command has several values, one for each input file being specified.

Examples

This section gives one example of how to use the Sort utility to sort records from several input files.

Example 1. Sorting Records from Five Input Files

This example processes five input transaction files, producing a single physical file as output. It also uses a ***forced character substitution*** to change part of the control field.

The control field is composed of two fields from the input record. The high order part comes from the ACCNO input field (columns 1 through 6), and the low order part a new character that is forced into the control field based on the value found in column 7. Letters in column 7 of the input records represent days of the week: M, T, W, R, and F. If column 7 contains an M, this character is a 1; if T, 2; if W, 3; if R, 4; and if F, 5. If it contains none of these, the new character will be 6. These modifications to the control field are made before the input records are sorted.

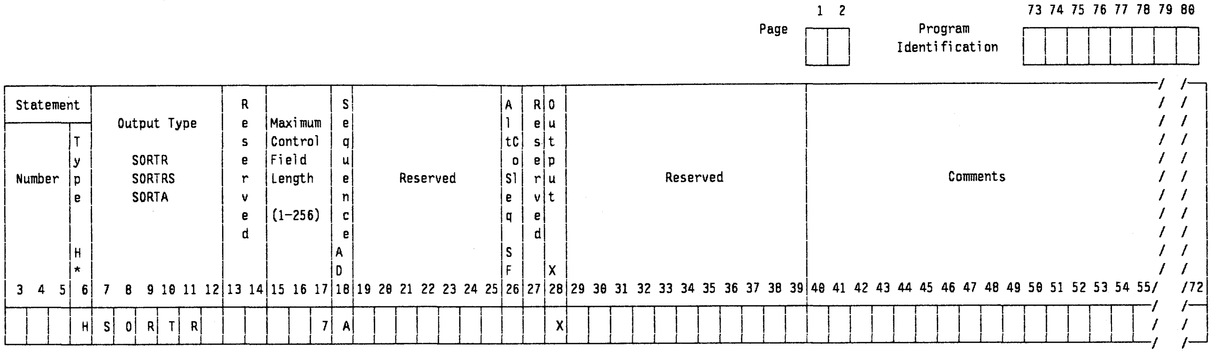
The original letters represent days of the week. One objective of the sort is to rearrange the input records so that Monday's records appear before Tuesday's, which appear before Wednesday's, and so on. If the letters were left in the control field, then the records would be sorted F-M-R-T-W. The change is for the convenience of this sorting only. It is invisible to you, since the input records remain unmodified, and the control fields are not included as control fields in the output records.

The output records are arranged in ascending order by ACCNO. If two records have the same ACCNO, they are arranged in ascending order by the character forced into the last column of the control field. All data fields will appear in the output records.

Entering the Specifications

To sort these files, enter the following header, record, and field specifications. (Only the columns important to this example are described.)

HEADER SPECIFICATIONS



Page 1 2 — Program Identification 73 74 75 76 77 78 79 80

Statement Number	Type H *	Output Type SORTR SORTRS SORTA	Reserved	Maximum Control Field Length (1-256)	Sequence A D	Reserved	Alt Col Seq S F	Reserved	Output X	Reserved	Comments
3 4 5	6	7 8 9 10 11 12	13 14	15 16 17	18	19 20 21 22 23 24 25	26	27	28	29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72
	H	S O R T R		7	A				X		

Columns	Entry	Explanation
7-12	SORTR	This is a regular sort: the output is to be a physical file.
18	A	The output records are to be sorted in ascending order.
28	X	The control field is not to be included in the output record.

No record specifications are entered. Thus, there are no conditions imposed on the selection of input records. This means that all input records are to be processed.

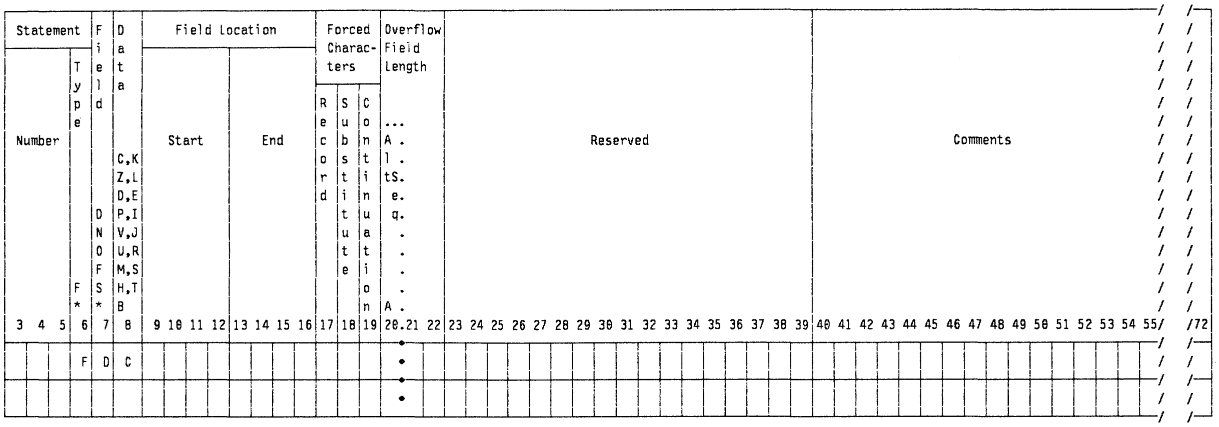
FIELD SPECIFICATIONS

Statement Number 3 4 5	Type F * 6	Field D N O F S * 7	Data Type C,K Z,L D,E P,I V,J U,R M,S H,T B 8	Field Location Start 9 10 11 12	Field Location End 13 14 15 16	Forced Characters Record 17	Forced Characters Substitute 18	Forced Characters Continuation 19	Overflow Field Length ... A. 1. tS. e. q. A. 20.21 22	Reserved 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39	Comments 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58	/72
	F	N	C	1	6						ACCNO IS CTL FIELD	
	F	F	C	7	7	M	1				IF MONDAY USE 1	
	F	F	C	7	7	T	2	X			IF TUESDAY USE 2	
	F	F	C	7	7	W	3	X			IF WEDNESDAY USE 3	
	F	F	C	7	7	R	4	X			IF THURSDAY USE 4	
	F	F	C	7	7	F	5	X			IF FRIDAY USE 5	
	F	F	C	7	7		6	X			USE 6 FOR	
	*										ANYTHING ELSE	
	*											

These field statements define the source fields that are used to make up the control field. The first specification defines the input field that is to become the first part of the control field, and the next six all pertain to what is to form the last part of the control field. The significant column entries are:

Columns	Explanation
7	The first field specification is for a normal control field. The remaining six specifications contain an F, and describe a forced control field.
9-12	The start position of the field in the input record from which the data for the control field is taken. Data from columns 1 through 6 of the input record forms the first part of the control field; data from column 7 forms the last part.
13-16	The end position of the field in the input record from which the data for the control field is taken.
17	The value in this column identifies the character which, if found in the input record, is replaced.
18	This contains the value that is substituted.
19	An X in this column links the field specification to the previously entered field specification. Here, the last six specifications describe the same field.

FIELD SPECIFICATIONS



```
Statement |F |D |    Field Location     | Forced  |Overflow|                                              |                                                 / /
----------|i |a |-----------------------| Charac- |Field   |                                              |                                                 / /
       |T |e |t |           |           | ters    |Length  |                                              |                                                 / /
       |y |l |a |           |           |---------|        |                                              |                                                 / /
       |p |d |  |           |           |R |S |C  |        |                                              |                                                 / /
       |e |  |  |           |           |e |u |o  |...     |                                              |                                                 / /
Number |  |  |  |   Start   |    End    |c |b |n  |A .     |                   Reserved                   |                   Comments                      / /
       |  |  |C,K|          |           |o |s |t  |l .     |                                              |                                                 / /
       |  |  |Z,L|          |           |r |t |i  |tS.     |                                              |                                                 / /
       |  |  |D,E|          |           |d |i |n  | e.     |                                              |                                                 / /
       |  |D |P,I|          |           |  |t |u  | q.     |                                              |                                                 / /
       |  |N |V,J|          |           |  |u |a  |  .     |                                              |                                                 / /
       |  |O |U,R|          |           |  |t |t  |  .     |                                              |                                                 / /
       |  |F |M,S|          |           |  |e |i  |  .     |                                              |                                                 / /
       |F |S |H,T|          |           |  |  |o  |  .     |                                              |                                                 / /
       |* |* |B  |          |           |  |  |n  |A .     |                                              |                                                 / /
3  4  5| 6| 7| 8 | 9 10 11 12|13 14 15 16|17|18|19 |20.21 22|23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39|40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72
       | F| D| C |           |           |  |  |   |  •     |                                              |                                                 / /
       |  |  |   |           |           |  |  |   |  •     |                                              |                                                 / /
```

This field specification identifies the data fields to be included in the output records. No start or end positions are specified; therefore, all the input data fields are to be included in the output. The data in these fields is character data (column 8 contains a C).

Processing These Specifications

Following is an example of a FMTDTA command that could be used to process this specification. It is through this command that you state the five input files from which the input records are selected.

Specified on FMTDTA Command	Explanation
FMTDTA INFILE((PROD/TRANS MONDAY)+ (PROD/TRANS TUESDAY)+ (PROD/TRANS WEDNESDAY)+ (PROD/TRANS THURSDAY)+ (PROD/TRANS FRIDAY))+	Specifies the five input members from file TRANS in library PROD.
OUTFILE(PROD/TMERGED MONDAY)+	The output records are to be put into member MONDAY of file TMERGED in library PROD.

The specifications are automatically taken from the first member of file QFMTSRC *(default source file) in the library list.*

The OPTION parameter defaults to *CHK, *PRT, *NODUMP, and *NOSECLVL.

The plus sign (+) shown for continuations is not required if the FMTDTA *command is entered from a display station.*

Chapter 4. Sorting Records from a Single File to Produce a Record Address File

The Sort utility can sort (but not reformat) records selected from a single physical file and produce a Record Address (RA) file that reflects the new order. See Figure 10.

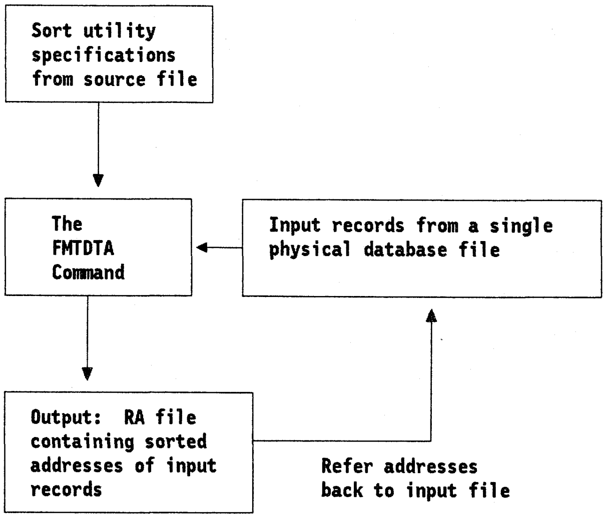

Sort utility specifications from source file
The FMTDTA Command
Input records from a single physical database file
Output: RA file containing sorted addresses of input records
Refer addresses back to input file

Figure 10. Sorting a Physical File into an RA File

The output is an RA file in the database. An RA file is a physical file that contains 4-byte binary relative record numbers rather than data. The output RA file has an arrival sequence access path. A relative record number of minus one (−1) indicates the end of an RA file.

Each record selected for processing produces a 4-byte, binary relative record number in the RA file.

When the relative record numbers are written to the output RA file, they are blocked up to the record size. Each output record represents a record in the input file. The position of the record in the output RA file is the position the input record has after the sort. When being printed or displayed, the RA file is read sequentially to process the records in the input file. As each relative record number is read, it can be used to access the original file directly.

Automatic Updating

An RA file is not a database object and does not have all the characteristics of a database file. It only reflects the characteristics of the input file at the time that it was created; it is not maintained dynamically as are database file access paths. If the input file is changed after the RA is created, you should be aware of the following:

- Records added to the input file after the RA file is created cannot be accessed by the RA file.
- If an RA file attempts to access a record that has been deleted from the input file, an exception condition will occur.
- Records that have been updated in the input file can still be accessed by the RA file, and will reflect the new data field values.

When you sort a single file to produce an RA output file, note the following:

- The output type on the header specification must be SORTA.
- The maximum control field length must be greater than zero.
- Column 28 of the header specification should contain an X. This excludes the control field from the output record.
- Field specifications must be entered to define the control field.
- No other field specifications should be entered. If you try to include data fields in the output records of an RA file, you can get inconsistent results.
- The INFILE parameter of the FMTDTA command has only one value, because only one input file can be specified for this type of sort.

Examples

This section gives one example of how to use the Sort utility to sort records and create an RA file.

Example 1. Sorting an Inventory File by Item Class

This example sorts the records taken from a file called ITMMSTR, which keeps track of the items and objects in a typical office. The items are grouped into classes, and each class is given a number. The records are to be sorted by item class.

The file will contain the addresses of the input records only; therefore, even if the original input file records are altered, any sorted output that is displayed or printed will contain the modifications and reflect the most up-to-date records.

Item class is a two-digit field in columns 41 through 42 of the input records, as shown in the following input file:

```
/ ITEM NUMBER     ITEM DESCRIPTION                 ITEM TYPE    ITEM CLASS    WAREHOUSE         /  /
/                                                                             STOCK LOCATION    /  /
/   20011230      Dbl pedestal desk lock               A            20        Frankfurt         /  /
/   30010010      Table desk-no center drawer          B            30        Rome              /  /
/   10012000      Swivel chair with arms               C            10        Toronto           /  /
/   70015120      5-drawer file with lock              D            70        New York          /  /
/   50011230      Storage cabinet with doors           E            50        Stockholm         /  /
/   40016210      Substitute drawer                    F            40        Montreal          /  /
/   60013000      Overhead desk unit-2 shelves         G            60        Los Angeles       /  /
/   80012010      Chair-armless                        H            80        Madrid            /  /
```

The records in the input file have the following format:

RECORD CODE	ITEM NUMBER	ITEM DESCRIPTION	ITEM TYPE	ITEM CLASS	WAREHOUSE STOCK LOCATION	
1	2 9	10 39	40	41 42	43 47	48 128

Entering the Specifications

To sort this file, enter the following header, record, and field specifications. Only those columns that are important to this example are described.

HEADER SPECIFICATIONS

Page (1 2) □□ Program Identification (73 74 75 76 77 78 79 80) □□□□□□□□

Statement Number	Type H *	Output Type SORTR SORTRS SORTA	Reserved	Maximum Control Field Length (1-256)	Sequence A D	Reserved	Alt Col Seq S F	Reserved	Output X	Reserved	Comments
3 4 5	6	7 8 9 10 11 12	13 14	15 16 17	18	19 20 21 22 23 24 25	26	27	28	29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 / /72
	H	S O R T A		2	A				X		

Columns	Entry	Explanation
7-12	SORTA	This is a Record Address (RA) sort: the output is to contain only record addresses.
15-17	2	The maximum control field length is 2 characters. The system will look at the entire control field and sort on the first two columns of that field only.
18	A	The output records are to be sorted in ascending order (A before B, 1 before 2, and so on). For the ordering of numbers relative to upper- and lowercase characters and special characters, refer to the collating sequences in Appendix C, "Standard and Alternative Collating Sequences."
26	No entry	The Sort utility defaults to the standard collating sequence.
28	X	The output record is not to contain the control field data.

FIELD SPECIFICATIONS

Statement		Field	Data	Field Location		Forced Characters			Overflow Field Length	Reserved	Comments
Number	Type F *	D N O F S *	C,K Z,L D,E P,I V,J U,R M,S H,T B	Start	End	Record	Substitute	Continuation	... A . l . tS. e. q. . . . . A .		
3 4 5	6	7	8	9 10 11 12	13 14 15 16	17	18	19	20.21 22	23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 / /72
	F	N	C	41	42				•		ITEMCLASS CTL FLD
	*								•		ANYTHING ELSE

This specification establishes the ITEMCLASS field as the control field. The contents of the specification are:

Columns	Entry	Explanation
7	N	The control field is to be treated as a normal control field. This means that the unchanged data from the input record is to be used, and that the sort sequence is specified in the header specification (ascending).
8	C	The system looks at the data in this control field as character data. Each group of 8 bits is assumed to represent a character, which can be a letter of the alphabet, a symbol, or a digit.
9-12	41	This control field is to begin in column 41 of the input record.
13-16	42	This control field is to end in column 42 of the input record. This selects the data from the TYPENO field, corresponding to the original data definition for the input records.
40-72	Comments	Identifies the name of the field selected as control field from the input record.

Processing These Specifications

Once the specifications for the RA sort job are stored in the source file, use the FMTDTA command to run the job. The INFILE parameter specifies a single database physical file. A FMTDTA command that could run this job is:

Specified on FMTDTA Command	Explanation
FMTDTA INFILE((LIBL1/ITMMSTR))+	The input records are to be taken from the first member of database file ITMMSTR in library LIBL1.
OUTFILE(LIBL2/RAMSTR)+	The output records are to be put into the first member of file RAMSTR in library LIBL2.

The specifications are automatically taken from the first member of file QFMTSRC *(default source file) in the library list.*

The OPTION parameter defaults to *CHK, *PRT, *NODUMP, and *NOSECLVL.

The plus sign (+) shown for continuations is not required if the FMTDTA *command is entered from a display station.*

Based on the actual input, the contents of the output file are:

```
/-------------------
/ RELATIVE RECORD
/  NUMBERS
/
/   00003
/   00001
/   00002
/   00006
/   00005
/   00007
/   00004
/   00008
/-------------------
```

Chapter 5. Sorting Records from a File and Producing Totals

In addition to sorting records from one or more input files, you can specify a ***summary sort***, whereby Sort adds together the contents of certain fields in the input records and produces a single output record containing the totals (see Figure 11). A maximum of 24 data fields can be summarized for each record type in a single job. These data fields are called ***summary data fields***, in order to distinguish them from regular data fields that are not summed.

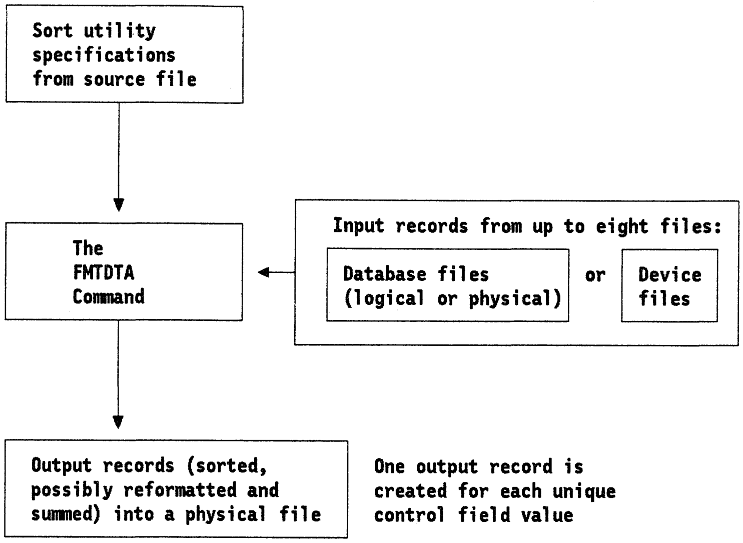

Sort utility specifications from source file
The FMTDTA Command
Input records from up to eight files:
Database files (logical or physical)
or
Device files
Output records (sorted, possibly reformatted and summed) into a physical file
One output record is created for each unique control field value

Figure 11. Sorting and Reformatting Records, and Producing Totals for Certain Data Fields

The output is a physical file in the database, meaning that it contains the actual output records. Note that the output file will contain only as many records as there are unique control field values; it is thus usually much smaller than the input file. The Sort utility sorts the output records according to the contents of the control field.

Handling Overflow

If the totals are larger than the size allowed by the original summary data fields, the system puts only the lower-order digits into the summary field. The higher-order digits are lost, and the system gives no indication that this has happened. For example, if the total is 1 324 567, and the summary data field is only four characters long, the output record will contain only the last four digits, 4567, and you will not be aware that this is not the correct total.

To avoid this, you can do one of two things:

- You can designate an overflow indicator to appear on the output record in the case of an overflow.
- You can increase the size of the summary data field.

If you designate an ***overflow indicator***, such as an asterisk, Sort increases the size of the output record to the right by one column and puts an asterisk into that column to indicate an overflow. This new right-hand column is called the ***overflow indicator field***. The last four digits (4567) are placed into the summary data field, and an asterisk placed into the first available column (following the last data field) of the record.

Only one overflow indicator can be specified for each record type. If you specify more than one, only the last one that you specified for each record type is used.

To increase the size of the summary data field, specify an ***overflow field***. This field replaces the corresponding summary data field. You can specify an overflow field for any summary data field.

You can designate both an overflow field and an overflow indicator.

When performing a summary sort, note the following:

- The output type on the header specification must be SORTRS.
- You must specify a control field by entering a maximum control field length greater than zero in the header specification.
- Enter a set of record specifications for each input record type. One output record will result from each set.
- There are three types of fields that need to be defined:
  - ***Control field.*** Enter one or more field specifications to define the control field. Column 7 will contain an N, O, or F.
  - ***Summary data field.*** Enter field specifications to define each data field to be summed. Column 7 will contain an S to identify the field specification for a summary data field.
  - ***Data field.*** Enter field specifications to define data fields that are not to be summed. Column 7 will contain a D for such field specifications. These fields, when part of the output record, will contain the data taken from the first record of that type found during the processing of the input file for the job.
- If desired, you can put a character into column 17 of the field specification for the summary data field. This is the overflow indicator that the system will put at the end of the output record if the total is too large to fit into the field. If you do not specify a character as an overflow indicator, the Sort utility will use an asterisk.
- If you anticipate that the total value of the summary data field will be larger than the size that the data field will allow, enter a limit (from 1 to 256) into columns 20 through 22 of the field specification for the summary data field. This will create a new field of the length specified in the output record to

contain the total for the data field. This new field will replace the summary data field in the output record.

Examples

Following are four examples that illustrate the summary sort feature.

Example 1. Sorting a File and Summing Data in Certain Fields—One Record Type

This example checks certain stock items for shortages. Here, the input file contains all inventory transactions. These are composed of three different record types according to the original data description: inventory records, receipt records, and adjustment records. The record code in column 2 (`I`, `R`, or `A`) of the input record identifies which of the three types the input record belongs to. Only the records with an `A` in column 2 (adjustment records) are to be selected. Figure 12 on page 56 shows part of the input file.

These adjustment records are sorted, and the number of items (`QUANTITY ORDERED` field) is totaled for each item (identified by the item number in the `ITEM NUMBER` field). The `ITEM NUMBER` field, therefore, is the control field, and the `QUANTITY ORDERED` field is the summary data field.

The output records are 14 columns long: the first 8 columns contain the control field data (the item number), and the last 6 columns contain the totals for each item. The output records are sorted so that the item numbers are in ascending order, according to the standard EBCDIC collating sequence for character data. There will be as many output records as there are different item numbers.

Because there is only one record type, all output records are sorted as one unit.

INVENTORY RECORDS

```
/---------------------------------------------------------------------------------------------------------------------
/ RECORD CODE   ITEM NUMBER   QUANTITY ORDERED   CUSTOMER NUMBER   INVOICE NUMBER   TRANSACTION DATE   SELLING PRICE
/
/     I          70015120           2                  900             0111              880812             212
/     I          10012000           3                 1100             0119              880812             295
/     I          70015120           4                 1100             0113              880812             212
/     I          50011230           5                  400             0662              880812             325
/     I          50011230           6                  400             0221              880812             325
/     I          20011230           6                  700             0568              880812             515
/     I          40016210           2                 1000             2110              880816              42
/     I          40016210           5                 1000             2110              880816              42
/     I          50011230           2                 1100             3110              880816             325
/     I          10012000           3                  400             7117              880816             295
/     .              .              .                   .                .                  .                .
/     .              .              .                   .                .                  .                .
/---------------------------------------------------------------------------------------------------------------------
```

DELETE CODE	RECORD CODE	ITEM NUMBER	QUANTITIY ORDERED	CUSTOMER NUMBER	INVOICE NUMBER	TRANSACTION DATE	SELLING PRICE	/ /
1	2	3 10	11 16	17 24	25 32	33 38	39 43	

RECEIPT RECORDS

```
/---------------------------------------------------------------------------------------------------------------------
/ RECORD CODE   ITEM CLASS   ITEM NUMBER   SELLING PRICE   PURCHASE ORDER #   QUANTITY ORDERED   TRANSACTION DATE
/
/      R            20        20011230         85000             0568                10                 880812
/      R            10        10012000          6295             4330                 6                 880816
/      R            40        40016210           542             2110                 3                 880816
/      R            50        50011230         28325             3110                 2                 880816
/      R            20        20011230         49515             0568                 5                 880816
/      .             .            .               .                .                  .                    .
/      .             .            .               .                .                  .                    .
/---------------------------------------------------------------------------------------------------------------------
```

DELETE CODE	RECORD CODE	ITEM CLASS	ITEM NUMBER	SELLING PRICE	PURCHASE ORDER NUMBER	QUANTITY ORDERED	TRANSACTION DATE	/ /
1	2	3 4	5 12	13 17	18 21	22 27	28 33	

ADJUSTMENT RECORDS

```
/---------------------------------------------------------------------------------------------------------------------
/ RECORD CODE   ITEM NUMBER   ADJUSTMENT CODE   QUANTITY ORDERED   TRANSACTION DATE   WAREHOUSE
/
/      A          10012000           1                  1              880816             2
/      A          20011230           1                  6              880812             2
/      A          20011230           1                  5              880816             3
/      A          40016210           2                  4              880816             1
/      A          30010010           1                  2              880816             1
/      .              .              .                  .                 .               .
/      .              .              .                  .                 .               .
/---------------------------------------------------------------------------------------------------------------------
```

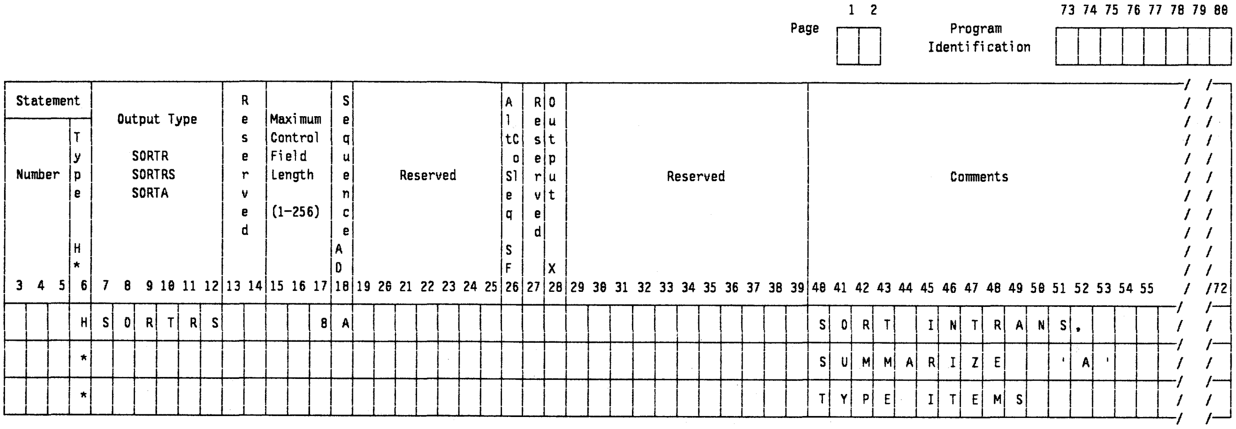
DELETE CODE	RECORD CODE	ITEM NUMBER	ADJUSTMENT CODE	QUANTITY ORDERED	TRANSACTION DATE	WAREHOUSE	/ /
1	2	3 10	11	12 17	18 23	24 25	

Figure 12. The Input File Used in Example 1 Contains Three Different Record Types According to the Original Data Description for the File

Entering the Specifications

To sort this file, enter the following header, record, and field specifications. (Only those columns that are important to this example are described.)

HEADER SPECIFICATIONS



Page 1 2 □□ Program Identification 73 74 75 76 77 78 79 80 □□□□□□□□

Statement Number 3 4 5	Type H * 6	Output Type SORTR SORTRS SORTA 7 8 9 10 11 12	Reserved 13 14	Maximum Control Field Length (1-256) 15 16 17	Sequence A D 18	Reserved 19 20 21 22 23 24 25	Alt Col Seq S F 26	Reserved 27	Output X 28	Reserved 29 30 31 32 33 34 35 36 37 38 39	Comments 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 / /72
	H	SORTRS		8	A						SORT INTRANS.
	*										SUMMARIZE 'A'
	*										TYPE ITEMS

The significant column entries are:

Columns	Entry	Explanation
12	S	Specifies the job as a summary sort. Data in specified summary data fields will be added together.
17	8	Specifies the length of the control field in the output record. In this example, item number, which spans eight columns, is the control field.
18	A	Specifies that the output records will be sorted in ascending order.
28	No Entry	Default. Specifies that the output records are to contain the control field.
48-72	Comments	Comments provide a record of your sort job.

RECORD SPECIFICATIONS

Statement Number 3 4 5	Type I O * 6	Continue A O * 7	Data Type C Z D P U 8	Factor 1 Start Position 9 10 11 12	Factor 1 End Position 13 14 15 16	Comparison Operator EQ,NE LT,GT LE,GE 17 18	Factor 2 C F K S 19	Factor 2 Constant / Factor 2 Keyword / Factor 2 Field Location Start End 20 21 22 23 24 25 26 27•28 29 30 31 32 33 34 35 36 37 38 39	Comments 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55	72
	I		C	2	2	EQ	C	A •	INCLUDE 'A' TYPE	
	*							•	RECORDS	

The significant column entries are:

Columns	Entry	Explanation
6	I	Specifies that the records described in this specification statement should be included in the sort (as opposed to omitted from the sort).
8	C	Identifies the data for Factor 1 and 2 as character data. The sort program will look at both the zone and digit portions of each byte when comparing Factor 1 with Factor 2.
9-12	No entry	The start position of the Factor 1 field is the same as the end position.
13-16	2	The end position of the Factor 1 field.
17-18	EQ	Specifies that the data in Factor 1 of each record must equal Factor 2 for the record to be selected for sorting.
19	C	Specifies that Factor 2 is to be a constant and equal to the value entered into columns 20 through 39 of this record specification.
20-39	A	This is the constant value for Factor 2.

Two field specifications are used. The first defines the control field; the second defines the data field to be summed (the summary data field).

FIELD SPECIFICATIONS

Statement Number 3 4 5	Type F * 6	Field D N O F S * 7	Data Type C,K Z,L D,E P,I V,J U,R M,S H,T B 8	Field Location Start 9 10 11 12	Field Location End 13 14 15 16	Forced Characters Record 17	Forced Characters Substitute 18	Forced Characters Continuation 19	Overflow Field Length ...A. 1. tS. e. q. .... A. 20.21 22	Reserved 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39	Comments 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55	72
	F	N	C	3	18				•		CONTROL FIELD	
	F	S	U	12	17				•		DATA FIELD	
									•			

These are the two field specifications. The significant column entries for the control field specification are:

Columns	Entry	Explanation
7	N	The control field data is to be treated as a normal control field. This means that the unchanged data from the input record is to be used, and that the sort sequence is to be that specified in the header specification (ascending).
8	C	Specifies that Sort is to interpret the data in the control field as character data where both the zone and digit portions of each byte are compared. If, for example, only the digit portions were compared, data would be summed for those records whose control field digit portions matched; the control field values would not necessarily have to be unique, since the zone portions could differ.
9-12	3	Start position of the control field data from the input record.
13-16	10	End position of the control field data from the input record.

The significant column entries for the summary data field specification are:

Columns	Entry	Explanation
7	S	Identifies the field as a summary data field. The data in this field is the data to be summed.
8	U	The data in this field is to be interpreted as numeric data in unpacked format: each digit is represented by both the zone and digit portions of the byte, with the zone portion of the last byte determining the sign (positive or negative) for the entire number.
9-12	12	Start position of the data field in the input records.
13-16	17	End position of the data field in the input records.

Processing These Specifications

To process these specifications, enter the FMTDTA command with parameters as for any of the examples in the previous chapters. For example, you could enter:

Specified on FMTDTA Command	Explanation
FMTDTA INFILE((Z/Y X))+	The input records are to be taken from member X of database file Y in library Z.
OUTFILE(SORTED)+	The output records are to be put into the first member of file SORTED in the current library.

The specifications are automatically taken from the first member of file QFMTSRC *(default source file) in the library list.*

The OPTION parameter defaults to *CHK, *PRT, *NODUMP, and *NOSECLVL.

The plus sign (+) shown for continuations is not required if the FMTDTA *command is entered from a display station.*

Sort sends the output automatically to the device file QSYSPRT, which is the system printer.

The output file looks like the following:

```
 ------------------------------------/
|  ITEM NUMBER   QUANTITY ORDERED   /
|                                   /
|    10012000           1          /
|    20011230          11          /
|    30010010           2          /
|    40016210           4          /
 ------------------------------------/
```

```
 -------------------------------/
|  Item     |   Quantity   |   /
|  Number   |   Ordered    |   /
 -------------------------------/
 1        8 9           14
```

Example 2. Producing Summary Totals Based on Two Input Record Types

In this example, you want to sum and sort the same file shown in Figure 12 on page 56 in the previous example. Two input record types are specified; inventory records (record code I), and receipt records (record code R). Both are reformatted in the same way: the control field (ITEM NUMBER) followed by the summary data field (SELLING PRICE).

Both types of input record are to be sorted by item number. If there are multiple occurrences of an item number, the selling prices are to be summed to produce a total selling price for each item number (total sales).

Figure 13, below, shows the two record types and the significant input fields for this file.

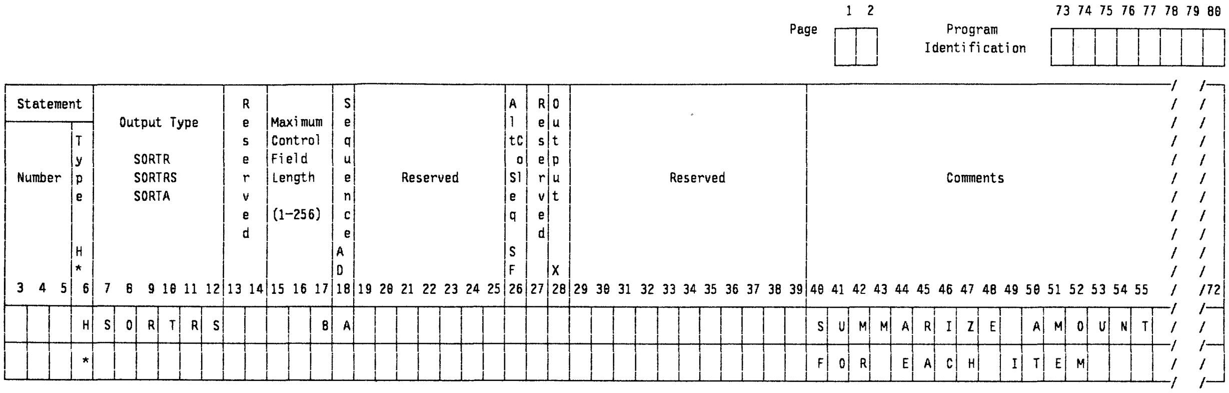
```
INVENTORY RECORDS
  /-------------------------------/  /--------------------------
  / RECORD CODE   ITEM NUMBER     /  /            SELLING PRICE |
  /                               /  /                          |
  /     I          70015120       /  /                 212      |
  /     I          10012000       /  /                 295      |
  /     I          70015120       /  /                 212      |
  /     I          50011230       /  /                 325      |
  /     I          50011230       /  /                 325      |
  /     I          20011230       /  /                 515      |
  /     I          40016210       /  /                  42      |
  /     I          40016210       /  /                  42      |
  /     I          50011230       /  /                 325      |
  /     I          10012000       /  /                 295      |
  /-------------------------------/  /--------------------------

  /-------------------------------/  /--------------------------/
  /   | RECORD | ITEM   |         /  /          | SELLING |     /
  /   | CODE   | NUMBER |         /  /          | PRICE   |     /
  /-------------------------------/  /--------------------------/
      2        3      10 11                  38 39      43

RECEIPT RECORDS
  /-------------/  /-------------------------------------------/
  / RECORD CODE /  /         ITEM NUMBER   SELLING PRICE /
  /             /  /                                           /
  /      R      /  /          20011230        85000            /
  /      R      /  /          10012000         6295            /
  /      R      /  /          40016210          542            /
  /      R      /  /          50011230        28325            /
  /      R      /  /          20011230        49515            /
  /-------------/  /-------------------------------------------/

  /-------------/  /------------------------/
  /   | RECORD  | /  /  | ITEM   | SELLING  | /
  /   | CODE    | /  /  | NUMBER | PRICE    | /
  /-------------/  /------------------------/
      2        3      5     12 13     17
```

Figure 13. Example of the Two Different Record Types in This Input File

Entering the Specifications

Enter the following sort specifications. (Only those columns that are important to these examples are described.)

HEADER SPECIFICATIONS



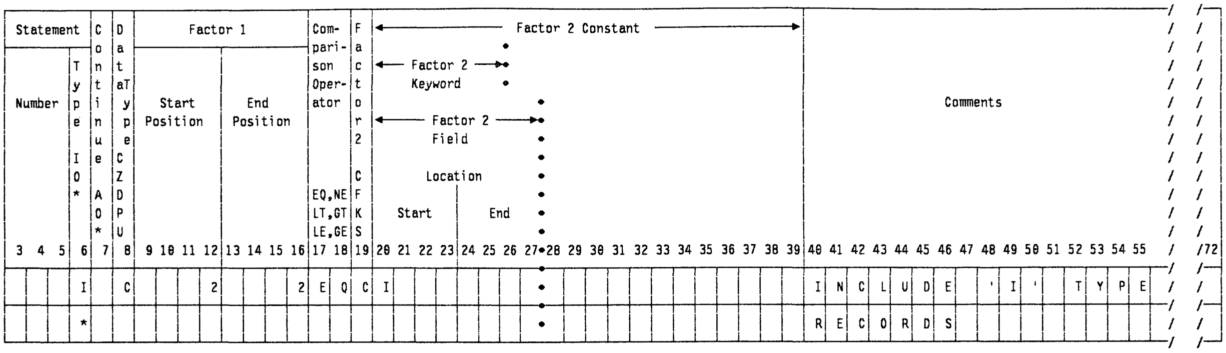
Page (1 2) □□ Program Identification (73 74 75 76 77 78 79 80) □□□□□□□□

Statement Number	Type H *	Output Type SORTR SORTRS SORTA	Reserved	Maximum Control Field Length (1-256)	Sequence A D	Reserved	Alt Col Seq S F	Reserved	Output X	Reserved	Comments
3 4 5	6	7 8 9 10 11 12	13 14	15 16 17	18	19 20 21 22 23 24 25	26	27	28	29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 / /72
	H	SORTRS		8	A						SUMMARIZE AMOUNT
	*										FOR EACH ITEM

The significant column entries are:

Columns	Entry	Explanation
12	S	Specifies the job as a summary sort. Data in specified summary data fields will be added together.
17	5	Specifies the length of the control field in the output record. In this example, item number, which spans five columns, is the control field.
18	A	Specifies that the output records are to be sorted in ascending order.
28	No entry	Specifies that the output records are to contain the control field as well as the summary data field.
40-72	Comments	Comments provide a record of your sort job.

RECORD SPECIFICATIONS



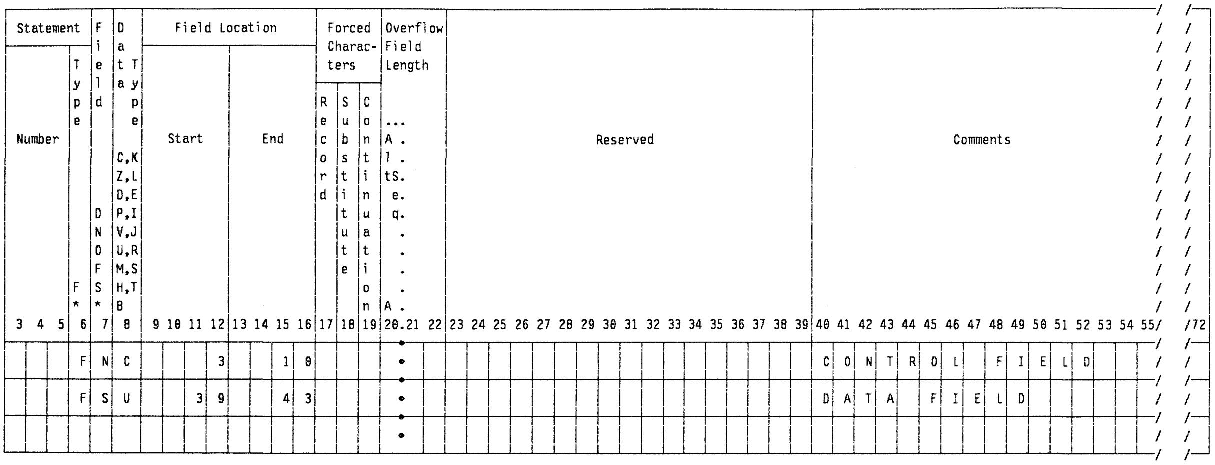
Statement Number	Type I O *	Continue A O *	Data Type C Z D P U	Factor 1 Start Position	Factor 1 End Position	Comparison Operator EQ,NE LT,GT LE,GE	Factor 2 C F K S	Factor 2 Constant • Factor 2 Keyword • Factor 2 Field Location Start End	Comments
3 4 5	6	7	8	9 10 11 12	13 14 15 16	17 18	19	20 21 22 23 24 25 26 27•28 29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 / /72
	I		C	2	2	EQ	C	I	INCLUDE 'I' TYPE
	*								RECORDS

The significant column entries are:

Columns	Entry	Explanation
6	I	Specifies that the records described in this specification should be included in the summary sort (as opposed to being omitted from it).
8	C	Identifies the data for Factor 1 and 2 as character data. The system will look at both the zone and digit portions of each byte when comparing Factor 1 with Factor 2.
13-16	2	Start and end position of the Factor 1 field.
17-18	EQ	Specifies that the data in Factor 1 of each record must equal Factor 2.
19	C	Specifies that the data in the Factor 2 field is to be equal to the constant value entered into columns 20 through 39 of this record specification.
20-39	I	The constant value for Factor 2.

Because the input file has two different record types, and you intend to work with both, you must specify them as two separate sets of specifications. In the field specifications for the first set, a summary data field is defined after the control field.

FIELD SPECIFICATIONS



Statement				Field Location		Forced Characters			Overflow Field Length		
Number	Type F *	Field D N O F S *	Data Type C,K Z,L D,E P,I V,J U,R M,S H,T B	Start	End	Record	Substitute	Continuation	... A . l . tS. e. q. . . . . A .	Reserved	Comments
3 4 5	6	7	8	9 10 11 12	13 14 15 16	17	18	19	20.21 22	23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72
	F	N	C	3	10				•		CONTROL FIELD
	F	S	U	39	43				•		DATA FIELD
									•		

The significant column entries are:

Columns	Entry	Explanation
7	N	Identifies the field as a normal control field. The data in the control field is not to be forced (altered) before being used to control the sort.
8	C	Specifies that Sort is to interpret the data in the control field as character data, where both the zone and digit portions of each byte are compared.
9-12	3	The start position of the control field is the same as the end position.
13-16	10	The end position of the control field data in the input record.

The significant column entries for the summary data field specification are:

Columns	Entry	Explanation
7	S	Identifies the field as a summary data field. The data in this field is to be summed.
8	U	The data in this field is to be interpreted as numeric data in unpacked format: each digit is represented by both the zone and digit portions of the byte, with the zone portion of the last byte determining the sign (positive or negative) for the entire number.
9-12	39	The start position of the control field is the same as the end position.
13-16	43	The end position of the control field data in the input record.

Summary data fields are defined very much like normal output data fields:

- Enter F into column 6, to indicate a field selection specification.
- Enter S into column 7, to indicate a summary data field.
- Enter the data type of the field to be added into column 8.

The same data types that are used for normal data fields are also used for summary data fields. This data type entry is important, because the method of adding and the interpretation of the result vary depending on the data type selected. In the following list, the word *number* refers to the entire sequence of digits: the number 4 526 is composed of the digits 4, 5, 2, and 6.

P **_Packed data type._** System considers each sequence of four bits as one digit, starting with the second sequence from the right. The four bits farthest to the right determine the sign of the number.

U **_Unpacked data type._** System considers each sequence of eight bits (each byte) as one digit. The digit portions determine the digit, and are added together. The zone portion of the last byte determines the sign of the number. (The zone portions of the other bytes remain as X'F' to indicate to the system that these bytes are digits, as opposed to other characters.)

D **_Digit data type._** System considers each byte as one digit, as for unpacked data, except that the zone portion of the last byte is not used to contain the sign of the number. The number has no sign; it is assumed to be positive.

C **_Character data type._** System considers each byte as one character.

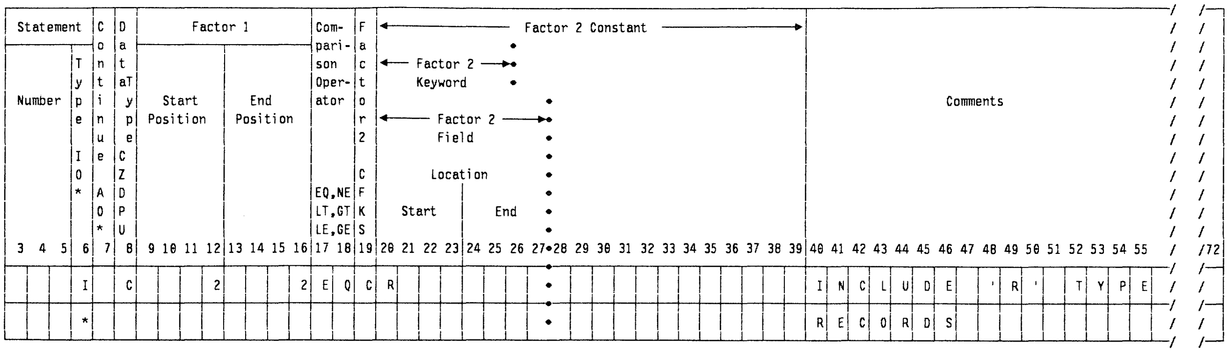
Z **_Zone data type._** System considers each byte as one digit, as for unpacked data. Only the zone portions are added together.

Note: When using summary data fields, you must ensure that the data in the input file matches the data type given in the field specifications; otherwise, the results are unpredictable.

- Enter the start and end position of that part of the input record that is to become the summary data field. Like normal data fields, the starting position need not be specified for a field that is only one position long.

To allow the Sort utility to also take data from type R records, specify another record type by entering a second set of record and field specifications. You need the new field specifications because the start and end positions of the ITEM NUMBER and SELLING PRICE fields for the R input records are different from those for the I input records.

RECORD SPECIFICATIONS



Statement Number	Type (I, O, *)	Continue (A, O, *)	Data Type (C, Z, D, P, U)	Factor 1 Start Position	Factor 1 End Position	Comparison Operator (EQ,NE LT,GT LE,GE)	Factor 2 (C, F, K, S)	Factor 2 Constant / Factor 2 Keyword / Factor 2 Field Location Start End	Comments	72
3 4 5	6	7	8	9 10 11 12	13 14 15 16	17 18	19	20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55	72
	I		C	2	2	EQ	C	R	INCLUDE 'R' TYPE	
	*								RECORDS	

The significant column entries are:

Columns	Entry	Explanation
6	I	Specifies that the records described in this specification are to be included in the sort.
8	C	Identifies the data for Factors 1 and 2 as character data. The system will look at both the zone and digit portions of each byte when comparing Factor 1 with Factor 2.
13-16	2	Start and end position of the Factor 1 field.
17-18	EQ	Specifies that the data in Factor 1 of each record must equal Factor 2.
19	C	Specifies that the value in Factor 2 is equal to the constant value entered into columns 20 through 39 of this record specification.
20-39	R	The constant value for Factor 2.

FIELD SPECIFICATIONS

Statement Number	Type F *	Field D N O F S *	Data Type C,K Z,L D,E P,I V,J U,R M,S H,T B	Field Location Start	Field Location End	Forced Characters Record	Forced Characters Substitute	Forced Characters Continuation	Overflow Field Length ...A. l. tS. e. q. . . . . A.	Reserved	Comments
3 4 5	6	7	8	9 10 11 12	13 14 15 16	17	18	19	20.21 22	23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72
	F	N	C	5	12				•		CONTROL FIELD
	F	S	U	13	17				•		DATA FIELD
									•		

The significant column entries are:

Columns	Entry	Explanation
7	N	Identifies the field as a normal control field. The control field data is not to be forced (altered) before being used to control the sort.
8	C	Specifies that Sort is to interpret the data in the control field as character data where both the zone and digit portions of each byte are compared.
9-12	5	Start position of the control field data in the input record.
13-16	12	End position of the control field data in the input record.

The significant column entries for the summary data field specification are:

Columns	Entry	Explanation
7	S	Identifies the field as a summary data field. The data in this field is to be summed.
8	U	The data in this field is to be interpreted as numeric data in unpacked format: each digit is represented by both the zone and digit portions of the byte, with the zone portion of the last byte determining the sign (positive or negative) for the entire number.
9-12	13	Start position of the data field in the input records.
13-16	17	End position of the data field in the input records.

Processing These Specifications

To process these specifications, enter the FMTDTA command with parameters as for any of the examples in the previous chapters. For example, you could enter:

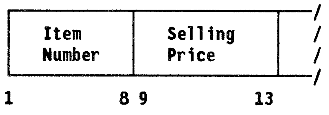
Specified on FMTDTA Command	Explanation
FMTDTA INFILE((PROD/INVENTRY MONDAY))+	The input records are to be taken from member MONDAY of database file INVENTRY in library PROD.
OUTFILE(PROD/NEWORD MONDAY)+	The output records are to be put into member MONDAY of file NEWORD in library PROD.
SRCFILE(TEST/EXAMPLE)+ SRCMBR(EXAMPLE1)+	The reformat specifications are taken from member EXAMPLE1 in database file EXAMPLE, which is in library TEST.

The OPTION parameter defaults to *CHK, *PRT, *NODUMP, and *NOSECLVL.

The plus sign (+) shown for continuations is not required if the FMTDTA *command is entered from a display station.*

The output file looks like the following:

```
     ITEM NUMBER    SELLING PRICE

      10012000          6885
      20011230         36030*
      40016210           626
      50011230         29300
      70015120           424
          .                .
          .                .

 * Overflow occurred
```



Example 3. Using an Overflow Field for Summary Data Overflow

This situation is the same as in "Example 2. Producing Summary Totals Based on Two Input Record Types" on page 60, except that here you will specify an overflow field to hold totals that may be more than five characters long.

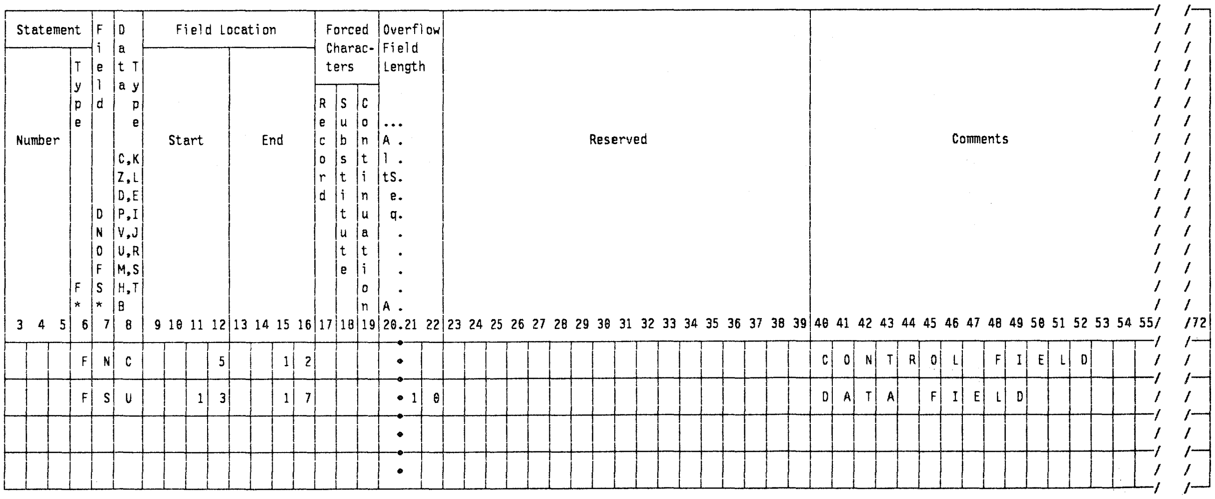
Entering the Specifications

To define the overflow field, enter a length for this overflow field into the Overflow Field Length columns (columns 20 through 22) of the field specification. The length that you specify here must not be less than the maximum length allowed for the input data type as specified in column 8 of the field specification (refer to Table 7 on page 113).

Note that, because of the addition of the overflow field, the output record length will be longer than the input record length.

Suppose you anticipate an overflow only for record type R of "Example 2. Producing Summary Totals Based on Two Input Record Types" on page 60. All header, record, and field specifications would therefore be the same as for that example, with the exception of a new field specification added to those for record type R. These specifications would then be as follows (only those columns that are important to this example are described):

FIELD SPECIFICATIONS



Statement Number	Type F*	Field DNOFS*	Data Type C,K Z,L D,E P,I V,J U,R M,S H,T B	Field Location Start	Field Location End	Forced Characters Record	Forced Characters Substitute	Forced Characters Continuation	Overflow Field Length ... A. l. tS. e. q. . . . . A.	Reserved	Comments
3 4 5	6	7	8	9 10 11 12	13 14 15 16	17	18	19	20.21 22	23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72
	F	N	C	5	12				•		CONTROL FIELD
	F	S	U	13	17				• 10		DATA FIELD
									•		
									•		

Figure 14. The Field Specifications for Record Type R from Example 2

The additional column entries for the summary data field specification are:

Columns	Entry	Explanation
20-22	10	Gives the length of the overflow field. By entering a value into this field, you automatically increase the size of this summary data field to 10 columns.

All other entries are the same as for Example 2.

Processing These Specifications

FMTDTA processes the job, as in "Example 2. Producing Summary Totals Based on Two Input Record Types" on page 60. The output file, however, looks like:

```
     ITEM NUMBER              SELLING PRICE

       10012000                       6885
       20011230                     135030
       40016210                        626
       50011230                      29300
       70015120                        424
          .                            .
          .                            .
```

```
 ___________________________________________________/
|   Item        |    Overflow     |   Selling    |  /
|   Number      |    Area         |   Price      |  /
|_______________|_________________|______________|__/
1              8 9              13 14           18
```

Figure 15. The Output File Produced in Example 3

Note that the larger summary data field can now accommodate the total value for item number 20011230.

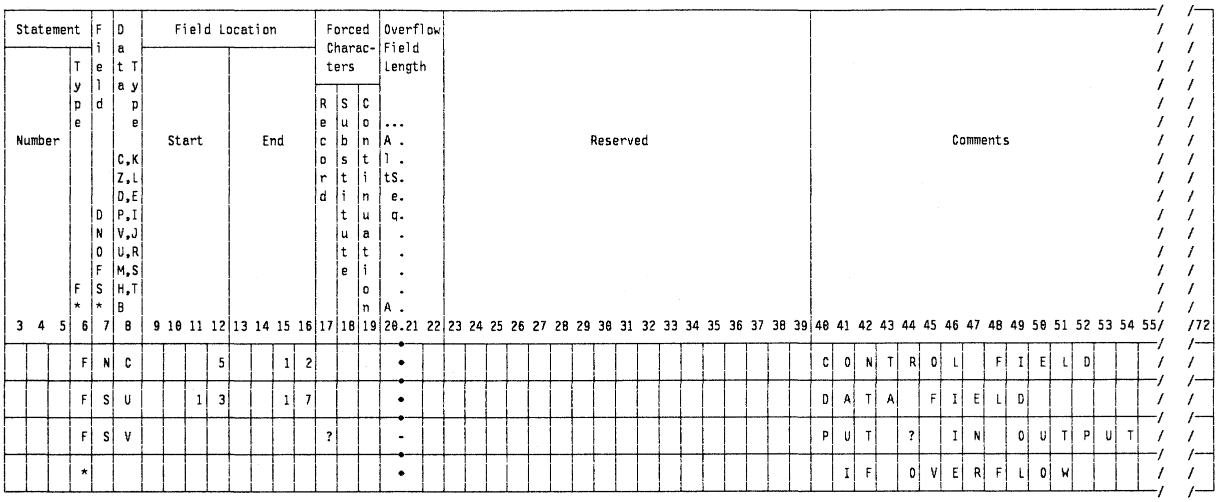
Example 4. Using an Overflow Indicator for Summary Data Overflow

There may be times when you do not want to specify a summary overflow field length, or when you do not know how large a summary overflow field will be. In these cases, you can cause the utility to put a constant (the *overflow indicator*) into the output record each time an overflow occurs. Subsequent programs that read your sorted output file can then test for the presence of this character constant and act accordingly.

Entering the Specifications

You can specify the overflow indicator on any field specification for the job. If you specify different overflow characters on different field specifications, Sort uses the last one that was specified for each record type. For example, if you use the summary data field specification for record type R of the previous example, the field specifications would then become as follows (only those columns that are important to this example are described):

FIELD SPECIFICATIONS



Statement Number	Type	Field Type (F *, D N O F S *)	Data Type (C,K Z,L D,E P,I V,J U,R M,S H,T B)	Field Location Start	Field Location End	Forced Characters Record	Forced Characters Substitute	Forced Characters Continuation	Overflow Field Length (... A . 1 . tS. e. q. . . . . A .)	Reserved	Comments
3 4 5	6	7	8	9 10 11 12	13 14 15 16	17	18	19	20.21 22	23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55
	F	N	C	5	12				•		CONTROL FIELD
	F	S	U	13	17				•		DATA FIELD
	F	S	V			?			-		PUT ? IN OUTPUT
	*								•		IF OVERFLOW

A new field specification is added to provide the overflow indicator. The significant column entries are:

Columns	Entry	Explanation
7	S	Identifies the field as a summary data field. The data in this field is to be summed.
8	V	Force a data character constant into the data field.
9-12	No Entry	Leave this part of the field specification blank.
13-16	No Entry	Leave this part of the field specification blank.
17	?	Provides the overflow indicator.

Note: If overflow occurs in any of the summary data fields, the character in column 17 will be written into the overflow indicator field.

If overflow occurs and no overflow character is identified (column 17 is blank) the system will set the overflow indicator to an asterisk (*).

Processing These Specifications

This job is processed like "Example 2. Producing Summary Totals Based on Two Input Record Types" on page 60. The output file contains the following entries:

```
  ITEM NUMBER   SELLING PRICE   OVERFLOW

   10012000         6885
   20011230        35030            ?
   40016210          626
   50011230        29300
   70015120          424
       .              .
       .              .
```

```
 ___________________________________________/
|   Item     |    Selling    |Ov|           /
|   Number   |    Price      |fl|           /
|____________|_______________|__|___________/
1           8 9            13 14
```

Figure 16. The Output Showing the Overflow Character

Notice that the system has expanded the output record by one column, and placed an asterisk into this column to indicate that the record with item number 20011230 has a summary data field with an overflow value.

Chapter 6. Copying and Merging Records from Several Files into One

If you do not specify any sorting of records, the Sort utility can be used to simply copy the data from one or more input files into a single physical file in the database. The data is placed in the output file in the same sequence as it is found in the input file; no reordering is done. See Figure 17.

If the output file already contains records, they are not cleared before the input records are copied. The input records are added to the end of the file.

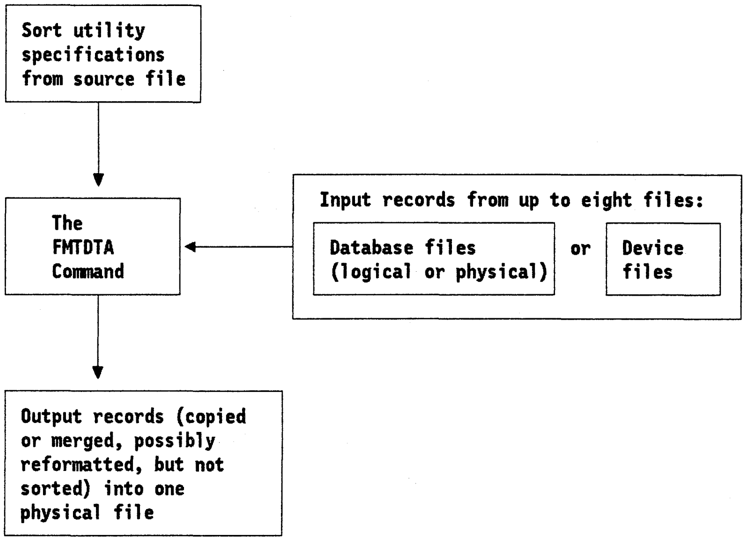

Sort utility specifications from source file
The FMTDTA Command
Input records from up to eight files:
Database files (logical or physical)
or
Device files
Output records (copied or merged, possibly reformatted, but not sorted) into one physical file

Figure 17. Copying or Merging One or More Files into One Physical File

The output is a physical file in the database, meaning that the output file contains a sorted and reformatted copy of the actual input records.

Copying records in this way has two aspects:

- Specifying Sort options with no reformatting of records
- Copying records and, at the same time, reformatting the output.

These two aspects follow the same rules as previously stated: for example, up to eight input files can be specified.

When copying and merging records from several files into one to produce a single physical output file, note the following:

- Enter `SORTR` as the output type on the header specification.
- Enter `0` as the maximum control field length, as there is to be no control field. This also implies that columns 15 to 39 of the header specification should be left blank, because the entries in these columns all pertain to the sorting process.

- Enter record specifications, if any conditions are placed on the input records selected for copying or merging.
- Enter field specifications, if the input record is reformatted in any way.

Examples

The following examples show the copying capabilities of Sort:

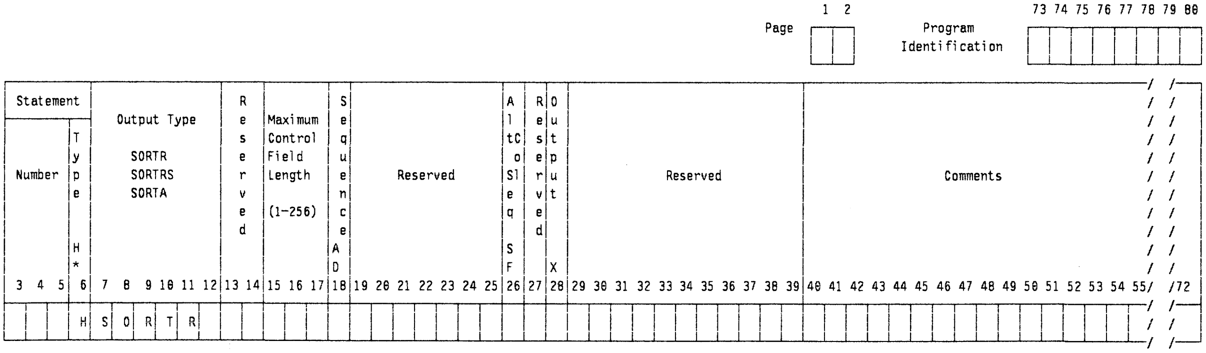
Example 1. Copying a File with No Reformatting

This example illustrates how to copy records from a file without sorting. Here records from three input files are to be merged into one output file. The header and field specifications do not specify any control field information. A number of "omit" record specifications (see "Column 6 (Specification Identifier)" on page 97) are present; records that meet the criteria of the specified comparisons are not to be included in the output file. Following the "omit" specifications is an "include-all" specification which specifies that all records not meeting the criteria of the specified "omit" comparisons are to be included in the output file. All data fields in the input records are included in the output records.

Entering the Specifications

Complete the following specifications. (Only those columns that are important to this example are described.)

HEADER SPECIFICATIONS



Page (1 2) □□ Program Identification (73 74 75 76 77 78 79 80) □□□□□□□□

Statement Number	Type H*	Output Type SORTR SORTRS SORTA	Reserved	Maximum Control Field Length (1-256)	Sequence A D	Reserved	Alt Col Seq S F	Reserved	Output X	Reserved	Comments
3 4 5	6	7 8 9 10 11 12	13 14	15 16 17	18	19 20 21 22 23 24 25	26	27	28	29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72
	H	S O R T R									

This header specification states that a copy-only request is performed. No control field information is needed on a copy-only request because the records are copied in the order they are found. No sorting is done.

RECORD SPECIFICATIONS

Statement Number 3 4 5	Type (I O *) 6	Continue (A O *) 7	Data Type (C Z D P U) 8	Factor 1 Start Position 9 10 11 12	Factor 1 End Position 13 14 15 16	Comparison Operator (EQ,NE LT,GT LE,GE) 17 18	Factor 2 (C F K S) 19	Factor 2 Constant / Factor 2 Keyword / Factor 2 Field Location Start, End 20 21 22 23 24 25 26 27•28 29 30 31 32 33 34 35 36 37 38 39	Comments 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55	/72
	O		C	6	62	EQ	C	D	OMIT IF COL62=D	
	O	A	C	5	55	EQ	C	X	AND COL55=X	
	O	O	C	6	62	EQ	C	G	OR IF COL62=G	
	O	A	C	5	55	EQ	C	X	AND COL55=X	
	I								INCLUDE ALL BUT	
	*								OMITTED RECORDS	

These omit record specifications indicate which records are not included in the output file. The significant column entries are:

Columns	Entry	Explanation
6	O	The records that meet these conditions are omitted from the copy.
7	A or O	These records continue to specify the conditions that the record must meet in order to be omitted from the copy. An input record is omitted if position 62 contains a D and position 55 contains an X, or if position 62 contains a G and position 55 contains an X.
8	C	Character data is used for the comparisons.
15-16	62, 55	Identify which fields in the input record are to meet certain conditions.
17-18	EQ	The condition is that the value found in those fields must be equal to the Factor 2 field.
19	C	The value of the Factor 2 field is to be a constant.
20	D, X, G	The constant value is to be a D, X, or G, respectively.

The last record specification is an include-all statement, meaning that the only entry on that record specification is the sequence number and the I in column 6. This causes all the records not omitted by the omit specifications to be included in the copy.

FIELD SPECIFICATIONS

Statement Number 3 4 5	Type F * 6	Field D N O F S * 7	Data Type C,K Z,L D,E P,I V,J U,R M,S H,T B 8	Field Location Start 9 10 11 12	Field Location End 13 14 15 16	Forced Characters Record 17	Forced Characters Substitute 18	Forced Characters Continuation 19	Overflow Field Length ... A. l. ts. e. q. A. 20.21 22	Reserved 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39	Comments 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57/ /72
	F	D	C						•		INCLUDE ALL INPUT
	*								-		FIELDS

This field specification states that all the input data fields are to be included in the output records. The data is character data.

Processing the Specifications

Below is an example of FMTDTA command that could be used to run this Sort job:

Specified on FMTDTA Command	Explanation
FMTDTA INFILE((PROD/DISKET1 MONDAY))+	Specifies input file in library PROD.
OUTFILE(PROD/TRANSM)+	The output file is TRANSM in library PROD. Since a member name is not specified, the output records are stored in the first member in the file.
SRCFILE(TEST/EXAMPLE)+ SRCMBR(EXAMPLE4)+	The reformat specifications are taken from member EXAMPLE4 in data file EXAMPLE, which is in library TEST.

The OPTION parameter defaults to *CHK, *PRT, *NODUMP, and *NOSECLVL.

The plus sign (+) shown for continuations is not required if the FMTDTA *command is entered from a display station.*

Example 2. Copying/Merging Several Files to Produce a Reformatted Output File

This example copies the same records from the same files as "Example 1. Copying a File with No Reformatting" on page 74. The fields in the output record, however, are to be rearranged.

Entering the Specifications

The header and record specifications are the same as for "Example 1. Copying a File with No Reformatting" on page 74.

The field specifications are as follows (only the column entries that are important to this example are described):

FIELD SPECIFICATIONS

Statement Number	Type (F*)	File (DNOFS*)	Data Type (C,K Z,L D,E P,I V,J U,R M,S H,T B)	Field Location Start	Field Location End	Forced Characters Record	Forced Characters Substitute	Forced Characters Continuation	Overflow Field Length (...A.1.tS.e.q....A.)	Reserved	Comments
3 4 5	6	7	8	9 10 11 12	13 14 15 16	17	18	19	20.21 22	23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57/ /72
	F	D	C	72	128				•		FIELD 7
	F	D	C	66	71				•		FIELD 6
	F	D	C	52	65				•		FIELD 5
	F	D	C	48	51				•		FIELD 4
	F	D	C	22	47				•		FIELD 3
	F	D	C	3	21				•		FIELD 2
	F	D	C	1	2				•		FIELD 1
									•		

Note that the entries in columns 9-16 reorder the fields on the output record in the reverse order from what they are in in the input record. Only the fields that are specified will appear in the output record.

Processing These Specifications

Assuming that the input records are in the same input files, the specifications are in the same source file, and the output file is to be the same output file as in "Example 1. Copying a File with No Reformatting" on page 74, enter the same FMTDTA command as in "Example 1. Copying a File with No Reformatting" on page 74 in order to process the specifications. See below.

Specified on FMTDTA Command	Explanation
FMTDTA INFILE((PROD/DISKET1 MONDAY)+ (PROD/DISKET2)+ (PROD/DISKET3))+	Specifies three input files, all in library PROD.
OUTFILE(PROD/TRANSM)+	The output file is TRANSM in library PROD. Since a member name is not specified, the output records are stored in the first member of the file.
SRCFILE(TEST/EXAMPLE)+ SRCMBR(EXAMPLE4)+	The reformat specifications are taken from member EXAMPLE4 in data file EXAMPLE, which is in library TEST.

The OPTION parameter defaults to *CHK, *PRT, *NODUMP, and *NOSECLVL.

The plus sign (+) shown for continuations is not required if the FMTDTA *command is entered from a display station.*

Part 2. Reference

You use the Sort utility by first entering a series of Sort specifications into a source file that tells the system what you want to do, and then calling up the CL command FMTDTA with its appropriate options.

The reference information contained here describes each possible Sort specification in detail, as well as the FMTDTA command used to call up the utility. The following topics are covered:

- Chapter 7, "The Format Data (FMTDTA) Command"
- Chapter 8, "The Header Specification"
- Chapter 9, "Record Specifications"
- Chapter 10, "Field Specifications"
- Chapter 11, "The Comment Specification."

Chapter 7. The Format Data (FMTDTA) Command

The CL command Format Data (FMTDTA), when used with the appropriate parameters, processes a series of Sort specifications previously stored as a member in a library. This chapter describes the parameters and options of this command, and how to use it.

You **must** enter values for the first two parameters, `INFILE` and `OUTFILE`. The remaining parameters are optional. Default values are assumed for parameters that you omit.

Accessing and Using the FMTDTA Command

There are two ways of accessing and running the FMTDTA command:

- ***From a CL prompt display or a command menu.*** To access the FMTDTA prompt displays, type `FMTDTA` on a command line and press F4. Alternatively, you can select FMTDTA from a command menu. Enter the appropriate parameters, and press Enter to process the sort job.
- ***As a line command.*** If you are familiar with both the CL command language, and with the FMTDTA command and its parameters, you can type the FMTDTA command with its parameters on a command line, and press Enter to process the command.

File Naming Conventions

When identifying files and members in the system, you must use the appropriate convention. For example, `LIBRAR1/FILE1 MEM3` identifies member `MEM3` of file `FILE1` in library `LIBRAR1`. If you do not specify a member, the system defaults to the first member in a file. If a file contains no members, then the whole file is considered as one member.

Syntax of the FMTDTA Command

The syntax you use when entering the FMTDTA command as a line command is shown below.

```
                                                 Job: B,I  Pgm: B,I  REXX: B,I  Exec
►►──FMTDTA─────────────────────────────────────────────────────────────────────────►

             ┌──────────────────────────────────────────────────────────────┐
             │   ┌─*CURLIB/───────┐           ┌─*FIRST─────────────────────┐  │
►──INFILE(───▼─(─┼────────────────┼─file-name─┼─diskette-file-identifier───┼─)─┴(1)──)───►
                 ├─*LIBL/─────────┤           └─member-name────────────────┘
                 └─library-name/──┘

            ┌─*CURLIB/───────┐           ┌─*FIRST───────┐
►──OUTFILE(─┼────────────────┼─file-name─┼──────────────┼─)──────────────────────►
            ├─*LIBL/─────────┤           └─member-name──┘
            └─library-name/──┘

►──┬──────────────────────────────────────────────────────┬──────────────────────►
   │           ┌─*LIBL/─────────┐ ┌─QFMTSRC────────────┐   │
   └─SRCFILE(──┼────────────────┼─┴─source-file-name───┴─)─┘
               ├─*CURLIB/───────┤
               └─library-name/──┘

►──┬───────────────────────────────────────────┬─────────────────────────────────►
   │          ┌─*FIRST─────────────────────┐    │
   └─SRCMBR(──┼─data-file-identifier───────┼─)──┘
              └─member-name────────────────┘

►──┬──────────────────────────────────────────────────────┬──────────────────────►
   │           ┌─*LIBL/─────────┐ ┌─QSYSPRT────────────┐   │
   └─PRTFILE(──┼────────────────┼─┴─print-file-name────┴─)─┘
               ├─*CURLIB/───────┤
               └─library-name/──┘

►──┬─────────────────────────────────────────────────────────────────┬───────────►
   │         ┌─*CHK───┐ ┌─*PRT───┐ ┌─*NODUMP─┐ ┌─*NOSECLVL─┐      │
   └─OPTION(─┼────────┼─┼────────┼─┼─────────┼─┼───────────┼──)───┘
             └─*NOCHK─┘ └─*NOPRT─┘ └─*DUMP───┘ └─*SECLVL───┘

►──┬──────────────────────────────────┬──────────────────────────────────────────►◄
   │          ┌─*CURRENT─┐           │
   └─PGMDATE(─┴─date─────┴──)────────┘
```

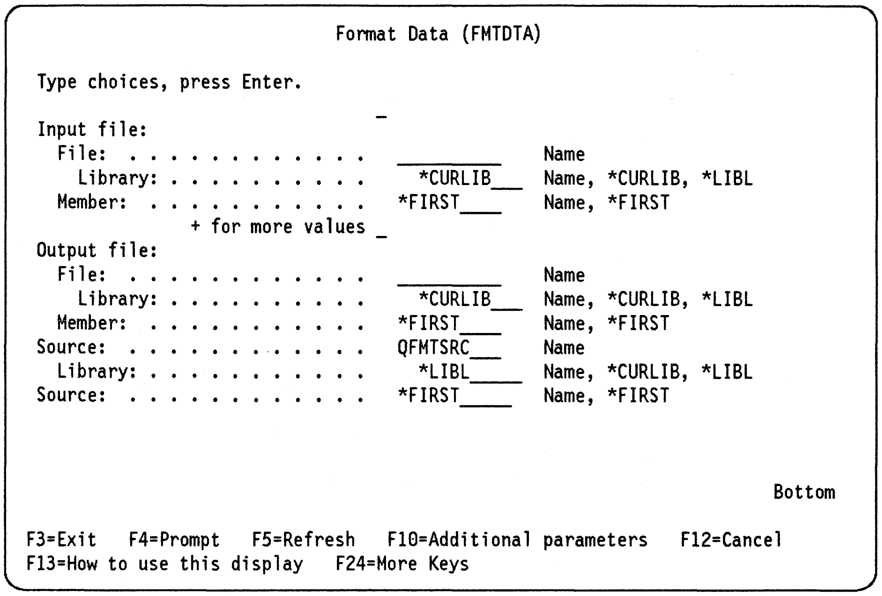
Note:

1 A maximum of 8 repetitions

Figure 18. Syntax of the FMTDTA Command

The FMTDTA Displays

Type FMTDTA with no parameters and press F4 to pull up the first FMTDTA prompt display.

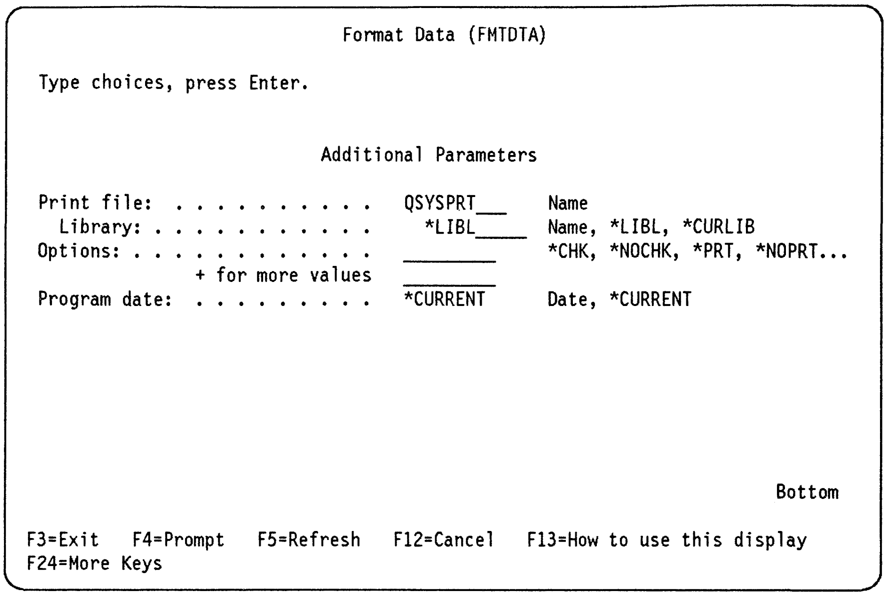


```
                              Format Data (FMTDTA)

 Type choices, press Enter.
                                          _
 Input file:
   File: . . . . . . . . . . . .    __________    Name
     Library: . . . . . . . . . .     *CURLIB___  Name, *CURLIB, *LIBL
   Member: . . . . . . . . . . .    *FIRST____    Name, *FIRST
             + for more values _
 Output file:
   File: . . . . . . . . . . . .    __________    Name
     Library: . . . . . . . . . .     *CURLIB___  Name, *CURLIB, *LIBL
   Member: . . . . . . . . . . .    *FIRST____    Name, *FIRST
 Source: . . . . . . . . . . . .    QFMTSRC___    Name
   Library: . . . . . . . . . . .     *LIBL_____  Name, *CURLIB, *LIBL
 Source: . . . . . . . . . . . .    *FIRST_____   Name, *FIRST




                                                                 Bottom

F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
F13=How to use this display   F24=More Keys
```

Figure 19. The First FMTDTA Screen

You must enter *at least* a value for Input File Name, and a value for Output File Name before you run the sort job. These names must already exist in the system. All other parameters have default values, which you can change if necessary. Press F10 to display additional parameters.

Additional parameters are found on this display.



```
                         Format Data (FMTDTA)

 Type choices, press Enter.


                        Additional Parameters

 Print file:  . . . . . . . . . .   QSYSPRT___    Name
   Library: . . . . . . . . . . .     *LIBL_____  Name, *LIBL, *CURLIB
 Options: . . . . . . . . . . . .   ________      *CHK, *NOCHK, *PRT, *NOPRT...
               + for more values    ________
 Program date:  . . . . . . . . .   *CURRENT      Date, *CURRENT









                                                                   Bottom

F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More Keys
```

Figure 20. The Second FMTDTA Display

When you have entered the option values you need, Press Enter to begin processing, or press F3 to exit without processing the command.

The Parameters of the FMTDTA Command

In the description of the parameters that follow, the defaults appear first. The parameters are presented in the sequence you would follow when entering the command on the command line. The parameter keyword is shown first, followed by the corresponding prompt that appears on the FMTDTA prompt display.

INFILE (*Input file*)

Specifies the names of the libraries, files, and members from which the input records are selected. If you type a plus sign (+) into this field, you can enter up to eight input files.

file_name

Enter the name of the file. This is a required parameter.

library_name

Enter any of the following values, or accept the default.

***CURLIB**

The current library. If you have not specified a current library, QGPL is used.

***LIBL**

The current library list. The system searches this list for the input file. The first file it finds with the specified file name is the one it searches for the input records.

library_name
The name of the particular library where the input file and member are to be found.

member_name
Enter any of the following values.

FIRST
The first member of the input file.

data_file_identifier
For diskette files, enter one data file identifier per diskette unit file name specified. If more than one diskette data file is being specified as the input file, the data file identifier must be entered for each.

member_name
For database files, enter the name of the member in which the input records are to be found.

OUTFILE (*Output file*)
Specifies the library, file, and member where the output (sorted and reformatted) records are stored.

file_name
Enter the name of the file. You must enter an option for this field.

library_name
Enter any of the following values, or accept the default.

CURLIB
The current library. If you have not specified a current library, QGPL is used.

***LIBL**
The current library list. The system will search this list for the output file. The first file it finds with the specified file name is the one into which it will put the output records.

library_name
The name of the particular library where the output file and member are to be found.

member_name
Enter any of the following values, or accept the default.

FIRST
The first member of the output file is to contain the output records.

member_name
Enter the name of the member into which the output records are to be put.

SRCFILE (*Source file name*)
Specifies the library and file where the specifications for this sort job are to be found. The possible values are:

QFMTSRC
An IBM-supplied source file.

source_file_name
Enter the name of a particular source file.

library_name
Enter any of the following values, or accept the default.

***LIBL**
The current library list. The system searches this list for the source file. The first file it finds with the specified file name is the one that it attempts to process for instructions.

***CURLIB**
The current library. If you have not specified a current library, QGPL is used.

library_name
The name of the particular library where the source file and member are to be found.

SRCMBR (*Source member name*)
Specifies the name of the member in which the source specifications are to be found. Enter any of the following values, or accept the default.

***FIRST**
Sort searches for the sort specifications in the first member of the source file.

data_file_identifier
For diskette files, enter the data file identifier for the diskette unit file name specified.

member_name
For database files, enter the name of the member in which the source specifications are to be found.

The following parameters are shown on the second FMTDTA display:

PRTFILE (*Print file name*)
Specifies the library and name of the printer device file to which the listing will be written. The possible values for the file name are:

QSYSPRT
The contents of this file are printed automatically by the system printer.

print_file_name
Enter the name of a particular printer device file.

library_name
The name of the library containing the print file. Possible values are:

***LIBL**
The current library list. The system searches this list for the printer device file. The first file it finds with the specified file name is the one that it uses as the printer device file.

**CURLIB*

The current library. If you have not specified a current library, QGPL is used.

library_name

The name of the particular library where the printer device file is to be found.

OPTION (*Options*)

Specifies the sequence-checking and print options to be used. If you specify more than one value for an option, the last value specified will be the value that is used. Enter a plus sign (+) into the field to the right of the **+ for more values** to enter more than one value. The possible options and their values are:

<u>*CHK</u>

The Sort specifications are sequence-checked. The system verifies if the sequence numbers of the job specifications in the source file match their order in the source file. If not, a warning message is issued.

***NOCHK**

The Sort specifications are not sequence checked.

<u>*PRT</u>

The Sort specifications for this job, as well as any error and warning messages issued by the system, are printed.

***NOPRT**

The specifications and messages are not printed.

<u>*NODUMP</u>

The internal tables used for this job are not printed.

***DUMP**

The internal tables used for this job are printed. These tables can then help you isolate the cause of any particular problem.

<u>*NOSECLVL</u>

Do not list second-level messages for this job.

***SECLVL**

List second-level messages for this job.

PGMDATE (*Program date*)

Specifies the date that is used with Factor 2 in the record specifications described in Chapter 9, “Record Specifications” The system can search for particular input records that contain the same, greater, or lesser value than this date. Possible values are:

<u>*CURRENT</u>

The current date the job is being run.

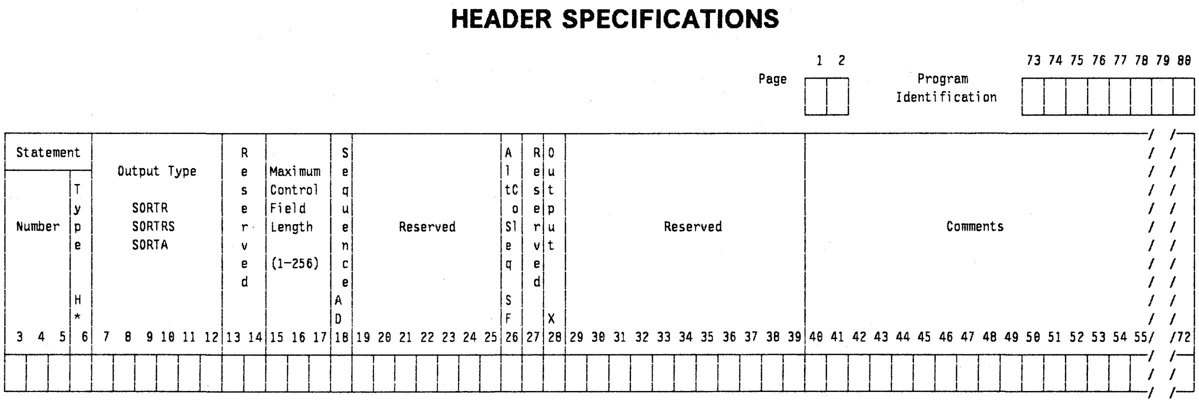
***DATE**

Use the date as entered with the CL command QDHTFMT; if separators are used, use the date as entered with the QDATSEP command.

Chapter 8. The Header Specification

The header specification must be the first statement (excluding comments) in any set of Sort specifications. It provides the following information:

- The type of output file: a physical file, a summary data file, or a Record Address (RA) file
- The length of the control field
- The Sort order: ascending or descending
- Whether the standard or an alternative collating sequence is used
- Whether or not the control field is to be included in the output
- The name of the file in which this set of Sort specifications is to be stored.



HEADER SPECIFICATIONS

	1 2		73 74 75 76 77 78 79 80
Page	□□	Program Identification	□□□□□□□□

Statement Number	Type H *	Output Type SORTR SORTRS SORTA	Reserved	Maximum Control Field Length (1-256)	Sequence A D	Reserved	Alt Col Seq S F	Reserved	Output X	Reserved	Comments
3 4 5	6	7 8 9 10 11 12	13 14	15 16 17	18	19 20 21 22 23 24 25	26	27	28	29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72
□□□	□	□□□□□□	□□	□□□	□	□□□□□□□	□	□	□	□□□□□□□□□□□	□□□□□□□□□□□□□□□□

Figure 21. The Form for Entering Header Specifications

Summary of Column Entries

Table 1 summarizes the column entries for header specifications.

Table 1. Summary of Column Entries for the Header Specification

Columns	Entry	Explanation
1-2	00-99	Page number (no entry required).
3-5	000-999	Statement number (no entry required).
6	H	Identifies this specification as a header specification.
	*	Identifies this specification as a comment specification.
7-12	SORTR	Input records are to be sorted in a regular manner.
	SORTRS	Input records are to be sorted and summed.
	SORTA	Output file is to contain only the relative record numbers of the sorted records (record address (RA) sort).
13-14	Blank	Reserved.
15-17	Blank	No control field (copy-only request).
	1-256	The maximum control field length.
18	Blank	Output order is ascending by control field.
	A	Output order is ascending by control field.
	D	Output order is descending by control field.
19-25	Blank	Reserved.
26	Blank	Standard collating sequence is used.
	S	An alternative collating sequence is used for the entire control field.
		Use an alternative collating sequence for parts of the specified control field.
	F	
27	Blank	Reserved.
28	Blank	The control field is included in the output record.
	X	The control field is not included in the output record.
29-39	Blank	Reserved.
40-72	Any entry	Comments.
73-80	Any entry	Program Identification (treated as a comment by the system).

Detailed Description of Each Column Entry

Columns 1 and 2 (Page)

You can enter any number from 0 through 99 in columns 1 and 2 for page numbers. The pages should be numbered in ascending order.

Columns 3 through 5 (Statement Number)

These columns specify the statement number.

Column 6 (Specification Identifier)

This column must contain an H to identify this specification as a header specification. If it contains an *, the specification will be treated as a comment.

Columns 7 through 12 (Output File Type)

These columns identify the type of output to be produced. Possible entries are:

SORTR Output is to be a set of physical records sorted as specified (a physical file).

SORTRS Output is to be a set of physical records (a physical file). There is to be only one output record for each input record type; the output record contains the summed totals of given fields for all input records of that type.

SORTA Output is to be a list of addresses of the records that were sorted (a record address file). These addresses are pointers to the input file.

Note: You must put an X into column 28 in order to omit the control field from the output record. The presence of control field data in an RA file would give meaningless results.

Columns 13 and 14 (Reserved)

These columns must be blank.

Columns 15 through 17 (Maximum Control Field Length)

These columns contain a number from 0 to 256, which will be the length used for the control field in the output record. Shorter control fields will be left-justified in this space and padded on the right with zeros.

The number entered must be right-justified. For example, if you enter a 6 into column 16 only, the system would assume that you entered a 60. The number must be equal to or greater than the sum of the longest control field (as specified in the field specifications).

Control fields are composed of one or more fields taken from the input records. A different grouping can be specified for each input record type. The entry in this field must equal or exceed the length of the largest grouping.

Copy-Only Request

If columns 15 through 17 are left blank, no sorting or reformatting occurs. This is equivalent to specifying that records are to be copied or merged only, as described in Chapter 6, "Copying and Merging Records from Several Files into One."

Column 18 (Sort Sequence)

The entry in this column specifies how the output records are to be sorted. Possible entries are:

Blank Ascending order

A Ascending order

D Descending order.

Note: For copy-only requests, this column must be left blank.

The sorting of input records is based on the contents of the control field for the record type. Input records are sorted according to this order unless this order is overridden by the field specifications for the particular control field.

Columns 19 through 25 (Reserved)

These columns must be blank.

Column 26 (Alternative Collating Sequence)

Column 26 defines whether the standard or alternative collating sequence is used. (See Appendix C, "Standard and Alternative Collating Sequences"). The possible entries are:

Blank Standard collating sequence

S Alternative collating sequence across the entire control field

F Alternative collating sequence for certain columns of the control field as specified by the field specifications for the control field.

Note: For copy-only requests, this column must be left blank.

If an alternative collating sequence is specified, you must enter the appropriate ALTSEQ specifications to define the alternative collating sequence. ALTSEQ statements, if used, must immediately follow the header specification.

Column 27 (Reserved)

This column must be blank.

Column 28 (Include/Exclude Control Field in Output)

This column specifies whether or not the control field is to appear in the output records. Possible entries are:

Blank The control field will appear as the first field in the output record

X The control field will not appear in the output record.

Notes:

1. Column 28 must contain an X for an RA sort.
2. The control field will appear in the output records in the same format it was in when used for processing the records. If, however, it was forced in any way (altered by the field specifications) or specified as being in packed format, the control field data will appear quite different from the source fields from which it was constructed.

Columns 29 through 39 (Reserved)

These columns must be blank.

Columns 40 through 72 (Comments)

These columns are available for comments.

Columns 73 through 80 (Program Identification)

Any name can be entered in these columns. This entry is treated as a comment.

Chapter 9. Record Specifications

Use record specifications to select the input records you want to process or to define which records you want to omit from processing. If all input records are to be processed, these specifications are not necessary.

Sort treats all input files as unformatted strings of bytes. You must divide the unformatted input file into the fields that are to be sorted or reformatted.

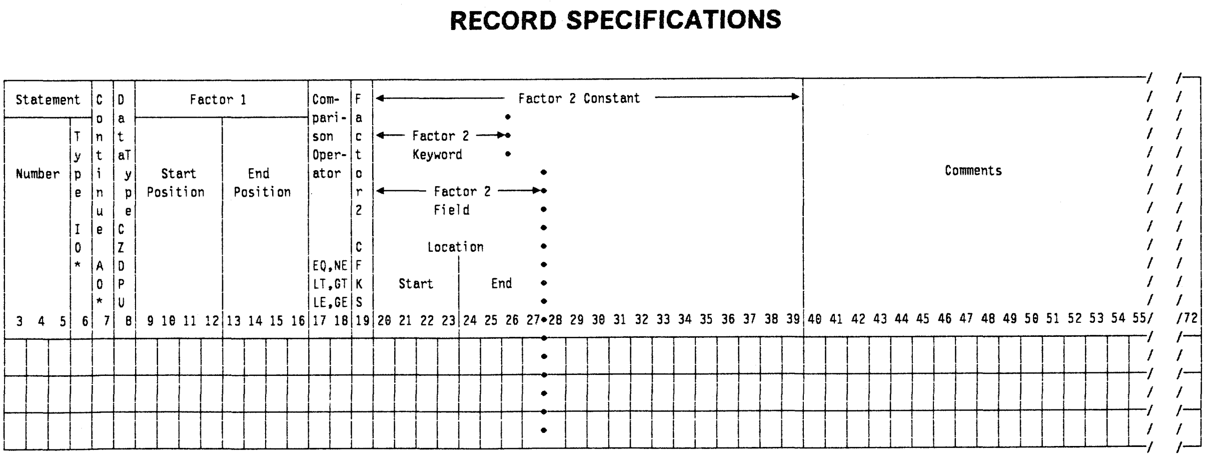
The record specification identifies the input records to be used (sorted or omitted) by identifying two fields, called Factor 1 and Factor 2. It states what the contents of these two fields should be, and what the relationship of these contents should be to each other in order for the input record to be processed. During processing, the Sort utility scans the input file for records whose contents match these conditions, and includes (or omits) them from the sort.

Set of Record Specifications

You can use one or more record specifications to establish all the conditions you want the input record to meet before being selected for sorting and reformatting.

Record Type

Any difference in either the conditions established for the selection of an input record, or the field specifications that define how these input records are to be processed, is considered as a difference in record type. Each new record type must be defined by its own set of record specifications.



RECORD SPECIFICATIONS

Statement		Continue	Data Type	Factor 1		Comparison Operator	Factor 2	Factor 2 Constant Factor 2 Keyword Factor 2 Field			Comments
Number	Type I O *	A O *	C Z D P U	Start Position	End Position	EQ,NE LT,GT LE,GE	C F K S	Location Start	Location End		
3 4 5	6	7	8	9 10 11 12	13 14 15 16	17 18	19	20 21 22 23	24 25 26 27	28 29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72

Figure 22. Form Used to Enter Record Specifications

Summary of Column Entries

Table 2 summarizes the column entries for the record statements.

Table 2. Summary of Column Entries for the Record Specification

Columns	Entry	Explanation
1-2	00-99	Page number (no entry required).
3-5	000-999	Statement number (no entry required).
6	I O *	The record is to be included in the sort. The record is to be omitted from the sort. Identifies this specification as a comment specification.
7	Blank A O *	This specification begins the definition of a new record type. This specification is in an AND relationship with the previous record specification. This specification is in an OR relationship with the previous record specification. Identifies this specification as a comment specification.
8	C Z D P U	Factor 1 and Factor 2 must contain character data. Factor 1 and Factor 2 must contain character data, and the zone portions of the binary representation of the characters are to be used for the comparison. Factor 1 and Factor 2 must contain character data, and the digit portions of the characters are to be used for the comparison. Factor 1 must contain signed, packed numeric data. If Factor 2 is defined, it must also contain signed, packed numeric data. Factor 1 must contain signed, zoned numeric data. If Factor 2 is defined, it must also contain signed, zoned numeric data.
9-12	1-9999	The start position of the Factor 1 field. This can be left blank.
13-16	1-9999	The end position of the Factor 1 field. If columns 9 through 12 are blank, this entry defines a Factor 1 field that is one character long in the position specified.
17-18	EQ NE LT GT LE GE	Factor 1 must equal Factor 2. Factor 1 must not equal Factor 2. Factor 1 must be less than Factor 2. Factor 1 must be greater than Factor 2. Factor 1 must be less than or equal to Factor 2. Factor 1 must be greater than or equal to Factor 2.
19	C F K S	Factor 2 is a constant. Factor 2 is a field in the input record. Factor 2 is a keyword. Factor 2 is a constant, but it is shifted one character to the left before comparison.
20-23	1-9999	The start position of the Factor 2 field. This can be left blank if the Factor 2 field is one character long.
24-27	1-9999	The end position of the Factor 2 field. If columns 20 through 23 are blank, this entry defines a Factor 2 field that is one character long in the position specified.
20-39	Any entry	If columns 20 through 27 are not being used to define the start and end positions of the Factor 2 field, then columns 20 through 39 can be used to specify a constant or keyword against which Factor 1 is compared.
40-72	Any entry	Comments.

Detailed Description of Each Column Entry

Columns 1 and 2 (Page) and Columns 3 through 5 (Statement Number)

Together, these columns form a 5-digit sequence number.

Use the *CHK option of the FMTDTA command (see Chapter 7, "The Format Data (FMTDTA) Command") to check for out-of-sequence conditions in the Sort specification set.

Note: Alternative collating sequence (ALTSEQ) statements are not sequence-checked, but must immediately follow the header statement.

Column 6 (Specification Identifier)

This column identifies the specification as a record specification, and indicates whether the defined record is to be included in or omitted from the sort, or if it is to be treated as a comment. Possible entries are:

I The record that is being identified is to be included. These record specifications are also known as *include* specifications.

O The record that is being identified is to be omitted. These record specifications are also known as *omit* specifications.

***** The record specification is being treated as a comment.

If there are no conditions specified (meaning that columns 7 to 39 of the record specification are blank), Sort will use all the input records that were not used by previous include or omit record specification sets. Such a record specification, also known as an *include-all* specification, must be the last in a series of record specification sets.

Only one such blank record specification can be used per sort job.

You can also omit the blank record specification. If field specifications are entered on their own (that is, without being preceded by record specifications for a record type), Sort assumes the field specifications apply to all the remaining unprocessed input records. Again, such field specifications must be the last ones entered for the particular sort job.

Column 7 (Begin/Continue Record Definition)

Column 7 is used to either begin a record specification set, or to continue one by specifying new criteria to be met. The possible entries are:

Blank This specification is the first of a set of include or omit specifications for a particular input record type.

A This specification is part of the definition of a record type. It is in an AND relationship with the previous specification: the conditions in both this specification and the previous one (in this set) must be met for the record to be used (or omitted).

O This specification is part of the definition of a record type. It is in an OR relationship with the previous specification: the conditions in either this specification or the previous one must be met in order for this type of record to be used (or omitted).

***** The record specification is treated as a comment.

Column 8 (Data Type)

This column entry tells the Sort utility how to interpret data in the Factor 1 and Factor 2 fields. The fields are defined as either alphanumeric or numeric.

- ***Alphanumeric fields*** are composed of characters, and, in EBCDIC, each character byte is assumed to be composed of eight bits. The first four bits form the zone portion; the last four bits form the digit portion.
- ***Numeric fields*** are composed only of the digits 0 to 9 plus the sign of the number (+ or -). In unpacked format, each digit is composed of eight bits: the first four bits form the zone portion, and the last four bits form the digit portion. The zone portion of the rightmost byte represents the sign. (Unpacked format is also called zoned format, because it is the addition of a zone portion to each digit that "unpacks" the format.) In packed format, each digit is composed of only four bits. The rightmost four bits of the entire number represent the sign for the number, rather than a digit.

Because Sort reads the input record as a sequence of unformatted bytes (and bits), column 8 specifies how many bits are to be assigned to each character. For example, in packed format each digit is represented by four bits; in zoned format, by eight bits.

When the fields contain alphanumeric data, either the digit portion, the zone portion, or both portions of each character can be used. When the fields contain signed numeric data, you must specify whether the format is to be unpacked or packed. Depending on which type of field you specify, there are certain restrictions on the length of Factor 1 and Factor 2 fields. The possible entries are shown in Figure 23 on page 99.

	Column 8 Entry	Compare Operations	Maximum Field Length *
Alpha-numeric Data	C	Use both zone and digit portions of the characters	256 characters
	Z	Use only the zone portion of the character	1 character
	D	Use only the digit portion of the character	16 characters
Signed Numeric Data	P	Numeric data is packed.**	8 bytes, or 15 digits plus sign
	U**	Numeric data is unpacked (zoned) **	16 digits

* For both Factor 1 and Factor 2 fields

** Do not use a packed or zoned data type for Factor 1 field in an include or omit specification (P or U in column 8) if you specify an alternative collating sequence (S in column 26) in the header specification

Figure 23. Column 8 Restrictions on Length of Factor 1 and Factor 2 Fields

Note: If an alternative collating sequence is specified (ALTSEQ statements are present), column 8 cannot contain a P or a U. Only alphanumeric data can be compared.

Interpreting Alphanumeric Data

Each EBCDIC character has two parts: a zone portion and a digit portion. Some characters may have identical zone portions or identical digit positions, but no two characters can have an identical combination of zone and digit portions. See Table 3.

Table 3. *Binary Representation of Selected AS/400 Characters*

	Binary Representation	
AS/400 Character	Zone Portion	Digit Portion
*	0101	1100
1	1111	0001
2	1111	0010
3	1111	0011
4	1111	0100
5	1111	0101
6	1111	0110
7	1111	0111
8	1111	1000
9	1111	1001
0	1111	0000
K	1101	0010
?	0110	1111
P	1101	0111
blank	0100	0000 [1]
0	1111	0000 [1]
⋮		

[1] Note that the digit portion of a zero and a blank are exactly the same.

If you instruct the Sort utility to use only the digit portions of characters (by putting a D into column 8), characters with identical digit portions will look alike and compare as equal. Likewise, if you instruct it to use only the zone position of characters (by putting a Z into column 8), characters with identical zone positions will look alike and compare as equal. Thus the column 8 entry is critical to ensuring that the compare operations produce the results you intend.

For example, suppose you want only those records with a 2 in column 15 and a 2 in column 50. If you put a D into column 8, you will get the records you want, but you may also get many records you do *not* want (several characters have the same digit position as a 2). To get *only* the desired records, with a 2 in column 15 and a 2 in column 50, you must put a C into column 8 instead. The C tells Sort to use both the zone and digit portions of characters in its compare operations, and no other character has the same combination of zone and digit portions as the ones you want.

Interpreting Numeric Data

If you specify that the Factor 1 and Factor 2 fields are to contain numeric data in packed format, Sort reads each four bits as a separate digit up to the last four bits in the field. These last four bits determine whether the number being read is positive or negative.

If you specify that these fields are to contain numeric data in zoned (unpacked) format, Sort reads the digit portion of each set of eight bytes up to and including the last byte. This determines the number in the field. Sort also reads the zone portion of the last byte. The value in that portion determines whether the number is to be positive or negative.

Table 3 shows the binary representation of the ten digits. Figure 24 shows some examples of packed and zoned numbers, and their signs.

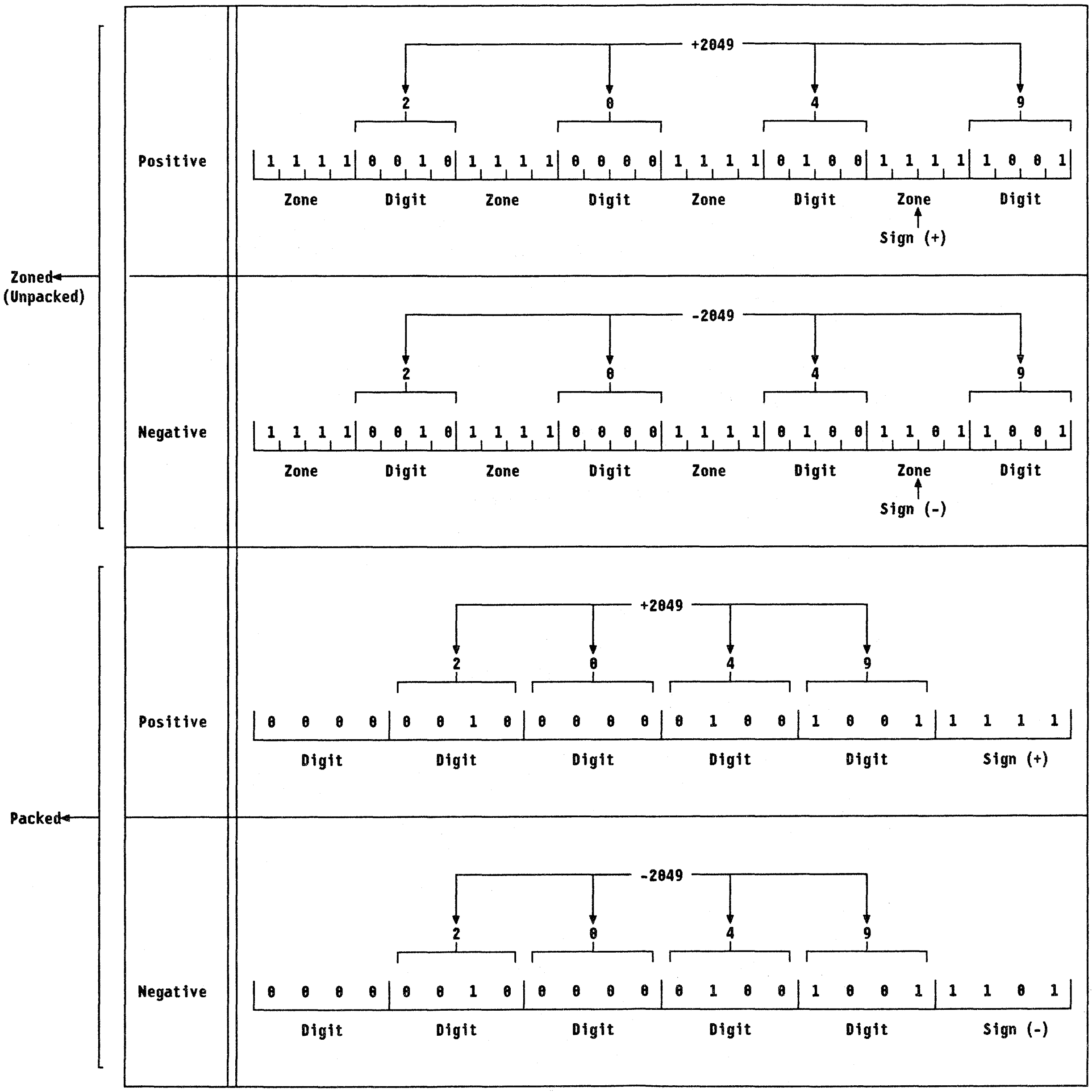


Figure 24. Sign Placement in Packed and Zoned (Unpacked) Numbers

Interpreting the Sign of a Number

Numbers can be either positive or negative. The sign of a number is indicated by a 4-bit binary code, as shown in Table 4.

Table 4. Binary Representation of Signs

Sign	Binary Code
+	1111 [1] 1010 1100 1110
−	1101 1011

[1] Standard Form. The Sort Utility accepts all four forms of the plus sign. Before sorting the file, however, the program converts all forms of the plus sign to the standard form (1111). If you print a dump, the plus sign will always be expressed as a hexadecimal F.

If you specify alphanumeric data, digit portion only (a D in column 8), then Sort interprets each set of four bits as a digit, and automatically assumes that the resulting number is positive.

Columns 9 through 12 (Factor 1 Start Position)

The entry in columns 9 through 12 identifies where in the input record the Factor 1 field begins. This entry must be right-justified.

Note that the difference between this entry and that entered into columns 13 through 16 (Factor 1 End Position) determines the length of the Factor 1 field. This length can be from 1 to 256 characters, but is subject to some restrictions, as shown in Table 5.

Table 5. Restrictions on the Maximum Length of the Factor 1 Field

Restriction	Maximum Factor 1 Field Length
Factor 2 field is a constant.	20 characters
Factor 2 field is the keyword UDATE.	6 characters
Factor 2 field is the keyword UMONTH, UDATE, or UYEAR.	2 characters
Factor 1 field is alphanumeric, but only the zone portion of each character is to be used (column 8 contains a Z).	1 character
Factor 1 field is alphanumeric, but only the digit portion of the character is to be used (column 8 contains a D).	16 characters
Factor 1 field is numeric in packed format (column 8 contains a P).	8 bytes, equivalent to 15 digits and the sign
Factor 1 field is numeric in zoned format (column 8 contains a U).	16 bytes, equivalent to 16 digits and the sign (the sign is included in the last byte)

Note: To describe a one-character Factor 1 field, leave columns 9 through 12 blank and enter the number of the record position that contains the character into columns 13 through 16 (end position).

Columns 13 through 16 (Factor 1 End Position)

The entry in these columns identifies the end position of the Factor 1 field in the input record. The entry must be right-justified. If columns 9 through 12 are blank, an entry in columns 13 through 16 defines the location of a one-character field in the input record.

Columns 17 and 18 (Comparison Operator)

These columns specify how the contents of the Factor 1 and Factor 2 fields must compare in order for the input record to be used. The possible entries are:

EQ	Factor 1 must be equal to Factor 2.
NE	Factor 1 must not be equal to Factor 2.
LT	Factor 1 must be less than Factor 2.
GT	Factor 1 must be greater than Factor 2.
LE	Factor 1 must be less than or equal to Factor 2.
GE	Factor 1 must be greater than or equal to Factor 2.

The collating sequence (described in Appendix C, "Standard and Alternative Collating Sequences" and specified in the header specification) determines whether one alphanumeric value is greater than or less than another. If an alternative collating sequence is specified on the entire control field, then both Factor 1 and Factor 2 are modified before the two are compared.

If only the zone portions of characters are to be compared (column 8 contains a Z), then EQ or NE are the only two entries you can make.

Column 19 (Type of Data Contained in Factor 2)

This column identifies whether Factor 2 is data, a constant, or a keyword. The possible entries are:

F	Factor 2 is to contain data from the input record.
C	Factor 2 is a constant, as specified in columns 20 through 39.
K	Factor 2 is the keyword specified in columns 20 through 25.
S	Factor 2 is a double-byte character set (DBCS) constant, requiring a shift one position to the left.

Columns 20 through 23 (Factor 2 Start Position)

If column 19 contains an F, the entry in these columns identifies the starting position of the Factor 2 field in the input record. The entry must be right-justified.

Columns 24 through 27 (Factor 2 End Position)

If column 19 contains an F, the entry in these columns identifies the end position of the Factor 2 field in the input record. The length of Factor 2 (the end position minus the start position plus 1) must equal that of Factor 1.

To describe fields that are only one-character long, leave columns 20 through 23 (start position) blank, and enter the number of the position on the input record that contains the character in columns 24 through 27 (end position).

Columns 20 through 39 (Factor 2 Is a Constant)

If column 19 contains a C, Factor 2 is a constant. Use columns 20 through 39 to enter the constant. The constant must be the same length as the Factor 1 field (unless packed or zoned numeric data is specified), and must be right-justified within the constant length.

For comparisons to packed numeric fields (column 8 contains P), the number of numeric digits in the Factor 2 constant must be equal to twice the Factor 1 length minus 1 (the sign occupies only one position in both the packed field and the zoned constant). For comparisons to zoned numeric fields (U in column 8), the number of numeric digits in the Factor 2 constant must equal the Factor 1 length.

Alphanumeric Constants (Column 8 Entry is C, Z, or D)

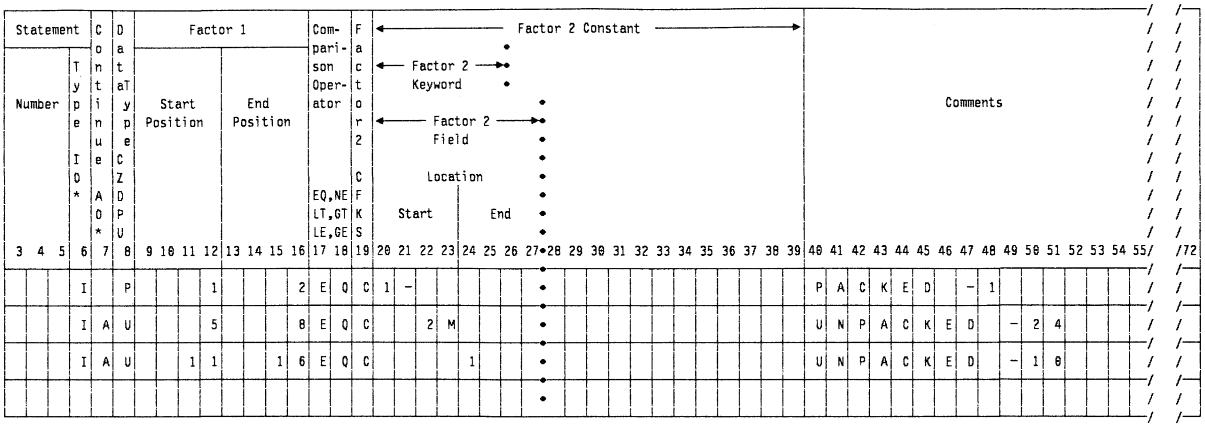
Alphanumeric constants can be combinations of letters, digits, punctuation, and special symbols—anything that appears in the EBCDIC collating sequence shown in Appendix C, "Standard and Alternative Collating Sequences." The constant must be the same length as the Factor 1 field, and must always begin in column 20.

Numeric Constants (Column 8 Entry is P or U)

Format: Numeric constants must be right-justified within the field length specified in Factor 1 (within twice the field length minus one position to contain the sign if Factor 1 is a packed number). For example, assume that Factor 1 defines a six-position zoned field in the input record, and that Factor 2 is the numeric constant 123. To right-justify the constant within the six positions specified, you must put it in columns 23, 24, and 25. Leading zeros are not required, and blanks and zeros look the same for numeric constants. In the previous example, columns 20 through 25 could contain either 000123 or XXX123 (with X representing a blank).

Signed Constants: When entering numeric constants, the rightmost character can either be a digit or a sign. If it is a digit, the entire number is assumed to be positive. If it is a sign, it can be either + or −. Figure 25 on page 105 shows the entries you could make to resequence or copy records that have a packed negative 1 (-1) in positions 1 and 2, a zoned negative 24 (-24) in positions 5 through 8, and a zoned negative 10 (-10) in positions 11 through 16:

RECORD SPECIFICATIONS



Statement Number (3 4 5)	Type (6)	Continuation (7)	Data Type (8)	Factor 1 Start Position (9 10 11 12)	Factor 1 End Position (13 14 15 16)	Comparison Operator (17 18)	Factor 2 (19)	20	21	22	23	24	25	26	27	28–39	Comments (40–55)
	I		P	1	2	EQ	C	1	-								PACKED -1
	I	A	U	5	8	EQ	C			2	M						UNPACKED -24
	I	A	U	11	16	EQ	C					1					UNPACKED -10

Figure 25. Examples of How to Code Negative Constants into Record Specifications

Columns 20 through 39 (Factor 2 Is a Keyword)

A K entered into column 19 identifies Factor 2 as a keyword that represents all or part of the program date. The keyword is entered into columns 20 through 39, starting with column 20. Unused columns should be left blank.

When Factor 2 is a keyword, Sort compares all or part of the program date with the Factor 1 field. The length of the Factor 1 field must be the same as the Factor 2 field. You can use the following keywords:

Keyword	Part of Program Date Compared	Factor 1 Field Length
UDATE	Entire program date	6 characters
UMONTH	Month portion of program date	2 characters
UDAY	Day portion of program date	2 characters
UYEAR	Year portion of program date	2 characters

When Factor 2 is a keyword, you must indicate that both the zone and digit portions of characters must be compared to the Factor 1 field (by entering a C into column 8, to specify character data).

If UDATE is used, the program date must be in the same format as the date contained in the input records.

If Factor 2 is UDATE, then record selection on or before, or on or after, a certain date (determined by the comparison operator entered into columns 17 and 18) works only with the international date format (YYMMDD). If the program date and the input records date are not in the international date format, the keywords UYEAR, UMONTH, and UDAY, should be used to select the records.

The program date parameter of the FMTDTA command (see Chapter 7, "The Format Data (FMTDTA) Command") provides the date, month, day, and year that will be used.

Columns 40 through 72 (Comments)

These columns are available for comments.

Chapter 10. Field Specifications

Field specifications define the fields in the input record. These can be control fields, data fields, and summary data fields.

Control fields are used to control the way in which the input record is sorted and reformatted, as described in Chapter 1, "Introduction." *Data fields* identify those fields that contain data to be summed (see Chapter 5, "Sorting Records from a File and Producing Totals"), or fields that appear in the output records. *Summary data fields* are fields in the output record that contain the totals that are produced.

You can enter one or more field specifications for each field.

A series of field specifications must be entered for each record type. Record types are defined by record specifications, as described in Chapter 9, "Record Specifications." Sort allows one series of field specifications to be entered without being preceded by the record specifications that define the record type. This can be done only once, and must be the last set of field-record specifications entered for the job. In this case, the system assumes that the record type is "all," meaning that the field specifications pertain to all the remaining input records that have not yet been processed.

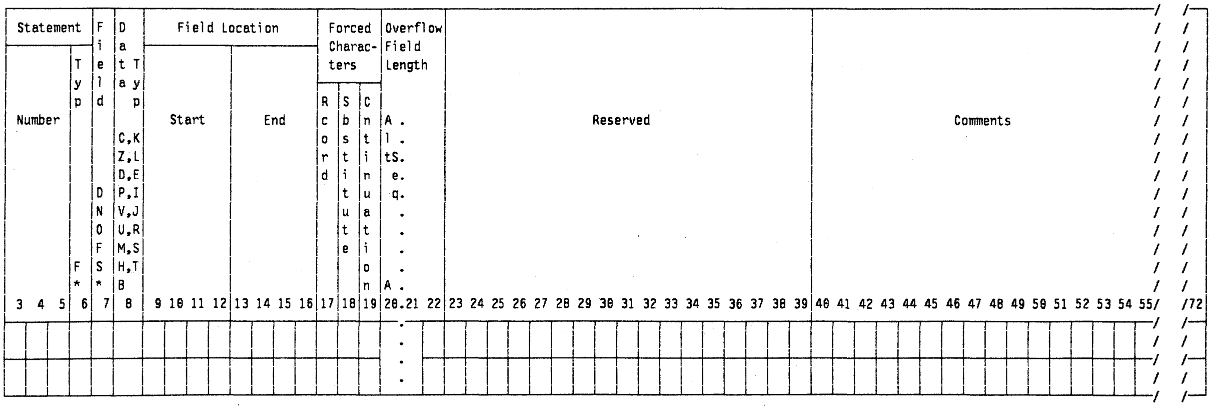
Order of Fields in the Output Record

The order of the fields in the output record will be the same as the order in which the fields are defined by the field specifications. It can be the same or different for each record type that is specified.

Order of Field Specifications in the Source File

The order of the field specifications relative to each other and to the header, record, and comment specifications, is determined by the specification sequence number entered into columns 1 through 5.

FIELD SPECIFICATIONS



Statement		Field	Data	Field Location		Forced Characters			Overflow Field Length			
Number	Typ F *	D N O F S *	Typ C,K Z,L D,E P,I V,J U,R M,S H,T B	Start	End	Record	Substitute	Continuation	A . l . tS. e. q. . . . . A .	Reserved	Comments	/ /
3 4 5	6	7	8	9 10 11 12	13 14 15 16	17	18	19	20.21 22	23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/	/72
									. .			/ /
									. .			/ /

Figure 26. Form for Entering Field Specifications

Summary of Column Entries

Table 6 summarizes the column entries for field statements.

Table 6 (Page 1 of 2). Summary of Column Entries for the Field Specifications

Columns	Entry	Explanation
1-2	00-99	Page number (no entry required).
3-5	000-999	Statement number (no entry required).
6	F	Identifies this specification as a field specification.
7	D	The field is a data field.
	N	The field is a normal control field.
	O	The field is an opposite control field.
	F	The field is a forced control field.
	S	The field is a summary data field.
	*	Identifies this specification as a comment specification.
8	P	The field contains signed decimal data, in packed format.
	U	The field contains signed decimal data, in zoned format.
	C	The field contains character data.
	Z	Only the zone portion is used for sorting.
	D	Only the digit portion of each character is used for sorting.
	V	Force a single data character into the data field.
	F	Simplified Chinese DBCS control field using character-type, total strokes, radical sequence.
	G	Simplified Chinese DBCS control field using character-type, radical, strokes beyond radical sequence.
	N	Simplified Chinese DBCS control field using character-type, single-pronunciation, radical, total strokes, tie-breaker sequence.
	Q	Simplified Chinese DBCS control field using character-type, single-pronunciation, total strokes, radical, tie-breaker sequence.
	W	Simplified Chinese DBCS control field using character-type, single-pronunciation, tie-breaker, radical, total strokes sequence.
	X	Simplified Chinese DBCS control field using character-type, total strokes, radical, single-pronunciation, tie-breaker sequence.
	Y	Simplified Chinese DBCS control field using character-type.
	M	Traditional Chinese DBCS control field using character-type sequence.
	H	Traditional Chinese DBCS control field using character-type, stroke, radical sequence.
	B	Traditional Chinese DBCS control field using character-type, radical, strokes beyond radical sequence.
	K	Korean DBCS control field using primary Hangeul pronunciation of Hanja characters.
	L	Korean DBCS control field using secondary Hangeul pronunciation of Hanja characters that start Korean DBCS words, and primary Hangeul pronunciation of all other Hanja characters.
	E	Sei-On Katakana control field.
	I	Japanese DBCS control field using single-pronunciation, radical, stroke, tie-breaker sequence.
	J	Japanese DBCS control field using single-pronunciation, stroke, radical, tie-breaker sequence.
	R	Japanese DBCS control field using radical, stroke, tie-breaker sequence.
	S	Japanese DBCS control field using stroke, radical, tie-breaker sequence.
	T	Japanese DBCS control field using character-type sequence.

Table 6 (Page 2 of 2). Summary of Column Entries for the Field Specifications

Columns	Entry	Explanation
9-12	1-9999	The start position of the field. This entry can be left blank.
13-16	1-9999	The end position of the field. If columns 9 through 12 are blank, this entry defines a one-character field in the position specified in columns 13 through 16. If columns 9 through 12 and 13 through 16 are blank, the field is the entire input record.
17	Any character	The force character that is to be changed. Also used for summary overflow indicator fields; if so, this is the character to be used as the overflow indicator.
18	Any character	The force character that is to be substituted. Also used for summary overflow indicator fields; if so, this is the character that is to be put into the overflow indicator field if there is *no* overflow.
19	Blank Any character	This specification begins the definition of a field. This specification is a continuation of the previous field specification.
20-22	1-256 A (column 20 only)	Overflow field length – used for summary sort only. Alternative collating sequence by field.
23-39	Blank	Reserved
40-72	Any entry	Comments.

Detailed Description of Each Column Entry

Columns 1 and 2 (Page) and Columns 3 through 5 (Statement Number)

Together, these columns form a 5-digit sequence number.

Use the *CHK option of the FMTDTA command (see Chapter 7, "The Format Data (FMTDTA) Command") to check for out-of-sequence conditions in the Sort specification set.

Note: Alternative collating sequence (ALTSEQ) statements are not sequence-checked, but must immediately follow the header statement.

Column 6 (Specification Identifier)

This column must contain an F to identify this specification as a field specification. If it contains an * instead, the specification will be treated as a comment.

Column 7 (Field Type)

The entry here specifies the type of field. If the field is a *forced control field*, the way in which the control field is changed (forced) is further defined in columns 9 through 19. The possible entries into column 7 are:

D Data field.

N Normal control field. Input records (of the type described in the corresponding set of record specifications) are sorted so that the data in this field is in the sequence specified in column 18 of the header specification.

0 Opposite control field. Input records (of the type described in the corresponding set of record specifications) are sorted so that the data in this element of the control field is in the sequence opposite to that specified in column 18 of the header specification.

F Forced control field. Before any sorting is to be done, the contents of the control field must be altered according to the entries in columns 9 through 16, 17, 18, and 19.

S Data field to be summed. Used for summary sort only. The data found in this field in the input records (of the type described in the corresponding set of record specifications) is added together and the result placed in this field in the output records.

* The record specification is treated as a comment.

If you are describing a control field, you can use the entry in column 8 to further specify which part of each character in the control is used for sorting or reformatting. Columns 8 through 19 allow you to control the sorting and reformatting more precisely. This can be useful for special types of sort, or to save space in memory and processing time during very long sorts.

Data Field (D in Column 7)

Data fields apply to copy and sort requests that produce physical output files (as opposed to RA output files). They are fields you want Sort to include in the output records. Control fields can also be specified as data fields, if you want them to appear in the output records. You can either globally request this in the header specification, or separately request it on a control field basis by respecifying this control field as a data field for this record type.

When your file has more than one type of record:

- The number of data fields does not have to be the same for all record types.
- The combined lengths of the data fields for each output record do not have to be the same for all record types. The Sort utility places blanks to the right of shorter output records so that all record lengths for all record types are equal to the output file record length.

Normal and Opposite Control Fields (N or O in Column 7)

Normal control fields sort according to the entry in column 18 of the header specification. Opposite control fields sort opposite to the entry found in column 18 of the header specification.

Forced Control Fields (F in Column 7)

You can change the contents of a control field (force them to be something else for the duration of the sort) before they are used to sort or reformat the input record.

There are three types of forced control fields:

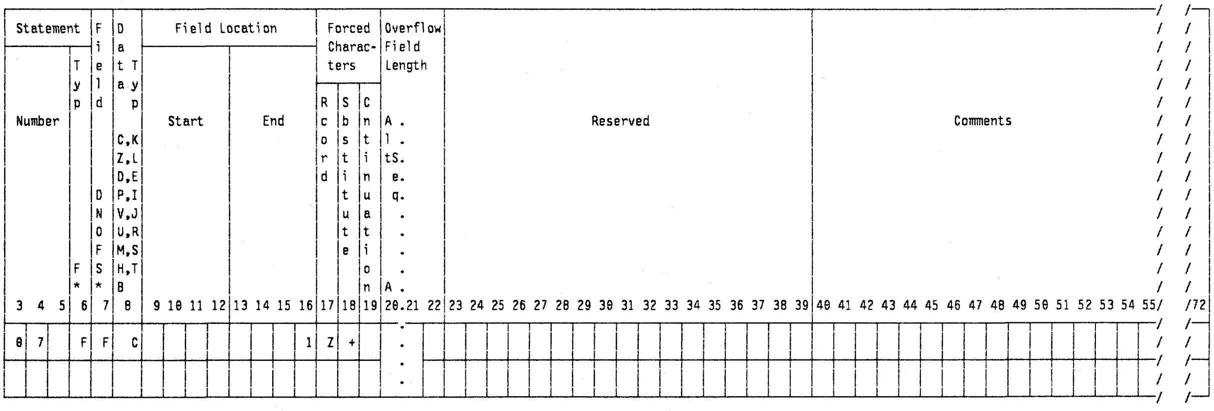
- ***Conditional*** — depends on the data found in the input record.
- ***Conditional force-all*** — forces all fields that have not yet been forced.
- ***Unconditional*** — modifies all the fields regardless of the data found in the input record.

A control field that is forced can be only one character long.

The contents of columns 17 and 18, and the position of this specification relative to other field specifications in the same set, determine if the forcing is to be conditional, conditional-all, or unconditional. See "Column 17 (Conditionally Forced Character)" on page 116, "Column 18 (Forced Character)" on page 116, and "Column 19 (Continuation)" on page 117 for information on how to fill out the field specifications when you are using forced control fields.

Conditional Forced Fields: A conditional force changes a character found in a control field element (the length of the control field element must be 1) to another character. Put the character you want to replace into column 17, and the character you want it replaced by into column 18. For example, if you want to replace all occurrences of Z in the first byte of the input record by a plus sign (+), complete the field specification as for a regular control field, and put a 1 in column 16, a Z in column 17, and a plus sign in column 18:

FIELD SPECIFICATIONS



Statement				Field Location		Forced Charac- ters			Overflow Field Length			
Number	Typ F *	Field D N O F S *	Data Type C,K Z,L D,E P,I V,J U,R M,S H,T B	Start	End	Rcord	Sbstitute	Cntinuation	A . 1 . tS. e. q. . . . . A .	Reserved	Comments	
3 4 5	6	7	8	9 10 11 12	13 14 15 16	17	18	19	20.21 22	23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55	72
0 7	F	F	C		1	Z	+		.			
									.			

Sort does this replacement before using the control field to process the input record.

Conditional Force-All Fields: Force-all is a special type of conditional force. The force-all specification applies the change (as specified in column 18) to all those input records that have not previously had a conditional force applied to the control field. A force-all specification must be the last in a series of conditional force specifications. Note that you need one conditional force specification for each character you want to change in the control field. For example:

- If the control field contains a C, replace it with a 1.
- If the control field contains an F, replace it with a 2.
- If the control field contains a $, replace it with a 3.
- If the control field does not contain a C, an F, or a $, put an X into it.

Enter a separate conditional force field specification for the first three cases, and a conditional force-all specification for the last case.

If you do not place a force-all statement after a conditional force line, and the Sort utility does not find the specified characters in the control field of the input record, then Sort will:

- Replace the control field character with X'FF' (if you specified ascending sequence in the header statement)
- Replace the control field character with X'00' (if you specified descending sequence in the header statement).

Unconditional Forced Fields: An unconditional force changes a character found in a control field element, without regard to what character is found in the field location. To cause an unconditional force of the elements of the control field, leave column 17 blank. Sort changes each element of the field to the character entered in column 18.

If you leave column 17 blank, and you do not specify start and end positions for the control field (i.e. columns 9 through 16 are blank) then for all input records which meet the record specifications, all elements of the record will be unconditionally forced to the value entered in column 18.

Summary Data Field (S in Column 7)

A summary data field is one that is designated to hold selected accumulated totals. These totals can only be specified in summary sort (SORTRS) jobs.

In summary sort jobs, the data found in the field are added for all input records (of the type specified in this record specification set). The same field in the output record is normally used to hold the totals, except in the case of an overflow.

In the case of a summary sort, only one output record is produced for each separate input record type specified. You can, in addition to specifying summary sort fields, also enter data field specifications. If you do so, however, the output record will contain the data field; the contents in that field will correspond to the contents of the data field found in the first input record (of that set) that was processed.

Column 8 (Data Type)

The column 8 entry here indicates what portion of the characters in the control field is used in sorting and reformatting the input records. Do not confuse it with the column 8 entry on the record specification, which helps select the input records for the job. This entry controls *how* those selected input records are to be sorted. You can also use it to specify the portions of data field characters that are to be transferred to the output record.

When you use this entry to change control field characters, the control field remains changed in the output records. Usually, this changed control field data is used only for the sorting and is otherwise meaningless; enter an X into column 28 of the header specification to exclude it from the output record. Or, use another field specification to respecify the original control field as a data field before entering the field specification that alters the contents of the control field.

Possible entries are shown in Table 7 on page 113.

Table 7 (Page 1 of 2). Possible Column 8 Entries and Restrictions on Field Length

Col. 8 Entry	Character Portion Used	Maximum Field Length
C	Use both zone and digit portions of the characters.	999 characters (data) 256 characters (control field)
Z	Use only the zone portion of the character.	1 character
D	Use only the digit portion of the characters.	16 characters
U	The characters are interpreted as signed decimal numbers in zoned (unpacked) format. ★	16 digits
P	The characters are interpreted as signed decimal numbers in packed format.[1]	8 bytes or 15 digits and sign
V	Force the replacement of the existing character with a new character.	1 character
F	Sort the Simplified Chinese DBCS control field into character-type, total strokes, radical sequence.	128 2-byte characters (=256 bytes)
G	Sort the Simplified Chinese DBCS control field into character-type, radical, strokes beyond radical sequence.	128 2-byte characters (=256 bytes)
N	Sort the Simplified Chinese DBCS control field into character-type, single-pronunciation, radical, total strokes, tie-breaker sequence.	128 2-byte characters (=256 bytes)
Q	Sort the Simplified Chinese DBCS control field into character-type, single-pronunciation, total strokes, radical, tie-breaker sequence.	128 2-byte characters (=256 bytes)
W	Sort the Simplified Chinese DBCS control field into character-type, single-pronunciation, tie-breaker, radical, total strokes sequence.	128 2-byte characters (=256 bytes)
X	Sort the Simplified Chinese DBCS control field into character-type, total strokes, radical, single-pronunciation, tie-breaker sequence.	128 2-byte characters (=256 bytes)
Y	Sort the Simplified Chinese DBCS control field into character-type sequence.	128 2-byte characters (=256 bytes)
M	Sort the Traditional Chinese control field into character-type sequence.	128 2-byte characters (=256 bytes)
H	Sort the Traditional Chinese control field into character-type, stroke, radical sequence.	128 2-byte characters (=256 bytes)
B	Sort the Traditional Chinese control field into character-type, radical, strokes beyond radical sequence.	128 2-byte characters (=256 bytes)
K	Use the primary Hangeul pronunciation of Hanja characters.	128 2-byte characters (=256 bytes)
L	Use the secondary Hangeul pronunciation of Hanja characters that start Korean DBCS words, and primary Hangeul pronunciation for all other Hanja characters.	128 2-byte characters (=256 bytes)
E	Sort a Katakana control field in SEI-ON sequence.	170 1-byte characters (= 170 bytes)

Table 7 (Page 2 of 2). Possible Column 8 Entries and Restrictions on Field Length

Col. 8 Entry	Character Portion Used	Maximum Field Length
I	Sort the Japanese DBCS control field into single-pronunciation, stroke, tie-breaker sequence.	128 2-byte characters (=256 bytes)
J	Sort the Japanese DBCS control field into single-pronunciation, stroke, radical, tie-breaker sequence.	128 2-byte characters (=256 bytes)
R	Sort the Japanese DBCS control field into radical, stroke, tie-breaker sequence.	128 2-byte characters (=256 bytes)
S	Sort the Japanese DBCS control field into stroke, radical, tie-breaker sequence.	128 2-byte characters (=256 bytes)
T	Sort the Japanese DBCS control field into character-type order.	128 2-byte characters (=256 bytes)

Note: ★ Note that -3 is less than 0, and +5 is greater than -6.

Suppose, for example, that your input records have a one-character control field that can be either *, 1, 2, or 3. The zone and digit portion of each character is:

Character	Zone	Digit
*	0101	1100
1	1111	0001
2	1111	0010
3	1111	0011

If you want the records resequenced in ascending order using the digit position of the control field characters, enter D into column 8. The records will then be sorted in this order:

1
2
3
*

If you want the records resequenced in ascending order using both the zone and digit positions, enter C into column 8. The records will then be sorted in this order:

*
1
2
3

Suppose you place a Z into column 8 and want the records resequenced in ascending order. You can be sure that the records with an * control field will precede the records with a 1, 2, or 3 control field. Because 1, 2, and 3 have identical zone positions, records with any of these numbers as a control field will be in the order in which they were encountered in the input file.

If you want to force characters into your data field, place a V into column 8 and specify the character to be forced in column 18. That character will be placed in the first available data field position of the output record.

Columns 7 and 8 (Details)

Table 8 shows the possible combinations for columns 7 and 8.

Table 8. Combinations of Column 7 and Column 8 Entries

Column 7	Column 8	Maximum Field Length
N or O	C	256 [1]
	Z	1 [1]
	D	16 [1]
	P	8 [1]
	U	16 [1]
F	C [2]	1
	Z [2]	1
	D [2]	1
D	C	99999
	Z	1
	D	16
	P	8
	U	16
	V	1
S	C	256
	Z	1
	D	16
	P	8
	U	16
	V	1

[1] *Cumulative maximum length for key fields.*
[2] *For an unconditional force and a force-all line, column 8 must contain a* C.

Columns 9 through 12 (Field Location Start Position)

These columns identify the starting position of a field. If columns 9 through 12 are blank, Sort assumes that the field length is equal to the record length.

To describe fields that are only one character long, leave columns 9 through 12 blank and enter the number of the record position that contains the character in columns 13 through 16.

Columns 13 through 16 (Field Location End Position)

These columns identify the position in which the field ends.

If columns 9 through 12 and 13 through 16 are blank, Sort assumes that the field length is equal to the record length.

To describe fields that are only one character long, leave columns 9 through 12 blank, and enter the number of the record position that contains the character in columns 13 through 16.

Column 17 (Conditionally Forced Character)

This entry tells Sort which character in the control field (defined in columns 13 through 16) you want to replace. The program checks to see if the control field in the input record contains the character you specified here. If it does, the character in column 18 replaces the control field character.

If a control field can contain any one of the several characters and you want to specify a replacement for each one, you must enter a field specification for each replacement, and use an entry in column 19 to relate the field specifications to each other.

See "Column 7 (Field Type)" on page 109 for a general discussion of forced control fields.

Make an entry in column 17 only when you want to see a conditional force. For example, use it to put an * instead of an A into a position on the output record. (See the descriptions for columns 7 and 18 in this chapter for more information about conditional force.)

Leaving column 17 blank implies that you want all fields that have not yet been modified to be changed to the entry in column 18.

Column 17 (Summary Overflow Indicator)

Enter the character you want Sort to put into the output record if overflow occurs. If nothing is specified, Sort assumes the asterisk (*) is the overflow indicator. This field should only be filled for SORTRS jobs.

In other words, if you specify a summary sort job, then in the case of an overflow (not enough room in the output record field for the accumulated total), the character you enter into column 17 will be the one that will be put into the overflow indicator field, a one-column field immediately to the right of the rightmost data field in the output record.

Column 18 (Forced Character)

The character here either replaces the control field character you specified in column 17, or, if there is no entry in column 17, is used to replace the control field character completely. Make an entry in column 18 only when you are using forced control fields. See "Column 7 (Field Type)" on page 109 for a general discussion of forced control fields.

You must use forced control characters only with one-character control fields.

Column 18 (Substitution Character)

When used in a summary sort job, the character you enter into this column is the one that is put into the overflow indicator field each time an overflow *does not* occur. You can use any character. If you do not enter a character, none is put into the output record.

Column 19 (Continuation)

Any entry put into this column links the field specification to the previously entered field specification. This is required when several field specifications are needed to define how a single field is processed (such as during a conditional force when the control field character is replaced by another character and several possibilities are to be specified).

If this column is left blank, the system assumes the field specification is for a new field.

Columns 20 through 22 (Overflow Field Length—Summary Sort)

The entry in these columns is a number from 1 to 256.

In summary sort jobs, the data fields that are summarized are used to contain the totals in the output record. It is possible, however, that these totals can require more space than the summary data field allows.

The length of this new overflow field should not exceed the maximum length for the output record.

The overflow field length should also not exceed the lengths specified in Table 8 on page 115 for each data type.

If the data to be summed is in packed format, each digit needs only 4 bits of memory for storage, plus another 4 bits to store the sign. Be aware that the number in columns 20 through 22 represents units of 8-bit bytes; that is, each byte represents two numbers in packed format, with the last byte representing only one digit and the sign (plus or minus) for the entire number. For example, if you specify 3 for the overflow field length, you are reserving 24 bits of storage: therefore 999 is the maximum number you can store in unpacked format, and +99999 is the maximum number you can store in packed format.

Column 20 (Alternative Collating Sequence by Field)

This column must contain an A for any normal or opposite control field that is to be altered by the alternative collating sequence when column 26 of the header specification contains an F.

If you specify an alternative collating sequence for a particular field, that field will be changed (according to the alternative collating sequence specified by ALTSEQ) whenever the field is used again as a control field for that record type.

Columns 23 through 39 (Reserved)

These columns must be left blank.

Columns 40 through 72 (Comments)

These columns are available for comments.

Chapter 11. The Comment Specification

One or more comment specifications can be used to document the job that is being done, so that you and other people will understand the sort process that is coded into the file. The comment specification can be inserted anywhere in the file, and can also precede the header specification.

RECORD SPECIFICATIONS

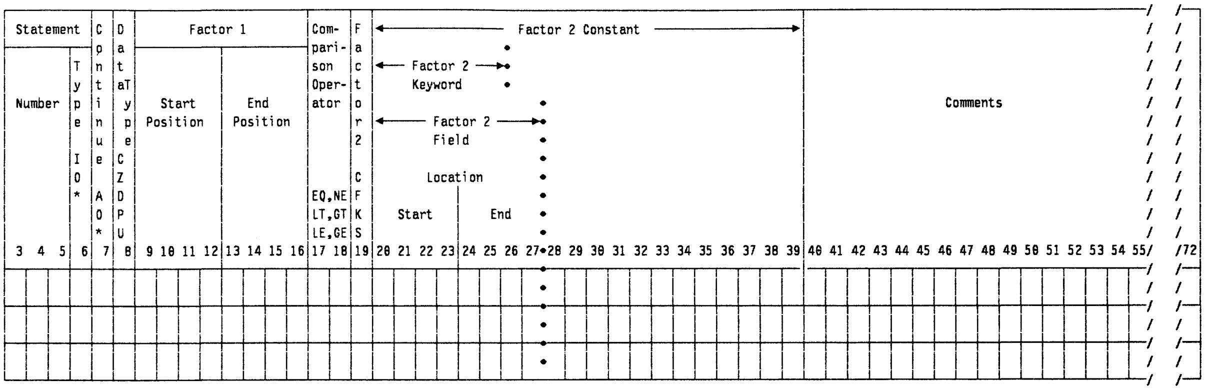


Figure 27. Comments Can Be Entered onto Header, Record, or Field Specification Forms

Summary of Column Entries

Table 1 summarizes the column entries for the comment specification.

Table 9. Summary of Column Entries for the Comment Specification

Columns	Entry	Explanation
6 or 7	*	Identifies this specification as a comment specification.
8-72	Any entry	Comments.

Detailed Description of Each Column Entry

Column 6 or 7 (Specification Identifier)

Column 6 or 7 must contain an * to identify this specification as a comment specification.

Columns 8 through 72 (Comments)

These columns are available for comments.

Appendix A. Information for System/36 Sort Utility Users Porting to the AS/400 System

This appendix describes those differences between the AS/400 system and System/36 that affect the way you enter Sort specifications.

Running a System/36 Sort Utility Job on the AS/400 System

Your System/36 specifications will continue to work on the AS/400 system. You should, however, be aware of the following items:

Header Specification

Print Option (Column 27)

Although Sort will accept all of the options available in the System/36 Sort Utility, assume the following:

0 Prints sort specifications, diagnostic messages, and program status message.

1, 2, or 3 This column is syntax-checked, but no printout is generated when the job is run.

Note: No messages are displayed.

Ideographic Sort (Column 35) — Valid on DBCS systems only

Support for ideographic fields:

- One Ideographic Character (IGC) field type is used.
- Multiple IGC fields are used.

Null Output (Column 36)

Within the AS/400 system, the entry in this column is syntax-checked only.

Record and Field Specifications

System/36 Sort Utility Level Support

When you select a summary sort on a file that contains nonnumeric data, your results may differ from those on the System/36.

Also, when your summary sort contains more than one record format, and the corresponding summary fields are either different lengths or different data types, your results may differ from those on the System/36.

Note: The AS/400 Sort warning and error message are different from those on the System/36.

Running a Sort Job in System/36 Sort Utility

If you enter your coding specifications in AS/400 environment, but run them on the System/36 Sort Utility, make sure they conform to those for System/36.

You should also be aware of the following:

- The maximum length of the Factor 1 and Factor 2 fields in the record specification is 4KB (KB equals 1024 bytes).
- Because the System/36 system handles arithmetic statements differently from the AS/400 system, different results may occur when using nonnumeric data in summary sorts.
- On the AS/400 system, you can sort input files with different record lengths in the same sort job, but to run AS/400 sort jobs on the System/36, the input files must have the same record length.
- System/36, unlike the AS/400 system, does not convert invalid digits to zeros or invalid signs to positives (X'F'). Therefore, if you specify Factor 1 as containing invalid packed numeric data, System/36 interprets the value differently from the AS/400 system. Your sort results will be different.

Appendix B. Information for System/38 Conversion Reformat Utility Users Porting to the AS/400 system

This appendix describes those differences between the AS/400 system and the System/38 Conversion Reformat Utility that affect the way that you enter Sort specifications.

Running a System/38 Conversion Reformat Utility Job in the AS/400 System

Your System/38 Conversion Reformat Utility specifications will continue to work on the AS/400 system. You should, however, be aware of the following:

Header Specification

Collating Sequence (Column 26): The Sort utility has the additional feature of being able to use an alternative collating sequence for specified parts of the control field. (Enter F.)

You must enter an A into column 20 of any field specification that defines a portion of the control field that is to be sorted with respect to the alternative collating sequence. If you specify an alternative collating sequence for any input field in this way, this sequence will apply to any other record types that also specify this input field as part of the control field.

Note: This enhancement cannot be used with the System/38 Conversion Reformat Utility.

Running an AS/400 Sort Job in the System/38 environment or on a System/38

You can run a Sort job in the System/38 environment of the AS/400 system, or on a System/38. If you do the latter, however, you should be aware of the following:

- The maximum control field length in the AS/400 system is 256 bytes; in System/38, it is 248.
- Although you can still use the terms RAF and FILE, AS/400 Sort uses SORTA in place of RAF, and SORTR in place of FILE.
- If you enter the coding specifications in the AS/400 system but run them in System/38 environment, make sure your coding specifications conform to those for System/38. In particular, the following AS/400 Sort features are not supported in System/38:
  - Summary Sort
  - DBCS Sorting
  - Selected Alternative Collating Sequences.

Appendix C. Standard and Alternative Collating Sequences

By default, the sorted output records are ordered according to the standard EBCDIC collating sequence. However, you can change this sequence for all or some characters by specifying an alternative collating sequence.

This appendix provides examples of the standard EBCDIC collating sequence, and explains how to define an alternative one.

Standard EBCDIC Collating Sequence

This collating sequence is an arrangement of data based on the EBCDIC character set. There are variations in the standard collating sequences, depending whether you are comparing:

- Both the zone and digit portions of characters
- Only the zone portions of characters
- Only the digit portions of characters.

Figure 28 on page 126 shows the standard collating sequence; Figure 29 on page 127 shows the collating sequence when you compare only the zone portion; and Figure 30 on page 128 shows the collating sequence when you compare only the digit portion.

Collating Sequence	Character	Hexadecimal Value
1	blank	40
2	¢	4A
3	.	4B
4	<	4C
5	(	4D
6	+	4E
7	|	4F
8	&	50
9	!	5A
10	$	5B
11	*	5C
12	)	5D
13	;	5E
14	¬	5F
15	-(minus)	60
16	/	61
17	](split bar)	6A
18	,	6B
19	%	6C
20	_(underscore)	6D
21	>	6E
22	?	6F
23	(grave)	79
24	:	7A
25	#	7B
26	@	7C
27	'	7D
28	=	7E
29	"	7F
30	a	81
31	b	82
32	c	83
33	d	84
34	e	85
35	f	86
36	g	87
37	h	88
38	i	89
39	j	91
40	k	92
41	l	93
42	m	94
43	n	95
44	o	96
45	p	97
46	q	98
47	r	99
48		A1
49	s	A2
50	t	A3
51	u	A4
52	v	A5
53	w	A6
54	x	A7
55	y	A8
56	z	A9
57	{	C0
58	A	C1
59	B	C2
60	C	C3
61	D	C4
62	E	C5
63	F	C6
64	G	C7
65	H	C8
66	I	C9
67	}	D0
68	J	D1
69	K	D2
70	L	D3
71	M	D4
72	N	D5
73	O	D6
74	P	D7
75	Q	D8
76	R	D9
77	\	E0
78	S	E2
79	T	E3
89	U	E4
81	V	E5
82	W	E6
83	X	E7
84	Y	E8
85	Z	E9
86	0	F0
87	1	F1
88	2	F2
89	3	F3
90	4	F4
91	5	F5
92	6	F6
93	7	F7
94	8	F8
95	9	F9

Figure 28. Standard Collating Sequence

Only Zone Portion of Character Used		
Order in the Sequence*	Character	Corresponding Hexadecimal Number **
1 (lowest)	¢	4A
	.	4B
	<	4C
	(	4D
	+	4E
	|	4F
2	!	5A
	$	5B
	*	5C
	)	5D
	;	5E
	¬	5F
3	/	61
	](split bar)	6A
	,	6B
	%	6C
	_ (underscore)	6D
	>	6E
	?	6F
4	(grave)	79
	:	7A
	#	7B
	@	7C
	' (apostrophe)	7D
	=	7E
	"	7F
5	a	81
	b	82
	c	83
	d	84
	e	85
con't	f	86
	g	87
	h	88
	i	89
6	j	91
	k	92
	l	93
	m	94
	n	95
	o	96
	p	97
	q	98
	r	99
7		A1
	s	A2
	t	A3
	u	A4
	v	A5
	w	A6
	x	A7
	y	A8
	z	A9
8	&	50
	{	C0
	A	C1
	B	C2
	C	C3
	D	C4
	E	C5
	F	C6
	G	C7
	H	C8
	I	C9
9	-(minus)	60
	}	D0
	J	D1
	K	D2
	L	D3
	M	D4
	N	D5
	O	D6
	P	D7
	Q	D8
	R	D9
10	\	E1
	S	E2
	T	E3
	U	E4
	V	E5
	W	E6
	X	E7
	Y	E8
	Z	E9
11 (highest)	blank	40
	0	F0
	1	F1
	2	F2
	3	F3
	4	F4
	5	F5
	6	F6
	7	F7
	8	F8
	9	F9

*Characters sharing the same position in the sequence are considered equal. For example, if you are using only the digit portions of characters, b, k, s, B, K, S, and 2 (position 3) are considered equal.

**This is the number you use in ALTSEQ statements to identify a character that you want to shift to a different order in the sequence.

Figure 29. Standard EBCDIC Collating Sequence Used When You Compare Only the Zone Portion of Characters

Only Digit Portion of Character Used		
Order in the Sequence*	Character	Corresponding Hexadecimal Number **

1
(lowest)
	blank
	&
	-(minus)
	{
	}
	0
		40
		50
		60
		C0
		D0
		F0

2	/ a j A J \ 1	61 81 91 A1 C1 D1 E1 F1
3	b k s B K S 2	82 92 A2 C2 D2 E2 F2
4	c l t C L T 3	83 93 A3 C3 D3 E3 F3
5	d m u D M	84 94 A4 C4 D4

Only Digit Portion of Character Used		
Order in the Sequence*	Character	Corresponding Hexadecimal Number **
	U 4	E4 F4
6	e n v E N V 5	85 95 A5 C5 D5 E5 F5
7	f o w F O W 6	97 98 A6 C6 D6 E6 F6
8	g p x G P X 7	87 97 A7 C7 D7 E7 F7
9	h q y H Q Y 8	88 98 A8 C8 D8 E8 F8
10	(grave) i r	79 89 99

Only Digit Portion of Character Used		
Order in the Sequence*	Character	Corresponding Hexadecimal Number**
	z I R Z 9	A9 C9 D9 E9 F9
11	¢ !] :	4A 5A 6A 7A
12	. $, #	4B 5B 6B 7B
13	< * % @	4C 5C 6C 7C
14	( ) _ (underscore) ' (apostrophe)	4D 5D 6D 7D
15	+ ; > =	4E 5E 6E 7E
16	| ¬ ? "	6F 5F 6F 7F

*Characters sharing the same position in the sequence are considered equal. For example, if you are using only the digit portions of characters, b, k, s, B, K, S, and 2 (position 3) are considered equal.

**This is the number you use in ALTSEQ statements to identify a character that you want to shift to a different order in the sequence.

Figure 30. Standard EBCDIC Collating Sequence Used When You Compare Only the Digit Portion of Characters

Defining an Alternative Collating Sequence

When you want the records in your output file to be sorted in an order different from the orders permitted by the standard collating sequences described in the first part of this appendix, define an alternative collating sequence.

To define an alternative collating sequence:

1. ***Header specification:*** Specify one of the following in column 26 (the ALTCOLLSEQ column) of the header specification:
   - An S to show that the alternative collating sequence applies to the entire control field

- An F to show that the alternative collating sequence applies to only parts of the control field.

2. ***Field specifications:*** If only parts of the control field are involved, enter an A in column 20 of those field specifications that define the input fields that are to become part of the control field and to which the alternative collating sequence is to apply.

Specifying an Alternative Collating Sequence for the Entire Control Field

To do this:

1. Enter S in column 26 of the header specification.
2. Code the required ALTSEQ specifications to immediately follow the header specification.

Sort will apply these changes to the entire job. The appropriate characters are changed in all input records before any processing is done: this means that the selection of input records, as stated on the record specifications for the job, is based on the changed characters as specified in the alternative collating sequence.

Forced characters and any other constants and comparisons will also be changed and controlled by the alternative collating sequence.

Note: Do not use packed or zoned Factor 1 or Factor 2 fields in an include or omit record specification (P or U in column 8) if you specify an alternative collating sequence on the entire control field. You can only do so when you are using an alternative collating sequence only on specified parts of the control field.

Specifying an Alternative Collating Sequence on Parts of the Control Field

To specify an alternative collating sequence for normal and opposite control fields:

1. Enter F in column 26 of the header specification.
2. Code the required ALTSEQ specifications immediately following the header specification.
3. Enter an A in column 20 of those field specifications that define an input field that is part of the control field, and to which the alternative collating sequence applies.

Be aware that:

- Record selection (including or omitting records) and conditional force (replacing a single character or all characters) are based on an input record that has not been changed by the alternative collating sequence.
- Any control field specification that has an A in column 20 must not be packed or zoned. (Do not code a P or U in column 8.)
- If you specify an alternative collating sequence for a particular input field, this sequence will be applied to any other input record type that uses the same input field as part of its control field.

- The alternative collating sequence will apply only to the specified normal and opposite control fields that were indicated in this way.

ALTSEQ specifications never change data fields in records or forced control field characters. Characters defined for an alternative collating sequence could be interpreted as other data fields.

How to Code an ALTSEQ Specification

For each character whose collating sequence you want to change from the standard EBCDIC, enter the original hexadecimal value followed by the new hexadecimal value into the ALTSEQ specification. The system then sorts the character according to its new position, relative to the other characters. You can code as many changes into one ALTSEQ specification as will fit.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
A	L	T	S	E	Q			H	X	H	Y	H	X	H	Y					...

Figure 31. How You Code an ALTSEQ Specification

Use the following steps to code ALTSEQ specifications. You can code them onto any Sort specifications form.

1. Code ALTSEQ into columns 1-6 to tell the Sort utility that you want to change the standard collating sequence.
2. Leave columns 7-8 blank.
3. Enter the hexadecimal equivalent (shown as X'HX' in the figure) of the character you are taking out of its normal sequence into the next two columns.
4. Enter the hexadecimal equivalent (shown as X'HY' in the figure) of the value that the character specified is to assume into the next two columns.
5. Enter as many pairs of original and new hexadecimal values (each occupying four columns) as required. Leave no spaces between sets of hexadecimal numbers.
6. When you reach the end of one specification (column 96), you can continue entering more pairs of hexadecimal values in a new ALTSEQ specification. (Repeat steps 1 to 5.)
7. Do not code comments on an ALTSEQ line.

Note: When you move a character into the sequence position normally assigned to another character, both the new and the original character occupy the same position and are considered equal. The system does not know which character should precede the other, and therefore, does not sort these two characters. If you do not want the two characters to be equal, you must also move the character that normally occupies that position. (See the examples later in this appendix.)

Examples

The following examples describe two situations that involve using an alternative collating sequence.

Example 1. Inserting a Special Character between Two Alphabetic Characters

You can alter the normal collating sequence several of ways. For example, you can insert a character between two existing characters, take a character out of the sequence, or change characters (put A where Z is and Z where A is). Regardless of how you alter the sequence, you must specify every character that is to be changed by the alteration. For example, if you want a dollar sign ($) to be positioned in the collating sequence between A and B, change the normal sequence as follows:

Normal Sequence	Altered Sequence
A	A
B	$
C	B
D	C
E	D
F	E
G	F
H	G
I	H
	I

Note: For this sequence, assign the dollar sign ($) the same value as B, B the same value as C; continue this process until the I has the same value as an unprintable character. This produces the desired results, because there are no printable characters between I and J. (See Figure 28 on page 126.)

The ALTSEQ specification used to enter this alternative collating sequence is:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	
A	L	T	S	E	Q			5	B	C	2	C	2	C	3	C	3	C	4	C	4	C	5	C	5	C	6	C	6	C	7	C	7	C	8	C	8	C	9	C	9	C	A		...

Columns	Entry	Explanation
1-6	ALTSEQ	Identifies the specification as an ALTSEQ specification.
7-8	Blanks	
9-12	5BC2	The $ is given the same value as the B.
13-16	C2C3	The B is given the same value as the C.
17-20	C3C4	The C is given the same value as the D.
21-24	C4C5	The D is given the same value as the E.
25-28	C5C6	The E is given the same value as the F.
29-32	C6C7	The F is given the same value as the G.
33-36	C7C8	The G is given the same value as the H.
37-40	C8C9	The H is given the same value as the I.
41-44	C9CA	The I is given the same value as an unprintable character.

Example 2. Making Characters Equal

If you want one character to be considered the same as another, both must hold the same position in the collating sequence. For example, you may want a blank to be considered a zero. Therefore, you need to define an alternative collating sequence, in which the blank is the same as the zero, because it holds the same position in the sequence.

The corresponding ALTSEQ specification would look like this:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
A	L	T	S	E	Q			4	0	F	0										...

Columns	Entry	Explanation
1-6	ALTSEQ	Identifies the specification as an ALTSEQ specification.
7-8	Blanks	
9-12	40F0	The blank is given the same value as the zero.

Whenever a blank is read and used in a comparison, it is considered to be a zero. Thus, if you were comparing the numbers 0036 and ƀƀ36 (where ƀ = blank), both would equal 0036.

Note: Use care when using D (digit) or U (unpacked) fields with an alternative sequence. The sign in the number is stored as part of the number, and could therefore be translated into a character that could be sorted; the record could be positioned at an unexpected place in the file.

Appendix D. Sorting Double-Byte Character Sets

This appendix describes the requirements for sorting double-byte character sets (DBCS) in the following languages:

- Japanese
- Simplified Chinese
- Traditional Chinese
- Korean.

The *Application Development Tools: Character Generator Utility User's Guide* contains additional information about creating and maintaining user-defined double-byte character sets, and updating the DBCS Sort Tables.

Before you can sort double-byte characters, you must have the following:

- The DBCS version of the AS/400 system installed on your system.
- A DBCS-capable display station (if you want to display or enter double-byte characters in your source file).
- A printer capable of printing characters in your language, if you are going to print double-byte characters.
- Sort tables
  - DBCS master sort table

    The DBCS master sort table for each language contains the sort information to specify for each user-defined DBCS character in that language. Every time you define a new character or make changes to an existing character, you must update the sort information for that character in this table.
  - DBCS active sort table

    The DBCS active sort table for each language contains the active collating sequence of the DBCS characters in that language. Every time you update the DBCS master sort table, you should update this table as well.

  Note: For Korean DBCS characters, there is a DBCS active sort table but no DBCS master sort table. The active sort table is used to convert Hanja characters to their equivalent Hangeul characters.

The *Data Management Guide* contains more information.

Coding Considerations for Double-Byte Character Sets

Although all the columns on the header, record, and field specifications are available for sorting double-byte character sets, certain combinations may not be valid or may not produce the desired results. This section provides you with necessary details unique to coding your specifications to avoid run-time errors.

HEADER SPECIFICATIONS

	1 2		73 74 75 76 77 78 79 80
Page	□□	Program Identification	□□□□□□□□

Statement		Output Type	Reserved	Maximum Control Field Length	Sequence	Reserved	Alt Col Seq	Reserved	Output	Reserved	Comments
Number	Type	SORTR SORTRS SORTA		(1-256)							
	H *				A D		S F		X		
3 4 5	6	7 8 9 10 11 12	13 14	15 16 17	18	19 20 21 22 23 24 25	26	27	28	29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72

Header Specifications

The following coding considerations must be noted to successfully run your program. For further details regarding coding your header specifications, see Chapter 8, "The Header Specification."

- Columns 15 through 17 (Maximum Control Field Length)

  Shift-in (SI) and shift-out (SO) control characters are present in all records and do not need to be included as part of a DBCS control field. The maximum control field length must not exceed 256 bytes. The control field is the number of bytes, not the number of characters.

  Note: When you convert a one-byte EBCDIC Katakana field to the Japanese (Sei-On) Katakana control field, you must calculate the value in columns 15 through 17. To do this, divide the EBCDIC Katakana field length by 4 and round the quotient, if there is one, up to the nearest whole number. Multiply this value by 2, and add the result to the original Katakana field length. The maximum control field length is 256 bytes.

- Column 26 (Alternative Collating Sequence)

  An S or F entry in this column can produce undesirable results, because the double-byte alternative collating sequence is not supported.

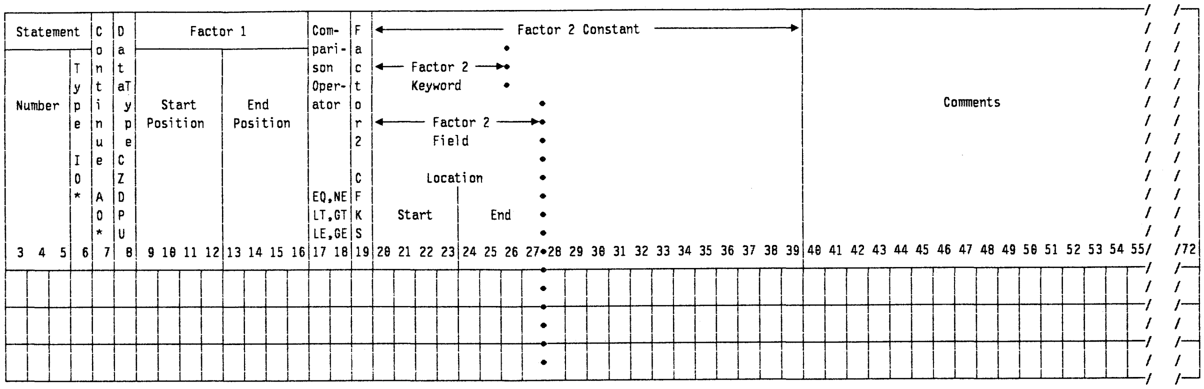
- Column 28 (Include or Exclude Control Field in Output)

  When DBCS control fields are used, they are changed in building the work record; therefore, if you must keep the original data, repeat the information as a data field. A blank in column 28 means to keep the control field; an X means to drop the control field.

- Column 35 (DBCS Sort Option)

  This column is valid **only** in the System/36 environment and applies **only** to Japanese DBCS sorts. Entries 1 and 2 will **only** be supported for System/36 compatibility; otherwise, you must leave this column blank.

RECORD SPECIFICATIONS



Statement		C o n t i n u e	D a t aT y p e	Factor 1		Com-pari-son Oper-ator	F a c t o r 2	← Factor 2 Constant → ← Factor 2 Keyword → ← Factor 2 Field →		Comments
Number	T y p e			Start Position	End Position			Location		
	I O *	A O *	C Z D P U			EQ,NE LT,GT LE,GE	C F K S	Start	End	
3 4 5	6	7	8	9 10 11 12	13 14 15 16	17 18	19	20 21 22 23	24 25 26 27•28 29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72

Record Specifications

For further details regarding coding your record specifications, see Chapter 9, "Record Specifications."

- Column 8 (Data Type)

  For users of double-byte characters, the only valid entry is C.

  Note: Although Z and D are not invalid entries and no error message will be issued if they are coded, undesirable results may occur when you sort double-byte character sets.

- Columns 17 through 18 (Comparison Operator)

  Although all entries are valid for Hangeul characters, only EQ and NE are meaningful when Factor 1 and Factor 2 contain all other DBCS characters.

- Column 19 (Type of Data Contained in Factor 2)

  Enter C to allow a DBCS data type field in the input record (Factor 1) to be compared to a DBCS constant that will be represented, for example, by SOKKKKSI (DBCS constant).

  Enter S to allow a DBCS constant to be shifted one byte to the left. A blank will be placed on the right.

  Factor 2 as a constant may contain shift-in or shift-out characters that are not defined as part of Factor 1. If Factor 2 is a DBCS constant, then it must be delimited by shift-out (SO) and shift-in (SI) on the record specification.

  If shift-in is not included in the Factor 2 comparison, the length of Factor 2 must be specified as the length of Factor 1 minus 1.

  Note: For packed data, Factor 2 must be the same size as the Factor 1 field.

FIELD SPECIFICATIONS

Statement		Field	Data Type	Field Location		Forced Characters			Overflow Field Length	Reserved	Comments
Number	Type			Start	End	Record	Substitute	Continuation	... A . l . tS. e. q. . . . . A .		
	F *	D N O F S *	C,K Z,L D,E P,I V,J U,R M,S H,T B								
3 4 5	6	7	8	9 10 11 12	13 14 15 16	17	18	19	20.21 22	23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72

Field Specifications

For further details regarding coding your field specifications, see Chapter 10, "Field Specifications."

- Column 8 (Data Type)

  This field describes the structure of the data in the field. You can show the data being defined, for example, one-byte alphanumeric Katakana or two-byte DBCS.

  A DBCS control field with a C in this column is sorted into IBM-code (EBCDIC) order, with a maximum length of 128 two-byte characters (256 bytes).

  A DBCS control field with a K or L in this column is sorted into the following sequence:

  - blanks
  - special symbols
  - a through z
  - A through Z
  - Greek letters
  - Japanese Katakana symbols
  - 0 through 9
  - Roman numerals
  - DBCS (in IBM-code sequence).

  If column 8 contains a K, each Hanja character will sort to the same position as the primary Hangeul pronunciation of that character.

  If column 8 contains an L, Hanja characters that start a DBCS word will sort to the same position as the secondary Hangeul pronunciation of that character. All other Hanja characters will sort to the same position as the primary Hangeul pronunciation.

- Columns 9 through 16 (Location of Field in the Input Record)

The length of the control field must be a multiple of two, and its length must not exceed 256 bytes.

Note: DBCS characters for which no entries in the active collating sequence exist will have a DBCS control field entry of X'FFFF' if ascending sequence is specified on the header specification. This will cause records with undefined DBCS characters to be placed behind those with defined DBCS characters.

- Columns 17 through 19 (Forced Character, Field, or Summary Overflow Indicator)

  A, N, and K (alphanumeric and Katakana) are valid, but DBCS characters are not supported.

Sorting Considerations for Japanese Double-Byte Character Sets

Japanese double-byte characters can be sorted into five different character sequences. Also, the alphanumeric Katakana fields can be sorted into the Sei-On Katakana sequence. These five sequences are:

1. Radical/stroke sequence/tie-breaker/DBCS code sequence
2. Stroke/strokes beyond radical/radical sequence/tie-breaker/ DBCS code sequence
3. Single-pronunciation/radical sequence/stroke sequence/tie-breaker/ DBCS code sequence
4. Single-pronunication/strokes beyond radical/radical sequence/ tie-breaker/DBCS code sequence
5. Character-type sequence.

Figure 32. Japanese Character Sequences

Radical: Characters can be ordered into their respective radicals. Within each radical set, the characters are ordered by strokes. Radical numbers can be user-defined. The *Application Development Tools: Character Generator Utility User's Guide* contains a listing of radical numbers.

Strokes: Characters can be ordered by the number of strokes used to write the character, by the total number of strokes, or by the number of strokes excluding the radical.

Single-pronunciation: Characters can be ordered by the phonetic sound they have when pronounced. Pronunciations can be either user-defined or defined by IBM, and are represented by Katakana.

Character-type: Characters can be ordered into one of the following character-type sequences:

- Special characters
- Alphabet
- Russian
- Greek
- Katakana
- Hiragana
- Arabic
- Roman
- Kanji.

Tie-breaker: The tie-breaker is one or more Katakana characters used to represent any alternative pronunciation of IBM-supplied characters only. In DBCS sorting, tie-breaker is a value (based on the sequence position of phonetic characters) that determines the output order of DBCS characters that otherwise compare equal.

DBCS Code Sequence: If all the sort criteria are the same for any two DBCS characters in sequences 1 through 4 in Figure 32 on page 139, then the characters will be ordered based on their internal hexadecimal representations.

Sei-On Katakana Sequence: Characters are a combination of single-pronunciation Kanji characters. Also, the equivalent pronunciations of voiced sound, semi-voiced sound, long sound, and Katakana small sound are used.

The following example shows the pronunciation and sort sequence:

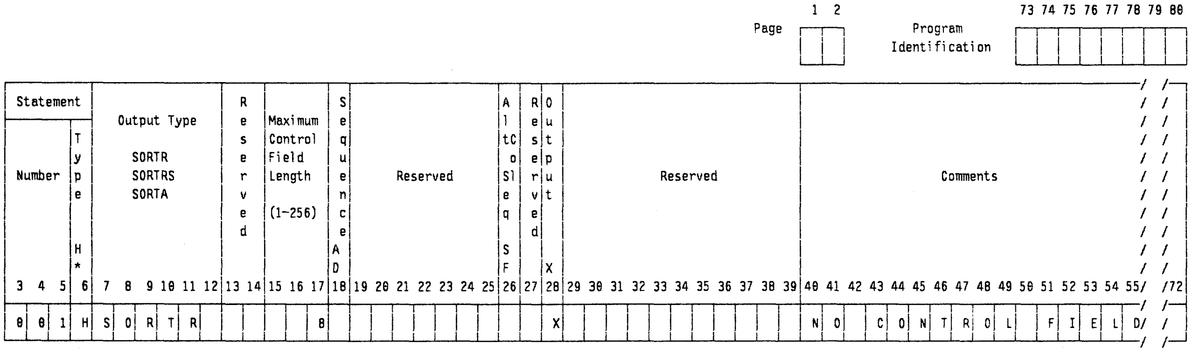
Meaning	Combination of Single-pronunciation and Kanji	Sei-on Pronunciation	Sort Sequence (ascending)
rule	kiyaku	kiyaku	2
customer	kyaku	kiyaku	3
reverse	gyaku	kiyaku	4
for conscience sake	kiyasume	kiyasume	5
rejection	kyakuka	kiyakuka	6
move backward	gyakukou	kyakukou	7
scream with laughter	kyah	kiyaa	1

Japanese Telephone Book Sorting Example

The following example illustrates sorting a person's name by telephone book type sort while the person's title is manager. The DBCS sort program requires one control field to sort into telephone book sequence. The example shows the field specification entries that generate the control field when the field in the input records contains four DBCS characters. The input layout file is as follows:

From	To	Explanation
1	10	Kanji field with So and Si person's name.
11	16	Kanji field with So and Si title.
17	64	Other information.

HEADER SPECIFICATIONS

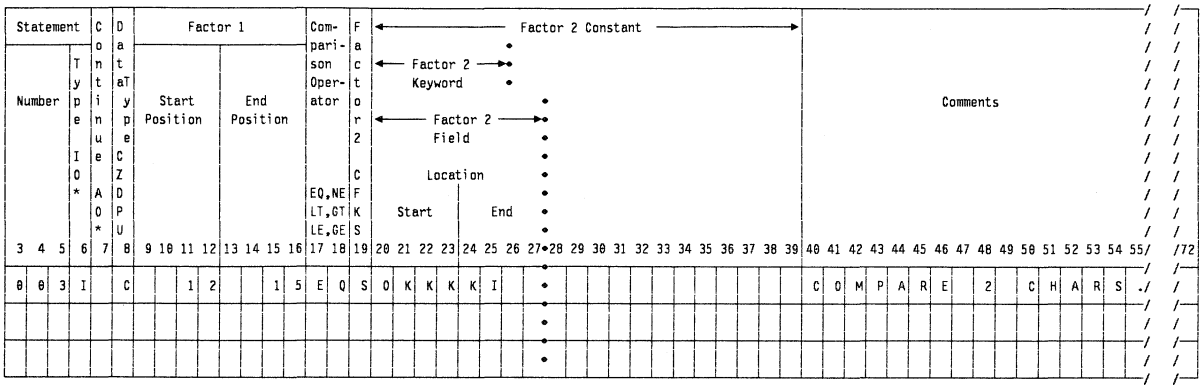


Page (1 2) □□ Program Identification (73 74 75 76 77 78 79 80) □□□□□□□□

Statement Number 3 4 5	Type H * 6	Output Type SORTR SORTRS SORTA 7 8 9 10 11 12	Reserved 13 14	Maximum Control Field Length (1-256) 15 16 17	Sequence A D 18	Reserved 19 20 21 22 23 24 25	Alt Col Seq S F 26	Reserved 27	Output X 28	Reserved 29 30 31 32 33 34 35 36 37 38 39	Comments 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72
0 0 1	H	S O R T R		8					X		N O C O N T R O L F I E L D

Columns	Entry	Explanation
7-12	SORTR	This is a regular sort: the output is a physical file.
17	8	The maximum control field length is 8 characters.
28	X	The control field does not appear in the output record.
40-72	Comments	Identifies that the control field is dropped.

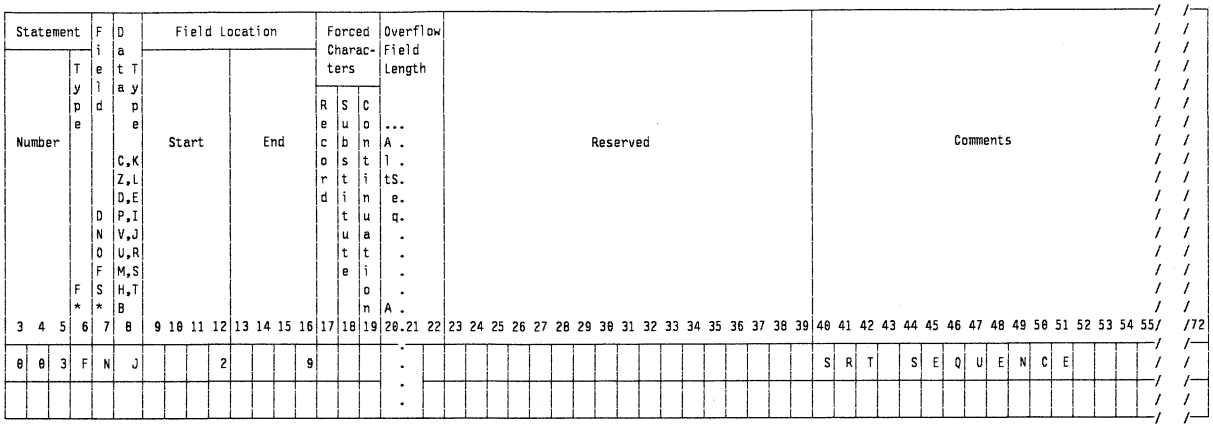
RECORD SPECIFICATIONS



Statement Number	Type I O *	Continue A O *	Data Type C Z D P U	Factor 1 Start Position	Factor 1 End Position	Comparison Operator EQ,NE LT,GT LE,GE	Factor 2 C F K S	Factor 2 Constant / Factor 2 Keyword / Factor 2 Field Location Start, End	Comments
3 4 5	6	7	8	9 10 11 12	13 14 15 16	17 18	19	20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 72
0 0 3	I		C	1 2	1 5	E Q	S	0 K K K K I	C O M P A R E 2 C H A R S .

Columns	Entry	Explanation
6	I	Specifies that the records described in this specification are to be included in the sort.
8	C	Identifies the data for Factor 1 and Factor 2 as character data. The system will look at both the zone and the digit portions of each byte when comparing Factor 1 with Factor 2.
9-12	12	Factor 1 field begins in column 12 of the input record.
13-16	15	Factor 1 field ends in column 15 of the input record.
17-18	EQ	The data in the Factor 1 field must equal the data in the Factor 2 constant for the input record to be selected for sorting.
19	S	The data in the Factor 2 field is constant, and is shifted one column to the left before comparison.
20	0	Represents the shift-out character.
21-24	KKKK	The two-byte characters to be compared.
25	I	Represents the shift-in character.
40-72	Comments	Identifies that two double-byte characters are being compared.

FIELD SPECIFICATIONS



Statement Number	Type	Field	Data Type	Field Location Start	Field Location End	Forced Characters Record	Forced Characters Substitute	Forced Characters Continuation	Overflow Field Length	Reserved	Comments
	F *	D N O F S *	C,K Z,L D,E P,I V,J U,R M,S H,T B						... A . l . tS. e. q. . . . . A .		
3 4 5	6	7	8	9 10 11 12	13 14 15 16	17	18	19	20.21 22	23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72
0 0 3	F	N	J	2	9				.		SRT SEQUENCE
									.		

Columns	Entry	Explanation
6	F	Identifies that this is a field specification.
7	N	Identifies the field as a normal control field. The control field data is not forced (modified) before it is used to control the sort.
8	J	The data field contains a Japanese DBCS control field using single-pronunciation, stroke, radical, tie-breaker sequence.
9-12	2	The data field begins in column 2 of the input record.
13-16	9	The control field ends in column 9 of the input record.
40-72	Comments	Identifies the sort as a telephone book type.

Japanese Word Dictionary Sorting Example

The following example illustrates the coding required on the field specification to sort in Japanese word dictionary type order. The program requires two control fields. The example shows the specification entries that generate the control fields when four DBCS characters are contained in the input record.

FIELD SPECIFICATIONS

Statement		Field	Data Type	Field Location		Forced Characters			Overflow Field Length	Reserved	Comments
Number	Type F *	D N O F S *	C,K Z,L D,E P,I V,J U,R M,S H,T B	Start	End	Record	Substitute	Continuation	... A. l. tS. e. q. . . . . A.		
3 4 5	6	7	8	9 10 11 12	13 14 15 16	17	18	19	20.21 22	23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72
0 0 4	F	N	E	1 1	2 6				.		S E I - O N K A T A K A N A
0 0 5	F	N	S	2	9				.		S R T S E Q U E N C E

Columns	Entry	Explanation
6	F	Identifies that this is a field specification.
7	N	Identifies the field as a normal control field. The control field data is not forced (modified) before being used to control the sort.
8	E	The data field contains a Sei-On Katakana control field.
9-12	11	The data field begins in column 11 of the input record.
13-16	26	The control field ends in column 26 of the input record.
40-72	Comments	Identifies the pronunciation of the word.

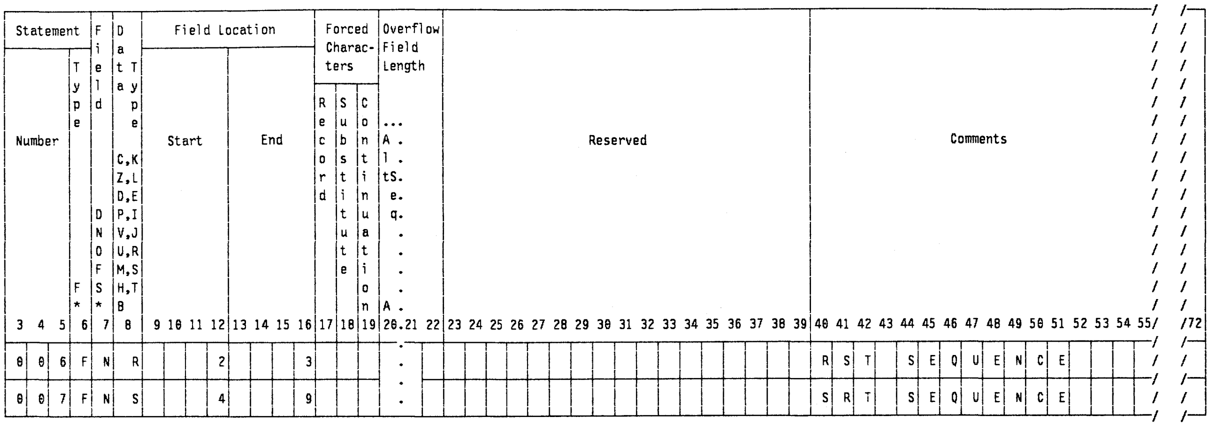
The following describes the column entries that differ on the second control field.

Columns	Entry	Explanation
8	S	The data field contains a Japanese DBCS control field using stroke, radical, tie-breaker sequence.
9-12	2	The data field begins in column 2 of the input record.
13-16	9	The control field ends in column 9 of the input record.
40-72	Comments	Identifies the stroke, radical, tie-breaker sequence.

Kanji Character Dictionary Type Sorting Example

The following example illustrates the coding required on the field specification to sort into Kanji character dictionary type order. The program requires two control fields. The example shows the specification entries that generate the control fields when four DBCS characters are contained in the input record.

FIELD SPECIFICATIONS



Statement		Field	Data Type	Field Location		Forced Characters			Overflow Field Length			
Number	Type F *	DNOFS *	C,K Z,L D,E P,I V,J U,R M,S H,T B	Start	End	Record	Substitute	Continuation	... A . 1 . tS. e. q. . . . . A .	Reserved	Comments	
3 4 5	6	7	8	9 10 11 12	13 14 15 16	17	18	19	20.21 22	23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/	/72
0 0 6	F	N	R	2	3				.		R S T S E Q U E N C E	
0 0 7	F	N	S	4	9				.		S R T S E Q U E N C E	

Columns	Entry	Explanation
6	F	Identifies that this is a field specification.
7	N	Identifies the field as a normal control field. The control field data is not forced (modified) before being used to control the sort.
8	R	The data field contains a Japanese DBCS control field using radical, stroke, tie-breaker sequence.
9-12	2	The data field begins in column 2 of the input record.
13-16	3	The control field ends in column 3 of the input record.
40-72	Comments	Identifies the radical, stroke, tie-breaker sequence.

The following describes the column entries that differ on the second control field.

Columns	Entry	Explanation
8	S	The data field contains a Japanese DBCS control field using stroke, radical, tie-breaker sequence.
9-12	4	The data field begins in column 4 of the input record.
13-16	9	The control field ends in column 9 of the input record.
40-72	Comments	Identifies the stroke, radical, tie-breaker sequence.

Sorting Considerations for Simplified Chinese Double-Byte Character Sets

Simplified Chinese double-byte characters can be sorted into the following seven different sequences:

1. Character-type/total strokes/radical/DBCS code sequence
2. Character-type/radical/strokes beyond radical/DBCS code sequence
3. Character-type/single-pronunciation/radical/total strokes/tie-breaker/ DBCS code sequence
4. Character-type/single-pronunciation/total strokes/radical/tie-breaker/ DBCS code sequence
5. Character-type/single-pronunciation/tie-breaker/radical/total strokes/ DBCS code sequence
6. Character-type/total strokes/radical/single-pronunciation/tie-breaker/ DBCS code sequence
7. Character-type.

Figure 33. Simplified Chinese Character Sequences

Character-Type: Different character-types can be ordered by the following sequences:

- User-defined special characters
- General character, Ordinal, and Numeric
- Latin alphabet
- Japanese Kana
- Greek alphabet
- Russian alphabet
- Chinese phonetic symbol
- Chinese phonetic-annotated letter
- Chinese characters.

Strokes: Characters can be ordered by the number of strokes used to draw the character or by the total number of strokes.

Radical: Characters can be ordered into their respective radicals. Within each radical set, the characters are ordered by strokes. Radical numbers can be user-defined. The *Application Development Tools: Character Generator Utility User's Guide* contains a listing of radical numbers.

Strokes beyond radical: Characters can be ordered by the number of strokes used to draw the character or by the number of strokes excluding the radical.

Single-pronunciation: Characters can be ordered by the phonetic sound they have when pronounced. Pronunciations are represented by tone concatenating Pinyin. There are five tones: light tone (without tone mark), high and level tone, rising tone, falling-rising tone, and falling tone. When you sort a Simplified Chinese character by single-pronunciation sequence, it is sorted by Pinyin and then by tone sequence.

Tie-breaker: The tie-breaker is the tone and Pinyin used to represent any alternative pronunciation of IBM-supplied characters only. In DBCS sorting, tie-breaker is a value (based on the sequence position of phonetic characters) that determines the output order of DBCS characters that otherwise compare equal.

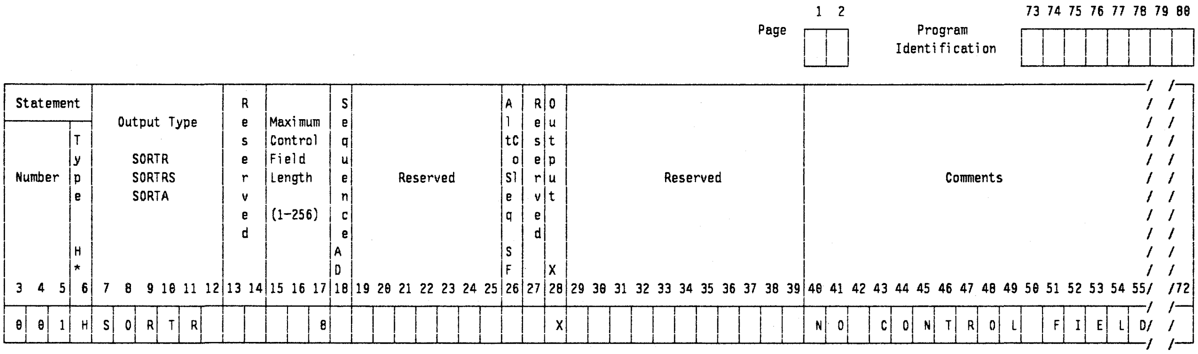
DBCS Code Sequence: If all the sort criteria are the same for any two DBCS characters in sequences 1 to 6 in Figure 33 on page 146, the characters will be ordered based on their internal hexadecimal representation.

Simplified Chinese Strokes/Radical Sorting Example

The following example illustrates sorting a person's name by Strokes/Radical sequence for employees working in the Purchasing Department. The DBCS sort program requires one control field to sort into this sequence. This example shows the specifications required to generate the control field if the field in the input records contains four DBCS characters. The input layout file is as follows:

From	To	Explanation
1	10	Simplified Chinese field with SO and SI person's name.
11	30	Simplified Chinese field with SO and SI department name.
31	64	Other information.

HEADER SPECIFICATIONS

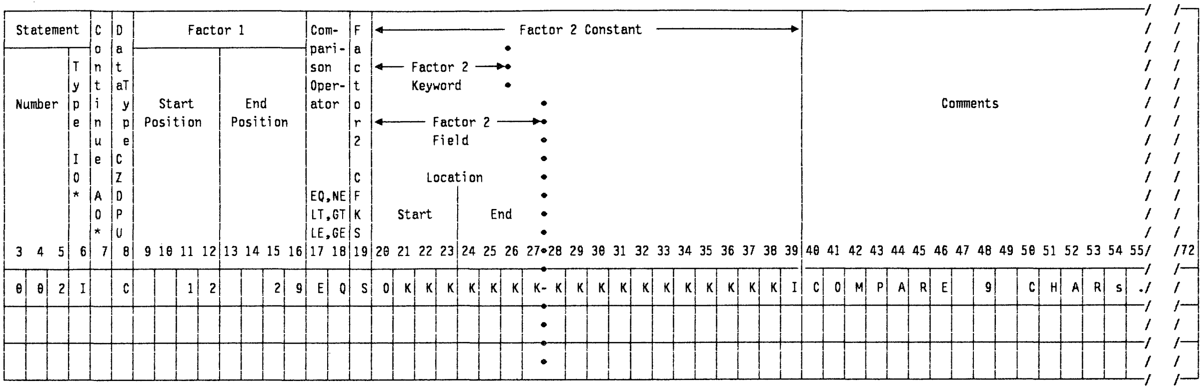


Page 1 2 □□ Program Identification 73 74 75 76 77 78 79 80 □□□□□□□□

Statement Number	Type	Output Type	Reserved	Maximum Control Field Length	Sequence	Reserved	Alt Col Seq	Reserved	Output	Reserved	Comments
	H *	SORTR SORTRS SORTA		(1-256)	A D		S F		X		
3 4 5	6	7 8 9 10 11 12	13 14	15 16 17	18	19 20 21 22 23 24 25	26	27	28	29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72
0 0 1	H	S O R T R		8					X		N O C O N T R O L F I E L D/

Columns	Entry	Explanation
6	H	Identifies that this is a Header Specification.
7-12	SORTR	This is a regular sort: the output is to be a physical file.
17	8	The maximum control field length is 8 characters.
28	X	The control field will not appear in the output record.
40-72	Comments	Identifies that the control field will be dropped.

RECORD SPECIFICATIONS


Statement
Number
Type I O *
Continue A O *
Data Type C Z D P U
Factor 1
Start Position
End Position
Comparison Operator EQ,NE LT,GT LE,GE
Factor 2 C F K S
Factor 2 Constant
Factor 2 Keyword
Factor 2 Field
Location
Start
End
Comments
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 72

```
002I C  12  29EQS0KKKKKKK-KKKKKKKKKKKI COMPARE 9 CHARs.
```

Columns	Entry	Explanation
6	I	Specifies that the records described in this specification are to be included in the sort.
8	C	Identifies the data for Factor 1 and Factor 2 as character data. The system will look at both the zone and the digit portions of each byte when comparing Factor 1 with Factor 2.
9-12	12	Factor 1 field begins in column 12 of the input record.
13-16	29	Factor 1 field ends in column 29 of the input record.
17-18	EQ	The data in the Factor 1 field must equal the data in the Factor 2 constant for the input record to be selected for sorting.
19	S	The data in the Factor 2 field is constant, and is shifted one column to the left before comparison.
20	0	Represents the shift-out character.
21-38	KKKKKKKKKKKKKKKKKK	The 9 two-byte characters (Purchasing Department) to be compared.
25	I	Represents the shift-in character.
40-72	Comments	Identifies that two Kanji characters are being compared.

FIELD SPECIFICATIONS

Statement Number	Type F *	Field D N O F S *	Data Type C,K Z,L D,E P,I V,J U,R M,S H,T B	Field Location Start	 End	Forced Characters Record	 Substitute	 Continuation	Overflow Field Length ... A. 1. tS. e. q. . . . . . A.	Reserved	Comments
3 4 5	6	7	8	9 10 11 12	13 14 15 16	17	18	19	20.21 22	23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72
0 0 3	F	N	F	2	9				. .		S R S E Q U E N C E
									. .		

Columns	Entry	Explanation
6	F	Identifies that this is a field specification.
7	N	Identifies the field as a normal control field. The control field data is not forced (modified) before it is used to control the sort.
8	F	The data field contains a DBCS control field using character-type, strokes, radical sequence.
9-12	2	The data field begins in column 2 of the input record.
13-16	9	The control field ends in column 9 of the input record.
40-72	Comments	Identifies the sort as a Strokes/Radical sequence.

Sorting Considerations for Traditional Chinese Double-Byte Character Sets

Traditional Chinese double-byte characters can be sorted into the following three different sequences:

1. Character-type/strokes/radical/DBCS code sequence
2. Character-type/radical/strokes beyond radical/DBCS code sequence
3. Character-type sequence.

Figure 34. Traditional Chinese Character Sequences

Character-Type: Characters can be ordered into one of the following character-type sequences:

- Special characters
- Alphabet
- Greek
- Katakana
- Roman.

Strokes: Characters can be ordered by the number of strokes used to draw the character or by the total number of strokes.

Radical: Characters can be ordered into their respective radicals. Within each radical set, the characters are ordered by strokes. Radical numbers can be user defined. For a listing of radical numbers, refer to the *Application Development Tools: Character Generator Utility User's Guide*.

Strokes beyond radical: Characters can be ordered by the number of strokes used to draw the character or by the number of strokes excluding the radical.

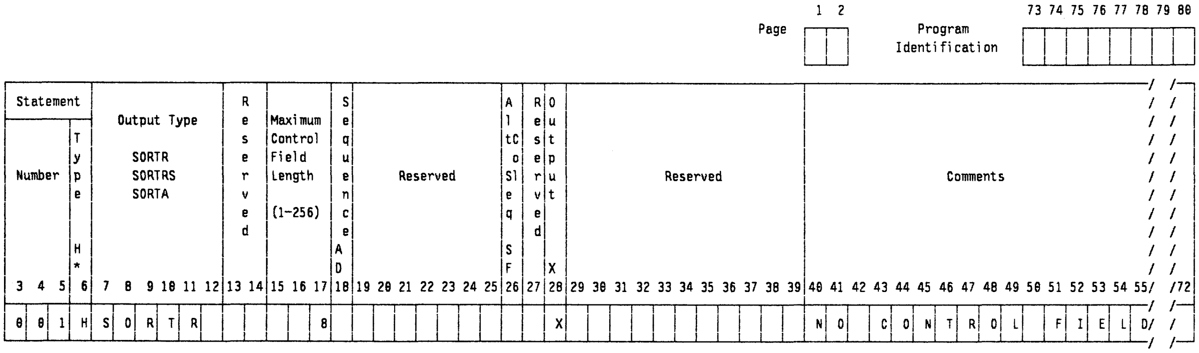
DBCS Code Sequence: If all of the sort criteria are the same for any two DBCS characters in sequences 1 and 2 in Figure 34, the characters will be ordered based on their internal hexadecimal representations.

Traditional Chinese Strokes/Radical Sorting Example

The following example illustrates sorting a person's name by Strokes/Radical sequence for employees working in the Purchasing Department. The DBCS sort program requires one control field to sort into this sequence. This example shows the specifications required to generate the control field if the field in the input records contains four DBCS characters. The input layout file is as follows:

From	To	Explanation
1	10	Traditional Chinese field with SO and SI person's name.
11	30	Traditional Chinese field with SO and SI department name.
31	64	Other information.

HEADER SPECIFICATIONS



Page (1 2) □□ Program Identification (73 74 75 76 77 78 79 80) □□□□□□□□

Statement Number	Type H*	Output Type SORTR SORTRS SORTA	Reserved	Maximum Control Field Length (1-256)	Sequence A D	Reserved	Alt Col Seq S F	Reserved	Output X	Reserved	Comments
3 4 5	6	7 8 9 10 11 12	13 14	15 16 17	18	19 20 21 22 23 24 25	26	27	28	29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72
0 0 1	H	S O R T R		8					X		N O C O N T R O L F I E L D/ /

Columns	Entry	Explanation
6	H	Identifies that this is a header specification.
7-12	SORTR	This is a regular sort: the output is a physical file.
17	8	The maximum control field length is 8 characters.
28	X	The control field does not appear in the output record.
40-72	Comments	Identifies that the control field is dropped.

RECORD SPECIFICATIONS

Statement Number	Type I O *	Continue A O *	Data Type C Z D P U	Factor 1 Start Position	Factor 1 End Position	Comparison Operator EQ,NE LT,GT LE,GE	Factor 2 C F K S	Factor 2 Constant Factor 2 Keyword Factor 2 Field Location Start / End	Comments
3 4 5	6	7	8	9 10 11 12	13 14 15 16	17 18	19	20 21 22 23 24 25 26 27•28 29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72
0 0 2	I		C	1 2	2 9	E Q	S	0 K K K K K K K- K K K K K K K K K K K I	C O M P A R E 9 C H A R s ./ /

Columns	Entry	Explanation
6	I	Specifies that the records described in this specification are to be included in the sort.
8	C	Identifies the data for Factor 1 and Factor 2 as character data. The system will look at both the zone and the digit portions of each byte when comparing Factor 1 with Factor 2.
9-12	12	Factor 1 field begins in column 12 of the input record.
13-16	29	Factor 1 field ends in column 29 of the input record.
17-18	EQ	The data in the Factor 1 field must equal the data in the Factor 2 constant for the input record to be selected for sorting.
19	S	The data in the Factor 2 field is constant, and is shifted one column to the left before comparison.
20	0	Represents the shift-out character.
21-38	KKKKKKKKKKKKKKKKKK	The 9 two-byte characters (Purchasing Department) to be compared.
25	I	Represents the shift-in character.
40-72	Comments	Identifies that two Kanji characters are being compared.

FIELD SPECIFICATIONS

Statement Number 3 4 5	Type F * 6	Field D N O F S * 7	Data Type C,K Z,L D,E P,I V,J U,R M,S H,T B 8	Field Location Start 9 10 11 12	 End 13 14 15 16	Forced Charac-ters Record 17	 Substitute 18	 Continuation 19	Overflow Field Length ... A . l . tS. e. q. . . . . . A . 20.21 22	Reserved 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39	Comments 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72
0 0 3	F	N	H	2	9						S R S E Q U E N C E

Columns	Entry	Explanation
6	F	Identifies that this is a field specification.
7	N	Identifies the field as a normal control field. The control field data is not forced (modified) before it is used to control the sort.
8	H	The data field contains a DBCS control field using character-type, strokes, radical sequence.
9-12	2	The data field begins in column 2 of the input record.
13-16	9	The control field ends in column 9 of the input record.
40-72	Comments	Identifies the sort as a Strokes/Radical sequence.

Sorting Considerations for Korean Double-Byte Character Sets

The Korean double-byte character set consists of two distinct types of characters: Hangeul and Hanja. Hangeul characters are sorted according to their DBCS codes.

For Korean DBCS characters, there is a DBCS active sort table but no DBCS master sort table. The *Data Management Guide* contains more information about these tables.

The Korean DBCS can be sorted according the following sequence:

- Pronunciation.

Pronunciation: Characters can be ordered by the phonetic sound they have when pronounced. Pronunciations can be either user-defined or defined by IBM. All Hanja characters are equivalent in pronunciation to some Hangeul character; however, a second pronunciation may be necessary if the character is at the start of a word.

Korean Pronunciation Sort Example

The following example illustrates sorting women's names. There are two fields: name and sex. The input layout file is as follows:

From	To	Explanation
1	10	Hangeul/Hanja field with shift-out and shift-in, person's name.
11	14	Hangeul/Hanja field with shift-out and shift-in, sex.
17	72	Other information.

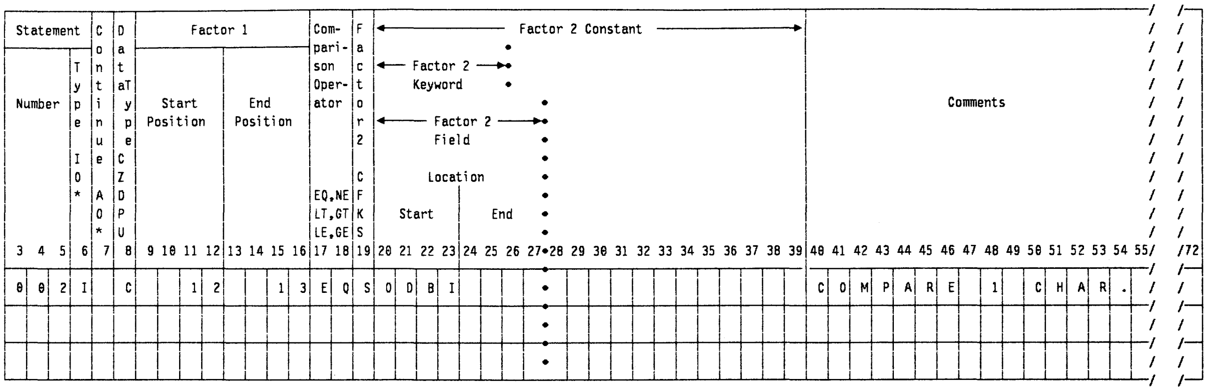
HEADER SPECIFICATIONS

Page □□ (1 2)   Program Identification □□□□□□□□ (73 74 75 76 77 78 79 80)

Statement Number	Type H *	Output Type SORTR SORTRS SORTA	Reserved	Maximum Control Field Length (1-256)	Sequence A D	Reserved	AltCol Seq S F	Reserved	Output X	Reserved	Comments
3 4 5	6	7 8 9 10 11 12	13 14	15 16 17	18	19 20 21 22 23 24 25	26	27	28	29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72
0 0 1	H	S O R T R		8					X		N O C O N T R O L F I E L D/

Columns	Entry	Explanation
7-12	SORTR	This is a regular sort: the output is a physical file.
17	8	The maximum control field length is 8 characters.
28	X	The control field does not appear in the output record.
40-72	Comments	Identifies that the control field is dropped.

RECORD SPECIFICATIONS



Statement Number	Type	Continue	Data Type	Factor 1 Start Position	Factor 1 End Position	Com-parison Oper-ator	Factor 2	Factor 2 Constant Factor 2 Keyword Factor 2 Field Location Start / End	Comments
	I O *	A O *	C Z D P U			EQ,NE LT,GT LE,GE	C F K S		
3 4 5	6	7	8	9 10 11 12	13 14 15 16	17 18	19	20 21 22 23 24 25 26 27•28 29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72
0 0 2	I		C	1 2	1 3	E Q	S	0 D B I	C O M P A R E 1 C H A R .

Columns	Entry	Explanation
6	I	Specifies that the records described in this specification are to be included in the sort.
8	C	Identifies the data for Factor 1 and Factor 2 as character data. The system will look at both the zone and the digit portions of each byte when comparing Factor 1 with Factor 2.
9-12	12	Factor 1 field begins in column 12 of the input record.
13-16	13	Factor 1 field ends in column 15 of the input record.
17-18	EQ	The data in the Factor 1 field must equal the data in the Factor 2 constant for the input record to be selected for sorting.
19	S	The data in the Factor 2 field is constant, and is shifted one column to the left before comparison.
20	0	Represents the shift-out character.
21-23	DB	The DBCS character to be compared.
25	I	Represents the shift-in character.
40-72	Comments	Compare 1 character.

FIELD SPECIFICATIONS

Statement		Field	Data Type	Field Location		Forced Characters			Overflow Field Length		
Number	Type F *	D N O F S *	C,K Z,L D,E P,I V,J U,R M,S H,T B	Start	End	Record	Substitute	Continuation	... A . l . tS. e. q. . . . . A .	Reserved	Comments
3 4 5	6	7	8	9 10 11 12	13 14 15 16	17	18	19	20.21 22	23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39	40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55/ /72
0 0 3	F	N	L	2	9						SORT USING
	*										CONVERSION TABLE

Columns	Entry	Explanation
6	F	Identifies that this is a field specification.
7	N	Identifies the field as a normal control field. The control field data is not forced (modified) before it is used to control the sort.
8	L	The Hanja characters that start the DBCS word will sort to the same position as the secondary Hangeul pronunciation of the characters.
9-12	2	The data field begins in column 2 of the input record.
13-16	9	The control field ends in column 9 of the input record.
40-72	Comments	Sort using conversion tables.

Glossary

active sort table. A system-supplied DBCS sort table that contains the collating sequences for all defined double-byte characters in a double-byte character set. These tables are maintained by the character generator utility function of the Application Programming Tools licensed program.

alternative collating sequence. A user-defined collating sequence that replaces the standard EBCDIC collating sequence.

ascending key sequence. The arrangement of data in order from the lowest value of the key field to the highest value of the key field. Contrast with *descending key sequence*.

binary. (1) Pertaining to a system of numbers to the base two; the binary digits are 0 and 1. (2) Involving a choice of two conditions, such as on-off or yes-no.

Character Generator Utility (CGU). A function of the Application Programming Tools licensed program that is used to define and maintain user-defined double-byte characters and related sort information.

collating sequence. The sequence in which characters are ordered within the computer for sorting, combining, or comparing.

conditional force. The replacement of control field characters before the records are sorted. This is done if the control field in the input record contains a particular entry.

control field. A field that identifies a record's relationship to other records (such as a part number in an inventory record). Control fields determine the order of records in the sorted file.

DBCS. See *double-byte character set (DBCS)*.

DBCS code. The hexadecimal code, 2 bytes in length, that identifies a double-byte character.

DBCS font file. A system-supplied file that holds the 24x24 character images of one of the following groups of commonly used characters: 1) Japanese non-Kanji and basic-Kanji, 2) Korean non-Hangeul/non-Hanja, Hangeul, and a subset of Hanja, 3) Traditional Chinese non-Chinese and a subset of Traditional primary Chinese characters, or 4) all IBM-defined Simplified Chinese characters.

DBCS font table. A system-supplied table that holds either 24x24 or 32x32 character images of a double-byte character set. Japanese 24x24 font table holds Japanese extended Kanji and user-defined characters. Korean 24x24 font table holds a subset of Hanja and user-defined characters. Traditional Chinese 24x24 font table holds a subset of primary Traditional Chinese, all secondary Chinese, and user-defined characters. Simplified Chinese 24x24 font table holds user-defined characters. A 32x32 DBCS font table holds character images of a complete double-byte character set, including its user-defined characters.

DBCS number. The decimal value, two through five digits in length, that identifies a double-byte character.

DBCS sort table. A system-supplied object that contains sequencing information to sort double-byte characters. See also *master sort table* and *active sort table*.

descending key sequence. The arrangement of data in order from the highest value of the key field to the lowest value of the key field. Contrast with *ascending key sequence*.

Double-Byte Character Set (DBCS). A set of characters in which each character is represented by 2 bytes. Languages such as Japanese, Chinese, and Korean, which contain more symbols than can be represented by 256 code points, require double-byte character sets. Because each character requires 2 bytes, typing, displaying, and printing DBCS characters requires hardware and supporting programs that are DBCS-capable. There are four double-byte character sets supported by the system: Japanese, Korean, Simplified Chinese, and Traditional Chinese.

force-all. A specification that tests if the control field in the input record contains a particular entry. If it does not, the control field character is replaced before the record is sorted.

forced character substitution. The substitution of one character of the control field by another for sorting purposes.

forced control field. A one-position control field that results from replacing one character with another, or from forcing a character into a control field position.

Hangeul. A written language of Korea. Each Hangeul character is composed of two to six Jamo characters.

Hanja. Chinese characters used in Korean written language.

Hiragana. A native Japanese character set used mainly to express the pronunciation of native Japanese words. Contrast with *Katakana*.

include set. Sequence specifications that identify one or more record types to be sorted.

Jamo. Elements of Korean written language. Korean alphabet.

Japanese basic-Kanji character set. A subset of Japanese DBCS, consisting of commonly used Kanji characters. There are 3 226 Kanji characters in this set.

Japanese extended-Kanji character set. A subset of Japanese DBCS, consisting of less commonly used Kanji characters. There are 3 487 characters in this set.

Japanese double-byte character set. An IBM-defined double-byte character set for Japanese consisting of the Japanese non-Kanji set, basic Kanji set, extended Kanji set, and up to 4 370 user-definable characters.

Japanese non-Kanji character set. A subset of the Japanese DBCS, consisting of non-Kanji characters like Greek, Russian, Roman numeric, alphanumeric and related symbols, Katakana, Hiragana, and special symbols. There are 550 characters in this set.

Kanji. Chinese characters used in Japanese written language.

Katakana. A native Japanese character set that is used to write foreign words phonetically in Japanese. Contrast with *Hiragana*.

Korean double-byte character set. An IBM-defined double-byte character set for Korean, consisting of Korean non-Hangeul/non-Hanja set, Hangeul set, Hanja set and up to 1 880 user-definable characters.

Korean Hangeul character set. A subset of the Korean DBCS, consisting of 2 369 Hangeul characters and 52 Jamo characters.

Korean Hanja character set. A subset of the Korean DBCS, consisting of 4 500 Hanja characters.

Korean non-Hangeul/non-Hanja character set. A subset of the Korean DBCS, consisting of non-Hangeul/non-Hanja characters, such as Greek, Russian, Roman numeric, alphanumeric and related symbols, Katakana, Hiragana, and special symbols. There are 398 characters in this set.

master sort table. A system-supplied table that contains sort information required for sorting double-byte characters. This table is maintained by the character generator utility function of the Application Development Tools licensed program.

normal control field. A control field that is sorted in the sequence specified in the header specification.

opposite control field. A control field that is sorted in the opposite sequence of that specified in the header specification.

output file. A file resulting from the resequencing or copy request.

overflow indicator. A specified character that is to be placed at the end of an output record in the case of an overflow during a summary sort.

overflow field. A field that allows for field expansion.

overflow indicator field. The one-character field into which the *overflow character* is placed.

packed decimal format. A format in which each byte (except the rightmost byte) within a field represents two numeric digits. The rightmost byte contains one digit and the sign. For example, the decimal value +123 is represented as 0001 0010 0011 1111. Contrast with *zoned decimal format*.

record address file. A physical file that contains 4-byte binary relative record numbers rather than data.

set. A grouping of one or more record specifications.

shift-in character. A control character (hex 0F) that indicates the end of a string of double-byte characters. Contrast with *shift-out character*.

shift-out character. A control character (hex 0E) that indicates the start of a string of double-byte characters. Contrast with *shift-in character*.

Simplified Chinese. The Chinese character set that has been simplified by reducing the number of strokes in common characters and deleting complicated variants. Simplified Chinese characters are used primarily in the People's Republic of China.

Simplified Chinese double-byte character set. An IBM-defined double-byte character set for Simplified Chinese. It consists of Simplified Chinese non-Chinese set, primary set, secondary set, and up to 1 880 user-definable characters.

Simplified Chinese non-Chinese character set. A subset of the Simplified Chinese DBCS, consisting of non-Chinese characters, such as Latin alphabet, Greek, Russian, Roman numeric, alphanumeric and related symbols, Katakana, Hiragana, Japanese, special symbols, and Chinese phonetic symbols. There are 712 characters in this set.

Simplified Chinese primary character set. A subset of the Simplified Chinese DBCS, consisting of commonly used Chinese characters. There are 3 755 characters in this set.

Simplified Chinese secondary character set. A subset of the Simplified Chinese DBCS, consisting of less commonly used Chinese characters. There are 3 008 characters in this set.

sort sequence specifications. Source statements that specify the sequence of a sort.

specification sheets. Forms on which a program is coded and described.

summary data field. A data field designated for accumulated totals.

Traditional Chinese. The Chinese character set expressed in traditional form. Traditional Chinese characters are used in Taiwan, Hong Kong, and some other parts of the world.

Traditional Chinese double-byte character set. An IBM-defined double-byte character set for Traditional Chinese, consisting of the traditional Chinese non-Chinese set, primary set, secondary set, and up to 2 632 user-definable characters.

Traditional Chinese non-Chinese character set. A subset of the Traditional Chinese DBCS, consisting of non-Chinese characters, such as Greek, Russian, Roman numeric, alphanumeric and related symbols, Katakana, Hiragana, special symbols, and Chinese phonetic symbols. There are 675 characters in this set.

Traditional Chinese primary character set. A subset of the Traditional Chinese DBCS, consisting of commonly used Chinese characters. There are 5 401 characters in this set.

Traditional Chinese secondary character set. A subset of the Traditional Chinese DBCS, consisting of less commonly used Chinese characters. There are 7 652 characters in this set.

unconditional force. A specification that always results in a character being forced into the control field before the records are sorted.

work area. An area in storage reserved for temporary storage of data that is being resequenced.

work file. A file that is used for temporary storage of data being processed.

work record. A record built by the Sort program for later processing.

zoned decimal format. A format for representing numbers in which the digit is contained in bits 4 through 7 and the sign is contained in bits 0 through 3 of the rightmost byte; bits 0 through 3 of all other bytes contain 1s (hexadecimal F). For example, in zoned decimal format, the decimal value of +123 is represented as 1111 0001 1111 0010 1111 0011. Contrast with *packed decimal format.*

zoned field. A field that contains data in the zoned decimal format.

Bibliography

The manuals below are listed with their full title and base order number, and with the shortened version of the title. When these manuals are referred to in the text, the shortened version of the title is used.

- *Application Development Tools: Character Generator Utility User's Guide*, SC09-1170
  Short title: *CGU User's Guide*
- *Application Development Tools: Programming Development Manager User's Guide and Reference*, SC09-1339
  Short title: *PDM User's Guide and Reference*
- *Application Development Tools: Screen Design Aid User's Guide and Reference*, SC09-1340
  Short title: *SDA User's Guide and Reference*
- *Application Development Tools: Screen Design Aid User's Guide and Reference for the System/36 Environment*, SC09-1418
  Short title: *SDA User's Guide/Reference for the System/36 Environment*
- *Application Development Tools: Source Entry Utility User's Guide and Reference*, SC09-1338
  Short title: *SEU User's Guide and Reference*
- *Backup and Recovery Guide*, SC41-8079
  Short title: *Backup and Recovery Guide*
- *Data Management Guide*, SC41-9658
  Short title: *Data Management Guide*
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  Short title: *New User's Guide*
- *Programming: Control Language Programmer's Guide*, SC41-8077
  Short title: *CL Programmer's Guide*
- *Programming: Control Language Reference*, SC41-0030
  Short title: *CL Reference*
- *Programming: Reference Summary*, SX41-0028
  Short title: *Programming Reference Summary*
- *Publications Guide*, GC41-9678
  Short title: *Publications Guide*
- *S/36 Sort Guide*, SC21-7903 *System/36 Sort Guide*, SC21-7903
  Short title: *System/36 Sort Guide*
- *S/38 Sort Guide*, SC21-7780 *System/38 Conversion Reformat Utility Reference Manual*, SC21-7780
  Short title: *System/38 Conversion Reformat Reference Manual*
- *Utilities: Sort Coding Form*, SX09-1068
  Short title: *Sort Coding Form*

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Publication No. SC09-1363-00

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