DFSORT Application Programming Guide
Before using this information and the product it supports, be sure to read the general information under "Notices" on page 907.

This edition applies to Version 1 Release 13 of z/OS™ (5694-A01) and to all subsequent releases and modifications until otherwise indicated in new editions.

This edition replaces SC26-7523-06.

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About this document

This document is intended to help you to sort, merge, and copy data sets using DFSORT. This document is not designed to teach you how to use DFSORT, but is for programmers who already have a basic understanding of DFSORT, and need a task-oriented guide and reference to its functions and options. If you are a new user, then you should read z/OS DFSORT: Getting Started first. z/OS DFSORT: Getting Started is a self-study guide that tells you what you need to know to begin using DFSORT quickly, with step-by-step examples and illustrations.

How to use this document

The various sections of this document present related information grouped according to tasks you want to do. The first three chapters of the document explain what you need to know to invoke and use DFSORT's primary record-processing functions. The remaining chapters explain more specialized features. The appendixes provide specific information about various topics.

- **Chapter 1, “Introducing DFSORT,” on page 1** presents an overview of DFSORT, explaining what you can do with DFSORT and how you invoke DFSORT processing. It describes how DFSORT works, discusses data set formats and limitations, and explains how installation defaults can affect your DFSORT applications.
- **Chapter 2, “Invoking DFSORT with Job Control Language,” on page 25** explains how to use job control language (JCL) to run your DFSORT jobs. It explains how to code JOB, EXEC, and DD statements, and how you can use cataloged procedures and EXEC PARM options to simplify your JCL and override installation defaults.
- **Chapter 3, “Using DFSORT Program Control Statements,” on page 81** presents the DFSORT control statements you use to sort, merge, and copy data. It explains how to filter your data so you work only with the records you need, how to edit data by reformatting and summing records, and how to produce multiple output data sets and reports. It explains how to write statements that direct DFSORT to use your own routines during processing.
- **Chapter 4, “Using a JOINKEYS Application for Joining Two Files,” on page 457** explains how you can perform various types of "join" applications on two files (F1 and F2) by one or more keys with DFSORT. It explains the JCL and control statements you can use for JOINKEYS applications.
- **Chapter 5, “Using Your Own User Exit Routines,” on page 489** describes how to use DFSORT’s program exits to call your own routines during program processing. You can write routines to delete, insert, alter, and summarize records, and you can incorporate your own error-recovery routines.
- **Chapter 6, “Invoking DFSORT from a Program,” on page 537** describes how you use a system macro instruction to initiate DFSORT processing from your own assembler program. It also lists specific restrictions on invoking DFSORT from PL/I and COBOL.
- **Chapter 7, “Using ICETOOL,” on page 555** describes how to use the multi-purpose DFSORT utility ICETOOL. It explains the JCL and operators you can use to perform a variety of tasks with ICETOOL.
- **Chapter 8, “Using Symbols for Fields and Constants,” on page 727** explains how to define symbols and use them in DFSORT control statements and ICETOOL operators.
Chapter 9, “Using Extended Function Support,” on page 763, explains how to use the Extended Function Support (EFS) interface to tailor control statements, to handle user-defined data types and collating sequences, and to have DFSORT issue customized informational messages during processing.

Chapter 10, “Improving Efficiency,” on page 797, recommends ways with which you can maximize DFSORT processing efficiency. This chapter covers a wide spectrum of improvements you can make, from designing individual applications for efficient processing at your site to using DFSORT features such as Hipersorting, dataspace sorting, and ICEGENER.

Chapter 11, “Examples of DFSORT Job Streams,” on page 817, contains annotated example job streams for sorting, merging, and copying records.

Appendix A, “Using Work Space,” on page 847, explains main storage considerations and how to estimate the amount of intermediate storage you might require when sorting data.

Appendix B, “Specification/Override of DFSORT Options,” on page 857, contains a series of tables you can use to find the order of override for similar options that are specified in different sources.


Appendix D, “EBCDIC and ASCII Collating Sequences,” on page 895, lists the collating sequences from low to high order for EBCDIC and ASCII characters.

Appendix E, “DFSORT Abend Processing,” on page 901, describes the ESTAE recovery routine for processing abends, and the Checkpoint/Restart facility.

“Notices” on page 907, includes the notices, Programming Interface information, and the trademark list.

#### Required product knowledge

To use this document effectively, you should be familiar with the following information:

- Job control language (JCL)
- Data management
- Tape and disk hardware

You should also be familiar with the information presented in the following related documents:

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<td>SC26-7525</td>
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<td>z/OS MVS JCL Reference</td>
<td>SA22-7597</td>
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<td>z/OS DFSMS Using Magnetic Tapes</td>
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<td>z/OS DFSMS Using Data Sets</td>
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<td>z/OS UNIX System Services User's Guide</td>
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The z/OS DFSORT Application Programming Guide is a part of a more extensive DFSORT library. These documents can help you work with DFSORT more effectively.

Table 3. Task publication title and order number

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<thead>
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<td>z/OS DFSORT Installation and Customization</td>
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<tr>
<td>Tuning DFSORT</td>
<td>z/OS DFSORT Tuning Guide</td>
<td>SC26-7526</td>
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Accessing z/OS DFSORT documents on the Internet

In addition to making softcopy documents available on CD-ROM, IBM provides access to unlicensed z/OS softcopy documents on the Internet. To find z/OS documents on the Internet, first go to the z/OS home page: http://www.ibm.com/servers/eserver/zseries/zos

From this Web site, you can link directly to the z/OS softcopy documents by selecting the Library icon. You can also link to the IBM Publications Center to order printed documentation.

Using LookAt to look up message explanations

LookAt is an online facility that lets you look up explanations for most of the IBM® messages you encounter, as well as for some system abends and codes. Using LookAt to find information is faster than a conventional search because in most cases LookAt goes directly to the message explanation.

You can use LookAt from these locations to find IBM message explanations for z/OS® elements and features, z/VM®, z/VSE, and Clusters for AIX® and Linux:
• The Internet. You can access IBM message explanations directly from the LookAt Web site at [www.ibm.com/servers/eserver/zseries/zos/bkserv/lookat/].

• Your z/OS TSO/E host system. You can install code on your z/OS systems to access IBM message explanations using LookAt from a TSO/E command line (for example: TSO/E prompt, ISPF, or z/OS UNIX System Services).

• Your Microsoft Windows workstation. You can install LookAt directly from the z/OS Collection (SK3T-4269) or the z/OS and Software Products DVD Collection (SK3T-4271) and use it from the resulting Windows graphical user interface (GUI). The command prompt (also known as the DOS > command line) version can still be used from the directory in which you install the Windows version of LookAt.

• Your wireless handheld device. You can use the LookAt Mobile Edition from www.ibm.com/servers/eserver/zseries/zos/bkserv/lookat/lookatm.html with a handheld device that has wireless access and an Internet browser.

You can obtain code to install LookAt on your host system or Microsoft Windows workstation from:

• A CD in the z/OS Collection (SK3T-4269).
• The z/OS and Software Products DVD Collection (SK3T-4271).
• The LookAt Web site (click Download and then select the platform, release, collection, and location that suit your needs). More information is available in the LOOKAT.ME files available during the download process.

Notational conventions

The syntax diagrams in this document are designed to make coding DFSORT program control statements simple and unambiguous. The lines and arrows represent a path or flowchart that connects operators, parameters, and delimiters in the order and syntax in which they must appear in your completed statement. Construct a statement by tracing a path through the appropriate diagram that includes all the parameters you need, and code them in the order that the diagram requires you to follow. Any path through the diagram gives you a correctly coded statement, if you observe these conventions:

• Read the syntax diagrams from left to right and from top to bottom.
• Begin coding your statement at the spot marked with the double arrowhead.

A single arrowhead at the end of a line indicates that the diagram continues on the next line or at an indicated spot.

A continuation line begins with a single arrowhead.

• Strings in upper-case letters, and punctuation (parentheses, apostrophes, and so on), must be coded exactly as shown.
Notational Conventions

- Semicolons are interchangeable with commas in program control statements and the EXEC PARM string. For clarity, only commas are shown in this document.
- Strings in all lowercase letters represent information that you supply.
- Required parameters appear on the same horizontal line (the main path) as the operator, while optional parameters appear in a branch below the main path.

Where you can make one choice between two or more parameters, the alternatives are stacked vertically.

If one choice within the stack lies on the main path (as in the example above, left), you must specify one of the alternatives. If the stack is placed below the main path (as in the example above, right), then selections are optional, and you can choose either one or none of them.

- The repeat symbol shows where you can return to an earlier position in the syntax diagram to specify a parameter more than once (see the first example below), to specify more than one choice at a time from the same stack (see the second example below), or to nest parentheses (see the third example below).

Do not interpret a repeat symbol to mean that you can specify incompatible parameters. For instance, do not specify both ABEND and NOABEND in the same EXEC statement, or attempt to nest parentheses incorrectly.

Use any punctuation or delimiters that appear within the repeat symbol to separate repeated items.

- A double arrowhead at the end of a line indicates the end of the syntax diagram.
Notational Conventions
How to send your comments to IBM

We appreciate your input on this publication. Feel free to comment on the clarity, accuracy, and completeness of the information or give us any other feedback that you might have.

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3. Mail the comments to the following address:
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   Attention: MHVRCFS Reader Comments
   Department H6MA, Building 707
   2455 South Road
   Poughkeepsie, NY 12601-5400
   U.S.A.
4. Fax the comments to us as follows:
   From the United States and Canada: 1+845+432-9405
   From all other countries: Your international access code +1+845+432-9405

Include the following information:
- Your name and address
- Your email address
- Your telephone or fax number
- The publication title and order number:
  z/OS DFSORT Application Programming Guide
  SC26-7523-05
- The topic and page number related to your comment
- The text of your comment.

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IBM or any other organizations will only use the personal information that you supply to contact you about the issues that you submit.

If you have a technical problem

Do not use the feedback methods listed above. Instead, do one of the following:
- Contact your IBM service representative
- Call IBM technical support
- Visit the IBM support portal at http://www.ibm.com/systems/z/support/
Summary of Changes

This document contains terminology, maintenance, and editorial changes. Technical changes or additions to the text and illustrations are indicated by a vertical line to the left of each change.

You might notice changes in the style and structure of some content in this document—for example, more specific headings for notes, such as Tip and Requirement. The changes are ongoing improvements to the consistency and retrievability of information in DFSORT documents.

The "Readers' Comments - We'd Like to Hear from You" section at the back of this publication has been replaced with a new section "How to send your comments to IBM" on page xix. The hardcopy mail-in form has been replaced with a page that provides information appropriate for submitting readers comments to IBM.

Summary of changes for SC26-7523-07, z/OS Version 1 Release 13 as updated April 2012

This document contains information that was previously presented in z/OS DFSORT Application Programming Guide, SC26-7523-06. This document contains terminology, maintenance, and editorial changes.

Summary of Changes for SC26-7523-06 z/OS Version 1 Release 13 (PTFs - October 2010)

This document contains information that was previously presented in z/OS DFSORT Application Programming Guide, SC26-7523-05, which supports z/OS Version 1 Release 12.

New Information

This edition includes the following new enhancements:

RESIZE
RESIZE is a new operator of ICETOOL that allows you to create a larger record from multiple shorter records, or multiple shorter records from a larger record. RESIZE makes it easy to “resize” fixed length records; you just indicate the desired length of the output records and DFSORT automatically resizes the records based on the input length.

Update the trailer record with OUTFIL
IFTRAIL is a new OUTFIL option that allows you to update count and total values in an existing trailer (last) record based on the current data records.

Various options of IFTRAIL allow you to identify the trailer record (TRLID), indicate the count and total values to be updated in the trailer record (TRLUPD), and indicate if the first record is a header record (HD=YES).

IFTRAIL makes it easy to update count and total values in an existing trailer record when you add, delete or modify data records.
DFSORT symbols can be used for fields and constants in TRLID. DFSORT symbols can be used for columns and fields in TRLUPD.

**Date Field Arithmetic**

New options for BUILD and OVERLAY allow you to perform various types of arithmetic on date fields in either Julian or Gregorian form, with 2-digit or 4-digit years, in CH, ZD and PD format.

ADDDAYS, ADDMONS and ADDYEARS can be used to add days, months or years to a date field.

SUBDAYS, SUBMONS and SUBYEARS can be used to subtract days, months or years from a date field.

DATEDIFF can be used to calculate the number of days between two date fields.

NEXTDday can be used to calculate the next specified day of the week for a date field.

PREVDday can be used to calculate the previous specified day of the week for a date field.

LASTDAYW, LASTDAYM, LASTDAYQ and LASTDAYY can be used to calculate the last day of the week, month, quarter or year for a date field.

DFSORT symbols can be used for fields and constants in date arithmetic.

**SET and PROC symbols in control statements**

SET and PROC symbols can now be included in DFSORT symbols, which in turn can be used in DFSORT and ICETOOL control statements. Up to ten special symbols (JP0-JP9), which can incorporate SET and PROC symbols, as well as other text and system symbols, can be included in the EXEC PARM string when DFSORT is called directly from JCL (PGM=SORT or PGM=ICEMAN) or ICETOOL is called directly from JCL (PGM=ICETOOL). These JPn symbols will be treated as if they were specified in the SYMNAMES data set. This makes it easy to use DFSORT symbols incorporating SET and PROC symbols in DFSORT and ICETOOL control statements.

**Accept n records with OUTFIL**

ACCEPT=n is a new OUTFIL option that allows you to limit the number of input records accepted for OUTFIL processing. A record is "accepted" if it is not deleted by STARTREC, ENDREC, SAMPLE, INCLUDE or OMIT processing. ACCEPT makes it easy to limit the number of OUTFIL input records selected for processing.

**New translation functions**

New TRAN=keyword options in BUILD and OVERLAY provide additional character translation capabilities as follows: ASCII characters to EBCDIC characters (TRAN=ATOE); EBCDIC characters to ASCII characters (TRAN=EOTO); binary values to EBCDIC hexadecimal values (TRAN=HEX); EBCDIC hexadecimal values to binary values (TRAN=UNHEX); binary values to EBCDIC bit values (TRAN=BIT) and EBCDIC bit values to binary values (TRAN=UNBIT). This makes it easy to do such translations on specific fields or entire records.

DFSORT symbols can be used for fields in translation functions.
Begin group when key changes
KEYBEGIN=(p,m) is a new option for WHEN=GROUP clauses that allows a new group to begin whenever a specified key value changes. KEYBEGIN operates in a similar way to the existing BEGIN option, but allows the change in a specified key field to be used as the trigger instead of a logical expression. KEYBEGIN makes it easy to treat records with the same key as a group and propagate fields, identifiers and sequence numbers to the records in each group.

DFSORT symbols can be used for fields in KEYBEGIN.

Larger header/trailer fields for OUTFIL
OUTFIL’s HEADERx and TRAILERx options now allow you to specify unedited fields (p,m) up to 32752 bytes (the previous limit was 256 bytes). This makes it easy to use one large header or trailer field rather than multiple header or trailer fields.

RC8 and RC12 for COUNT
ICETOOL’s COUNT operator now allows you to use a new RC8 option to set RC=8 (instead of RC=12) or RC=0 based on the count of records in a data set. RC12 can also be used to set RC=12 explicitly instead of by default. RC4, RC8 and RC12 make it easy to set the return code you need for a COUNT operation.

More fields for DISPLAY
ICETOOL’s DISPLAY operator now allows you to specify up to 50 HEADER and ON fields (the previous limit was 20). This makes it easy to produce reports that display more information.

Larger fields for ICETOOL
ICETOOL’s DISPLAY, OCCUR, SELECT, SPLICE and UNIQUE operators now allow you to specify character ON fields of up to 4000 bytes (the previous limit was 1500 bytes). ICETOOL’s DISPLAY and OCCUR operators now allow you to specify hexadecimal ON fields of up to 2000 bytes (the previous limit was 1000 bytes). This makes it easy to use one ON operand for large fields rather than multiple ON operands.

Longer reports for DISPLAY/OCCUR
ICETOOL’s DISPLAY and OCCUR operators now allow you to produce reports with a line length up to 8192 bytes (the previous limit was 2048 bytes). This makes it easy to produce reports that display more information.

Timestamp with microseconds
A new DATE5 option can be used to generate a timestamp constant of the form ‘yyyy-mm-dd-hh.mm.ss.nnnnnn’ with the year, month, day, hours, minutes, seconds and microseconds for the run. This is similar to the previously available DATE4 constant, but includes microseconds (nnnnnn).

Operational Changes that may Require User Action
The following are operational changes that may require user action for existing DFSORT/ICETOOL applications that use certain functions as specified:

New reserved words for symbols
The following are new DFSORT/ICETOOL reserved words which are no longer allowed as symbols: DATE5, ADDDAYS, SUBDAYS, ADDMONS, SUBMONS, ADDYEARS, SUBYEARS, DATEDIFF, LASTDAYW, LASTDAYM, LASTDAYQ, LASTDAYY, NEXTDday and PREVDday (where day is SUN, MON, TUE, WED, THU, FRI or SAT).
If you used any of these words as a symbol previously, you must change them. For example, if you used SUBDAYS, you can change it to Subdays.

Summary of Changes for SC26-7523-05 z/OS Version 1 Release 12

This document contains information that was previously presented in z/OS DFSORT Application Programming Guide, SC26-7523-04.

The following sections summarize the changes to that information.

New Information
This edition includes the following new enhancements:

Improvements in Performance
DFSORT can now use memory object storage as intermediate work space or as an extension of main storage. A memory object is a data area in virtual storage that is allocated above the bar and backed by central storage. Using memory object storage as intermediate work space is the preferred choice.

A new MOWRK installation and run-time option allows you to specify whether memory object storage can be used for intermediate work space or as an extension of main storage, as appropriate, or only as an extension of main storage.

The MOSIZE installation default will still limit the total amount of memory object storage that can be used by a sort application.

Improved Diagnostics
DFSORT now provides additional information in new messages ICE248I and ICE249I when message ICE083A, ICE254I or ICE258I is issued. These new messages will assist with determining why DFSORT was unable to dynamically allocate all of the requested disk work space and what corrective action may be required.

File size for Improperly Closed VSAM Data Sets
When a VSAM data set is opened for output by a program or utility, but not closed properly, the statistics associated with the data set are not updated. This may result in inaccurate file size information for the VSAM data set. When possible, DFSORT will attempt to calculate a more accurate file size for such an improperly closed VSAM fixed-length record data set.

Improved First Failure Data Capture
When an error message (ICExxxA) is issued and the message data set is available, DFSORT will display the diagnostic messages (ICE75xxI, ICE8xxI and ICE9xxI) unless MSGPRT=NONE is in effect. This can improve first failure data capture and remove the need to rerun the application to display diagnostic messages.

Dynamic Allocation Improvements
DFSORT’s dynamic allocation of work data sets has been enhanced to improve reliability in situations where the disk work space requirements are larger than expected. A new DYNAPCT installation and run-time option allows you to specify additional work data sets to be allocated with zero space. DFSORT only extends these data sets when necessary to complete a sort application. New message ICE278I is issued if these additional work data sets are used.
**Extended Address Volumes**
DFSORT supports EAS-eligible data set types on Extended Address Volumes to the extent that z/OS supports these data sets. With full track blocking, the maximum number of 1048576 tracks can be used for a single work data set allocated in the cylinder managed space on an Extended Address Volume. Without full track blocking, less than 1048576 tracks may be used.

**XTIOT, Uncaptured UCBs and DSAB Above 16 Megabytes Virtual**
A program that invokes DFSORT, ICETOOL or ICEGENER can dynamically allocate input, output and work data sets using the options for XTIOT, uncaptured UCBs, and DSAB above 16 megabyte virtual. These data sets are supported to the extent that z/OS supports them.

**Note:** A program that invokes DFSORT, ICETOOL or ICEGENER should not allocate other data sets such as message, control, list, count, or symbol data sets using the options for XTIOT, uncaptured UCBs, and DSAB above 16 megabyte virtual. These data set options are not supported and the data set will not be recognized.

**Operational Changes that may Require User Action**
The following are operational changes that may require user action for existing DFSORT/ICETOOL applications that use certain functions as specified:

**Memory Objects**
DFSORT’s new shipped installation default of MOWRK=YES allows memory object storage to be used as intermediate work space or as an extension of main storage, as appropriate. MOWRK=YES can improve performance. If you want DFSORT to only use memory object storage as an extension of main storage, as in previous releases, you can set MOWRK=NO.

The MOSIZE installation default will still limit the total amount of memory object storage that can be used by a sort application.

**Incorrect Statistics Message for VSAM Copy**
DFSORT will now issue message ICE264I instead of message ICE255I when it detects that the Catalog statistics are incorrect for a VSAM data set used as input for a Copy application. Any automated actions based on the ICE255I message should be evaluated; you may now want to base these actions on the ICE264I message for Copy applications.

**Additional Diagnostic Messages**
To improve first failure data capture, diagnostic messages ICE75xI, ICE8xxI and ICE9xxI will now be displayed for error situations (ICExxxA message issued) unless MSGPRT=NONE is in effect. Any automated actions based on the presence of diagnostic messages should be evaluated; these messages may now be present if an error message is issued.

**Dynamically Allocated Work Data Sets**
DFSORT’s new shipped installation default of DYNAPCT=10 increases the number of dynamically allocated work data sets by 10%. These additional work data sets are allocated with zero space and only extended if required to complete a sort application. The availability of these additional work data sets can improve reliability in situations where the disk work space requirements are larger than expected. The DYNAPCT=n percentage can be changed at installation or run-time, if appropriate. If you want DFSORT to behave as it did in prior releases, you can set DYNAPCT=OLD.
New Information
This edition includes the following new enhancements:

JOINKEYS Application
A new JOINKEYS application helps you to perform various "join" operations on two files by one or more keys. A JOINKEYS application makes it easy to create joined records in a variety of ways including inner join, full outer join, left outer join, right outer join, and unpaired combinations. The two input files can be of different types (fixed, variable, VSAM, and so on) and have keys in different locations.

Three new control statements can be used for a JOINKEYS application. One JOINKEYS statement is required for each input file to indicate the ddname of the file, describe the keys, indicate whether the file is already sorted by those keys, and so on. An inner join is performed by default, but a JOIN statement can be used to specify a different type of join. A REFORMAT statement is used to describe the fields from the two files to be included in the joined records, and optionally an indicator of where the key was found (‘B’ for both files, ‘1’ for file1 only or ‘2’ for file2 only).

The records from the two input files can be processed in a variety of ways before and after they are joined.

A new JKFROM operand makes it easy to use a JOINKEYS application with a COPY or SORT operator of ICETOOL.

DFSORT symbols can be used for fields and constants specified in the JOINKEYS and REFORMAT statements and in the other DFSORT statements used with a JOINKEYS application.

Date Field Conversions
Y2x, Y4x, TOJUL, TOGREG, WEEKDAY, DT and DTNS keywords for the BUILD and OVERLAY operands make it easy to convert input date fields of one type to corresponding output date fields of another type, and to convert a date field to a corresponding day of the week in several forms.

The date field can be in either Julian or Gregorian form, with 2-digit or 4-digit years, in CH, ZD and PD format. For example, C'ccyyddd', P'ymmd', Z'dddccyy', C'ccyymmdd', P'dddyy', and so on.

CH output date fields can also be displayed with separators. For example, C'ccyy/ddd', C'mm-dd-ccyy', and so on.

The day of the week can be displayed as a 1 digit, 3 character or 9 character constant. For example, C'4', C'WED' or CWEDNESDAY' for Wednesday.

DFSORT symbols can be used for fields in date conversions.
**MERGE Operator**
MERGE is a new operator of ICETOOL that allows you to merge up to 50 input files that are already in order by the same keys. MERGE makes it easy to include DFSORT MERGE operations in your ICETOOL jobs.

Various options of MERGE allow you to define the ddnames for the input data sets (FROM), the ddnames for the output data sets (TO), the MERGE and other DFSORT control statements to be used for the MERGE operation (USING), and so on.

DFSORT symbols can be used in the DFSORT statements used with a MERGE operator.

**MERGEIN Alternate ddnames**
A new MERGEIN operand can be specified on an OPTION statement in DFSPARM or an extended parameter list to supply alternate ddnames for input data sets used for a MERGE application. MERGEIN makes it easy to use any ddnames you like instead of SORTINnn ddnames. You can specify up to 100 ddnames to be merged with MERGEIN.

**New 24-Bit Parameter List Codes**
DFSORT now accepts and processes the following as 24-Bit parameter list control statement entry codes: X'0E', X'0F' and X'11'.

**Operational Changes that may Require User Action**
The following are operational changes that may require user action for existing DFSORT/ICETOOL applications that use certain functions as specified:

**New Reserved Word for Symbols**
Y4x, where Y is uppercase and x is any character, is a new DFSORT/ICETOOL reserved word which is no longer allowed as a symbol. If you used Y4x as a symbol, you must change it. For example, if you used Y4T, you can change it to y4t.

**MERGE ddname in Message ICE217A**
When message ICE217A is issued for a MERGE application, DFSORT will now display the actual ddname for the MERGE input data set rather than 'SORTINNN'.

Any automated actions based on the ICE217A message should be evaluated since the ddname will change for a MERGE application.

**Summary of Changes for SC26-7523-04 z/OS Version 1 Release 11 (PTFs - July, 2008)**
This document contains information that was previously presented in z/OS DFSORT Application Programming Guide, SC26-7523-03.

The following sections summarize the changes to that information.

**New Information**
This edition includes the following new enhancements:

**Find and Replace**
FINDREP is a new option that allows you to do various types of find and replace operations on your records. FINDREP makes it easy to replace character or
hexadecimal input constants anywhere in your records with character, hexadecimal or null output constants. For input and output constants of different lengths, bytes after the replaced constants will be shifted left or right, as appropriate. For fixed-length records, blanks will be filled in on the right as needed. For variable-length records, the record length will be changed as needed.

FINDREP can be used in an INREC, OUTREC or OUTFIL statement, or in an IFTHEN clause, in the same way BUILD and OVERLAY can be used.

Various options of FINDREP allow you to define one or more input constants and a corresponding output constant (IN, OUT), define one or more pairs of input and output constants (INOUT), start and end the find scan at specified positions (STARTPOS, ENDPOS), stop after a specified number of constants are replaced (DO), increase or decrease the length of the output record (MAXLEN), define the action to be taken if nonblank characters overrun the end of the record (OVERRUN), and specify whether output constants are to replace or overlay input constants (SHIFT).

DFSORT symbols can be used for constants specified with FINDREP.

Group Operations
WHEN=GROUP is a new type of IFTHEN clause that allows you to do various types of operations involving groups of records. WHEN=GROUP makes it easy to propagate fields from the first record of a group to the other records of the group, add an identifier to each record of the group, or add a sequence number to each record of the group. These functions are useful by themselves, and can also facilitate other types of group operations such as sorting groups, including or omitting groups, and so on.

WHEN=GROUP can be used in IFTHEN clauses in an INREC, OUTREC or OUTFIL statement in the same way WHEN=INIT can be used.

Various options of WHEN=GROUP allow you to use logical expressions to define the beginning and end of a group (BEGIN, END), define the number of records in a group (RECORDS), and define the fields, identifiers and sequence numbers to be added to the records of each group (PUSH).

DFSORT symbols can be used for columns, fields and constants specified with WHEN=GROUP clauses.

DATASORT
DATASORT is a new operator of ICETOOL that allows you to sort data records between header (first) records and trailer (last) records. DATASORT makes it easy to sort the data records while keeping one or more header records and/or one or more trailer records in place. DATASORT does not require an ‘identifier’ in the header or trailer records; it can treat the first n records as header records and the last n records as trailer records.

Various options of DATASORT allow you to define the number of header records and/or trailer records (HEADER or FIRST, TRAILER or LAST), the ddname for the input data set (FROM), the ddname for the output data set (TO), and the SORT and other DFSORT control statements to be used for the DATASORT operation (USING).

DFSORT symbols can be used for the number of header and trailer records specified with DATASORT.
**SUBSET**

SUBSET is a new operator of ICETOOL that allows you to create a subset of the input or output records by specifying that you want to keep or remove header (first) records, trailer (last) records, or records with specific relative record numbers. SUBSET makes it easy to keep or remove records based on these criteria. SUBSET does not require an “identifier” or “sequence number” in the records to be kept or removed.

Various options of SUBSET allow you to define the criteria (HEADER or FIRST, TRAILER or LAST, RRN), the ddname for the input data set (FROM), the ddname for the output data set to contain the records that meet the criteria and/or don’t meet the criteria (TO, DISCARD), whether the records that meet the criteria are to be kept or removed (KEEP, REMOVE), whether the criteria are to be applied to the input or output records (INPUT, OUTPUT), and DFSORT control statements to be used for the SUBSET operation (USING).

DFSORT symbols can be used for the number of header and trailer records and for the relative record numbers specified with SUBSET.

**SELECT First n Duplicates**

ICETOOL’s SELECT operator now allows you to select the first n records with each key or the first n duplicate records with each key. New FIRST(n) and FIRSTDUP(n) options make it easy to select records representing "top" and "bottom" categories (for example, the top 5 students in each class).

DFSORT symbols can be used for n with FIRST(n) or FIRSTDUP(n).

**SPLICE with Non-Blank Fields**

ICETOOL’s SPLICE operator now allows you to create a single record for each key by splicing the base record with every specified nonblank field from each overlay record. A new WITHANY option makes it easy to collect information from multiple records with the same key. You can now do a splice involving duplicate records with nonconsecutive or missing WITH fields, something that could not be accomplished previously with the existing WITHEACH option.

**DISPLAY with Count**

ICETOOL’s DISPLAY operator now allows you to display counts in reports. New COUNT('string'), EDCOUNT(formatting), BCOUNT('string') and EDBCOUNT(formatting) options make it easy to print overall record count and break record count statistics in various forms in a report, similar to the existing statistics for a report (overall total, maximum, minimum and average and break total, maximum, minimum and average).

DFSORT symbols can be used for ‘string’ with COUNT('string') and BCOUNT('string').

**DISPLAY and OCCUR with Multiple and Multipart Titles**

ICETOOL’s DISPLAY and OCCUR operators now allow you to display up to three title lines, each composed of up to three strings. The enhanced TITLE('string1','string2','string3') option makes it easy to use multiple strings for each title, including a combination of inline constants, and constants from DFSORT symbols including system information. The use of up to three TITLE options makes it easy to display multiline titles.
A new TLEFT option allows you to left justify the title lines instead of centering them. A new TFIRST option allows you to only display the title lines on the first page of the report instead of on every page of the report.

DFSORT symbols can be used for 'string1', 'string2' and 'string3' with TITLE('string1','string2','string3').

**DISPLAY and OCCUR without Carriage Control**
ICETOOL's DISPLAY and OCCUR operators now allow you to create reports without carriage control characters and with RECFM=FB instead of RECFM=FBA. A new NOCC option makes it easy to suppress the carriage control character. With NOCC, a blank line is used instead of a page eject control character to separate elements of the report.

**COUNT in Output Record**
ICETOOL's COUNT operator now allows you to create a count data set with an output record containing the record count. New WRITE(countdd), TEXT('string'), DIGITS(n) and EDCOUNT(formatting) options make it easy to create an output data set with a record containing text and the record count in various forms.

DFSORT symbols can be used for 'string' with TEXT('string').

**COUNT with Add and Subtract**
ICETOOL's COUNT operator now allows you to add a value to, or subtract a value from, the record count. New ADD(n) and SUB(n) options make it easy to increase or decrease, respectively, the actual record count to get a resulting modified record count. This is especially useful for dealing with data sets that contain header and/or trailer records.

The resulting modified record count is displayed in the count message in TOOLMSG and in the count data set, and used to determine if the criteria specified by the existing EMPTY, NOTEMPTY, HIGHER(x), LOWER(y), EQUAL(v) or NOTEQUAL(w) option is satisfied.

DFSORT symbols can be used for n with ADD(n) and SUB(n).

**BLKSIZE Default for Input DUMMY**
DFSORT will no longer terminate for a SORTIN DD DUMMY or SORTINnn DD DUMMY statement with RECFM and LRECL, but no BLKSIZE. Instead, DFSORT will use an an appropriate BLKSIZE to process the DUMMY data set successfully.

**Note:** If DFSORT's Blockset technique is not selected, DFSORT may still terminate for a SORTIN DD DUMMY or SORTINnn DD DUMMY statement with RECFM and LRECL, but no BLKSIZE.

**SKIP=0L Default for SECTIONS**
DFSORT will no longer terminate when an OUTFIL SECTIONS field is not followed by a keyword (SKIP, HEADER3, TRAILER3). Instead, DFSORT will use a default keyword of SKIP=0L to process the sections successfully with no blank lines between sections on the same page.

DFSORT symbols can be used for section fields.

**SORTOUT=ddname Default for FNAMES**
DFSORT will now use the ddname specified by a SORTOUT=ddname option in DFSPARM, the ddname specified by a SORTOUT=ddname option in a parameter
list, or the ddname specified in a TO(ddname) option of an ICETOOL operator, as the default ddname for an OUTFIL statement without a FNAMES or FILES option.

**Operational Changes that may Require User Action**

The following are operational changes that may require user action for existing DFSORT/ICETOOL applications that use certain functions as specified:

- Prior to this PTF, an ICETOOL job with an operator (for example, SELECT) that uses TO(ddname) and USING(xxxx) with //ddname and //xxxxOUT DD statements and an OUTFIL statement without FNAMES or FILES, would treat the ddname data set as a SORTOUT data set and the xxxxOUT data set as the OUTFIL data set.

  With this PTF, the same job will treat the ddname data set as the OUTFIL data set and ignore the xxxxOUT data set. If you want to treat the xxxxOUT data set as the OUTFIL data set, change your ICETOOL operator to use TO(xxxxOUT).

- Prior to this PTF, an OUTFIL statement with FTOV and IFOUTLEN=n would set the LRECL of the OUTFIL data set and the length of each OUTFIL record to n.

  With this PTF, the same situation will result in setting the LRECL of the OUTFIL data set and the length of each record to n+4. If you want to set the LRECL of the OUTFIL data set and the length of each OUTFIL record to n, change IFOUTLEN to specify n-4.

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**Summary of Changes for SC26-7523-03 z/OS Version 1 Release 10**

This document contains information that was previously presented in *DFSORT Application Programming Guide*, SC26-7523-02.

The following sections summarize the changes to that information.

**New Information**

This edition includes the following new enhancements:

**Installation Options**

ICEPRMxx members in concatenated PARMLIB can now be used to specify changes to DFSORT’s installation options. Each ICEPRMxx member can contain options to be changed for any or all of DFSORT’s eight installation environments (JCL, INV, TSO, TSOINV and TD1-TD4). Up to ten ICEPRMxx members can be activated by a START ICEOPT started task command. The options in the activated members will be merged with the ICEMAC defaults at run-time.

A different ICEPRMxx member, or combination of ICEPRMxx members, for different LPARs can be activated at IPL time by including a START ICEOPT command in an appropriate COMMNDxx member in PARMLIB, or at any time by issuing a START ICEOPT command from the console.

ICEPRMxx members are now the recommended way to change DFSORT installation defaults since they are easier to use and more flexible than the old method using the ICEMAC macro and usermods. However, the old method is still supported.

The ICETOOL DEFAULTS operator can be used at any time to produce a report showing the merged PARMLIB/ICEMAC installation default values for each environment that will be used at run-time, as well as the active ICEPRMxx and ICEMAC values.
VSAM Extended Address Volume
DFSORT now supports VSAM input and output data sets on Extended Address Volumes to the extent that z/OS supports these data sets.

Improvements in Performance and Resource Usage and Reporting
Memory object sorting can now be used for DFSORT applications that use the INREC, OUTREC or SUM functions.

The channel programs associated with DFSORT’s input, output and work data sets can now reside above 16 megabytes virtual.

Total storage usage for dataspace sorting can now be controlled with the EXPMAX, EXPRES and EXPOLD installation options.

DFSORT now provides new fields ICEMNVLX, ICEMNVLY and ICEMNVLZ in its SMF type 16 record to aid in tuning main storage usage.

The information DFSORT passes to the termination exit (ICETEXIT) now includes setting ICEPTST flag bit 6 on if the phase TCB timings are not valid.

Syntax for Run-Time Parameters
DFSORT now allows additional syntactical forms for all of its PARM and control statement run-time parameters. Any parameter of the form keyword=value can now also be specified as keyword(value) or keyword=(value). Any parameter of the form keyword=(list) can now also be specified as keyword(list).

Improved Diagnostics
DFSORT now provides additional information in messages ICE098I, ICE253I and ICE254I to aid in diagnosing and correcting out-of-space conditions associated with message ICE046A.

DFSORT now provides specific reason codes and associated documentation to aid in diagnosing and correcting errors associated with the following messages: ICE017A, ICE018A, ICE024A, ICE042A, ICE043A, ICE109A, ICE126A and ICE251A.

Operational Changes that may Require User Action
The following are operational changes that may require user action for existing DFSORT/ICETOOL applications that use certain functions as specified:

DFSORT ISPF and ISMF Panels Removed
The English and Japanese ISPF panels, and the ISMF Sort operator, have been removed. These facilities are no longer available.

Installation Options
ICEPRMxx members are now the recommended way to change DFSORT installation defaults since they are easier to use and more flexible than the old method using the ICEMAC macro and usermods. However, the old method is still supported.

Dataspce Sorting
The existing EXPMAX, EXPOLD and EXPRES installation options now apply to dataspace sorting as well as to memory object sorting and Hipersorting.
IOMAXBF Default Changed
The IBM-supplied default for the existing IOMAXBF installation option has been changed from 33554432 (32 MB) to 35651584 (34 MB).

STIMER Option Ignored
The STIMER installation option, and the STIMER and NOSTIMER run-time options, are now ignored. These options are no longer meaningful since DFSORT now uses the TIMEUSED service rather than the STIMER service to monitor processor time.

ICEDTEX Macro
Previously, fields ICEDSBKA, ICEDSBKB and ICEDSBKC in the ICEDTEX macro provided statistics on expanded storage pages available for dataspace sorting, while fields ICEDSBTA, ICEDSBTB and ICEDSBTC provided total expanded and central storage pages available for dataspace sorting. Since this level of DFSORT and z/OS no longer supports expanded storage, fields ICEDSBKA, ICEDSBKB and ICEDSBKC are no longer relevant and have been removed. If you have an ICETEXIT program that uses fields ICEDSBKA, ICEDSBKB and ICEDSBKC, you should remove any references to those fields (you can change your program to use fields ICEDSBTA, ICEDSBTB and ICEDSBTC instead) and recompile your program before using it with this level of DFSORT.

Output Data Set Allocation
Previously, if an allocation of 0 primary tracks was specified for a SORTOUT or OUTFIL output data set, at least 1 primary track was allocated. In this release, if an allocation of 0 primary tracks is specified for a SORTOUT or OUTFIL data set, 0 primary tracks will be allocated provided that:

- The application is a SORT
- An E35 exit is not specified
- No records are to be written to the output data set.

For this situation, if the output data set was allocated with 0 secondary tracks, it will not have any space available. Thus, any subsequent attempt to add records to that data set will fail with an out of space condition unless you explicitly specify a space allocation for that data set.

Summary of Changes for SC26-7523-02 z/OS Version 1 Release 8 (PTFs - April, 2006)
This document contains information that was previously presented in z/OS DFSORT Application Programming Guide, SC26-7523-01.

The following sections summarize the changes to that information.

New Information
This edition includes the following new enhancements:

INCLUDE and OMIT Enhancements
COND now allows you to compare date fields in various formats to past and future dates (relative to the date of your DFSORT run) using new DATEn+r, DATEn-r, DATEn(c)+r, DATEn(c)-r, DATEnP+r, DATEnP-r, Y’DATEn’+r and Y’DATEn’-r constants. &DATEn+r, &DATEn-r, &DATEn(c)+r, &DATEn(c)-r, &DATEnP+r and &DATEnP-r can be used as aliases for DATEn+r, DATEn-r, DATEn(c)+r, DATEn(c)-r, DATEnP+r and DATEnP-r, respectively.
COND now allows you to test a field for numerics (field, EQ, NUM) or non-numerics (field, NE, NUM) in character (FS), zoned decimal (ZD) or packed decimal (PD) format.

COND now allows you to use &DATEn, &DATEn(c) and &DATEnP as aliases for DATEn, DATEn(c) and DATEnP, respectively.

**INREC and OUTREC Enhancements**

PARSE and IFTHEN PARSE are new options that allow you to extract variable position/length fields into fixed-length parsed fields defined as %nn fields. PARSE gives you powerful new capabilities for handling variable fields such as delimited fields, comma separated values (CSV), tab separated values, blank separated values, keyword separated fields, null-terminated strings, and many other types.

You can use various PARSE options to define the rules for extracting variable fields into up to one hundred %nn fixed-length parsed fields (%00-%99), and then use these %nn fields where you can use p,m fields in BUILD, OVERLAY, IFTHEN BUILD, IFTHEN OVERLAY and FIELDS. You can edit, convert, justify, squeeze, translate, and do arithmetic with %nn fields.

BUILD, OVERLAY, IFTHEN BUILD, IFTHEN OVERLAY and FIELDS now allow you to use a new JFY option to left-justify or right-justify the data in a field. For a left-justified field, leading blanks are removed and the characters from the first nonblank to the last nonblank are shifted left, with blanks inserted on the right if needed. For a right-justified field, top trailing blanks are removed and the characters from the last nonblank to the first nonblank are shifted right, with blanks inserted on the left if needed.

Optionally for JFY, specific leading and trailing characters can be changed to blanks before justification begins, a leading string can be inserted, a trailing string can be inserted, and the output length can be changed.

BUILD, OVERLAY, IFTHEN BUILD, IFTHEN OVERLAY and FIELDS now allow you to use a new SQZ option to left-squeeze or right-squeeze the data in a field. For a left-squeezed field, all blanks are removed and the characters from the first nonblank to the last nonblank are shifted left, with blanks inserted on the right if needed. For a right-squeezed field, all blanks are removed and the characters from the last nonblank to the first nonblank are shifted right, with blanks inserted on the left if needed.

Optionally for SQZ, specific characters can be changed to blanks before squeezing begins, a leading string can be inserted, a trailing string can be inserted, a string can be inserted wherever a group of blanks is removed between the first nonblank and the last nonblank, blanks can be kept as is between paired apostrophes or paired quotes, and the output length can be changed.

BUILD, OVERLAY, IFTHEN BUILD, IFTHEN OVERLAY and FIELDS now allow you to insert past and future dates (relative to the date of your DFSORT run) into your records in various forms using new DATEn+r, DATEn-r, DATEn(c)+r, DATEn(c)-r, DATEnP+r and DATEnP-r constants. &DATEn+r, &DATEn-r, &DATEn(c)+r, &DATEn(c)-r, &DATEnP+r and &DATEnP-r can be used as aliases for DATEn+r, DATEn-r, DATEn(c)+r, DATEn(c)-r, DATEnP+r and DATEnP-r, respectively.
BUILD, OVERLAY, IFTHEN BUILD, IFTHEN OVERLAY and FIELDS now allow you to use FL format to convert 4-byte or 8-byte hexadecimal floating-point values to integer values.

BUILD, OVERLAY, IFTHEN BUILD, IFTHEN OVERLAY and FIELDS now allow you to use new TO=PDF and TO=PDC options to convert numeric values to PD values with F or C for the positive sign, respectively. The TO=PDC option is equivalent to the existing TO=PD option.

BUILD, OVERLAY, IFTHEN BUILD, IFTHEN OVERLAY and FIELDS now allow you to use &DATEn, &DATEn(c), &DATEnP, &YDDD=(abc), &YDDDNS=(ab), &TIMEn, &TIMEn(c) and &TIMEnP as aliases for DATEn, DATEn(c), DATEnP, YDDD=(abc), YDDDNS=(ab), TIMEn, TIMEn(c) and TIMEnP, respectively.

IFTHEN WHEN now allows you to compare date fields in various formats to past and future dates (relative to the date of your DFSORT run) using new DATEn+r, DATEn-r, DATEn(c)+r, DATEn(c)-r, DATEnP+r, DATEnP-r, Y’DATEn’+r, and Y’DATEn’-r constants. &DATEn+r, &DATEn-r, &DATEn(c)+r, &DATEn(c)-r, &DATEnP+r and &DATEnP-r can be used as aliases for DATEn+r, DATEn-r, DATEn(c)+r, DATEn(c)-r, DATEnP+r and DATEnP-r, respectively.

IFTHEN WHEN now allows you to test a field for numerics (field,EQ,NUM) or non-numerics (field,NE,NUM) in character (FS), zoned decimal (ZD) or packed decimal (PD) format.

IFTHEN WHEN now allows you to use &DATEn, &DATEn(c) and &DATEnP as aliases for DATEn, DATEn(c) and DATEnP, respectively.

**OUTFIL Enhancements**

BLKCCH1 is a new report option that allows you to avoid forcing a page eject at the start of the report header; the ANSI carriage control character of '1' (page eject) in the first line of the report header (HEADER1) is replaced with a blank.

BLKCCH2 is a new report option that allows you to avoid forcing a page eject at the start of the first page header; the ANSI carriage control character of '1' (page eject) in the first line of the first page header (HEADER2) is replaced with a blank.

BLKCCT1 is a new report option that allows you to avoid forcing a page eject at the start of the report trailer; the ANSI carriage control character of '1' (page eject) in the first line of the report trailer (TRAILER1) is replaced with a blank.

SPLIT1R is a new option that allows you to write contiguous groups of records in one rotation among multiple output data sets. A specified number of records is written to each output data set and extra records are written to the last output data set.

PARSE and IFTHEN PARSE are new options that allow you to extract variable position/length fields into fixed-length parsed fields defined as %nn fields. PARSE gives you powerful new capabilities for handling variable fields such as delimited fields, comma separated values (CSV), tab separated values, blank separated values, keyword separated fields, null-terminated strings, and many other types.

You can use various PARSE options to define the rules for extracting variable fields into up to one hundred %nn fixed-length parsed fields (%00-%99), and then use these %nn fields where you can use p,m fields in BUILD, OVERLAY, IFTHEN.
BUILD, IFTHEN OVERLAY and OUTREC. You can edit, convert, justify, squeeze, translate, and do arithmetic with %nn fields.

BUILD, OVERLAY, IFTHEN BUILD, IFTHEN OVERLAY and OUTREC now allow you to use a new JFY option to left-justify or right-justify the data in a field. For a left-justified field, leading blanks are removed and the characters from the first nonblank to the last nonblank are shifted left, with blanks inserted on the right if needed. For a right-justified field, trailing blanks are removed and the characters from the last nonblank to the first nonblank are shifted right, with blanks inserted on the left if needed.

Optionally for JFY, specific leading and trailing characters can be changed to blanks before justification begins, a leading string can be inserted, a trailing string can be inserted, and the output length can be changed.

BUILD, OVERLAY, IFTHEN BUILD, IFTHEN OVERLAY and OUTREC now allow you to use a new SQZ option to left-squeeze or right-squeeze the data in a field. For a left-squeezed field, all blanks are removed and the characters from the first nonblank to the last nonblank are shifted left, with blanks inserted on the right if needed. For a right-squeezed field, all blanks are removed and the characters from the last nonblank to the first nonblank are shifted right, with blanks inserted on the left if needed.

Optionally for SQZ, specific characters can be changed to blanks before squeezing begins, a leading string can be inserted, a trailing string can be inserted, a string can be inserted wherever a group of blanks is removed between the first nonblank and the last nonblank, blanks can be kept as is between paired apostrophes or paired quotes, and the output length can be changed.

BUILD, OVERLAY, IFTHEN BUILD, IFTHEN OVERLAY and OUTREC now allow you to insert past and future dates (relative to the date of your DFSORT run) into your records in various forms using new DATEn+r, DATEn-r, DATEn(c)+r, DATEn(c)-r, DATEnP+r and DATEnP-r constants. &DATEn+r, &DATEn-r, &DATEn(c)+r, &DATEn(c)-r, &DATEnP+r and &DATEnP-r can be used as aliases for DATEn+r, DATEn-r, DATEn(c)+r, DATEn(c)-r, DATEnP+r and DATEnP-r, respectively.

TRAILERx, BUILD, OVERLAY, IFTHEN BUILD, IFTHEN OVERLAY and OUTREC now allow you to use FL format to convert 4-byte or 8-byte hexadecimal floating-point values to integer values.

TRAILERx, HEADERx, BUILD, OVERLAY, IFTHEN BUILD, IFTHEN OVERLAY and OUTREC now allow you to use new TO=PDF and TO=PDC options to convert numeric values to PD values with F or C for the positive sign, respectively. The TO=PDC option is equivalent to the existing TO=PD option.

BUILD, OVERLAY, IFTHEN BUILD, IFTHEN OVERLAY and OUTREC now allow you to use &DATEn, &DATEn(c), &DATEnP, &YDDD=(abc), &YDDDNS=(ab), &TIMEn, &TIMEn(c) and &TIMEnP as aliases for DATEn, DATEn(c), DATEnP, YDDD=(abc), YDDDNS=(ab), TIMEn, TIMEn(c) and TIMEnP, respectively.

INCLUDE, OMIT and IFTHEN WHEN now allow you to compare date fields in various formats to past and future dates (relative to the date of your DFSORT run) using new DATEn+r, DATEn-r, DATEn(c)+r, DATEn(c)-r, DATEnP+r, DATEnP-r, Y'DATEn'+r, and Y'DATEn'-r constants. &DATEn+r, &DATEn-r, &DATEn(c)+r,
&DATEn(c)-r, &DATEnP+r and &DATEnP-r can be used as aliases for DATEn+r, DATEn-r, DATEn(c)+r, DATEn(c)-r, DATEnP+r and DATEnP-r, respectively.

INCLUDE, OMIT and IFTHEN WHEN now allow you to test a field for numerics (field,EQ,NUM) or non-numerics (field,NE,NUM) in character (FS), zoned decimal (ZD) or packed decimal (PD) format.

INCLUDE, OMIT and IFTHEN WHEN now allow you to use &DATEn, &DATEn(c) and &DATEnP as aliases for DATEn, DATEn(c) and DATEnP, respectively.

**Symbol Enhancements**
A symbol can now be used for a %nn parsed field. For example, if Account,%01 is defined in SYMNAMES, Account can be used for %01. A symbol for %nn can be used in DFSORT control statements where %nn can be used. A symbol for %nn results in substitution of %nn.

A symbol can now be used for an output column. For example, if Start_address,18 is defined in SYMNAMES, Start_address: can be used for 18:. symbol: can be used in DFSORT control statements where c: can be used. A symbol for p or p,m or p,m,f results in substitution of p: for symbol: (output column).

A symbol can now be used for a new system symbol string constant. symbol,S'string' can be used to define a string containing any combination of EBCDIC characters and system symbols you want to use to form a character string. For example, if whererun,S'&JOBNAME. on &SYSPLEX' is defined in SYMNAMES, wherun can be used for the resulting constant. You can use dynamic system symbols such as &JOBNAME, &DAY, and so on, system-defined static system symbols such as &SYSNAME, &SYSPLEX, and so on, and installation-defined static system symbols specified by your installation in an IEASYMxx member of SYS1.PARMLIB.

A symbol for a system symbol string can be used in DFSORT and ICETOOL control statements where a symbol for a character string can be used. DFSORT will replace each system symbol in S'string' with its substitution text to create a character string in the format C'new_string'.

**ICETOOL Enhancements**
DISPLAY now allows you to use FL format to convert 4-byte or 8-byte hexadecimal floating-point values to integer values.

DISPLAY and OCCUR now allow you to use a new TBETWEEN(n) option to specify the number of blanks between title elements (title, page number, date, time).

SELECT and SPLICE now allow you to use an INREC statement to reformat your records before they are selected or spliced. All of the operands of the INREC statement (PARSE, BUILD, OVERLAY, IFTHEN, IFOUTLEN and FIELDS) are now available with SELECT and SPLICE.

**SORT and MERGE Enhancements**
The maximum length for a PD or ZD sort or merge field has been raised to 256.

**SUM Enhancements**
The maximum position for the end of a sum field has been raised to 32752.
Other Enhancements
DFSORT supports large physical sequential data sets for input, output and work data sets.

DSA can now be specified as a run-time option. This allows you to adjust the maximum amount of storage available to DFSORT for dynamic storage adjustment of individual Blockset sort applications when SIZE/MAINSIZE=MAX is in effect.

DFSORT now accepts and ignores zero values in the starting and ending address of the RECORD statement image in the 24-bit Parameter List. You can set these addresses to zero if you don’t want to pass a control statement to DFSORT using the third and fourth words of the parameter list.

Operational Changes that may Require User Action
The following are operational changes that may require user action for existing DFSORT/ICETOOL applications that use certain functions as specified:

New reserved words for symbols
The following are new DFSORT/ICETOOL reserved words (uppercase only, as shown), which are no longer allowed as symbols: DATE1..., DATE2..., DATE3..., PDC and PDF.

If you used these words as symbols, you must change them to other words, such as lowercase or mixed case forms (for example, Date1p, date3(/) or pdc).

FL Conversion
DFSORT’s INREC, OUTREC and OUTFIL statements, and ICETOOL’s DISPLAY operator, can now convert FL (hexadecimal floating-point) values to integer values, providing you are running in z/Architecture mode. If you use FL in INREC, OUTREC, OUTFIL or DISPLAY when running in ESA/390 mode, FL will be recognized and the error messages issued may be different than those issued previously when FL was not allowed in INREC, OUTREC, OUTFIL or DISPLAY.

If you want to use FL in INREC, OUTREC, OUTFIL or DISPLAY, you must be running in z/Architecture mode.

OUTREC Statement with SELECT or SPLICE
DFSORT will now issue error message ICE652A and terminate if an OUTREC statement is used with ICETOOL’s SELECT or SPLICE operator. This will make it easier to identify this error condition.

Note: If ABEND is in effect, DFSORT will ABEND with U0652, but will not issue ICE652A

If you want to reformat your records after SELECT or SPLICE processing, use an OUTFIL statement rather than an OUTREC statement.

Summary of Changes for SC26-7523-01 z/OS Version 1 Release 6 (PTFs - December, 2004)
This document contains information that was previously presented in z/OS DFSORT Application Programming Guide, SC26-7523-00.

The following sections summarize the changes to that information.
New Information

This edition includes the following new enhancements:

**ICETOOL Enhancements**
ICETOOL’s DISPLAY, OCCUR, RANGE, SELECT, SPLICE, STATS, UNIQUE and VERIFY operators now allow you to use larger numeric values for ON and BREAK fields. PD, ZD and FS fields can now be up to 31 digits (or more in some cases). BI and FI fields can now be up to 8 bytes (or more in some cases).

ICETOOL’s RANGE operator now allows you to use larger decimal values for the HIGHER(n), LOWER(n), EQUAL(n) and NOTEQUAL(n) options. These values can now be up to 31 digits.

ICETOOL’s DISPLAY, OCCUR, RANGE, SELECT, SPLICE, STATS and UNIQUE operators now allow you to use new UFF (unsigned free form) and SFF (signed free form) formats for ON and BREAK fields. UFF extracts a positive numeric value from a free form field (for example, ‘$1234.56’ is treated as +123456). SFF extracts a positive or negative value from a free form field (for example, ‘(1,234.56)’ is treated as -123456).

ICETOOL’s DISPLAY and OCCUR operators now allow you to use new DC1-DC3 (TOD date), DE1-DE3 (ETOD date), TC1-TC4 (TOD time) and TE1-TE4 (ETOD time) formats for ON and BREAK fields. These new formats produce meaningful representations of TOD and ETOD date and time values.

ICETOOL’s DISPLAY and OCCUR operators now allow you to specify multiline headings for the columns of your reports. You can specify one, two or three line headings with the HEADER option.

ICETOOL’s DISPLAY and OCCUR operators now allow you to use new edit masks G1-G6 to display numeric values with 4 decimal digits in various ways.

ICETOOL’s DISPLAY and OCCUR operators now allow you to use new YDDD(abc) and YDDDNS(abc) options to insert the year (yyyy) and day of the year (ddd) of your ICETOOL run into your titles in various forms.

ICETOOL’s COUNT operator now allows you to use a new RC4 option to set RC=4 (instead of RC=12) or RC=0 based on the count of records in a data set.

ICETOOL’s SPLICE operator now allows you to use a new KEEPBASE option to keep the base records as well as the spliced records.

ICETOOL’s SPLICE operator now allows you to use new VLENMAX or VLENOVLY options to set the length of spliced records to the maximum of the base or overlay record length, or to the overlay record length.

**OUTFIL Enhancements**
OUTFIL now allows you to reformat records in one of the following three ways using unedited, edited, or converted input fields and a variety of constants:

- **BUILD or OUTREC**: The existing OUTREC parameter, or its new alias of BUILD, allows you to reformat each record by specifying all of its items one by one. BUILD or OUTREC gives you complete control over the items you want in your reformatted OUTFIL records and the order in which they appear. You can delete, rearrange and insert fields and constants.
OVERLAY: The new OVERLAY parameter allows you to reformat each record by specifying just the items that overlay specific columns. Overlay lets you change specific existing columns without affecting the entire record.

IFTHEN clauses: The new IFTHEN clauses allow you to reformat different records in different ways by specifying how BUILD or OVERLAY items are applied to records that meet given criteria. IFTHEN clauses let you use sophisticated conditional logic to choose how different record types are reformatted.

OUTFIL OUTREC, as well as BUILD, OVERLAY, and IFTHEN, now allows you to use larger numeric values for fields and decimal constants to be edited, converted or used in arithmetic expressions. PD, ZD and FS fields, and decimal constants, can now be up to 31 digits. BI and FI fields can now be up to 8 bytes.

OUTFIL OUTREC, as well as BUILD, OVERLAY, and IFTHEN, now allows you to use new UFF (unsigned free form) and SFF (signed free form) formats for fields to be edited, converted or used in arithmetic expressions.

OUTFIL OUTREC, as well as BUILD, OVERLAY, and IFTHEN, now allows you to use new DC1-DC3 (TOD date), DE1-DE3 (ETOD date), TC1-TC4 (TOD time) and TE1-TE4 (ETOD time) formats for fields to be edited, converted or used in arithmetic expressions. These new formats produce meaningful representations of TOD and ETOD date and time values.

OUTFIL OUTREC, as well as BUILD, OVERLAY and IFTHEN, now allows you to use a set field in the CHANGE option (for example, 1,2,CHANGE=(4,C'FY',C'0001',C'VV',21,4)).

OUTFIL OUTREC, as well as BUILD, OVERLAY and IFTHEN, now allows you to restart the sequence number when the binary value of a specified field changes (for example, SEQNUM,5,ZD,RESTART=(11,4)).

OUTFIL OUTREC, as well as BUILD, OVERLAY and IFTHEN, now allows you to use DATE, DATE=(abcd), DATENS=(abc), YDDD=(abc), YDDDNS=(ab), TIME, TIME=(abc) and TIMENS=(ab) options to insert the date and time of your DFSORT run into your records in various forms.

OUTFIL OUTREC, as well as BUILD, OVERLAY and IFTHEN, now allows you to use new TO=ZDC and TO=ZDF options to convert numeric values to ZD values with C or F for the positive sign, respectively. The TO=ZDF option is equivalent to the existing TO=ZD option.

OUTFIL INCLUDE and OMIT now allow you to use larger FS values for compare fields. These values can now be up to 32 digits.

OUTFIL INCLUDE and OMIT now allow you to use larger decimal constants for comparison to BI and FI fields. Decimal constants can now be up to +18446744073709551615 for comparison to BI fields. Decimal constants can now be between -9223372036854775808 and +9223372036854775807 for comparison to FI fields.

OUTFIL INCLUDE and OMIT now allow you to use new UFF (unsigned free form) and SFF (signed free form) formats for compare fields. A UFF or SFF field can be compared to a UFF, SFF, FS, CSL or CST field or to a decimal constant.
OUTFIL TRAILERx now allows you to use larger numeric values for statistical fields (total, maximum, minimum, average). PD, ZD and FS fields, and decimal constants, can now be up to 31 digits. BI and FI fields can now be up to 8 bytes.

OUTFIL TRAILERx now allows you to use new UFF (unsigned free form) and SFF (signed free form) formats for statistical fields (total, maximum, minimum, average).

OUTFIL TRAILERx now allows you to use TO=fo and fo (to) options to convert statistical fields (total, maximum, minimum, average) and counts to BI, FI, PD, ZD, ZDC, ZDF or FS output values.

OUTFIL TRAILERx now allows you to use COUNT+n=(edit), COUNT+n=(to), COUNT-n=(edit) and COUNT-n=(to) to add or subtract n from a count to be edited or converted (for example, COUNT+1=(TO=ZD)).

OUTFIL HEADERx and TRAILERx now allow you to insert hexadecimal strings (X’yy...yy’ or nX’yy...yy’) in your headers and trailers.

OUTFIL HEADERx and TRAILERx now allow you to use new YDDD=(abc) and YDDDNS=(ab) options to insert the year (yyyy) and day of the year (ddd) of your DFSORT run in your headers and trailers. OUTFIL HEADERx and TRAILERx now allow you to use PAGE=(edit) and PAGE=(to) to edit or convert the page number (for example, PAGE=(M11,LENGTH=3)).

**INREC and OUTREC Enhancements**

INREC and OUTREC now allow you to reformat records in one of the following three ways using unedited, edited, or converted input fields and a variety of constants:

- **BUILD or FIELDS**: The existing FIELDS parameter, or its new alias of BUILD, allows you to reformat each record by specifying all of its items one by one. BUILD or FIELDS gives you complete control over the items you want in your reformatted INREC or OUTREC records and the order in which they appear. You can delete, rearrange and insert fields and constants.

- **OVERLAY**: The new OVERLAY parameter allows you to reformat each record by specifying just the items that overlay specific columns. Overlay lets you change specific existing columns without affecting the entire record.

- **IFTHEN clauses**: The new IFTHEN clauses allow you to reformat different records in different ways by specifying how BUILD or OVERLAY items are applied to records that meet given criteria. IFTHEN clauses let you use sophisticated conditional logic to choose how different record types are reformatted.

INREC and OUTREC now allow you to use larger numeric values for fields and decimal constants to be edited, converted or used in arithmetic expressions. PD, ZD and FS fields, and decimal constants, can now be up to 31 digits. BI and FI fields can now be up to 8 bytes.

INREC and OUTREC now allow you to use new UFF (unsigned free form) and SFF (signed free form) formats for fields to be edited, converted or used in arithmetic expressions.

INREC and OUTREC now allow you to use new DC1-DC3 (TOD date), DE1-DE3 (ETOD date), TC1-TC4 (TOD time) and TE1-TE4 (ETOD time) formats for fields to be edited, converted or used in arithmetic expressions. These new formats produce meaningful representations of TOD and ETOD date and time values.
INREC and OUTREC now allow you to use a set field in the CHANGE option.

INREC and OUTREC now allow you to restart the sequence number when the binary value of a specified field changes.

INREC and OUTREC now allow you to use new TO=ZDC and TO=ZDF options to convert numeric values to ZD values with C or F for the positive sign, respectively. The TO=ZDF option is equivalent to the existing TO=ZD option.

INREC and OUTREC now allow you to use new DATE, DATE=(abcd), DATENS=(abc), YDDD=(abc), YDDDNS=(ab), TIME, TIME=(abc) and TIMENS=(ab) options to insert the date and time of your DFSORT run into your records in various forms.

**SORT and MERGE Enhancements**

SORT and MERGE now allow you to use larger FS values for control fields. These values can now be up to 32 digits.

SORT and MERGE now allow you to use new UFF (unsigned free form) and SFF (signed free form) formats for control fields.

SORT and MERGE now allow you to use other characters besides '+' (plus) as a positive sign in control field values for CSL, CST, ASL, and AST formats. A '-' (minus) sign is treated as negative and any other sign (for example, blank) is treated as positive.

**INCLUDE and OMIT Enhancements**

INCLUDE and OMIT now allow you to use larger FS values for compare fields. These values can now be up to 32 digits.

INCLUDE and OMIT now allow you to use larger decimal constants for comparison to BI and FI fields. Decimal constants can now be up to $+18446744073709551615$ for comparison to BI fields. Decimal constants can now be between $-9223372036854775808$ and $+9223372036854775807$ for comparison to FI fields.

INCLUDE and OMIT now allow you to use new UFF (unsigned free form) and SFF (signed free form) formats for compare fields. A UFF or SFF field can be compared to a UFF, SFF, FS, CSL or CST field or to a decimal constant.

**SUM Enhancement**

SUM now allows you to use larger ZD values for sum fields. These values can now be up to 31 digits.

**Other Enhancements**

For sort and copy applications with concatenated variable-length input data sets for SORTIN, DFSORT now uses the largest LRECL it finds in the concatenation.

DFSORT now allows control statements in SYSIN and SORTCNTL to contain labels up to 70 characters, and allows any character in the label. DFSORT now ignores statements with a label followed only by blanks.

**Operational Changes that may Require User Action**

The following are operational changes that may require user action for existing DFSORT/ICETOOL applications that use certain functions as specified:
Return Area for ICETOOL STATS Operator
In order to handle larger numbers, ICETOOL will now return 16-byte PD values rather than 8-byte PD values in the return area for the STATS operator. If you have programs that call ICETOOL and use the returned STATS values, change the DCs for those values from PL8 to PL16 and recompile the programs before running them against this level of DFSORT/ICETOOL.

16-Byte FS Fields
In order to handle larger FS fields (a sign and up to 31 digits), DFSORT and ICETOOL will now treat a 16-byte FS field as having a maximum of 16 digits, rather than 15 digits.

For ICETOOL’s DISPLAY and OCCUR operators, ON and BREAK fields for 16-byte FS values may result in different formatting for the output reports. You can use the new U15 formatting item to limit these values to 15 digits instead of 16 digits. For example, ON(11,16,FS,U15).

For INREC, OUTREC and OUTFIL OUTREC, 16-byte FS values may be edited or converted differently for output. You can use EDIT=(pattern) or LENGTH=n to change the length of the output fields, if appropriate. For example, 11,16,FS,EDIT=(SIIIIIIIIIIIIIIIT),SIGNS=(+,−).

TO=BI and TO=FI for 10-digit values
In order to handle larger numbers, INREC, OUTREC and OUTFIL OUTREC will create an 8-byte field instead of a 4-byte field when TO=BI or TO=FI is used for a 10-digit value. You can use LENGTH=n to change the length of the output fields, if appropriate. For example, 11,10,ZD,TO=BI,LENGTH=4

New reserved words for symbols
The following are new DFSORT/ICETOOL reserved words (uppercase only, as shown), which are no longer allowed as symbols: DC1, DC2, DC3, DE1, DE2, DE3, SFF, TC1, TC2, TC3, TC4, TE1, TE2, TE3, TE4, UFF, ZDC, and ZDF.

If you used these words as symbols, you must change them to other words, such as lowercase or mixed case forms (for example, dc1 or Dc1).
# Chapter 1. Introducing DFSORT

This chapter introduces IBM z/OS DFSORT Licensed Program 5694-A01.

DFSORT is intended to run in problem state and in a user key (that is, key 8 or higher).

DFSORT is a program you use to sort, merge, and copy information.

- When you sort records, you arrange them in a particular sequence, choosing an order more useful to you than the original one.
- When you merge records, you combine the contents of two or more previously sorted data sets into one.
- When you copy records, you make an exact duplicate of each record in your data set.

Merging records first requires that the input data sets are identically sorted for the information you will use to merge them and that they are in the same order required for output. You can merge up to 100 different data sets at a time.

In addition to the three basic functions, you can perform other processing simultaneously:

**You can control which records to keep** in the final output data set of a DFSORT run by using INCLUDE and OMIT statements in your application. These statements work like filters, testing each record against criteria that you supply and retaining only the ones you want for the output data set. For example, you might choose to work only with records that have a value of “Kuala Lumpur” in the field reserved for office location. Or perhaps you want to leave out any record dated after 2001 if it also contains a value greater than 20 for the number of employees.

**You can parse, edit, and reformat your records** before or after other processing by using INREC and OUTREC statements. INREC and OUTREC statements support a wide variety of reformatting tasks including:

- The use of fixed position/length fields or variable position/length fields. For fixed fields, you specify the starting position and length of the field directly. For variable fields, such as delimited fields, comma separated values (CSV), tab

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Separated values, blank separated values, keyword separated fields, null-terminated strings (and many other types), you define rules that allow DFSORT to extract the relevant data into fixed parsed fields, and then use the parsed fields as you would use fixed fields.

- Insertion of blanks, zeros, strings, current date, future date, past date, current time, sequence numbers, decimal constants, and the results of arithmetic expressions before, between, and after the input fields in the reformatted records.

- Sophisticated conversion capabilities, such as find and replace, hexadecimal display, bit display, translation of EBCDIC letters from lowercase to uppercase or uppercase to lowercase, translation of characters from EBCDIC to ASCII and from ASCII to EBCDIC, translation of characters using the ALTSEQ translation table, conversion of numeric values from one format to another, left-justify or left-squeeze (remove leading blanks or all blanks and shift left), and right-justify or right-squeeze (remove trailing blanks or all blanks and shift right).

- Sophisticated editing capabilities, such as control of the way numeric fields are presented with respect to length, leading or suppressed zeros, thousands separators, decimal points, leading and trailing positive and negative signs, and so on.

  Twenty-seven pre-defined editing masks are available for commonly used numeric editing patterns, encompassing many of the numeric notations used throughout the world. In addition, a virtually unlimited number of numeric editing patterns are available via user-defined editing masks.

- Transformation of SMF, TOD, and ETOD date and time values to more usable forms.

- Conversion of input date fields of one type (CH, ZD, PD, 2-digit year, 4-digit year, Julian, Gregorian) to corresponding output date fields of another type or to a corresponding day of the week.

- Various types of arithmetic operations for input date fields.

- Selection of a character constant, hexadecimal constant, or input field from a lookup table for output, based on a character, hexadecimal, or bit string as input (that is, lookup and change).

You can create the reformatted INREC or OUTREC records in one of the following ways:
- By building the entire record one item at a time.
- By only overlaying specific columns.
- By performing find and replace operations.
- By using sophisticated conditional logic or group operations to choose how different records are reformatted.

You can sum numeric information from many records into one record with the SUM statement. For example, if you want to know the total amount of a yearly payroll, you can add the values for a field containing salaries from the records of all your employees.

You can create one or more output data sets for a sort, copy, or merge application from a single pass over one or more input data sets by using OUTFIL control statements. You can use multiple OUTFIL statements, with each statement specifying the OUTFIL processing to be performed for one or more output data sets. OUTFIL processing begins after all other processing ends (that is, after processing for exits, options, and other control statements). OUTFIL statements support a wide variety of output data set tasks, including:
Creation of multiple output data sets containing unedited or edited records from a single pass over one or more input data sets.

Creation of multiple output data sets containing different ranges or subsets of records from a single pass over one or more input data sets. In addition, records that are not selected for any subset can be saved in a separate output data set.

Conversion of variable-length record data sets to fixed-length record data sets.

Conversion of fixed-length record data sets to variable-length record data sets.

A wide variety of parsing, editing and reformatting tasks including:

- The use of fixed position/length fields or variable position/length fields. For fixed fields, you specify the starting position and length of the field directly. For variable fields, such as delimited fields, comma separated values (CSV), tab separated values, blank separated values, keyword separated fields, null-terminated strings (and many other types), you define rules that allow DFSORT to extract the relevant data into fixed parsed fields, and then use the parsed fields as you would use fixed fields.

- Insertion of blanks, zeros, strings, current date, future date, past date, current time, sequence numbers, decimal constants, and the results of arithmetic expressions before, between, and after the input fields in the reformatted records.

- Sophisticated conversion capabilities, such as find and replace, hexadecimal display, bit display, translation of EBCDIC letters from lowercase to uppercase or uppercase to lowercase, translation of characters from EBCDIC to ASCII or from ASCII to EBCDIC, translation of characters using the ALTSEQ translation table, conversion of numeric values from one format to another, left-justify or left-squeeze (remove leading blanks or all blanks and shift left), and right-justify or right-squeeze (remove trailing blanks or all blanks and shift right).

- Sophisticated editing capabilities, such as control of the way numeric fields are presented with respect to length, leading or suppressed zeros, thousands separators, decimal points, leading and trailing positive and negative signs, and so on.

Twenty-seven pre-defined editing masks are available for commonly used numeric editing patterns, encompassing many of the numeric notations used throughout the world. In addition, a virtually unlimited number of numeric editing patterns are available via user-defined editing masks.

- Transformation of SMF, TOD, and ETOD date and time values to more usable forms.

- Conversion of input date fields of one type (CH, ZD, PD, 2-digit year, 4-digit year, Julian, Gregorian) to corresponding output date fields of another type or to a corresponding day of the week.

- Various types of arithmetic operations for input date fields.

- Selection of a character constant, hexadecimal constant, or input field from a lookup table for output, based on a character, hexadecimal, or bit string as input (that is, lookup and change).

- Creation of the reformatted records in one of the following ways:
  - By building the entire record one item at a time.
  - By only overlaying specific columns.
  - By performing find and replace operations.
  - By using sophisticated conditional logic or group operations to choose how different records are reformatted.
DFSORT Overview

- Highly detailed three-level (report, page, and section) reports containing a variety of report elements you can specify (for example, current date, current time, edited or converted page numbers, character strings, and blank lines) or derive from the input records (for example, character fields; unedited, edited, or converted numeric input fields; edited or converted record counts; and edited or converted totals, maximums, minimums, and averages for numeric input fields).
- Creation of multiple output records from each input record, with or without intervening blank output records.
- Repetition and sampling of data records.
- Splitting of data records in rotation among a set of output data sets.

You can perform various "join" operations on two files by one or more keys. A JOINKEYS application allows you to create joined records in a variety of ways including inner join, full outer join, left outer join, right outer join and unpaired combinations. The two input files can be of different types (fixed, variable, VSAM, and so on) and have keys in different locations. The records from the two input files can be processed in a variety of ways before and after they are joined.

You can control DFSORT functions with other control statements by specifying alternate collating sequences, invoking user exit routines, overriding installation defaults, and so on.

You can direct DFSORT to pass control during run time to routines you design and write yourself. For example, you can write user exit routines to summarize, insert, delete, shorten, or otherwise alter records during processing. However, keep in mind that the extensive editing capabilities provided by the INCLUDE, OMIT, INREC, OUTREC, SUM, and OUTFIL statements can eliminate the need to write user exit routines. You can write your own routines to correct I/O errors that DFSORT does not handle, or to perform any necessary abnormal end-of-task operation before DFSORT terminates.

You can write an EFS (Extended Function Support) program to intercept DFSORT control statements and PARM options for modification prior to use by DFSORT or to provide alternate sequence support for user-defined data.

You can define and use a symbol for any field, constant, or output column that is recognized in a DFSORT control statement or ICETOOL operator. This makes it easy to create and reuse collections of symbols (that is, mappings) representing information associated with various record layouts. You can use system symbols (for example, &JOBNAME.) in your symbol constants. You can use SET and PROC symbols in your symbol constants. See Chapter 8, “Using Symbols for Fields and Constants,” on page 727.

DFSORT on the Web

For articles, online documents, news, tips, techniques, examples, and more, visit the DFSORT home page at:
http://www.ibm.com/storage/dfsort

DFSORT FTP Site

You can obtain DFSORT articles and examples via anonymous FTP to:
ftp.software.ibm.com/storage/dfsорт/mvs/
Invoking DFSORT

You can invoke DFSORT processing in the following ways:

- With an EXEC job control statement in the input stream using the name of the program (for example, PGM=ICEMAN or PGM=SORT) or the name of a cataloged procedure (for example, SORTD). See Chapter 2, “Invoking DFSORT with Job Control Language,” on page 25.

  TSO users can allocate the needed ddnames (for example, SYSOUT, SORTIN, SORTOUT and SYSIN), and invoke DFSORT using a calling method equivalent to PGM=ICEMAN. For example:
  
  ```
  call *(iceman)
  ```

  **Restriction:** TSO users cannot invoke DFSORT using:
  
  ```
  iceman
  ```
  
  or any other alias for DFSORT (for example, SORT) in this form.

  See Chapter 11, “Examples of DFSORT Job Streams,” on page 817 for examples of invoking DFSORT from REXX and CLISTS.

- With a program written in basic assembler language using a system macro instruction. See Chapter 6, “Invoking DFSORT from a Program,” on page 537.

- With programs written in either COBOL or PL/I with a special facility of the language. See the programmer’s guide describing the compiler version available at your location.

- With the ICETOOL utility. See Chapter 7, “Using ICETOOL,” on page 555.

In this document, the term directly invoked means that DFSORT is not initiated from another program. The term program invoked means that DFSORT is initiated from another program.

How DFSORT Works

This section contains a list of the operating systems supported by DFSORT and an explanation of how DFSORT uses control fields and collating sequences to sort, merge, and copy the records of a data set.

The Blockset technique is DFSORT’s most efficient technique for sorting, merging and copying data sets. DFSORT uses the Blockset technique whenever possible to take advantage of its highly optimized internal algorithms and efficient utilization of IBM hardware. If Blockset cannot be used, DFSORT uses another of its techniques — Peerage/Vale or Conventional.

Operating Systems

DFSORT runs under control of your z/OS operating system and must be initiated according to the appropriate conventions.

Additionally, DFSORT runs under z/OS when it is running as a guest under z/VM.

DFSORT is compatible with all of the IBM processors supported by z/OS. In addition to any device supported by z/OS for program residence, DFSORT also operates with any device QSAM or VSAM uses for input or output.
Control Fields and Collating Sequences

You define control fields to identify the information you want DFSORT to sort or merge. When thinking of the contents of your data sets, you probably think of names, dates, account numbers, or similar pieces of useful information. For example, when sorting your data sets, you might choose to arrange your records in alphabetical order, by family name. By using the byte position and length (in bytes) of the portion of each record containing a family name, you can define it as a control field to manipulate with DFSORT.

DFSORT uses the control fields you define as keys in processing. A key is a concept, such as family name, that you have in mind when you design a record processing strategy for a particular application. A control field, on the other hand, is a discrete portion of a record that contains the text or symbols corresponding to that information in a form that can be used by DFSORT to identify and sort, or merge the records. For all practical purposes, you can think of keys as equivalent to the control fields DFSORT uses in processing.

To arrange your records in a specific order, identify one or more control fields of your records to use as keys. The sequence in which you list the control fields becomes the order of priority DFSORT uses to arrange your records. The first control field you specify is called the major control field. Subsequent control fields are called minor control fields, as in first, second, third minor control fields, and so on.

If two or more records have identical values for the first control field, they are arranged according to the values in the second. Records with identical values for the first and second are arranged according to the third, and so on, until a difference is found or no more control fields are available.

Records with identical values for all the control fields specified retain their original input order or are arranged randomly, depending upon which of the two options, EQUALS or NOEQUALS, is in effect. You can direct DFSORT to retain the original input order for records with identical values for all control fields by specifying EQUALS.

Control fields may overlap, or be contained within other control fields (such as a three-digit area code, within a 10-digit telephone number). They do not need to be contiguous but must be located within the first 32752 bytes of the record (see Figure 1).

Control fields may overlap, or be contained within other control fields. DFSORT offers several standard collating sequences. You can choose to arrange your records according to these standard collating sequences or according to a collating sequence defined in the active locale. Conceptually, a collating sequence is a specific arrangement of character priority used to determine which of two values

Figure 1. Control Fields. Control fields may overlap, or be contained within other control fields.
in the same control field of two different records should come first. DFSORT uses
EBCDIC, the standard IBM collating sequence, or the ASCII collating sequence
when sorting or merging records. If locale processing is in effect, DFSORT will use
the collating sequence defined in the active locale.

The collating sequence for character data and binary data is absolute; character and
binary fields are not interpreted as having signs. For packed decimal, zoned
decimal, fixed-point, normalized floating-point, and the signed numeric data
formats, collating is algebraic; each quantity is interpreted as having an algebraic
sign.

You can modify the standard EBCDIC sequence to collate differently if, for
example, you want to allow alphabetic collating of national characters. An alternate
collating sequence can be defined with the ALTSEQ installation option, or you can
define it yourself at run-time with the ALTSEQ program control statement. You can
also specify a modified collating sequence with an E61 user exit or with an EFS
program.

You can specify the LOCALE installation or run-time option to use an active
locale’s collating rules.

Cultural Environment Considerations

DFSORT’s collating behavior can be modified according to your cultural
environment. Your cultural environment is defined to DFSORT using the X/Open**
locale model. A locale is a collection of data grouped into categories that describes
the information about your cultural environment.

The collate category of a locale is a collection of sequence declarations that defines
the relative order between collating elements (single character and multi-character
collating elements). The sequence declarations define the collating rules.

The cultural environment is established by selecting the active locale. The active
locale affects the behavior of locale-sensitive functions. In particular, the active
locale’s collating rules affect DFSORT’s SORT, MERGE, INCLUDE, and OMIT
processing as follows:

- **Sort and Merge**
  DFSORT produces sorted or merged records for output according to the collating
  rules defined in the active locale. This provides sorting and merging for single-
  or multi-byte character data based on defined collating rules that retain the
cultural and local characteristics of a language.

- **Include and Omit**
  DFSORT includes or omits records for output according to the collating rules
  defined in the active locale. This provides inclusion or omission for single- or
  multi-byte character data based on defined collating rules that retain the cultural
  and local characteristics of a language.

  **Note:** Locale processing is not used for IFTRAIL TRLID or IFTHEN WHEN,
  BEGIN or END constants or compare fields.

The DFSORT option LOCALE specifies whether locale processing is to be used
and, if so, designates the active locale. Only one locale can be active at a time for
any DFSORT application.
DFSORT Processing

You must prepare job control language (JCL) statements and DFSORT program control statements to invoke DFSORT processing. JCL statements (see Chapter 6, "Invoking DFSORT from a Program," on page 537) are processed by your operating system. They describe your data sets to the operating system and initiate DFSORT processing. DFSORT program control statements (see Chapter 3, “Using DFSORT Program Control Statements,” on page 81) are processed by the DFSORT program. They describe the functions you want to perform and invoke the processing you request.

A sort application usually requires intermediate storage as working space during the program run. This storage can be one of the following:

1. Hiperspace, using DFSORT’s Hipersorting feature.
2. Work data sets—either allocated dynamically by DFSORT’s DYNALLOC facility or specified by the user, using JCL DD statements. If specified by the user, the intermediate storage devices and the amount of work space must be indicated. Methods for determining the amount of work space to allocate are explained in Appendix A, “Using Work Space,” on page 847.
3. A combination of Hiperspace and work data sets.

Merge and copy applications do not require intermediate storage.

Figure 2 on page 9 illustrates the processing order for record handling, exits, statements, and options. Use this diagram with the text following it to understand the order DFSORT uses to run your job.
As shown in Figure 2, DFSORT processing follows this order:
1. DFSORT first checks whether you supplied a SORTIN data set for SORT and COPY jobs or SORTINnn data sets for MERGE jobs. If so, DFSORT reads the input records from them.
   - If no SORTIN data set is present for a SORT or COPY job, you must use an E15 user exit to insert all the records. (This is also true if you invoke DFSORT from a program with the address of an E15 user exit in the parameter list, because SORTIN will be ignored.) DFSORT can use a COBOL E15 routine if you specified the E15 user exit in the MODS statement.
   - If no SORTINnn data sets are present for a MERGE job, you must use an E32 user exit to insert all the records.

2. If input records for SORT or COPY jobs are read from a SORTIN data set, DFSORT performs processing specified with the SKIPREC option. DFSORT deletes records until the SKIPREC count is satisfied. Eliminating records before a SORT or COPY gives better performance.

3. If the input records for a SORT or COPY job are read from a SORTIN data set, DFSORT checks whether you specified an E15 user exit. If so, DFSORT transfers control to the user exit routine. You can use a COBOL E15 routine if the E15 user exit is specified in the MODS statement. The E15 routine can insert, delete, or reformat records.

4. DFSORT performs processing specified on an INCLUDE or OMIT statement. If you used an E15 user exit routine to reformat the records, the INCLUDE/OMIT fields you specify must apply to the current format rather than to the original format. If you use the INCLUDE or OMIT statements to delete unnecessary records before SORT, MERGE, or COPY processing, your jobs run more efficiently.

5. For SORT or COPY jobs, DFSORT performs processing specified with the STOPAFT option. Record input stops after the maximum number of records (n) you specify have been accepted. DFSORT accepts records for processing if they are:
   - Read from SORTIN or inserted by E15
   - Not deleted by SKIPREC
   - Not deleted by E15
   - Not deleted by an INCLUDE or OMIT statement.

6. DFSORT performs processing specified in an INREC statement. Data records are parsed, edited and reformatted according to the options specified. If you reformatted the records before this step, the INREC fields you specify must apply to the current format rather than to the original format.

7. DFSORT performs processing specified in the SORT, MERGE, or OPTION COPY statement.
   - For SORT, all input records are processed before any output record is processed.
   - For COPY or MERGE, an output record is processed after an input record is processed.
   - For SORT or MERGE, if a SUM statement is present, DFSORT processes it during the SORT or MERGE processing. DFSORT summarizes the records and deletes duplicates. If you reformatted the records before this step, the SORT or MERGE and SUM fields you specify must apply to the current format rather than to the original format.

8. DFSORT performs processing specified in an OUTREC statement. Data records are parsed, edited and reformatted according to the options specified. If you reformatted the records before this step, the OUTREC fields you specify must apply to the current format rather than to the original format.
DFSORT Processing

9. If an E35 user exit is present, DFSORT transfers control to your user exit routine after all statement processing (except OUTFIL) is completed. If you reformatted the records, the E35 user exit receives the records in the current format rather than in the original format. You can use a COBOL E35 routine if you specify the E35 user exit in the MODS statement. You can use the E35 exit routine to add, delete, or reformat records.

If SORTOUT and OUTFIL data sets are not present, the E35 exit must dispose of all the records because DFSORT treats these records as deleted. (This is also true if you do not specify OUTFIL data sets and DFSORT is invoked with the address of an E35 user exit in the parameter list, because SORTOUT will be ignored.)

10. DFSORT writes your records to the SORTOUT data set, if present.

11. DFSORT performs processing specified in one or more OUTFIL statements, if present:
   • DFSORT performs processing specified with the STARTREC, SAMPLE, and ENDREC options. Record input for the OUTFIL data sets starts with the record indicated by STARTREC, ends with the record indicated by ENDREC, and is sampled according to the records indicated by SAMPLE.
   • DFSORT performs processing specified with the INCLUDE, OMIT, or SAVE option. Records are included or omitted from the OUTFIL data sets according to the criteria specified.
   • DFSORT performs processing specified with the ACCEPT option. Record processing ends when the ACCEPT limit is reached.
   • DFSORT performs processing specified with the PARSE, OUTREC (or BUILD), OVERLAY, FINDREP, IFTHEN, FTOV, VTOF (or CONVERT), VL/FILL, VLTRIM and REPEAT options. Data records are parsed, edited, reformatted, converted and repeated according to the options specified.
   • DFSORT performs processing specified with the LINES, HEADER1, TRAILER1, HEADER2, TRAILER2, SECTIONS, NODETAIL, BLKCCH1, BLKCCH2, BLKCC1 and REMOVECC options. Data records are reformatted and report records are generated for the OUTFIL data sets.
   • DFSORT performs SPLIT, SPLITBY, or SPLIT1R processing. Records are distributed among the OUTFIL data sets as evenly as possible.
   • DFSORT writes your OUTFIL records to the appropriate OUTFIL data sets.

Input Data Sets—SORTIN and SORTINnn

DFSORT processes two types of input data sets, referred to as the SORTIN data set (or just SORTIN) and the SORTINnn data sets (or just SORTINnn).

The SORTIN DD statement specifies the input data set (or concatenated input data sets) for a sort or copy application. If a SORTIN DD statement is present, it will be used by default for a sort or copy application unless you invoke DFSORT from a program with the address of an E15 user exit in the parameter list.

The SORTINnn DD statements (where nn can be 00 to 99) specify the data sets for a merge application. If a SORTINnn DD statement is present, it will be used by default for a merge application unless you invoke DFSORT from a program with the address of an E32 user exit in the parameter list.
Output Data Sets—SORTOUT and OUTFIL

DFSORT processes two types of output data sets, referred to as the SORTOUT data set (or just SORTOUT) and the OUTFIL data sets.

The SORTOUT DD statement specifies the single non-OUTFIL output data set for a sort, copy, or merge application. OUTFIL processing does not apply to SORTOUT. If a SORTOUT DD statement is present, it will be used by default for a sort, copy, or merge application unless you invoke DFSORT from a program with the address of an E35 user exit in the parameter list.

The FNames and FILES parameters of one or more OUTFIL statements specify the ddnames of the OUTFIL data sets for a sort, copy, or merge application. The parameters specified for each OUTFIL statement define the OUTFIL processing to be performed for the OUTFIL data sets associated with that statement. Each ddname specified must have a corresponding DD statement.

Although the ddname SORTOUT can actually be used for an OUTFIL data set, the term “SORTOUT” will be used to denote the single non-OUTFIL output data set.

Data Set Considerations

You must define any data sets you provide for DFSORT according to the conventions your operating system requires. You can use the label checking facilities of the operating system during DFSORT processing. See Application Development Guide for details.

You must describe all data sets (except those allocated with the DYNALLOC parameter) in DD statements. You must place the DD statements in the operating system input stream with the job step that allocates data sets for DFSORT processing.

Sorting or Copying Records

Input to a sort or copy application can be a blocked or unblocked QSAM or VSAM data set containing fixed- or variable-length records. QSAM input data sets can be concatenated even if they are on dissimilar devices. See “SORTIN DD Statement” on page 69 for the restrictions that apply.

Output from a sort or copy application can be blocked or unblocked QSAM or VSAM data sets, regardless of whether the input is QSAM or VSAM. Unless OUTFIL is used to convert variable input to fixed output, or fixed input to variable output, an output data set must be the same type (fixed or variable) as the input data set.
Files in a z/OS file system are supported as input and output for sort and copy applications.

Merging Records
Input to a merge application can be up to 100 blocked or unblocked QSAM or VSAM data sets containing fixed- or variable-length records. The input data sets can be either QSAM or VSAM, but not both. The records in all input data sets must already be sorted in the same order as that required for output.

Output from a merge application can be blocked or unblocked QSAM or VSAM data sets, regardless of whether the input is QSAM or VSAM. Unless OUTFIL is used to convert variable input to fixed output, or fixed output to variable output, an output data set must be the same type (fixed or variable) as the input data set.

Files in a z/OS file system are supported as input and output for merge applications.

Data Set Notes and Limitations
There are some considerations and limitations that you need to be aware of. These are described in the following sections.

For more information about specific DFSORT data sets, see “Using DD Statements” on page 62.

General Considerations
Variable-length records are processed with a record descriptor word (RDW) in positions 1-4, so the data starts in position 5. Fixed-length records are processed without an RDW, so the data starts in position 1. Control statement positions should be specified accordingly.

Your records can be EBCDIC, ASCII, Japanese, and data types you define yourself. To process Japanese data types with DFSORT, you can use the IBM Double Byte Character Set Ordering Support Program (DBCS Ordering), Licensed Program 5665-360, Release 2.0, or you can use locale processing with the appropriate locale.

Input and output data sets must be on devices that can be used with QSAM or VSAM.

Standard system data management rules apply to all data set processing. In particular:
• Be aware that when using fixed standard record format for input data sets, the first short block is treated like an End of Volume. See z/OS DFSMS Using Data Sets for more details.
• Be aware that, in some cases, if a DD statement specifies a data set for output that is extended to a second or subsequent volume, and another DD statement within the same step requests the same data set, only the records on the first volume will be read, and incorrect output will result.
Specifically, when a new output data set is allocated with a unit count and volume count greater than one, but specifies no volume serial numbers, one volume is allocated. If a second or succeeding DD statement within the same step requests the same data set, the same volume is allocated to it. If this job step extends the output data set to more volumes, this new volume information is not available to the second or succeeding DD statement.
Data Set Considerations

Thus, you should not use different DDs for a data set to be used for output and then input in the same step, unless the data set cannot be extended to a second or subsequent volume, or is allocated with the guaranteed space attribute in the storage class. See z/OS MVS JCL Reference, SA22-7597 and z/OS DFSMS Using Data Sets, SC26-7410 for more details.

The maximum record length DFSORT can handle is subject to the following limitations:

- Record length can never exceed the maximum record length you specify.
- Variable-length records are limited to 32756 bytes.
- VSAM variable-length records are limited to 32752 bytes.
- Fixed-length records are limited to 32760 bytes.
- Variable block-spanned records are limited to 32767 bytes.
- For a tape work data set sort, the maximum record length is limited to 32752 bytes with NOEQUALS in effect and to 32748 bytes with EQUALS in effect.

**Note:** If AQ format is specified, or CH format is specified and the CHALT option is in effect, the maximum record length for variable-length records is 32767 bytes, less the length of the control fields.

The number of records that can be sorted using a given amount of storage is reduced by:

- Processing control fields of different formats
- Large numbers of control fields
- Large numbers of intermediate data sets.

Providing an Extended Function Support program with an EFS01 routine can limit the record length that can be used when processing variable-length records.

The minimum block length for tape work data sets is 18 bytes; the minimum record length is 14 bytes.

**Padding and Truncation**

You can control the action that DFSORT takes when the SORTOUT LRECL is smaller than the SORTIN/SORTINnn LRECL with the TRUNC option as described in “OPTION Control Statement” on page 173.

DFSORT truncates fixed-length records on the right when the SORTOUT LRECL is smaller than the SORTIN/SORTINnn LRECL provided that:

- The application is not a conventional merge or tape work data set sort.
- TRUNC=RC16 is not in effect.

You can control the action that DFSORT takes when a variable-length output record is longer than the LRECL of the SORTOUT or OUTFIL data set to which it is to be written by using the VLLONG or NOVLLONG option as described in “OPTION Control Statement” on page 173.

You can control the action that DFSORT takes when the SORTOUT LRECL is larger than the SORTIN/SORTINnn LRECL with the PAD option as described in “OPTION Control Statement” on page 173.

DFSORT pads fixed-length records with binary zeros on the right when the SORTOUT LRECL is larger than the SORTIN LRECL provided that:

- The Blockset technique is selected.
Data Set Considerations

- The application is a sort or copy.
- PAD=RC16 is not in effect.

DFSORT does not pad or truncate records returned from an E15 or E35 user exit since it expects the exit to pad or truncate each record appropriately.

You can use INREC, OUTREC, and OUTFIL to pad, truncate, and reformat records. See "INREC Control Statement" on page 125 and "OUTREC Control Statement" on page 403 for details.

See "Use ICEGENER Instead of IEBGENER" on page 812 for information about padding and truncating with ICEGENER.

For more information about Blockset and other DFSORT techniques, see “Specify Efficient Sort/Merge Techniques” on page 799.

QSAM Considerations

- If you use DSN=NULLFILE on your DD statement for an input data set, a system restriction prevents DFSORT from using the EXCP access method.
- Empty input data sets can be used.
- If any of the input data sets are on tape without standard labels, DCB parameters must be specified on their DD statements.
- ISO/ANSI Version 1 tape files can only be used as input—never as output.
- DFSORT sets appropriate BUFNO values for the input and output data sets; specifying BUFNO in the DD statements for these data sets has no effect.

See “SORTIN DD Statement” on page 69 for additional considerations.

VSAM Considerations

- You can have DFSORT process VSAM records as fixed-length (F) or variable-length (V). When you use VSAM input, DFSORT selects fixed-length processing if you specify RECORD TYPE=F or variable-length processing if you specify RECORD TYPE=V. If you do not specify RECORD TYPE=x, DFSORT selects the record type to use according to the “rules” described in the discussion of the TYPE operand in "RECORD Control Statement” on page 437. The record type selected affects how the records are treated, and how control statement positions should be specified, as follows:
  - Variable-length processing: An RRDS, KSDS, ESDS or VRRDS can always be processed as variable-length. For VSAM input, DFSORT reads each record and prepends a record descriptor word (RDW) to it. For VSAM output, DFSORT removes the RDW before writing each record. Since DFSORT uses an RDW in positions 1-4 to process variable-length records, the data starts in position 5. Control statement positions should be specified accordingly.
  - Fixed-length processing: An RRDS can always be processed as fixed-length. A KSDS, ESDS or VRRDS used for input should only be processed as fixed-length if all of its records have a length equal to the maximum record size defined for the cluster. Otherwise, input records which are shorter than the maximum record size are padded with bytes that may or may not be zeros (that is, “garbage” bytes). DFSORT does not use an RDW to process fixed-length records, so the data starts in position 1. Control statement positions should be specified accordingly.
- If a data set is password protected, passwords can be entered at the console or (with some restrictions) through routines at user exits E18, E38, and E39.
Data Set Considerations

Note: Passwords cannot be handled in this way for OUTFIL data sets.

- If VSAMIO and RESET are in effect, a data set defined with REUSE can be used for both input and output for a sort; that is, the data set can be sorted in-place.
- A data set used for input or output must have been previously defined.
- If VSAMEMT is in effect, an empty input data set is processed as having zero records.
- VSAM data sets must not be concatenated (system restriction).
- VSAM and non-VSAM input data sets must not be specified together for a sort, merge or copy application.
- If output is a VSAM key-sequenced data set (KSDS), the key must be the first control field (or the key fields must be in the same order as the first control field). VSAM does not allow you to store records with duplicate primary keys.
- Any VSAM exit function available for input data sets can be used except EODAD. See the description of E18 use with VSAM in Chapter 5, “Using Your Own User Exit Routines,” on page 489.
- You must build the VSAM exit list with the VSAM EXLST macro instruction giving the addresses of your routines that handle VSAM exit functions.
- When processing variable-length records with VSAM input and non-VSAM output, the output LRECL must be at least 4 bytes greater than the maximum record size defined for the cluster. Non-VSAM variable-length records have a record descriptor word (RDW) field 4 bytes long at the beginning of each record, but VSAM records do not. The record size defined for the VSAM cluster is therefore 4 bytes less than the non-VSAM LRECL.
- An output data set defined without REUSE is processed as MOD.
- If RESET is in effect, an output data set defined with REUSE is processed as NEW. If NORESET is in effect, an output data set defined with REUSE is processed as MOD.
- DFSORT cannot access VSAM data sets in RLS mode, that is, RLS=CR and RLS=NRI are not supported for VSAM input and output data sets.

XTIOT, Uncaptured UCBs and DSAB Above 16 Megabytes

A program that invokes DFSORT, ICETOOL or ICEGENER can dynamically allocate input, output and work data sets using the options for XTIOT, uncaptured UCBs, and DSAB above 16 megabyte virtual. These data sets are supported to the extent that z/OS supports them.

Note: A program that invokes DFSORT, ICETOOL or ICEGENER should not allocate other data sets such as message, control, list, count, or symbol data sets using the options for XTIOT, uncaptured UCBs, and DSAB above 16 megabyte virtual. These data set options are not supported and the data set will not be recognized.

z/OS File System Considerations

Files in a z/OS file system can be used for input and output, but are only supported by the Blockset technique. If Blockset is not selected for a DFSORT application that uses z/OS UNIX files, DFSORT will issue an error message and terminate.

You should be familiar with the information found in z/OS UNIX System Services User’s Guide regarding z/OS UNIX files if you use them. DFSORT uses BSAM to
access z/OS UNIX files and is thus subject to all of the capabilities and restrictions that entails, as described in z/OS DFSMS Using Data Sets.

**Installation Defaults**

When your system programmers installed DFSORT, they selected separate sets of installation defaults for the following eight installation environments:

- **ICEAM1 (JCL)** is the batch direct invocation environment. This set of installation defaults is used at run time when DFSORT is invoked directly (that is, not through programs) by batch jobs, provided that an enabled time-of-day installation environment (ICETDx) is not activated.

- **ICEAM2 (INV)** is the batch program invocation environment. This set of installation defaults is used at run time when DFSORT is invoked through batch programs, provided that an enabled time-of-day installation environment (ICETDx) is not activated.

- **ICEAM3 (TSO)** is the TSO direct invocation environment. This set of installation defaults is used at run time when DFSORT is invoked directly (that is, not through programs) by foreground TSO users, provided that an enabled time-of-day installation environment (ICETDx) is not activated.

- **ICEAM4 (TSOINV)** is the TSO program invocation environment. This set of installation defaults is used at run time when DFSORT is invoked through programs by foreground TSO users, provided that an enabled time-of-day installation environment (ICETDx) is not activated.

- **ICETD1 (TD1)** is the first time-of-day installation environment. This set of installation defaults is used at run time when it is activated for the time-of-day of the run, provided it is enabled by the installation environment (ICEAMx) in effect.

- **ICETD2 (TD2)** is the second time-of-day installation environment. This set of installation defaults is used at run time when it is activated for the time-of-day of the run, provided it is enabled by the installation environment (ICEAMx) in effect.

- **ICETD3 (TD3)** is the third time-of-day installation environment. This set of installation defaults is used at run time when it is activated for the time-of-day of the run, provided it is enabled by the installation environment (ICEAMx) in effect.

- **ICETD4 (TD4)** is the fourth time-of-day installation environment. This set of installation defaults is used at run time when it is activated for the time-of-day of the run, provided it is enabled by the installation environment (ICEAMx) in effect.
Installation Defaults

The selected installation defaults can affect the way your applications run, and in many cases can be overridden by specifying the appropriate run-time parameters (see Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details). This document assumes that DFSORT is running with the installation defaults it was delivered with (that is, with the IBM-supplied installation defaults).

You can use an ICETOOL job similar to the following one to display a report of the installation defaults to be used at run-time.

```
//DFRUN JOB A402,PROGRAMMER
//LISTDEF EXEC PGM=ICETOOL
//TOOLMSG DD SYSOUT=A
//DFSMSG DD SYSOUT=A
//SHOWDEF DD SYSOUT=A
//TOOLIN DD *
DEFAULTS LIST(SHOWDEF)
/*
```

Figure 3. Using ICETOOL to List Installation Defaults

See Chapter 7, “Using ICETOOL,” on page 555 and “DEFAULTS Operator” on page 583 for more information on using ICETOOL and the DEFAULTS operator.

The functions of the available installation options are summarized below. z/OS DFSORT Installation and Customization contains complete descriptions of the available installation options, as well as planning considerations and general information about installing DFSORT. Step-by-step installation procedures are listed in the z/OS Program Directory.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>INV</td>
<td>JCL</td>
</tr>
<tr>
<td>Specifies the invocation installation environment (ICEAMx) or time-of-day installation environment (ICETDx) for which this set of installation defaults is to be used.</td>
<td></td>
</tr>
<tr>
<td>ENABLE</td>
<td>Specifies whether ICETDx installation defaults are to be used if activated for this ICEAMx installation environment.</td>
</tr>
<tr>
<td>day</td>
<td>Specifies the time ranges for each day of the week when this ICETDx installation environment is to be activated.</td>
</tr>
<tr>
<td>ABCODE</td>
<td>Specifies the ABEND code used when DFSORT abends for a critical error.</td>
</tr>
<tr>
<td>ALTSEQ</td>
<td>Specifies changes to the ALTSEQ translation table.</td>
</tr>
<tr>
<td>ARESALL</td>
<td>Specifies the number of bytes reserved above 16MB virtual for system use.</td>
</tr>
<tr>
<td>ARESINV</td>
<td>Specifies the number of bytes reserved above 16MB virtual for the invoking program when DFSORT is program invoked.</td>
</tr>
<tr>
<td>CFW</td>
<td>Specifies whether DFSORT can use cache fast write when processing work data sets.</td>
</tr>
<tr>
<td>CHALT</td>
<td>Translates format CH as well as format AQ, or translates format AQ only.</td>
</tr>
<tr>
<td>CHECK</td>
<td>Specifies whether record count checking is suppressed for applications that use an E35 user exit routine without an output data set.</td>
</tr>
</tbody>
</table>
## Installation Defaults

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CINV</td>
<td>Specifies whether DFSORT can use control interval access for VSAM data sets.</td>
</tr>
<tr>
<td>COBEXIT</td>
<td>Specifies the library for COBOL E15 and E35 routines.</td>
</tr>
<tr>
<td>DIAGSIM</td>
<td>Specifies whether a SORTDIAG DD statement is to be simulated for DFSORT applications.</td>
</tr>
<tr>
<td>DSA</td>
<td>Specifies the maximum amount of storage available to DFSORT for dynamic storage adjustment of Blockset sort applications.</td>
</tr>
<tr>
<td>DSPSIZE</td>
<td>Specifies the maximum amount of data space to use for dataspace sorting.</td>
</tr>
<tr>
<td>DYNALOC</td>
<td>Specifies the default values for device name and number of work data sets to be dynamically allocated. These default values are used in conjunction with the DYNAUTO installation option and the DYNALLOC run-time option.</td>
</tr>
<tr>
<td>DYNAPCT</td>
<td>Specifies additional work data sets to be dynamically allocated and only used when needed.</td>
</tr>
<tr>
<td>DYNAUTO</td>
<td>Specifies whether work data sets are dynamically allocated automatically.</td>
</tr>
<tr>
<td>DYNSPC</td>
<td>Specifies the total default primary space allocation for all of the dynamically allocated work data sets when the file size is unknown.</td>
</tr>
<tr>
<td>EFS</td>
<td>Specifies the name of a user-written Extended Function Support program to be called by DFSORT.</td>
</tr>
<tr>
<td>EQUALS</td>
<td>Specifies whether the order of records that collate identically is preserved from input to output.</td>
</tr>
<tr>
<td>ERET</td>
<td>Specifies the action taken if DFSORT encounters a critical error.</td>
</tr>
<tr>
<td>ESTAE</td>
<td>Specifies whether DFSORT deletes its ESTAE recovery routine early or uses it for the entire run.</td>
</tr>
<tr>
<td>EXITCK</td>
<td>Specifies whether DFSORT terminates or continues when it receives certain invalid return codes from E15 or E35 user exit routines.</td>
</tr>
<tr>
<td>EXPMAX</td>
<td>Specifies the maximum total amount of available storage to be used at any one time by all Hipersorting and memory object sorting applications.</td>
</tr>
<tr>
<td>EXPOLD</td>
<td>Specifies the maximum total amount of old storage to be used at any one time by all Hipersorting and memory object sorting applications.</td>
</tr>
<tr>
<td>EXPRES</td>
<td>Specifies the minimum amount of available storage to be reserved for use by non-Hipersorting and non-memory object sorting applications.</td>
</tr>
<tr>
<td>FSZEST</td>
<td>Specifies whether DFSORT treats run-time options FILSZ=n and SIZE=n as exact or estimated file sizes.</td>
</tr>
<tr>
<td>GENER</td>
<td>Specifies the name that ICEGENER is to use to transfer control to the IEBGENER system utility. (ICEGENER is DFSORT’s facility for IEBGENER jobs.)</td>
</tr>
<tr>
<td>GNPAD</td>
<td>Specifies the action to be taken by ICEGENER for LRECL padding.</td>
</tr>
</tbody>
</table>
### Installation Defaults

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GNTRUNC</td>
<td>Specifies the action to be taken by ICEGENER for LRECL truncation.</td>
</tr>
<tr>
<td>HIPRMAX</td>
<td>Specifies the maximum amount of Hiperspace to use for Hipersorting.</td>
</tr>
<tr>
<td>IDRCPCT</td>
<td>Specifies a percentage which represents the approximate amount of data compaction achieved by using the Improved Data Recording Capability feature of IBM tape devices that support compaction.</td>
</tr>
<tr>
<td>IEXIT</td>
<td>Specifies whether DFSORT passes control to your site's ICEIEXIT routine.</td>
</tr>
<tr>
<td>IGNCKPT</td>
<td>Specifies whether the checkpoint/restart facility is ignored if it is requested at run-time and the Blockset technique (which does not support the checkpoint/restart facility) can be used.</td>
</tr>
<tr>
<td>IOMAXBF</td>
<td>Specifies an upper limit to the amount of buffer space to be used for SORTIN, SORTINnn and SORTOUT data sets.</td>
</tr>
<tr>
<td>LIST</td>
<td>Specifies whether DFSORT prints control statements.</td>
</tr>
<tr>
<td>LISTX</td>
<td>Specifies whether DFSORT prints control statements returned by an Extended Function Support program.</td>
</tr>
<tr>
<td>LOCALE</td>
<td>Specifies whether locale processing is to be used and, if so, designates the active locale.</td>
</tr>
<tr>
<td>MAXLIM</td>
<td>Specifies an upper limit to the amount of main storage available to DFSORT below 16MB virtual.</td>
</tr>
<tr>
<td>MINLIM</td>
<td>Specifies a lower limit to the amount of main storage available to DFSORT.</td>
</tr>
<tr>
<td>MOSIZE</td>
<td>Specifies the maximum amount of memory object storage to use for memory object sorting.</td>
</tr>
<tr>
<td>MOWRK</td>
<td>Specifies whether DFSORT can use memory object storage as intermediate work space.</td>
</tr>
<tr>
<td>MSGCON</td>
<td>Specifies the class of program messages DFSORT writes to the master console.</td>
</tr>
<tr>
<td>MSGDDN</td>
<td>Specifies an alternate name for the message data set.</td>
</tr>
<tr>
<td>MSGPRT</td>
<td>Specifies the class of program messages DFSORT writes to the message data set.</td>
</tr>
<tr>
<td>NOMSGDD</td>
<td>Specifies whether DFSORT terminates or continues when the message data set is required but is not available.</td>
</tr>
<tr>
<td>NULLOFL</td>
<td>Specifies the action to be taken by DFSORT when there are no data records for an OUTFIL data set.</td>
</tr>
<tr>
<td>NULLOUT</td>
<td>Specifies the action to be taken by DFSORT when there are no records for the SORTOUT data set.</td>
</tr>
<tr>
<td>ODMAXBF</td>
<td>Specifies an upper limit to the amount of buffer space to be used for each OUTFIL data set.</td>
</tr>
<tr>
<td>OUTREL</td>
<td>Specifies whether unused temporary output data set space is released.</td>
</tr>
<tr>
<td>OUTSEC</td>
<td>Specifies whether DFSORT uses automatic secondary allocation for output data sets that are temporary or new.</td>
</tr>
</tbody>
</table>
### Installation Defaults

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OVERRGN</strong></td>
<td>Specifies the amount of main storage above the REGION value available to Blockset.</td>
</tr>
<tr>
<td><strong>OVFLO</strong></td>
<td>Specifies the action to be taken by DFSORT when BI, FI, PD or ZD summary fields overflow.</td>
</tr>
<tr>
<td><strong>PAD</strong></td>
<td>Specifies the action to be taken by DFSORT for LRECL padding.</td>
</tr>
<tr>
<td><strong>PARMDDN</strong></td>
<td>Specifies an alternate ddname for the DFSORT DFSPARM data set.</td>
</tr>
<tr>
<td><strong>RESALL</strong></td>
<td>Reserves storage for system and application use when SIZE/MAINSIZE=MAX is in effect.</td>
</tr>
<tr>
<td><strong>RESET</strong></td>
<td>Specifies whether DFSORT processes a VSAM output data set defined with REUSE as a NEW or MOD data set.</td>
</tr>
<tr>
<td><strong>RESINV</strong></td>
<td>Reserves storage for programs invoking DFSORT when SIZE/MAINSIZE=MAX is in effect.</td>
</tr>
<tr>
<td><strong>SDB</strong></td>
<td>Specifies whether DFSORT should use the system-determined optimum block size for output data sets when the block size is zero.</td>
</tr>
<tr>
<td><strong>SDBMSG</strong></td>
<td>Specifies whether DFSORT and ICETOOL should use the system-determined optimum block size for message and list data sets when the block size is zero.</td>
</tr>
<tr>
<td><strong>SIZE</strong></td>
<td>Specifies the maximum amount of main storage available to DFSORT.</td>
</tr>
<tr>
<td><strong>SMF</strong></td>
<td>Specifies whether DFSORT produces SMF type-16 records.</td>
</tr>
<tr>
<td><strong>SOLRF</strong></td>
<td>Specifies whether DFSORT uses the reformatted record length for the SORTOUT LRECL.</td>
</tr>
<tr>
<td><strong>SORTLIB</strong></td>
<td>Specifies whether DFSORT searches a system or private library for the modules used with a tape work data set sort or Conventional merge.</td>
</tr>
<tr>
<td><strong>SPANINC</strong></td>
<td>Specifies the action to be taken by DFSORT when incomplete spanned records are detected.</td>
</tr>
<tr>
<td><strong>SVC</strong></td>
<td>Specifies a user SVC number for DFSORT.</td>
</tr>
<tr>
<td><strong>SZERO</strong></td>
<td>Specifies whether DFSORT treats numeric −0 and +0 values as signed (that is, different) or unsigned (that is, the same).</td>
</tr>
<tr>
<td><strong>TEXIT</strong></td>
<td>Specifies whether DFSORT passes control to your site's ICETEXIT routine.</td>
</tr>
<tr>
<td><strong>TMAXLIM</strong></td>
<td>Specifies an upper limit to the total amount of main storage above and below 16MB virtual available to DFSORT when SIZE/MAINSIZE=MAX is in effect.</td>
</tr>
<tr>
<td><strong>TRUNC</strong></td>
<td>Specifies the action to be taken by DFSORT for LRECL truncation.</td>
</tr>
<tr>
<td><strong>VERIFY</strong></td>
<td>Specifies whether the sequence of output records is verified.</td>
</tr>
<tr>
<td><strong>VIO</strong></td>
<td>Specifies whether virtual allocation of work data sets is accepted.</td>
</tr>
<tr>
<td><strong>VLLONG</strong></td>
<td>Specifies whether DFSORT truncates long variable-length output records.</td>
</tr>
<tr>
<td><strong>VLSCMP</strong></td>
<td>Specifies whether DFSORT pads short variable-length compare fields.</td>
</tr>
</tbody>
</table>
**Installation Defaults**

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VLSHRT</td>
<td>Specifies whether DFSORT continues processing if a short variable-length control field, compare field or summary field is found.</td>
</tr>
<tr>
<td>VSAMBSP</td>
<td>Specifies the number of VSAM buffers DFSORT can use.</td>
</tr>
<tr>
<td>VSAMEMT</td>
<td>Specifies whether DFSORT accepts an empty VSAM input data set.</td>
</tr>
<tr>
<td>VSAMIO</td>
<td>Specifies whether DFSORT allows a VSAM data set defined with REUSE to be sorted in-place.</td>
</tr>
<tr>
<td>WRKREL</td>
<td>Specifies whether unused temporary work data set space is released.</td>
</tr>
<tr>
<td>WRKSEC</td>
<td>Specifies whether DFSORT uses automatic secondary allocation for temporary work data sets.</td>
</tr>
<tr>
<td>Y2PAST</td>
<td>Specifies the sliding or fixed century window.</td>
</tr>
<tr>
<td>ZDPRINT</td>
<td>Specifies whether DFSORT produces printable numbers from positive ZD fields that result from summarization.</td>
</tr>
</tbody>
</table>

Tables showing all the possible sources of specification and order of override for each option are shown in Appendix B, “Specification/Override of DFSORT Options,” on page 857.

**Migrating to DFSORT from Other Sort Products**

If you are migrating to DFSORT, you should run an ICETOOL DEFAULTS report to review the installation defaults set at your site. In particular, the options shown in the table that follows can make DFSORT operate more like other sort products, thus making migration easier. The installation options, described in z/OS DFSORT Installation and Customization, change the way DFSORT works globally by default. The run-time options, described in Chapter 2, “Invoking DFSORT with Job Control Language,” on page 25 and Chapter 3, “Using DFSORT Program Control Statements,” on page 81, can be used to override the installation defaults for specific jobs.

**Table 3. Options That Can Ease Migration**

<table>
<thead>
<tr>
<th>Installation</th>
<th>Run-Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABCODE=MSG/n</td>
<td>DYNALLOC=(d,n)</td>
</tr>
<tr>
<td>DYNALOC=(d,n)</td>
<td>DYNALLOC=(d,n)</td>
</tr>
<tr>
<td>DYNAPCT=x/OLD</td>
<td>DYNAPCT=x/OLD</td>
</tr>
<tr>
<td>DYNAUTO=YES/IGNWKDD/NO</td>
<td>DYNALLOC=(d,n)</td>
</tr>
<tr>
<td>DYNNSPC=n</td>
<td>DYNNSPC=n</td>
</tr>
<tr>
<td>EQUALS=YES/NO/VBLKSET</td>
<td>EQUALS/NOEQUALS</td>
</tr>
<tr>
<td>EXITCK=STRONG/WEAK</td>
<td>EXITCK=STRONG/WEAK</td>
</tr>
<tr>
<td>FSZEST=YES/NO</td>
<td>FILSZ=n/En/Un</td>
</tr>
<tr>
<td>NOMSGDD=QUIT/ALL/CRITICAL/NONE</td>
<td></td>
</tr>
<tr>
<td>PARMDDN=ddname</td>
<td></td>
</tr>
<tr>
<td>RESET=YES/NO</td>
<td>RESET/NORESET</td>
</tr>
<tr>
<td>SORTLIB=SYSTEM/PRIVATE</td>
<td></td>
</tr>
<tr>
<td>SZERO=YES/NO</td>
<td>SZERO/NOSZERO</td>
</tr>
<tr>
<td>VLLONG=YES/NO</td>
<td>VLLONG/NOVLLONG</td>
</tr>
</tbody>
</table>
Table 3. Options That Can Ease Migration (continued)

<table>
<thead>
<tr>
<th>Installation</th>
<th>Run-Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>VLSCMP=YES/NO</td>
<td>VLSCMP/NOVLSCMP</td>
</tr>
<tr>
<td>VSAMET=YES/NO</td>
<td>VSAMET/NVSAMET</td>
</tr>
<tr>
<td>VSAMIO=YES/NO</td>
<td>VSAMIO/NOVSAMIO</td>
</tr>
<tr>
<td>ZDPRINT=YES/NO</td>
<td>ZDPRINT/NZDPRINT</td>
</tr>
</tbody>
</table>

**DFSORT Messages and Return Codes**

You can determine, during installation or run-time, whether DFSORT writes messages to the message data set, to the master console, or to both. You can also direct an Extended Function Support program to write messages to the message data set.

Messages written to the message data set can be either critical error messages, informational error messages, or diagnostic messages, as determined during installation or run-time.

Messages written to the master console can be either critical error messages or informational error messages, as determined during installation.

See [z/OS DFSORT Messages, Codes and Diagnosis Guide](#) for complete information about DFSORT messages.

For successful completion, DFSORT passes back a return code of 0 or 4 to the operating system or the invoking program.

For unsuccessful completion due to an unsupported operating system, DFSORT passes back a return code of 24 to the operating system or the invoking program.

For unsuccessful completion with NOABEND in effect, DFSORT passes back a return code of 16 or 20 to the operating system or the invoking program.

For unsuccessful completion with ABEND in effect, DFSORT issues a user abend with the appropriate code as specified by the ABCODE installation option (either the error message number or a number between 1 and 99).

The meanings of the return codes that DFSORT passes back (in register 15) are:

0  **Successful completion.** DFSORT completed successfully.

4  **Successful completion.** DFSORT completed successfully, and:
   - OVFLO=RC4 was in effect and summary fields overflowed, or
   - PAD=RC4 was in effect and the SORTOUT LRECL was larger than the SORTIN/SORTINnn LRECL (LRECL padding), or
   - TRUNC=RC4 was in effect and the SORTOUT LRECL was smaller than the SORTIN/SORTINnn LRECL (LRECL truncation), or
   - SPANINC=RC4 was in effect and one or more incomplete spanned records was detected, or
   - NULLOUT=RC4 was in effect and there were no records for the SORTOUT data set, or
   - NULLOFL=RC4 was in effect and there were no data records for an OUTFIL data set.
DFSORT Messages and Return Codes

16 Unsuccessful completion. DFSORT detected an error that prevented it from completing successfully.

20 Message data set missing. Installation option NOMSGDD=QUIT was in effect and neither a message data set DD statement nor a SYSOUT DD statement was provided.

24 Unsupported operating system. This release of DFSORT does not support this operating system.

Use Blockset Whenever Possible

Blockset is DFSORT's most efficient technique. It supports many features not supported by DFSORT's less efficient Peerage/Vale and Conventional techniques (see ICE189A in z/OS DFSORT Messages, Codes and Diagnosis Guide for a list of these features). DFSORT always selects Blockset for a copy application. DFSORT selects Blockset for a sort or merge application unless something prevents it from doing so (see ICE800I in z/OS DFSORT Messages, Codes and Diagnosis Guide for a list of reasons Blockset cannot be used).

Note: Blockset cannot be used to process BDAM data sets.

Message ICE143I indicates whether Blockset or a less efficient technique was selected for a particular run. If Blockset was not selected for a sort or merge application, check the reason code in message ICE800I, which indicates the reason Blockset could not be used. If you did not get message ICE800I, add the following DD statements to your application and rerun it:

//SORTDIAG DD DUMMY
//SYSOUT DD SYSOUT=*  

If possible and appropriate, remove the obstacle that is causing Blockset not to be selected.
Chapter 2. Invoking DFSORT with Job Control Language

Your operating system uses the job control language (JCL) you supply with your DFSORT program control statements to:

- Identify you as an authorized user
- Allocate the necessary resources to run your job
- Run your job
- Return information to you about the results
- Terminate your job.

You must supply JCL statements with every DFSORT job you submit.

Required JCL includes a JOB statement, an EXEC statement, and several DD statements. The statements you need and their exact form depend upon whether you:

- Use an EXEC statement in the input job stream or a system macro instruction within another program to invoke DFSORT
- Use EXEC statement cataloged procedures to invoke DFSORT
- Specify various DFSORT control statements or PARM options
- Want to use program exits to activate routines of your own
- Use dynamic link-editing
- Want to see diagnostic messages.

The JCL statements and their functions are listed below. Details on coding the individual statements are presented in subsequent sections.

<table>
<thead>
<tr>
<th>JCL Statement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>//JOBLIB DD</td>
<td>Defines your program link library if it is not already known to the system</td>
</tr>
<tr>
<td>//STEPLIB DD</td>
<td>Same as //JOBLIB DD</td>
</tr>
<tr>
<td>//SORTLIB DD</td>
<td>Defines the data set that contains special load modules if it is not already known to the system</td>
</tr>
<tr>
<td>//SYSOUT DD1</td>
<td>Defines the message data set</td>
</tr>
</tbody>
</table>
### Using the JCL

<table>
<thead>
<tr>
<th>DD Statement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>//SYMNames DD</td>
<td>Defines the SYMNames data set containing statements to be used for symbol processing</td>
</tr>
<tr>
<td>//SymnOut DD</td>
<td>Defines the data set in which SYMNames statements and the symbol table are to be listed</td>
</tr>
<tr>
<td>//SortIN DD1</td>
<td>Defines the input data set for a sort or copy</td>
</tr>
<tr>
<td>//SortINnn DD1</td>
<td>Defines the input data sets for a merge</td>
</tr>
<tr>
<td>//SortOUT DD1</td>
<td>Defines the SORTOUT output data set for a sort, merge, or copy</td>
</tr>
<tr>
<td>//outfil DD</td>
<td>Defines an OUTFIL output data set for a sort, merge, or copy</td>
</tr>
<tr>
<td>//SortWKdd DD1</td>
<td>Defines intermediate storage data sets for a sort</td>
</tr>
<tr>
<td>//DFSPARM DD1</td>
<td>Contains DFSORT PARM options and program control statements</td>
</tr>
<tr>
<td>//SYsin DD</td>
<td>Contains DFSORT program control statements</td>
</tr>
<tr>
<td>//SortCntrl DD1</td>
<td>Same as //SYsin DD</td>
</tr>
<tr>
<td>//SortDiag DD</td>
<td>Specifies that all messages and program control statements be printed</td>
</tr>
<tr>
<td>//Sortckpt DD</td>
<td>Defines the data set for checkpoint records</td>
</tr>
<tr>
<td>//Sysudump DD</td>
<td>Defines the data set for output from a system ABEND dump routine</td>
</tr>
<tr>
<td>//Sysmdump DD</td>
<td>Same as //SYudump DD</td>
</tr>
<tr>
<td>//Sysabend DD</td>
<td>Same as //SYudump DD</td>
</tr>
<tr>
<td>//Sortsnap DD</td>
<td>Defines the snap dump data set dynamically allocated by DFSORT</td>
</tr>
<tr>
<td>//ddname</td>
<td>Defines the data set containing exit routines (as specified in the MODS program control statement).</td>
</tr>
</tbody>
</table>

The following DD statements are necessary only for dynamic link-editing of exit routines:

<table>
<thead>
<tr>
<th>DD Statement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>//SYsPrint DD</td>
<td>Defines the message data set for the linkage editor</td>
</tr>
<tr>
<td>//SYsUT1 DD</td>
<td>Defines the intermediate storage data set for the linkage editor</td>
</tr>
<tr>
<td>//SYsLIN DD</td>
<td>Defines the data set for control information for the linkage editor</td>
</tr>
<tr>
<td>//SYsLMod DD</td>
<td>Defines the data set for output from the linkage editor</td>
</tr>
<tr>
<td>//SortMods DD</td>
<td>Defines the temporary partitioned data set for user exit routines from SYsin.</td>
</tr>
</tbody>
</table>

1 These are the default ddnames with which DFSORT was delivered. SYSOUT and DFSPARM may have been changed during DFSORT installation. You can change all of the indicated ddnames at run time. For override information, see Appendix B, “Specification/Override of DFSORT Options,” on page 857.
Using the JOB Statement

The JOB statement is the first JCL statement of your job. It must contain a valid job name in the name field and the word JOB in the operation field. All parameters in the operand field are optional, although your site may have made information such as account number and the name of the programmer mandatory:

```
//jobname JOB accounting information, programmer's name, etc.
```

Using SET and PROC Symbols in DFSORT Control Statements

For jobs that directly invoke DFSORT (PGM=SORT or PGM=ICEMAN), you can construct DFSORT symbols that incorporate JCL PROC or SET symbols as well as text and system symbols. You can then use those constructed DFSORT symbols in DFSORT control statements in the same way you use regular DFSORT symbols.

For complete information, see Chapter 8, “Using Symbols for Fields and Constants,” on page 727.

Using the EXEC Statement

The EXEC statement is the first JCL statement of each job step or of each procedure step in a cataloged procedure. It identifies DFSORT to the operating system. You can also specify DFSORT options on the EXEC statement.

The format of the EXEC statement is:

```
//stepname EXEC PGM= sortproc [PARM = options ] [ other parameters ]
```

If you use a cataloged procedure (discussed in detail below), specify PROC=SORT or PROC=SORTD. You can omit PROC= and simply specify SORT or SORTD. However, PROC= can remind you that a cataloged procedure is being used.

If you do not use a cataloged procedure, use PGM= either with the actual name of the sort module (ICEMAN) or with one of its aliases: SORT, IERRCO00, or IGHRCO00. Be sure that the alias has not been changed at your site.

Specifying EXEC Statement Cataloged Procedures

A cataloged procedure is a set of JCL statements, including DD statements, that has been assigned a name and placed in a partitioned data set called the procedure library. Two cataloged procedures are supplied with the program: SORT and SORTD. Specify them in the first parameter of the EXEC statement by PROC=SORT, PROC=SORTD, or simply SORT or SORTD.

SORT Cataloged Procedure

You can use the supplied SORT cataloged procedure when you include user routines that require link-editing. Using this procedure without using link-edited
user routines is inefficient because the SORT cataloged procedure allocates linkage editor data sets whether or not you include user routines.

When you specify EXEC PROC=SORT or EXEC SORT, the following JCL statements are generated:

<table>
<thead>
<tr>
<th>Line</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>The stepname of the procedure is SORT. This EXEC statement initiates the program, which is named ICEMAN.</td>
</tr>
<tr>
<td>10</td>
<td>The STEPLIB DD statement defines the data set containing the DFSORT program modules. If DFSORT was installed as part of the normal system link libraries, the STEPLIB DD statement is unnecessary. It is needed only if DFSORT resides in a separate link library which is not part of the &quot;link list.&quot; (Your installation's system programmers can give you this information.) The STEPLIB DD statement shown assumes that the data set name represented by yyy is cataloged.</td>
</tr>
<tr>
<td>20</td>
<td>The SORTLIB DD statement defines a private data set containing the modules needed for a sort using tape work files or a merge using the Conventional technique. The data set is cataloged, and the data set name represented by xxx was specified at installation time; it can be SYS1.SORTLIB. If the modules were installed in a system library and installation option SORTLIB=SYSTEM is used, the SORTLIB DD statement is unnecessary and is ignored unless dynamic link of user exits is used.</td>
</tr>
<tr>
<td>30</td>
<td>Defines an output data set for system use (messages). It is directed to system output class A.</td>
</tr>
<tr>
<td>40</td>
<td>Defines SYSPRINT as a dummy data set because linkage editor diagnostic output is not required.</td>
</tr>
<tr>
<td>50</td>
<td>Defines a data set for linkage editor output. Any system disk device is acceptable for the output. Space for 20 records with an average length of 3600 bytes is requested; this is the primary allocation. Space for 20 more records is requested if the primary space allocation is not sufficient; this is the secondary allocation, which is requested each time primary space is exhausted. The last value is space for a directory, which is required because SYSLMOD is a new partitioned data set.</td>
</tr>
<tr>
<td>60</td>
<td>The SYSLIN data set is used by the program for linkage editor control statements. It is created on any system disk device, and it has space for 10 records with an average length of 80 bytes. If the primary space allocation is exhausted, additional space is requested in blocks large enough to contain 10 records. No directory space is necessary.</td>
</tr>
<tr>
<td>70/80</td>
<td>The SYSUT1 DD statement defines a work data set for the linkage editor.</td>
</tr>
</tbody>
</table>
SORTD Cataloged Procedure

You can use the supplied SORTD cataloged procedure when you do not include user routines or when you include user routines that do not require link-editing.

When you specify EXEC PROC=SORTD or EXEC SORTD, the following JCL statements are generated:

<table>
<thead>
<tr>
<th>Line</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>The stepname of the SORTD procedure is SORT</td>
</tr>
<tr>
<td>10</td>
<td>The STEPLIB DD statement defines the data set containing the DFSORT program modules. If DFSORT was installed as part of the normal system link libraries, the STEPLIB DD statement is unnecessary. It is needed only if DFSORT resides in a separate link library which is not part of the “link list.” (Your installation’s system programmers can give you this information.) The STEPLIB DD statement shown assumes that the data set name represented by yyy is cataloged.</td>
</tr>
<tr>
<td>20</td>
<td>The SORTLIB DD statement defines a private data set that contains the modules needed for a sort using tape work files or a merge that uses the Conventional technique. The data set name of the program subroutine library, represented by xxx, is specified at installation time; it can be SYS1.SORTLIB. If the modules were installed in a system library and installation option SORTLIB=SYSTEM is used, then the SORTLIB DD statement is unnecessary and is ignored unless dynamic link edit of user exits is used.</td>
</tr>
<tr>
<td>30</td>
<td>Directs messages to system output class A</td>
</tr>
</tbody>
</table>

Specifying EXEC/DFSPARM PARM Options

When you invoke DFSORT with JCL, you can specify some DFSORT options on the PARM parameter of the EXEC statement as illustrated on the following page. These options include EFS, LIST, NOLIST, LISTX, NOLISTX, MSGPRT, and MSGDDN, which are ignored if specified in an OPTION statement in SYSIN. Full override and applicability details are listed in Appendix B, “Specification/Override of DFSORT Options,” on page 857.

If you use the DFSPARM DD statement instead, you can specify both EXEC PARM options and DFSORT control statements in a single source data set that overrides all other sources. See “DFSPARM DD Statement” on page 77.

Details of aliases for PARM options are given under the description of individual options. “Aliases for PARM Options” on page 61 summarizes the available aliases.

DFSORT accepts but does not process the following EXEC/DFSPARM PARM options: BALANCE, BALN, BIAS=value, BMSG, CASCADE, CMP=value, CPU, CRCX, DEBUG, DIAG, ELAP, EXCPVR=value, IO, INCOR=value, INCORE=value, LRGSORT, L6=value, L7=value, NOCOMMAREA, NOINC, NOIOERR, NOSTIMER, OPT=value, OSCL, PEER, POLY, PRINT121 and STIMER.
Using The EXEC Statement

**Note:** If DEBUG is specified as the first value in a DFSPARM statement, it will be interpreted as a DEBUG control statement rather than as a DFSPARM PARM option.

An option shown in the form parameter=value can also be specified in the equivalent form parameter=(value) or parameter=(value). For example, the following are equivalent:

- DYNALLOC=SYSDA
- DYNALLOC(SYSDA)
- DYNALLOC=(SYSDA)

An option shown in the form parameter=(list) can also be specified in the equivalent form parameter=(list). For example, the following are equivalent:

- DYNALLOC=(SYSDA,5)
- DYNALLOC=SYSDA,5
- DYNALLOC(SYSDA,5)
Figure 4. Syntax Diagram for EXEC PARM (Part 1 of 3)

Chapter 2. Invoking DFSORT with Job Control Language
31
Figure 4. Syntax Diagram for EXEC PARM (Part 2 of 3)
Using The EXEC Statement

**ABEND or NOABEND**

Temporarily overrides the ERET installation option, which specifies whether DFSORT abends or terminates with a return code of 16 if your sort, copy, or merge is unsuccessful.

**ABEND** specifies that if your sort, copy, or merge is unsuccessful, DFSORT abends with a user completion code equal to the appropriate message number or with a user-defined number between 1 and 99, as set during installation with installation option ABCODE=n.

When DEBUG ABEND is in effect, a user abend code of zero may be issued when a tape work data set sort or Conventional merge is unsuccessful.

**NOABEND** specifies that an unsuccessful sort, copy, or merge terminates with a return code of 16.

*Note:* RC16=ABE and NORC16 can be used instead of ABEND and NOABEND, respectively.

*Default:* Usually the installation default. See Appendix B, “Specification/Override of DFSORT Options” on page 857 for full override details.

*Applicable Functions:* See Appendix B, “Specification/Override of DFSORT Options”

**ARESALL**

Temporarily overrides the ARESALL installation option, which specifies the number of bytes to be reserved above 16MB virtual for system use. For more information, see the discussion of the ARESALL option in OPTION Control Statement on page 173.
n specifies that n bytes of storage are to be reserved.
Limit: 8 digits.

nK specifies that n times 1024 bytes of storage are to be reserved.
Limit: 5 digits.

nM specifies that n times 1048576 bytes of storage are to be reserved.
Limit: 2 digits.

Note: RESERVEX=value can be used instead of ARESALL=value.


AVGRLEN

```
AVGRLEN=n
```

Specifies the average input record length in bytes for variable-length record sort applications. For more information, see the discussion of the AVGRLEN option in “OPTION Control Statement” on page 173.

n specifies the average input record length. The value for n must be between 4 and 32767 and must include the 4 byte record descriptor word (RDW).

Note: L5=n can be used instead of AVGRLEN=n.

Default: If AVGRLEN=n is not specified, DFSORT will use one-half of the maximum record length as the average record length. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.


BSAM

```
BSAM
```

Temporarily bypasses the EXCP access method normally used for input and output data sets. BSAM is ignored for VSAM input and output data sets. Note that if Blockset is not selected and BSAM processing is used with concatenated SORTIN input and both null and non-null data sets are specified, all null data sets must precede all non-null data sets; otherwise, the results are unpredictable.

Attention: This option can degrade performance.

Using The EXEC Statement


CINV or NOCINV

Temporarily overrides the CINV installation option, which specifies whether DFSORT can use control interval access for VSAM data sets. For more information, see the explanation of the CINV option in “OPTION Control Statement” on page 173.

CINV directs DFSORT to use control interval access when possible for VSAM data sets.

NOCINV directs DFSORT not to use control interval access.


COBEXIT

Temporarily overrides the COBEXIT installation option, which specifies the library for COBOL E15 and E35 routines.

COB1 specifies that COBOL E15 and E35 routines are run with the OS/VS COBOL run-time library or, in some cases, with no COBOL run-time library.

COBEXIT=COB1 is obsolete, but is still available for compatibility reasons.

Note that Language Environment® is the only run-time library for COBOL supported by IBM service.

COB2 specifies that COBOL E15 and E35 routines are run with either the VS COBOL II run-time library or the Language Environment run-time library.

Note that Language Environment is the only run-time library for COBOL supported by IBM service.

Note: The DFSORT documents only discuss the Language Environment run-time library, and assume that COBEXIT=COB2 is in effect. Although it is possible to run with older run-time libraries, and with COBEXIT=COB1, these are not recommended or discussed, and are not supported by IBM service.
Using The EXEC Statement

**Default:** Usually the installation default. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.

**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT Options,” on page 857.

**DSA**

```
>> DSA=n
```

Temporarily overrides the DSA installation option, which specifies the maximum amount of storage available to DFSORT for dynamic storage adjustment of a Blockset sort application when SIZE/MAINSIZE=MAX is in effect. For more information, see the discussion of the DSA option in the "OPTION Control Statement" on page 173.

- **n** specifies that DFSORT can dynamically adjust storage to improve performance, subject to a limit of n MB. n must be a value between 0 and 2000. If n is less than or equal to the TMAXLIM value in effect, n is set to 0 to indicate that storage will not be dynamically adjusted.

**Default:** Usually the installation default. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.

**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT Options,” on page 857.

**DSPSIZE**

```
>> DSPSIZE=MAX
```

```
>> DSPSIZE=n
```

Temporarily overrides the DSPSIZE installation option which specifies the maximum amount of data space to be used for dataspace sorting. For more information, see the discussion of the DSPSIZE option in the "OPTION Control Statement" on page 173.

- **MAX** specifies that DFSORT dynamically determines the maximum amount of data space to be used for dataspace sorting. In this case, DFSORT bases its data space usage on the size of the file being sorted and the paging activity of the system.

- **n** specifies the maximum amount, in megabytes, of data space to be used for dataspace sorting. n must be a value between 0 and 9999. The actual amount of data space used does not exceed n, but may be less depending on the size of the file being sorted and the paging activity of the system.

  If n is zero, dataspace sorting is not used.

**Default:** Usually the installation default. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.
Using The EXEC Statement


**DYNAALLOC**

```
  DYNALLOC
    d
    (d,n)
    (d,n)
```

Specifies that DFSORT dynamically allocates needed work space. You do not need to calculate and use JCL to specify the amount of work space needed by the program.

For more information, see the discussion of the DYNALLOC option in “OPTION Control Statement” on page 173 and Appendix A, “Using Work Space,” on page 847.

d specifies the device name. You can specify any IBM disk or tape device supported by your operating system in the same way you would specify it in the JCL UNIT parameter. You can also specify a group name, such as DISK or SYSDA.

-For best performance, specify an emulated 33909 device (such as a RAMAC-) or another highspeed IBM disk device, and avoid specifying a tape, virtual (VIO) or real 33909 device.

n specifies the maximum number of requested work data sets. If you specify more than 255, a maximum of 255 data sets is used. If you specify 1 and the Blockset technique is selected, a maximum of 2 data sets is used. If you specify more than 32 and the Blockset technique is not selected, a maximum of 32 data sets is used.

**Note:** For optimum allocation of resources such as virtual storage, avoid specifying a large number of work data sets unnecessarily.


**DYNAALLOC=OFF**

```
  DYNALLOC=OFF
```

Directs DFSORT not to allocate intermediate workspace dynamically. It overrides installation option DYNAUTO=YES or the DYNALLOC parameter (without OFF) specified at run-time. For more information, see the discussion of the DYNALLOC option in “OPTION Control Statement” on page 173.

**OFF**

directs DFSORT not to allocate intermediate workspace dynamically.
DYNAPCT

specifies additional work data sets to be dynamically allocated with zero space. DFSORT only extends these data sets when necessary to complete a sort application. The availability of additional work data sets can help avoid out of space ABENDs.

\[ x \]

specifies the number of additional work data sets (y) as a percentage of the maximum number of dynamically allocated work data sets (DYNALLOC/DYNALOC n value) in effect. y will be set to \( n \times x\% \). The total number of dynamically allocated work data sets will be \( n + y \). For example, if DYNALLOC=(SYSDA,20) and DYNAPCT=20 are in effect, 4 additional work data sets will be allocated for a total of 24.

The value \( x \) must be between 0 and 254. The minimum value for \( y \) is 1 and the maximum value for \( y \) is 254. The maximum value for \( n + y \) is 255; if \( x \) results in a value for \( n + y \) greater than 255, \( y \) will be set to 255-n.

OLD

specifies additional work data sets should only be allocated when DFSORT cannot determine the file size. When DFSORT is able to determine the file size, additional work data sets will not be allocated (\( y=0 \)), and the total number of work data sets will be \( n \).

Note: When message ICE118I is issued indicating that DFSORT cannot determine the file size, \( y \) is set as follows:

- For DYNAPCT=OLD, \( y \) is set to \( n \times 50\% \)
- For DYNAPCT=x with \( x \leq 50 \), \( y \) is set to \( n \times 50\% \)
- For DYNAPCT=x with \( x > 50 \), \( y \) is set to \( n \times x\% \)


DYNSPC

Temporarily overrides the DYNSPC installation option, which specifies the total default primary space allocation for all of the dynamically allocated work data sets when the input file size is unknown. That is, when DFSORT cannot determine the input file size for a sort application and the number of records is
not supplied by a FILSZ or SIZE value. For more information, see the discussion of the DYNSPC option in "OPTION Control Statement" on page 173.

n specifies the total default primary space, in megabytes, to be allocated for all dynamically allocated work data sets (n is not the primary space for each data set). n must be a value between 1 and 65535.

Do not specify a value which exceeds the available disk space, because this causes dynamic allocation to fail for sort applications that use this value.


EFS

Temporarily overrides the EFS installation option, which specifies whether DFSORT passes control to an EFS program. See Chapter 9, “Using Extended Function Support,” on page 763 for more information on EFS.

name specifies the name of the EFS program that will be called to interface with DFSORT.

NONE means no call will be made to the EFS program.

Note: If you use locale processing for SORT, MERGE, INCLUDE, or OMIT fields, you must not use an EFS program. DFSORT’s locale processing may eliminate the need for an EFS program. See “OPTION Control Statement” on page 173 for information related to locale processing.


EQUALS or NOEQUALS

Temporarily overrides the EQUALS installation option, which specifies whether the original sequence of records that collate identically for a sort or a merge should be preserved from input to output. For more information, see the discussion of the EQUALS and NOEQUALS options in "OPTION Control Statement” on page 173.

EQUALS specifies that the original sequence must be preserved.
Using The EXEC Statement

**NOEQUALS** specifies that the original sequence need not be preserved.


**E15=COB**

Specifies that your E15 routine is written in COBOL and temporarily overrides the MODS statement for E15. If you specify E15=COB but do not identify an E15 module with a MODS statement, the E15=COB is ignored.

*Default:* None; optional. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.


**E35=COB**

Specifies that your E35 routine is written in COBOL and temporarily overrides the MODS statement for E35. If you specify E35=COB but do not identify an E35 module with a MODS statement, the E35=COB is ignored.

*Default:* None; optional. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.


**FILSZ**

Specifies either the exact number of records to be sorted or merged, or an estimate of the number of records to be sorted. This record count is used by DFSORT for two purposes:

1. To check that the actual number of records sorted or merged is equal to the exact number of records expected. FILSZ=x causes this check to be performed and results in termination with message ICE047A if the check fails.
Using The EXEC Statement

2. To determine the input file size for a sort application. DFSORT performs calculations based on the user supplied record count and other parameters (such as AVGRLEN) to estimate the total number of bytes to be sorted. This value is important for sort applications, since it is used for several internal optimizations as well as for dynamic work data set allocation (see OPTION DYNALLOC). If no input record count (or only an estimate) is supplied for the sort application, DFSORT attempts to automatically compute the file size to be used for the optimizations and allocations.

The type of FILSZ value specified (x, Ex, Ux, or none) controls the way DFSORT performs the above two functions, and can have a significant effect on performance and work data set allocation. See “Specify Input/Output Data Set Characteristics Accurately” on page 799 and “Allocation of Work Data Sets” on page 849 for more information on file size considerations.

x specifies the exact number of records to be sorted or merged. This value is always used for both the record check and file size calculations. FILSZ=x can be used to force DFSORT to perform file size calculations based on x, and to cause DFSORT to terminate the sort or merge application if x is not exact.

If installation option FSZEST=NO is in effect and FILSZ=x is specified, DFSORT terminates if the actual number of records is different from the specified value (x), the actual number of records placed in the IN field of message ICE047A (or message ICE054I) before termination. However, if installation option FSZEST=YES is in effect, DFSORT treats FILSZ=x like FILSZ=Ex; it does not terminate when the actual number of records does not equal x.

The specified value (x) must take into account the number of records in the input data sets, records to be inserted or deleted by exit E15 or E32, and records to be deleted by the INCLUDE/OMIT statement, SKIPREC, and STOPAFT. x must be changed whenever the number of records to be sorted or merged changes in any way.

FILSZ=0 causes Hipersorting, dataspace sorting, and dynamic allocation of work space not to be used, and results in termination with the message ICE047A unless the number of records sorted or merged is 0.

Limit: 28 digits (15 significant digits)

Ex specifies an estimated number of records to be sorted. This value is not used for the record check. It is used for file size calculations, but only if DFSORT could not automatically compute the file size. In all other cases, this value is ignored by DFSORT. See “Dynamic Allocation of Work Data Sets” on page 850 for details on exactly when FILSZ=Ex is used or ignored by DFSORT.

The specified value (x) should take into account the number of records in the input data sets, records to be inserted or deleted by exit E15, and records to be deleted by the INCLUDE/OMIT statement, SKIPREC, and STOPAFT. x should be changed whenever the number of records to be sorted changes significantly.

FILSZ=Ex will always be ignored.

Limit: 28 digits (15 significant digits)

Ux specifies the number of records to be sorted. This value is not used for the record check, but is always used for file size calculations. FILSZ=Ux can be used to force DFSORT to perform file size calculations based on x, while avoiding termination if x is not exact.
The FSZEST installation option has no effect on FILSZ=Ux processing. The specified value (x) should take into account the number of records in the input data sets, records to be inserted or deleted by exit E15, and records to be deleted by the INCLUDE/OMIT statement, SKIPREC, and STOPAFT. x should be changed whenever the number of records to be sorted changes significantly.

FILSZ=U0 causes Hipersorting, dataspace sorting, and dynamic allocation of work space not to be used, and can cause degraded performance or termination with the message ICE046A, if the actual number of records to be sorted is significantly larger than 0.

Limit: 28 digits (15 significant digits)

Table 4 summarizes: the differences for the three FILSZ variations

Table 4. FILSZ Variations Summary.

| FILSZ=n is equivalent to FILSZ=En if installation option FSZEST=YES is specified. |
|-----------------------------------------|-------------------|-------------------|-------------------|
| FILSZ=n | FILSZ=Un | FILSZ=En |
|-----------------|-----------------|
| **Number of records** | Exact | Estimate | Estimate |
| **Applications** | Sort, merge | Sort | Sort |
| **Terminate if wrong?** | Yes | No | No |
| **Use for file size calculation?** | Yes | Yes | When DFSORT cannot compute file size |

n includes records:

| In input data sets | Yes | Yes | Yes |
| Inserted/deleted by E15 | Yes | Yes | Yes |
| Inserted by E32 | Yes | No | No |
| Deleted by INCLUDE/OMIT statement | Yes | Yes | Yes |
| Deleted by SKIPREC | Yes | Yes | Yes |
| Deleted by STOPAFT | Yes | Yes | Yes |

Update n when number of records changes:

| In any way | Significantly | Significantly |
| Effects of n=0 | Hipersorting and DYNALLOC not used | Hipersorting and DYNALLOC not used | None |

Note: Using the FILSZ parameter to supply inaccurate information to DFSORT can negatively affect DFSORT's performance, and when work space is dynamically allocated, can result in wasted disk space or termination with message ICE083A or ICE046A. Therefore, it is important to update the record count value whenever the number of records to be sorted changes significantly.


HIPRMAX

TEMPorarily overrides the HIPRMAX installation option, which specifies the maximum amount of Hiperspace to be used for Hipersorting. For more information, see the discussion of the HIPRMAX option in the OPTION Control Statement on page 173.

OPTIMAL

specifies that DFSORT determines dynamically the maximum amount of Hiperspace to be used for Hipersorting.

\[ n \]

specifies that DFSORT determines dynamically the maximum amount of Hiperspace to be used for Hipersorting, subject to a limit of \( n \)MB. \( n \) must be a value between 0 and 32767. If \( n \) is 0, Hipersorting is not used.

\[ p\% \]

specifies that DFSORT determines dynamically the maximum amount of hiperspace to be used for Hipersorting, subject to a limit of \( p \) percent of an appropriate portion of central storage. \( p \) must be a value between 0 and 100. If \( p \) is 0, Hipersorting is not used. The value calculated for \( p\% \) is limited to 32767MB, and is rounded down to the nearest MB.


LIST or NOLIST

TEMPorarily overrides the LIST installation option, which specifies whether DFSORT program control statements should be written to the message data set. See z/OS DFSORT Messages, Codes and Diagnosis Guide for full details on use of the message data set.

LIST

specifies that all DFSORT control statements are printed on the message data set.

NOLIST

specifies that DFSORT control statements are not printed.


LISTX or NLISTX

Temporarily overrides the LISTX installation option, which specifies whether DFSORT writes to the message data set the program control statements returned by an EFS program. See z/OS DFSORT Messages, Codes and Diagnosis Guide for full details on use of the message data set.

LISTX specifies that control statements returned by an EFS program are printed to the message data set.

NLISTX specifies that control statements returned by an EFS program are not printed to the message data set.

Notes:
1. If EFS=NONE is in effect after final override rules have been applied, NLISTX will be set in effect.
2. LISTX and NLISTX can be used independently of LIST and NLIST.
3. For more information on printing EFS control statements, see z/OS DFSORT Messages, Codes and Diagnosis Guide.


LOCALE

Temporarily overrides the LOCALE installation option, which specifies whether locale processing is to be used and, if so, designates the active locale. For more information, see the discussion of the LOCALE option in “OPTION Control Statement” on page 173.

name specifies that locale processing is to be used and designates the name of the locale to be made active during DFSORT processing.

The locales are designated using a descriptive name. For example, to set the active locale to represent the French language and the cultural conventions of Canada, specify LOCALE=FR_CA. You can specify up to 32 characters for the descriptive locale name. The locale names themselves are not case-sensitive. See Using Locales for complete locale naming conventions.

You can use IBM-supplied and user-defined locales.
The state of the active locale prior to DFSORT being entered will be restored on DFSORT’s completion.

**CURRENT** specifies that locale processing is to be used, and the current locale active when DFSORT is entered will remain the active locale during DFSORT processing.

**NONE** specifies that locale processing is not to be used. DFSORT will use the binary encoding of the code page defined for your data for collating and comparing.


**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT Options,” on page 857.

**MOSIZE**

```
MOSIZE= MAX

n

%p
```

Temporarily overrides the MOSIZE installation option, which specifies the maximum amount of memory object storage to be used for memory object sorting. For more information, see the discussion of the MOSIZE option in “OPTION Control Statement” on page 173.

**MAX** specifies that DFSORT determines dynamically the maximum amount of memory object storage to be used for memory object sorting.

**n** specifies that DFSORT determines dynamically the maximum amount of memory object storage to be used for memory object sorting, subject to a limit of nMB. n must be a value between 0 and 2147483646. If n is 0, memory object sorting is not used.

**%p** specifies that DFSORT determines dynamically the maximum amount of memory object storage to be used for memory object sorting, subject to a limit of p percent of the available central storage. p must be a value between 0 and 100. If p is 0, memory object sorting is not used. The value calculated for p% is limited to 2147483646MB, and is rounded down to the nearest MB.


**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT Options,” on page 857.

**MOWRK or NOMOWRK**

```
MOWRK
NOMOWRK
```

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Using The EXEC Statement

Temporarily overrides the MOWRK installation option, which specifies whether the memory object storage available to DFSORT for memory object sorting can be used as intermediate work space. DFSORT has the capability of using memory object storage as intermediate work space (similar to the way Hiperspace is used but more efficient), or as an extension of main storage. Using memory object storage as intermediate work space is the preferred and recommended choice, but can be disabled, if appropriate.

**MOWRK** specifies that memory object storage can be used as intermediate work space, or as an extension of main storage, as appropriate.

**NOMOWRK** specifies that memory object storage can only be used as an extension of main storage.


**MSGDDN**

```plaintext
>>> MSGDDN=ddname
```

Temporarily overrides the MSGDDN installation option, which specifies an alternate ddname for the message data set. For more information, see the discussion of the MSGDDN option in the OPTION Control Statement” on page 173.

The ddname can be any 1- through 8-character name, but must be unique within the job step; do not use a name that is used by DFSORT (for example, SORTIN). If the ddname specified is not available at run-time, SYSOUT is used instead. For details on using the message data set, see z/OS DFSORT Messages, Codes and Diagnosis Guide.

*Note:* MSGDD=ddname can be used instead of MSGDDN=ddname.


**MSGPRT**

```plaintext
>>> MSGPRT= ALL
    CRITICAL
    NONE
```

Using The EXEC Statement

Temporarily overrides the MOWRK installation option, which specifies whether the memory object storage available to DFSORT for memory object sorting can be used as intermediate work space. DFSORT has the capability of using memory object storage as intermediate work space (similar to the way Hiperspace is used but more efficient), or as an extension of main storage. Using memory object storage as intermediate work space is the preferred and recommended choice, but can be disabled, if appropriate.

**MOWRK** specifies that memory object storage can be used as intermediate work space, or as an extension of main storage, as appropriate.

**NOMOWRK** specifies that memory object storage can only be used as an extension of main storage.


**MSGDDN**

```plaintext
>>> MSGDDN=ddname
```

Temporarily overrides the MSGDDN installation option, which specifies an alternate ddname for the message data set. For more information, see the discussion of the MSGDDN option in the OPTION Control Statement” on page 173.

The ddname can be any 1- through 8-character name, but must be unique within the job step; do not use a name that is used by DFSORT (for example, SORTIN). If the ddname specified is not available at run-time, SYSOUT is used instead. For details on using the message data set, see z/OS DFSORT Messages, Codes and Diagnosis Guide.

*Note:* MSGDD=ddname can be used instead of MSGDDN=ddname.


**MSGPRT**

```plaintext
>>> MSGPRT= ALL
    CRITICAL
    NONE
```
Using The EXEC Statement

Temporarily overrides the MSGPRT installation option, which specifies the class of messages to be written to the message data set. See z/OS DFSORT Messages, Codes and Diagnosis Guide for full details on use of the message data set.

**ALL** specifies that all messages except diagnostic messages ICE800I to ICE999I are printed on the message data set. Control statements are printed only if LIST is in effect.

**CRITICAL** specifies that only critical messages are printed on the message data set. Control statements are printed only if LIST is in effect.

**NONE** specifies that no messages or control statements are printed.

**Note:** The forms FLAG(I) | FLAG(U) | NOFLAG, and MSG={NO|NOF|AB|AP|AC|CB|CC|CP|PC|SC|SP} are also accepted. The following table lists the equivalent MSGPRT/MSGCON specifications for these alternate forms:

<table>
<thead>
<tr>
<th>Option</th>
<th>MSGPRT</th>
<th>MSGCON</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>NONE</td>
<td>NONE</td>
</tr>
<tr>
<td>NOF</td>
<td>NONE</td>
<td>NONE</td>
</tr>
<tr>
<td>AB</td>
<td>ALL</td>
<td>ALL</td>
</tr>
<tr>
<td>AP</td>
<td>ALL</td>
<td>CRITICAL</td>
</tr>
<tr>
<td>AC</td>
<td>NONE</td>
<td>ALL</td>
</tr>
<tr>
<td>CB</td>
<td>CRITICAL</td>
<td>CRITICAL</td>
</tr>
<tr>
<td>CC</td>
<td>NONE</td>
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</tr>
<tr>
<td>CP</td>
<td>CRITICAL</td>
<td>CRITICAL</td>
</tr>
<tr>
<td>PC</td>
<td>ALL</td>
<td>ALL</td>
</tr>
<tr>
<td>SC</td>
<td>ALL</td>
<td>CRITICAL</td>
</tr>
<tr>
<td>SP</td>
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</tr>
<tr>
<td>FLAG(U)</td>
<td>CRITICAL</td>
<td>CRITICAL</td>
</tr>
</tbody>
</table>

*Figure 5. Aliases for MSGPRT/MSGCON Options*

**Default:** Usually the installation default. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.

**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT Options,” on page 857.

**NULLOUT**
Using The EXEC Statement

Temporarily overrides the NULLOUT installation option, which specifies the action to be taken by DFSORT when there are no records for the SORTOUT data set. For more information, see the discussion of the NULLOUT option in “OPTION Control Statement” on page 173.

RC0 specifies that DFSORT should issue message ICE173I, set a return code of 0, and continue processing when there are no records for the SORTOUT data set.

RC4 specifies that DFSORT should issue message ICE173I, set a return code of 4, and continue processing when there are no records for the SORTOUT data set.

RC16 specifies that DFSORT should issue message ICE206A, terminate, and give a return code of 16 when there are no records for the SORTOUT data set.


ODMAXBF

Temporarily overrides the ODMAXBF installation option, which specifies the maximum buffer space DFSORT can use for each OUTFIL data set. For more information, see the discussion of the ODMAXBF option in “OPTION Control Statement” on page 173.

n specifies that a maximum of n bytes of buffer space is to be used for each OUTFIL data set. If you specify less than 262144, 262144 is used. If you specify more than 16777216, 16777216 is used.

Limit: 8 digits

nK specifies that a maximum of n times 1024 bytes of buffer space is to be used for each OUTFIL data set. If you specify less than 256K, 256K is used. If you specify more than 16384K, 16384K is used.

Limit: 5 digits

nM specifies that a maximum of n times 1048576 bytes of buffer space is to be used for each OUTFIL data set. If you specify 0M, 256K is used. If you specify more than 16M, 16M is used.

Limit: 2 digits

OUTREL or NOOUTREL

Temporarily overrides the OUTREL installation option, which specifies whether unused temporary output data set space is to be released.

**OUTREL**
- specifies that unused temporary output data set space is released.

**NOOUTREL**
- specifies that unused temporary output data set space is not released.

**Note:** RLSOUT and NORLSOUT can be used instead of OUTREL and NOOUTREL, respectively.

**Default:** Usually the installation default. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.

**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT Options,” on page 857.

OVFLO

Temporarily overrides the OVFLO installation option, which specifies the action to be taken by DFSORT when BI, FI, PD or ZD summary fields overflow. For more information, see the discussion of the OVFLO option in “OPTION Control Statement” on page 173.

**RC0**
- specifies that DFSORT should issue message ICE152I (once), set a return code of 0 and continue processing when summary fields overflow.

**RC4**
- specifies that DFSORT should issue message ICE152I (once), set a return code of 4 and continue processing when summary fields overflow.

**RC16**
- specifies that DFSORT should issue message ICE195A, terminate and give a return code of 16 when summary fields overflow.

**Default:** Usually the installation default. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.

**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT Options,” on page 857.

PAD
Using The EXEC Statement

**PAD=RC0**

Temporarily overrides the PAD installation option, which specifies the action to be taken by DFSORT when the SORTOUT LRECL is larger than the SORTIN/SORTINnn LRECL, for the cases where DFSORT allows LRECL padding. For more information, see the discussion of the PAD option in "OPTION Control Statement" on page 173.

**RC0**
specifies that DFSORT should issue message ICE171I (once), set a return code of 0 and continue processing when the SORTOUT LRECL is larger than the SORTIN/SORTINnn LRECL.

**RC4**
specifies that DFSORT should issue message ICE171I, set a return code of 4 and continue processing when the SORTOUT LRECL is larger than the SORTIN/SORTINnn LRECL.

**RC16**
specifies that DFSORT should issue message ICE196A, terminate and give a return code of 16 when the SORTOUT LRECL is larger than the SORTIN/SORTINnn LRECL.

**Default:** Usually the installation default. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.

**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT Options,” on page 857.

**RESALL**

Temporarily overrides the RESALL installation option, which specifies the number of bytes to be reserved in a REGION for system use when SIZE/MAINSIZE=MAX is in effect. For more information, see the discussion of the RESALL option in "OPTION Control Statement" on page 173.

**n**
specifies that n bytes of storage are to be reserved. If you specify less than 4096, 4096 is used.

Limit: 8 digits.

**nK**
specifies that n times 1024 bytes of storage are to be reserved. If you specify less than 4K, 4K is used.

Limit: 5 digits.

**nM**
specifies that n times 1048576 bytes of storage are to be reserved. If you specify 0M, 4K is used.

Limit: 2 digits.

**Note:** RESERVE=value can be used instead of RESALL=value.
RESET or NORESET

Temporarily overrides the RESET installation option, which specifies whether DFSORT should process a VSAM output data set defined with REUSE as a NEW or MOD data set.

RESET specifies that DFSORT processes a VSAM output data set defined with REUSE as a NEW data set. The high-used RBA is reset to zero and the output data set is effectively treated as an initially empty cluster.

NORESET specifies that DFSORT processes a VSAM output data set defined with REUSE as a MOD data set. The high-used RBA is not reset and the output data set is effectively treated as an initially non-empty cluster.

Note: A VSAM output data set defined without REUSE is processed as a MOD data set.

SDB

Temporarily overrides the SDB installation option, which specifies whether DFSORT should use the system-determined optimum block size for output data sets when the block size is specified as zero or defaulted to zero. For more information, see the discussion of the SDB option in “OPTION Control Statement” on page 173.

LARGE specifies that DFSORT is to use the system-determined optimum block size for an output data set when its block size is zero. SDB=LARGE allows DFSORT to select a block size greater than 32760 bytes for a tape output data set, when appropriate.
Using The EXEC Statement

**YES**
specifies that DFSORT is to use the system-determined optimum block size for an output data set when its block size is zero, but is to limit the selected block size to a maximum of 32760 bytes.

**INPUT**
specifies that DFSORT is to use the system-determined optimum block size for an output data set when its block size is zero, but is to limit the selected block size to a maximum of 32760 bytes if the input block size is less than or equal to 32760 bytes.

**NO**
specifies that DFSORT is not to use the system-determined optimum block size.

**Note:** SDB, SDB=ON, and SDB=SMALL can be used instead of SDB=YES. NOSDB and SDB=OFF can be used instead of SDB=NO.

**Default:** Usually the installation default. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.

**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT Options,” on page 857.

**SIZE**

Temporarily overrides the SIZE installation option, which specifies the amount of main storage available to DFSORT. For more information, see the discussion of the MAINSIZE option in “OPTION Control Statement” on page 173.

- **n** specifies that n bytes of storage are to be allocated. If you specify more than 2097152000, 2097152000 is used.
  - Limit: 10 digits.
- **nK** specifies that n times 1024 bytes of storage are to be allocated. If you specify more than 2048000K, 2048000K is used.
  - Limit: 7 digits.
- **nM** specifies that n times 1048576 bytes of storage are to be allocated. If you specify more than 2000M, 2000M is used.
  - Limit: 4 digits.
- **MAX** instructs DFSORT to calculate the amount of virtual storage available and allocate an amount of storage up to the TMAXLIM or DSA value when Blockset is selected, or up to the MAXLIM value when Blockset is not selected.
- **MAX-m** specifies the RESALL value (m) in bytes. MAX-m instructs DFSORT to
Using The EXEC Statement

calculate the amount of storage available and allocate this amount up to the MAX value minus the amount of storage reserved for system and application use (RESALL).

If you specify less than 4096 for m, 4096 is used.

Limit for m: 8 digits.

**MAX=mK**

specifies the RESALL value (m times 1024) in KBs. MAX=mK instructs DFSORT to calculate the amount of storage available and allocate this amount up to the MAX value minus the amount of storage reserved for system and application use (RESALL).

If you specify less than 4K for m, 4K is used.

Limit for m: 5 digits.

**MAX=mM**

specifies the RESALL value (m times 1048576) in s. MAX=mM instructs the program to calculate the amount of storage available and allocate this amount up to the MAX value minus the amount of storage reserved for system and application use (RESALL).

If you specify 0M for m, 4K is used.

Limit for m: 2 digits.

**Note:** The forms SIZE(value), CORE=value, and CORE(value) can be used instead of SIZE=value.


**SKIPREC**

```plaintext
>>>SKIPREC=z
```

Specifies the number of records (z) you want to skip (delete) before starting to sort or copy the input data set. SKIPREC is typically used to bypass records not processed from the previous DFSORT job. For more information, see the discussion of the SKIPREC option in “OPTION Control Statement” on page 173.

z specifies the number of records to be skipped.

Limit: 28 digits (15 significant digits).

*Default:* None; optional. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.


**SOLRF or NOSOLRF**
Using The EXEC Statement

Temporarily overrides the SOLRF installation option, which specifies whether DFSORT should set the SORTOUT LRECL to the reformatted record length when the SORTOUT LRECL is unknown. For more information, see the discussion of the SOLRF and NOSOLRF options in “OPTION Control Statement” on page 173.

SOLRF specifies that DFSORT should use the reformatted record length for the SORTOUT LRECL when the SORTOUT LRECL is not specified or available.

NOSOLRF specifies that DFSORT should not use the reformatted record length for the SORTOUT LRECL.


SPANINC

Temporarily overrides the SPANINC installation option, which specifies the action to be taken by DFSORT when one or more incomplete spanned records are detected in a variable spanned input data set. For more information, see the discussion of the SPANINC option in “OPTION Control Statement” on page 173.

RC0 specifies that DFSORT should issue message ICE197I (once), set a return code of 0 and eliminate all incomplete spanned records it detects.

RC4 specifies that DFSORT should issue message ICE197I (once), set a return code of 4 and eliminate all incomplete spanned records it detects.

RC16 specifies that DFSORT should issue message ICE204A, terminate and give a return code of 16 when an incomplete spanned record is detected.


STOPAFT
Using The EXEC Statement

---

**STOPAFT=n**

Specifies the maximum number of records you want accepted for sorting or copying (that is, read from SORTIN or inserted by E15 and not deleted by SKIPREC, E15, or an INCLUDE/OMIT statement). For more information, see the discussion of the STOPAFT option in “OPTION Control Statement” on page 173.

n specifies the maximum number of records to be accepted.

Limit: 28 digits (15 significant digits).

**Note:** If you specify (1) FILSZ=x in the EXEC PARM, or (2) SIZE=x or FILSZ=x on the OPTION or SORT statement, and the number of records accepted for processing does not equal x, DFSORT issues an error message and terminates unless installation option FSZEST=YES was specified.

**Default:** None; optional. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.

**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT Options,” on page 857.

---

**SZERO or NOSZERO**

Temporarily overrides the SZERO installation option, which specifies whether DFSORT should treat numeric 0 and 0 values as signed (that is, different) or unsigned (that is, the same) for collation, comparisons, editing, conversions, minimums and maximums. For more information, see the discussion of the SZERO and NOSZERO options in “OPTION Control Statement” on page 173.

**SZERO** specifies that DFSORT should treat numeric zero values as signed.

**NOSZERO** specifies that DFSORT should treat numeric zero values as unsigned.

**Default:** Usually the installation default. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.

**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT Options,” on page 857.

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**TRUNC**
Temporarily overrides the TRUNC installation option, which specifies the action to be taken by DFSORT when the SORTOUT LRECL is smaller than the SORTIN/SORTINnn LRECL, for the cases where DFSORT allows LRECL truncation. For more information, see the discussion of the TRUNC option in "OPTION Control Statement" on page 173.

**RC0**
- specifies that DFSORT should issue message ICE171I, set a return code of 0 and continue processing when the SORTOUT LRECL is smaller than the SORTIN/SORTINnn LRECL.

**RC4**
- specifies that DFSORT should issue message ICE171I, set a return code of 4 and continue processing when the SORTOUT LRECL is smaller than the SORTIN/SORTINnn LRECL.

**RC16**
- specifies that DFSORT should issue message ICE196A, terminate and give a return code of 16 when the SORTOUT LRECL is smaller than the SORTIN/SORTINnn LRECL.

**Default:** Usually the installation default. See Appendix B, “Specification/Override of DFSORT Options,” on page 857.

**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT Options,” on page 857.

**VERIFY or NOVERIFY**

Temporarily overrides the VERIFY installation option, which specifies whether sequence checking of the final output records must be performed.

**VERIFY**
- specifies that sequence checking is performed.

**NOVERIFY**
- specifies that sequence checking is not performed.

**Notes:**
1. Using VERIFY can degrade performance.
2. SEQ=YES can be used instead of VERIFY. SEQ=NO can be used instead of NOVERIFY.

**Default:** Usually the installation default. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.

**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT Options,” on page 857.
Using The EXEC Statement

**VLLONG or NOVLLONG**

Temporarily overrides the VLLONG installation option, which specifies whether DFSORT is to truncate “long” variable-length output records. For more information, see the discussion of the VLLONG and NOVLLONG options in “OPTION Control Statement” on page 173.

**VLLONG**

specifies that DFSORT truncates long variable-length output records to the LRECL of the SORTOUT or OUTFIL data set.

**NOVLLONG**

specifies that DFSORT terminates if a long variable-length output record is found.


**VLSCMP or NOVLSCMP**

Temporarily overrides the VLSCMP installation option, which specifies whether DFSORT is to pad “short” variable-length INCLUDE/OMIT compare fields with binary zeroes. For more information, see the discussion of the VLSCMP and NOVLSCMP options in “OPTION Control Statement” on page 173.

**VLSCMP**

specifies that short variable-length compare fields are padded with binary zeros.

**NOVLSCMP**

specifies that short variable-length compare fields are not padded.


Temporarily overrides the VLSHRT installation option, which specifies whether DFSORT is to continue processing if a "short" variable-length SORT/MERGE control field, INCLUDE/OMIT compare field, or SUM summary field is found. For more information, see the discussion of the VLSHRT and NOVLSHRT options in the "OPTION Control Statement" on page 173.

**VLSHRT**  
specifies that DFSORT continues processing if a short control field or compare field is found.

**NOVLSHRT**  
specifies that DFSORT terminates if a short control field or compare field is found.


**VSAMMT or NVSAMMT**

Temporarily overrides the VSAMMT installation option, which specifies whether DFSORT should accept an empty VSAM input data set.

**VSAMMT**  
specifies that DFSORT accepts an empty VSAM input data set and processes it as having zero records.

**NVSAMMT**  
specifies that DFSORT terminates if an empty VSAM input data set is found.

*Note:* VSAMMT=YES can be used instead of VSAMMT. VSAMMT=NO can be used instead of NVSAMMT.


**VSAMIO or NOVSAMIO**
Using The EXEC Statement

Temporarily overrides the VSAMIO installation option, which specifies whether DFSORT should allow a VSAM data set defined with REUSE to be sorted in-place.

VSAMIO specifies that DFSORT can use the same VSAM data set for input and output: when all of the following conditions are met
  • The application is a sort.
  • RESET is in effect.
  • The VSAM data set was defined with REUSE.

These conditions ensure that the VSAM data set is processed as NEW for output and will contain the sorted input records; that is it will be sorted in-place.

DFSORT terminates if the same VSAM data set is specified for input and output, and any of the above conditions are not met.

NOVSAMIO specifies that DFSORT terminates if the same VSAM data set is specified for input and output.


WRKREL or NOWRKREL

Temporarily overrides the WRKREL installation option, which specifies whether unused temporary SORTWKdd data set space will be released.

WRKREL specifies that unused space is released.

NOWRKREL specifies that unused space is not released.

Notes:
1. If you have dedicated certain volumes for SORTWKdd data sets, and you do not want unused temporary space to be released, you should specify NOWRKREL.
2. If WRKREL is in effect, DFSORT releases space for the SORTWKdd data sets just prior to termination. Space is released only for those SORTWKdd data sets that were used for the sort application.
3. RELEASE=OFF and RLS=0 can be used instead of NOWRKREL.
   RELEASE=ON and RLS=n (n greater than 0) can be used instead of WRKREL.


Using The EXEC Statement

**WRKSEC or NOWRKSEC**

Temporarily overrides the WRKSEC installation option, which specifies whether DFSORT uses automatic secondary allocation for temporary JCL SORTWKdd data sets.

**WRKSEC** specifies that automatic secondary allocation for temporary JCL SORTWKdd data sets is used and that 25 percent of the primary allocation will be used as the secondary allocation.

**NOWRKSEC** specifies that automatic secondary allocation for temporary JCL SORTWKdd data sets is not used.

**Note:** SECOND=OFF and SEC=0 can be used instead of NOWRKSEC. SECOND=ON and SEC=n (n greater than 0) can be used instead of WRKSEC.

**Default:** Usually the installation default. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.

**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT Options,” on page 857.

**Y2PAST**

Temporarily overrides the Y2PAST installation option, which specifies the sliding (s) or fixed (f) century window. The century window is used with DFSORT’s Y2 formats to correctly interpret two-digit year data values as four-digit year data values.

**s** specifies the number of years DFSORT is to subtract from the current year to set the beginning of the sliding century window. Since the Y2PAST value is subtracted from the current year, the century window slides as the current year changes. For example, Y2PAST=81 would set a century window of 1925-2024 in 2006 and 1926-2025 in 2007. s must be a value between 0 and 100.

**f** specifies the beginning of the fixed century window. For example, Y2PAST=1962 would set a century window of 1962-2061. f must be a value between 1000 and 3000.

**Note:** CENTWIN=value can be used instead of Y2PAST=value.

**Default:** Usually the installation default. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.
Using The EXEC Statement


**ZDPRINT or NZDPRINT**

Temporarily overrides the ZDPRINT installation option, which specifies whether positive zoned-decimal (ZD) fields resulting from summing must be converted to printable numbers. For more information, see the discussion of the ZDPRINT and NZDPRINT options in "OPTION Control Statement" on page 173.

**ZDPRINT**

means convert positive ZD summation results to printable numbers.

**NZDPRINT**

means do not convert positive ZD summation results to printable numbers.

**Note:** ZDPRINT=YES can be used instead of ZDPRINT. ZDPRINT=NO can be used instead of NZDPRINT.

**Default:** Usually the installation default. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.


### Aliases for PARM Options

For compatibility reasons, the following EXEC/DFSPARM PARM options can be specified by using the aliases listed below. See the indicated PARM options for complete details.

**Table 5. Aliases for PARM Options**

<table>
<thead>
<tr>
<th>Alias</th>
<th>PARM Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>CENTWIN=value</td>
<td>Y2PAST=value</td>
</tr>
<tr>
<td>CORE=value</td>
<td>SIZE=value</td>
</tr>
<tr>
<td>FLAG(I)</td>
<td>MSGPRT=ALL</td>
</tr>
<tr>
<td>FLAG(U)</td>
<td>MSGPRT=CRTICAL</td>
</tr>
<tr>
<td>L5=value</td>
<td>AVGRLEN=value</td>
</tr>
<tr>
<td>MSG=value</td>
<td>MSGPRT=value</td>
</tr>
<tr>
<td>MSGD=value</td>
<td>MSGDDN=value</td>
</tr>
<tr>
<td>NOFLAG</td>
<td>MSGPRT=NONE</td>
</tr>
<tr>
<td>NORC16</td>
<td>NOABEND</td>
</tr>
<tr>
<td>NORSLSOUT</td>
<td>NOOUTREL</td>
</tr>
<tr>
<td>NOSDB</td>
<td>SDB=NO</td>
</tr>
<tr>
<td>RC16=ABE</td>
<td>ABEND</td>
</tr>
<tr>
<td>RELEASE=ON</td>
<td>WRKREL</td>
</tr>
</tbody>
</table>
### Aliases for PARM Options

<table>
<thead>
<tr>
<th>Alias</th>
<th>PARM Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>RELEASE=OFF</td>
<td>NOWRKREL</td>
</tr>
<tr>
<td>RESERVE=value</td>
<td>RESALL=value</td>
</tr>
<tr>
<td>RESERVEX=value</td>
<td>AREALL=value</td>
</tr>
<tr>
<td>RLS=n</td>
<td>WRKREL</td>
</tr>
<tr>
<td>RLS=0</td>
<td>NOWRKREL</td>
</tr>
<tr>
<td>RLSOUT</td>
<td>OUTREL</td>
</tr>
<tr>
<td>SDB</td>
<td>SDB=YES</td>
</tr>
<tr>
<td>SDB=ON</td>
<td>SDB=YES</td>
</tr>
<tr>
<td>SDB=OFF</td>
<td>SDB=NO</td>
</tr>
<tr>
<td>SDB=SMALL</td>
<td>SDB=YES</td>
</tr>
<tr>
<td>SEC=n</td>
<td>WRKSEC</td>
</tr>
<tr>
<td>SEC=0</td>
<td>NOWRKSEC</td>
</tr>
<tr>
<td>SECOND=ON</td>
<td>WRKSEC</td>
</tr>
<tr>
<td>SECOND=OFF</td>
<td>NOWRKSEC</td>
</tr>
<tr>
<td>SEQ=YES</td>
<td>VERIFY</td>
</tr>
<tr>
<td>SEQ=NO</td>
<td>NOVERIFY</td>
</tr>
<tr>
<td>VSAMEMT=YES</td>
<td>VSAMEMT</td>
</tr>
<tr>
<td>VSAMEMT=NO</td>
<td>NVSAMEMT</td>
</tr>
<tr>
<td>ZDPRINT=YES</td>
<td>ZDPRINT</td>
</tr>
<tr>
<td>ZDPRINT=NO</td>
<td>NZDPRINT</td>
</tr>
</tbody>
</table>

### Using DD Statements

A DFSORT job always requires DD statements after the EXEC statement. DD statements fall into two categories:

- System DD statements (discussed in detail in “System DD Statements” on page 65).
- Program DD statements (discussed in detail in “Program DD Statements” on page 67).

System DD statements, and some program DD statements, are usually supplied automatically when you use a cataloged procedure. Others you must always supply yourself.

The DD statement parameters, the conditions under which they are required, and the default values, are summarized in Table 6 on page 63. The subparameters of the DCB parameter (a DD statement parameter) are described similarly in Table 7 on page 63.

**Notes:**

1. Performance is enhanced if the LRECL subparameter of the DCB is accurately specified for variable-length records. The maximum input record length you can specify for your particular configuration is given in “Data Set Notes and Limitations” on page 13.

2. When using DFSORT applications, FREE=CLOSE cannot be used on any DD statements except DFSPARM.
### Table 6. DD Statement Parameters Used by DFSORT

<table>
<thead>
<tr>
<th>Parameter</th>
<th>When Required</th>
<th>Parameter Values</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>{AMP</td>
<td>BUFSP}</td>
<td>When password-protected VSAM data sets are used and the password is supplied through E18, E38, or E39.</td>
<td>Minimum buffer pool value given when creating the data set.</td>
</tr>
<tr>
<td>DCB</td>
<td>Required when 7-track tape is used; for input on tape without standard labels; and when the default values are not applicable.</td>
<td>Specifies information used to fill the data control block (DCB) associated with the data set.</td>
<td>(See separate subparameters in Table 7)</td>
</tr>
<tr>
<td>DISP</td>
<td>When the default value is not applicable.</td>
<td>Indicates the status and disposition of the data set.</td>
<td>The system assumes (NEW, DELETE).</td>
</tr>
<tr>
<td>DSNAME or DSN</td>
<td>When the DD statement defines a labeled input data set (for example, SORTIN), or when the data set being created is to be kept or cataloged (for example, SORTOUT), or passed to another step.</td>
<td>Specifies the fully qualified or temporary name of the data set.</td>
<td>The system assigns a unique name.</td>
</tr>
<tr>
<td>LABEL</td>
<td>When the default value is not applicable.</td>
<td>Specifies information about labeling and retention for the data set.</td>
<td>The system assumes standard labeling.</td>
</tr>
<tr>
<td>SPACE</td>
<td>When the DD statement defines a new data set on disk.</td>
<td>Specifies the amount of space needed to contain the data set.</td>
<td>None.</td>
</tr>
<tr>
<td>UNIT</td>
<td>When the input data set is neither cataloged nor passed or when the data set is being created.</td>
<td>Specifies (symbolically or actually) the type and quantity of I/O units required by the data set.</td>
<td>None.</td>
</tr>
<tr>
<td>VOLUME or VOL</td>
<td>When the input data set is neither cataloged nor passed, for multireel input or when the output data set is on disk and is to be kept or cataloged.</td>
<td>Specifies information used to identify the volume or volumes occupied by the data set.</td>
<td>None.</td>
</tr>
</tbody>
</table>

### Table 7. DCB Subparameters Used by DFSORT

<table>
<thead>
<tr>
<th>Subparameter</th>
<th>Condition When Required</th>
<th>Subparameter Values</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUFOFF</td>
<td>When processing data in ASCII format.</td>
<td>Specifies the length of the buffer offset or specifies that the buffer offset is the block length indicator.</td>
<td></td>
</tr>
<tr>
<td>DEN</td>
<td>When the data set is located on a 7-track tape unit.</td>
<td>Specifies the density at which the tape was recorded.</td>
<td>800 bpi</td>
</tr>
<tr>
<td>OPTCD</td>
<td>When processing data in ASCII format.</td>
<td>Specifies that the tape processed is in ASCII format.</td>
<td></td>
</tr>
</tbody>
</table>
Using DD Statements

Table 7. DCB Subparameters Used by DFSORT (continued)

<table>
<thead>
<tr>
<th>Subparameter</th>
<th>Condition When Required</th>
<th>Subparameter Values</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRTCH</td>
<td>When the data set is located on a tape device with IDRC and system IDRC is not used.</td>
<td>Specifies whether data set is compacted.</td>
<td>System default option.</td>
</tr>
</tbody>
</table>
| BLKSIZE 1, 2 | When the DCB parameter is required and the default value is not suitable except on SORTWKdd statements. | Specifies the maximum length (in bytes) of the physical records in the data set. | • For old data sets, the value in the data set label.  
  • For new output data sets, appropriate values based on the input data set or RECORD statement values.  
  Unless SDB=NO is in effect, Blockset uses the system-determined optimum block size when the output data set block size is zero.  
  Applications which require a specific output data set block size should be changed to specify that block size EXPLICITLY.  
  • No default if input on unlabeled tape or BLP or NSL specified. |
| LRECL 2, 3   | Specifies the maximum length (in bytes) of the logical records in the data set. | | |
| RECFM        | Specifies the format of the records in the data set. | | |

Duplicate Ddnames

If you specify a particular ddname (such as SORTIN) more than once within the same step, DFSORT uses the first ddname and ignores subsequent duplicates. Processing continues normally.

In addition, SORTIN0, SORTIN1...SORTIN9 can be specified instead of SORTIN00, SORTIN01...SORTIN09, respectively. If you specify both SORTINn and SORTIN0n in the same job step, DFSORT treats them as duplicates, and ignores each usage after the first. For example, SORTIN2 and SORTIN02 are treated as duplicates and only SORTIN2 is used.

Note: For a Conventional merge, SORTINn will not be recognized because of the existing restriction which allows only SORTIN01, SORTIN02...SORTIN16. Duplicates of these accepted ddnames will be ignored.

Duplicate OUTFIL ddnames are ignored at the OUTFIL statement level as explained in “OUTFIL Statements Notes” on page 375.

Shared Tape Units

The following pairs of DFSORT data sets can be assigned to a single tape unit:

1. See "SORTIN DD Statement" on page 69 and "SORTINnn DD Statement" on page 71.
2. This is the only subparameter allowed for DD * data sets.
3. For padding and truncating fixed-length records, see “Data Set Notes and Limitations” on page 13.
Using DD Statements

- The SORTIN data set and the SORTWK01 data set (tape work data set sorts only)
- The SORTIN data set and the SORTOUT data set or one OUTFIL data set (sort applications only).

If you want to associate the SORTIN data set with SORTWK01, you can include the parameter UNIT=AFF=SORTIN in the DD statement for SORTWK01. The AFF subparameter causes the system to place the data set on the same unit as the dataset with the ddname following the subparameter (SORTIN, in this case).

In the same way, you can associate the SORTIN data set with the SORTOUT data set or an OUTFIL data set by including UNIT=AFF=SORTIN in the SORTOUT or OUTFIL DD statement.

SORTINnn tape data sets must all be on different tape units because they are read concurrently. SORTOUT and OUTFIL tape data sets must all be on different tape units because they are written concurrently.

System DD Statements

If you choose not to use the SORT or SORTD cataloged procedures to invoke DFSORT, you might need to supply system DD statements in your input job stream (See also the following section for DD statements dedicated to DFSORT, such as SORTIN). The DD statements contained in the cataloged procedure (or provided by you) are:

//JOBLIB DD
Defines your program link library if it is not already known to the system.

//STEPLIB DD
Same as //JOBLIB DD.

//SYSIN DD
Contains DFSORT control statements, comment statements, blank statements and remarks when DFSORT is invoked with JCL rather than by another program. It can also contain user exit routines, in object deck format, to be link-edited by DFSORT.
- If you use DFSPARM, then SYSIN is not necessary unless your job requires link-editing.
- The SYSIN data set usually resides in the input stream; however, it can be defined as a sequential data set or as a member of a partitioned data set.
- The data set must be defined with a RECFM of F or FB. The LRECL can be 80, or more (when valid). If the LRECL is greater than 80, DFSORT will use the first 80 bytes of each record. If user exit routines are in SYSIN, the LRECL must be 80.
- DFSORT supports concatenated SYSIN data sets to the extent that the system supports “like” concatenated data sets for BSAM. Refer to z/OS DFSMS Using Data Sets for further information about “like” concatenated data sets.

Note: The OPTION statement keywords EFS, LIST, NOLIST, LISTX, NOLISTX, LOCALE,
Using DD Statements

MSGPRT, MSGDDN, SMF, SORTDD, SORTIN, and SORTOUT are used only when they are passed by an extended parameter list or when in the DFSPARM data set. If they are specified on an OPTION statement read from the SYSIN or SORTCNTL data set, the keyword is recognized, but the parameters are ignored.

If you use the DFSPARM DD statement instead, you can specify both EXEC PARM options and DFSORT control statements in a single source data set that overrides all other sources. See "DFSPARM DD Statement" on page 77.

If user exit routines are in SYSIN, make sure that:
- The LRECL of SYSIN is 80.
- The END statement is the last control statement.
- The user exit routines are arranged in numeric order (for example, E11 before E15).
- The user exit routines are supplied immediately after the END control statement.
- Nothing follows the last object deck in SYSIN.
- A SORTMODS DD statement is included.

If DFSORT is program invoked, and you supply the DFSORT control statements through the 24-bit or extended parameter list, SORTCNTL, or DFSPARM, SYSIN remains the source of user exit routines placed in the system input stream.

//SYSOUT DD

Identifies the DFSORT message data set. The default ddname is SYSOUT, but you can specify an alternate ddname for the message data set using the MSGDDN installation or run-time option. Always supply a DD statement for the message data set if a catalogued procedure is not used. (If you are invoking DFSORT from a COBOL program and are using the ddname SYSOUT for the message data set, the use of DISPLAY in your COBOL program can produce uncertain printing results.)

DFSORT uses RECFM=FBA, LRECL=121, and the specified BLKSIZE for the message data set. If the BLKSIZE you specify is not a multiple of 121, DFSORT uses BLKSIZE=121. If you do not specify the BLKSIZE, DFSORT selects the block size as directed by the SDBMSG installation option (see z/OS DFSORT Installation and Customization).

If you use a temporary or permanent message data set, it is best to specify a disposition of MOD to ensure you see all messages and control statements in the message data set.

//SYSUDUMP DD

 Defines the data set for output from a system ABEND dump routine.
Using DD Statements

//SYSMDUMP DD  Same as //SYSUDUMP DD.
//SYSABEND DD  Same as //SYSUDUMP DD.

If you are using the supplied SORT cataloged procedure, the DD statements below are automatically supplied. If you are not using the SORT cataloged procedure and you are using the linkage editor, you must supply the following: DD statements

//SYSPRINT DD  Contains messages from the linkage editor.
//SYSUT1 DD  Defines the intermediate storage data set for the linkage editor.
//SYSLIN DD  Defines a data set for control information for the linkage editor.
//SYSLMOD DD  Defines a data set for output from the linkage editor.

Note: If you do not include user routines, or if you include user routines that do not require link-editing, you can use the supplied SORTD cataloged procedure. If you include user routines that require link-editing, you can use the SORT cataloged procedure.

Program DD Statements

Even if you use the SORT or SORTD cataloged procedure to invoke DFSORT, you might need to supply additional dedicated DD statements. The following list summarizes each of these statements, and a more detailed explanation of each one follows.

//SORTLIB DD  Defines the data set that contains special load modules for DFSORT. Can usually be omitted.
//SYMNAMES DD  Defines the SYMNAMES data set containing statements to be used for symbol processing. Required only if symbol processing is to be performed.
//SYMNOUS DD  Defines the data set in which SYMNAMES statements and the symbol table are to be listed. Optional if SYMNAMES DD is specified. Otherwise ignored.
//SORTIN DD  Defines the input data set for a sorting or copying application. Will not be used for a merging application.
//SORTINnn DD  Defines the input data sets for a merging application. Will not be used for a sorting or copying application.
//SORTWKdd DD  Defines intermediate storage data sets. Usually needed for a sorting application unless dynamic allocation is requested. Will not be used for a copying or merging application.
//SORTOUT DD  Defines the SORTOUT output data set for a sorting, merging, or copying application.
//outfil DD  Defines an OUTFIL output data set for a sorting, merging, or copying application.
Using DD Statements

//SORTCKPT DD Defines the data set used to store the information that the system needs to restart the sort from the last checkpoint. This is only needed if you are using the checkpoint facility.

//SORTCNTL DD Defines the data set from which additional or changed DFSORT control statements can be read when DFSORT is program-invoked.

//DFSPARM DD Defines the data set from which both additional or changed DFSORT program control statements and EXEC statement PARM options can be read when DFSORT is directly invoked or program invoked.

//SORTDKdd DD Defines the data set used for a VIO SORTWKdd allocation by DFSORT if it is dynamically reallocated; SORTDKdd must never be specified in the job stream.

//SORTDIAG DD Specifies that all messages and control statements are printed. Used primarily for diagnostics and debugging.

//SORTSNAP DD Defines the snap dump data set dynamically allocated by DFSORT. SORTSNAP must never be specified in the job stream.

//SORTMODS DD Defines a temporary partitioned data set. This temporary data set must be large enough to contain all your user exit routines that appear in SYSIN for a given application. If none of your routines appear in SYSIN, this statement is not required. If your routines are in libraries, you must include DD statements defining the libraries.

DFSORT temporarily transfers the user exit routines in SYSIN to the data set defined by this DD statement before they are link-edited for processing.

SORTLIB DD Statement
The SORTLIB DD statement can usually be omitted. This statement describes the data set that contains special DFSORT load modules.

When Required: If installation option SORTLIB=PRIVATE is in effect or dynamic link edit of user exits is specified
• For sort applications using tape work data sets
• For merge applications for which Blockset cannot be used (see message ICE800I).

The SORTLIB installation option determines whether DFSORT searches a system library or private library for the load modules required by tape work data set sorts and Conventional merges.

Example 1 SORTLIB DD Statement:
//SORTLIB DD DSNAME=USORTLIB,DISP=SHR

This example shows DD statement parameters that define a previously cataloged input data set:

DSNAME causes the system to search the catalog for a data set with the
name USORTLIB. When the data set is found, it is associated with the ddname SORTLIB. The control program obtains the unit assignment and volume serial number from the catalog and, if the volume is not already mounted, writes a mounting message to the operator.

**DISP** indicates that the data set existed before this job step, that it should be kept after this job step, and that it can be used concurrently by several jobs (SHR). None of the jobs should change the data set in any way.

For information on the parameters used in the SORTLIB DD statement, the conditions under which they are required, and the default values assumed if a parameter is not included, see Table 6 on page 63. The subparameters of the DCB parameter are described in the same detail in Table 7 on page 63. For more detailed information, see **z/OS MVS JCL Reference** and **z/OS MVS JCL User’s Guide**.

**SYMNAMES DD and SYMNOUT DD Statements**


**SORTIN DD Statement**

The SORTIN DD statement describes the characteristics of the data set in which the records to be sorted or copied reside and also indicates its location.

**When Required:** A SORTIN DD statement is required for all sort or copy applications, unless you provide an E15 user exit that supplies all input to DFSORT and include a RECORD statement in the program control statements. The SORTIN DD statement is ignored if your program invokes DFSORT and passes the address of your E15 user exit in the parameter list.

**Data Set Characteristics:** DFSORT accepts empty and null non-VSAM data sets, and DUMMY data sets, for sorting and copying (be sure to supply RECFM, LRECL and BLKSIZE). DFSORT also accepts empty VSAM data sets for sorting and copying provided VSAMEMT is in effect. For non-VSAM data sets, DFSORT examines the DS1LSTAR field in the format-1 DSCB to determine whether the data set is empty or null. If DS1LSTAR is zero, DFSORT treats the data set as empty or null. If the data set is a null multivolume data set and the DS1IND80 flag is off in the format-1 DSCB of the first volume of the multivolume data set, DFSORT opens the data set for output to force an end of file (EOF) mark before using the data set for input.

Note that a null data set is one that has been newly created, but never successfully closed. Null data sets cannot be processed successfully for a tape work data set sort. The “System Code” field in the data set label in the disk Volume Table of Contents (DSCB in the VTOC) indicates a data set created by the VSE operating system if it contains the letters DOS or VSE within it. Such data sets are never treated as null; however, they may be empty. DFSORT cannot process VSE disk data sets that do not have DOS or VSE within the System Code field.

DFSORT may set what it considers to be appropriate values for missing attributes (RECFM, LRECL, BLKSIZE) of input data sets based on other attributes, or may terminate due to a missing attribute. If a missing attribute results in termination, or you don't want to use a missing attribute set by DFSORT, specify that attribute explicitly (for example, specify RECFM=VB).

See “Data Set Considerations” on page 12 for additional considerations.
Using DD Statements

The following rules apply to concatenated data sets:

- **RECFM** must be either all fixed-length or all variable-length for the data sets in the concatenation.
- **BLKSIZE** can vary. However, if a tape data set has the largest block size and is not first in the concatenation, you must specify BLKSIZE explicitly on its DD statement in the following two situations:
  - Blockset is selected and the tape data set has a block size greater than 32760 bytes, but the block size is not available from DFSMSrmm or ICETPEX.
  - Blockset is not selected.
- With fixed-length records, LRECL must be the same for all data sets. With variable-length records, LRECL can vary. However:
  - If Blockset is selected: If a tape data set has the largest LRECL and is not first in the concatenation, you must specify LRECL explicitly on its DD statement if the LRECL is not available from DFSMSrmm or ICETPEX.
  - If Blockset is not selected, the first data set in the concatenation must have the largest LRECL (LRECL can be specified explicitly on its DD statement).
- If the data sets are on unlike devices, you cannot use the EXLST parameter at user exit E18.
- If Blockset is not selected and BSAM is used, all null data sets must precede all non-null data sets; otherwise, the results are unpredictable.
- DFSORT forces an EOF mark on all null data sets whose format-1 DSCB DS1IND80 flag is off before using BSAM to process the null data sets.
- If you define a data set using the DUMMY parameter, do not concatenate other data sets to it; the system ignores data sets concatenated to a DUMMY data set.
- VSAM data sets must not be concatenated (system restriction).
- Input cannot consist of both VSAM and non-VSAM data sets.

**General Coding Notes:**

- For a copy application, the SORTIN data set should not be the same as the SORTOUT data set or any OUTFIL data set because this can cause lost or incorrect data or unpredictable results.
- For a sort application, the SORTIN data set should not be the same as any SORTWKdd data set because this can cause lost or incorrect data or unpredictable results. The SORTIN data set can be the same as the SORTOUT data set or an OUTFIL data set, but this situation can lead to the loss of the data set if the sort application does not end successfully.
- **FREE=CLOSE** cannot be specified. User labels are not copied.

**Example 2 SORTIN DD Statement:**

```//SORTIN DD DSNAME=INPUT,DISP=SHR```

This example shows DD statement parameters that define a previously cataloged input data set:

**DSNAME**

causes the system to search the catalog for a data set with the name INPUT. When the data set is found, it is associated with the ddname SORTIN. The control program obtains the unit assignment and volume serial number from the catalog and, if the volume is not already mounted, writes a mounting message to the operator.

**DISP** indicates that the data set existed before this job step, that it should be
Using DD Statements

kept after this job step, and that it can be used concurrently by several jobs (SHR). None of the jobs should change the data set in any way.

Example 3 Volume Parameter on SORTIN DD:

```plaintext
//SORTIN DD DSN=SORTIN,DISP=(OLD,KEEP),UNIT=3490,
// VOL=SER=(75836,79661,72945)
```

If the input data set is contained on more than one reel of magnetic tape, the VOLUME parameter must be included on the SORTIN DD statement to indicate the serial numbers of the tape reels. In this example, the input data set is on three reels that have serial numbers 75836, 79661, and 72945.

If a data set is not on a disk or on a standard-labeled tape, you must specify DCB parameters in its DD statement.

SORTINnn DD Statement

The SORTINnn DD statements describe the characteristics of the data sets in which records to be merged reside and indicate the locations of these data sets.

When Required: SORTINnn DD statements are always needed for a merge, unless the merge is invoked from another program and all input is supplied through a routine at user exit E32.

Data Set Characteristics: Input data sets can be either non-VSAM or VSAM, but not both. DFSORT accepts empty and null non-VSAM data sets, and DUMMY data sets, for merging (be sure to supply RECFM, LRECL and BLKSIZE). DFSORT also accepts empty VSAM data sets for merging provided VSAMEMT is in effect. For non-VSAM data sets, DFSORT examines the DS1LSTAR field in the format-1 DSCB to determine whether the data set is null or empty. If DS1LSTAR is zero, DFSORT treats the data set as null or empty. A null data set is one that has been newly created but never successfully closed. Null data sets cannot be processed successfully by the Conventional merge technique.

RECFM must be the same for all input data sets.

BLKSIZE can vary, but for a Conventional merge, SORTIN01 must specify the largest block size.

With fixed-length records, LRECL must be the same for all data sets. With variable-length records, LRECL can vary.

Data sets can be multivolume but not concatenated. If a SORTINnn data set is multivolume and null, DFSORT forces an EOF mark on the data set before use.

DFSORT may set what it considers to be appropriate values for missing attributes (RECFM, LRECL, BLKSIZE) of input data sets based on other attributes, or may terminate due to a missing attribute. If a missing attribute results in termination, or you don't want to use a missing attribute set by DFSORT, specify that attribute explicitly (for example, specify RECFM=VB).

See "Data Set Notes and Limitations" on page 13 for additional considerations.

General Coding Notes:

- A SORTINnn data set should not be the same as the SORTOUT data set or any OUTFIL data set because this can cause lost or incorrect data or unpredictable results.
Using DD Statements

- You can merge up to 100 data sets with Blockset merge or up to 16 data sets with Conventional merge. If Conventional merge is selected, check message ICE800I for the reason Blockset could not be used and correct the indicated condition, if possible.
  - With Blockset merge, nn can be any integer from 00 (the initial zero is optional) to 99, in any order. Blockset merge treats ddnames of the form SORTINn and SORTIN0n as duplicates, and ignores any occurrences after: the first. For example, if you have
    //SORTIN4 DD
    //SORTIN04 DD
    //SORTIN04 DD
  
  the SORTIN04 DD will be ignored.
  - With Conventional merge, nn can range from 01 to 16. The first number you use must be 01 and the remainder must follow in numeric order. Numbers cannot be skipped. Conventional merge cannot use ddnames of the form SORTIN0-SORTIN9, SORTIN00 or SORTIN17-SORTIN99.
- FREE=CLOSE cannot be specified. User labels are not copied.

Example 4 SORTIN01-03 DD Statements (Merge):
//SORTIN01 DD DSNAME=MERGE1,VOLUME=SER=000111,DISP=OLD,
  // DCB=(RECFM=FB,LRECL=80,BLKSIZE=32000)
//SORTIN02 DD DSNAME=MERGE2,VOLUME=SER=000121,DISP=OLD,
  // DCB=(RECFM=FB,LRECL=80,BLKSIZE=32000)
//SORTIN03 DD DSNAME=MERGE3,VOLUME=SER=000131,DISP=OLD,
  // DCB=(RECFM=FB,LRECL=80,BLKSIZE=32000)

Example 5 SORTIN01-02 DD Statements (Merge):
//SORTIN01 DD DSNAME=INPUT1,VOLUME=SER=000101, *
  // UNIT=3390,DISP=OLD *DCB PARAMETERS
//SORTIN02 DD DSNAME=INPUT2,VOLUME=SER=000201, *SUPPLIED FROM
  // UNIT=3390,DISP=OLD *LABELS

SORTWKdd DD Statement
The SORTWKdd DD statements describe the characteristics of the data sets used as intermediate storage areas for records to be sorted; they also indicate the location of these data sets.

Up to 255 SORTWKdd DD statements can be specified. However, if you specify more than 32 and the Blockset technique is not selected, only the first 32 are used.

When Required: One or more SORTWKdd statements are required for each sort application (but not a merge or copy), unless:
- Input can be contained in main storage
- Dynamic work space allocation has been requested (DYNALLOC)
- dataspaces sorting, Hipersorting, or memory object sorting is used.

For information on using work data sets, see Appendix A, “Using Work Space,” on page 847.

Diagnostic message ICE803I gives information on intermediate storage allocation and use.
Using DD Statements

Devices: SORTWKdd data sets can be on disk or on tape, but not both. Disk types can be mixed.

Tape must be nine-track unless input is on seven-track tape, in which case work tapes can (but need not) be seven-track.

General Coding Notes:

- Unless the input file is very large, two or three SORTWKdd data sets are usually sufficient. Two or three large SORTWKdd data sets are preferable to several small data sets. Placing each SORTWKdd data set on a separate device can improve performance.

- For optimum allocation of resources such as virtual storage, avoid specifying a large number of work data sets unnecessarily.

- A SORTWKdd data set should not be the same as the SORTIN data set, the SORTOUT data set, any OUTFIL data set, or any other SORTWKdd data set because this can cause lost or incorrect data or unpredictable results.

- Cylinder allocation is preferable for performance reasons. Temporary SORTWKdd data sets allocated in tracks or blocks (without ROUND) are readjusted to cylinders by DFSORT.

- For disk work data sets, any valid ddname of the form SORTWKdd or SORTWKd can be used (for example, SORTWK01, SORTWK03, SORTWK2, SORTWK#5, SORTWKA, SORTWKXY and so on). The ddnames can be in any order. SORTWKd and SORTWK0d are not treated as duplicate ddnames (for example, SORTWK5 and SORTWK05 will both be used if specified, as will SORTWKQ and SORTWK0Q). If you specify more than 255 ddnames and the Blockset technique is selected, only the first 255 ddnames are used. If you specify more than 32 ddnames and the Blockset technique is not selected, only the first 32 ddnames are used.

- For tape work data sets, at least three SORTWKdd data sets must be specified. The first three ddnames must be SORTWK01, SORTWK02 and SORTWK03. Subsequent ddnames, if specified, must be in order from SORTWK04 through SORTWK32, with no numbers skipped,

- FREE=CLOSE cannot be specified.

- Spool, dummy, subsystem, VSAM and z/OS UNIX file system data sets, and z/OS UNIX files, must not be specified as work data sets

- Parameters relating to ASCII data should not be included for tape work data sets.

Disk Work Data Set Coding Notes:

- Data sets must be physical sequential; they cannot be partitioned or extended format.

- The SPLIT cylinder parameter must not be specified.

- If no secondary allocation is requested for temporary SORTWKdd data sets, automatic secondary allocation will be used unless NOWRKSEC is in effect. (Secondary allocation is limited to 12 work data sets in the Peerage and Vale sorting techniques only.)

- If the data set is allocated to VIO, there is no automatic secondary allocation.

- Secondary allocation can be requested for work data sets. For the Peerage and Vale sorting techniques only, secondary allocation is limited to the first 12 work data sets; if more work data sets are defined, they are used with only the primary allocation.
**Using DD Statements**

- DFSORT uses *only* the space on the first volume specified for a multivolume data set. Space on the second and subsequent volumes is not used. Multivolume SORTWKdd data sets are, therefore, treated as single-volume SORTWKdd data sets.

- DFSORT work data sets can exceed 65536 tracks if allocated as large format data sets on disk devices. Dynamically allocated disk work data sets are automatically allocated by DFSORT as large format. DSNTYPE=LARGE must be specified on SORTWKdd DD statements to allocate JCL work data sets as large format.

- DFSORT work data sets cannot be allocated as large format data sets if VIO is used.

**Virtual I/O:** If a SORTWKdd data set is specified on a virtual device:

- With VIO=NO: DFSORT performs dynamic reallocation using the ddname SORTDKdd on a real device with the same device type as the virtual device. If a real device corresponding to the virtual device is not available in the system, DFSORT terminates with an ICE083A message; see [z/OS DFSORT Messages, Codes and Diagnosis Guide](#) for more information about this error. Non-VIO SORTWKdd data sets are also reallocated when VIO SORTWKdd data sets are present.

- With VIO=YES: the virtual device is used; performance may be degraded.

The following is an example of a SORTWKdd DD statement using a disk work data set:

**Example 6 SORTWK01 DD Statement, Disk Work Data Set:**

```bash
//SORTWK01 DD SPACE=(CYL,(15,5)),UNIT=3390
```

If you use the checkpoint/restart facility and need to make a deferred restart, you must make the following additions to the above statement so that the sort work data set is not lost:

```bash
DSNAME=name1,DISP=(NEW,DELETE,CATLG)
```

Thus the same SORTWKdd DD statement for a deferred restart would be:

```bash
//SORTWK01 DD DSNAME=name1,UNIT=3390,SPACE=(CYL,(15,5)),
// DISP=(NEW,DELETE,CATLG)
```

The following is an example of SORTWKdd DD statements using three tape devices.

**Example 7 SORTWK01-03 DD Statement, Tape Intermediate Storage:**

```bash
//SORTWK01 DD UNIT=3480,LABEL=(,NL)
//SORTWK02 DD UNIT=3480,LABEL=(,NL)
//SORTWK03 DD UNIT=3480,LABEL=(,NL)
```

If DFSORT terminates unsuccessfully and the above DD statements have been specified, the intermediate storage data sets remain in the system until the step has been successfully rerun or until the data sets have been deleted by some other means.

These parameters specify unlabeled data sets on three 3480 tape units. Because the DSNAME parameters are omitted, the system assigns unique names.
SORTOUT and OUTFIL DD Statements

The SORTOUT and OUTFIL DD statements describe the characteristics of the data sets in which the processed records are to be placed and indicate their location.

The SORTOUT DD statement specifies the single non-OUTFIL output data set for a sort, copy, or merge application. OUTFIL processing does not apply to SORTOUT.

The FFILES and FILES parameters of one or more OUTFIL statements specify the ddnames of the OUTFIL data sets for a sort, copy, or merge application. The parameters specified for each OUTFIL statement define the OUTFIL processing to be performed for the OUTFIL data sets associated with that statement. For specific information about OUTFIL processing, see "OUTFIL Control Statements" on page 229.

Although the ddname SORTOUT can actually be used for an OUTFIL data set, the term "SORTOUT" will be used to denote the single non-OUTFIL output data set.

When Required: Each ddname specified in an OUTFIL statement requires a corresponding DD statement for that OUTFIL data set.

If you do not specify OUTFIL statements, a SORTOUT DD statement is required unless you provide an E35 user exit that disposes of all output. A SORTOUT DD statement is ignored if your program invokes DFSORT and passes the address of an E35 user exit in the parameter list.

If you specify OUTFIL statements, you do not have to specify a SORTOUT DD statement or an E35 user exit, although you can use either or both.

Data Set Characteristics: See "Data Set Considerations" on page 12 for additional considerations.

Block size: Unless SDB=NO is in effect, Blockset uses the system-determined optimum block size in most cases when the output data set block size is zero. See the discussion of the SDB option in "OPTION Control Statement" on page 173 for complete details about DFSORT's use of system-determined block size.

For some jobs, the selection of a larger output data set block size can require an increase in the amount of storage needed for successful DFSORT processing.

Applications which require a specific output data set block size should be changed to specify that block size explicitly.

If SDB=NO is in effect, DFSORT selects an appropriate (though not necessarily optimum) block size for the output data set based on the available attributes from the output data set, the input data set, and the RECORD statement. The output data set block size will not necessarily be the same as the input block size.

Reblockable Indicator: DFSORT sets the reblockable indicator in the output data set label when

Blockset is selected and

* DFSORT sets the system-determined optimum block size for the output data set (see "Block size") or
* Allocation sets the system-determined optimum block size for the output data set before DFSORT gets control.
SORTOUT and OUTFIL DD Statements

General Coding Notes:
- For a copy application, neither the SORTOUT data set nor any OUTFIL data set should be the same as the SORTIN data set because this can cause lost or incorrect data or unpredictable results.
- For a merge application, neither the SORTOUT data set nor any OUTFIL data set should be the same as any SORTINnn data set because this can cause lost or incorrect data or unpredictable results.
- For a sort application, the SORTOUT data set or an OUTFIL data set can be the same as the SORTIN data set, but this situation can lead to the loss of the data set if the sort application does not end successfully.
- An OUTFIL data set should not be the same as the SORTOUT data set or any other OUTFIL data set because this can cause lost or incorrect data or unpredictable results.
- Do not specify OPTCD=W for a full function IBM 3480 tape unit; it is overridden. For a 3480 operating in 3420 compatibility mode (specified as 3400-9), the OPTCD=W request is not overridden, but performance might be degraded.
- If no secondary allocation is requested for a temporary or new output data set, automatic secondary allocation will be used unless NOOUTSEC is in effect.
- The RECFM, LRECL, and BLKSIZE in a tape label are used only for a tape output data set with DISP=MOD, a DD volser present, and an AL, SL, or NSL label, when appropriate.
- FREE=CLOSE cannot be specified.
- See the discussion of the SOLRF and NOSOLRF options in "OPTION Control Statement" on page 173 for information related to the SORTOUT LRECL.

Example 8 SORTOUT DD Statement:
```plaintext
//SORTOUT DD DSN=C905460.OUTPT,UNIT=3390,SPACE=(CYL,5),
// DISP=(NEW,CATLG)
```
- **DISP** specifies the data set unknown to the operating system (NEW) and catalogs (CATLG) it under the name C905460.OUTPT.
- **DSNAME** specifies that the data set is called C905460.OUTPT.
- **SPACE** requests five cylinders of storage for the data set.
- **UNIT** indicates that the data set is on a 3390.

**SORTCKPT DD Statement**
The SORTCKPT data set can be allocated on any device that operates with the Basic Sequential Access Method (BSAM). Processing must be restarted only from the last checkpoint taken.

Example 9 SORTCKPT DD Statement:
```plaintext
//SORTCKPT DD DSNAME=CHECK,VOLUME=SER=000123,
// DSP=(NEW,KEEP),UNIT=3480
```
- **DSNAME** specifies that the data set is called CHECK.
- **VOLUME** specifies the volume serial number.
- **DSP** specifies the data set unknown to the operating system (NEW) and catalogs (KEEP) it under the name CHECK.
- **UNIT** indicates that the data set is on a 3480.

When you allocate the SORTCKPT data set, you must include at least one work data set.
If the CKPT operand is specified on the OPTION or SORT control statement, more intermediate storage could be required.

If you want to use the Checkpoint/Restart Facility, refer to "Checkpoint/Restart" on page 901.

**SORTCNTL DD Statement**

The SORTCNTL data set can be used to supply DFSORT control statements, comment statements, blank statements, and remarks when DFSORT is invoked from another program (written, for example, in COBOL or PL/I).

- The SORTCNTL data set usually resides in the input stream, but can be defined as a sequential data set or as a member of a partitioned data set.
- The data set must be defined with RECFM of F or FB. The LRECL can be 80, or more (when valid). If the LRECL is greater than 80, DFSORT will use the first 80 bytes of each record.
- DFSORT supports concatenated SORTCNTL data sets to the extent that the system supports “like” concatenated data sets for BSAM. Refer to z/OS DFSMS Using Data Sets for further information about “like” concatenated data sets.
- When DFSORT is invoked from a PL/I program, the SORTCNTL or DFSPARM data set must not be used to supply a new RECORD control statement.

Example 10 SORTCNTL DD Statement:

```
//SORTCNTL DD *
OPTION MAINSIZE=8M
```

**Notes:**

1. The OPTION statement keywords EFS, LIST, NOLIST, LISTX, NOLISTX, LOCALE, MSGPRT, MSGDDN, SMF, SORTDD, SORTIN, and SORTOUT are used only when they are passed by an extended parameter list or when in the DFSPARM data set. If they are specified on an OPTION statement read from the SYSIN or SORTCNTL data set, the keyword is recognized, but the parameters are ignored.
   
   If your program invokes DFSORT more than once, you can direct DFSORT to read different versions of the SORTCNTL data set at each call. See the explanation of the SORTDD parameter in "OPTION Control Statement" on page 173.

2. If you use the DFSPARM DD statement instead of the SORTCNTL DD statement, you can specify both EXEC PARM options and DFSORT control statements in a single source data set that overrides all other sources. See "DFSPARM DD Statement." For override rules, see Appendix B, "Specification/Override of DFSORT Options," on page 857.

**DFSPARM DD Statement**

The DFSPARM DD statement can be used to supply DFSORT program control statements and EXEC statement PARM options from a single DD source. Because statements in the DFSPARM data set are read whether DFSORT is program invoked or directly invoked, you can specify EXEC PARM options when invoking DFSORT from another program (unlike SORTCNTL). DFSPARM accepts all DFSORT program control statements and all EXEC statement PARM options (including those ignored by SYSIN and SORTCNTL) and any equivalent options specified on a DFSORT OPTION statement.

DFSPARM also accepts comment statements, blank statements, and remarks.
DFSPARM DD Statement

For examples of using DFSPARM when you call DFSORT from a program, see "Overriding DFSORT Control Statements from Programs" on page 538.

Full override and applicability details are listed below and in Appendix B, “Specification/Override of DFSORT Options,” on page 857.

- If you use DFSPARM, SYSIN is not necessary unless your job requires link-editing.
- The DFSPARM data set usually resides in the input stream, but it can be defined as a sequential data set or as a member of a partitioned data set.
- The data set must be defined with RECFM of F or FB. The LRECL can be 80, or more (when valid). If the LRECL is greater than 80, DFSORT will use the first 80 bytes of each record.
- DFSORT supports concatenated DFSPARM data sets to the extent that the system supports “like” concatenated data sets for BSAM. Refer to z/OS DFSMS Using Data Sets for further information about “like” concatenated data sets.
- When DFSORT is invoked from a PL/I program, the SORTCNTL or DFSPARM data set must not be used to supply a new RECORD control statement.

Note: The ddname DFSPARM is used throughout this document to refer to this data set source for EXEC PARM options and DFSORT program control statements. When your system programmers installed DFSORT, they might have changed this name to one more appropriate for your site with the PARMDDN installation option. However, DFSORT will always use a DFSPARM data set of present, unless a DD statement with the PARMDDN name is also present.

General Coding Notes: Coding of parameters in the DFSPARM DD statement follows the same rules used for the JCL EXEC statement PARM options and the program control statements specified in SYSIN or SORTCNTL. The following exceptions apply:

- Labels are not allowed.
- PARM options and program control statements cannot be mixed on the same line, but can be specified in any order on different lines.
- PARM options must be specified without the PARM= keyword and without quote marks.
- Commas (or semicolons) are accepted, but not required, to continue PARM options to another line.
- Leading blanks are not required for PARM options, but at least one leading blank is required for program control statements.

FREE=CLOSE can be used for applicable DFSPARM data sets (for example, with temporary and permanent sequential data sets, but not with DD * data sets).

When DFSORT is called from another program, FREE=CLOSE causes the DFSPARM data set to be released when DFSORT returns to the caller. This allows another DFSPARM data set to be used for a subsequent call.

For example, if a COBOL program contains three SORT verbs, the following would cause the control statements in DP1 to be used for the first SORT verb, the control statements in DP2 to be used for the second SORT verb, and the control statements in DP3 to be used for the third SORT verb.
Without FREE=CLOSE, DP1 would be used for all three SORT verbs.

Example 11 DFSPARM DD Statement:
```
//DFSPARM DD *
SORT FIELDS=(1,2,CH,A),STOPAFT=300
ABEND
OPTION SORTIN=DATAIN
STOPAFT=500
```

In this example, the DFSPARM DD data set passes a DFSORT SORT statement, the ABEND and STOPAFT parameters equivalent to specifying PARM=ABEND,STOPAFT=500 in a JCL EXEC statement, and a DFSORT OPTION statement.

Notes:
1. SORT and OPTION are control statements. ABEND and STOPAFT=500 are PARM options.
2. The PARM option STOPAFT=500 overrides the SORT control statement option STOPAFT=300.
3. When PARMDDN=DFSPARM is specified or defaulted
   - if a //DFSPARM DD data set is available at run-time, DFSORT will use it
   - if a //DFSPARM DD data set is not available at run-time, DFSORT will use a //SORTPARM DD data set if available.
   Thus with PARMDDN=DFSPARM, you can choose to specify either a //DFSPARM DD data set or a //SORTPARM DD data set for a particular DFSORT application.
4. When PARMDDN=ddname is specified
   - if a //ddname DD data set is available at run-time, DFSORT will use it
   - if a //ddname DD data set is not available at run-time, DFSORT will use a //DFSPARM DD data set if available.
   Thus with PARMDDN=ddname, you can choose to specify either a //ddname DD data set or a //DFSPARM DD data set for a particular DFSORT application.

Example 12 DFSPARM DD Statement:
```
//DFSPARM DD *
SORT FIELDS=(5,2,CH,D),SKIPREC=10
STOPAFT=100,BSAM,SKIPREC=5
OPTION SORTIN=DATAIN,SKIPREC=20
```

In this example, the DFSPARM DD data set contains a SORT program control statement, three PARM options on one line, and an OPTION program control statement.

Note: Because PARM options override program control statements, DFSORT uses SKIPREC=5 and ignores the other SKIPREC specifications.

For information on the parameters used in the DFSPARM DD statement, the conditions under which they are required, and any default values assumed if a parameter is omitted, see "Specifying EXEC/DFSPARM PARM Options" on page 29 and Chapter 3, "Using DFSORT Program Control Statements," on page 81.
SORTDKdd DD Statement

SORTDKdd DD Statement
SORTWKdd data sets can be assigned to VIO. If the VIO installation option is specified or defaults to NO, SORTWKdd data sets are deallocated and reallocated by DFSORT using SORTDKdd ddnames. SORTDKdd ddnames are reserved for use by DFSORT.

SORTDIAG DD Statement
The SORTDIAG DD statement specifies that all messages, including diagnostic messages (ICE800I through ICE999I), and control statements are to be written to the message data set. The statement can be used for all DFSORT techniques and provides information on EXCP counts, intermediate storage allocation and use, and so on. The SORTDIAG DD statement has no effect on console messages. The statement is intended as a diagnostic tool.

When SORTDIAG is used, a SYSOUT DD statement or a ddname DD statement (where ddname is the alternate message data set ddname specified during installation or run-time) should be provided. If installation option NOMSGDD=QUIT is in effect and neither an alternate message data set ddname statement nor a SYSOUT ddname statement is provided, DFSORT terminates with a return code of 20.

Example 13 SORTDIAG DD Statement:
//SORTDIAG DD DUMMY

SORTSNAP DD Statement
The SORTSNAP DD statement defines the data set where the snap dumps requested by the ESTAE recovery routine, or the snap dumps requested before or after a call to an EFS program are printed. SORTSNAP is dynamically allocated by DFSORT whenever it is required. The ddname, SORTSNAP, is reserved for DFSORT.
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Using Program Control Statements

Program control statements direct DFSORT in processing your records. Some program control statements are required while others are optional. You use the control statements to:

- Indicate whether a sort, merge, or copy is performed.
- Describe the control fields to be used.
Using Program Control Statements

- Indicate program exits for transferring control to your own routines.
- Describe DFSORT functions you want to have invoked.
- Describe input and output files.
- Indicate various options you want to use during processing.

You can supply program control statements to DFSORT from:
- A SYSIN data set
- A SORTCNTL data set
- A DFSPARM data set
- A 24-Bit parameter list
- An extended parameter list

See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for an explanation of when to use each source.

This chapter begins with a summary of DFSORT program control statements and coding rules. A detailed description of each statement follows.

Control Statement Summary

Describing the Primary Task
The only required program control statement in a DFSORT application is a SORT, MERGE, or OPTION statement that specifies whether you want to sort, merge, or copy records. (Copying can be specified on any of the three statements.)

- **SORT** Describes control fields if you are coding a sort application, or specifies a copy application. Indicates whether you want ascending or descending order for the sort.
- **MERGE** Describes control fields if you are coding a merge application, or specifies a copy application. Indicates whether you want ascending or descending order for the merge.
- **OPTION** Overrides installation defaults (such as EQUALS, CHALT, and CHECK) and supplies optional information (such as DYNALLOC and SKIPREC). Can specify a copy application.

Including or Omitting Records
You can specify whether certain records are included in the output data sets or omitted from them.

- **INCLUDE** Specifies that only records whose fields meet certain criteria are included.
- **OMIT** Specifies that any records whose fields meet certain criteria are deleted.
- **OUTFIL** Specifies the records to be included or omitted in multiple output data sets.

Reformatting and Editing Records
You can modify individual records by deleting and reordering fields and inserting blanks, zeros, or constants.
INREC  Specifies how records are reformatted before they are sorted, copied, or merged.

OUTREC  Specifies how records are reformatted after they are sorted, copied, or merged.

OUTFIL  Specifies how records are reformatted in multiple output data sets.

**Producing Multiple Output and Reports and Converting Records**

You can produce multiple output data sets and reports, convert variable-length records to fixed-length records, and convert fixed-length records to variable-length records.

OUTFIL  Specifies the output data sets and which records are to appear in each. Specifies how records are to be converted from variable-length to fixed-length or from fixed-length to variable-length.

**Joining Two Files**

You can perform various types of "join" applications on two files (F1 and F2) by one or more keys.

JOINKEYS  One JOINKEYS statement is required for each input file to indicate the ddname of the file, describe the keys, indicate whether the file is already sorted by those keys, and so on.

JOIN  An inner join is performed by default, but a JOIN statement can be used to specify a different type of join.

REFORMAT  Describes the fields from the two files to be included in the joined records, and optionally an indicator of where the key was found ('B' for both files, '1' for file1 only or '2' for file2 only.

The three JOINKEYS application control statements (JOINKEYS, JOIN and REFORMAT) are completely described in Chapter 4, “Using a JOINKEYS Application for Joining Two Files,” on page 457.

**Invoking Additional Functions and Options**

You can use the remaining control statements to perform a variety of tasks.

ALTSEQ  Specifies changes to the ALTSEQ translation table to be used for SORT, MERGE, INCLUDE or OMIT fields with format AQ, for INREC, OUTREC, and OUTFIL fields with TRAN=ALTSEQ, and for INREC, OUTFIL fields with format AQ in logical expressions.

DEBUG  Specifies various diagnostic options.

END  Causes DFSORT to discontinue reading SYSIN, SORTCNTL, or DFSPARM.

MODS  Specifies use of one or more user exit routines in a DFSORT application. See Chapter 5, “Using Your Own User Exit Routines,” on page 489 for information about user exit routines.

RECORD  Can be used to supply length and type information.
Control Statement Summary

**SUM**
Specifies that numeric summary fields in records with equal
control fields are summed in one record and that the other records
are deleted.

**Using Symbols**
You can define and use a symbol for any field or constant in the following
DFSORT control statements: INCLUDE, INREC, JOINKEYS, MERGE, OMIT,
OUTFIL, OUTREC, REFORMAT, SORT and SUM. You can also use a symbol for an
output column in the following DFSORT control statements: INREC, OUTFIL and
OUTREC. This makes it easy to create and reuse collections of symbols (that is,
mappings) representing information associated with various record layouts. You
can use system symbols (for example, &JOBNAME.) in your symbol constants. You
can use SET and PROC symbols in your symbol constants. See Chapter 8, “Using
Symbols for Fields and Constants,” on page 727 for complete details.

**General Coding Rules**
See “Inserting Comment Statements” on page 89 for an explanation of how to use
comment statements, blank statements, and remarks. DFSORT program control
statements and EXEC PARM options can also be specified together in a
user-defined DD data set. See “DFSPARM DD Statement” on page 77 for special
coding conventions that apply to this DD source.

All other DFSORT control statements have the same general format, shown in
Figure 6. The illustrated format does *not* apply to control statements you supply in
a parameter list. See Chapter 6, “Invoking DFSORT from a Program,” on page 537
for information on the special rules that apply.

![Figure 6. Control Statement Format](image)

The control statements are free-form; that is, the operation definer, operands, and
comment field can appear anywhere in a statement, provided they appear in the
proper order and are separated by one or more blank characters. Column 1 of each
control statement must be blank, unless the first field is a label or a comment
statement (see “Inserting Comment Statements” on page 89).

- **Label Field**
  A label can be specified on any control statement in SYSIN or SORTCNTL. A
  label is never required. If present, a label must begin in column 1 with any
  character other than a blank or asterisk (*). A label can be 1 to 70 characters and
  ends when a blank character is found. Any character can be used in a label. A
  label followed only by blanks is printed but otherwise not processed.
  Labels cannot be specified in the parameter list, in DFSPARM or in continuation
  lines.
To skip the label, specify one or more blanks starting in column 1.

The following illustrates the use of control statements with and without labels:

```
OPTION EQUALS
MYSORT SORT FIELDS=(5,4,CH,A)
OUTREC FIELDS=(1,20,51,30)
OUT_1 OUTFIL FNAMES=OUT1,INCLUDE=(5,1,CH,EQ,'C\''A')
OUT_2 OUTFIL FNAMES=OUT2,INCLUDE=(5,1,CH,EQ,'C\''B')
```

- **Operation Field**
  This field can appear anywhere between column 2 and column 71 of the first line. It contains a word (for example, SORT or MERGE) that identifies the statement type to the program. In the example below, the operation definer, SORT, is in the operation field of the sample control statement.

- **Operand Field**
  The operand field is composed of one or more operands separated by commas or semicolons. This field must follow the operation field, and be separated from it by at least one blank. No blanks are allowed within the parameters, but a blank is required at the end of all parameters. If the statement occupies more than one line, the operand must begin on the first line. Each operand has an operand definer, or parameter (a group of characters that identifies the operand type to DFSORT). A value or a list of values can be associated with a parameter.

  The five possible operand forms shown in this chapter are:

  - parameter. Examples: CHALT, NOCHALT, REMOVECC
  - parameter(c). Examples: DATE1(/), TIME2(‘), Y2W(‘)
  - parameter=value. An operand shown in the form parameter=value can also be specified in the equivalent form parameter(value) or parameter=(value). Examples: AVGREN=100, AVGREN(100), and AVGREN=(100) are equivalent, DYNALLOC=SYSDA, DYNALLOC(SYSDA), and DYNALLOC=(SYSDA) are equivalent, SAMPLE=20, SAMPLE(20), and SAMPLE=(20) are equivalent.
  - parameter=(list). An operand shown in the form parameter=(list) can also be specified in the equivalent form parameter(list). Examples: FIELDS=(1,20,CH,A) and FIELDS(1,20,CH,A) are equivalent, BUILD=(1,20,HEX) and BUILD(1,20,HEX) are equivalent.
  - parameter=(value). An operand shown in the form parameter=(value) can also be specified in the equivalent form parameter(value). Examples: DATE=(4MD/) and DATE(4MD/) are equivalent, TIMENS=(12) and TIMENS(12) are equivalent, NOMATCH=(C’***’) and NOMATCH(C’***’) are equivalent.

  The following example illustrates the parameter, parameter=value and parameter=(list) forms.

  ```
  SORT EQUALS,FORMAT=CH,FIELDS=(10,30,A),STOPAFT=1000
  ```

  The following example illustrates the parameter, parameter(value), parameter(list) and parameter=(value) forms.

  ```
  SORT EQUALS,FORMAT(CH),FIELDS(10,30,A),STOPAFT(1000)
  ```

  The two SORT statements above are equivalent.

- **Remark Field**
General Coding Rules

This field can contain any information. It is not required, but if it is present, it must be separated from the last operand field by at least one blank.

- **Continuation Column (72)**
  Any character other than a blank in this column indicates that the present statement is continued on the next line. However, as long as the last character of the operand field on a line is a comma or semicolon or colon followed by a blank, the program assumes that the next line is a continuation line. The nonblank character in column 72 is required only when a remark field is to be continued or when an operand is broken at column 71.

- **Columns 73 through 80**
  This field can be used for any purpose.

**Continuation Lines**

The format of the DFSORT continuation line is shown in Figure 7.

![Figure 7. Continuation Line Format](image)

The continuation column and columns 73 through 80 of a continuation line have the same purpose as they do on the first line of a control statement. Column 1 must be blank.

A continuation line is treated as a logical extension of the preceding line. Either an operand or a remark field can begin on one line (referred to as "line 1" in the bullets below) and continue on the next line (referred to as "line 2" in the bullets below). The following are the rules for continuation illustrated with examples (these different types of continuation can be intermixed):

- **Implicit continuation in 2-71**: If line 1 breaks at a comma-blank or semicolon-blank or colon-blank, DFSORT continues on line 2 with the first nonblank character it finds in columns 2-71. For example:

  ![Example](image)

  The above statements will be treated as if they were specified as:

  INCLUDE COND=(5,4,CH,EQ,'C'ABCD')
  SORT FIELDS=(9,3,ZD,A)
  OUTREC FIELDS=(1,27,2X,51,2,BI,M11,60:9,3,ZD,PD)

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General Coding Rules
v Explicit continuation in 16: If line 1 breaks at column 71 with a nonblank in
column 72, and columns 2-15 of line 2 are blank, DFSORT continues on line 2
with whatever character it finds in column 16 (blank or nonblank). For example:
*
1
2
3
4
5
6
7
*23456789012345678901234567890123456789012345678901234567890123456789012
INCLUDE COND=(5,4,CH,E*
Q,C’ABCD’)
SORT FIELDS=(9,3,*
ZD,A)
OUTREC FIELDS=(1,80,C’BLANK WITHIN A*
LITERAL’)

The above statements will be treated as if they were specified as:
INCLUDE COND=(5,4,CH,EQ,C’ABCD’)
SORT FIELDS=(9,3,ZD,A)
OUTREC FIELDS=(1,80,C’BLANK WITHIN A LITERAL’)

Attention: You should only start with a blank in column 16 of line 2 if you
need a blank as the first character of the continued operand, as shown in the
OUTREC statement above. A blank in column 16 of line 2 will be included in the
operand and will result in invalid syntax if incorrectly placed. For example:
*
1
2
3
4
5
6
7
*23456789012345678901234567890123456789012345678901234567890123456789012
SORT FIELDS=(5,4,Z*
D,A)
SUM FIELDS=(5,4,Z*
D)

The above statements will be treated as if they were specified as:
SORT FIELDS=(5,4,ZD,A)
SUM FIELDS=(5,4,Z D)

With the 'D' in column 16 of line 2, we get 'ZD' in the SORT statement. But with
the 'D' in column 17 of line 2, we get 'Z D' in the SUM statement instead of 'ZD',
resulting in a syntax error.
v Explicit continuation in 2-15: If line 1 breaks at column 71 with a nonblank in
column 72, and columns 2-15 of line 2 are nonblank, DFSORT continues on line
2 with the first nonblank character it finds in columns 2-15. For example:
*
1
2
3
4
5
6
7
*23456789012345678901234567890123456789012345678901234567890123456789012
INCLUDE COND=(5,4,CH,EQ,C’AB*
CD’)
SORT FIELDS=(9,3,*
ZD,A)
OUTREC FIELDS=(5,4,2X*
,9,3,ZD,M26,80:X)

The above statements will be treated as if they were specified as:
INCLUDE COND=(5,4,CH,EQ,C’ABCD’)
SORT FIELDS=(9,3,ZD,A)
OUTREC FIELDS=(5,4,2X,9,3,ZD,M26,80:X)

v Remark continuation in 2-71: If a statement ends on line 1 with a blank before
column 72 and a nonblank in column 72, DFSORT treats the first nonblank
character it finds in columns 2-71 of line 2 as the start of a remark. For example:
*
1
2
3
4
5
6
7
*23456789012345678901234567890123456789012345678901234567890123456789012
SORT FIELDS=(9,3,ZD,A)
THIS IS A
*
CONTINUED REMARK

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Tip: A simpler way to do the same thing (without continuation) is to use a comment statement for line 2. For example:

```
* 1 2 3 4 5 6 7
*23456789012345678901234567890123456789012345678901234567890123456789012
SORT FIELDS=(9,3,ZD,A) THIS IS A CONTINUED REMARK
*```

Inserting Comment Statements

- Specify comment statements by coding an asterisk (*) in column 1. A comment statement is printed along with other DFSORT program control statements but is not otherwise processed.
- A statement with blanks in columns 1 through 71 is treated as a comment statement.
- Comment statements are allowed only in the DFSPARM, SYSIN, and SORTCNTL data sets.

Coding Restrictions

The following rules apply to control statement preparation:

- Operation definers and operands must be in uppercase EBCDIC.
- Column 1 of each control statement can be used only for a label or for a comment statement that begins with an asterisk in column 1.
- If present, a label must begin in column 1. Labels are allowed only in the SYSIN and SORTCNTL data sets.
- The entire operation definer must be contained on the first line of a control statement.
- The first operand must begin on the first line of a control statement. The last operand in a statement must be followed by at least one blank.
- Blanks are not allowed in operands. Anything following a blank is considered part of the remark field.
- Remarks are allowed only in the DFSPARM, SYSIN, and SORTCNTL data sets.
- Commas, semicolons, and blanks can be used only as delimiters. They can be used in values only if the values are constants.
- Each type of program control statement can appear only once within a single source (for example, the SYSIN data set).

EFS Restrictions When an EFS Program Is in Effect

In addition to the items above, the following restrictions apply to control statement preparation for an EFS program.

- Non-DFSORT operation definers can be up to 8 bytes long.
- An operation definer with no operands is allowed only if:
  - It is supplied through SYSIN, SORTCNTL, or DFSPARM.
  - It is the only operation definer on a line; column 72 must contain a blank.

Using Control Statements from Other IBM Programs

The INPFIL control statement, which is used by other IBM sort programs, is accepted but not processed. However, control statement errors can result from continuation of an INPFIL statement. The information contained in the INPFIL statement for other IBM sort programs is supplied to DFSORT with DD statements.
Because DFSORT uses the OPTION control statement, OPTION control statements in any job streams from other IBM sort programs cause DFSORT to terminate unless the parameters from the other program conform to the DFSORT OPTION control statement parameters.

**ALTSEQ Control Statement**

The ALTSEQ control statement can be used to change the alternate translation table (ALTSEQ table). Any modifications you specify are applied to the standard EBCDIC translation table. The modified ALTSEQ table overrides the installation default ALTSEQ table (the shipped default is the EBCDIC translation table).

The ALTSEQ table can be used in two ways as follows:

- To apply an alternate collating sequence for SORT, MERGE, INCLUDE, or OMIT fields, or for INREC, OUTREC, or OUTFIL fields in logical expressions with format AQ (or format CH with CHALT in effect). In this case, the ALTSEQ table is used to change only the order in which data is collated, not the data itself. If you specify AQ (or CH with CHALT) without specifying an ALTSEQ control statement, DFSORT uses the installation default ALTSEQ table. For example, if you want to specify that the character $ (X'5B') is to collate at position X'EA', after uppercase Z (X'E9'), you should specify:
  
  ALTSEQ CODE=(5BEA)

- To convert characters for INREC, OUTREC, or OUTFIL OUTREC fields with TRAN=ALTSEQ. In this case, the ALTSEQ table is used to change the actual data. If you specify TRAN=ALTSEQ without specifying an ALTSEQ control statement, DFSORT uses the installation default ALTSEQ table. For example, if you want to change the character $ (X'5B') to the character * (X'5C'), you should specify:

  ALTSEQ CODE=(5B5C)

**CODE**

Specifies the original and modified EBCDIC collating positions.

- **ff** specifies, in hexadecimal, the character whose position is to be changed in the ALTSEQ table.

- **tt** specifies, in hexadecimal, the new position the character is to occupy in the ALTSEQ table.

The order in which the parameters are specified is not important.
Notes:
1. If CHALT is in effect, control fields with format CH are collated using the ALTSEQ table, in addition to those with format AQ.
2. If you use locale processing for SORT, MERGE, INCLUDE, or OMIT fields, you must not use CHALT. If you need alternate sequence processing for a particular field, use format AQ.

**Default:** Usually the installation option. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.

**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT Options,” on page 857.

### Altering EBCDIC Collating Sequence—Examples

#### Example 1

SORT FIELDS=(18,20,AQ,A)
ALTSEQ CODE=(5BEA)

The character $ (X'5B') is to collate at position X'EA', that is, after uppercase Z (X'E9').

#### Example 2

MERGE FIELDS=(25,7,A,1,10,D), FORMAT=CH
OPTION CHALT
ALTSEQ CODE=(F0B0,F1B1,F2B2,F3B3,F4B4,F5B5,F6B6,F7B7,F8B8,F9B9)

The numerals 0 through 9 are to collate before uppercase letters (but after lowercase letters).

#### Example 3

SORT FIELDS=(55,8,AQ,A)
ALTSEQ CODE=(C1F1,C2F2)

The uppercase A (X'C1') is to collate at the same position as the numeral 1 (X'F1') and the uppercase B (X'C2') is to collate at the same position as the numeral 2 (X'F2').

Note that this ALTSEQ statement does NOT cause collating of A before or after 1, or of B before or after 2.

#### Example 4

SORT FIELDS=(55,8,AQ,A)
ALTSEQ CODE=(81C1,82C2,83C3,84C4,85C5,86C6,87C7,88C8,89C9,91D1,92D2,93D3,94D4,95D5,96D6,97D7,98D8,99D9,A2E2,A3E3,A4E4,A5E5,A6E6,A7E7,A8E8,A9E9)

Each lowercase letter is to collate at the same position as the corresponding uppercase letter. For example, the lowercase a (X'81') is to collate at the same position as the uppercase A (X'C1'). This results in case-insensitive collating.

#### Example 5

OPTION COPY
ALTSEQ CODE=(0040)
OUTREC FIELDS=(1,80,TRAN=ALTSEQ)
Each binary zero (X'00') is changed to a space (X'40').

The DEBUG control statement is not intended for regular use; only ABEND, NOABEND, and BSAM are of general interest. For a tape work sort or a Conventional merge, only the ABEND or NOABEND parameters of the DEBUG statement are used. For more information about problem diagnosis, see z/OS DFSORT Messages, Codes and Diagnosis Guide.

**ABEND or NOABEND**

Temporarily overrides the ERET installation option, which specifies whether DFSORT abends or terminates with a return code of 16, if your sort, copy, or merge is unsuccessful.

**ABEND**

Specifies that if your sort, copy, or merge is unsuccessful, DFSORT abends with a user completion code equal to the appropriate message number or with a user-defined number between 1 and 99, as set during installation with installation option ABCODE=n.

When DEBUG ABEND is in effect, a user abend code of zero might be issued when a tape work data set sort or Conventional merge is unsuccessful.

**NOABEND**

Specifies that an unsuccessful sort, copy, or merge terminates with a return code of 16.
DEBUG Control Statement

**Default:** Usually the installation default. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.

**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT Options,” on page 857.

### ABSTP

Prevents loss of needed information in a dump when Blockset terminates. This option overrides ERET, ABEND, and NOABEND. If the DFSORT application is unsuccessful, an abend is forced with a completion code equal to the appropriate message number, or with the user ABEND code set with installation option ABCODE=MSG or ABCODE=n. The message is not written if NOESTAE is in effect.

**Default:** None; optional. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.

**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT Options,” on page 857.

### BSAM

Temporarily bypasses the EXCP access method for input and output data sets. BSAM is ignored for VSAM input and output data sets.

**Attention:** If Blockset is not selected and BSAM processing is used with concatenated SORTIN input, and both null and non-null data sets are specified, all null data sets must precede all non-null data sets; otherwise, the results are unpredictable.

**Attention:** This option can degrade performance.

**Default:** None; optional. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.

**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT Options,” on page 857.

### CFW or NOCFW

Temporarily overrides the CFW installation option, which specifies whether DFSORT can use cache fast write when processing SORTWKdd data sets that reside on devices connected to cached 3990 control units.

- **CFW** Specifies that DFSORT can use cache fast write when processing SORTWKdd data sets.
- **NOCFW** Specifies that DFSORT cannot use cache fast write.

**Attention:** The NOCFW option can degrade performance.
DEBUG Control Statement

**CTRx**

Keeps a count of the input and output records, and abends with code 0C1 when the count reaches n. The numbers that can be assigned to x are:

- **2** Counts the input records being moved from the input buffer (not used for a copy).
- **3** Counts the output records being moved to the output buffer (not used for a copy or merge).
- **4** Counts the input records inserted by E15 (not used for Blockset).
- **5** Counts the output records deleted by E35 (not used for Blockset).

**Default:** Usually the installation default. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.

**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT Options,” on page 857.

**EFSDPAFT**

Initiates a SNAP dump after a Major Call to an EFS program. Any combination of the numbers can be specified.

The numbers have the following meanings:

- **2** Takes the SNAP dump after Major Call 2 to the EFS program.
- **3** Takes the SNAP dump after Major Call 3 to the EFS program.
- **4** Takes the SNAP dump after Major Call 4 to the EFS program.
- **5** Takes the SNAP dump after Major Call 5 to the EFS program.

**Default:** None; optional. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.

**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT Options,” on page 857.
Initiates a SNAP dump before a Major Call to an EFS program. Any combination of the numbers can be specified.

The numbers have the following meanings:

- **2**: Takes the SNAP dump before Major Call 2 to the EFS program.
- **3**: Takes the SNAP dump before Major Call 3 to the EFS program.
- **4**: Takes the SNAP dump before Major Call 4 to the EFS program.
- **5**: Takes the SNAP dump before Major Call 5 to the EFS program.

**Default**: None; optional. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.


---

**EQUCOUNT**

Determines the number of records having equal keys (that is, duplicate keys) which have been sorted by the Blockset technique (printed in message ICE184I). For variable-length records, EQUCOUNT can only be used with either Hiperspace (when Hipersorting is used) or work data sets.

**Notes**:

1. Using EQUCOUNT can degrade performance.
2. ICETOOL’s UNIQUE and OCCUR operators provide unique and non-unique key reporting capabilities that may be more useful for your application than EQUCOUNT.
3. If VLSHRT is in effect, EQUCOUNT will not be used.

**Default**: None; optional. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.


---

**ESTAE or NOESTAE**


DEBUG Control Statement

Temporarily overrides the ESTAE installation option, which determines whether DFSORT should delete its ESTAE recovery routine early or use it for the entire run.

DFSORT normally establishes an ESTAE recovery routine at the beginning of a run. If an abend occurs and the ESTAE option is in effect, the system passes control to the recovery routine. The routine terminates the run after attempting to:

• Print additional abend information
• Continue a sort, merge, or copy application after successful SORTOUT output
• Call the EFS program at Major Calls 4 and 5 for cleanup and housekeeping
• Write an SMF record
• Call the ICETEXIT termination exit.

If an abend occurs and the ESTAE option is not in effect, these functions might not be performed.

**ESTAE** specifies that DFSORT can use its ESTAE recovery routine for the entire run.

**NOESTAE** specifies that DFSORT is to delete its ESTAE recovery routine at a point early in its processing. If DFSORT terminates or abends before this point is reached, it will not delete its ESTAE recovery routine; that is, NOESTAE will not be in effect.

**Note:** See [Appendix E, “DFSORT Abend Processing,” on page 901] for more information on the DFSORT ESTAE recovery routine.


**Applicable Functions:** See [Appendix B, “Specification/Override of DFSORT Options.”]

**NOASSIST**

DFSORT uses Sorting Instructions when possible. If you do not want to use these instructions, you can temporarily bypass them by specifying this parameter.

**Attention:** This option can degrade performance.

**Default:** None; optional. See [Appendix B, “Specification/Override of DFSORT Options,” on page 857] for full override details.

**Applicable Functions:** See [Appendix B, “Specification/Override of DFSORT Options,” on page 857].
Specifying Diagnostic Options—Examples

Example 1

SORT FIELDS=(1,4,CH,A)
DEBUG EQUCOUNT

If the input records contain the following keys:
   KEYA, KEYA, KEYB, KEYB, KEYC, KEYD, KEYD, KEYE

the following message will be issued:
   ICE184I THE NUMBER OF RECORDS SORTED WITH EQUAL KEYS IS 3

The three equal keys are KEYA, KEYB, and KEYD.

Note: ICETOOL's UNIQUE and OCCUR operators provide full equal key
reporting capabilities and should be used instead of EQUCOUNT.

Example 2

SORT FIELDS=(12,2,BI,D)
DEBUG BSAM,ABEND

Directs DFSORT to use the BSAM access method for the SORTIN and SORTOUT
data sets and to abend if the sort application is unsuccessful.

END Control Statement

The END control statement allows DFSORT to discontinue reading SYSIN,
DFSPARM, or SORTCNTL before end of file (EOF).

When you link-edit user exit routines dynamically, the END statement marks the
end of the DFSORT control statements and the beginning of exit routine object
decks in SYSIN.

Discontinue Reading Control Statements—Examples

Example 1

//SYSIN DD *
SORT FIELDS=(1,6,A,28,5,D),FORMAT=CH
   RECORD TYPE=V,LENGTH=(200,,,,80)
   END
   OPTION DYNALLOC

Because the OPTION statement appears after the END statement, it is not read.

Example 2

//SYSIN DD *
SORT FIELDS=(5,8,CH,A)
MODS E15=(E15,1024,SYSIN,T)
   END
   ←object deck for E15 user exit here→
INCLUDE Control Statement

The END statement precedes the E15 user exit routine object deck in SYSIN.

INCLUDE Control Statement

Use an INCLUDE statement if you want only certain records to appear in the output data set. The INCLUDE statement selects the records you want to include.

You can specify either an INCLUDE statement or an OMIT statement in the same DFSORT run, but not both.

The way in which DFSORT processes short INCLUDE/OMIT compare fields depends on the settings for VLSCMP/NOVLSCMP and VLSHRT/NOVLSHRT. A short field is one where the variable-length record is too short to contain the entire field, that is, the field extends beyond the record. For details about including or omitting short records, see the discussion of the VLSCMP and NOVLSCMP options in "OPTION Control Statement" on page 173.

A logical expression is one or more relational conditions logically combined, based on fields in the input record, and can be represented at a high level as follows:

If the logical expression is true for a given record, the record is included in the output data set.

Five types of relational conditions can be used as follows:

1. **Comparisons:**
   Compare two compare fields or a compare field and a decimal, hexadecimal, character, or current, future, or past date constant.
   For example, you can compare the first 6 bytes of each record with its last 6 bytes, and include only those records in which those fields are identical. Or you can compare a date field with today’s date, yesterday’s date, or tomorrow’s date, and include records accordingly.
   See "Comparisons" on page 101 for information about comparisons.

2. **Substring Comparison Tests:**
   Search for a constant within a field value or a field value within a constant.
INCLUDE Control Statement

For example, you can search the value in a 6-byte field for the character constant C'OK', and include only those records for which C'OK' is found somewhere in the field. Or you can search the character constant C'J69,L92,J82' for the value in a 3-byte field, and include only those records for which C'J69', C'L92', or C'J82' appears in the field.

See "Substring Comparison Tests" on page 112 for information about substring comparison tests.

3. Bit Logic Tests:
   Test the state (on or off) of selected bits in a binary field using a bit or hexadecimal mask or a bit constant.
   For example, you can include only those records which have bits 0 and 2 on in a 1-byte field. Or you can include only those records which have bits 3 and 12 on and bits 6 and 8 off in a 2-byte field.

   See "Bit Logic Tests" on page 114 for information about bit logic tests.

4. Date Comparisons:
   Compare a two-digit year date field to a two-digit year date constant, a current, future or past two-digit year date, or to another two-digit year date field, using the century window in effect.
   For example, you can include only those records for which a Z'yymm' date field is between January 1996 and March 2005. Or you can include only those records for which a P'dddyy' field is less than another P'ddyy' field. Or you can include only those records for which a C'yymdd' field is between today's date and 5 days earlier than today's date.

   See "Date Comparisons" on page 119 for information about date comparisons.

5. Numeric Tests:
   Test a field for numerics or non-numerics in character, zoned decimal or packed decimal format.
   For example, you can include only those records in which a 5-byte field contains only '0'-9' characters (that is, numerics). Or you can include only those records in which a 9-byte field contains invalid ZD numeric data (that is, non-numerics). Or you can include only those records in which a 12-byte field contains valid PD numeric data (that is, numerics).

   See "Numeric Tests" on page 122 for information about numeric tests.

By nesting relational conditions within parentheses, you can create logical expressions of higher complexity.

Although comparisons, substring comparison tests, bit logic tests, date comparisons, and numeric tests are explained separately below for clarity, they can be combined to form logical expressions.

The INCLUDE control statement differs from the INCLUDE parameter of the OUTFIL statement in the following ways:
• The INCLUDE statement applies to all input records; the INCLUDE parameter applies only to the OUTFIL input records for its OUTFIL group.
• FORMAT=f can be specified with the INCLUDE statement but not with the INCLUDE parameter. Thus, you can use FORMAT=f and p.m or p.m,f fields with the INCLUDE statement, but you must only use p.m,f fields with the INCLUDE parameter. For example:
INCLUDE Control Statement

INCLUDE FORMAT=BI,
   COND=(5,4,LT,11,4,OR,21,4,EQ,31,4,OR,
   61,20,SS,ΕQ,'FLY'

OUTFIL INCLUDE=(5,4,BI,LT,11,4,BI,OR,21,4,BI,EQ,31,4,BI,OR,
   61,20,SS,ΕQ,'FLY'

- D2 format can be specified with the INCLUDE statement but not with the
  INCLUDE parameter.

See “OUTFIL Control Statements” on page 229 for more details on the OUTFIL
INCLUDE parameter.

COND

logical expression specifies one or more relational conditions
logically combined, based on fields in the input
record. If the logical expression is true for a
given record, the record is included in the
output data sets.

ALL specifies that all of the input records are to be
included in the output data sets.

NONE specifies that none of the input records are to
be included in the output data sets.

Default: ALL. See Appendix B, “Specification/Override of DFSORT Options,”
on page 857 for full override details.

Applicable Functions: See Appendix B, “Specification/Override of DFSORT
Options,” on page 857.

FORMAT

FORMAT=f can be used to specify a particular format for one or more compare
fields. f from FORMAT=f is used for p,m fields. f from FORMAT=f is ignored
for p,m,f fields. For example, the following are all equivalent:

INCLUDE COND=(5,5,ZD,EQ,12,3,PD,OR,21,3,PD,NE,35,5,ZD)
INCLUDE FORMAT=ZD,COND=(5,5,EQ,12,3,PD,OR,21,3,PD,NE,35,5)
INCLUDE COND=(5,5,ZD,EQ,12,3,OR,21,3,NE,35,5,ZD),FORMAT=PD

The permissible field formats for comparisons are shown in Table 8 on page
102 SS (substring) is the only permissible field format for substring
comparison tests. BI (unsigned binary) is the only permissible field format for
bit logic tests. The Y2x formats are the only permissible field formats for date
comparisons. The FS or CSF (floating sign), ZD (zoned decimal), and PD
(packed decimal) formats are the only permissible field formats for numeric
tests.
INCLUDE Control Statement

Default: None. FORMAT=f must be specified if any field is specified as p,m rather than p,m,f. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.


Note: DFSORT issues an informational message and ignores FORMAT=f if all of the fields are specified as p,m,f.

Relational Condition

A relational condition specifies a comparison, substring comparison test, bit logic test, date comparison or numeric test to be performed. Relational conditions can be logically combined, with AND or OR, to form a logical expression. If they are combined, the following rules apply:

- AND statements are evaluated before OR statements unless parentheses are used to change the order of evaluation; expressions inside parentheses are always evaluated first. (Nesting of parentheses is limited only by the amount of storage available.)
- The symbols & (AND) and | (OR) can be used instead of the words.

Comparisons

Relational Condition Format

Two formats for the relational condition can be used:

Or, if the FORMAT=f operand is used:

Comparison operators are as follows:

EQ  Equal to
NE  Not equal to
GT  Greater than
GE  Greater than or equal to
LT  Less than
INCLUDE Control Statement

LE  Less than or equal to.

Fields:

\( p1,m1,f1: \) These variables specify a field in the input record to be compared either to another field in the input record or to a constant.

- \( p1 \) specifies the first byte of the compare field relative to the beginning of the input record. The first data byte of a fixed-length record (FLR) has relative position 1. The first data byte of a variable-length (VLR) record has relative position 5 (because the first 4 bytes contain the record descriptor word). All compare fields must start on a byte boundary, and no compare field can extend beyond byte 32752.

- \( m1 \) specifies the length of the compare field. Acceptable lengths for different formats are in Table 8.

- \( f1 \) specifies the format of the data in the compare field. Permissible formats are given in Table 8.

You can use \( p1,m1 \) rather than \( p1,m1,f1 \) if you use FORMAT=f to supply the format for the field.

Table 8. Compare Field Formats and Lengths

<table>
<thead>
<tr>
<th>Format Code</th>
<th>Length</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH</td>
<td>1 to 256 bytes</td>
<td>Character</td>
</tr>
<tr>
<td>AQ</td>
<td>1 to 256 bytes</td>
<td>Character with alternate collating sequence</td>
</tr>
<tr>
<td>ZD</td>
<td>1 to 256 bytes</td>
<td>Signed zoned decimal</td>
</tr>
<tr>
<td>PD</td>
<td>1 to 255 bytes</td>
<td>Signed packed decimal</td>
</tr>
<tr>
<td>PD0</td>
<td>2 to 8 bytes</td>
<td>Packed decimal with sign and first digit ignored</td>
</tr>
<tr>
<td>FI</td>
<td>1 to 256 bytes</td>
<td>Signed fixed-point</td>
</tr>
<tr>
<td>BI</td>
<td>1 to 256 bytes</td>
<td>Unsigned binary</td>
</tr>
<tr>
<td>AC</td>
<td>1 to 256 bytes</td>
<td>ASCII character</td>
</tr>
<tr>
<td>CSF or FS</td>
<td>1 to 32 bytes</td>
<td>Signed numeric with optional leading floating sign</td>
</tr>
<tr>
<td>UFF</td>
<td>1 to 44 bytes</td>
<td>Unsigned free form numeric</td>
</tr>
<tr>
<td>SFF</td>
<td>1 to 44 bytes</td>
<td>Signed free form numeric</td>
</tr>
<tr>
<td>CSL or LS</td>
<td>2 to 256 bytes</td>
<td>Signed numeric with leading separate sign</td>
</tr>
<tr>
<td>CST or TS</td>
<td>2 to 256 bytes</td>
<td>Signed numeric with trailing separate sign</td>
</tr>
<tr>
<td>CLO or OL</td>
<td>1 to 256 bytes</td>
<td>Signed numeric with leading overpunch sign</td>
</tr>
<tr>
<td>CTO or OT</td>
<td>1 to 256 bytes</td>
<td>Signed numeric with trailing overpunch sign</td>
</tr>
<tr>
<td>ASL</td>
<td>2 to 256 bytes</td>
<td>Signed ASCII numeric with leading separate sign</td>
</tr>
<tr>
<td>AST</td>
<td>2 to 256 bytes</td>
<td>Signed ASCII numeric with trailing separate sign</td>
</tr>
</tbody>
</table>

---

4. If your E15 user exit routine formats the record, \( p1 \) must refer to the record as reformatted by the exit.
INCLUDE Control Statement

Table 8. Compare Field Formats and Lengths (continued)

<table>
<thead>
<tr>
<th>Format Code</th>
<th>Length</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D2</td>
<td>1 to 256 bytes</td>
<td>User-defined data type (requires an EPS program)</td>
</tr>
</tbody>
</table>

Note: See Appendix C, “Data Format Descriptions,” on page 885 for detailed format descriptions.

p2,m2,f2: These variables specify another field in the input record with which the p1,m1,f1 field will be compared. Permissible comparisons between compare fields with different formats are shown in Table 9 and Table 10.

AC, ASL, and AST formats sequence EBCDIC data using the ASCII collating sequence.

You can use p2,m2 rather than p2,m2,f2 if you use FORMAT=f to supply the format for the field.

Table 9. Permissible Field-to-Field Comparisons for INCLUDE/OMIT (Group 1)

<table>
<thead>
<tr>
<th>Field Format</th>
<th>BI</th>
<th>CH</th>
<th>ZD</th>
<th>PD</th>
<th>FI</th>
<th>CSF or FS</th>
<th>UFF</th>
<th>SFF</th>
<th>CSL or LS</th>
<th>CST or TS</th>
</tr>
</thead>
<tbody>
<tr>
<td>BI</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CH</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ZD</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PD</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSF or FS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSL or LS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>CST or TS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Table 10. Permissible Field-to-Field Comparisons for INCLUDE/OMIT (Group 2)

<table>
<thead>
<tr>
<th>Field Format</th>
<th>PD0</th>
<th>AC</th>
<th>ASL</th>
<th>AST</th>
<th>CLO or OL</th>
<th>CTO or OT</th>
<th>AQ</th>
<th>D2</th>
</tr>
</thead>
<tbody>
<tr>
<td>PD0</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AC</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASL</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AST</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLO or OL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CTO or OT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AQ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

Note: D2 field formats are user-defined.

5. If CHALT is in effect, CH is treated as AQ.
INCLUDE Control Statement

**Constants:** A constant can be a decimal number \( (n, +n, -n) \), character string \( (C'xx...x') \), or hexadecimal string \( (X'yy...yy') \).

The **current date** can be used as a decimal number \( (\text{DATE1P, } \&\text{DATE1P, } \text{DATE2P, } \&\text{DATE2P, } \text{DATE3P, } \&\text{DATE3P}) \) or character string \( (\text{DATE1, } \&\text{DATE1, } \text{DATE1(c), } \&\text{DATE1(c), } \text{DATE2, } \&\text{DATE2, } \text{DATE2(c), } \&\text{DATE2(c), } \text{DATE3, } \&\text{DATE3, } \text{DATE3(c), } \&\text{DATE3(c), } \text{DATE4, } \&\text{DATE4, } \text{DATE5, } \&\text{DATE5}) \).

A **future date** can be used as a decimal number \( (\text{DATE1P+d, } \&\text{DATE1P+d, } \text{DATE2P+m, } \&\text{DATE2P+m, } \text{DATE3P+d, } \&\text{DATE3P+d}) \) or character string \( (\text{DATE1+d, } \&\text{DATE1+d, } \text{DATE1(c)+d, } \&\text{DATE1(c)+d, } \text{DATE2+m, } \&\text{DATE2+m, } \text{DATE2(c)+m, } \&\text{DATE2(c)+m, } \text{DATE3+d, } \&\text{DATE3+d, } \text{DATE3(c)+d, } \&\text{DATE3(c)+d}) \).

A **past date** can be used as a decimal number \( (\text{DATE1P-d, } \&\text{DATE1P-d, } \text{DATE2P-m, } \&\text{DATE2P-m, } \text{DATE3P-d, } \&\text{DATE3P-d}) \) or character string \( (\text{DATE1-d, } \&\text{DATE1-d, } \text{DATE1(c)-d, } \&\text{DATE1(c)-d, } \text{DATE2-m, } \&\text{DATE2-m, } \text{DATE2(c)-m, } \&\text{DATE2(c)-m, } \text{DATE3-d, } \&\text{DATE3-d, } \text{DATE3(c)-d, } \&\text{DATE3(c)-d}) \).

The different constants are explained in detail below. Permissible comparisons between compare fields and constants are shown in Table 11.

<table>
<thead>
<tr>
<th>Field Format</th>
<th>Self-Defining Term</th>
<th>Decimal Number</th>
<th>Character String</th>
<th>Hexadecimal String</th>
</tr>
</thead>
<tbody>
<tr>
<td>BI</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CH</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ZD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PD0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AC</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>ASL</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AST</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSF or FS</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UFF</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SFF</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSL or LS</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CST or TS</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLO or OL</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CTO or OT</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AQ</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>D2</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** D2 field formats are user-defined.

**Decimal Number Format:** The format for coding a decimal constant is:
When an FI field is compared with a decimal constant, n or +n cannot be larger than +9223372036854775807 and −n cannot be smaller than -9223372036854775808.

When a BI field is compared with a decimal constant, n or +n cannot be larger than +18446744073709551615 nor smaller than +0. A BI field cannot be compared to a negative number (−n). A BI field cannot be compared to −0 even if NOSZERO is in effect.

Examples of valid and invalid decimal constants are:

<table>
<thead>
<tr>
<th>Valid</th>
<th>Invalid</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>++15</td>
<td>Too many sign characters</td>
</tr>
<tr>
<td>+15</td>
<td>15+</td>
<td>Sign in wrong place</td>
</tr>
<tr>
<td>−15</td>
<td>1.5</td>
<td>Contains invalid character</td>
</tr>
<tr>
<td>18000000</td>
<td>1,500</td>
<td>Contains invalid character</td>
</tr>
</tbody>
</table>

**Figure 8. Valid and Invalid Decimal Constants**

**Current Date as Decimal Number:** DATE1P, &DATE1P, DATE2P, &DATE2P, DATE3P, or &DATE3P can be used to generate a decimal number for the current date of the run.

Table 12 shows the form of the decimal number constant generated for each current date operand along with an example of the actual decimal number generated when the date of the run is June 21, 2005. yyyy represents the year, mm represents the month (01-12), dd represents the day (01-31) and ddd represents the day of the year (001-366).

**Table 12. Decimal Numbers for Current Date**

<table>
<thead>
<tr>
<th>Format of Operand</th>
<th>Format of Constant</th>
<th>Example of Constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATE1P</td>
<td>+yyyymmdd</td>
<td>+20050621</td>
</tr>
<tr>
<td>DATE2P</td>
<td>+yyyymm</td>
<td>+200506</td>
</tr>
<tr>
<td>DATE3P</td>
<td>+yyyyyddd</td>
<td>+2005172</td>
</tr>
</tbody>
</table>

**Note:** You can precede each of the operands in the table with an & with identical results.

**Future Date as Decimal Number:** DATE1P+d, &DATE1P+d, DATE2P+m, &DATE2P+m, DATE3P+d, or &DATE3P+d can be used to generate a decimal number for a future date relative to the current date of the run. d is days in the future and m is months in the future. d and m can be 0 to 9999.

Table 13 on page 106 shows the form of the decimal number constant generated for each future date operand along with an example of the actual decimal number generated when the date of the run is June 21, 2005. yyyy represents the year, mm represents the month (01-12), dd represents the day (01-31) and ddd represents the day of the year (001-366).
INCLUDE Control Statement

Table 13. Decimal Numbers for Future Dates

<table>
<thead>
<tr>
<th>Format of Operand</th>
<th>Format of Constant</th>
<th>Example of Operand</th>
<th>Example of Constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATE1P+d</td>
<td>+yyyymmdd</td>
<td>DATE1P+11</td>
<td>+20050702</td>
</tr>
<tr>
<td>DATE2P+m</td>
<td>+yyyymm</td>
<td>DATE2P+2</td>
<td>+200508</td>
</tr>
<tr>
<td>DATE3P+d</td>
<td>+yyyyyddd</td>
<td>DATE3P+200</td>
<td>+2006007</td>
</tr>
</tbody>
</table>

Note: You can precede each of the operands in the table with an & with identical results.

Past Date as Decimal Number: DATE1P-d, &DATE1P-d, DATE2P-m, &DATE2P-m, DATE3P-d, or &DATE3P-d can be used to generate a decimal number for a past date relative to the current date of the run. d is days in the past and m is months in the past. d and m can be 0 to 9999.

Table 14 shows the form of the decimal number constant generated for each past date operand along with an example of the actual decimal number generated when the date of the run is June 21, 2005. yyyy represents the year, mm represents the month (01-12), dd represents the day (01-31) and ddd represents the day of the year (001-366).

Table 14. Decimal Numbers for Past Dates

<table>
<thead>
<tr>
<th>Format of Operand</th>
<th>Format of Constant</th>
<th>Example of Operand</th>
<th>Example of Constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATE1P-d</td>
<td>+yyyymmdd</td>
<td>DATE1P-30</td>
<td>+20050522</td>
</tr>
<tr>
<td>DATE2P-m</td>
<td>+yyyymm</td>
<td>DATE2P-12</td>
<td>+200406</td>
</tr>
<tr>
<td>DATE3P-d</td>
<td>+yyyyyddd</td>
<td>DATE3P-172</td>
<td>+2004366</td>
</tr>
</tbody>
</table>

Note: You can precede each of the operands in the table with an & with identical results.

Character String Format: The format for coding a character string constant is:

C'xx...x'

The value x may be any EBCDIC character (the EBCDIC character string is translated appropriately for comparison to an AC or AQ field). You can specify up to 256 characters.

If you want to include a single apostrophe in the character string, you must specify it as two single apostrophes. Thus:

Required: O'NEILL Specify: C'O''NEILL'

Examples of valid and invalid character string constants are shown below:
Double-byte data may be used in a character string for INCLUDE/OMIT comparisons. The start of double-byte data is delimited by the shift-out (SO) control character (X'0E'), and the end by the shift-in (SI) control character (X'0F'). SO and SI control characters are part of the character string and must be paired with zero or an even number of intervening bytes. Nested shift codes are not allowed. All characters between SO and SI must be valid double-byte characters. No single-byte meaning is drawn from the double-byte data.

Examples of valid and invalid character string constants containing double-byte characters are shown below using:
- < to represent SO
- > to represent SI
- Dn to represent a double-byte character

<table>
<thead>
<tr>
<th>Valid</th>
<th>Invalid</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>C’Q&lt;D1D2&gt;T’</td>
<td>C’Q&lt;R&gt;S’</td>
<td>Single-byte data within SO/SI</td>
</tr>
<tr>
<td>C’&lt;D1D2D3’</td>
<td>C’D1D2D3’</td>
<td>Missing SO/SI; treated as single-byte data</td>
</tr>
<tr>
<td>C’&lt;D1&gt;R&lt;D2’</td>
<td>C’Q&lt;D1&lt;D2&gt;&gt;’</td>
<td>Nested SO/SI</td>
</tr>
</tbody>
</table>

Tip: X'0E', X'0F', and X'7D' are treated as the special characters shift-out, shift-in, and single apostrophe in a character string. If you don’t want to treat one or more of these characters as special in a particular value, use a hexadecimal string instead of a character string. For example, if you want to treat the binary value 000E0E7D as its decimal equivalent of 921213, use X'000E0E7D'; 0E will not be treated as shift-out and 7D will not be treated as a single apostrophe.

Current Date as Character String: DATE1, &DATE1, DATE1(c), &DATE1(c), DATE2, &DATE2, DATE2(c), &DATE2(c), DATE3, &DATE3, DATE3(c), &DATE3(c), DATE4, &DATE4, DATE5 or &DATE5 can be used to generate a character string for the current date of the run.

Table 16 on page 108 shows the form of the character string constant generated for each current date operand along with an example of the actual character string generated when the date of the run is June 21, 2005 at 04:42:45 PM, using (/) for (c) where relevant. yyy represents the year, mm (for date) represents the month (01-12), dd represents the day (01-31), ddd represents the day of the year (001-366), hh represents the hour (00-23), mm (for time) represents the minutes (00-59), ss represents the seconds (00-59), nnnnnn represents the microseconds (000000-999999) and c can be any character except a blank.
**INCLUDE Control Statement**

### Table 16. Character Strings for Current Date

<table>
<thead>
<tr>
<th>Format of Operand</th>
<th>Format of Constant</th>
<th>Example of Constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATE1</td>
<td>C'yyyymmdd'</td>
<td>C'20050621'</td>
</tr>
<tr>
<td>DATE1(c)</td>
<td>C'yyyymmmccd'</td>
<td>C'2005/06/21'</td>
</tr>
<tr>
<td>DATE2</td>
<td>C'yyyymm'</td>
<td>C'200506'</td>
</tr>
<tr>
<td>DATE2(c)</td>
<td>C'yyyymmm'</td>
<td>C'2005/06'</td>
</tr>
<tr>
<td>DATE3</td>
<td>C'yyyyyddd'</td>
<td>C'2005172'</td>
</tr>
<tr>
<td>DATE3(c)</td>
<td>C'yyyyycdd'</td>
<td>C'2005/172'</td>
</tr>
<tr>
<td>DATE4</td>
<td>C'yyyy-mm-dd-hh.mm.ss'</td>
<td>C'2005-06-21-16.52.45'</td>
</tr>
<tr>
<td>DATE5</td>
<td>C'yyyy-mm-dd-hh.mm.ss.nnnnnn'</td>
<td>C'2005-06-21-16.52.45.582013'</td>
</tr>
</tbody>
</table>

**Note:** You can precede each of the operands in the table with an & with identical results.

**Tip:** When a field is shorter than the character string it's compared to, DFSORT truncates the string on the right. You can take advantage of this to compare a field to only part of the DATE4 timestamp when appropriate. For example:

```plaintext
INCLUDE COND=(1,13,CH,GT,DATE4)
```

would compare the field in positions 1-13 to the truncated DATE4 constant C'yyyy-mm-dd-hh'.

**Future Date as Character String:** DATE1+d, &DATE1+d, DATE1(c)+d, 
&DATE1(c)+d, DATE2+m, &DATE2+m, DATE2(c)+m, &DATE2(c)+m, DATE3+d, 
&DATE3+d, DATE3(c)+d or &DATE3(c)+d can be used to generate a character string for a future date relative to the current date of the run. d is days in the future and m is months in the future. d and m can be 0 to 9999.

Table 17 shows the form of the character string constant generated for each future date operand along with an example of the actual character string generated when the date of the run is June 21, 2005. yyyy represents the year, mm represents the month (01-12), dd represents the day (01-31), ddd represents the day of the year (001-366), and c can be any character except a blank.

### Table 17. Character Strings for Future Dates

<table>
<thead>
<tr>
<th>Format of Operand</th>
<th>Format of Constant</th>
<th>Example of Operand</th>
<th>Example of Constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATE1+d</td>
<td>C'yyymmmdd'</td>
<td>DATE1+11</td>
<td>C'20050702'</td>
</tr>
<tr>
<td>DATE1(c)+d</td>
<td>C'yyyyymmmccd'</td>
<td>DATE1(/)+90</td>
<td>C'2005/09/19'</td>
</tr>
<tr>
<td>DATE2+m</td>
<td>C'yyyyymm'</td>
<td>DATE2+2</td>
<td>C'200508'</td>
</tr>
<tr>
<td>DATE2(c)+m</td>
<td>C'yyyyymmm'</td>
<td>DATE2()+25</td>
<td>C'2007.07'</td>
</tr>
<tr>
<td>DATE3+d</td>
<td>C'yyyyyddd'</td>
<td>DATE3+200</td>
<td>C'2006007'</td>
</tr>
<tr>
<td>DATE3(c)+d</td>
<td>C'yyyyycdd'</td>
<td>DATE3(+1)</td>
<td>C'2005-171'</td>
</tr>
</tbody>
</table>

**Note:** You can precede each of the operands in the table with an & with identical results.
**INCLUDE Control Statement**

**Past Date as Character String:** DATE1-d, &DATE1-d, DATE1(c)-d, &DATE1(c)-d, DATE2-m, &DATE2-m, DATE2(c)-m, &DATE2(c)-m, DATE3-d, &DATE3-d, DATE3(c)-d or &DATE3(c)-d can be used to generate a character string for a past date relative to the current date of the run. d is days in the past and m is months in the past. d and m can be 0 to 9999.

Table 18 shows the form of the character string constant generated for each past date operand along with an example of the actual character string generated when the date of the run is June 21, 2005. yyyy represents the year, mm represents the month (01-12), dd represents the day (01-31), ddd represents the day of the year (001-366), and c can be any character except a blank.

<table>
<thead>
<tr>
<th>Format of Operand</th>
<th>Format of Constant</th>
<th>Example of Operand</th>
<th>Example of Constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATE1-d</td>
<td>C'yyymmd'</td>
<td>DATE1-1</td>
<td>C'20050620'</td>
</tr>
<tr>
<td>DATE1(c)-d</td>
<td>C'yyymmcdd'</td>
<td>DATE1(-)-60</td>
<td>C'2005-04-22'</td>
</tr>
<tr>
<td>DATE2-m</td>
<td>C'yyymm'</td>
<td>DATE2-6</td>
<td>C'200412'</td>
</tr>
<tr>
<td>DATE2(c)-m</td>
<td>C'yyymmm'</td>
<td>DATE2(/)-1</td>
<td>C'2005/05'</td>
</tr>
<tr>
<td>DATE3-d</td>
<td>C'yyyyddd'</td>
<td>DATE3-300</td>
<td>C'2004238'</td>
</tr>
<tr>
<td>DATE3(c)-d</td>
<td>C'yyyycddd'</td>
<td>DATE3(.)-21</td>
<td>C'2005.151'</td>
</tr>
</tbody>
</table>

**Note:** You can precede each of the operands in the table with an & with identical results.

**Hexadecimal String Format:** The format for coding a hexadecimal string constant is:

\[ \text{X}'yy...yy' \]

The value \( yy \) represents any pair of hexadecimal digits. You can specify up to 256 pairs of hexadecimal digits.

Because the first digit and sign are ignored in a PD0 field, you should not include the first digit or sign in a hexadecimal constant to be compared to a PD0 field. For example, 3-byte PD0 values like \( \text{X'}01234'C' \) and \( \text{X'}01234'D' \) would be equal to a hexadecimal constant of \( \text{X'}1234' \).

Examples of valid and invalid hexadecimal constants are shown in the following table.

<table>
<thead>
<tr>
<th>Valid</th>
<th>Invalid</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{X'}ABCD' )</td>
<td>( \text{X'}ABGD' )</td>
<td>Invalid hexadecimal digit</td>
</tr>
<tr>
<td>( \text{X'}BF3C' )</td>
<td>( \text{X'}BF3' )</td>
<td>Incomplete pair of digits</td>
</tr>
<tr>
<td>( \text{X'}AF050505' )</td>
<td>( \text{X'}AF050505' )</td>
<td>Missing X identifier</td>
</tr>
<tr>
<td>( \text{X'}BF3C' )</td>
<td>( \text{X'}BF3C'X )</td>
<td>X identifier in wrong place</td>
</tr>
</tbody>
</table>

**Figure 10. Valid and Invalid Hexadecimal Constants**


**INCLUDE Control Statement**

**Padding and Truncation**
In a field-to-field comparison, the shorter compare field is padded appropriately. In a field-to-constant comparison, the constant is padded or truncated to the length of the compare field.

Character and hexadecimal strings are truncated and padded on the right.

The padding characters are:
- X'40' For a character string
- X'00' For a hexadecimal string.

Decimal constants are padded and truncated on the left. Padding is done with zeros in the proper format.

**Cultural Environment Considerations**
DFSORT’s collating behavior can be modified according to your cultural environment. The cultural environment is established by selecting the active locale. The active locale’s collating rules affect INCLUDE and OMIT processing as follows:
- DFSORT includes or omits records for output according to the collating rules defined in the active locale. This provides inclusion or omission for single- or multi-byte character data, based on defined collating rules which retain the cultural and local characteristics of a language.

If locale processing is to be used, the active locale will only be used to process character (CH) compare fields and character and hexadecimal constants compared to character (CH) compare fields.

For more information on locale processing, see "Cultural Environment Considerations" on page 7 or LOCALE in "OPTION Control Statement" on page 173.

**Including Records in the Output Data Set—Comparison Examples**

**Example 1**

```
INCLUDE COND=(5,8,GT,13,8,|,105,4,LE,1000),FORMAT=CSF
```

This example illustrates how to only include records in which:
- The floating sign number in bytes 5 through 12 is greater than the floating sign number in bytes 13 through 20
  OR
- The floating sign number in bytes 105 through 108 is less than or equal to 1000.

Note that all three compare fields have the same format.

**Example 2**

```
INCLUDE COND=(1,10,CH,_EQ,C'STOCKHOLM',
AND,21,8,ZD,GT,+50000,
OR,31,4,CH,NE,C'HERR')
```

This example illustrates how to only include records in which:
- The first 10 bytes contain STOCKHOLM (this nine-character string was padded on the right with a blank) AND the zoned-decimal number in bytes 21 through 28 is greater than 50 000.
Note that the AND is evaluated before the OR. ("Omitting Records from the Output Data Set—Example" on page 171 illustrates how parentheses can be used to change the order of evaluation.) Also note that ending a line with a comma or semicolon followed by a blank indicates that the parameters continue on the next line, starting in any position from columns 2 through 71.

**Example 3**

```plaintext
INCLUDE FORMAT=CH,
    COND=((5,1,EQ,8,1),&,
        ((20,1,EQ,'A',&30,1,FI,GT,10),|,
        (20,1,EQ,'B',&30,1,FI,LT,100),|,
        (20,1,NE,'A',&20,1,NE,'B')))```

This example illustrates how to only include records in which:
- Byte 5 equals byte 8
  AND
- At least one of the following is true:
  - Byte 20 equals 'A' and byte 30 is greater than 10
  - Byte 20 equals 'B' and byte 30 is less than 100
  - Byte 20 is not equal to 'A' or 'B'.

Note that p,m,FI is used for the FI fields, and p,m with FORMAT=CH is used for all of the CH fields. With FORMAT=f, you can mix p,m and p,m,f fields when that's convenient such as when all or most of the fields have the same format (although you can always code p,m,f for all fields and not use FORMAT=f, if you prefer).

**Example 4**

```plaintext
INCLUDE COND=(7,2,CH,EQ,'T1',OR,
    (1,2,BI,GE,'X'001A',AND,20,2,CH,EQ,25,2,CH))```

This example shows the effects of VLSCMP/NOVLSCMP and VLSHRT/NOVLSHRT on INCLUDE processing when short records are present.

Consider the records shown in Figure 11 on page 112:
- If VLSCMP is in effect, the first record is included because bytes 7-8 are equal to 'CT1', even though the comparison of bytes 20-21 to 25-26 involves short fields. The second record is included or omitted based on the comparison of bytes 20-21 to bytes 25-26.
- If NOVLSCMP and VLSHRT are in effect, the first record is omitted because the comparison of bytes 20-21 to 25-26 involves short fields. The second record is included or omitted based on the comparison of bytes 20-21 to bytes 25-26.
- If NOVLSCMP and NOVLSHRT are in effect, the first record causes message ICE015A or ICE218A to be issued because the comparison of bytes 20-21 to bytes 25-26 involves short fields.
Example 5

INCLUDE COND=(21,8,ZD,GT,DATE1P)

This example illustrates how to include records in which a zoned-decimal date of the form Z'yyyymmdd' in bytes 21-28 is greater than today's date. DATE1P generates a decimal number for the current date in the form +yyyymmdd.

Example 6

INCLUDE COND=(15,7,CH,GE,DATE3-7,AND,15,7,CH,LE,DATE3+7)

This example illustrates how to include records in which a character date of the form C'yyyyddd' in bytes 15-21 is between 7 days in the past and 7 days in the future, relative to the current date. DATE3-7 generates a character constant in the form C'yyyyddd' where yyyyddd is the current date minus 7 days. DATE3+7 generates a character constant in the form C'yyyyddd' where yyyyddd is the current date plus 7 days.

Example 7

INCLUDE COND=(21,10,CH,GE,DATE1(-)-365)

This example illustrates how to include records in which a character date of the form C'yyyy-mm-dd' in bytes 21-30 is within 365 days of the current date. DATE1(-)-365 generates a character constant in the form C'yyyy-mm-dd' where yyyyymmdd is the current date minus 365 days.

Substring Comparison Tests

Two types of substring comparison tests are offered, as follows:

1. Find a constant within a field value. For example, you can search the value in a 6-byte field for the character constant C'OK'. If the field value is, for example, C'*OK*' or C'***OK', the relational condition is true; if the field value is C'*ERR*', the relational condition is false.

2. Find a field value within a constant. For example, you can search the character constant C'J69,L92,J82' for the value in a 3-byte field. If the field value is C'J69', C'L92', or C'J82', the relational condition is true; if the field value is C'X24', the relational condition is false. Note that the comma is used within the constant to separate the valid 3-character values; any character that will not appear in the field value can be used as a separator in the constant.
Relational Condition Format
Two formats for the relational condition can be used:

```
(    , , )
   , , ,      
   , , ,
```

Or, if the FORMAT=SS operand is used:

```
(    , , )
   , , ,      
   , , ,
```

Restriction: FORMAT=SS can precede COND but cannot follow it.

Substring comparison operators are as follows:
- **EQ** Equal to
- **NE** Not equal to

Fields:
- **p1,m1**: These variables specify the character field in the input record for the substring test.
  - **p1** specifies the first byte of the character input field for the substring test, relative to the beginning of the input record. If your E15 user exit routine formats the record, p1 must refer to the record as reformatted by the exit.
  - **m1** specifies the length of the field to be tested. The length can be 1 to 32752 bytes.

Constant: The constant can be a character string or a hexadecimal string. See “Character String Format” on page 106 and “Hexadecimal String Format” on page 109 for details.

If m1 is greater than the length of the constant, the field value will be searched for the constant and the condition will be true if a match is found when the EQ comparison operator is specified or if a match is not found when the NE comparison operator is specified.

If m1 is smaller than the length of the constant, the constant will be searched for the field value and the condition will be true if a match is found when the EQ comparison operator is specified or if a match is not found when the NE comparison operator is specified.

6. If your E15 user exit routine formats the record, p1 must refer to the record as reformatted by the exit.
INCLUDE Control Statement

Including Records in the Output Data Set—Substring Comparison Example

Example

INCLUDE FORMAT=SS,COND=(11,6000,EQ,C'OK',OR,5,3,EQ,C'J69,L92,J82')

This example illustrates how to include only records in which:
- OK is found somewhere within bytes 11 through 6010
- OR
- Bytes 5 through 7 contain J69, L92 or J82.

Bit Logic Tests

Two methods for bit logic testing are offered as follows:
- Bit operator with hexadecimal or bit mask
- Bit comparison tests

While any bit logic test can be specified using either of the two methods, each of them offers unique advantages not found with the other.

The ability to specify selected bits in a field, by either of the two methods, can greatly reduce the number of INCLUDE conditions that must be specified to achieve a given result, because the need to account for unspecified bits is eliminated.

Method 1: Bit Operator Tests

This method of bit logic testing allows you to test whether selected bits in a binary field are all on, all off, in a mixed on-off state, or in selected combinations of these states. While this method allows you to test many different possible bit combinations with a single operation, similar to the Test Under Mask (TM) machine instruction, it is less suited to determine if a field contains exactly one particular combination of on and off bits than Method 2 described below.

Relational Condition Format

Two formats for the relational condition can be used:

```
(p1,m1,BI,-mask)
```

Or, if the FORMAT=BI operand is used:
INCLUDE Control Statement

Bit operators describe the input field to mask relationship to be tested as follows:

- **ALL or BO**: All mask bits are on in the input field
- **SOME or BM**: Some, but not all mask bits are on in the input field
- **NONE or BZ**: No mask bits are on in the input field
- **NOTALL or BNO**: Some or no mask bits are on in the input field
- **NOTSOME or BNM**: All or no mask bits are on in the input field
- **NOTNONE or BNZ**: All or some mask bits are on in the input field

The first set of operators (ALL, SOME, and so on) are intended for those who like meaningful mnemonics. The second set of operators (BO, BM, and so on) are intended for those familiar with the conditions associated with the Test Under Mask (TM) instruction.

**Fields**

**p1,m1**: These variables specify the binary field in the input record to be tested against the mask.

- **p1** specifies the first byte of the binary input field to be tested against the mask, relative to the beginning of the input record. The first data byte of a fixed-length record (FLR) has relative position 1. The first data byte of a variable-length (VLR) record has relative position 5 (because the first 4 bytes contain the record descriptor word). All fields to be tested must start on a byte boundary and must not extend beyond byte 32752.
- **m1** specifies the length of the field to be tested. The length can be 1 to 256 bytes.

**Mask**

A hexadecimal string or bit string that indicates the bits in the field selected for testing. If a mask bit is on (1), the corresponding bit in the field is tested. If a mask bit is off (0), the corresponding bit in the field is ignored.

**Hexadecimal String Format**: The format for coding a hexadecimal string mask is:

```
X'y1...yj'
```

---

7. If your E15 user exit routine formats the record, p1 must refer to the record as reformatted by the exit.
**INCLUDE Control Statement**

The value `yy` represents any pair of hexadecimal digits that constitute a byte (8 bits). Each bit must be 1 (test bit) or 0 (ignore bit). You can specify up to 256 pairs of hexadecimal digits.

**Bit String Format:** The format for coding a bit string mask is:

```
B'bbbbbbbb...bbbbbbbb'
```

The value `bbbbbbbb` represents 8 bits that constitute a byte. Each bit must be 1 (test bit) or 0 (ignore bit). You can specify up to 256 groups of 8 bits. The total number of bits in the mask must be a multiple of 8. A bit mask string can only be used with a bit operator.

**Padding and Truncation**

The hexadecimal or bit mask is truncated or padded on the right to the byte length of the binary field. The padding character is `X'00'` (all bits off and thus not tested).

**Including Records in the Output Data Set—Bit Operator Test Examples**

**Example 1**

```
INCLUDE COND=(27,1,CH,EQ,'C'D',AND,18,1,BI,B'10000000')
```

This example illustrates how to only include records in which:
- Byte 27 contains D
  
  **AND**
  
  - Byte 18 has bit 0 on.

**Example 2**

```
INCLUDE COND=(11,1,BI,BM,X'85')
```

This example illustrates how to only include records in which byte 11 has some, but not all of bits 0, 5 and 7 on. Results for selected field values are shown below:

*Table 19. Bit Comparison Example 2: Results for Selected Field Values*

<table>
<thead>
<tr>
<th>11,1,BI Value</th>
<th>11,1,BI Result</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>X'85'</td>
<td>False</td>
<td>Omit Record</td>
</tr>
<tr>
<td>X'C1'</td>
<td>True</td>
<td>Include Record</td>
</tr>
<tr>
<td>X'84'</td>
<td>True</td>
<td>Include Record</td>
</tr>
<tr>
<td>X'00'</td>
<td>False</td>
<td>Omit Record</td>
</tr>
</tbody>
</table>

**Example 3**

```
INCLUDE COND=(11,2,ALL,B'0001000110110100', OR,21,1,NONE,B'01001100'),FORMAT=BI
```

This example illustrates how to only include records in which:
- Bytes 11 through 12 have all of bits 3, 6, 10, 11 and 13 on
  
  **OR**
  
  - Byte 21 has none of bits 1, 4, or 5 on.
INCLUDE Control Statement

Results for selected field values are shown below:

Table 20. Bit Comparison Example 3: Results for Selected Field Values

<table>
<thead>
<tr>
<th>11,2,BI Value</th>
<th>11,2,BI Result</th>
<th>21,1,BI Value</th>
<th>21,1,BI Result</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>X'1234'</td>
<td>True</td>
<td>X'4C'</td>
<td>False</td>
<td>Include Record</td>
</tr>
<tr>
<td>X'02C4'</td>
<td>False</td>
<td>X'81'</td>
<td>True</td>
<td>Include Record</td>
</tr>
<tr>
<td>X'0204'</td>
<td>False</td>
<td>X'40'</td>
<td>False</td>
<td>Omit Record</td>
</tr>
<tr>
<td>X'F334'</td>
<td>True</td>
<td>X'00'</td>
<td>True</td>
<td>Include Record</td>
</tr>
<tr>
<td>X'1238'</td>
<td>False</td>
<td>X'4F'</td>
<td>False</td>
<td>Omit Record</td>
</tr>
</tbody>
</table>

Method 2: Bit Comparison Tests

This method of bit logic testing allows you to test whether selected bits in a binary field are either in an exact pattern of on and off bits, or not in that exact pattern. Unlike Method 1 described above, only “equal” and “unequal” comparisons are allowed; however, this method has the advantage of being able to test for a precise combination of on and off bits.

Relational Condition Format

Two formats for the relational condition can be used:

```
(p1,m1,BI, EQ, constant)
```

Or, if the FORMAT=BI operand is used:

```
(p1,m1, BI, EQ, constant)
```

Bit comparison operators are as follows:

- **EQ** Equal to
- **NE** Not equal to

Fields

**p1,m1**: These variables specify the binary field in the input record to be compared to the bit constant.
- p1 specifies the first byte of the binary input field to be compared to the bit constant, relative to the beginning of the input record. The first data byte of a fixed-length record (FLR) has relative position 1. The first data byte of a variable-length (VLR) record has relative position 5 (because the first 4 bytes contain the record descriptor word). All fields to be tested must start on a byte boundary and must not extend beyond byte 32752.
- m1 specifies the length of the field to be tested. The length can be 1 to 256 bytes.

---

8. If your E15 user exit routine formats the record, p1 must refer to the record as reformatted by the exit.
**Bit Constant**
A bit string constant that specifies the pattern to which the binary field is compared. If a bit in the constant is 1 or 0, the corresponding bit in the field is compared to 1 or 0, respectively. If a bit in the constant is . (period), the corresponding bit in the field is ignored.

**Bit String Format:** The format for coding a bit string constant is:

```
B'bbbbbbbb...bbbbbbbb'
```

The value bbbbbbbbb represents 8 bits that constitute a byte. Each bit must be 1 (test bit for 1), 0 (test bit for 0) or . (ignore bit). You can specify up to 256 groups of 8 bits. The total number of bits in the mask must be a multiple of 8. A bit constant can only be used for bit comparison tests (BI format and EQ or NE operator).

**Padding and Truncation**
The bit constant is truncated or padded on the right to the byte length of the binary field. The padding character is B'00000000' (all bits equal to 0). Note that the padded bytes are compared to the excess bytes in the binary field.

**Recommendation:** To ensure that comparison of the padded bytes to the excess bytes in the binary field does not cause unwanted results, shorten the field length to eliminate the padding characters, or increase the length of the bit constant to specify the exact test pattern you want.

**Including Records in the Output Data Set—Bit Comparison Test Examples**

**Example 1**
```
INCLUDE COND=(27,1,CH,EQ,C'D',AND,18,1,BI,EQ,B'1.......
```

This example illustrates how to only include records in which:
- Byte 27 contains D
  AND
- Byte 18 is equal to the specified pattern of bit 0 on.

**Example 2**
```
INCLUDE COND=(11,1,BI,NE,B'10...1.1')
```

This example illustrates how to only include records in which byte 11 is not equal to the specified pattern of bit 0 on, bit 1 off, bit 5 on and bit 7 on. Results for selected field values are shown below:

**Table 21. Bit Comparison Example 2: Results for Selected Field Values**

<table>
<thead>
<tr>
<th>I1,1,BI Value</th>
<th>I1,1,BI Result</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>X'85'</td>
<td>False</td>
<td>Omit Record</td>
</tr>
<tr>
<td>X'C1'</td>
<td>True</td>
<td>Include Record</td>
</tr>
<tr>
<td>X'84'</td>
<td>True</td>
<td>Include Record</td>
</tr>
<tr>
<td>X'97'</td>
<td>False</td>
<td>Omit Record</td>
</tr>
</tbody>
</table>
Example 3

```
INCLUDE COND=(11,2,EQ,B'..01....0......1', OR,21,1,EQ,B'01......'),FORMAT=BI
```

This example illustrates how to only include records in which:

- Bytes 11 through 12 are equal to the specified pattern of bit 2 off, bit 3 on, bit 8 off and bit 15 on
- OR
- Byte 21 is equal to the specified pattern of bit 0 off and bit 1 on.

Results for selected field values are shown below:

Table 22. Bit Comparison Example 3: Results for Selected Field Values

<table>
<thead>
<tr>
<th>11,2,BI Value</th>
<th>11,2,BI Result</th>
<th>21,1,BI Value</th>
<th>21,1,BI Result</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>X'1221'</td>
<td>True</td>
<td>X'C0'</td>
<td>False</td>
<td>Include Record</td>
</tr>
<tr>
<td>X'02C4'</td>
<td>False</td>
<td>X'41'</td>
<td>True</td>
<td>Include Record</td>
</tr>
<tr>
<td>X'1234'</td>
<td>False</td>
<td>X'00'</td>
<td>False</td>
<td>Omit Record</td>
</tr>
<tr>
<td>X'5F7F'</td>
<td>True</td>
<td>X'7F'</td>
<td>True</td>
<td>Include Record</td>
</tr>
<tr>
<td>X'FFFF'</td>
<td>False</td>
<td>X'2F'</td>
<td>False</td>
<td>Omit Record</td>
</tr>
</tbody>
</table>

Date Comparisons

You can use DFSORT's Y2 formats in conjunction with the century window in effect, as follows:

- Use the full date formats (Y2T, Y2U, Y2V, Y2W, Y2X and Y2Y) to compare a two-digit year date field to a two-digit year date constant, a current, future or past two-digit year date (Y constant), or to another two-digit year date field.
- Use the year formats (Y2C, Y2Z, Y2S, Y2P, Y2D and Y2B) to compare a two-digit year field to a two-digit year constant (Y constant) or to another two-digit year field.

For example, you can include only those records for which a Z'yymm' date field is between January 1996 and March 2005. Or you can include only those records for which a P'dddyy' field is less than another P'dddyy' field. Or you can include only those records for which a C'yyddd' field is between today's date and 5 days earlier than today's date.

The ordering of dates and special indicators used for comparisons with Y2 fields and Y constants is the same as the ascending orders for sorting and merging Y2 fields (see "SORT Control Statement" on page 442 for details).

Relational Condition Format

Two formats for the relational condition can be used:
INCLUDE Control Statement

Or, if the FORMAT=Y2x operand is used:

Comparison operators are as follows:

- **EQ** Equal to
- **NE** Not equal to
- **GT** Greater than
- **GE** Greater than or equal to
- **LT** Less than
- **LE** Less than or equal to.

**Fields:**

- **p1,m1,Y2x:** These variables specify a two-digit year date field in the input record to be compared either to another two-digit year date field in the input record or to a two-digit year date constant.
  - p1 specifies the first byte of the date field relative to the beginning of the input record. The first data byte of a fixed-length record (FLR) has relative position 1. The first data byte of a variable-length (VLR) record has relative position 5 (because the first 4 bytes contain the record descriptor word). All date fields must start on a byte boundary, and no date field can extend beyond byte 32752.
  - m1 specifies the length of the date field. Appendix C, “Data Format Descriptions,” on page 885 describes the length and format for each type of date field.
  - Y2x specifies the Y2 format. Appendix C, “Data Format Descriptions,” on page 885 describes the length (m) and format (Y2x) for each type of date field.

You can use p1,m1 rather than p1,m1,Y2x if you use FORMAT=Y2x to supply the format for the date field.

- **p2,m2,Y2x:** These variables specify another two-digit year date field in the input record with which the p1,m1,Y2x field will be compared.

---

9. If your E15 user exit routine formats the record, p1 must refer to the record as reformatted by the exit.
INCLUDE Control Statement

You can use p2,m2 rather than p2,m2,Y2x if you use FORMAT=Y2x to supply the format for the date field.

**Constant:** A two-digit year date constant in the form Y'string', Y'DATE1', Y'DATE1'+d, Y'DATE1'-d, Y'DATE2', Y'DATE2'+m, Y'DATE2'-m, Y'DATE3', Y'DATE3'+d, or Y'DATE3'-d, with which the p1,m1,Y2x field will be compared.

**Comparisons:** A date field can be compared to a date constant or another date field with the same number of non-year (x) digits. Table 23 shows the type of field-to-field and field-to-constant comparisons you can use. The fields shown for any type of date (for example, yyx and xxy) can be compared to any other fields shown for that type of date or to the Y constant shown for that type of date.

*Table 23. Permissible Comparisons for Dates*

<table>
<thead>
<tr>
<th>Type of Date</th>
<th>Fields (m,f)</th>
<th>Y Constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>yyx and xyy</td>
<td>3,Y2T</td>
<td>2,Y2U</td>
</tr>
<tr>
<td></td>
<td>3,Y2W</td>
<td>2,Y2X</td>
</tr>
<tr>
<td>yyxx and xxyy</td>
<td>4,Y2T</td>
<td>3,Y2V</td>
</tr>
<tr>
<td></td>
<td>4,Y2W</td>
<td>3,Y2Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>yyxxx and xxxyy</td>
<td>5,Y2T</td>
<td>3,Y2U</td>
</tr>
<tr>
<td></td>
<td>5,Y2W</td>
<td>3,Y2X</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>yyxxxx and xxxxyy</td>
<td>6,Y2T</td>
<td>4,Y2V</td>
</tr>
<tr>
<td></td>
<td>6,Y2W</td>
<td>4,Y2Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>yy</td>
<td>2,Y2C</td>
<td>2,Y2Z</td>
</tr>
<tr>
<td></td>
<td>2,Y2S</td>
<td>2,Y2P</td>
</tr>
<tr>
<td></td>
<td>1,Y2D</td>
<td>1,Y2B</td>
</tr>
</tbody>
</table>

Y constants for current, future, and past two-digit year dates are as follows. d can be 0 to 9999 days and m can be 0 to 9999 months.
- Y'DATE1' generates a Y constant for the current date in the form Y'ymmmdd'
- Y'DATE1'+d generates a Y constant for the current date plus d days in the form Y'ymmmdd'
- Y'DATE1'-d generates a Y constant for the current date minus d days in the form Y'ymmmdd'
- Y'DATE2' generates a Y constant for the current date in the form Y'ymm'
- Y'DATE2'+m generates a Y constant for the current date plus m months in the form Y'ymm'
- Y'DATE2'-m generates a Y constant for the current date minus m months in the form Y'ymm'
- Y'DATE3' generates a Y constant for the current date in the form Y'yydd'
- Y'DATE3'+d generates a Y constant for the current date plus d days in the form Y'yydd'
- Y'DATE3'-d generates a Y constant for the current date minus d days in the form Y'yydd'.

You must use the same number of digits in a Y constant as the type of date; leading zeros must be specified (for example, for Y'ymm', use Y'0001' for January 2000 and Y'0501' for January 2005).
INCLUDE Control Statement

You can also use Y constants for special indicators as follows:

- Y'0...0' (CH/ZD/PD zeros) and Y'9...9' (CH/ZD/PD nines) can be used with Y2T, Y2U, Y2V, Y2W, Y2X and Y2Y dates. You must use the same number of digits as the type of date (for example, Y'000' for yyq or qyy, Y'0000' for yymm or mmty, and so forth).
- Y'LOW' (BI zeros), Y'BKNN' (blanks) and Y'HIGH' (BI ones) can be used with Y2T, Y2W and Y2S dates.

Including Records in the Output Data Set—Date Comparisons

Example 1

```
INCLUDE FORMAT=Y2T, 
COND=(3,4,GE,Y'9901',AND, 
  3,4,LE,Y'0312',OR, 
  3,4,LE,Y'0000' )
```

This example illustrates how to only include records in which:

- A C'yymm' date field in bytes 3 through 6 is between January 1999 and December 2003
  OR
- Bytes 3 through 6 contain CH zeros (C'0000'), ZD zeros (Z'0000') or BI zeros (X'00000000').

Note that the century window in effect will be used to interpret the Y'9901' and Y'0312' date constants, as well as real dates in the C'yymm' date field. However, the century window will not be used to interpret the Y'0000' special indicator constant or special indicators in the C'yymm' date field.

Example 2

```
INCLUDE COND=(2,3,Y2X,LT,36,5,Y2T)
```

This example illustrates how to only include records in which a P'dddyy' date field in bytes 2 through 4 is less than a Z'yyddd' date field in bytes 36 through 40.

Note that the century window in effect will be used to interpret real dates in the P'dddyy' and Z'yyddd' date fields. However, the century window will not be used to interpret special indicators in the P'dddyy' and Z'yyddd' date fields.

Numeric Tests

You can test a field for numerics or non-numerics in character, zoned decimal or packed decimal format.

For example, you can include only those records in which a 5-byte field contains only '0'-9' characters (that is, character numerics). Or you can include only those records in which a 9-byte field contains invalid zoned decimal data (that is, zoned decimal non-numerics). Or you can include only those records in which a 12-byte field contains valid packed decimal data (that is, packed decimal numerics).

A field to be tested for numerics in character format looks like this in hexadecimal:
```
FdFd...Fd
```

The field is considered to be character numeric if every d is 0-9. (This is equivalent to '0'-9' for each character.) Otherwise, the field is considered to be character
non-numeric. For example, '1234', '0001' and '9999' are all considered to be character numeric, whereas 'A234', '12.3', '1' and '123D' are all considered to be character non-numeric.

A field to be tested for numerics in zoned decimal format looks like this in hexadecimal:

zdzd...sd

The field is considered to be zoned decimal numeric if every z is F, every d is 0-9, and s is C, D or F. Otherwise, the field is considered to be zoned decimal non-numeric. For example, '1234' (X'F1F2F3F4'), '123D' (X'F1F2F3C4') and '123M' (X'F1F2F3D4') are all considered to be zoned decimal numeric, whereas 'A234' (X'C1F2F3F4'), '12.3' (X'F1F24BF3') and '123X' (X'F1F2F3E7') are all considered to be zoned decimal non-numeric.

A field to be tested for numerics in packed decimal format looks like this in hexadecimal:

dddd...ds

The field is considered to be packed decimal numeric if every d is 0-9, and s is C, D or F. Otherwise, the field is considered to be packed decimal non-numeric. For example, X'12345C', X'12345D' and X'12345F' are all considered to be packed decimal numeric, whereas X'A2345C', X'1B345D' and X'12F45F' are all considered to be packed decimal non-numeric.

Relational Condition Format

Two formats for the relational condition can be used:

```
(p1,m1,f1, EQ ,NUM)
```

Or, if the FORMAT=f operand is used:

```
(p1,m1, f1, EQ ,NUM)
```

Numeric test operators are as follows:

- **EQ** Equal to numerics
- **NE** Not equal to numerics (non-numerics)

Fields:

- **p1,m1,f1**: These variables specify the field in the input record for the numeric test.
- p1 specifies the first byte of the field relative to the beginning of the input record. The first data byte of a fixed-length record (FLR) has relative position 1. The first data byte of a variable-length (VLR) record has relative position 5.

---

10. If your E15 user exit routine formats the record, p1 must refer to the record as reformatted by the exit.
INCLUDE Control Statement

(because the first 4 bytes contain the record descriptor word). All fields must
start on a byte boundary, and no field can extend beyond byte 32752.
- m1 specifies the length of the field. The length can be 1 to 256 bytes.
- f1 specifies the type of numerics the field is to be tested for as follows:

  FS  test for numerics in character format (‘0’-'9' (X'F0'-X'F9') in all bytes).

  Note: CSF can be used instead of FS.

  ZD  test for numerics in zoned decimal format (‘0’-'9' (X'F0'-X'F9') in all
non-sign bytes; X'F0'-X'F9', X'D0'-X'D9' or X'C0'-X'C9' in the sign byte)

  PD  test for numerics in packed decimal format (0-9 for all digits; F, D or C for
the sign).

You can use p1,m1 rather than p1,m1,f1, if you use FORMAT=f to supply the
format for the field.

NUM:  Specifies a test for numerics or non-numerics. The condition will be true if
the field is numeric when the EQ operator is specified or if the field is
non-numeric when the NE operator is specified.

Including Records in the Output Data Set--Numeric Tests

Example 1

INCLUDE COND=(1,20,FS,EQ,NUM)

This example illustrates how to only include records in which the field in bytes 1
through 20 contains valid character numeric data (that is, ‘0’-'9' in all bytes).

Example 2

INCLUDE COND=(21,8,ZD,NE,NUM,OR,31,5,PD,NE,NUM)

This example illustrates how to only include records in which the field in bytes 21
through 28 contains invalid zoned decimal data, or the field in bytes 31 through 35
contains invalid packed decimal data (that is, one of the fields is non-numeric).

INCLUDE/OMIT Statement Notes

- Floating point compare fields cannot be referenced in INCLUDE or OMIT
  statements.

- Any selection can be performed with either an INCLUDE or an OMIT statement.
  INCLUDE and OMIT are mutually exclusive.

- If several relational conditions are joined with a combination of AND and OR
  logical operators, the AND statement is evaluated first. The order of evaluation
  can be changed by using parentheses inside the COND expression.

- If any changes are made to record formats by user exits E15 or E32, the
  INCLUDE or OMIT statement must apply to the newest formats.

- DFSORT issues a message and terminates if an INCLUDE or OMIT statement is
  specified for a tape work data set sort or conventional merge application.

- If SZERO is in effect, −0 compares as less than +0 when numeric fields and
  constants are used. If NOSZERO is in effect, −0 compares as equal to +0 when
  numeric fields and constants are used.
INCLUDE Control Statement

Table 24 on page 125 shows how DFSORT reacts to the result of a relational condition comparison, depending on whether the statement is INCLUDE or OMIT and whether the relational condition is followed by an AND or an OR logical operator.

When writing complex statements, the table in [Table 24] helps you get the result that you want.

Table 24. Logic Table for INCLUDE/OMIT.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Relational Condition</th>
<th>AND</th>
<th>OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>OMIT</td>
<td>True</td>
<td>Check next compare, or if last compare OMIT record.</td>
<td>OMIT record</td>
</tr>
<tr>
<td>OMIT</td>
<td>False</td>
<td>INCLUDE record</td>
<td>Check next compare, or if last compare, INCLUDE record.</td>
</tr>
<tr>
<td>INCLUDE</td>
<td>True</td>
<td>Check next compare, or if last compare, INCLUDE record.</td>
<td>INCLUDE record</td>
</tr>
<tr>
<td>INCLUDE</td>
<td>False</td>
<td>OMIT record</td>
<td>Check compare, or if last compare, OMIT record.</td>
</tr>
</tbody>
</table>

INREC Control Statement

The INREC control statement allows you to reformat the input records before they are sorted, merged, or copied.

The INREC control statement supports a wide variety of parsing, editing, and reformatting tasks, including:
The use of fixed position/length fields or variable position/length fields. For fixed fields, you specify the starting position and length of the field directly. For variable fields, such as delimited fields, comma separated values (CSV), tab separated values, blank separated values, keyword separated fields, null-terminated strings (and many other types), you define rules that allow DFSORT to extract the relevant data into fixed parsed fields, and then use the parsed fields as you would use fixed fields.

Insertion of blanks, zeros, strings, current date, future date, past date, current time, sequence numbers, decimal constants, and the results of arithmetic expressions before, between, and after the input fields in the reformatted records.

Sophisticated conversion capabilities, such as find and replace, hexadecimal display, bit display, translation of EBCDIC letters from lowercase to uppercase or uppercase to lowercase, translation of characters from EBCDIC to ASCII and from ASCII to EBCDIC, translation of characters using the ALTSEQ translation table, conversion of numeric values from one format to another, left-justify or left-squeeze (remove leading blanks or all blanks and shift left), and right-justify or right-squeeze (remove trailing blanks or all blanks and shift right).

Sophisticated editing capabilities, such as control of the way numeric fields are presented with respect to length, leading or suppressed zeros, thousands separators, decimal points, leading and trailing positive and negative signs, and so on.

Twenty-seven pre-defined editing masks are available for commonly used numeric editing patterns, encompassing many of the numeric notations used throughout the world. In addition, a virtually unlimited number of numeric editing patterns are available via user-defined editing masks.

Transformation of SMF, TOD, and ETOD date and time values to more usable forms.

Conversion of input date fields of one type (CH, ZD, PD, 2-digit year, 4-digit year, Julian, Gregorian) to corresponding output date fields of another type or to a corresponding day of the week.

Various types of arithmetic operations for input date fields.

Selection of a character constant, hexadecimal constant, or input field from a lookup table, based on a character, hexadecimal, or bit string as input (that is, lookup and change).

You can create the reformatted INREC records in one of the following ways using unedited, edited, or converted input fields (p,m for fixed fields, or %nn for parsed fields - see PARSE), and a variety of constants:

**BUILD or FIELDS:** Reformat each record by specifying all of its items one by one. Build gives you complete control over the items you want in your reformatted INREC records and the order in which they appear. You can delete, rearrange and insert fields and constants. Example:

```
INREC BUILD=(1,20,C'ABC',26:5C'*',
15,3,PD,EDIT=(TTT.TT),21,30,80:X)
```

**OVERLAY:** Reformat each record by specifying just the items that overlay specific columns. Overlay lets you change specific existing columns without affecting the entire record. Example:

```
INREC OVERLAY=(45:45,8,TRAN=LTOU)
```

**FINDREP:** Reformat each record by doing various types of find and replace operations. Example:

```
INREC FINDREP=(IN=C'Mr.',OUT=C'Mister')
```
**IFTHEN clauses:** Reformat different records in different ways by specifying how build, overlay, find/replace, or group operation items are applied to records that meet given criteria. IFTHEN clauses let you use sophisticated conditional logic to choose how different record types are reformatted. Example:

```
INREC IFTHEN=(WHEN=(1,5,CH,EQ,C'TYPE1'),
  BUILD=(1,40,C'**',+1,TO=PD)),
IFTHEN=(WHEN=(1,5,CH,EQ,C'TYPE2'),
  BUILD=(1,40,+2,TO=PD,X'FFFF')),
IFTHEN=(WHEN=NONE,OVERLAY=(45:C'NONE'))
```

You can choose to include any or all of the following items in your reformatted INREC records:

- Fixed position/length fields or variable position/length fields. For fixed fields, you specify the starting position and length of the field directly. For variable fields, such as delimited fields, comma separated values (CSV), tab separated values, blank separated values, keyword separated fields, null-terminated strings (and many other types), you define rules that allow DFSORT to extract the relevant data into fixed parsed fields, and then use the parsed fields as you would use fixed fields.
- Blanks, binary zeros, character strings, and hexadecimal strings
- Current date, future date, past date, and current time in various forms
- Unedited input fields aligned on byte, halfword, fullword, and doubleword boundaries
- Replaced or removed strings.
- Hexadecimal or bit representations of binary input fields
- Characters translated from uppercase to lowercase, lowercase to uppercase, ASCII to EBCDIC or EBCDIC to ASCII.
- Left-justified, right-justified, left-squeezed, or right-squeezed input fields.
- Numeric input fields of various formats converted to different numeric formats, or to character format edited to contain signs, thousands separators, decimal points, leading zeros or no leading zeros, and so on.
- Decimal constants converted to different numeric formats, or to character format edited to contain signs, thousands separators, decimal points, leading zeros or no leading zeros, and so on.
- The results of arithmetic expressions combining fields, decimal constants, operators (MIN, MAX, MUL, DIV, MOD, ADD and SUB) and parentheses converted to different numeric formats, or to character format edited to contain signs, thousands separators, decimal points, leading zeros or no leading zeros, and so on.
- SMF, TOD and ETOD date and time fields converted to different numeric formats, or to character format edited to contain separators, leading zeros or no leading zeros, and so on.
- Input date fields of one type (CH, ZD, PD, 2-digit year, 4-digit year, Julian, Gregorian) converted to corresponding output date fields of another type or to a corresponding day of the week.
- The results of various types of arithmetic operations for input date fields.
- Sequence numbers in various formats.
- A character constant, hexadecimal constant or input field selected from a lookup table, based on a character, hexadecimal or bit constant as input.
- A zoned decimal group identifier, a zoned decimal group sequence number, or a field propagated from the first record of a group to all of the records of a group.
INREC Control Statement

For information concerning the interaction of INREC and OUTREC, see "INREC Statement Notes" on page 148.

PARSE

This operand allows you to extract variable position/length fields into fixed parsed fields. Parsed fields (%nn) can be used where fixed position/length fields (p,m) can be used in the BUILD (or FIELDS) or OVERLAY operands as described later in this section.

PARSE can be used for many different types of variable fields including delimited fields, comma separated values (CSV), tab separated values, blank separated values, keyword separated fields, null-terminated strings, and so on. You can assign up to 100 %nn parsed fields (%00-%99) to the variable fields you want to extract.

Note that if all of the fields in your records have fixed positions and lengths, you don't need to use PARSE. But if any of the fields in your records have variable positions or lengths, you can use PARSE to treat them as fixed parsed fields in BUILD or OVERLAY. You can mix p,m fields (fixed fields) and %nn fields (parsed fields) in BUILD and OVERLAY.

See PARSE under "OUTFIL Control Statements" for complete details.

Sample Syntax

INREC PARSE=(%00=(ENDBEFR=C'*',FIXLEN=3),
%01=(ENDBEFR=BLANKS,FIXLEN=6),
%02=(STARTAT=C'MAX',FIXLEN=8),
%03=(STARTAFT=C'(',ENDBEFR=C')',FIXLEN=6),
%04=(STARTAFT=BLANKS,FIXLEN=5)),
BUILD=(%03,X,%03,HEX,21:%02,31:%01,SFF,M26,LENGTH=7,
18,6,%00,UFF,M11,LENGTH=3,%04,JFY=(SHIFT=RIGHT))

Default for PARSE: None; must be specified. See Appendix B "Specification/Override of DFSORT Options," on page 857.

Specifies all of the items in the reformatted INREC record in the order in which they are to be included. The reformatted INREC record consists of the separation fields, edited and unread input fields (p,m for fixed fields, or %nn for parsed fields - see PARSE), edited decimal constants, edited results of arithmetic expressions, and sequence numbers you select, in the order in which you select them, aligned on the boundaries or in the columns you indicate.

For variable-length records, the first item in the BUILD or FIELDS parameter must specify or include the unedited 4-byte record descriptor word (RDW),
that is, you must start with \(1,m\) with \(m\) equal to or greater than 4. If you want to include the bytes from a specific position to the end of each input record at the end of each reformatted output record, you can specify that starting position \(p\) as the last item in the BUILD or FIELDS parameter. For example:

\[
\text{INREC FIELDS=(1,4, unedited RDW, } 1,2,81, T0=ZD, \text{LENGTH}=5, C'|', \text{ separator, } 5) \text{ display input positions 5 to end}
\]

For fixed-length records, the first input and output data byte starts at position 1. For variable-length records, the first input and output data byte starts at position 5, after the RDW in positions 1-4.

c: Specifies the position (column) for a separation field, input field, decimal constant, arithmetic expression, or sequence number, relative to the start of the reformatted input record. Unused space preceding the specified column is padded with EBCDIC blanks. The following rules apply:

- \(c\) must be a number between 1 and 32752.
- \(c\): must be followed by a separation field, input field, decimal constant, or arithmetic expression.
- \(c\) must not overlap the previous input field or separation field in the reformatted input record.
- for variable-length records, \(c\): must not be specified before the first input field (the record descriptor word) nor after the variable part of the input record.
- The colon (:) is treated like the comma (,) or semicolon (;) for continuation to another line.

Both valid and invalid examples are shown in Table 25.

### Table 25. Examples of Valid and Invalid Column Alignment

<table>
<thead>
<tr>
<th>Validity</th>
<th>Specified</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>33:C'State '</td>
<td>Columns 1-32 — blank. Columns 33-38 — 'State '</td>
</tr>
<tr>
<td>Invalid</td>
<td>0:5,4</td>
<td>Column value cannot be zero.</td>
</tr>
<tr>
<td>Invalid</td>
<td>.25Z</td>
<td>Column value must be specified.</td>
</tr>
<tr>
<td>Invalid</td>
<td>32753:21,8</td>
<td>Invalid — column value must be less than 32753.</td>
</tr>
<tr>
<td>Invalid</td>
<td>5:10:2,5</td>
<td>Column values cannot be adjacent.</td>
</tr>
<tr>
<td>Invalid</td>
<td>20,10,6:C'AB'</td>
<td>Column value overlaps previous field.</td>
</tr>
</tbody>
</table>

s: Specifies that a separation field (blanks, zeros, character string, hexadecimal string, current date, future date, past date, or current time) is to appear in the reformatted input record. It can be specified before or after any input field. Consecutive separation fields can be specified. For variable-length records, separation fields must not be specified before the first input field (the record descriptor word), or after the variable part of the input record. Permissible values are \(nX\), \(nZ\), \(nC'xx...x'\), \(nX'yy...yy'\), and various date and time constants.

**nX** Blank separation. \(n\) bytes of EBCDIC blanks (X'40') are to
appear in the reformatted input records. \( n \) can range from 1 to 4095. If \( n \) is omitted, 1 is used.

Examples of valid and invalid blank separation are shown in Table 26.

<table>
<thead>
<tr>
<th>Validity</th>
<th>Specified</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>X or 1X</td>
<td>1 blank</td>
</tr>
<tr>
<td>Valid</td>
<td>4095X</td>
<td>4095 blanks</td>
</tr>
<tr>
<td>Invalid</td>
<td>5000X</td>
<td>Too many repetitions. Use two adjacent separation fields instead (2500X,2500X, for example)</td>
</tr>
<tr>
<td>Invalid</td>
<td>0X</td>
<td>0 is not allowed.</td>
</tr>
</tbody>
</table>

\( nZ \)

Binary zero separation. \( n \) bytes of binary zeros (X'00') are to appear in the reformatted input records. \( n \) can range from 1 to 4095. If \( n \) is omitted, 1 is used.

Examples of valid and invalid binary zero separation are shown in Table 27.

<table>
<thead>
<tr>
<th>Validity</th>
<th>Specified</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>Z or 1Z</td>
<td>1 binary zero</td>
</tr>
<tr>
<td>Valid</td>
<td>4095Z</td>
<td>4095 binary zeros</td>
</tr>
<tr>
<td>Invalid</td>
<td>4450Z</td>
<td>Too many repetitions. Use two adjacent separation fields instead (4000Z,450Z for example).</td>
</tr>
<tr>
<td>Invalid</td>
<td>0Z</td>
<td>0 is not allowed.</td>
</tr>
</tbody>
</table>

\( nC'xx...x' \)

Character string separation. \( n \) repetitions of the character string constant (C'xx...x') are to appear in the reformatted input records. \( n \) can range from 1 to 4095. If \( n \) is omitted, 1 is used. \( x \) can be any EBCDIC character. You can specify from 1 to 256 characters.

If you want to include a single apostrophe in the character string, you must specify it as two single apostrophes:

Required: O'NEILL  Specify: C'O''NEILL'

Examples of valid and invalid character string separation are shown in Table 28.

<table>
<thead>
<tr>
<th>Validity</th>
<th>Specified</th>
<th>Result</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>C'John Doe'</td>
<td>John Doe</td>
<td>8</td>
</tr>
<tr>
<td>Valid</td>
<td>C'JOHN DOE'</td>
<td>JOHN DOE</td>
<td>8</td>
</tr>
<tr>
<td>Valid</td>
<td>C'$@#'</td>
<td>$@#</td>
<td>3</td>
</tr>
<tr>
<td>Valid</td>
<td>C'+0.193'</td>
<td>+0.193</td>
<td>6</td>
</tr>
<tr>
<td>Valid</td>
<td>4000C'</td>
<td>8000 blanks</td>
<td>8000</td>
</tr>
<tr>
<td>Valid</td>
<td>20C'<em>FILLER</em>'</td>
<td><strong>FILLER</strong> repeated 20 times</td>
<td>200</td>
</tr>
<tr>
<td>Valid</td>
<td>C'Frank's'</td>
<td>Frank's</td>
<td>7</td>
</tr>
<tr>
<td>Invalid</td>
<td>C'</td>
<td>Apostrophes not paired</td>
<td>n/a</td>
</tr>
</tbody>
</table>
### INREC Control Statement

#### Table 28. Examples of Valid and Invalid Character String Separation (continued)

<table>
<thead>
<tr>
<th>Validity</th>
<th>Specified</th>
<th>Result</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invalid</td>
<td>'ABCDEF'</td>
<td>C identifier missing</td>
<td>n/a</td>
</tr>
<tr>
<td>Invalid</td>
<td>C'ABCDE'</td>
<td>Apostrophe missing</td>
<td>n/a</td>
</tr>
<tr>
<td>Invalid</td>
<td>4450'C'T</td>
<td>Too many repetitions. Use two adjacent separation fields instead (4000'C'T,450'C'T, for example).</td>
<td>n/a</td>
</tr>
<tr>
<td>Invalid</td>
<td>0'C'ABC'</td>
<td>0 is not allowed</td>
<td>n/a</td>
</tr>
<tr>
<td>Invalid</td>
<td>'C'</td>
<td>No characters specified</td>
<td>n/a</td>
</tr>
<tr>
<td>Invalid</td>
<td>C'Frank's'</td>
<td>Two single apostrophes needed for one</td>
<td>n/a</td>
</tr>
</tbody>
</table>

nX'yy...yy'  
Hexadecimal string separation. n repetitions of the hexadecimal string constant (X'yy...yy') are to appear in the reformatted input records. n can range from 1 to 4095. If n is omitted, 1 is used.

The value yy represents any pair of hexadecimal digits. You can specify from 1 to 256 pairs of hexadecimal digits. Examples of valid and invalid hexadecimal string separation are shown in Table 29.

#### Table 29. Examples of Valid and Invalid Hexadecimal String Separation

<table>
<thead>
<tr>
<th>Validity</th>
<th>Specified</th>
<th>Result</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>X'FF'</td>
<td>FF</td>
<td>1</td>
</tr>
<tr>
<td>Valid</td>
<td>X'BF3C'</td>
<td>BF3C</td>
<td>2</td>
</tr>
<tr>
<td>Valid</td>
<td>3X'00000F'</td>
<td>00000F00000F00000F</td>
<td>9</td>
</tr>
<tr>
<td>Valid</td>
<td>4000X'FFFF'</td>
<td>FF repeated 8000 times</td>
<td>8000</td>
</tr>
<tr>
<td>Invalid</td>
<td>X'ABGD'</td>
<td>G is not a hexadecimal digit</td>
<td>n/a</td>
</tr>
<tr>
<td>Invalid</td>
<td>X'F1F'</td>
<td>Incomplete pair of digits</td>
<td>n/a</td>
</tr>
<tr>
<td>Invalid</td>
<td>'BF3C'</td>
<td>X identifier missing</td>
<td>n/a</td>
</tr>
<tr>
<td>Invalid</td>
<td>'F2F1'X</td>
<td>X in wrong place</td>
<td>n/a</td>
</tr>
<tr>
<td>Invalid</td>
<td>8000X'01'</td>
<td>Too many repetitions. Use two adjacent separation fields instead (4000X'01',4000X'01', for example).</td>
<td>n/a</td>
</tr>
<tr>
<td>Invalid</td>
<td>0X'23AB'</td>
<td>0 is not allowed</td>
<td>n/a</td>
</tr>
<tr>
<td>Invalid</td>
<td>'X'</td>
<td>No hexadecimal digits specified</td>
<td>n/a</td>
</tr>
</tbody>
</table>

**DATEn, DATEn(c), DATEnP**

Constant for current date. The current date of the run is to appear in the reformatted input records. See DATEn, DATEn(c), DATEnP under OUTFIL OUTREC for details.

**&DATEn, &DATEn(c), &DATEnP**

Can be used instead of DATEn, DATEn(c) and DATEnP, respectively.

**DATEn+r, DATEn(c)+r, DATEnP+r**

Constant for future date. A future date relative to the current date of the run is to appear in the reformatted input records. See DATEn+r, DATEn(c)+r, DATEnP+r under OUTFIL OUTREC for details.
INREC Control Statement

&DATEn+r, &DATEn(c)+r, &DATEnP+r
Can be used instead of DATEn+r, DATEn(c)+r and DATEnP+r, respectively.

DATEn-r, DATEn(c)-r, DATEnP-r
Constant for past date. A past date relative to the current date of the run is to appear in the reformatted input records. See DATEn-r, DATEn(c)-r, DATEnP-r under OUTFIL OUTREC for details.

&DATEn-r, &DATEn(c)-r, &DATEnP-r
Can be used instead of DATEn-r, DATEn(c)-r and DATEnP-r, respectively.

TIMEn, TIMEn(c), TIMEnP
Constant for current time. The time of the run is to appear in the reformatted input records. See TIMEn, TIMEn(c), TIMEnP under OUTFIL OUTREC for details.

&TIMEn, &TIMEn(c), &TIMEnP
Can be used instead of TIMEn, TIMEn(c) and TIMEnP, respectively.

DATE
Specifies that the current date is to appear in the reformatted input records in the form 'mm/dd/yy'. See DATE under OUTFIL OUTREC for details.

&DATE
Can be used instead of DATE.

DATE=(abcd)
Specifies that the current date is to appear in the reformatted input records in the form 'adbdc'. See DATE=(abcd) under OUTFIL OUTREC for details.

&DATE=(abcd)
Can be used instead of DATE=(abcd).

DATENS=(abc)
Specifies that the current date is to appear in the reformatted input records in the form 'abc'. See DATENS=(ab) under OUTFIL OUTREC for details.

&DATENS=(abc)
Can be used instead of DATENS=(abc).

YDDD=(abc)
specifies that the current date is to appear in the reformatted input records in the form 'acb'. See YDDD=(abc) under OUTFIL OUTREC for details.

&YDDD=(abc)
Can be used instead of YDDD=(abc).

YDDDNS=(ab)
specifies that the current date is to appear in the reformatted input records in the form 'ab'. See YDDDNS=(ab) under OUTFIL OUTREC for details.

&YDDDNS=(ab)
can be used instead of YDDDNS=(ab).

TIME
specifies that the current time is to appear in the reformatted input records in the form 'hh:mm:ss'. See TIME under OUTFIL OUTREC for details.

&TIME
Can be used instead of TIME.

TIME=(abc)
specifies that the current time is to appear in the reformatted input records
INREC Control Statement

in the form 'hhcmcss' (24-hour time) or 'hhcmcss xx' (12-hour time). See TIME=(abc) under OUTFIL OUTREC for details.

&TIME=(abc)
Can be used instead of TIME=(abc).

TIMENS=(ab)
specifies that the current time is to appear in the reformatted input record in the form 'hhmmss' (24-hour time) or 'hhmmss xx' (12-hour time). See TIMENS=(ab) under OUTFIL OUTREC for details.

&TIMENS=(ab)
Can be used instead of TIMENS=(ab).

p,m,a
Specifies that an unedited input field is to appear in the reformatted input record.

p
Specifies the first byte of the input field relative to the beginning of the input record. The first data byte of a fixed-length record has relative position 1. The first data byte of a variable-length record has relative position 5 (because the first 4 bytes contain the RDW). All fields must start on a byte boundary, and no field can extend beyond byte 32752. For special rules concerning variable-length records, see “INREC Statement Notes” on page 148.

m
Specifies the length of the input field. It must include the sign if the data is signed, and must be an integer number of bytes. See “INREC Statement Notes” on page 148 for more information.

a
Specifies the alignment (displacement) of the input field in the reformatted input record relative to the start of the reformatted input record.

Permissible values of a are:

H Halfword aligned. The displacement (p-1) of the field from the beginning of the reformatted input record, in bytes, is a multiple of two (that is, position 1, 3, 5, and so forth).

F Fullword aligned. The displacement is a multiple of four (that is, position 1, 5, 9, and so forth).

D Doubleword aligned. The displacement is a multiple of eight (that is, position 1, 9, 17, and so forth).

Alignment can be necessary if, for example, the data is to be used in a COBOL application program where items are aligned through the SYNCHRONIZED clause. Unused space preceding aligned fields will always be padded with binary zeros.

%nn
specifies that an unedited parsed input field is to appear in the reformatted input record. See PARSE for details of parsed fields. See p,m,a for further details. Note that alignment (H, F, D) is not permitted for %nn fields (for example, %nn,F results in an error message and termination).

p
specifies that the unedited variable part of the input record (that part
INREC Control Statement

beyond the minimum record length), is to appear in the reformatted input record, as the last field. p without m can only be used for variable-length records; not for fixed-length records.

Attention: If 1,4,p is specified (only RDW and variable part of record), “null” records containing only an RDW will result if the record length is less than p.

A value must be specified for p that is less than or equal to the minimum record length (RECORD statement L4 value) plus 1 byte.

p,m,TRAN=keyword
   Specifies that an input field is to be translated as indicated by the keyword. See p,m,TRAN=keyword under OUTFIL OUTREC for details.

%nn,TRAN=keyword
   Specifies that a parsed input field is to be translated as indicated by the keyword. See %nn,TRAN=keyword under OUTFIL OUTREC for details.

p,TRAN=keyword
   Specifies that the variable part of the input record is to be translated as indicated by the keyword. See p,TRAN=keyword under OUTFIL OUTREC for details.

p,m,HEX
   Can be used instead of p,m,TRAN=HEX. See p,m,HEX under OUTFIL OUTREC for details.

%nn,HEX
   Can be used instead of %nn,TRAN=HEX. See %nn,HEX under OUTFIL OUTREC for details.

p,HEX
   Can be used instead of p,TRAN=HEX. See p,HEX under OUTFIL OUTREC for details.

p,m,f,edit or (p,m,f),edit
   specifies that an edited numeric input field is to appear in the reformatted input record. You can edit BI, FI, PD, PD0, ZD, FL, CSF, FS, UFF, SFF, DC1, DC2, DC3, DE1, DE2, DE3, DT1, DT2, DT3, TC1, TC2, TC3, TC4, TE1, TE2, TE3, TE4, TM1, TM2, TM3 or TM4 fields using either pre-defined edit masks (M0-M26) or specific edit patterns you define. You can control the way the edited fields look with respect to length, leading or suppressed zeros, thousands separators, decimal points, leading and trailing positive and negative signs, and so on. See p,m,f,edit under OUTFIL OUTREC for details.

Sample Syntax:
   INREC FIELDS=(5:21,8,ZD,M19,X,46,5,ZD,M13,
   31:(35,6,FS),SIGNS=(,,+,+),LENGTH=10,
   51:8,4,PD,EDIT=(**II,IIT.TTXS),SIGNS=(,,+,+))

%nn,f,edit or (%nn,f),edit
   specifies that an edited numeric parsed input field is to appear in the reformatted input record. See PARSE for details of parsed fields. See p,m,f,edit or (p,m,f),edit for further details.

p,m,f,to or (p,m,f),to
   specifies that a converted numeric input field is to appear in the reformatted input record. You can convert BI, FI, PD, PD0, ZD, FL, CSF, FS, UFF, SFF, DC1, DC2, DC3, DE1, DE2, DE3, DT1, DT2, DT3, TC1, TC2, TC3,
INREC Control Statement

TC4, TE1, TE2, TE3, TE4, TM1, TM2, TM3, or TM4 fields to BI, FI, PD, PDC, PDF, ZD, ZDF, ZDC, or CSF/FS fields.

See p,m,f,to under OUTFIL OUTREC for details.

Sample Syntax:

```
Sample Syntax:
INREC FIELDS=(21,5,ZD,TO=PD,X,(8,4,ZD),FI,LENGTH=2,X,55,4,FL,TO=FS)
```

%nn,f,to or (%nn,f),to
specifies that a converted numeric parsed input field is to appear in the reformatted input record. See PARSE for details of parsed fields. See p,m,f,to or (p,m,f),to for further details.

decon,edit or (decon),edit
specifies that an edited decimal constant is to appear in the reformatted input record. The decimal constant must be in the form +n or −n where n is 1 to 31 decimal digits. The sign (+ or −) must be specified. A decimal constant produces a signed, 31-digit zoned decimal (ZD) result to be edited as specified.

See decon,edit under OUTFIL OUTREC for details.

Sample Syntax:

```
Sample Syntax:
INREC FIELDS=(5:+5000,EDIT=(T,TTT),X,(-25500),M18,LENGTH=8)
```

decon,to or (decon),to
specifies that a converted decimal constant is to appear in the reformatted input record. The decimal constant must be in the form +n or −n where n is 1 to 31 decimal digits. The sign (+ or −) must be specified. A decimal constant produces a signed, 31-digit zoned decimal (ZD) result to be converted as specified.

See decon,to under OUTFIL OUTREC for details.

Sample Syntax:

```
Sample Syntax:
inREC FIELDS=(+0,TO=PD,LENGTH=6,3Z,(-512000),FI)
```

arexp,edit or (arexp),edit
specifies that the edited result of an arithmetic expression is to appear in the reformatted input record. The arithmetic expression can consist of input fields, decimal constants, operators and parentheses. An arithmetic expression produces a signed, 31-digit zoned decimal (ZD) result to be edited as specified.

See arexp,edit under OUTFIL OUTREC for details.

Sample Syntax:

```
Sample Syntax:
inREC FIELDS=(C'**',27,2,FI,MIN,83,4,PD,EDIT=(STTTTTT),SIGNS=(+,-),15:(((15,5,ZD,ADD,+1),MUL,+100),DIV,62,2,PD),M25,LENGTH=10)
```

arexp,to or (arexp),to
specifies that the converted result of an arithmetic expression is to appear in the reformatted input record. The arithmetic expression can consist of input fields, decimal constants, operators and parentheses. An arithmetic expression produces a signed, 31-digit zoned decimal (ZD) result to be converted as specified.

See arexp,to under OUTFIL OUTREC for details.

Sample Syntax:
INREC Control Statement

INREC FIELDS=((15,6,FS,SUB,+5),ADD,(-1,MUL,36,6,FS),ZD,X,
3,2,FI,MIN,-6,LENGTH=4,TO=PD)

p,m,Y2x or p,m,Y4x
Specifies that an input date field is to be edited. Real Y2x dates are edited using the century window established by the Y2PAST option in effect. Y2x and Y4x dates with special indicators are expanded appropriately (for example, p,6,Y21 transforms C'000000' to C'00000000').

See "p,m,Y2x or p,m,Y4x" under OUTFIL OUTREC for details.

Sample Syntax:
INREC BUILD=(21,3,Y2U,X,3,8,Y4W)

%nn,Y2x or %nn,Y4x
Specifies that a parsed input date field is to be edited. See PARSE for details of parsed fields. See "p,m,Y2x or p,m,Y4x" for further details.

p,m,Y2x,edit or p,m,Y4x,edit
Specifies that the output for a p,m,Yxx input date field is to be edited according to the edit parameters you specify. For example, if you specify:

INREC BUILD=(28,5,Y4V,EDIT=(TTTT-TT-TT)

The P'ccymmdidd' (X'0ccymmdiddC') date value will be transformed to a C'ccymmdidd' date value and then edited to a C'ccyy-mm-dd' date value.

See "p,m,Y2x or p,m,Y4x" and "p,m,f,edit" for related details.

%nn,Y2x,edit or %nn,Y4x,edit
Specifies that the output for a parsed Yxx input date field is to be edited according to the edit parameters you specify. See PARSE for details of parsed fields. See "p,m,Y2x,edit or p,m,Y4x,edit" for further details.

p,m,Y2x,to or p,m,Y4x,to
Specifies that an input date field is to be converted according to the to parameters you specify. For example, if you specify:

INREC BUILD=(5,6,Y2W,TO=PD,LENGTH=5)

The C'mmddyy' date value will be transformed to a Z'mmddccyy' date value and then converted to a P'mmddccyy' (X'0mmddccyyC') date value.

See "p,m,Y2x or p,m,Y4x" and "p,m,f,to" for related details.

%nn,Y2x,to or %nn,Y4x,to
Specifies that a parsed input date field is to be converted according to the to parameters you specify. See PARSE for details of parsed fields. See "p,m,Y2x,to or p,m,Y4x,to" for further details.

p,m,Y2x,todate or p,m,Y4x,todate
Specifies that an input date field of one type is to be converted to a corresponding output date field of another type. You can convert date fields between combinations of 2-digit and 4-digit year dates, CH/ZD and PD dates, and Julian and Gregorian dates. You can also convert a date field to a corresponding day of the week in several forms.

See "p,m,Y2x,todate or p,m,Y4x,todate" under OUTFIL OUTREC for details.

Sample Syntax:
INREC Control Statement

* Convert a P'dddyy' input date to a C'ccyy/mm/dd' output date
  INREC BUILD=(21,3,Y2X,TOLREG=Y4T(/),X,
* Convert a C'ccyymmdd' input date to a P'ccyyddd' output date
  42,8,Y4T,TOJUL=Y4U,X,
* Convert a C'mmddyy' input date to a C'yymmdd' output date
  11,6,Y2W,TOLREG=Y2T)

%nn,Y2x,todate or %nn,Y4x,todate
  Specifies that an input date field of one type is to be converted to a
  corresponding output date field of another type. See PARSE for details of
  parsed fields. See "p,m,Y2x,todate or p,m,Y4x,todate" for further details.

p,m,Y2x,dateop or p,m,Y4x,dateop
  Specifies an arithmetic operation for an input date field. See
  "p,m,Y2x,dateop or p,m,Y4x,dateop" under OUTFIL OUTREC for details.

%nn,Y2x,dateop or %nn,Y4x,dateop
  Specifies an arithmetic operation for a parsed input date field. See
  "%nn,Y2x,dateop or %nn,Y4x,dateop" under OUTFIL OUTREC for details.

p,m,Y2x(s) or p,m,Y4x(s)
  Specifies that an input date field is to be edited with separators. s can be
  any character except a blank. Real Y2x dates are edited using the century
  window established by the Y2PAST option in effect. Y2x and Y4x dates
  with special indicators are expanded appropriately (for example, p,8,Y4T(/)
  transforms C'00000000' to C'0000/00/00').

  See "p,m,Y2x(s) or p,m,Y4x(s)" under OUTFIL OUTREC for details.

Sample Syntax:
  * Convert a Z'dddccyy' date to a C'ddd/ccyy' date.
    INREC BUILD=(19,7,Y4W(/),X,
  * Convert a P'ccyymmdd' date to a C'ccyy-mm-dd' date.
    43,5,Y4V(-))

%nn,Y2x(s) or %nn,Y4x(s)
  Specifies that a parsed input date field is to be edited with separators. See
  PARSE for details of parsed fields. See "p,m,Y2x(s) or p,m,Y4x(s)" for
  further details.

p,m,Y2xP
  Specifies that an input date field is to be converted to a packed decimal
  output date field. Real Y2x dates are edited using the century window
  established by the Y2PAST option in effect. Y2x and Y4x dates with special
  indicators are expanded appropriately (for example, p,6,Y2TP transforms
  C'00000000' to P'0000000000').

  See "p,m,Y2xP" under OUTFIL OUTREC for details.

Sample Syntax:
  INREC BUILD=(11,3,Y2XP,X,21,4,Y2WP)

%nn,Y2xP
  Specifies that a parsed input date field is to be converted to a packed
  decimal output date field. See PARSE for details of parsed fields. See
  "p,m,Y2xP" for further details.

p,m,lookup or %nn,lookup
  specifies that a character constant, hexadecimal constant, input field (p,m),
  or parsed input field (%nn) from a lookup table is to appear in the
  reformatted input record. You can use p,m,lookup or %nn,lookup to select
  a specified character set constant (that is, a character or hexadecimal string)
or set field (that is, an input field or parsed input field) based on matching
an input value against find constants (that is, character, hexadecimal, or bit
constants).

See p,m,lookup or %nn,lookup under OUTFIL OUTREC for details.

Sample Syntax:

```
INREC FIELDS=(11,1,
  CHANGE=(6,
    C'R',C'READ',
    C'U',C'UPDATE',
    X'FF',C'EMPTY',
    C'A',C'ALTER'),
  NOMATCH=(11,6),
  4X,
  21,1,
  CHANGE=(10,
    B'.1......',C'VSAM',
    B'.0......',C'NON-VSAM'))
```

p,m,justify specifies that a left-justified or right-justified input field is to appear in the
reformatted input record. For a left-justified field, leading blanks are
removed and the characters from the first nonblank to the last nonblank
are shifted left, with blanks inserted on the right if needed. For a
right-justified field, trailing blanks are removed and the characters from the
last nonblank to the first nonblank are shifted right, with blanks inserted
on the left if needed. Optionally:
- specific leading and trailing characters can be changed to blanks before
  justification begins
- a leading string can be inserted
- a trailing string can be inserted
- the output length can be changed (it's equal to the input length by
default)

See p,m,justify under OUTFIL OUTREC for details.

Sample Syntax:

```
INREC FIELDS=(1,10,
  21,20,JFY=(SHIFT=RIGHT),5X,
  52,12,JFY=(SHIFT=LEFT,PREBLANK=C'()',LEAD=C'VOL=SER=',
    LENGTH=16))
```

%nn,justify specifies that a left-justified or right-justified parsed input field is to appear in
the reformatted input record. See PARSE for details of parsed fields. See
p,m,justify for further details.

p,m,squeeze specifies that a left-squeezed or right-squeezed input field is to appear in
the reformatted input record. For a left-squeezed field, all blanks are
removed and the characters from the first nonblank to the last nonblank
are shifted left, with blanks inserted on the right if needed. For a
right-squeezed field, all blanks are removed and the characters from the
last nonblank to the first nonblank are shifted right, with blanks inserted
on the left if needed. Optionally:
- specific characters can be changed to blanks before squeezing begins
- a leading string can be inserted
- a trailing string can be inserted
INREC Control Statement

- a string (for example, a comma delimiter) can be inserted wherever a group of blanks is removed between the first nonblank and the last nonblank
- blanks can be kept as is between paired apostrophes ('AB CD EF') or paired quotes ("AB CD EF")
- the output length can be changed (it's equal to the input length by default)

See p,m,squeeze under OUTFIL OUTREC for details.

Sample Syntax:

```plaintext
INREC FIELDS=(21,20,SQZ=(SHIFT=LEFT),5X,
              152,18,SQZ=(SHIFT=RIGHT,PREBLANK=X'00',
                     LEAD=C<'`,MID=C',',',TRAIL=C'>',PAIR=APOST))
```

%nn,squeeze
specifies that a left-squeezed or right-squeezed parsed input field is to appear in the reformatted input record. See PARSE for details of parsed fields. See p,m,squeeze for further details.

seqnum
specifies that a sequence number is to appear in the reformatted input record. The sequence numbers are assigned in the order in which the records are received for INREC processing. You can create BI, PD, ZD, CSF, or FS sequence numbers and control their lengths, starting values and increment values. You can restart the sequence number at the start value each time a specified input field (p,m) or parsed input field (%nn) changes.

See seqnum under OUTFIL OUTREC for details.

Sample Syntax:

```plaintext
INREC FIELDS=(1,80,SEQNUM,8,ZD)
```

Default for BUILD or FIELDS: None; must be specified. See Appendix B, “Specification/Override of DFSORT Options,” on page 857.


OVERLAY
Specifies each item that is to overlay specific columns in the reformatted record. Columns that are not overlaid remain unchanged. If you want to insert, rearrange, or delete fields, use BUILD or FIELDS rather than OVERLAY. Use OVERLAY only to overlay existing columns or to add fields at the end of every record. OVERLAY can be easier to use than BUILD or FIELDS when you just want to change a few fields without rebuilding the entire record.

For fixed-length records, the first input and output data byte starts at position 1. For variable-length records, the first input and output data byte starts at position 5, after the RDW in positions 1-4.

Use c: (column) to specify the output positions to be overlaid. If you do not specify c: for the first item, it defaults to 1:. If you do not specify c: for any other item, it starts after the previous item. For example, if you specify:

INREC OVERLAY=(25,2,11:C’A’,15,3,C’**’)

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Input positions 25-26 are placed at output positions 1-2; C'A' is placed at output position 11; input positions 15-17 are placed at output positions 12-14; and C'*' is placed at output positions 15-16. The rest of the record remains unchanged.

You can specify items in any order, you can change the same item multiple times and you can overlap output columns. Changes to earlier items affect changes to later items. For example, say you specify:

```
INREC OVERLAY=(21:8,4,ZD,TO=PD,LENGTH=6,
5:5,1,TRAN=UTOL,
5:5,1,CHANGE=(1,'a','X','b','Y'),NOMATCH=(5,1))
```

and input position 5 has 'A'. The second item (UTOL) would change 'A' to 'a' and the third item (CHANGE) would change 'a' again to 'X'.

If you specify an OVERLAY item that extends the overlay record beyond the end of the input record, the reformatted record length is automatically increased to that length, and blanks are filled in on the left as needed. For variable-length records, the RDW length is also increased to correspond to the larger reformatted record length after all of the OVERLAY items are processed. For example, if your input record has a length of 40 and you specify:

```
INREC OVERLAY=(16:C'ABC',51:5C'*',35:15,2)
```

the output record is given a length of 55. Blanks are filled in from columns 41-50. For variable-length records, the length in the RDW is changed from 40 to 55 after all of the OVERLAY items are processed.

Missing bytes in specified input fields are replaced with blanks so the padded fields can be processed.

See INREC FIELDS for details of the items listed in the OVERLAY syntax diagram above. You can specify all of the items for OVERLAY in the same way that you can specify them for BUILD or FIELDS with the following exceptions:

- You cannot specify p or p,HEX or p,TRAN=keyword for OVERLAY.
- For p,m,H or p,m,F or p,m,D fields specified for OVERLAY, fields are aligned as necessary without changing the preceding bytes.
- For variable-length records, you must not overlay positions 1-4 (the RDW) for OVERLAY, so be sure to specify the first column (c:) as 5 or greater. If you do not specify the first column, it will default to 1: which is invalid for variable-length records with OVERLAY. Whereas FIELDS=(1,m,...) is required, OVERLAY=(1,m) is not allowed, since it would overlay the RDW.

Sample Syntax:

Fixed input records:

```
INREC OVERLAY=(21:21,4,ZD,TO=PD,LENGTH=4,
2:5,8,HEX,45:C'*',32,4,C'*',81:SEQNUM,5,ZD)
```

Variable input records:

```
INREC OVERLAY=(5:X'0001',28:C'Date is ',YDDDNS=(4D),
17:5C'*')
```

Default for OVERLAY: None; must be specified. See Appendix B, “Specification/Override of DFSORT Options,” on page 857.

You can use FINDREP to find constants anywhere in a record and replace them with other constants of the same or different lengths. You can find character or hexadecimal input constants anywhere in your records and replace them with character, hexadecimal or null output constants. As appropriate, bytes can be shifted left or right, blank padding can be added for fixed-length records, and the length can be changed for variable-length records.

Various options of FINDREP allow you to define one or more input constants and a corresponding output constant, define one or more pairs of input and output constants, start and end the find scan at specified positions, stop after a specified number of constants are replaced, increase or decrease the length of the output record, define the action to be taken if nonblank characters overrun the end of the record, and specify whether output constants are to replace or overlay input constants.

See FINDREP under "OUTFIL Control Statements" for complete details.

Sample syntax

```
INREC FINDREP=('IN=C'Goodbye',OUT=C'Bye')
```

Default for FINDREP: None; must be specified. See Appendix B, "Specification/Override of DFSORT Options," on page 857.

IFTHEN clauses allow you to reformat different records in different ways by specifying how build, overlay, find/replace or group operation items are to be applied to records that meet given criteria. IFTHEN clauses let you use simple or complex conditional logic to choose how different record types are reformatted.

If you want to insert, rearrange, or delete fields in the same way for every record, use BUILD or FIELDS rather than IFTHEN. If you want to overlay existing columns in the same way for every record, use OVERLAY rather than IFTHEN. If you want to do find and replace operations in the same way for every record, use FINDREP rather than IFTHEN. Use IFTHEN clauses if you want to insert, rearrange, delete or overlay fields, or perform find/replace operations in different ways for different records, or if you want to perform operations on groups of records.

You can use five types of IFTHEN clauses as follows:

- **WHEN=INIT**: Use one or more WHEN=INIT clauses to apply build, overlay or find/replace items to all of your input records. WHEN=INIT clauses and WHEN=GROUP clauses are processed before any of the other IFTHEN clauses.

- **WHEN=GROUP**: Use one or more WHEN=GROUP clauses to propagate fields, identifiers and sequence numbers within specified groups of records. WHEN=INIT clauses and WHEN=GROUP clauses are processed before any of the other IFTHEN clauses.

- **WHEN=(logexp)**: Use one or more WHEN=(logexp) clauses to apply build, overlay or find/replace items to your input records that meet specified criteria. A WHEN=(logexp) clause is satisfied when the logical expression evaluates as true.

- **WHEN=ANY**: Use a WHEN=ANY clause after multiple WHEN=(logexp) clauses to apply additional build, overlay or find/replace items to your input records if they satisfied the criteria for any of the preceding WHEN=(logexp) clauses.

- **WHEN=NONE**: Use one or more WHEN=NONE clauses to apply build, overlay or find/replace items to your input records that did not meet the criteria for any of the WHEN=(logexp) clauses. WHEN=NONE clauses are processed after any of the other IFTHEN clauses. If you do not specify a
WHEN=NONE clause, only the WHEN=INIT and WHEN=GROUP changes (if any) are applied to input records that do not meet the criteria for any of the WHEN=(logexp) clauses.

IFTHEN clauses are processed in the following order:
- WHEN=INIT clauses and WHEN=GROUP clauses
- WHEN=(logexp) clauses and WHEN=ANY clauses
- WHEN=NONE clauses

Processing of IFTHEN clauses continues unless one of the following occurs:
- A WHEN=(logexp) or WHEN=ANY clause is satisfied, and HIT=NEXT is not specified.
- There are no more IFTHEN clauses to process. When processing of IFTHEN clauses stops, the IFTHEN record created so far is used as the output record.

Example:

```
INREC IFTHEN=(WHEN=(12,1,BI,ALL,X'3F'),OVERLAY=(18:C'Yes')),
            IFTHEN=(WHEN=(35,2,PD,EQ,+14),BUILD=(1,40,45,3,HEX),HIT=NEXT),
            IFTHEN=(WHEN=(35,2,PD,GT,+17),BUILD=(1,40,41,5,HEX),HIT=NEXT),
            IFTHEN=(WHEN=ANY,BUILD=(1,55,C'ABC',70:X)),
            IFTHEN=(WHEN=(63,2,CH,EQ,C'AB'),OVERLAY=(18:C'No')),
            IFTHEN=(WHEN=NONE,BUILD=(1,40,51,8,TRAN=LTO))
```

For this example, the IFTHEN clauses are processed as follows:
- If IFTHEN clause 1 is satisfied, its overlay item is applied and IFTHEN processing stops.
- If IFTHEN clause 1 is not satisfied, its overlay item is not applied and IFTHEN processing continues.
- If IFTHEN clause 2 is satisfied, its build items are applied and IFTHEN processing continues.
- If IFTHEN clause 2 is not satisfied, its build items are not applied and IFTHEN processing continues.
- If IFTHEN clause 3 is satisfied, its build items are applied and IFTHEN processing continues.
- If IFTHEN clause 3 is not satisfied, its build items are not applied and IFTHEN processing continues.
- If IFTHEN clause 4 is satisfied, its build items are applied and IFTHEN processing continues.
- If IFTHEN clause 4 is not satisfied, its build items are not applied and IFTHEN processing continues.
- If IFTHEN clause 5 is satisfied, its overlay item is applied and IFTHEN processing stops.
- If IFTHEN clause 5 is not satisfied, its overlay item is not applied and IFTHEN processing continues.
- If IFTHEN clause 6 is satisfied, its build items are applied and IFTHEN processing stops.
- If IFTHEN clause 6 is not satisfied, its build items are not applied and IFTHEN processing stops.

All of the IFTHEN clauses operate sequentially on an IFTHEN record. The IFTHEN record is created initially from the input record. Each IFTHEN clause tests and changes the IFTHEN record, as appropriate. Thus, changes made by earlier IFTHEN clauses are "seen" by later IFTHEN clauses. For example, if you have a 4-byte input record and specify:

```
INREC IFTHEN=(WHEN=INIT,OVERLAY=(8:B,4,ADD,+1,TO=ZD,LENGTH=4)),
            IFTHEN=(WHEN=(8,B,4,ADD,+1,TO=ZD,LENGTH=4)),
            IFTHEN=(WHEN=NONE,OVERLAY=(28:F,'Yes' ))
```

For this example, the IFTHEN clauses are processed as follows:
- If IFTHEN clause 1 is satisfied, its overlay item is applied and IFTHEN processing stops.
- If IFTHEN clause 1 is not satisfied, its overlay item is not applied and IFTHEN processing continues.
- If IFTHEN clause 2 is satisfied, its build items are applied and IFTHEN processing continues.
- If IFTHEN clause 2 is not satisfied, its build items are not applied and IFTHEN processing continues.
- If IFTHEN clause 3 is satisfied, its build items are applied and IFTHEN processing stops.
- If IFTHEN clause 3 is not satisfied, its build items are not applied and IFTHEN processing continues.

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INREC Control Statement

The WHEN=INIT clause adds 1 to the ZD value and stores it in the IFTHEN record. The WHEN=(8,4,ZD,EQ,+27) clause tests the incremented ZD value in the IFTHEN record rather than the original ZD value in the input record.

The IFTHEN record is adjusted as needed for the records created or changed by the IFTHEN clauses. For fixed-length records, blanks are filled in on the left as needed. For variable-length records, the RDW length is adjusted as needed each time the IFTHEN record is changed.

Missing bytes in specified input fields are replaced with blanks so the padded fields can be processed.

DFSORT sets an appropriate LRECL (or reformatted record length if the INREC record is further modified) for the output records based on the build, overlay, find/replace and group operation items specified by the IFTHEN clauses. However, DFSORT does not analyze the possible results of WHEN=(logexp) conditions when determining an appropriate LRECL. When you use INREC IFTHEN clauses, you can override the INREC LRECL determined by DFSORT with the INREC IFOUTLEN parameter.

If SEQNUM is used in multiple IFTHEN clauses, the sequence number will be incremented for each record that satisfies the IFTHEN clause, that is, a separate SEQNUM counter will be kept for each IFTHEN clause. For example, if your input is:

RECORD A 1
RECORD B 1
RECORD B 2
RECORD C 1
RECORD A 2
RECORD C 2
RECORD B 3
RECORD D 1

and you specify:

INREC IFTHEN=(WHEN=(8,1,CH,EQ,C'A'),OVERLAY=(15:SEQNUM,4,ZD)),
IFTHEN=(WHEN=(8,1,CH,EQ,C'B'),OVERLAY=(16:SEQNUM,4,ZD)),
IFTHEN=(WHEN=NONE,OVERLAY=(17:SEQNUM,4,ZD))

your output will be:

RECORD A 1 0001
RECORD B 1 0001
RECORD B 2 0002
RECORD C 1 0001
RECORD A 2 0002
RECORD C 2 0002
RECORD B 3 0003
RECORD D 1 0003

Separate SEQNUM counters are kept for the 'A' record, for the 'B' record, and for the NONE records.

WHEN=INIT clause

See "WHEN=INIT clause" under OUTFIL IFTHEN for details. Note that / cannot be used to create blank records or new records.

Sample Syntax:

INREC IFTHEN=(WHEN=INIT,
    BUILD=(1,20,21:C'Department',31:3X,21,60)),
    IFTHEN=(WHEN=(5,2,CH,EQ,C'D1'),OVERLAY=(31:8,3)),
    IFTHEN=(WHEN=(5,2,CH,EQ,C'D2'),OVERLAY=(31:12,3))
WHEN=GROUP clause

See "WHEN=GROUP clause" under OUTFIL IFTHEN for details.

Sample Syntax:

```
INREC IFTHEN=(WHEN=GROUP,
    BEGIN=(1,40,SS,EQ,C'J82',OR,1,40,SS,EQ,C'M72'),
    PUSH=(41:ID=5))
```

WHEN=(logexp) clause

See "WHEN=(logexp) clause" under OUTFIL IFTHEN for details. Note that although / can be used to create blank records and new records with OUTFIL, it cannot be used with INREC.

Sample Syntax:

```
INREC IFTHEN=(WHEN=(1,3,CH,EQ,C'T01',AND,18,4,ZD,LE,+2000),OVERLAY=(42:C'Type1 <= 2000'),HIT=NEXT),
    IFTHEN=(WHEN=(1,3,CH,EQ,C'T01',AND,6,1,BI,BO,X'03'),BUILD=(1,2,42,13)),
    IFTHEN=(WHEN=(1,3,CH,EQ,C'T01',AND,18,4,ZD,GT,+2000),OVERLAY=(42:C'Type1 > 2000'),HIT=NEXT),
    IFTHEN=(WHEN=(1,3,CH,EQ,C'T01',AND,6,1,BI,BO,X'01'),BUILD=(1,25,42,13))
```

WHEN=ANY clause

See "WHEN=ANY clause" under OUTFIL IFTHEN for details. Note that although / can be used to create blank records and new records with OUTFIL, it cannot be used with INREC.

Sample Syntax:

```
INREC IFTHEN=(WHEN=(1,3,SS,EQ,C'T01,T02,T03'),BUILD=(C'Group A',X,1,80),HIT=NEXT),
    IFTHEN=(WHEN=(1,3,SS,EQ,C'T04,T05,T06'),BUILD=(C'Group B',X,1,80),HIT=NEXT),
    IFTHEN=(WHEN=(1,3,SS,EQ,C'T07,T08,T09,T10'),BUILD=(C'Group C',X,1,80),HIT=NEXT),
    IFTHEN=(WHEN=ANY,OVERLAY=(16:C'Group Found'))
```

WHEN=NONE clause

See "WHEN=NONE clause" under OUTFIL IFTHEN for details. Note that although / can be used to create blank records and new records with OUTFIL, it cannot be used with INREC.

Sample Syntax:

```
INREC IFTHEN=(WHEN=INIT,BUILD=(1,20,21:C'Department',31:3X,21,60)),
    IFTHEN=(WHEN=(5,2,CH,Eq,C'D01'),OVERLAY=(31:8,3)),
    IFTHEN=(WHEN=(5,2,CH,Eq,C'D02'),OVERLAY=(31:12,3)),
    IFTHEN=(WHEN=NONE,OVERLAY=(31:C'**'))
```

Default for IFTHEN clauses: None; must be specified. See Appendix B, "Specification/Override of DFSORT Options".

Applicable Functions: See Appendix B, "Specification/Override of DFSORT Options".

IFOUTLEN

```
>>> IFOUTLEN=n
```

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INREC Control Statement

Overrides the INREC LRECL (or reformatted record length if the INREC record is further modified) determined by DFSORT from your INREC IFTHEN clauses. DFSORT sets an appropriate LRECL for the output records based on the build, overlay, find/replace and group operation items specified by the IFTHEN clauses. However, DFSORT does not analyze the possible results of WHEN=(logexp) conditions when determining an appropriate INREC LRECL. When you use INREC IFTHEN clauses, you can override the INREC LRECL determined by DFSORT with the INREC IFOUTLEN parameter.

Fixed-length records longer than the IFOUTLEN length are truncated to the IFOUTLEN length. Fixed-length records shorter than the IFOUTLEN are padded with blanks to the IFOUTLEN length. Variable-length records longer than the IFOUTLEN length are truncated to the IFOUTLEN length.

n specifies the length to use for the INREC LRECL (or for the reformatted record length if the INREC record is further modified). The value for n must be between 1 and 32767, but must not be larger than the maximum LRECL allowed for the RECFM, and must not conflict with the specified or retrieved LRECL for the fixed-length output data set.

Sample Syntax:

```
INREC IFOUTLEN=70,
  IFTHEN=(WHEN=(5,1,CH,EQ,C'1',AND,8,3,ZD,EQ,+10),
            BUILD=(1,40,C'T01-GROUP-A',65)),
  IFTHEN=(WHEN=(5,1,CH,EQ,C'2',AND,8,3,ZD,EQ,+12),
            BUILD=(1,40,C'T02-GROUP-B',65))
```

Default for IFOUTLEN: The LRECL determined from the IFTHEN clauses.

INREC Statement Notes

- When INREC is specified, DFSORT reformats the input records after user exit E15 or INCLUDE/OMIT statement processing is finished. Thus, references to fields by your E15 user exit and INCLUDE/OMIT statements are not affected, whereas your SORT, OUTREC, and SUM statements must refer to fields in the reformatted input records. Your E35 user exit must refer to fields in the reformatted output record.
- In general, OUTREC should be used rather than INREC so your SORT and SUM statements can refer to fields in the original input records.
- If you use locale processing for SORT, MERGE, INCLUDE, or OMIT fields, you must not use INREC. Use the OUTREC statement or the OUTFIL statement instead of INREC.
- When you specify INREC, you must be aware of the change in record size and layout of the resulting reformatted input records.
- Performance can be improved if you can significantly reduce the length of your records with INREC. INREC and OUTREC should not be used unless they are actually needed to reformat your records.
- For variable-length records, the first entry in the FIELDS, BUILD, or IFTHEN BUILD parameter must specify or include the unedited 4-byte record descriptor word (RDW), that is, the first field must be 1,4 or 1,m with m greater than 4. DFSORT sets the length of the reformatted record in the RDW.

If the first field in the data portion of the input record is to appear unedited in the reformatted record immediately following the RDW, the entry in the FIELDS, BUILD, or IFTHEN BUILD parameter can specify both RDW and data field in one (1,m,...). Otherwise, the RDW must be specifically included in the reformatted record (for example, 1,4,1,4,HEX).
INREC Control Statement

- For variable-length records, OVERLAY, IFTHEN OVERLAY or IFTHEN PUSH items must not overlay the RDW in bytes 1-4. You must ensure that 1, 2, 3, or 4 is not specified or defaulted for any OVERLAY or PUSH item. Note that the default for the first OVERLAY or PUSH item is 1, so you must override it.

- If the SORTOUT LRECL is specified or available, DFSORT will use it even if it does not match the reformatted INREC record length; this can cause padding or truncation of the reformatted INREC records, or termination. If the SORTOUT LRECL is not specified or available, DFSORT can automatically use the reformatted INREC record length as the SORTOUT LRECL, when appropriate. See the discussion of the SOLRF and NOSOLRF options in "OPTION Control Statement" on page 173.

For VSAM data sets, the maximum record size defined in the cluster is equivalent to the LRECL when processing fixed-length records, and is four bytes less than the LRECL when processing variable-length records. See "VSAM Considerations" on page 15 for more information.

- With FIELDS, BUILD, or IFTHEN BUILD, the variable part of the input record (that part beyond the minimum record length) can be included in the reformatted record, and if included, must be the last part. In this case, a value must be specified for pr that is less than or equal to the minimum record length (see L4 of the RECORD control statement) plus 1 byte; mn and am must be omitted. For example:

  INREC FIELDS=(1,8,20C'***',9)

  With OVERLAY, the variable part of the input record must not be included in the reformatted record.

- If INREC with FIELDS or BUILD and OUTREC with FIELDS and BUILD are specified, either both must specify position-only for the last part, or neither must specify position-only for the last part. For example:

  INREC BUILD=(1,8,20C'***',9)
  OUTREC BUILD=(1,4,32,5)

  or:

  INREC FIELDS=(1,40,45,5)
  OUTREC FIELDS=(1,45,C'****')

OVERLAY or IFTHEN, and FIELDS or BUILD, can differ with respect to position-only. For example:

  INREC BUILD=(1,24,32;25)
  OUTREC IFTHEN=(WHEN=(8,1ZD,GT,1),
    BUILD=(1,24,25;C'Yes',28,10)),
  IFTHEN=(WHEN=NONE,
    BUILD=(1,24,25;C'No ',28,10))

  or:

  INREC FIELDS=(1,18,8C'***',23)
  OUTREC OVERLAY=(24:C'A')

- If the reformatted record includes only the RDW and the variable part of the input record, "null" records containing only an RDW could result.

- The input records are reformatted before processing, as specified by INREC. The output records are in the format specified by INREC, unless OUTREC is also specified.

- Fields referenced in INREC statements can overlap each other and control fields or both.

- If input is variable records, the output is also variable. This means that each record is given the correct RDW by DFSORT before output.
INREC Control Statement

- If overflow might occur during summation, INREC can be used to create a larger SUM field in the reformatted input record (perhaps resulting in a larger record for sorting or merging) so that overflow does not occur. “Example 5” on page 456 illustrates this technique.
- DFSORT issues a message and terminates if an INREC statement is specified for a tape work data set sort or conventional merge application.
- If SZERO is in effect, −0 is treated as negative and +0 is treated as positive for edited or converted input fields, decimal constants, and the results of arithmetic expressions. If NOSZER0 is in effect, −0 and +0 are treated as positive for edited or converted input fields, decimal constants, and the results of arithmetic expressions.
- If SZERO is in effect, -0 compares as less than +0 when numeric fields and constants are used. If NOSZER0 is in effect, -0 compares as equal to +0 when numeric fields and constants are used.

Note: OPTION SZERO or OPTION NOSZER0 is ignored for INREC IFTHEN=(WHEN=(logexp),...) unless the OPTION statement is found in a higher source (for example, DFSPARM is a higher source than SYSIN) or before the INREC statement in the same source. For example, NOSZER0 will be used in both of the following cases:

Case 1:
//DFSPARM DD *
   OPTION COPY,NOSZER0
/*
//SYSIN DD *
   INREC IFTHEN=(WHEN=(1,2,FS,EQ,+0),OVERLAY=(22:C'Yes')),
                  IFTHEN=(WHEN=NONE,OVERLAY=(22:C'No'))
/*
Case 2:
//SYSIN DD *
   OPTION COPY,NOSZER0
   INREC IFTHEN=(WHEN=(1,2,FS,EQ,+0),OVERLAY=(28:C'A')),
                  IFTHEN=(WHEN=NONE,OVERLAY=(28:C'B'))
/*

Reformatting Records Before Processing — Examples
Both INREC and OUTREC can be used to reformat records, either separately or together. The two control statements perform similar functions, although INREC reformats records before sort, merge, or copy processing, whereas OUTREC reformats records after sort, merge, or copy processing. This section shows INREC examples. See "Reformatting Records After Processing — Examples” on page 426 for OUTREC examples.

Example 1

INREC Method:
INCLUDE COND=(5,1,GE,C'M'),FORMAT=CH
INREC FIELDS=(10,3,20,8,33,11,5,1)
SORT FIELDS=(4,8,CH,A,1,3,FI,A)
SUM FIELDS=(17,4,BI)

OUTREC Method:
INCLUDE COND=(5,1,GE,C'M'),FORMAT=CH
OUTREC FIELDS=(10,3,20,8,33,11,5,1)
SORT FIELDS=(20,8,CH,A,10,3,FI,A)
SUM FIELDS=(38,4,BI)
INREC Control Statement

The above examples illustrate how a fixed-length input data set is sorted and reformatted for output. Unnecessary fields are eliminated from the output records using INREC or OUTREC. The SORTIN LRECL is 80.

Records are also included or excluded by means of the INCLUDE statement, and summed by means of the SUM statement.

The reformatted input records are fixed length with a record size of 23 bytes. SOLRF (the IBM-supplied default) is in effect, so unless the SORTOUT LRECL is specified or available, it will automatically be set to the reformatted record length of 23. The reformatted records look as follows after INREC or OUTREC processing:

<table>
<thead>
<tr>
<th>Position</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3</td>
<td>Input positions 10 through 12</td>
</tr>
<tr>
<td>4-11</td>
<td>Input positions 20 through 27</td>
</tr>
<tr>
<td>12-22</td>
<td>Input positions 33 through 43</td>
</tr>
<tr>
<td>23</td>
<td>Input position 5</td>
</tr>
</tbody>
</table>

Identical results are achieved with INREC or OUTREC. However, use of OUTREC makes it easier to code the SORT and SUM statements. In either case, the INCLUDE COND parameters must refer to the fields of the original input records. However, with INREC, the SUM and SORT FIELDS parameters must refer to the fields of the reformatted input records, while with OUTREC, the SUM and SORT FIELDS parameters must refer to the fields of the original input records.

Example 2

INREC FIELDS=(1,35,2Z,36,45)
MERGE FIELDS=(20,4,CH,D,10,3,CH,D),FILES=3
SUM FIELDS=(36,4,BI,40,8,PD)
RECORD TYPE=F,LENGTH=(80,,82)

This example illustrates how overflow of a summary field can be prevented when three fixed-length data sets are merged and reformatted for output. The input record size is 80 bytes. To illustrate the use of the RECORD statement, assume that SORTIN and SORTOUT are not present (that is, all input/output is handled by user exits).

The reformatted input records are fixed-length with a record size of 82 bytes (an insignificant increase from the original size of 80 bytes). They look as follows:

<table>
<thead>
<tr>
<th>Position</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-35</td>
<td>Input positions 1 through 35</td>
</tr>
<tr>
<td>36-37</td>
<td>Binary zeros (to prevent overflow)</td>
</tr>
<tr>
<td>38-82</td>
<td>Input positions 36 through 80</td>
</tr>
</tbody>
</table>

The MERGE and SUM statements must refer to the fields of the reformatted input records.

The reformatted output records are identical to the reformatted input records.

Thus, the 2-byte summary field at positions 36 and 37 in the original input records expands to a 4-byte summary field in positions 36 through 39 of the reformatted input/output record before merging. This prevents overflow of this summary field.

Restriction: If OUTREC were used instead of INREC, the records would be reformatted after merging, and the 2-byte summary field might overflow.
Note: This method of preventing overflow cannot be used for negative FI summary fields because padding with zeros rather than ones would change the sign.

Example 3

INREC BUILD=(20,4,12,3)
SORT FIELDS=(1,4,D,5,3,D),FORMAT=CH
OUTREC BUILD=(5X,1,4,H,19:1,2,5,3,DATE1(-),80X'FF')

This example illustrates how a fixed-length input data set can be sorted and reformatted for output. A more efficient sort is achieved by using INREC before sorting to reduce the input records as much as possible, and using OUTREC after sorting to add padding, the current date and repeated fields. The SORTIN LRECL is 80 bytes.

The reformatted input records are fixed-length, and have a record size of seven bytes (a significant reduction from the original size of 80 bytes). They look as follows:

<table>
<thead>
<tr>
<th>Position</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-4</td>
<td>Input positions 20 through 23</td>
</tr>
<tr>
<td>5-7</td>
<td>Input positions 12 through 14</td>
</tr>
</tbody>
</table>

The SORT and OUTREC statements must refer to the fields of the reformatted input records.

The reformatted output records are fixed length with a record size of 113 bytes. SOLRF (the IBM-supplied default) is in effect, so unless the SORTOUT LRECL is specified or available, it will automatically be set to the reformatted record length of 113. The reformatted output records look as follows:

<table>
<thead>
<tr>
<th>Position</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5</td>
<td>EBCDIC blanks</td>
</tr>
<tr>
<td>6</td>
<td>Binary zero (for H alignment)</td>
</tr>
<tr>
<td>7-10</td>
<td>Input positions 20 through 23</td>
</tr>
<tr>
<td>11-18</td>
<td>EBCDIC blanks</td>
</tr>
<tr>
<td>19-20</td>
<td>Input positions 20 through 21</td>
</tr>
<tr>
<td>21-23</td>
<td>Input positions 12 through 14</td>
</tr>
<tr>
<td>24-33</td>
<td>The current date in the form C'yyyy-mm-dd'</td>
</tr>
<tr>
<td>34-113</td>
<td>Hexadecimal FFs</td>
</tr>
</tbody>
</table>

Thus, the use of INREC and OUTREC allows sorting of 7-byte records rather than 80-byte records, even though the output records are 113 bytes long.

Example 4

OPTION COPY,Y2PAST=1985
INREC FIELDS=(SEQNUM,4,BI,
             8,5,ZD,TO=PD,
             31,2,PD,TO=FI,LENGTH=2,
             15,6,Y2TP,
             25,3,CHANGE=(1,C'92',X'01',C'M72',X'02',C'J42',X'03'),
             NOMATCH=(X'FF'))

This example illustrates how a sequence number can be generated, how values in one numeric or date format can be converted to another format, and how a lookup table can be used.

The reformatted input records will look as follows:

<table>
<thead>
<tr>
<th>Position</th>
<th>Contents</th>
</tr>
</thead>
</table>

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INREC Control Statement

1-4 A binary sequence number that starts at 1 and increments by 1.
5-7 A PD field containing the converted ZD field from input positions 8 through 12.
8-9 An FI field containing the converted PD field from input positions 31 through 32.
10-14 A P’yyyyymmdd’ date field containing the C’yymmdd’ date field from input positions 15-20 transformed according to the specified century window of 1985-2084.
15 A BI field containing X’01’, X’02’, X’03’ or X’FF’ as determined by using a lookup table for the input field in positions 25-27.

The SORT statement can now refer to the “sort” field in the reformatted input records. The OUTREC statement is used to restore the records to their original format.

Example 5

```plaintext
INREC OVERLAY=(61:21,11,SFF,ADD,41,11,SFF,TO=PD,LENGTH=5)
SORT FIELDS=(61,PD,A)
OUTREC OVERLAY=(61:61,5,PD,EDIT=(SIII,IIT.TT),SIGNS=(+,-))
```

This example illustrates how you can use the OVERLAY parameter with INREC and OUTREC to change certain columns in your records without affecting other columns.

Positions 61-65 of the reformatted input records are overlaid with a 5-byte PD value derived from adding the sddd,ddd.dd field at positions 21-31 to the sddd,ddd.dd field at positions 41-51. The records are then sorted by this 5-byte PD field. Positions 61-71 of the reformatted output records are overlaid with an sddd,ddd.dd field derived from the 5-byte PD value. The data before positions 61-71 and after positions 61-71 are not affected.

Example 6

```plaintext
OPTION COPY
INREC IFTHEN=(WHEN=(5,2,CH,EQ,C'GP',AND,2,1,BI,EQ,+1),
           BUILD=(1,6,16,20,C'T1',X'0003',1,7,20C'1'))),
           IFTHEN=(WHEN=(5,2,CH,EQ,C'GP',AND,2,1,BI,EQ,+2),
           BUILD=(1,6,45,20,C'T2',X'0008',16,7,20C'2'))),
           IFTHEN=(WHEN=(5,2,CH,EQ,C'GP',AND,2,1,BI,EQ,+3),
           BUILD=(1,6,31,20,C'T3',X'0005',25,7,20C'3'))),
           IFTHEN=(WHEN=NONE,OVERLAY=(27:C'00',X'FFFF'))),
IFOUTLEN=57
```

This example illustrates how you can use IFTHEN clauses with INREC to reformat different records in different ways. IFOUTLEN=57 is used to set the reformatted record length to 57.

Records with 'GP' in positions 5-6 and X'01' in position 2 are reformatted as follows:

<table>
<thead>
<tr>
<th>Position</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-6</td>
<td>Input positions 1-6</td>
</tr>
<tr>
<td>7-26</td>
<td>Input positions 16-35</td>
</tr>
<tr>
<td>27-28</td>
<td>'T1'</td>
</tr>
<tr>
<td>29-30</td>
<td>X'0003'</td>
</tr>
<tr>
<td>31-37</td>
<td>Input positions 1-7</td>
</tr>
<tr>
<td>38-57</td>
<td>20 '1's</td>
</tr>
</tbody>
</table>
INREC Control Statement

Records with 'GP' in positions 5-6 and X'02' in position 2 are reformatted as follows:

<table>
<thead>
<tr>
<th>Position</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-6</td>
<td>Input positions 1-6</td>
</tr>
<tr>
<td>7-26</td>
<td>Input positions 45-64</td>
</tr>
<tr>
<td>27-28</td>
<td>'T2'</td>
</tr>
<tr>
<td>29-30</td>
<td>X'0008'</td>
</tr>
<tr>
<td>31-37</td>
<td>Input positions 16-22</td>
</tr>
<tr>
<td>38-57</td>
<td>20 '2's</td>
</tr>
</tbody>
</table>

Records with 'GP' in positions 5-6 and X'03' in position 2 are reformatted as follows:

<table>
<thead>
<tr>
<th>Position</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-6</td>
<td>Input positions 1-6</td>
</tr>
<tr>
<td>7-26</td>
<td>Input positions 31-50</td>
</tr>
<tr>
<td>27-28</td>
<td>'T3'</td>
</tr>
<tr>
<td>29-30</td>
<td>X'0005'</td>
</tr>
<tr>
<td>31-37</td>
<td>Input positions 25-31</td>
</tr>
<tr>
<td>38-57</td>
<td>20 '3's</td>
</tr>
</tbody>
</table>

Records without 'GP' in positions 5-6 or without X'01', X'02', or X'03' in position 2 are reformatted as follows:

<table>
<thead>
<tr>
<th>Position</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-26</td>
<td>Input positions 1-26</td>
</tr>
<tr>
<td>27-28</td>
<td>'00'</td>
</tr>
<tr>
<td>29-30</td>
<td>X'FFFF'</td>
</tr>
<tr>
<td>31-57</td>
<td>Input positions 31-57</td>
</tr>
</tbody>
</table>

Example 7

```
INREC OVERLAY=(16:1,15,JFY=(SHIFT=LEFT))
SORT FIELDS=(16,15,CH,A)
OUTREC BUILD=(1,15)
```

This example illustrates how you can left-justify characters in an input field so they can be sorted without regard to the leading blanks.

The 15-byte input records might look like this:

```
CARRIE
VICKY
FRANK
SAM
DAVID
MARTIN
```

Note that if we sort these records using just this control statement:

```
SORT FIELDS=(1,15,CH,A)
```

The 15-byte output records are as follows:

```
FRANK
VICKY
SAM
MARTIN
CARRIE
DAVID
```
Because of the different number of leading blanks in the input records, we don’t get what we want. To fix that, while keeping the leading blanks in the original records, we use the JFY function of INREC to make a left-justified copy of the 15-byte input field at positions 16-30, sort on it and use OUTREC to remove the left-justified field. With the INREC, SORT and OUTREC control statements shown above, the output records are:

CARRIE
DAVID
FRANK
MARTIN
SAM
VICKY

If we wanted the output to contain the sorted left-justified fields, we could use these control statements:

INREC BUILD=(1,15,JFY=(SHIFT=LEFT))
SORT FIELDS=(1,15,CH,A)

The output records would then be:

CARRIE
DAVID
FRANK
MARTIN
SAM
VICKY

Example 8

INREC PARSE=(%00=(ENDBEFR=C',',FIXLEN=11),
%01=(ENDBEFR=C',',FIXLEN=5),
%02=(FIXLEN=6)),
OVERLAY=(31:%00,42:%01,47:%02)
SORT FIELDS=(31,11,CH,A,42,5,UFF,A,47,6,SFF,D)
OUTREC BUILD=(1,30)

This example illustrates how you can sort FB input records with variable position/length fields, such as comma separated values.

The 30-byte input records might look like this:

Marketing,96218,+27365
Development,3807,+1275
Research,7283,+5001
Development,1700,-5316
Research,978,+13562
Development,3807,-150
Research,7283,+5002
Marketing,52,-8736
Development,5781,+2736
Marketing,52,+1603
Research,16072,-2022

We want to sort the first field as character ascending, the second field as unsigned numeric ascending and the third field as signed numeric descending.

Note that each record has three variable fields in comma separated value format. The fields do not start and end in the same position in every record and do not have the same length in every record. The first and second fields end with a comma and the third field ends with a blank.

In order to sort variable fields like these, we use the PARSE and OVERLAY functions of INREC to create a fixed parsed copy of each variable field. We use
INREC Control Statement

%00 to create an 11-byte fixed parsed field into which we extract the value before the first comma. We use %01 to create a 5-byte fixed parsed field into which we extract the value after the first comma and before the second comma. We use %02 to create a 6-byte fixed parsed field into which we extract the value after the second comma. Then we SORT on the fixed parsed fields. Finally, we use OUTREC to remove the fixed parsed fields.

After the INREC statement is processed, the records look like this:

<table>
<thead>
<tr>
<th>Data</th>
<th>Build</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marketing,96218,+27365</td>
<td>96218+27365</td>
</tr>
<tr>
<td>Development,3807,+1275</td>
<td>3807 +1275</td>
</tr>
<tr>
<td>Research,7283,+5001</td>
<td>7283 +5001</td>
</tr>
<tr>
<td>Development,1700,-5316</td>
<td>1700 -5316</td>
</tr>
<tr>
<td>Research,978,+13562</td>
<td>978 +13562</td>
</tr>
<tr>
<td>Development,3807,-158</td>
<td>3807 -158</td>
</tr>
<tr>
<td>Research,7283,+5002</td>
<td>7283 +5002</td>
</tr>
<tr>
<td>Marketing,52,-8736</td>
<td>52 -8736</td>
</tr>
<tr>
<td>Development,5781,+2736</td>
<td>5781 +2736</td>
</tr>
<tr>
<td>Marketing,52,+1603</td>
<td>52 +1603</td>
</tr>
<tr>
<td>Research,16072,-2022</td>
<td>16072-2022</td>
</tr>
<tr>
<td>Research,978,+13562</td>
<td>978 +13562</td>
</tr>
<tr>
<td>Research,7283,+5002</td>
<td>7283 +5002</td>
</tr>
<tr>
<td>Research,16072,-2022</td>
<td>16072-2022</td>
</tr>
</tbody>
</table>

Since the second fixed parsed field is unsigned and left-justified, we sort it with the UFF format. Since the third fixed parsed field is signed and left-justified, we sort it with the SFF format.

After the SORT and OUTREC statements are processed, the output records look like this:

<table>
<thead>
<tr>
<th>Data</th>
<th>Build</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development,1700,-5316</td>
<td>1700 -5316</td>
</tr>
<tr>
<td>Development,3807,+1275</td>
<td>3807 +1275</td>
</tr>
<tr>
<td>Development,3807,-158</td>
<td>3807 -158</td>
</tr>
<tr>
<td>Development,5781,+2736</td>
<td>5781 +2736</td>
</tr>
<tr>
<td>Marketing,52,+1603</td>
<td>52 +1603</td>
</tr>
<tr>
<td>Marketing,52,-8736</td>
<td>52 -8736</td>
</tr>
<tr>
<td>Research,96218,+27365</td>
<td>96218+27365</td>
</tr>
<tr>
<td>Research,978,+13562</td>
<td>978 +13562</td>
</tr>
<tr>
<td>Research,7283,+5002</td>
<td>7283 +5002</td>
</tr>
<tr>
<td>Research,7283,+5001</td>
<td>7283 +5001</td>
</tr>
<tr>
<td>Research,16072,-2022</td>
<td>16072-2022</td>
</tr>
</tbody>
</table>

Example 9

INREC PARSE=(%00=(ENDBEFR=C',',FIXLEN=11),%01=(ENDBEFR=C',',FIXLEN=5),%02=(FIXLEN=6),BUILD=(1,4,5:000,16:001,21:002,27:5),SORT FIELDS=(5,11,CH,A,16,5,UFF,A,21,6,SFF,D),OUTREC BUILD=(1,4,27)

This example illustrates how you can sort VB input records with variable position/length fields, such as comma separated values. This example is very similar to the previous example for FB records, except that with VB records we need to copy the fixed parsed fields after the 4-byte RDW rather than at the end of the records.

The VB input records might look like this:

<table>
<thead>
<tr>
<th>Data</th>
<th>Build</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marketing,96218,+27365</td>
<td>96218+27365</td>
</tr>
<tr>
<td>Development,3807,+1275</td>
<td>3807 +1275</td>
</tr>
<tr>
<td>Research,7283,+5001</td>
<td>7283 +5001</td>
</tr>
<tr>
<td>Development,1700,-5316</td>
<td>1700 -5316</td>
</tr>
<tr>
<td>Research,978,+13562</td>
<td>978 +13562</td>
</tr>
<tr>
<td>Development,3807,-158</td>
<td>3807 -158</td>
</tr>
<tr>
<td>Research,7283,+5002</td>
<td>7283 +5002</td>
</tr>
</tbody>
</table>

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INREC Control Statement

22 Marketing,52,-8736
26 Development,5781,+2736
22 Marketing,52,+1603
24 Research,16072,-2022

After the INREC statement is processed, the records look like this:

<table>
<thead>
<tr>
<th>Length</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>48</td>
<td>Marketing,96218+27365</td>
</tr>
<tr>
<td>48</td>
<td>Development,3807+1275</td>
</tr>
<tr>
<td>45</td>
<td>Research,7283+5001</td>
</tr>
<tr>
<td>48</td>
<td>Development,1700-5316</td>
</tr>
<tr>
<td>45</td>
<td>Research,978+13562</td>
</tr>
<tr>
<td>47</td>
<td>Development,3807-158</td>
</tr>
<tr>
<td>45</td>
<td>Research,7283+5002</td>
</tr>
<tr>
<td>44</td>
<td>Marketing,52,-8736</td>
</tr>
<tr>
<td>48</td>
<td>Development,5781,+2736</td>
</tr>
<tr>
<td>44</td>
<td>Marketing,52,+1603</td>
</tr>
<tr>
<td>46</td>
<td>Research,16072,-2022</td>
</tr>
</tbody>
</table>

After the SORT and OUTREC statements are processed, the output records look like this:

<table>
<thead>
<tr>
<th>Length</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td>Development,1700,-5316</td>
</tr>
<tr>
<td>26</td>
<td>Development,3807,+1275</td>
</tr>
<tr>
<td>25</td>
<td>Development,3807,-158</td>
</tr>
<tr>
<td>26</td>
<td>Development,5781,+2736</td>
</tr>
<tr>
<td>22</td>
<td>Marketing,52,+1603</td>
</tr>
<tr>
<td>22</td>
<td>Marketing,52,-8736</td>
</tr>
<tr>
<td>26</td>
<td>Marketing,96218,+27365</td>
</tr>
<tr>
<td>23</td>
<td>Research,978,+13562</td>
</tr>
<tr>
<td>23</td>
<td>Research,7283,+5002</td>
</tr>
<tr>
<td>23</td>
<td>Research,7283,+5001</td>
</tr>
<tr>
<td>24</td>
<td>Research,16072,-2022</td>
</tr>
</tbody>
</table>

Example 10

OPTION COPY
INREC FINDREP=(IN=(X'00',X'FF'),OUT=C'')

This example illustrates how you can remove characters from FB or VB records.

The VB input records might look like this in hexadecimal:

```
RDW----|Data
000F0000D1E4D5C500C1D7D9C9D3FF
0010000C2C5E3E3E3B00C4C1C9E2E2FF
```

We want to remove each X'00' and X'FF' character. We use IN=(X'00',X'FF') to indicate we want to find each X'00' and X'FF' character, and OUT=C'' (null) to indicate we want to remove it.

The output records look like this:

```
RDW----|Data
00000000D1E4D5C5C1D7D9C9D3
000E000C2C5E3E3E3C4C1C9E2E8
```

Note that the X'00' and X'FF' characters have been removed and the RDW length decreased accordingly. For VB input records, FINDREP processing automatically starts at position 5 after the RDW so the X'00' characters in the RDW are not affected.
**Example 11**

```
OPTION COPY
INREC FINDREP=(IN=C'BALANCE',
    OUT=C'BALANCE 1000',SHIFT=NO,DO=1)
```

This example illustrates how you can find a value in FB or VB records and overlay it with a larger value without shifting other bytes in the records.

The FB input records might look like this:

```
CUSTOMER1 10100
MNHLY STMT BALANCE 2000
CUSTOMER2 11100
MNHLY STMT REQUIRES NO MODIFICATION ACCT BALANCE 5000
CUSTOMER3 11111
YOUR INFO ENCLOSED
MNHLY STMT REQUIRES MODIFICATION ACCT BALANCE 7000
```

We want to replace every instance of 'BALANCE dddd' with 'BALANCE 1000' where dddd can be any value. We use IN=C'BALANCE' to indicate we want to find each instance of 'BALANCE'. We use OUT='BALANCE 1000' to indicate we want to replace it with 'BALANCE 1000'. We use SHIFT=NO to do an overlay, overriding the default of shifting bytes. Since we only have at most one instance of 'BALANCE dddd' in a record, we can use DO=1 to stop processing a record after one replacement of 'BALANCE dddd' with 'BALANCE 1000'. In this case, DO=1 is more efficient than the default of continuing to look for more instances of 'BALANCE dddd' after the first instance. We would get the same result without DO=1, just less efficiently.

The output records look like this:

```
CUSTOMER1 10100
MNHLY STMT BALANCE 1000
CUSTOMER2 11100
MNHLY STMT REQUIRES NO MODIFICATION ACCT BALANCE 1000
CUSTOMER3 11111
YOUR INFO ENCLOSED
MNHLY STMT REQUIRES MODIFICATION ACCT BALANCE 1000
```

**Example 12**

```
INREC IFTHEN=(WHEN=GROUP,BEGIN=(2,4,CH,EQ,C'RPT.'),
    PUSH=(31:6,8))
OPTION EQUALS
SORT FIELDS=(31,8,CH,A)
OUTFIL INCLUDE=(31,8,CH,EQ,C'FRANK',OR,
    31,8,CH,EQ,C'SRIHARI'),BUILD=(1,30)
```

This example illustrates how you can SORT and INCLUDE groups of FB records depending on a value in the first record of each group. We propagate the value in the first record of the group to every record of the group, SORT and INCLUDE on the value, and then remove it.

The 30-byte FBA input records might look like this:

```
1RPT.SRIHARI
    LINE 1 FOR REPORT 1
    LINE 2 FOR REPORT 1
    ....
1RPT.VICKY
    LINE 1 FOR REPORT 2
    LINE 2 FOR REPORT 2
    ....
1RPT.FRANK
```
Each report starts with 'RPT.reptname' in positions 2-13. In the output data set we only want to include records for reports with specific reptname values, and the reptname values we want can change from run to run. We also want to sort by the reptname values in ascending order. For this example, let’s say we just want the SRIHARI and FRANK reports.

We use an IFTHEN WHEN=GROUP clause to propagate the reptname value to each record of the group. BEGIN indicates a group starts with 'RPT.' in positions 2-5. PUSH overlays the reptname value from the first record of the group (the 'RPT.reptname' record) at positions 31-38 (after the end of the record) in each record of the group including the first. After the IFTHEN GROUP clause is executed, the intermediate records look like this:

```
1RPT.SRIHARI   SRIHARI
LINE 1 FOR REPORT 1   SRIHARI
LINE 2 FOR REPORT 1   SRIHARI
...   SRIHARI
1RPT.VICKY   VICKY
LINE 1 FOR REPORT 2   VICKY
LINE 2 FOR REPORT 2   VICKY
...   VICKY
1RPT.FRANK   FRANK
LINE 1 FOR REPORT 3   FRANK
LINE 2 FOR REPORT 3   FRANK
...   FRANK
1RPT.DAVID   DAVID
LINE 1 FOR REPORT 4   DAVID
LINE 2 FOR REPORT 4   DAVID
...   DAVID
```

Note that the records of each group have the reptname value from the first record of that group in positions 31-38.

We use a SORT statement to sort ascending on the reptname in positions 31-38. We use the EQUALS option to ensure that records in the same group (that is, with the same reptname value) are kept in their original order. After the SORT statement is executed, the intermediate records look like this:

```
1RPT.DAVID   DAVID
LINE 1 FOR REPORT 4   DAVID
LINE 2 FOR REPORT 4   DAVID
...   DAVID
1RPT.FRANK   FRANK
LINE 1 FOR REPORT 3   FRANK
LINE 2 FOR REPORT 3   FRANK
...   FRANK
1RPT.SRIHARI   SRIHARI
LINE 1 FOR REPORT 1   SRIHARI
LINE 2 FOR REPORT 1   SRIHARI
...   SRIHARI
1RPT.VICKY   VICKY
LINE 1 FOR REPORT 2   VICKY
LINE 2 FOR REPORT 2   VICKY
...   VICKY
```
We use an OUTFIL statement to only INCLUDE the records with a reptname of FRANK or SRIHARI in positions 31-38, and to remove the reptname from positions 31-38 so the included output records will be identical to the input records. After the OUTFIL statement is executed, the final output records look like this:

1RPT.FRANK
LINE 1 FOR REPORT 3
LINE 2 FOR REPORT 3

1RPT.SRIHARI
LINE 1 FOR REPORT 1
LINE 2 FOR REPORT 1

Example 13

OPTION COPY,Y2PAST=1996
INREC BUILD=(1,6,Y2W,TOJUL=Y4T,X,
1,6,Y2W,WEEKDAY=CHAR3,X,
9,7,Y4T,TOGREG=Y4T(/),X,
9,7,Y4T,WEEKDAY=DIGIT1)

This example illustrates how to convert an mmddyy date to a ccyyddd date and a 3-character weekday string, and how to convert a ccyyddd date to a ccyy/mm/dd date and 1-digit weekday string.

The input records might be as follows:
120409 1999014
051895 2003235
999999 0000000
013099 1992343

The output records would be as follows:
2009338 FRI 1999/01/14 5
2095138 WED 2003/08/23 7
9999999 999 0000/00/00 0
1999030 SAT 1992/12/08 3

The Y2PAST=1996 option sets the century window to 1996-2095. The century window is used to transform yy in the Y2W field to ccyy.

Note that date conversion is not performed for the special indicators (all 9s and all 0s); the special indicator is just used appropriately for the output date field.

Example 14

OPTION COPY
INREC OVERLAY=(11:1,8,Y4T,ADDDAYS,+50,TOGREG=Y4T,
21:1,8,Y4T,SUBMONS,+7,TOGREG=Y4T,
31:1,8,Y4T,ADDYEARS,+2,TOGREG=Y4T)
OUTFIL REMOVECC,
HEADER1=('Input +50 days -7 months +2 years')

This example illustrates how you can add and subtract days, months and years from date fields.

The SORTIN data set has these input records with a C'ccymmdd' date field in positions 1-8:
20070305
20071213
20080219
20080901
20091122
The INREC statement performs three different date field arithmetic operations on the input date field. It adds 50 days, subtracts 7 months and adds 2 years. We use 1,8,Y4T for the input field to match the C'ccyymmdd' input date, and we use TOGREG=Y4T to give us a C'ccyymmdd' output date. The OUTFIL statement adds headings.

SORTOUT will have these records:

<table>
<thead>
<tr>
<th>Input</th>
<th>+50 days</th>
<th>-7 months</th>
<th>+2 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>20070305</td>
<td>20070424</td>
<td>20060805</td>
<td>20090305</td>
</tr>
<tr>
<td>20071213</td>
<td>20080201</td>
<td>20070513</td>
<td>20091213</td>
</tr>
<tr>
<td>20080219</td>
<td>20080409</td>
<td>20070719</td>
<td>20100219</td>
</tr>
<tr>
<td>20080901</td>
<td>20081012</td>
<td>20080201</td>
<td>20100901</td>
</tr>
<tr>
<td>20091122</td>
<td>20100111</td>
<td>20090422</td>
<td>20111122</td>
</tr>
<tr>
<td>20090115</td>
<td>20090306</td>
<td>20080615</td>
<td>20110115</td>
</tr>
<tr>
<td>20100915</td>
<td>20101104</td>
<td>20100215</td>
<td>20120915</td>
</tr>
<tr>
<td>20100630</td>
<td>20100819</td>
<td>20091130</td>
<td>20120630</td>
</tr>
<tr>
<td>99999999</td>
<td>99999999</td>
<td>99999999</td>
<td>99999999</td>
</tr>
</tbody>
</table>

Note that the '99999999' input value is treated as a special indicator for output.

### JOINKEYS Control Statement

Used only for a JOINKEYS application. See Chapter 4, “Using a JOINKEYS Application for Joining Two Files,” on page 457 for details.

### JOIN Control Statement

Used only for a JOINKEYS application. See Chapter 4, “Using a JOINKEYS Application for Joining Two Files,” on page 457 for details.
The MERGE control statement must be used when a merge operation is to be performed; this statement describes the control fields in the input records on which the input data sets have previously been sorted.

A MERGE statement can also be used to specify a copy application. User labels will not be copied to the output data sets.

You can merge up to 100 data sets with Blockset merge or up to 16 data sets with Conventional merge. If Blockset merge is not selected, you can use a SORTDIAG DD statement to force message ICE800I, which gives a code indicating why Blockset could not be used.

The way in which DFSORT processes short MERGE control fields depends on the setting for VLSHRT/NOVLSHRT. A short field is one where the variable-length record is too short to contain the entire field, that is, the field extends beyond the record. For details about merging short records, see the discussion of the VLSHRT and NOVLSHRT options in "OPTION Control Statement" on page 173.

The options available on the MERGE statement can be specified in other sources as well. A table showing all possible sources for these options and the order of override are given in Appendix B, "Specification/Override of DFSORT Options," on page 857. When an option can be specified on either the MERGE or OPTION statement, it is preferable to specify it on the OPTION statement.

DFSORT accepts but does not process the following MERGE operands: WORK=value and ORDER=value.
DFSORT’s collating behavior can be modified according to your cultural environment. The cultural environment is established by selecting the active locale. The active locale’s collating rules affect MERGE processing as follows:

- DFSORT produces merged records for output according to the collating rules defined in the active locale. This provides merging for single- or multi-byte character data, based on defined collating rules that retain the cultural and local characteristics of a language.

If locale processing is to be used, the active locale will only be used to process character (CH) control fields.

For more information on locale processing, see “Cultural Environment Considerations” on page 7 or LOCALE in “OPTION Control Statement” on page 173.

Note: For a merge application, records deleted during an E35 exit routine are not sequence checked. If you use an E35 exit routine without an output data set, sequence checking is not performed at the time the records are passed to the E35 user exit; therefore, you must ensure that input records are in correct sequence.

**FIELDS**

```
<table>
<thead>
<tr>
<th>FIELD</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIELDS</td>
<td>(p,m,f,s)</td>
</tr>
</tbody>
</table>
```

Is written exactly the same way for a merge as it is for a sort. The meanings of p, m, f, and s are described in the discussion of the SORT statement. The defaults for this and the following parameters are also given there. See “SORT Control Statement” on page 442.

**FIELDS=COPY**

```
<table>
<thead>
<tr>
<th>FIELD</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIELDS=COPY</td>
<td></td>
</tr>
</tbody>
</table>
```

See the discussion of the COPY option on the OPTION statement, in “OPTION Control Statement” on page 173.

**FORMAT=f**

```
<table>
<thead>
<tr>
<th>FIELD</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>FORMAT=f</td>
<td></td>
</tr>
</tbody>
</table>
```

See the discussion of the FORMAT option in “SORT Control Statement” on page 442. Used the same way for a merge as for a sort.

**EQUALS or NOEQUALS**
MERGE Control Statement

**EQUALS**

**NOEQUALS**

See the discussion of these options on the OPTION statement, in "OPTION Control Statement" on page 173.

**FILES=n**

See the discussion of this option on the OPTION statement, in "OPTION Control Statement" on page 173.

**FILSZ or SIZE**

See the discussion of these options on the OPTION statement, in "OPTION Control Statement" on page 173.

**SKIPREC**

See the discussion of this option on the OPTION statement, in "OPTION Control Statement" on page 173.

**STOPAFT**

See the discussion of this option on the OPTION statement, in "OPTION Control Statement" on page 173.

**Default:** None; must be specified when an E32 exit is used.

**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT Options,” on page 857.

**Note:** SKIPREC is used for a copy or sort application, but is not used for a merge application.
Note: STOPAFT is used for a copy or sort application, but is not used for a merge application.

Y2PAST

See the discussion of this option on the OPTION statement, in "OPTION Control Statement" on page 173.

Note: CENTURY=value and CENTWIN=value can be used instead of Y2PAST=value.

Specifying a MERGE or COPY—Examples

**Example 1**

```mergetrace
MERGE FIELDS=(2,5,CH,A),FILSZ=29483
```

**FIELDS**
The control field begins on byte 2 of each record in the input data sets. The field is 5 bytes long and contains character (EBCDIC) data that has been presorted in ascending order.

**FILSZ**
The input data sets contain exactly 29483 records.

**Example 2**

```mergetrace
MERGE FIELDS=(3,8,ZD,E,40,6,CH,D)
```

**FIELDS**
The major control field begins on byte 3 of each record, is 8 bytes long, and contains zoned decimal data that is modified by your routine before the merge examines it.

The second control field begins on byte 40, is 6 bytes long, and contains character data in descending order.

**Example 3**

```mergetrace
MERGE FIELDS=(25,4,A,48,8,A),FORMAT=ZD
```

**FIELDS**
The major control field begins on byte 25 of each record, is 4 bytes long, and contains zoned decimal data that has been placed in ascending sequence.

The second control field begins on byte 48, is 8 bytes long, is also in zoned decimal format, and is also in ascending sequence. The FORMAT parameter is used to indicate that both fields have ZD format.

**Example 4**

```mergetrace
MERGE FIELDS=COPY
```

**FIELDS**
The input data set is copied to output. No merge takes place.
The MODS statement is needed only when DFSORT passes control to your routines at user exits. The MODS statement associates user routines with specific DFSORT exits and provides DFSORT with descriptions of these routines. For details about DFSORT user exits and how user routines can be used, see Chapter 5, "Using Your Own User Exit Routines," on page 489.

To use one of the user exits, you substitute its three-character name (for example, E31) for the word exit in the MODS statement format above. You can specify any valid user exit, except E32. (E32 can be used only in a merge operation invoked from a program; its address must be passed in a parameter list.)

**exit**

The values that follow the exit parameter describe the user routine. These values are:

- **n** specifies the name of your routine (member name if your routine is in a library). You can use any valid operating system name for your routine. This allows you to keep several alternative routines with different names in the same library.

- **m** specifies the number of bytes of main storage your routine uses. Include storage obtained (via GETMAIN) by your routine (or, for example, by OPEN) and the storage required to load the COBOL library subroutines.

- **s** specifies either the name of the DD statement in your DFSORT job step that defines the library in which your routine is located or SYSIN if your routine is in the input stream. SYSIN is not valid for copy processing.

  If a value is not specified for s, DFSORT uses the following search order to find the library in which your routine is located:
  1. The libraries identified by the STEPLIB DD statement
  2. The libraries identified by the JOBLIB DD statement (if there is no STEPLIB DD statement)
  3. The link library.

- **e** specifies the linkage editor requirements of your routine or indicates that your routine is written in COBOL. The following values are allowed:
  - **N** specifies that your routine has already been link-edited and can be used in
the DFSORT run without further link-editing. This is the default for e. N (specified or defaulted) can be overridden by the EXEC PARM parameters 'E15=COB' and 'E35=COB' or by the HILEVEL=YES parameter.

C specifies that your E15 or E35 routine is written in COBOL. If you code C for any other exit, it is ignored, and N is assumed. Your COBOL-written routine must already have been link-edited. The COBEXIT option of the OPTION statement specifies the library for the COBOL exits.

T specifies that your routine must be link-edited together with other routines to be used in the same phase (for example, E1n routines) of DFSORT. See “Dynamically Link-Editing User Exit Routines” on page 499 for additional information. This value is not valid for copy processing.

S specifies that your routine requires link-editing but that it must be link-edited separately from the other routines (for example, E3n routines) to be used in a particular phase of DFSORT. E11 and E31 exit routines are the only routines eligible for separate link-editing. See “Dynamically Link-Editing User Exit Routines” on page 499 for additional information. This value is not valid for copy processing.

If you do not specify a value for e, N is assumed.

**HILEVEL=YES**

specifies that:

- if an E15 routine is identified on the MODS statement, it is written in COBOL.
- if an E35 routine is identified on the MODS statement, it is written in COBOL.

If you identify an E15 routine and an E35 routine on the MODS statement, specify HILEVEL=YES only if both routines are written in COBOL. If you do not identify an E15 or E35 routine on the MODS statement, HILEVEL=YES is ignored.

**Note:** COBOL=YES can be used instead of HILEVEL=YES.

***Notes:***

1. The s parameter must be the same or omitted for each routine with N or C for the e parameter (library concatenation is allowed). These routines cannot be placed in SYSIN. Each such routine must be a load module.

2. Each routine for which T or S is specified for the e parameter can be placed in any library or in SYSIN; they do not all have to be in the same library or SYSIN (but can be). Some routines can even be in different libraries (or the same library) and the rest can be in SYSIN. Each such routine, if in a library, can be either an object deck or a load module; if in SYSIN, it must be an object deck.

3. If the same routine is used in both input (that is, E1n routines) and output (that is, E3n routines) DFSORT program phases, a separate copy of the routine must be provided for each exit.
4. HILEVEL=YES can be used instead of C as the fourth parameter, to indicate that an E15 or E35 routine is written in COBOL. In this case, if T is specified as the fourth parameter for E15 or E35, DFSORT terminates. If you identify an E15 routine and an E35 routine on the MODS statement, specify HILEVEL=YES only if both routines are written in COBOL.

5. EXEC PARM parameter E15=COB can be used instead of C as the fourth parameter, to indicate that an E15 is written in COBOL. In this case, if T is specified as the fourth parameter for E15, DFSORT terminates.

6. EXEC PARM parameter E35=COB can be used instead of C as the fourth parameter, to indicate that an E35 is written in COBOL. In this case, if T is specified as the fourth parameter for E35, DFSORT terminates.

7. If HILEVEL=YES, E15=COB, or E35=COB is used instead of C as the fourth parameter, to indicate that an exit is written in COBOL, the fourth parameter for that exit must be specified as N or not specified.

8. If a COBOL E15 or E35 is specified for a conventional merge or tape work data set sort, DFSORT terminates.

9. exit=(n,m) can be used to omit both the s and e parameters.

10. exit=(n,m,e) can be used to omit the s parameter, but not the parameter.

11. The s parameter must be specified for a conventional merge or tape work data set sort, or when S or T is specified for the e parameter.

**Default**: None; must be specified if you use exit routines. N is the default for the fourth parameter.


For information on user exit routines in SYSIN, see “System DD Statements” on page 65.

For details on how to design your routines, refer to “Summary of Rules for User Exit Routines” on page 496.

When you are preparing your MODS statement, remember that DFSORT must know the amount of main storage your routine needs so that it can allocate main storage properly for its own use. If you do not know the exact number of bytes your program requires (including requirements for system services), make a slightly high estimate. The value of m in the MODS statement is written the same way whether it is an exact figure or an estimate: you do not precede the value by E for an estimate.

**Identifying User Exit Routines—Examples**

**Example 1**

MODS E15=(ADDREC,552,MODLIB),E35=(ALTREC,11032,MODLIB)

**E15**

At exit E15, DFSORT transfers control to your own routine. Your routine is in the library defined by a job control statement with the ddname MODLIB. Its member name is ADDREC and uses 552 bytes.

**E35**

At exit E35, DFSORT transfers control to your routine. Your routine is in the library defined by the job control statement with the ddname MODLIB. Its member name is ALTREC and will use 11032 bytes.
Example 2

MODS  E15=(COBOLE15,7000,,C),
      E35=(COBOLE35,7000,EXITC,C)

E15
At exit E15, DFSORT transfers control to your own routine. Your routine is
written in COBOL and is in the STEPLIB/JOBLIB or link libraries. Its member
name is COBOLE15 and it uses 7000 bytes.

E35
At exit E35, DFSORT transfers control to your routine. Your routine is written
in COBOL and is in the library defined by the job control statement with the
ddbname EXITC. Its member name is COBOLE35 and it uses 7000 bytes.

OMIT Control Statement

Use an OMIT statement if you do not want all of the input records to appear in
the output data sets. The OMIT statement selects the records you do not want to
include.

You can specify either an INCLUDE statement or an OMIT statement in the same
DFSORT run, but not both.

The way in which DFSORT processes short INCLUDE/OMIT compare fields
depends on the settings for VLSCMP/NOVLSCMP and VLSHRT/NOVLSHRT. A
short field is one where the variable-length record is too short to contain the entire
field, that is, the field extends beyond the record. For details about including or
omitting short records, see the discussion of the VLSCMP and NOVLSCMP options
in "OPTION Control Statement" on page 173.

A logical expression is one or more relational conditions logically combined, based
on fields in the input record, and can be represented at a high level as follows:

If the logical expression is true for a given record, the record is omitted from the
output data set.

Five types of relational conditions can be used as follows:
OMIT Control Statement

1. **Comparisons:**
   Compare two compare fields or a compare field and a decimal, hexadecimal, character or current, future, or past date constant.

   For example, you can compare the first 6 bytes of each record with its last 6 bytes, and omit those records in which those fields are identical. Or you can compare a date field with today's date, yesterday's date, or tomorrow's date and omit those records accordingly.

2. **Substring Comparison Tests:**
   Search for a constant within a field value or a field value within a constant.

   For example, you can search the value in a 6-byte field for the character constant C'OK', and omit those records for which C'OK' is found somewhere in the field. Or you can search the character constant C'J69,L92,J82' for the value in a 3-byte field, and omit those records for which C'J69', C'L92', or C'J82' appears in the field.

3. **Bit Logic Tests:**
   Test the state (on or off) of selected bits in a binary field using a bit or hexadecimal mask or a bit constant.

   For example, you can omit those records which have bits 0 and 2 on in a 1-byte field. Or you can omit those records which have bits 3 and 12 on and bits 6 and 8 off in a 2-byte field.

4. **Date Comparisons:**
   Compare a two-digit year date field to a two-digit year date constant, the current two-digit year date or another two-digit year date field, using the century window in effect.

   For example, you can omit only those records for which a Z'yymm' date field is between January 1996 and March 2005. Or you can omit only those records for which a P'dddyy' field is less than another P'dddyy' field.

5. **Numeric Tests:**
   Test a field for numerics or non-numerics in character, zoned decimal, or packed decimal format.

   For example, you can omit only those records in which a 5-byte field contains only '0'-9' characters (that is, numerics). Or you can omit only those records in which a 9-byte field contains invalid ZD numeric data (that is, non-numerics). Or you can omit only those records in which a 12-byte field contains valid PD numeric data (that is, numerics).

For complete details on the parameters of the OMIT control statement, see “INCLUDE Control Statement” on page 98.

The OMIT control statement differs from the OMIT parameter of the OUTFIL statement in the following ways:

- The OMIT statement applies to all input records; the OMIT parameter applies only to the OUTFIL input records for its OUTFIL group.

- FORMAT=f can be specified with the OMIT statement but not with the OMIT parameter. Thus, you can use FORMAT=f and p,m or p,m,f fields with the OMIT statement, but you must only use p,m,f fields with the OMIT parameter. For example:

```
OMIT FORMAT=BI,
   COND=(5,4,LT,11,4,OR,21,4,EQ,31,4,OR,
       61,20,SS,EQ,C'FLY')

OUTFIL OMIT=(5,4,BI,LT,11,4,BI,OR,21,4,BI,EQ,31,4,BI,OR,
        61,20,SS,EQ,C'FLY')
```
OMIT Control Statement

- D2 format can be specified with the OMIT statement but not with the OMIT parameter.

See “OUTFIL Control Statements” on page 229 for more details on the OUTFIL OMIT parameter.

COND

COND= (logical expression)

logical expression specifies one or more relational conditions logically combined, based on fields in the input record. If the logical expression is true for a given record, the record is omitted from the output data sets.

ALL specifies that all of the input records are to be omitted from the output data sets.

NONE specifies that none of the input records are to be omitted from the output data sets.


FORMAT

FORMAT=f

For details on this parameter, see “INCLUDE Control Statement” on page 98.

Omitting Records from the Output Data Set—Example

Example

OMIT COND=(27,1,CH,EQ,C'D',&,
(22,2,BI,SOME,X'C008',|,
28,1,BI,EQ,B'.1....01'))

This statement omits records in which:
- Byte 27 contains D
- Bytes 22 through 23 have some, but not all of bits 0, 1 and 12 on OR byte 28 is equal to the specified pattern of bit 1 on, bit 6 off and bit 7 on.

Note that the AND and OR operators can be written with the AND and OR signs, and that parentheses are used to change the order in which AND and OR are evaluated.
For additional examples of logical expressions, see "INCLUDE Control Statement" on page 98.
Figure 12. Syntax Diagram for the Option Control Statement (Part 1 of 3)
OPTION Control Statement
OPTION Control Statement

The OPTION control statement allows you to override some of the options available at installation time (such as EQUALS and CHECK) and to supply other optional information (such as DYNALLOC, COPY, and SKIPREC).

Some of the options available on the OPTION statement are also available on the SORT or MERGE statement (such as FILSZ and SIZE). It is preferable to specify these options on the OPTION statement. For override rules, see Appendix B, “Specification/Override of DFSORT Options,” on page 857.

Details of aliases for OPTION statement options are given under the description of individual options. Table 34 on page 225 summarizes the available aliases.

DFSORT accepts but does not process the following OPTION operands: ALGQ, APP, APPEND, BIAS=value, BLKSET, CASCADE, DIAG, ERASE, EXCPVR=value,
OPTION Control Statement

MAXPFIX=value, NEW, NEWFILE, NODIAG, NOERASE, NOINC, NOSTIMER, NOSWAP, OPT=value, REP, REPLACE, ROUTE=value, WRKADR=value, WRKDEV=value, and WRKSIZ=value.

ARESALL

```
ARESALL=n
ARESALL=nK
ARESALL=nM
```

Temporarily overrides the ARESALL installation option, which specifies the number of bytes to be reserved above virtual for system use.

ARESALL applies only to the amount of main storage above virtual. This option is normally not needed because of the large amount of storage available above 16MB virtual (the default for ARESALL is 0 bytes). The RESALL option applies to the amount of main storage below 16MB virtual.

- **n** specifies that n bytes of storage are to be reserved.
  - Limit: 8 digits.
- **nK** specifies that n times 1024 bytes of storage are to be reserved.
  - Limit: 5 digits.
- **nM** specifies that n times 1048576 bytes of storage are to be reserved.
  - Limit: 2 digits.

**Default:** Usually the installation default. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.

**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT Options,” on page 857.

ARESINV

```
ARESINV=n
ARESINV=nK
ARESINV=nM
```

Temporarily overrides the ARESINV installation option, which specifies the number of bytes to be reserved for an invoking program's user exits that reside in or use space above 16MB virtual. The reserved space is not meant to be used for the invoking program's executable code. ARESINV is used only when DFSORT is dynamically invoked.

ARESINV applies only to the amount of main storage above 16MB virtual. The RESINV option applies to the amount of main storage below 16MB virtual.

- **n** specifies that n bytes of storage are to be reserved.
  - Limit: 8 digits.
- **nK** specifies that n times 1024 bytes of storage are to be reserved.
  - Limit: 5 digits.
OPTION Control Statement

**nM** specifies that n times 1048576 bytes of storage are to be reserved.

Limit: 2 digits.


**AVGRLEN**

```
| AVGRLEN=n |
```

Specifies the average input record length in bytes for variable-length record sort applications. This value is used when necessary to determine the input file size. The resulting value is important for sort applications, because it is used for several internal optimizations as well as for dynamic work data set allocation (see OPTION DYNALLOC). See “Specify Input/Output Data Set Characteristics Accurately” on page 799 and “Allocation of Work Data Sets” on page 849 for more information on file size considerations.

**n** specifies the average input record length. n must be between 4 and 32767 and must include the 4-byte record descriptor word (RDW).

**Notes:**

1. AVGRLEN=n on the OPTION statement overrides the L5 value on the RECORD statement (LENGTH operand) if both are specified. The L5 value on the RECORD statement is ignored for Blockset.
2. L5=n can be used instead of AVGRLEN=n.

*Default:* If AVGRLEN=n is not specified, DFSORT uses one-half of the maximum record length as the average record length. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.


**CHALT** or **NOCHALT**

```
<table>
<thead>
<tr>
<th>CHALT</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOCHALT</td>
</tr>
</tbody>
</table>
```

Temporarily overrides the CHALT installation option, which specifies whether format CH fields are translated by the alternate collating sequence as well as format AQ or just the latter.

**CHALT** specifies that DFSORT translates character control fields and compare fields with formats CH and AQ using the alternate collating sequence.

**NOCHALT** specifies that format CH fields are not translated.
OPTION Control Statement

**Note:** If you use locale processing for SORT, MERGE, INCLUDE, or OMIT fields, you must not use CHALT. If you need alternate sequence processing for a particular field, use format AQ.


### CHECK or NOCHECK

Temporarily overrides the CHECK installation option, which specifies whether the record count should be checked for applications that use the E35 user exit routine without an output data set.

- **CHECK** specifies that the record count should be checked.
- **NOCHECK** specifies that the record count should not be checked.


### CINV or NOCINV

Temporarily overrides the CINV installation option, which specifies whether DFSORT can use control interval access for VSAM data sets. The Blockset technique uses control interval access for VSAM input data sets, when possible, to improve performance.

- **CINV** specifies that DFSORT should use control interval access when possible for VSAM data sets.
- **NOCINV** specifies that DFSORT should not use control interval access.


### CKPT
Activates the Checkpoint/Restart facility for sorts that use the Peerage or Vale techniques.

Because CKPT is only supported in the Peerage and Vale techniques, the Blockset technique must be bypassed for the Checkpoint/Restart facility to be used. Installation option IGNCKPT=NO causes Blockset to be bypassed when CKPT is specified at run-time. The NOBLKSET option can also be used to bypass Blockset at run-time.

A SORTCKPT DD statement must be coded when you use the Checkpoint/Restart facility (see "SORTCKPT DD Statement" on page 76).

Notes:
1. CHKPT can be used instead of CKPT.
2. Functions such as OUTFIL processing, which are supported only by the Blockset technique, cannot be used if the Checkpoint/Restart facility is used.

Default: None; optional. See Appendix B, "Specification/Override of DFSORT Options," on page 857 for full override details.


COBEXIT

Temporarily overrides the COBEXIT installation option, which specifies the library for COBOL E15 and E35 routines.

COB1
specifies that COBOL E15 and E35 routines are run with the OS/VS COBOL run-time library or, in some cases, with no COBOL run-time library.

COBEXIT=COB1 is obsolete, but is still available for compatibility reasons.

Note that Language Environment is the only run-time library for COBOL supported by IBM service.

COB2
specifies that COBOL E15 and E35 routines are run with either the VS COBOL II run-time library or the Language Environment run-time library.

Note that Language Environment is the only run-time library for COBOL supported by IBM service.

Note: The DFSORT documents only discuss the Language Environment run-time library, and assume that COBEXIT=COB2 is in effect. Although
**OPTION Control Statement**

it is possible to run with older run-time libraries, and with COBEXIT=COB1, these are not recommended or discussed, and are not supported by IBM service.


**COPY**

```
COPY
```

Causes DFSORT to copy a SORTIN data set or inserted records to the output data sets unless all records are disposed of by an E35 exit routine. Records can be edited by E15 and E35 exit routines; INCLUDE/OMIT, INREC, OUTREC, and OUTFIL statements; and SKIPREC and STOPAFT parameters. E35 is entered after each SORTIN or E15 record is copied.

The following must not be used in copy applications:

- BDAM data sets
- Dynamic link-editing.

See message ICE160A in z/OS DFSORT Messages, Codes and Diagnosis Guide for additional restrictions that apply to copy applications.

*Note:* User labels will not be copied to the output data sets.

*Default:* None; optional. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.


**DSA**

```
DSA=n
```

Temporarily overrides the DSA installation option, which specifies the maximum amount of storage available to DFSORT for dynamic storage adjustment of a Blockset sort application when SIZE/MAINSIZE=MAX is in effect. If you specify a DSA value greater than the TMAXLIM value in effect, you allow DFSORT to use more storage than the TMAXLIM value if doing so should improve performance. The amount of storage DFSORT uses is subject to the DSA value as well as system limits such as region size. However, whereas DFSORT always tries to obtain as much storage as it can up to the TMAXLIM value, DFSORT only tries to obtain as much storage as needed to improve performance up to the DSA value.

The performance improvement from dynamic storage adjustment usually provides a good tradeoff against the increased storage used by DFSORT. On storage constrained systems, however, the DSA value should be set low enough to prevent unacceptable paging.
n specifies that DFSORT can dynamically adjust storage to improve performance, subject to a limit of n MB. n must be a value between 0 and 2000. If n is less than or equal to the TMAXLIM value in effect, n is set to 0 to indicate that storage will not be dynamically adjusted.


DSPSIZE

Temporarily overrides the DSPSIZE installation option, which specifies the maximum amount of data space to be used with dataspace sorting. A data space is an area of contiguous virtual storage that is backed by real and auxiliary storage, whichever is necessary as determined by the system. Because DFSORT is able to sort large pieces of data using data space, CPU time and elapsed time are reduced.

Several factors can limit the amount of data space an application uses:

- The IEFUSI exit can limit the total amount of Hiperspace, memory objects and data space available to an application.
- DSPSIZE can limit the amount of data space available to an application, as detailed below.
- Sufficient available storage must be present to back DFSORT’s data spaces. “Available” storage is the storage used to back new data space data and consists of the following two types:
  1. Free storage. This is storage not being used by any application.
  2. Old storage. This is storage used by another application whose data has been unreferenced for a sufficiently long time so that the system considers it eligible to be paged out to auxiliary storage to make room for new data space data.

The amount of available storage constantly changes, depending on current system activity. Consequently, DFSORT checks the amount of available central storage throughout a data space sorting run and switches from using a data space to using disk work data sets if the available central storage is too low.

- Other concurrent Hipersorting, memory sorting and dataspace sorting applications further limit the amount of available storage. A dataspace sorting application knows the storage needs of every other Hipersorting, memory object sorting and dataspace sorting application on the system. A dataspace sorting application does not try to back its data space data with storage needed by another Hipersorting, memory object sorting or dataspace sorting application. This prevents overcommitment of storage resources if multiple large concurrent DFSORT applications start at similar times on the same system.
- The installation options EXPMAX, EXPOLD, and EXPRES can also be used to further limit the amount of storage available to dataspace sorting applications. EXPMAX limits the total amount of available storage that can
OPTION Control Statement

be used at any one time to back DFSORT Hiperspaces, memory objects and
data spaces. EXPOLD limits the total amount of old storage that can be used
at any one time to back DFSORT Hiperspaces, memory objects and data
spaces. EXPRES sets aside a specified amount of available storage for use by
non-Hipersorting, non-memory object sorting and non-dataspace sorting
applications.

Some of these limits depend on system and other DFSORT activity throughout
the time a dataspace sorting application runs. Consequently, the amount of
data space a dataspace sorting application uses can vary from run to run.

If the amount of data space DFSORT decides to use is sufficient, DFSORT sorts
your data in main storage and does not require additional temporary work
space. If the amount of data space is not sufficient, DFSORT uses disk as
temporary work space. Installation option DYNAUTO=NO is changed to
DYNAUTO=YES whenever dataspace sorting is possible. Hiperspace is not
used when dataspace sorting is used.

**MAX**

specifies that DFSORT dynamically determines the maximum amount of
data space to be used for dataspace sorting. In this case, DFSORT bases its
data space usage on the size of the file being sorted and the paging activity
of the system.

**n**

specifies the maximum amount, in MB, of data space to be used for
dataspace sorting, n must be a value between 0 and 9999. The actual
amount of data space used does not exceed n, but may be less than n
depending on the size of the file being sorted and the paging activity of
the system.

If n is zero, dataspace sorting is not used.

**Default:** Usually the installation default. See Appendix B, “Specification/
Override of DFSORT Options,” on page 857 for full override details.

**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT
Options,” on page 857.

**DYNALLOC**

Assigns DFSORT the task of dynamically allocating needed work space. You
do not need to calculate and use JCL to specify the amount of work space
needed by the program. DFSORT uses the dynamic allocation facility of the
operating system to allocate work space for you.

Refer to Appendix A, “Using Work Space,” on page 847 for guidelines on the
use of DYNALLOC.

**d**

specifies the device name. You can specify any IBM disk or tape device
supported by your operating system in the same way you would specify it
in the JCL UNIT parameter. You can also specify a group name, such as
DISK or SYSDA.
For best performance, specify an emulated 3390-9 device (such as RAMAC) or another high-speed IBM disk device, and avoid specifying a tape, virtual (VIO), or real 3390-9 device.

\( n \) specifies the maximum number of requested work data sets. If you specify more than 255, a maximum of 255 data sets is used. If you specify 1 and the Blockset technique is selected, a maximum of 2 data sets is used. If you specify more than 32 and the Blockset technique is not selected, a maximum of 32 data sets is used.

**Tip:** For optimum allocation of resources such as virtual storage, avoid specifying a large number of work data sets unnecessarily.

For tape work data sets, the number of volumes specified (explicitly or by default) is allocated to the program. The program requests standard label tapes.

DYNALLOC is not used if SORTWKdd DD statements are provided unless installation option DYNAUTO=IGNWKDD is specified and OPTION USEWKDD is not in effect.

**If VIO=NO is in effect:**
- Work space can be allocated on nontemporary data sets (DSNAME parameter specified).
- If the device (d) you specify is a virtual device and reallocation to a real device fails, DFSORT will ignore VIO=NO and use the virtual device.

**Note:** Message ICE165I gives information about work data set allocation/use.

**Default:** None; optional. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.
- DYNALLOC can automatically be activated by using the DYNAUTO installation option.
- If DYNALLOC is specified without d, the default for d is that specified (or defaulted) by the DYNALOC installation option.
- If DYNALLOC is specified without n, the default for n is that specified (or defaulted) by the DYNALOC installation option.

You can specify DYNALLOC without n, without d, or without both. If DYNALLOC is specified without n, and the IBM-supplied default for the n value of the DYNALOC installation option is chosen, then:
- If one of the Blockset techniques is chosen, four work data sets will be requested.
- If a technique other than Blockset is chosen, three work data sets will be requested.

**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT Options,” on page 857.

**DYNALLOC=OFF**

Directs DFSORT not to allocate work space dynamically, overriding that function of installation option DYNAUTO=YES, or DYNAUTO=IGNWKDD, or
the run-time option DYNALLOC (without OFF). Use this option when you know that an in-core sort can be performed, and you want to suppress dynamic allocation of work space.

**OFF**

- directs DFSORT not to allocate work space dynamically.

**Note:** When Hipersorting or dataspace sorting is in effect, DFSORT uses dynamic allocation when necessary, even if DYNALLOC=OFF has been specified.

**Default:** None; optional. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.

**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT Options,” on page 857.

**DYNAPCT**

\[ \text{DYNAPCT} = x \]

\[ \text{OLD} \]

specifies additional work data sets to be dynamically allocated with zero space. DFSORT only extends these data sets when necessary to complete a sort application. The availability of additional work data sets can help avoid out of space ABENDs.

- \( x \) specifies the number of additional work data sets (\( y \)) as a percentage of the maximum number of dynamically allocated work data sets (DYNALLOC/DYNALOC \( n \) value) in effect. \( y \) will be set to \( n \times x\% \). The total number of dynamically allocated work data sets will be \( n + y \). For example, if DYNALLOC=(SYSDA,20) and DYNAPCT=20 are in effect, 4 additional work data sets will be allocated for a total of 24.

The value \( x \) must be between 0 and 254. The minimum value for \( y \) is 1 and the maximum value for \( y \) is 254. The maximum value for \( n + y \) is 255; if \( x \) results in a value for \( n + y \) greater than 255, \( y \) will be set to 255-n.

- \( \text{OLD} \) specifies additional work data sets should only be allocated when DFSORT cannot determine the file size. When DFSORT is able to determine the file size, additional work data sets will not be allocated (\( y=0 \)), and the total number of work data sets will be \( n \).

**Note:** When message ICE118I is issued indicating that DFSORT cannot determine the file size, \( y \) is set as follows:

- For DYNAPCT=OLD, \( y \) is set to \( n \times 50\% \)
- For DYNAPCT=x with \( x \leq 50 \), \( y \) is set to \( n \times 50\% \)
- For DYNAPCT=x with \( x > 50 \), \( y \) is set to \( n \times x\% \)

**Default:** None; optional. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.

**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT Options,” on page 857.
DYNSPC temporarily overrides the DYNSPC installation option, which specifies the total default primary space allocation for all of the dynamically allocated work data sets when the input file size is unknown. That is, when DFSORT cannot determine the input file size for a sort application and the number of records is not supplied by a FILSZ or SIZE value.

Generally, DFSORT can automatically determine the input file size. However, in a few cases, such as when an E15 supplies all of the input records, when information about a tape data set is not available from a tape management system, or when Blockset is not selected, DFSORT cannot determine an accurate file size. In these cases, if the number of records is not supplied by the FILSZ or SIZE run-time option, and dynamic allocation of work data sets is used, DFSORT uses the DYNSPC value in effect as the approximate amount of primary space. DFSORT uses 20% of the primary space as secondary space. Although the primary space is always allocated, secondary space (up to 15 extents) is only allocated as needed.

You may want to use DYNSPC to override the installation default with a larger or smaller value depending on the amount of disk space available for DFSORT work data sets, and the amount of data to be sorted for this application. As a guideline, Table 30 shows the approximate primary space in cylinders that is allocated on a 3390 when Blockset sorts an unknown number of 6000-byte records.

<table>
<thead>
<tr>
<th>DYNSPC value (megabytes)</th>
<th>Primary space (cylinders)</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>48</td>
</tr>
<tr>
<td>64</td>
<td>93</td>
</tr>
<tr>
<td>128</td>
<td>183</td>
</tr>
<tr>
<td>256</td>
<td>366</td>
</tr>
<tr>
<td>512</td>
<td>732</td>
</tr>
</tbody>
</table>

The larger your DYNSPC value, the more data DFSORT can sort when the file size is unknown. For example, in a test using just dynamically allocated work space (no Hiperspace or data space) with the primary space shown in Table 30 and all of the corresponding secondary space, Blockset is able to sort approximately 150 megabytes with DYNSPC=32 and approximately 1200 megabytes with DYNSPC=256. If Hiperspace or data space can be used along with dynamically allocated work space, the amount of data DFSORT can sort will increase according to the amount of Hiperspace or data space available.

n specifies the total default primary space, in megabytes, to be allocated for all dynamically allocated work data sets (n is not the primary space for each data set). n must be a value between 1 and 65535.

Do not specify a value which exceeds the available disk space, because this causes dynamic allocation to fail for sort applications that use this value.
OPTION Control Statement

**EFS**

```
EFS=name
   NONE
```

Temporarily overrides the EFS installation option, which specifies whether DFSORT is to pass control to an Extended Function Support (EFS) program. See Chapter 9, “Using Extended Function Support,” on page 763 for more information.

- **name** specifies the name of the EFS program that will be called to interface with DFSORT.
- **NONE** specifies no call will be made to the EFS program.

**Notes:**

1. EFS is processed only if it is passed on the OPTION control statement in an extended parameter list or in DFSPARM.
2. If you use locale processing for SORT, MERGE, INCLUDE, or OMIT fields, you must not use an EFS program. DFSORT's locale processing may eliminate the need for an EFS program. See the LOCALE option later in this section for information related to locale processing.

**EQUALS or NOEQUALS**

```
EQUALS
NOEQUALS
```

Temporarily overrides the EQUALS installation option, which specifies whether the original sequence of records that collate identically for a sort or a merge should be preserved from input to output.

- **EQUALS** specifies that the original sequence must be preserved.
- **NOEQUALS** specifies that the original sequence need not be preserved.
OPTION Control Statement

For sort applications, the sequence of the output records depends upon the order of:
- The records from the SORTIN file
- The records inserted by an E15 user exit routine
- The E15 records inserted within input from SORTIN.

For merge applications, the sequence of the output records depends upon the order of:
- The records from a SORTINnn file. Records that collate identically are output in the order of their file increments. For example, records from SORTIN01 are output before any records that collate identically from SORTIN02.
- The records from an E32 user exit routine for the same file increment number. Records that collate identically from E32 are output in the order of their file increments. For example, records from the file with increment 0 are output before any records that collate identically from the file with increment 4.

Notes:
1. When EQUALS is in effect, the total number of bytes occupied by all control fields must not exceed 4088.
2. Using EQUALS can degrade performance.
3. When EQUALS is in effect with SUM, the first record of summed records is kept. When NOEQUALS is in effect with SUM, the record to be kept is unpredictable.
   If a technique other than Blockset is selected, NOEQUALS is forced if SUM is specified.
4. Do not specify EQUALS if variable-length records are sorted using tape work files and the RDW is part of the control field.
5. The number of records to be sorted cannot exceed 4294967295 (4 gigarecords minus 1); if the number of records exceeds this number, message ICE121A is issued and DFSORT terminates.


EXITCK

Temporarily overrides the EXITCK installation option, which specifies whether DFSORT terminates or continues when it receives certain invalid return codes from E15 or E35 user exit routines. For full details of the return codes affected by this parameter, see “E15/E35 Return Codes and EXITCK” on page 534.

STRONG
specifies that DFSORT issues an error message and terminates when it receives an invalid return code from an E15 or E35 user exit routine.

WEAK
specifies that DFSORT interprets certain invalid return codes from E15
and E35 user exit routines as valid and continues processing. Use of EXITCK=WEAK can make it difficult to detect errors in the logic of E15 and E35 user exit routines.

Note: EXITCK=WEAK is treated like EXITCK=STRONG when:
- Tape work data sets are specified for a sort application.
- The Blockset technique is not selected for a merge application.


FILSZ or SIZE

The FILSZ parameter specifies either the exact number of records to be sorted or merged, or an estimate of the number of records to be sorted. The SIZE parameter specifies either the exact number of records in the input data sets, or an estimate of the number of records in the input data sets. The supplied record count is used by DFSORT for two purposes:

1. To check that the actual number of records sorted or merged or the number of records in the input data sets is equal to the exact number of records expected. FILSZ=x or SIZE=y causes this check to be performed and results in termination with message ICE047A if the check fails.

2. To determine the input file size for a sort application. DFSORT performs calculations based on the user supplied record count and other parameters (such as AVGRELEN) to estimate the total number of bytes to be sorted. This value is important for sort runs, because it is used for several internal optimizations as well as for dynamic work data set allocation (see OPTION DYNALLOC). If no input record count (or only an estimate) is supplied for the sort run, DFSORT attempts to automatically compute the file size to be used for the optimizations and allocations.

The type of FILSZ or SIZE value specified (x/y, Ux/Uy, Ex/Ey, or none) controls the way DFSORT performs the above two functions, and can have a significant effect on performance and work data set allocation. See Chapter 10, “Improving Efficiency,” on page 797 and “File Size and Dynamic Allocation” on page 851 for more information on file size considerations.

x or y

specifies the exact number of records to be sorted or merged (x) or the exact number of records in the input data sets (y). This value is always used for both the record check and the file size calculations. FILSZ=x or SIZE=y can be used to force DFSORT to perform file size calculations based on x or y, and to cause DFSORT to terminate the sort or merge application if x or y is not exact.
OPTION Control Statement

If installation option FSZEST=NO is in effect and either FILSZ=x or SIZE=y is specified, DFSORT terminates if the actual number of records is different from the specified exact value (x or y). In this case, the actual number of records is placed in the IN field of message ICE047A (or message ICE054I in some cases) before termination. However, if installation option FSZEST=YES is in effect, DFSORT treats FILSZ=x or SIZE=y like FILSZ=Ex or SIZE=Ey, respectively; it does not terminate when the actual number of records does not equal x or y.

FILSZ=0 causes Hipersorting, dataspace sorting, and dynamic allocation of work space not to be used, and results in termination with message ICE047A unless the number of records sorted or merged is 0. If no E15 user exit is present, SIZE=0 has the same effect in terms of Hipersorting and dynamic allocation of work space, and results in termination with message ICE047A unless the number of records in the input data sets is 0.

x specifies the exact number of records to be sorted or merged; it must take into account the number of records in the input data sets, records to be inserted or deleted by E15 or E32, and records to be deleted by the INCLUDE/OMIT statement, SKIPREC, and STOPAFT. x must be changed whenever the number of records to be sorted or merged changes in any way.

y specifies the exact number of records in the input data sets; it must take into account the number of records to be deleted by STOPAFT. y must be changed whenever the number of records in the input data sets changes in any way.

Limit: 28 digits (15 significant digits)

Ex or Ey specifies an estimate of the number of records to be sorted (x) or an estimate of the number of records in the input data sets (y). This value is not used for the record check. It is used for the file size calculations, but only if DFSORT could not reasonably estimate the input file size itself. In all other cases, this value is ignored by DFSORT. See "Dynamic Allocation of Work Data Sets" on page 850 for details on exactly when an estimated record count is used and when it is ignored by DFSORT.

FILSZ=E0 or SIZE=E0 is always ignored.

x specifies an estimate of the number of records to be sorted; it should take into account the number of records in the input data sets, records to be inserted or deleted by E15, and records to be deleted by the INCLUDE/OMIT statement, SKIPREC, and STOPAFT. x should be changed whenever the number of records to be sorted changes significantly.

y specifies an estimate of the number of records in the input data sets; it should take into account the number of records to be deleted by STOPAFT. y should be changed whenever the number of records in the input data sets changes significantly.

Limit: 28 digits (15 significant digits)

Ux or Uy specifies the number of records to be sorted (x) or the number of records in the input data sets (y). This value is not used for the record check, but is always used for the file size calculations. FILSZ=Ux or SIZE=Uy can be used to force DFSORT to perform file size calculations based on x or y, while avoiding termination if x or y is not exact.
OPTION Control Statement

The FSZEST installation option has no effect on FILSZ=Ux or SIZE=Uy processing.

FILSZ=U0 causes Hipersorting, dataspace sorting, and dynamic allocation of work space not to be used, and may cause degraded performance or termination with message ICE046A, if the actual number of records to be sorted is significantly larger than 0. If no E15 user exit is present, SIZE=U0 has the same effect in terms of Hipersorting, dataspace sorting, and dynamic allocation of work space, and may cause degraded performance or termination with message ICE046A, if the actual number of records in the input data sets is significantly larger than 0.

\[ x \]
\[ y \]
\[ x \] specifies the number of records to be sorted; it should take into account the number of records in the input data sets, records to be inserted or deleted by E15, and records to be deleted by the INCLUDE/OMIT statement, SKIPREC, and STOPAFT. \[ x \] should be changed whenever the number of records to be sorted changes significantly.

\[ y \] specifies the number of records in the input data sets; it should take into account the number of records to be deleted by STOPAFT. \[ y \] should be changed whenever the number of records in the input data sets changes significantly.

Limit: 28 digits (15 significant digits)

Table 31 summarizes the differences for the three FILSZ variations:

<table>
<thead>
<tr>
<th>Conditions</th>
<th>FILSZ=n</th>
<th>FILSZ=Un</th>
<th>FILSZ=En</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of records</td>
<td>Exact</td>
<td>Estimate</td>
<td>Estimate</td>
</tr>
<tr>
<td>Applications</td>
<td>Sort, merge</td>
<td>Sort</td>
<td>Sort</td>
</tr>
<tr>
<td>Terminate if ( n ) wrong?</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Use for file size calculation?</td>
<td>Yes</td>
<td>Yes</td>
<td>When DFSORT cannot compute file size</td>
</tr>
<tr>
<td>( n ) includes records:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In input data sets</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Inserted/deleted by E15</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Inserted by E32</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Deleted by INCLUDE/OMIT</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Deleted by SKIPREC</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Deleted by STOPAFT</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Update ( n ) when number of records changes:</td>
<td>In any way</td>
<td>Significantly</td>
<td>Significantly</td>
</tr>
<tr>
<td>Effects of ( n=0 )</td>
<td>Hipersorting and DYNALLOC not used</td>
<td>Hipersorting and DYNALLOC not used</td>
<td>None</td>
</tr>
</tbody>
</table>

Table 32 on page 192 summarizes the differences for the three SIZE variations:
### OPTION Control Statement

**Table 32. SIZE Variations Summary.** SIZE=n is equivalent to SIZE=En if installation option FSZEST=YES is specified.

<table>
<thead>
<tr>
<th>Conditions</th>
<th>SIZE=n</th>
<th>SIZE=Un</th>
<th>SIZE=En</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of records</td>
<td>Exact</td>
<td>Estimate</td>
<td>Estimate</td>
</tr>
<tr>
<td>Applications</td>
<td>Sort, merge</td>
<td>Sort</td>
<td>Sort</td>
</tr>
<tr>
<td>Terminate if n wrong?</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Use for file size calculation?</td>
<td>Yes</td>
<td>Yes</td>
<td>When DFSORT cannot compute file size</td>
</tr>
</tbody>
</table>

n includes records:
- In input data sets: Yes | Yes | Yes |
- Inserted/deleted by E15: No | No | No |
- Inserted by E32: No | No | No |
- Deleted by INCLUDE/OMIT: No | No | No |
- Deleted by SKIPREC: No | No | No |
- Deleted by STOPAFT: Yes | Yes | Yes |

Update n when number of records changes:
- In any way: Significantly | Significantly |

Effects of n=0:
- Hipersorting and DYNALLOC not used: Hipersorting and DYNALLOC not used | None |

Attention: Using the SIZE or FILSZ parameter to supply inaccurate information to DFSORT can negatively affect DFSORT performance, and, when work space is dynamically allocated, can result in wasted disk space or termination with message ICE083A or ICE046A. Therefore, it is important to update the record count value whenever the number of records to be sorted changes significantly.


### HIPRMAX

![Diagram of HIPRMAX]

Temporarily overrides the HIPRMAX installation option, which specifies the maximum amount of Hiperspace to be used for Hipersorting. Hiperspace is a high-performance data space that resides in central storage and is backed by auxiliary storage (if necessary). Because I/O processing is reduced for Hipersorting, elapsed time, EXCP counts, and channel usage are also reduced.

Several factors can limit the amount of Hiperspace an application uses:
- The IEFUSI exit can limit the total amount of Hiperspace, memory objects and data space available to an application.
**OPTION Control Statement**

- HIPRMAX can limit the amount of Hiperspace available to an application, as detailed below.
- Sufficient available storage must be present to back DFSORT’s Hiperspaces. "Available" storage is the storage used to back new Hiperspace data and consists of the following two types:
  1. Free storage. This is storage not being used by any application.
  2. Old storage. This is storage used by another application whose data has been unreferenced for a sufficiently long time so that the system considers it eligible to be paged out to auxiliary storage to make room for new Hiperspace data.

The amount of available storage constantly changes, depending upon current system activity. Consequently, DFSORT checks the available storage level throughout a Hipersorting application and switches from Hiperspace to work data sets if the available storage level gets too low.

- Other concurrent Hipersorting, memory sorting and dataspace sorting applications further limit the amount of available storage. A Hipersorting application knows the storage needs of every other Hipersorting, memory object sorting and dataspace sorting application on the system. A Hipersorting application does not try to back its Hiperspace data with storage needed by another Hipersorting, memory object sorting, or dataspace sorting application. This prevents overcommitment of storage resources if multiple large concurrent DFSORT applications start at similar times on the same system.

- The installation options EXPMAX, EXPOLD, and EXPRES can also be used to further limit the amount of storage available to Hipersorting applications. EXPMAX limits the total amount of available storage that can be used at any one time to back DFSORT Hiperspaces, memory objects and data spaces. EXPOLD limits the total amount of old storage that can be used at any one time to back DFSORT Hiperspaces, memory objects and data spaces. EXPRES sets aside a specified amount of available storage for use by non-Hipersorting, non-memory object sorting, and non-dataspace sorting applications.

Some of these limits depend on system and other DFSORT activity throughout the time a Hipersorting application runs. Consequently, the amount of Hiperspace a Hipersorting application uses can vary from run to run.

HIPRMAX=n specifies a fixed value for HIPRMAX. HIPRMAX=p% specifies a value for HIPRMAX that varies as a percentage of an appropriate portion of central storage. If the storage on a system changes, HIPRMAX=p% will cause a corresponding change in the HIPRMAX value selected by DFSORT, whereas HIPRMAX=n will not. When sharing DFSORT installation options between systems, such as in a sysplex, HIPRMAX=p% can be used to tailor the HIPRMAX value to the system selected for the application, providing a more dynamic HIPRMAX value than HIPRMAX=n.

If the amount of Hiperspace available for Hipersorting is insufficient for temporary storage of the records, intermediate disk storage is used along with Hiperspace. If the amount of Hiperspace is too small to improve performance, Hipersorting is not used. DYNAUTO=NO is changed to DYNAUTO=YES for Hipersorting.

Hipersorting can cause a small CPU time increase. When CPU optimization is a concern, you can use HIPRMAX=0 to suppress Hipersorting.
OPTION Control Statement

Note: HIPRLIM=OPTIMAL can be used instead of HIPRMAX=OPTIMAL.
HIPRLIM=m can be used instead of HIPRMAX=n. HIPRLIM=m
specifies a Hiperspace limit of m times 4096 bytes rounded up to the
nearest megabyte. m must be a value between 0 and 2559744. If m is 0,
Hipersorting is not used.

OPTIMAL
specifies that DFSORT determines dynamically the maximum amount
of Hiperspace to be used for Hipersorting.

n
specifies that DFSORT determines dynamically the maximum amount
of Hiperspace to be used for Hipersorting, subject to a limit of nMB. n
must be a value between 0 and 32767. If n is 0, Hipersorting is not
used.

p%
specifies that DFSORT determines dynamically the maximum amount
of hiperspace to be used for Hipersorting, subject to a limit of p
percent of an appropriate portion of central storage. p must be a value
between 0 and 100. If p is 0, Hipersorting is not used. The value
calculated for p% is limited to 32767MB, and is rounded down to the
nearest MB.

Default: Usually the installation default. See Appendix B, “Specification/
Override of DFSORT Options,” on page 857 for full override details.

Applicable Functions: See Appendix B, “Specification/Override of DFSORT
Options,” on page 857.

LIST or NOLIST

LIST
specifies that DFSORT control statements are printed to the message data
set.

NOLIST
specifies that DFSORT control statements are not printed to the message
data set.

Note: LIST or NOLIST are processed only if they are passed on the OPTION
control statement in an extended parameter list or in DFSPARM.

Default: Usually the installation default. See Appendix B, “Specification/
Override of DFSORT Options,” on page 857 for full override details.

Applicable Functions: See Appendix B, “Specification/Override of DFSORT
Options,” on page 857.
OPTION Control Statement

LISTX

Temporarily overrides the LISTX installation option, which specifies whether DFSORT writes to the message data set program control statements that are returned by an EFS program. See z/OS DFSORT Messages, Codes and Diagnosis Guide for details on use of the message data set.

LISTX specifies that control statements returned by an EFS program are printed to the message data set.

NOLISTX specifies that control statements returned by an EFS program are not printed to the message data set.

Notes:
1. LISTX or NOLISTX are processed only if they are passed on the OPTION control statement in an extended parameter list or in DFSPARM.
2. If EFS=NONE is in effect after final override rules have been applied, NOLISTX is in effect.
3. LISTX and NOLISTX can be used independently of LIST and NOLIST.
4. For more information on printing EFS control statements, see z/OS DFSORT Messages, Codes and Diagnosis Guide.


LOCALE

Temporarily overrides the LOCALE installation option, which specifies whether locale processing is to be used and, if so, designates the active locale.

DFSORT’s collating behavior can be modified according to your cultural environment. Your cultural environment is defined to DFSORT using the X/Open locale model. A locale is a collection of data grouped into categories that describes the information about your cultural environment.

The collate category of a locale is a collection of sequence declarations that defines the relative order between collating elements (single character and multi-character collating elements). The sequence declarations define the collating rules.

If locale processing is to be used, the active locale will affect the behavior of DFSORT’s SORT, MERGE, INCLUDE, and OMIT functions. For SORT and MERGE, the active locale will only be used to process character (CH) control fields. For INCLUDE and OMIT, the active locale will only be used to process...
OPTION Control Statement

character (CH) compare fields, and character and hexadecimal constants
compared to character (CH) compare fields.

Note: Locale processing is not used for IFTRAIL TRLID or IFTHEN WHEN,
BEGIN or END constants or compare fields.

name specifies that locale processing is to be used and designates the
name of the locale to be made active during DFSORT
processing.

The locales are designated using a descriptive name. For
example, to set the active locale to represent the French
language and the cultural conventions of Canada, specify
LOCALE=FR_CA. You can specify up to 32 characters for the
descriptive locale name. The locale names themselves are not
case-sensitive. See Using Locales for complete locale naming
conventions.

You can use IBM-supplied and user-defined locales.

The state of the active locale prior to DFSORT being entered
will be restored on DFSORT's completion.

CURRENT specifies that locale processing is to be used, and the current
locale active when DFSORT is entered will remain the active
locale during DFSORT processing.

NONE specifies that locale processing is not to be used. DFSORT will
use the binary encoding of the code page defined for your data
for collating and comparing.

Notes:
1. LOCALE is processed only if it is passed on the OPTION control statement
   in an extended parameter list or in DFSPARM.
2. To use an IBM-supplied locale, DFSORT must have access to the Language
   Environment run-time library. For example, this library might be called
   SYS1.SCEERUN. If you are unsure of the name of this library at your
   location, contact your system administrator. To use a user-defined locale,
   DFSORT must have access to the load library containing it.
3. If you use locale processing for SORT, MERGE, INCLUDE, or OMIT fields:
   • VLSHRT is not used for SORT or MERGE
   • INREC or an E61 user exit must not be used for SORT or MERGE.
   • CHALT or an EFS program must not be used.
4. Locale processing is not used for IFTRAIL TRLID or IFTHEN WHEN,
   BEGIN or END constants or compare fields.
5. Locale processing for DFSORT’s SORT, MERGE, INCLUDE, and OMIT
   functions can improve performance relative to applications that must
   perform pre-processing or post-processing of data to produce the desired
   collating results. However, locale processing should be used only when
   required, because it can show degraded performance relative to collating,
   using character encoding values.
6. DFSORT locale processing may require an additional amount of storage
   that depends on the environment supporting the locale as well as the locale
   itself. It may be necessary to specify a REGION of several MB or more for
   DFSORT applications that use locale processing.

Default: Usually the installation default. See Appendix B, “Specification/
Override of DFSORT Options,” on page 857 for full override details.
OPTION Control Statement


MAINSIZE

TEMPORARILY overrides the SIZE installation option, which specifies the amount of main storage available to DFSORT.

MAINSIZE applies to the total amount of main storage above and below 16MB virtual. DFSORT determines how much storage to allocate above and below 16MB virtual, but the total amount of storage cannot exceed MAINSIZE.

Storage used for OUTFIL processing will be adjusted automatically, depending upon several factors, including:

- Total available storage
- Non-OUTFIL processing storage requirements
- Number of OUTFIL data sets and their attributes (for example, block size).

OUTFIL processing is subject to the ODMAXBF limit and your system storage limits (for example, IEFUSI) but not to DFSORT storage limits, that is, SIZE/MAINSIZE, MAXLIM, and TMAXLIM. DFSORT attempts to use storage above 16MB virtual for OUTFIL processing whenever possible.

For details on main storage allocation, see “Tuning Main Storage” on page 805.

n specifies that n bytes of storage are to be allocated. If you specify more that 2097152000, 2097152000 is used.

Limit: 10 digits

nK specifies that n times 1024 bytes of storage are to be allocated. If you specify more than 2048000K, 2048000K is used.

Limit: 7 digits

nM specifies that n times 1048576 bytes of storage are to be allocated. If you specify more than 2000M, 2000M is used.

Limit: 4 digits.

MAX

instructs DFSORT to calculate the amount of virtual storage available and allocate an amount of storage up to the TMAXLIM or DSA value when Blockset is selected, or up to the MAXLIM value when Blockset is not selected.

Note: CORE=value can be used instead of MAINSIZE=value.


OPTION Control Statement

MERGEIN

Specifies up to 100 ddnames to be used for a MERGE application instead of the SORTINnn ddnames. This allows you to use any valid alternate ddnames for the MERGE data sets.

If EQUALS is in effect, records that collate identically are output in the order of their ddnames in the MERGEIN list.

Each ddname can be 1 through 8 characters. If a ddname is specified more than once in the MERGEIN operand, it will only be used once. If more than 100 unique ddnames are specified in the MERGEIN operand, only the first 100 will be used. Do not use ddnames reserved for use by DFSORT, such as SYSOUT, ccccOUT, cccWKd, cccWKdd, cccDKd, or cccDKdd, where cccc is the specified or defaulted value for the SORTDD operand and d is any character.

Notes:
1. MERGEIN is processed only if it is passed on the OPTION control statement in an extended parameter list, or in DFSPARM.
2. If both MERGEIN=(ddname1,ddname2,...) and SORTDD=ccc are specified, ddname1, ddname2 and so on are used for the input files. The same ddname cannot be specified for MERGEIN and SORTOUT, or for MERGEIN and OUTFIL.

Default: SORTINnn, unless SORTDD=ccc is specified in an extended parameter list or in DFSPARM, in which case cccINnn is the default.


MOSIZE

Temporarily overrides the MOSIZE installation option, which specifies the maximum amount of memory object storage to be used for memory object sorting in 64-bit virtual storage. A memory object is a data area in virtual storage that is allocated above the bar and backed by central storage. Because I/O processing is reduced for memory object sorting, elapsed time, EXCP counts, and channel usage are also reduced.
OPTION Control Statement

Note: The "bar" refers to the 2-gigabyte address within the 64-bit address space. The bar separates storage below the 2-gigabyte address called "below the bar", from storage above the 2-gigabyte address called "above the bar".

There are several factors that can limit the total memory object storage used by an application:

1. The MEMLIMIT parameter on the JOB or EXEC JCL statement can limit the total number of usable virtual pages above the bar in a single address space.
2. In addition to limiting the total amount of Hiperspace and data space available to an application, the IEFUSI exit can also limit the total number of usable virtual pages above the bar in a single address space.
3. MOSIZE can limit the total amount of memory object storage available to an application, as detailed below.
4. Sufficient available central storage must be present to back DFSORT's memory object storage. The amount of available central storage changes constantly, depending on current system activity. Consequently, DFSORT checks the amount of available central storage throughout a memory object sorting run and switches from using a memory object to using disk work data sets if the available central storage is too low.
5. Other concurrent Hipersorting, memory object sorting, and dataspace sorting applications further limit the amount of available storage. A memory object sorting application keeps track of the storage needs of all other Hipersorting, memory object sorting, and dataspace sorting applications on the system, and does not attempt to back its memory object storage with storage needed by another Hipersorting, memory object sorting, or dataspace sorting application. This prevents overcommitment of storage resources in the event of multiple large concurrent Hipersorting, memory object sorting, and dataspace sorting applications starting at similar times on the same system.
6. The installation options EXPMAX, EXPOLD, and EXPRES can also be used to further limit the amount of storage available to memory object sorting applications. EXPMAX limits the total amount of available storage that can be used at any one time to back DFSORT Hiperspaces, memory objects, and data spaces. EXPOLD limits the total amount of old storage that can be used at any one time to back DFSORT Hiperspaces, memory objects, and data spaces. EXPRES sets aside a specified amount of available storage for use by non-Hipersorting, non-memory object sorting, and non-dataspace sorting applications.

Some of these limits depend on system and other DFSORT activity during the time that a memory object sorting application runs. Consequently, the total amount of memory object storage that a memory object sorting application uses can vary from run to run.

MOSIZE=n specifies a fixed value for MOSIZE. MOSIZE=p% specifies a value for MOSIZE that varies as a percentage of the available central storage on the system at run-time. If the available central storage on a system changes, MOSIZE=p% will cause a corresponding change in the MOSIZE value selected by DFSORT, whereas MOSIZE=n will not. When sharing DFSORT installation options between systems, such as in a sysplex, MOSIZE=p% can be used to tailor the MOSIZE value to the system selected for the application, providing a more dynamic MOSIZE value than MOSIZE=n.
OPTION Control Statement

If the total memory object storage available for memory object sorting is insufficient for temporary storage of the records, intermediate disk storage can be used along with the memory object. When memory object sorting is enabled, DFSORT changes DYNAUTO=NO to DYNAUTO=YES in some cases.

**MAX** specifies that DFSORT determines dynamically the maximum size of a memory object to be used for memory object sorting. In this case, DFSORT bases its memory object usage on the size of the file being sorted and the central storage usage activity.

**n** specifies that DFSORT determines dynamically the maximum size of a memory object to be used for memory object sorting, subject to a limit of n MB. n must be a value between 0 and 2147483646. The actual size used does not exceed n, but may be less, depending on the size of the file being sorted and the central storage usage activity on the system. If n is 0, memory object sorting is not used.

**p%** specifies that DFSORT determines dynamically the maximum size of a memory object to be used for memory object sorting, subject to a limit of p percent of the available central storage. p must be a value between 0 and 100. If p is 0, memory object sorting is not used. The value calculated for p% is limited to 2147483646 MB, and is rounded down to the nearest MB.


**MOWRK or NOMOWRK**

Temporarily overrides the MOWRK installation option, which specifies whether the memory object storage available to DFSORT for memory object sorting can be used as intermediate work space. DFSORT has the capability of using memory object storage as intermediate work space (similar to the way Hiperspace is used but more efficient), or as an extension of main storage. Using memory object storage as intermediate work space is the preferred and recommended choice, but can be disabled, if appropriate.

**MOWRK** specifies that memory object storage can be used as intermediate work space, or as an extension of main storage, as appropriate.

**NOMOWRK** specifies that memory object storage can only be used as an extension of main storage.


OPTION Control Statement

MSGDDN

```
>> MSGDDN=ddname
```

Temporarily overrides the MSGDDN installation option, which specifies an alternate ddname for the message data set. MSGDDN must be in effect if:

- A program that invokes DFSORT uses SYSOUT (for instance, COBOL uses SYSOUT) and you do not want DFSORT messages intermixed with the program messages.
- Your E15 and E35 routines are written in COBOL and you do not want DFSORT messages intermixed with the program messages.
- A program invokes DFSORT more than once and you want separate messages for each invocation of DFSORT.

The ddname can be any 1- through 8- character name but must be unique within the job step; do not use a name that is used by DFSORT (for example, SORTIN). If the ddname specified is not available at run-time, SYSOUT is used instead. For details on use of the message data set, see "z/OS DFSORT Messages, Codes and Diagnosis Guide".

**Note:** MSGDDN is processed only if it is passed on the OPTION control statement in an extended parameter list or in DFSPARM.

**Default:** Usually the installation default. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.

**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT Options,” on page 857.

MSGPRT

```
>> MSGPRT= ALL
       CRITICAL
       NONE
```

Temporarily overrides the MSGPRT installation option, which specifies the class of messages to be written to the message data set. For details on use of the message data set, see "z/OS DFSORT Messages, Codes and Diagnosis Guide".

**ALL** specifies that all messages except diagnostic messages (ICE800I to ICE999I) are to be printed. Control statements print only if LIST is in effect.

**CRITICAL** specifies that only critical messages will be printed. Control statements print only if LIST is in effect.

**NONE** specifies that no messages and control statements will be printed.
OPTION Control Statement

Notes:
1. MSGPRT is processed only if it is passed on the OPTION control statement in an extended parameter list or in DFSPARM.
2. PRINT=value can be used instead of MSGPRT=value.


NOBLKSET

Causes DFSORT to bypass the Blockset technique normally used for a sort or merge application. Using this option generally results in degraded performance.

Note: Functions such as OUTFIL processing, which are supported only by the Blockset technique, cause the NOBLKSET option to be ignored.


NOOUTREL

Temporarily overrides the OUTREL installation option, which specifies whether unused temporary output data set space is released. NOOUTREL means that unused temporary output data set space is not released.


NOOUTSEC
OPTION Control Statement

Temporarily overrides the OUTSEC installation option, which specifies whether automatic secondary allocation is used for temporary or new output data sets. NOOUTSEC means that automatic secondary allocation for output data sets is not used.


**NULLOUT**

Temporarily overrides the NULLOUT installation option, which specifies the action to be taken by DFSORT when there are no records for the SORTOUT data set, as indicated by an OUT count of 0 in message ICE054I

**RC0**
- specifies that DFSORT should issue message ICE173I, set a return code of 0, and continue processing when there are no records for the SORTOUT data set.

**RC4**
- specifies that DFSORT should issue message ICE173I, set a return code of 4, and continue processing when there are no records for the SORTOUT data set.

**RC16**
- specifies that DFSORT should issue message ICE206A, terminate, and give a return code of 16 when there are no records for the SORTOUT data set.

*Notes:*
1. The return code of 0 or 4 set when there are no records for the SORTOUT data set can be overridden by a higher return code set for some other reason.
2. NULLOUT does not apply when SORTOUT is not present, when tape work data sets are specified for a sort application, or when the Blockset technique is not selected for a merge application. DFSORT does not check if there are no records for the SORTOUT data set in these cases.
3. NULLOUT applies to the SORTOUT data set. NULLOFL on the OUTFIL statement applies to OUTFIL data sets.
4. For an ICEGENER application, NULLOUT applies to the SYSUT2 data set if DFSORT copy is used. Note that ICEGENER passes back return code 12 instead of return code 16.


OPTION Control Statement

**ODMAXBF**

Temporarily overrides the ODMAXBF installation option, which specifies the maximum buffer space DFSORT can use for each OUTFIL data set. The actual amount of buffer space used for a particular OUTFIL data set will not exceed the ODMAXBF limit, but can be less than the limit. OUTFIL processing is supported by the Blockset technique for sort, copy, and merge applications.

The storage used for OUTFIL processing is adjusted automatically according to the total storage available, the storage needed for non-OUTFIL processing, and the number of OUTFIL data sets and their attributes (for example, block size). OUTFIL processing is subject to the ODMAXBF limit in effect and the system storage limits (for example, IEFUSI), but not to the DFSORT storage limits (that is, SIZE, MAXLIM, and TMAXLIM). DFSORT attempts to use storage above 16MB virtual for OUTFIL processing whenever possible.

Lowering ODMAXBF below 2M can cause performance degradation for the application, but may be necessary if you consider the amount of storage used for OUTFIL processing to be a problem. Raising ODMAXBF can improve EXCPs for the application but can also increase the amount of storage needed.

- **n** specifies that a maximum of n bytes of buffer space is to be used for each OUTFIL data set. If you specify less than 262144, 262144 is used. If you specify more than 16777216, 16777216 is used.
  - Limit: 8 digits
- **nK** specifies that a maximum of n times 1024 bytes of buffer space is to be used for each OUTFIL data set. If you specify less than 256K, 256K is used. If you specify more than 16384K, 16384K is used.
  - Limit: 5 digits
- **nM** specifies that a maximum of n times 1048576 bytes of buffer space is to be used for each OUTFIL data set. If you specify 0M, 256K is used. If you specify more than 16M, 16M is used.
  - Limit: 2 digits


**OVFLO**

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OPTION Control Statement

Temporarily overrides the OVFLO installation option, which specifies the action to be taken by DFSORT when BI, FI, PD or ZD summary fields overflow.

RC0
specifies that DFSORT should issue message ICE152I (once), set a return code of 0 and continue processing when summary fields overflow. The pair of records involved in a summary overflow is left unsummed and neither record is deleted. Summary overflow does not prevent further summation.

RC4
specifies that DFSORT should issue message ICE152I (once), set a return code of 4 and continue processing when summary fields overflow. The pair of records involved in a summary overflow is left unsummed and neither record is deleted. Summary overflow does not prevent further summation.

RC16
specifies that DFSORT should issue message ICE195A, terminate and give a return code of 16 when summary fields overflow.

Note: The return code of 0 or 4 set for summary overflow can be overridden by a higher return code set for some other reason.


PAD

Temporarily overrides the PAD installation option, which specifies the action to be taken by DFSORT when the SORTOUT LRECL is larger than the SORTIN/SORTINnn LRECL, for the cases where DFSORT allows LRECL padding.

RC0
specifies that DFSORT should issue message ICE171I, set a return code of 0 and continue processing when the SORTOUT LRECL is larger than the SORTIN/SORTINnn LRECL.

RC4
specifies that DFSORT should issue message ICE171I, set a return code of 4 and continue processing when the SORTOUT LRECL is larger than the SORTIN/SORTINnn LRECL.

RC16
specifies that DFSORT should issue message ICE196A, terminate and give a return code of 16 when the SORTOUT LRECL is larger than the SORTIN/SORTINnn LRECL.
OPTION Control Statement

Notes:
1. The return code of 0 or 4 set for LRECL padding can be overridden by a higher return code set for some other reason.
2. For an ICEGENER application, the GNPAD value is used and the PAD value is ignored.
3. For some LRECL padding situations (for example, a tape work data set sort), DFSORT issues ICE043A and terminates with a return code of 16. The PAD value has no effect in these cases.
4. DFSORT does not check for LRECL padding if:
   a. A SORTIN DD (sort/copy), SORTINnn DD (merge) or SORTOUT DD is not present
   b. A SORTIN DD (sort/copy), SORTINnn DD (merge) or SORTOUT DD specifies a VSAM data set.
5. DFSORT does not check OUTFIL data sets for LRECL padding.


RESALL

Temporarily overrides the RESALL installation option, which specifies the number of bytes to be reserved in a REGION for system use. Usually, only 4K bytes (the standard default) of main storage must be available in a region for system use. However, in some cases, this may not be enough; for example, if your installation does not have BSAM/QSAM modules resident, you have user exits that open data sets, or you have COBOL exits. RESALL is used only when MAINSIZE/SIZE=MAX is in effect.

RESALL applies only to the amount of main storage below 16MB virtual. The ARESALL option applies to the amount of main storage above 16MB virtual.

n specifies that n bytes of storage are to be reserved. If you specify less than 4096, 4096 is used.
Limit: 8 digits.

nK specifies that n times 1024 bytes of storage are to be reserved. If you specify less than 4K, 4K is used.
Limit: 5 digits.

nM specifies that n times 1048576 bytes of storage are to be reserved. If you specify 0M, 4K is used.
Limit: 2 digits.

Tip: A better way to reserve the required storage for user exits activated by the MODS statement is to use the m parameter of the MODS statement.
OPTION Control Statement

**RESET or NORESET**

Temporarily overrides the RESET installation option, which specifies whether DFSORT should process a VSAM output data set defined with REUSE as a NEW or MOD data set.

**RESET** specifies that DFSORT processes a VSAM output data set defined with REUSE as a NEW data set. The high-used RBA is reset to zero and the output data set is effectively treated as an initially empty cluster.

**NORESET** specifies that DFSORT processes a VSAM output data set defined with REUSE as a MOD data set. The high-used RBA is not reset and the output data set is effectively treated as an initially non-empty cluster.

**Note:** A VSAM output data set defined without REUSE is processed as a MOD data set.

**RESINV**

Temporarily overrides the RESINV installation option, which specifies the number of bytes to be reserved in a REGION for the invoking program. RESINV is used only when DFSORT is dynamically invoked and MAINSIZE/SIZE=MAX is in effect.

RESINV applies only to the amount of main storage below 16MB virtual. The ARESINV option applies to the amount of main storage above 16MB virtual.

This extra space is usually required for data handling by the invoking program or user exits while DFSORT is running (as is the case with some PL/I- and COBOL- invoked sort applications). Therefore, if your invoking program’s user exits do not perform data set handling, you do not need to specify this parameter. The reserved space is not meant to be used for the invoking program’s executable code.
OPTION Control Statement

The amount of space required depends upon what routines you have, how the data is stored, and which access method you use.

\[ n \] specifies that \( n \) bytes of storage are to be reserved.

Limit: 8 digits

\[ nK \] specifies that \( n \) times 1024 bytes of storage are to be reserved.

Limit: 5 digits

\[ nM \] specifies \( n \) times 1048576 bytes of main storage are to be reserved.

Limit: 2 digits.

Tip: A better way to reserve the required storage for user exits activated by the MODS statement is to use the \( m \) parameter of the MODS statement.

Default: 


SDB

Temporarily overrides the SDB installation option, which specifies whether DFSORT should use the system-determined optimum block size for output data sets when the block size is specified as zero or defaulted to zero. System-determined block size applies to both SMS-managed and non-SMS-managed data sets and results in the most efficient use of space for the device on which the output data set resides.

DFSORT can select system-determined optimum block sizes greater than 32760 bytes for tape output data sets.

If you want DFSORT to use system-determined block sizes for disk and tape output data sets, specify one of the following values:

- \( \text{SDB}=\text{LARGE} \) if you want to allow DFSORT to select tape output block sizes greater than 32760 bytes.
- \( \text{SDB}=\text{YES} \) (or its alias \( \text{SDB}=\text{SMALL} \)) if you want DFSORT to select tape output block sizes less than or equal to 32760 bytes.
- \( \text{SDB}=\text{INPUT} \) if you want to allow DFSORT to select tape output block sizes greater than 32760 bytes only when tape input data sets with block sizes greater than 32760 bytes are used.

DFSORT will not select a tape output block size greater than the BLKSZLIM in effect. In particular, if a default BLKSZLIM of 32760 is in effect, DFSORT will not select a tape output block size greater than 32760 bytes. Therefore, in order to allow DFSORT to select tape output block sizes greater than 32760 bytes for particular jobs, you may need to ensure that your JCL or data class supplies appropriately large BLKSZLIM values (for example, 1GB) for those jobs.
OPTION Control Statement

If you don’t want DFSORT to use system-determined block sizes, specify SDB=NO (not recommended as an installation option).

**LARGE**

describes how DFSORT is to use the system-determined optimum block size for an output data set when its block size is zero. SDB=LARGE allows DFSORT to select a block size greater than 32760 bytes for a tape output data set, when appropriate. A larger tape block size can improve elapsed time and tape utilization, but you must ensure that applications which subsequently use the resulting tape data set can handle larger block sizes.

DFSORT selects the system-determined optimum block size as follows:

- For a disk output data set, the optimum block size for the device used is selected based on the obtained or derived RECFM and LRECL for the output data set. The maximum block size for disk output data sets is 32760 bytes.
- For a tape output data set, the optimum block size is selected based on the obtained or derived RECFM and LRECL for the output data set, as shown in Table 33.

**Table 33. SDB=LARGE Block Sizes for Tape Output Data Sets**

<table>
<thead>
<tr>
<th>RECFM</th>
<th>BLKSIZE is set to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>F or FS</td>
<td>LRECL</td>
</tr>
<tr>
<td>FB or FBS</td>
<td>Highest possible multiple of LRECL that is less than or equal to the optimum block size for the device, subject to the BLKSZLIM in effect.</td>
</tr>
<tr>
<td>V, D, VS, or DS</td>
<td>LRECL + 4</td>
</tr>
<tr>
<td>VB, DB, VBS, or DBS</td>
<td>Optimum block size for the device, subject to the BLKSZLIM in effect.</td>
</tr>
</tbody>
</table>

DFSORT uses the system-determined optimum block size for the output data set in most cases when the block size is zero. However, the following conditions prevent DFSORT from using the system-determined block size:

- Output data set block size is available (that is, non-zero) in the JFCB (disk or tape) or format 1 DSCB (disk) or tape label (only for DISP=MOD with AL, SL, or NSL label, when appropriate)
- Output is a spool, dummy, VSAM, or unmovable data set, or a z/OS UNIX file.
- The output data set is on tape with a label type of AL
- DFSORT’s Blockset technique is not selected.

In the above cases, DFSORT uses the specified block size, or determines an appropriate (though not necessarily optimum) block size for the output data set. The selected block size is limited to 32760 bytes.

**YES**

describes how DFSORT is to use the system-determined optimum block size for an output data set when its block size is zero, but is to limit the selected block size to a maximum of 32760 bytes. See the discussion of SDB=LARGE for more information; the only difference between SDB=LARGE and SDB=YES is that SDB=LARGE allows block sizes greater than 32760 bytes for tape output data sets, whereas SDB=YES does not.

**INPUT**

describes how DFSORT is to use the system-determined optimum block size.
for an output data set when its block size is zero, but is to limit the
selected block size to a maximum of 32760 bytes if the input block size is
less than or equal to 32760 bytes. Thus, SDB=INPUT works like
SDB=LARGE if the input block size is greater than 32760 bytes (only
possible for tape input data sets) and works like SDB=YES if the input
block size is less than or equal to 32760 bytes. See the discussions of
SDB=LARGE and SDB=YES for more information.

**NO** specifies that DFSORT is not to use the system-determined optimum block
size. When the output data set block size is zero, DFSORT selects an
appropriate (though not necessarily optimum) block size for the output
data set based on the obtained or derived output or input attributes.
SDB=NO limits the selected block sizes to a maximum of 32760 bytes.
SDB=NO works like SDB=YES if the input block size is greater than 32760
bytes (only possible for tape input data sets). See the discussion of
SDB=YES for more information.

**Notes:**
1. SDB=NO does not prevent the use of system-determined block size for the
   output data set at allocation or in other cases where the output data set
   block size is set before DFSORT gets control.
2. When DFSORT uses system-determined block size, the selected output data
   set block size may be different from the block size selected previously.
   Applications that require a specific output data set block size should be
   changed to specify that block size explicitly.
3. SDB and SDB=SMALL can be used instead of SDB=YES. NOSDB can be
   used instead of SDB=NO.

**Default:** Usually the installation default. See Appendix B, “Specification/
Override of DFSORT Options,” on page 857 for full override details.

**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT
Options,” on page 857.

**SIZE**
See FILSZ.

**SKIPREC**

```
  SKIPREC=z
```

Specifies the number of records z you want to skip (delete) before starting to
sort or copy the input data set. SKIPREC is usually used if, on a preceding
DFSORT run, you have processed only part of the input data set.

An application with an input data set that exceeds intermediate storage
capacity usually terminates unsuccessfully. However, for a tape work data set
sort, you can use a routine at E16 (as described in Chapter 5, “Using Your Own
User Exit Routines,” on page 489) to instruct the program to sort only those
records already read in. It then prints a message giving the number of records
sorted. You can use SKIPREC in a subsequent sort run to bypass the
previously-sorted records, sort only the remaining records, and then merge the
output from different runs to complete the application.

z specifies the number of records to be skipped.
OPTION Control Statement

Limit: 28 digits (15 significant digits)

Notes:
1. SKIPREC applies only to records read from SORTIN (not from E15 routines). (See Figure 2 on page 9.)
2. If SKIPREC=0 is in effect, SKIPREC is not used.
3. You may want to consider using the STARTREC parameter of the OUTFIL statement as an alternative to using SKIPREC.


SMF

Temporarily overrides the SMF installation option, which specifies whether a DFSORT SMF record is to be produced as described in z/OS DFSORT Installation and Customization.

SHORT specifies that DFSORT is to produce a short SMF type-16 record for a successful run. The short SMF record does not contain record-length distribution statistics or data set sections.

FULL specifies that DFSORT is to produce a full SMF type-16 record for a successful run. The full SMF record contains the same information as the short record, as well as record-length distribution and data set sections, as appropriate.

NO specifies that DFSORT is not to produce an SMF type-16 record for this run.

Notes:
1. SMF is processed only if it is passed on the OPTION control statement in an extended parameter list or in DFSPARM.
2. SMF=FULL can degrade performance for a variable-length record application.
3. The DFSORT SVC is called to write SMF type-16 records. If SMF=SHORT or SMF=FULL is in effect, the correct DFSORT SVC for this release must be loaded in LPA or MLPA.


SOLRF or NOSOLRF
OPTION Control Statement

Temporarily overrides the SOLRF installation option, which specifies whether DFSORT should set the SORTOUT LRECL to the reformatted record length when the SORTOUT LRECL is unknown.

**SOLRF** specifies that DFSORT should use the reformatted record length for the SORTOUT LRECL when the SORTOUT LRECL is not specified or available. DFSORT will use one of the following for the SORTOUT LRECL, in the order listed:

1. The SORTOUT LRECL if available from the JFCB, format 1 DSCB, DFSMSrmm, ICETPEX, or tape label
2. The L3 length if specified in the RECORD statement
3. The OUTREC length if the OUTREC statement is specified
4. The INREC length if the INREC statement is specified
5. The L2 length if specified in the RECORD statement providing an E15 user exit is present
6. The SORTIN or SORTINnn LRECL if available from the JFCB, format 1 DSCB, DFSMSrmm, ICETPEX, or tape label
7. The L1 length in the RECORD statement

**NOSOLRF** specifies that DFSORT should not use the reformatted record length for the SORTOUT LRECL. DFSORT will use one of the following for the SORTOUT LRECL, in the order listed:

1. The SORTOUT LRECL if available from the JFCB, format 1 DSCB, DFSMSrmm, ICETPEX, or tape label
2. The L3 length if specified in the RECORD statement providing an E35 exit, OUTREC statement or INREC statement is present
3. The L2 length if specified in the RECORD statement providing an E15 user exit is present
4. The SORTIN or SORTINnn LRECL if available from the JFCB, format 1 DSCB, DFSMSrmm, ICETPEX, or tape label
5. The L1 length in the RECORD statement

**Notes:**

1. With SOLRF in effect (the IBM-supplied default), DFSORT sets the SORTOUT LRECL to the INREC or OUTREC record length when appropriate, which is usually what you want when you use INREC or OUTREC. If you want DFSORT to use the input length for the SORTOUT LRECL even when INREC or OUTREC is present, you can use NOSOLRF, but be aware that this can cause padding or truncation of the reformatted records, or termination.

2. CAOUTREC can be used instead of SOLRF.

**Default:** Usually the installation default. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.

**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT Options,” on page 857.
OPTION Control Statement

SORTDD

Specifies a four-character prefix for the ddnames to be used when you
dynamically invoke DFSORT more than once in a program step. The four
characters replace “SORT” in the following ddnames: SORTIN, SORTOUT,
SORTINn, SORTINnn, SORTOFd, SORTOFdd, SORTWKd, SORTWKdd,
SORTJNF1, SORTJNF2 and SORTCNTL. This allows you to use a different set
of ddnames for each call to DFSORT.

cccc
Specifies a four-character prefix. The four characters must all be
alphanumeric or national ($, #, or @). The first character must be
alphabetic. The first three characters must not be SYS.

For example, if you use ABC# as replacement characters, DFSORT uses DD
statements ABC#IN, ABC#CNTL, ABC#WKdd, and ABC#OUT instead of
SORTIN, SORTCNTL, SORTWKdd, and SORTOUT.

Notes:
1. SORTDD is processed only if it is passed on the OPTION control statement
   in an extended parameter list, or in DFSPARM.
2. If both SORTIN=ddname and SORTDD=cccc are specified, ddname is used
   for DFSORT input.
3. If both SORTOUT=ddname and SORTDD=cccc are specified, ddname is
   used for DFSORT output.
4. If both MERGEIN=(ddname1,ddname2,...) and SORTDD=cccc are specified,
   ddname1, ddname2, and so on are used for DFSORT input.

Default: SORT. See Appendix B, “Specification/Override of DFSORT Options,”
on page 857 for full override details.

Applicable Functions: See Appendix B, “Specification/Override of DFSORT
Options,” on page 857.

SORTIN

Specifies a ddname to be associated with the SORTIN data set. This allows you
to dynamically invoke DFSORT more than once in a program step, passing a
different ddname for each input data set.

The ddname can be 1 through 8 characters, but must be unique within the job
step. Do not use ddnames reserved for use by DFSORT, such as ccccWKd,
ccccWKdd, ccccDKd, or ccccDKdd , where cccc is the specified or defaulted
value for the SORTDD operand and d is any character.
OPTION Control Statement

Notes:
1. SORTIN is processed only if it is passed on the OPTION control statement in an extended parameter list, or in DFSPARM.
2. If both SORTIN=ddname and SORTDD=cccc are specified, ddname is used for the input file. The same ddname cannot be specified for SORTIN and SORTOUT, or for MERGEIN and SORTOUT.
3. If SORTIN is used for a tape work data set sort, DFSORT terminates.

Default: SORTIN, unless SORTDD=cccc is specified in which case ccccIN is the default. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.


SORTOUT

-SORTOUT=ddname

Specifies a ddname to be associated with the SORTOUT data set or with an OUTFIL data set for which FNAMES and FILES are not specified. This allows you to dynamically invoke DFSORT more than once in a program step, passing a different ddname for each output data set.

The ddname can be 1 through 8 characters, but must be unique within the job step. Do not use ddnames reserved for use by DFSORT, such as cccWKd, cccWKdd, ccccDkdd, or ccccDKdd, where cccc is the specified or defaulted value for the SORTDD operand and d is any character.

Notes:
1. SORTOUT is processed only if it is passed on the OPTION control statement in an extended parameter list or in DFSPARM.
2. If both SORTOUT=ddname and SORTDD=cccc are specified, ddname is used for the output file. The same ddname cannot be specified for SORTIN and SORTOUT, or for MERGEIN and SORTOUT.
3. If SORTOUT is specified for a conventional merge or for a tape work data set sort, DFSORT terminates.

Default: SORTOUT, unless SORTDD=cccc is specified, in which case ccccOUT is the default. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.


SPANINC

-SPANINC= RC0
-RC4  RC16

OPTION Control Statement

Notes:
1. SORTIN is processed only if it is passed on the OPTION control statement in an extended parameter list, or in DFSPARM.
2. If both SORTIN=ddname and SORTDD=cccc are specified, ddname is used for the input file. The same ddname cannot be specified for SORTIN and SORTOUT, or for MERGEIN and SORTOUT.
3. If SORTIN is used for a tape work data set sort, DFSORT terminates.

Default: SORTIN, unless SORTDD=cccc is specified in which case ccccIN is the default. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.

OPTION Control Statement

Temporarily overrides the SPANINC installation option, which specifies the action to be taken by DFSORT when one or more incomplete spanned records are detected in a variable spanned input data set.

**RC0**
specifies that DFSORT should issue message ICE197I (once), set a return code of 0 and eliminate all incomplete spanned records it detects. Valid records will be recovered.

**RC4**
specifies that DFSORT should issue message ICE197I (once), set a return code of 4 and eliminate all incomplete spanned records it detects. Valid records will be recovered.

**RC16**
specifies that DFSORT should issue message ICE204A, terminate and give a return code of 16 when an incomplete spanned record is detected.

**Notes:**
1. The return code of 0 or 4 set for incomplete spanned records can be overridden by a higher return code set for some other reason.
2. In cases where a spanned record cannot be properly assembled (for example, it has a segment length less than 4 bytes), DFSORT issues ICE141A and terminates with a return code of 16. The SPANINC value has no effect in these cases.


**STOPAFT**

```
<<<<STOPAFT=n
```

Specifies the maximum number of records (n) you want accepted for sorting or copying (that is, read from SORTIN or inserted by E15 and not deleted by SKIPREC, E15, or the INCLUDE/OMIT statement). When n records have been accepted, no more records are read from SORTIN; E15 continues to be entered as if EOF were encountered until a return code of 8 is sent, but no more records are inserted. If end-of-file is encountered before n records are accepted, only those records accepted up to that point are sorted or copied.

n  specifies the maximum number of records to be accepted.

Limit: 28 digits (15 significant digits)

*Default:* None; optional. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.


**SZERO or NOSZERO**
OPTION Control Statement

Temporarily overrides the SZERO installation option, which specifies whether DFSORT should treat numeric −0 and +0 values as signed (that is, different) or unsigned (that is, the same) for collation, comparisons, editing and conversions, minimums and maximums. The following DFSORT control statements are affected by this option: INCLUDE, INREC, MERGE, OMIT, OUTFIL, OUTREC and SORT.

**SZERO** specifies that DFSORT should treat numeric zero values as signed. −0 and +0 are treated as different values, that is, −0 is treated as a negative value and +0 is treated as a positive value. SZERO affects DFSORT processing of numeric values as follows:

- For collation of SORT and MERGE fields, −0 collates before +0 in ascending order and after +0 in descending order.
- For comparisons of INCLUDE, OMIT, and OUTFIL compare fields and constants, −0 compares as less than +0.
- For editing and conversions of INREC, OUTREC, and OUTFIL reformatting fields, decimal constants, and the results of arithmetic expressions, −0 is treated as negative and +0 is treated as positive.
- For minimums and maximums of OUTFIL TRAILERx fields, −0 is treated as negative and +0 is treated as positive.

**NOSZERO** specifies that DFSORT should treat numeric zero values as unsigned. −0 and +0 are treated as the same value, that is, −0 and +0 are both treated as positive values. NOSZERO affects DFSORT processing of numeric values as follows:

- For collation of SORT and MERGE fields, −0 collates equally with +0.
- For comparisons of INCLUDE, OMIT and OUTFIL compare fields and constants, −0 compares as equal to +0.
- For editing and conversions of INREC, OUTREC, and OUTFIL reformatting fields, decimal constants, and the results of arithmetic expressions, −0 and +0 are treated as positive.
- For minimums and maximums of OUTFIL TRAILERx fields, −0 and +0 are treated as positive.

**Note:** OPTION SZERO or OPTION NOSZERO is ignored for OUTFIL INCLUDE and OMIT, and INREC, OUTREC, and OUTFIL WHEN, BEGIN and END, if the OPTION statement is "found" after the INREC, OUTREC, or OUTFIL statement. To avoid this, specify SZERO or NOSZERO as an EXEC/DFSPARM PARM option, or in an OPTION statement before the INREC, OUTREC, or OUTFIL statement in the same source, for example:

```
//SYSIN DD *
OPTION NOSZERO,COPY
OUTFIL INCLUDE=(...) /*
```

**Default:** Usually, the installation default. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.
OPTION Control Statement


TRUNC

<table>
<thead>
<tr>
<th>TRUNC</th>
<th>RC0</th>
<th>RC4</th>
<th>RC16</th>
</tr>
</thead>
</table>

Temporarily overrides the TRUNC installation option, which specifies the action to be taken by DFSORT when the SORTOUT LRECL is smaller than the SORTIN/SORTINnn LRECL, for the cases where DFSORT allows LRECL truncation.

**RC0**
- specifies that DFSORT should issue message ICE171I, set a return code of 0 and continue processing when the SORTOUT LRECL is smaller than the SORTIN/SORTINnn LRECL.

**RC4**
- specifies that DFSORT should issue message ICE171I, set a return code of 4 and continue processing when the SORTOUT LRECL is smaller than the SORTIN/SORTINnn LRECL.

**RC16**
- specifies that DFSORT should issue message ICE196A, terminate and give a return code of 16 when the SORTOUT LRECL is smaller than the SORTIN/SORTINnn LRECL.

Notes:
1. The return code of 0 or 4 set for LRECL truncation can be overridden by a higher return code set for some other reason.
2. For an ICEGENER application, the GNTRUNC value is used and the TRUNC value is ignored.
3. For some LRECL truncation situations (for example, a tape work data set sort), DFSORT issues ICE043A and terminates with a return code of 16. The TRUNC value has no effect in these cases.
4. DFSORT does not check for LRECL truncation if:
   a. A SORTIN DD (sort/copy), SORTINnn DD (merge) or SORTOUT DD is not present
   b. A SORTIN DD (sort/copy), SORTINnn DD (merge) or SORTOUT DD specifies a VSAM data set.
5. DFSORT does not check OUTFIL data sets for LRECL truncation.


USEWKDD
OPTION Control Statement

Temporarily overrides the DYNAUTO=IGNWKDD option, which specifies that dynamic work data sets are used even if SORTWKdd DD statements are present. This option allows JCL SORTWKdd data sets to be used rather than deallocated.

**Note:** USEWKDD is processed only if it is passed on the OPTION control statement in an extended parameter list or in DFSPARM.


**VERIFY or NOVERIFY**

Temporarily overrides the VERIFY installation option, which specifies whether sequence checking of the final output records must be performed.

**VERIFY** specifies that sequence checking is performed.

**NOVERIFY** specifies that sequence checking is not performed.

**Notes:**
1. Using VERIFY can degrade performance.
2. SEQ=YES can be used instead of VERIFY, SEQ=NO can be used instead of NOVERIFY.


**VLLONG or NOVLLONG**

Temporarily overrides the VLLONG installation option, which specifies whether DFSORT is to truncate “long” variable-length output records. A long output record is one whose length is greater than the LRECL of the SORTOUT or OUTFIL data set it is to be written to.
OPTION Control Statement

VLLONG is not meaningful for fixed-length output record processing.

**VLLONG** specifies that DFSORT truncates long variable-length output records to the LRECL of the SORTOUT or OUTFIL data set.

**NOVLLONG** specifies that DFSORT terminates if a long variable-length output record is found.

**Notes:**

1. **VLLONG** should not be used unless you want the data at the end of long variable-length output records to be truncated for your DFSORT application; inappropriate use of **VLLONG** can result in unwanted loss of data.
2. **VLLONG** can be used to truncate long OUTFIL data records, but has no effect on long OUTFIL header or trailer records.


**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT Options,” on page 857.

VLSCMP or NOVLSCMP

Temporarily overrides the VLSCMP installation option, which specifies whether DFSORT is to pad "short" variable-length INCLUDE/OMIT compare fields with binary zeros. A short field is one where the variable-length record is too short to contain the entire field, that is, the field extends beyond the record. **VLSCMP** and **NOVLSCMP** apply to the INCLUDE and OMIT statements and to the INCLUDE and OMMIT parameters of the OUTFIL statement.

The compare fields are only padded temporarily for testing; they are not actually changed for output.

**VLSCMP** is not meaningful for fixed-length record processing.

The settings for **VLSCMP/NOVLSCMP** and **VLSHRT/NOVLSHRT** provide three levels of processing for short INCLUDE/OMIT fields in the following hierarchy:

1. **VLSCMP** allows all of the INCLUDE/OMIT comparisons to be performed even if some fields are short. Because short fields are padded with binary zeros, comparisons involving short fields are false (unless a test against binary zero is relevant, as discussed below). Comparisons involving non-short fields can be true or false.
2. **NOVLSCMP** and **VLSHRT** treat the entire INCLUDE/OMIT logical expression as false if any field is short. Thus comparisons involving non-short fields are ignored if any comparison involves a short field.
3. **NOVLSCMP** and **NOVLSHRT** result in termination if any field is short.

To illustrate how this works, suppose the following INCLUDE statement is used:

```
INCLUDE COND=(6,1,CH,EQ,C'1',OR,70,2,CH,EQ,C'T1')
```
If a variable-length input record has a length less than 71 bytes, the field at bytes 70-71 is short and the following occurs:

- With VLSCMP, the record is included if byte 6 of the input record is C’1’ or omitted if byte 6 is not C’1’. The comparison of bytes 70-71 equal to C’T1’ is false because bytes 70-71 contain either X’hh00’ (for a record length of 70 bytes) or X’0000’ (for a record length of less than 70 bytes). The comparison involving the non-short field is performed even though a short field is present.

- With NOVLSCMP and VLSHRT, the record is omitted because any short field makes the entire logical expression false. The comparison involving the non-short field is not performed because a short field is present.

- With NOVLSCMP and NOVLSHRT, DFSORT terminates because any short field results in termination.

In general, comparisons involving short fields are false with VLSCMP. However, if a binary zero value is relevant to the comparison, the use of binary zeros for padding might make the comparison true. For example, suppose the following INCLUDE statement is used:

```
INCLUDE COND=(21,2,CH,EQ,C'JX', OR,
(55,2,CH,EQ,58,2,CH,AND,
  70,1,BI,LT,X'08'))
```

If a variable-length input record has a length less than 70 bytes, the field at byte 70 is short and is padded to X'00'. This makes the comparison of byte 70 less than X'08' true even though byte 70 is a short field and so probably irrelevant.

Likewise, if a variable-length record has a length less than 55 bytes, the fields at bytes 55-56 and 58-59 are short and are each padded to X'0000', and the field at byte 70 is short and is padded to X'00'. This makes the comparison of bytes 55-56 equal to 58-59 true and the comparison of byte 70 less than X'08' true even though all three fields are short and probably irrelevant.

In such cases where padding of short fields with binary zeros may result in unwanted true comparisons, you can get the result you want by adding an appropriate check of the record length to the INCLUDE/OMIT logical expression, such as:

```
INCLUDE COND=(21,2,CH,EQ,C'JX', OR,
(1,2,BI,GE,X'0046',AND,
  55,2,CH,EQ,58,2,CH,AND,
  70,1,BI,LT,X'08'))
```

Now the comparisons involving bytes 55-56, 58-59 and 70 can only be true for records that are 70 bytes (X'0046') or longer. Thus, the irrelevant comparisons involving short fields are eliminated.

Keep in mind that short compare fields are padded with zeros when VLSCMP is in effect and code your INCLUDE/OMIT logical expressions to allow for that or even take advantage of it.

- **VLSCMP** specifies that short variable-length compare fields are padded with binary zeros.
- **NOVLSCMP** specifies that short variable-length compare fields are not padded.

OPTION Control Statement


VLSHRT or NOVLSHRT

Temporarily overrides the VLSHRT installation option, which specifies whether DFSORT is to continue processing if a "short" variable-length SORT/MERGE control field, INCLUDE/OMIT compare field, or SUM summary field is found. A short field is one where the variable-length record is too short to contain the entire field, meaning that the field extends beyond the record. VLSHRT applies to the SORT, MERGE, INCLUDE, OMIT and SUM statements, and to the INCLUDE and OMIT parameters of the OUTFIL statement.

VLSHRT processing is not meaningful for fixed-length record processing.

The way in which DFSORT processes short INCLUDE/OMIT compare fields depends on the settings for VLSCMP/NOVLSCMP and VLSHRT/NOVLSHRT. For details, see the discussion of the VLSCMP and NOVLSCMP options.

VLSHRT

specifies that DFSORT continues processing if a short control field, compare field or summary field is found.

NOVLSHRT

specifies that DFSORT terminates if a short control field, compare field or summary field is found.

Notes:

1. VLSHRT is not used if an INREC or OUTREC statement is specified, if you have an EFS01 or EFS02 routine, or if locale processing is used for SORT or MERGE fields. Note that none of these situations prevents the use of VLSCMP.

2. Unlike the OUTREC statement, the OUTREC, BUILD, OVERLAY, FINDREP or IFTHEN parameter of the OUTFIL statement does not force NOVLSHRT. Thus, you can use VLSHRT with OUTFIL to eliminate records with the INCLUDE or OMIT parameter and reformat the remaining records with the OUTREC, BUILD, OVERLAY, FINDREP or IFTHEN parameter. If a short OUTFIL OUTREC or BUILD field is found, DFSORT terminates (even if VLSHRT is in effect) unless the VLFILL=byte parameter of OUTFIL is specified. If a short OUTFIL OVERLAY, FINDREP or IFTHEN field is found, DFSORT pads the missing bytes with blanks so it can be processed.

3. If VLSHRT is in effect and Blockset is selected:
   • DFSORT pads short SORT or MERGE control fields with binary zeros, thus making the order predictable for records with equal control fields of different lengths. The control fields are only padded temporarily for collation; they are not actually changed for output. Padding may increase the amount of work space required.
   • Records with short SUM summary fields are excluded from summation; that is, if either one of a pair of records being summed has a short SUM field, the records are left unsummed and neither record is deleted.

4. If VLSHRT is in effect and Blockset is not selected:
OPTION Control Statement

- DFSORT terminates if the first byte of the first (major) SORT or MERGE control field is not included in the record.
- DFSORT does not pad short SORT or MERGE control fields, thus making the order unpredictable for records with equal control fields of different lengths.
- In certain cases, VLSHRT is not used because of the number and position of the SORT or MERGE control fields.
- EQUALS is not used.

Tip: You can use a SORTDIAG DD statement to force message ICE800I, which gives a code indicating why Blockset could not be used.


VSAMEMT or NVSAMEMT

Temporarily overrides the VSAMEMT installation option, which specifies whether DFSORT should accept an empty VSAM input data set.

VSAMEMT
specifies that DFSORT accepts an empty VSAM input data set and processes it as having zero records.

NVSAMEMT
specifies that DFSORT terminates if an empty VSAM input data set is found.


VSAMIO or NOVSAMIO

Temporarily overrides the VSAMIO installation option, which specifies whether DFSORT should allow a VSAM data set defined with REUSE to be sorted in-place.

VSAMIO
specifies that DFSORT can use the same VSAM data set for input and output when all of the following conditions are met:
- The application is a sort.
**OPTION Control Statement**

- RESET is in effect.
- The VSAM data set was defined with REUSE.

These conditions ensure that the VSAM data set is processed as NEW for output and will contain the sorted input records, that is, it will be sorted in-place.

DFSORT terminates if the same VSAM data set is specified for input and output and any of the above conditions are not met.

**NOVSAMIO**

specifies that DFSORT terminates if the same VSAM data set is used for input and output.


**WRKREL or NOWRKREL**

Temporarily overrides the WRKREL installation option, which specifies whether unused temporary SORTWKdd data set space will be released.

**WRKREL**

specifies that unused space is released.

**NOWRKREL**

specifies that unused space is not released.

**Notes:**

1. If you have dedicated certain volumes for SORTWKdd data sets, and you do not want unused temporary space to be released, you should specify NOWRKREL.
2. If WRKREL is in effect, DFSORT releases space for the SORTWKdd data sets just prior to termination. Space is released only for those SORTWKdd data sets that were used for the sort application.
3. RLS=0 can be used instead of NOWRKREL. RLS=n (n greater than 0) can be used instead of WRKREL.


**WRKSEC or NOWRKSEC**
OPTION Control Statement

Temporarily overrides the WRKSEC installation option, which specifies whether DFSORT uses automatic secondary allocation for temporary JCL SORTWKdd data sets.

WRKSEC

specifies that automatic secondary allocation for temporary JCL SORTWKdd data sets is used and that 25 percent of the primary allocation will be used as the secondary allocation.

NOWRKSEC

specifies that automatic secondary allocation for temporary JCL SORTWKdd data sets is not used.

Note: SEC=0 can be used instead of NOWRKSEC. SEC=n (n greater than 0) can be used instead of WRKSEC.


Y2PAST

Temporarily overrides the Y2PAST installation option, which specifies the sliding (s) or fixed (f) century window. The century window is used with DFSORT’s Y2 formats to correctly interpret two-digit year data values as four-digit year data values.

s specifies the number of years DFSORT is to subtract from the current year to set the beginning of the sliding century window. Because the Y2PAST value is subtracted from the current year, the century window slides as the current year changes. For example, Y2PAST=81 would set a century window of 1925-2024 in 2006 and 1926-2025 in 2007. s must be a value between 0 and 100.

f specifies the beginning of the fixed century window. For example, Y2PAST=1962 would set a century window of 1962-2061. f must be a value between 1000 and 3000.

Note: CENTURY=value and CENTWIN=value can be used instead of Y2PAST=value.


ZDPRINT or NZDPRINT
OPTION Control Statement

Temporarily overrides the ZDPRINT installation option, which specifies whether positive zoned-decimal (ZD) fields resulting from summing must be converted to printable numbers (that is, whether the zone of the last digit should be changed from a hexadecimal C to a hexadecimal F). See "SUM Control Statement" on page 452 for further details on the use of ZDPRINT and NZDPRINT.

**ZDPRINT**

means convert positive ZD summation results to printable numbers. For example, change hexadecimal F3F2C5 (prints as 32E) to F3F2F5 (prints as 325).

**NZDPRINT**

means do not convert positive ZD summation results to printable numbers.

**Note:** ZDPRINT=YES can be used instead of ZDPRINT. ZDPRINT=NO can be used instead of NZDPRINT.

**Default:** Usually the installation default. See Appendix B, "Specification/Override of DFSORT Options," on page 857 for full override details.

**Applicable Function:** See Appendix B, "Specification/Override of DFSORT Options," on page 857.

### Aliases for OPTION Statement Options

For compatibility reasons, the following OPTION statement options can be specified by using the aliases listed below. See the indicated OPTION statement options for complete details.

**Table 34. Aliases for OPTION Statement Options**

<table>
<thead>
<tr>
<th>Alias</th>
<th>OPTION Statement Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAOUTREC</td>
<td>SOLRF</td>
</tr>
<tr>
<td>CENTURY=value</td>
<td>Y2PAST=value</td>
</tr>
<tr>
<td>CENTWIN=value</td>
<td>Y2PAST=value</td>
</tr>
<tr>
<td>CHKPT</td>
<td>CKPT</td>
</tr>
<tr>
<td>CORE=value</td>
<td>MAINSIZE=value</td>
</tr>
<tr>
<td>HIPRLIM=value</td>
<td>HIPRMAX=value</td>
</tr>
<tr>
<td>L5=value</td>
<td>AVGRLEN=value</td>
</tr>
<tr>
<td>NOSDB</td>
<td>SDB=NO</td>
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<td>PRINT=value</td>
<td>MSGPRT=value</td>
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<tr>
<td>RLS=n</td>
<td>WRKREL</td>
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<td>RLS=0</td>
<td>NOWRKREL</td>
</tr>
<tr>
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<td>NOWRKSEC</td>
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<tr>
<td>SEQ=YES</td>
<td>VERIFY</td>
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</table>
Table 34. Aliases for OPTION Statement Options (continued)

<table>
<thead>
<tr>
<th>Alias</th>
<th>OPTION Statement Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEQ=NO</td>
<td>NOVERIFY</td>
</tr>
<tr>
<td>ZDPRINT=YES</td>
<td>ZDPRINT</td>
</tr>
<tr>
<td>ZDPRINT=NO</td>
<td>NZDPRINT</td>
</tr>
</tbody>
</table>

Specifying DFSORT Options or COPY—Examples

Example 1

SORT FIELDS=(1,20,CH,A)
OPTION SIZE=50000,SKIPREC=5,EQUALS,DYNALLOC

FIELDS
The control field begins on the first byte of each record in the input data set, is 20 bytes long, contains character data, and is to be sorted in ascending order.

SIZE
The data set to be sorted contains 50000 records.

SKIPREC
Five records are skipped (deleted) before starting to process the input data set.

EQUALS
The sequence of records that collate identically is preserved from input to output.

DYNALLOC
Two data sets (by default) are allocated on SYSDA (by default). The space on the data set is calculated using the SIZE value in effect.

Example 2

SORT FIELDS=(1,2,CH,A),CKPT
OPTION EQUALS,NOCHALT,NOVERIFY,CHECK

FIELDS
The control field begins on the first byte of each record in the input data set, is 2 bytes long, contains character data, and is to be sorted in ascending order.

CKPT
DFSORT takes checkpoints during this run.

Note: CKPT is ignored if the Blockset technique is used. If checkpoints are required, you must bypass the Blockset technique by specifying the NOBLKSET option, or by specifying installation option IGNCKPT=NO. However, functions such as OUTFIL, which are supported only by the Blockset technique, cannot be used if the Checkpoint/Restart facility is used.

EQUALS
The sequence of records that collate identically is preserved from input to output.

NOCHALT
Only AQ fields are translated through the ALTSEQ translate table. If installation option CHALT=YES was specified, then NOCHALT temporarily overrides it.
OPTION Control Statement

NOVERIFY
No sequence check is performed on the final output records.

CHECK
The record count is checked at the end of program processing.

Example 3
OPTION FILSZ=50,SKIPREC=5,DYNALLOC=3390
SORT FIELDS=(1,2,CH,A),SKIPREC=1,SIZE=200,DYNALLOC=(3380,5)

This example shows how parameters specified on the OPTION control statement override those specified on the SORT control statement, regardless of the order of the two statements.

FILSZ
DFSORT expects 50 records on the input data set. (Note that there is a difference in meaning between FILSZ and SIZE and that the OPTION specification of FILSZ is used in place of SIZE.)

SKIPREC
DFSORT causes five records from the beginning of the input file to be skipped. (SKIPREC=1 on the SORT statement is ignored.)

DYNALLOC
DFSORT allocates two work data sets (by default) on an IBM 3390.

FIELDS
The control field begins on the first byte of each record in the input data set, is 2 bytes long, contains character data, and is to be sorted in ascending order.

Example 4
OPTION NOBLKSET

NOBLKSET
DFSORT does not use the Blockset technique for a sort or merge.

Example 5
OPTION STOPAFT=100

STOPAFT
DFSORT accepts 100 records before sorting or copying.

Example 6
OPTION RESINV=32000,MSGPRT=NONE,
MSGDDN=SORTMSGS,SORTDD=ABCD,SORTIN=MYINPUT,
SORTOUT=MYOUTPUT,NOLIST

This example illustrates the parameters RESINV, MSGPRT, MSGDDN, SORTDD, SORTIN, SORTOUT, and NOLIST, and the actions taken when these parameters are supplied on an OPTION statement read from the SYSIN data set or the SORTCNTL data set. The parameters are recognized, but not used.

RESINV
32000 bytes of storage are reserved for the user.

MSGPRT=NONE The keyword is ignored, and messages are printed according to the installation default.

MSGDDN=SORTMSGs The keyword is ignored, and all messages are written to the SYSOUT data set.

SORTDD=ABCD The keyword is ignored, and the standard prefix SORT is used.
OPTION Control Statement

SORTIN=MYINPUT
The keyword is ignored, and the ddname SORTIN is used to reference the input data set.

SORTOUT=MYOUTPUT
The keyword is ignored, and the ddname SORTOUT is used to reference the output data set.

NOLIST
The keyword is ignored, and control statements are printed according to the installation defaults.

Example 7
OPTION RESINV=32000, MSGPRT=CRTICAL
MSGDDN=SORTMSGS, SORTDD=ABCD, SORTIN=MYINPUT,
SORTOUT=MYOUTPUT, NOLIST

This example illustrates keywords RESINV, MSGPRT, MSGDDN, SORTDD, SORTIN, SORTOUT, and NOLIST and the actions taken when these keywords are supplied on the OPTION control statement passed by DFSPARM. These options can also be passed in an extended parameter list, but must be coded as one contiguous statement without continuation lines.

RESINV
32000 bytes of storage are reserved for the user.

MSGPRT=CRTICAL
Only critical messages are printed on the message data set.

MSGDDN=SORTMSGS
Messages are written to the SORTMSGS data set.

SORTDD=ABCD
SORT uses ABCD as a prefix for all sort names.

SORTIN=MYINPUT
The ddname MYINPUT is used to reference the input data set.

SORTOUT=MYOUTPUT
The ddname MYOUTPUT is used to reference the output data set.

NOLIST
Control statements are not printed.

Example 8
SORT FIELDS=(3,4,CH,A)
OPTION COPY, SKIPREC=10, CKPT
MODS E15=(E15,1024,MODLIB), E35=(E35,1024,MODLIB)

SORT
The sort statement is ignored because the COPY option has been specified.

COPY
The copy processing is always done on a record-by-record basis. Each record is therefore read from SORTIN, passed to the E15 exit, passed to the E35 exit, and written to SORTOUT. (Contrast this with a sort, where all the records are read from SORTIN and passed to the E15 exit before any records are passed to the E35 exit and written to SORTOUT.)

SKIPREC
Ten records are skipped before copying starts.

CKPT
The checkpoint option is not used for copy applications.

Example 9
SORT FIELDS=(5,4,CH,A)
SUM FIELDS=(12,5,ZD,25,6,ZD)
OPTION ZDPRINT
OPTION Control Statement

ZDPRINT
The positive summed ZD values are printable because DFSORT uses an F sign for the last digit.

Example 10

```
//S1 EXEC PGM=SORT
//SYSOUT DD SYSOUT=* 
//SARA DD * 
AAA FROM SARA 
CCC FROM SARA 
DDD FROM SARA 
//MOLLY DD * 
AAA FROM MOLLY 
BBB FROM MOLLY 
DDD FROM MOLLY 
//NORA DD * 
AAA FROM NORA 
BBB FROM NORA 
CCC FROM NORA 
//SORTOUT DD SYSOUT=* 
//DFSPARM DD * 
OPTION EQUALS,MERGEIN=(NORA,SARA,MOLLY) 
MERGE FIELDS=(1,3,CH,A) 
/*
```

This example illustrates the use of the alternate ddnames NORA, SARA and MOLLY for a MERGE application instead of SORTINnn ddnames. Since EQUALS is specified, equally collating records will be from NORA, then SARA, then MOLLY, that is, in the order specified in the MERGEIN list. Thus, SORTOUT contains these records:

AAA FROM NORA 
AAA FROM SARA 
AAA FROM MOLLY 
BBB FROM NORA 
BBB FROM MOLLY 
CCC FROM NORA 
CCC FROM SARA 
DDD FROM NORA 
DDD FROM MOLLY 

If MERGEIN=(SARA,MOLLY,NORA) was specified in the MERGEIN list in DFSPARM, SORTOUT would contain these records:

AAA FROM SARA 
AAA FROM MOLLY 
AAA FROM NORA 
BBB FROM MOLLY 
BBB FROM NORA 
CCC FROM SARA 
CCC FROM NORA 
DDD FROM SARA 
DDD FROM MOLLY 

OUTFIL Control Statements
OUTFIL Control Statements

```
OUTFIL
  FNAME= ddname
  FILES= suffix
  STARTREC= n
  ENDDR= n
  SAMPLE= (n,m)
  INCLUDE= (logical expression)
  INCLUDE= ALL
  INCLUDE= NONE
  OMIT= (logical expression)
  OMIT= ALL
  OMIT= NONE
  SAVE
  ACCEPT= n
  PARSE=(definition)
  OUTREC= (item)
  BUILD= ,VTOF ,VLFILL=byte,CONVERT
  OVERLAY= (item)
  FINDREP= (item)
  IFTHEN=(clause)
  IFOUTLEN=n
  FTOV
  VLTRIM=byte
  REPEAT= n
  SPLIT
    SPLITBY= n
    SPLIT1R= n
  NulloFl= RC0
  RC4
  RC16
  LINES= n
  HEADER1= (item)
  TRAILER1= (item)
  HEADER2= (item)
  TRAILER2= (item)
```

Additional Parameters for OUTFIL
OUTFIL control statements allow you to create one or more output data sets for a sort, copy, or merge application from a single pass over one or more input data sets. You can use multiple OUTFIL statements, with each statement specifying the OUTFIL processing to be performed for one or more output data sets. OUTFIL processing begins after all other processing ends (that is, after processing for exits, options, and other control statements).

OUTFILE can be used as an alias for OUTFIL.

OUTFIL statements support a wide variety of output data set tasks, including:

- Creation of multiple output data sets containing unedited or edited records from a single pass over one or more input data sets.
- Creation of multiple output data sets containing different ranges or subsets of records from a single pass over one or more input data sets. In addition, records that are not selected for any subset can be saved in a separate output data set.
- Conversion of variable-length record data sets to fixed-length record data sets.
- Conversion of fixed-length record data sets to variable-length record data sets.
- A wide variety of parsing, editing, and reformatting tasks including:
  - The use of fixed position/length fields or variable position/length fields. For fixed fields, you specify the starting position and length of the field directly. For variable fields, such as delimited fields, comma separated values (CSV), tab separated values, blank separated values, keyword separated fields, null-terminated strings (and many other types), you define rules that allow DFSORT to extract the relevant data into fixed parsed fields, and then use the parsed fields as you would use fixed fields.
  - Insertion of blanks, zeros, strings, current date, future date, past date, current time, sequence numbers, decimal constants, and the results of arithmetic expressions before, between, and after the input fields in the reformatted records.
  - Sophisticated conversion capabilities, such as find and replace, hexadecimal display, bit display, translation of EBCDIC letters from lowercase to uppercase or uppercase to lowercase, translation of characters from EBCDIC to ASCII and from ASCII to EBCDIC, translation of characters using the ALTSEQ translation table, conversion of numeric values from one format to another, left justify or left-squeeze (remove leading blanks or all blanks and shift left), and right-justify or right-squeeze (remove trailing blanks or all blanks and shift right).
OUTFIL Control Statements

- Sophisticated editing capabilities, such as control of the way numeric fields are presented with respect to length, leading or suppressed zeros, thousands separators, decimal points, leading and trailing positive and negative signs, and so on.

- Twenty-seven pre-defined editing masks are available for commonly used numeric editing patterns, encompassing many of the numeric notations used throughout the world. In addition, a virtually unlimited number of numeric editing patterns are available via user-defined editing masks.

- Transformation of SMF, TOD, and ETOD date and time values to more usable forms.

- Conversion of input date fields of one type (CH, ZD, PD, 2-digit year, 4-digit year, Julian, Gregorian) to corresponding output date fields of another type or to a corresponding day of the week.

- Various types of arithmetic operations for input date fields.

- Selection of a character constant, hexadecimal constant, or input field from a lookup table for output, based on a character, hexadecimal, or bit string as input (that is, lookup and change).

- Creation of the reformatted records in one of the following ways:
  - By building the entire record one item at a time.
  - By only overlaying specific columns.
  - By performing find and replace operations.
  - By using sophisticated conditional logic or group operations to choose how different records are reformatted.

- Highly detailed three-level (report, page, and section) reports containing a variety of report elements you can specify (for example, current date, current time, edited or converted page numbers, character strings, and blank lines) or derive from the input records (for example, character fields; unedited, edited or converted numeric input fields; edited or converted record counts; and edited or converted totals, maximums, minimums, and averages for numeric input fields).

- Creation of multiple output records from each input record, with or without intervening blank output records.

- Repetition and sampling of data records.

- Splitting of data records in rotation among a set of output data sets.

- Updating counts and totals in an existing trailer (last) record based on the current data records.

The parameters of OUTFIL are grouped by primary purpose as follows:

- **FNames** and **Files** specify the ddnames of the OUTFIL data sets to be created. Each OUTFIL data set to be created must be specifically identified using FNames or Files in an OUTFIL statement. By contrast, the SORTOUT data set is created by default if a DD statement for it is present. The term “SORTOUT data set” denotes the single non-OUTFIL output data set, but in fact, the SORTOUT ddname can be used for an OUTFIL data set either explicitly or by default.

  If SORTOUT is identified as an OUTFIL ddname, either explicitly (for example, via FILES=OUT) or by default (OUTFIL without FILES or FNames), the data set associated with the SORTOUT ddname will be processed as an OUTFIL data set rather than as the SORTOUT data set.

  OUTFIL data sets have characteristics and requirements similar to those for the SORTOUT data set, but there are differences in the way each is processed. The major differences are that an E39 exit routine is not entered for OUTFIL data sets, and that OUTFIL processing does not permit the use of the LRECL value to
pad fixed-format OUTFIL records. (DFSORT will automatically determine and set an appropriate RECFM, LRECL, and BLKSIZE for each OUTFIL data set for which these attributes are not specified or available.)

For a single DFSORT application, OUTFIL data sets can be intermixed with respect to VSAM and non-VSAM, tape and disk, and so on. All of the data sets specified for a particular OUTFIL statement are processed in a similar way and thus are referred to as an **OUTFIL group**. (That is, you group OUTFIL data sets that use the same operands by specifying them on a single OUTFIL statement.)

For example, the first OUTFIL statement might have an INCLUDE operand that applies to an OUTFIL group of one non-VSAM data set on disk and another on tape; a second OUTFIL statement might have OMIT and OUTREC operands that apply to an OUTFIL group of one non-VSAM data set on disk and two VSAM data sets.

Records are processed for OUTFIL as they are for SORTOUT, after all other DFSORT processing is complete. Conceptually, you can think of an **OUTFIL input record** as being intercepted at the point between being passed from an E35 exit and written to SORTOUT, although neither an E35 exit nor SORTOUT need actually be specified with OUTFIL processing. With that in mind, see Figure 2 on page 9 for details on the processing that occurs prior to processing the OUTFIL input record. In particular:

- Records deleted by an E15 or E35 exit, an INCLUDE, OMIT or SUM statement, or the SKIPREC or STOPAFT parameter are not available for OUTFIL processing
- If records are reformatted by an E15 exit, an INREC or OUTREC statement, or an E35 exit, the resulting reformatted record is the OUTFIL input record to which OUTFIL fields must refer.

- **STARTREC** starts processing for an OUTFIL group at a specific OUTFIL input record. **ENDREC** ends processing for an OUTFIL group at a specific OUTFIL input record. **SAMPLE** selects a sample of OUTFIL input records for an OUTFIL group using a specific interval and number of records in that interval. Separately or together, STARTREC, ENDREC, and SAMPLE select a range of records to which subsequent OUTFIL processing will apply.

- **INCLUDE, OMIT**, and **SAVE** select the records to be included in the data sets of an OUTFIL group. INCLUDE and OMIT operate against the specified fields of each OUTFIL input record to select the output records for their OUTFIL group (all records are selected by default). SAVE selects the records that are not selected for any other OUTFIL group.

Whereas the INCLUDE and OMIT statements apply to all input records, the INCLUDE and OMIT parameters apply only to the OUTFIL input records for their OUTFIL group. The INCLUDE and OMIT parameters have all of the logical expression capabilities of the INCLUDE and OMIT statements.

- **ACCEPT** limits the number of OUTFIL input records accepted for processing for an OUTFIL group. A record is accepted if it is not deleted by STARTREC, ENDREC, SAMPLE, INCLUDE or OMIT processing. ACCEPT limits the number of records to which subsequent OUTFIL processing will apply.

- **PARSE, OUTREC, BUILD, OVERLAY, FINDREP**, or **IFTHEN** reformat the output records for an OUTFIL group. These parameters allow you to rearrange, edit, replace, remove and change fixed position/length fields or variable position/length fields from the OUTFIL input records and to insert blanks, zeros, strings, current date, future date, past date, current time, sequence numbers, decimal constants, and the results of arithmetic expressions.

OUTFIL allows you to change specific existing columns without affecting the entire record.
OUTFIL Control Statements

FINDREP allows you to do various find and replace operations.
IFTHEN clauses allow you to reformat different records in different ways according to the criteria you specify. IFOUTLEN can be used with IFTHEN clauses to set the output LRECL.
OUTREC or BUILD gives you complete control over the items in your reformatted records and the order in which they appear, and also allows you to produce multiple reformatted output records from each input record, with or without intervening blank output records.
VTOF or CONVERT can be used with OUTREC or BUILD to convert variable-length input records to fixed-length output records.
VLFILL can be used to allow processing of variable-length input records which are too short to contain all specified OUTREC or BUILD fields.
Whereas the FIELDS, BUILD, OVERLAY, FINDREP, and IFTHEN parameters of the OUTREC statement apply to all input records, the OUTREC, BUILD, OVERLAY, FINDREP, and IFTHEN parameters of the OUTFIL statement apply only to the OUTFIL input records for its OUTFIL group. In addition, the OUTREC and BUILD parameters of the OUTFIL statement support the forward slash (/) separator for creating blank records and new records, whereas the FIELDS and BUILD parameters of the OUTREC statement do not.

- FTOV can be used to convert fixed-length input records to variable-length output records. FTOV can be used with or without OUTREC, BUILD, OVERLAY, FINDREP, or IFTHEN.
- VLTRIM can be used to remove the trailing bytes with a specified value, such as blanks, binary zeros or asterisks, from variable-length records. VLTRIM can be used with or without FTOV.
- REPEAT can be used to repeat each output record a specified number of times.
- SPLIT, SPLITBY, or SPLIT1R splits the output records in rotation among the data sets of an OUTFIL group.
  With SPLIT, the first output record is written to the first OUTFIL data set in the group, the second output record is written to the second data set, and so on. When each OUTFIL data set has one record, the rotation starts again with the first OUTFIL data set.
  SPLITBY can be used to rotate by a specified number of records rather than by one record, for example, records 1-10 to the first OUTFIL data set, records 11-20 to the second OUTFIL data set, and so on. When each OUTFIL data set has n records, the rotation starts again with the first OUTFIL data set.
  SPLIT1R can be used to rotate once by a specified number of records. SPLIT1R continues with the last OUTFIL data set instead of rotating back to the first OUTFIL data set. When each OUTFIL data set has n records, the last OUTFIL data set will have the remainder of the records even if that is more than n.

- LINES, HEADER1, TRAILER1, HEADER2, TRAILER2, SECTIONS, and NODETAIL indicate that a report is to be produced for an OUTFIL group, and specify the details of the report records to be produced for the report. Reports can contain report records for a report header (first page), report trailer (last page), page header and page trailer (at the top and bottom of each page, respectively), and section headers and trailers (before and after each section, respectively).
  Data records for the report result from the inclusion of OUTFIL input records. All of the capabilities of the OUTREC, BUILD, OVERLAY, FINDREP, or IFTHEN parameters are available to create reformatted data records from the OUTFIL
input records. Each set of sequential OUTFIL input records, with the same binary value for a specified field, results in a corresponding set of data records that is treated as a section in the report.

The length for the data records must be equal to or greater than the maximum report record length. OUTFIL data sets used for reports must have or will be given ANSI control character format (‘A’ as in, for example, RECFM=FBA or RECFM=VBA), and must allow an extra byte in the LRECL for the carriage control character that DFSORT will add to each report and data record. DFSORT uses these carriage control characters to control page ejects and the placement of the lines in your report according to your specifications. DFSORT uses appropriate carriage controls (for example, C‘-' for triple space) in header and trailer records when possible, to reduce the number of report records written. DFSORT always uses the single space carriage control (C‘ ') in data records. Although these carriage control characters may not be shown when you view an OUTFIL data set (depending upon how you view it), they will be used if you print the report.

- **BLKCCH1, BLKCCT1 or BLKCCH2** can be used avoid forcing a page eject for the report header, report trailer or first page header, respectively, by using a blank instead of a ‘1’ for the ANSI control carriage character of its first line.
- **REMOVECC** can be used to remove the ANSI control characters from a report. In this case, an ‘A’ is not added to or required for the RECFM and an extra byte is not added to or required for the LRECL.
- **IFTRAIL** can be used to update count and total values in an existing trailer (last) record based on the current data records.
- **Figure 13 on page 236** illustrates the order in which OUTFIL records and parameters are processed.
Notes:

1. DFSORT accepts but does not process the following OUTFIL operands:
   - BLKSIZE=value
   - BUFLIM=value
   - BUFOFF=value
   - CARDS=value
   - CLOSE=value
   - DISK
   - ESDS
   - EXIT
   - FREEOUT
   - KSDS
   - LRECL=value
   - NOTPMK
   - OPEN=value
   - OUTPUT
   - PAGES=value
   - PRINT
   - PUNCH
   - REUSE
   - RRDS
   - SPAN
   - SYSLST
   - TAPE
   - TOL.

2. Sample syntax is shown throughout this section. Complete OUTFIL statement examples are shown and explained under "OUTFIL Features—Examples" on page 378.

Figure 13. OUTFIL Processing Order
OUTFIL Control Statements

Specifies ddnames associated with the OUTFIL data sets for this OUTFIL statement. The ddnames specified using the F N A M E S and FILES parameters constitute the output data sets for this OUTFIL group to which all of the other parameters for this OUTFIL statement apply.

If F N A M E S specifies the ddname in effect for the SORTOUT data set (that is, whichever is in effect among ddname from SORTOUT=ddname, ccccOUT from SORTDD=cccc, or SORTOUT) DFSORT will treat the data set associated with that ddname as an OUTFIL data set rather than as the SORTOUT data set.

ddname specifies a 1- through 8-character ddname. A DD statement must be present for this ddname.

Sample Syntax:

```
OUTFIL FNAMES=(OUT1,OUT2,PRINTER,TAPE)
OUTFIL FNAMES=BACKUP
```

Default for F N A M E S: If neither F N A M E S nor FILES is specified for an OUTFIL statement, the default ddname is:

- ddname if SORTOUT=ddname is in effect
- ccccOUT if SORTDD=cccc is in effect and SORTOUT=ddname is not in effect
- SORTOUT if neither SORTOUT=ddname nor SORTDD=cccc is in effect.

FILES

Specifies suffixes for ddnames to be associated with the OUTFIL data sets for this OUTFIL statement. The ddnames specified using the F N A M E S and FILES parameters constitute the output data sets for this OUTFIL group to which all of the other parameters for this OUTFIL statement apply.

If FILES specifies the ddname in effect for the SORTOUT data set (that is, whichever is in effect among ddname from SORTOUT=name, ccccOUT from SORTDD=cccc, or SORTOUT), DFSORT will treat the data set associated with that ddname as an OUTFIL data set rather than as the SORTOUT data set.

d specifies the 1-character suffix to be used to form the ddname SORTOFd or ccccOFd if SORTDD=cccc is in effect. A DD statement must be present for this ddname.
OUTFIL Control Statements

**dd** specifies the 2-character suffix to be used to form the ddname `SORTOFdd` or `ccccOFdd` if `SORTDD=cccc` is in effect. A DD statement must be present for this ddname.

**OUT** specifies the suffix OUT is to be used to form the ddname `SORTOUT` or `ccccOUT` if `SORTDD=cccc` is in effect. A DD statement must be present for this ddname.

Sample Syntax:

```
OUTFIL FILES=(1,2,PR,TP)
OUTFIL FILES=OUT
```

Default for FILES: If neither FNAMES nor FILES is specified for an OUTFIL statement, the default ddname is:

- ddname if `SORTOUT=ddname` is in effect
- `ccccOUT` if `SORTDD=cccc` is in effect and `SORTOUT=ddname` is not in effect
- `SORTOUT` if neither `SORTOUT=ddname` nor `SORTDD=cccc` is in effect.

**STARTREC**

```
STARTREC=n
```

Specifies the OUTFIL input record at which OUTFIL processing is to start for this OUTFIL group. OUTFIL input records before this starting record are not included in the data sets for this OUTFIL group.

- **n** specifies the relative record number. The value for n starts at 1 (the first record) and is limited to 28 digits (15 significant digits).

Sample Syntax:

```
OUTFIL FNAMES=SKIP20,STARTREC=21
```

Default for STARTREC: 1.

**ENDREC**

```
ENDREC=n
```

Specifies the OUTFIL input record at which OUTFIL processing is to end for this OUTFIL group. OUTFIL input records after this ending record are not included in the data sets for this OUTFIL group.

The ENDREC value must be equal to or greater than the STARTREC value if both are specified on the same OUTFIL statement.

- **n** specifies the relative record number. The value for n starts at 1 (the first record) and is limited to 28 digits (15 significant digits).

Sample Syntax:

```
OUTFIL FNAMES=TOP10,ENDREC=10
OUTFIL FNAMES=FRONT,ENDREC=500
OUTFIL FNAMES=MIDDLE,STARTREC=501,ENDREC=2205
OUTFIL FNAMES=BACK,STARTREC=2206
```
OUTFIL Control Statements

Default for ENDREC: The last OUTFIL input record.

SAMPLE

```
>> SAMPLE=n
(n,m)
```

Specifies a sample of OUTFIL input records to be processed for this OUTFIL group. The sample consists of the first \( m \) records in every \( n \)th interval.

- \( n \) specifies the interval size. The value for \( n \) starts at 2 (sample every other record) and is limited to 28 digits (15 significant digits).
- \( m \) specifies the number of records to be processed in each interval. The value for \( m \) starts at 1 (process the first record in each interval) and is limited to 28 digits (15 significant digits). If \( m \) is not specified, 1 is used for \( m \). If \( m \) is specified, it must be less than \( n \).

Sample Syntax:
```
* PROCESS RECORDS 1, 6, 11, ...
  OUTFIL FNAMES=OUT1,SAMPLE=5

* PROCESS RECORDS 1, 2, 1001, 1002, 2001, 2002
  OUTFIL FNAMES=OUT2,SAMPLE=(1000,2),ENDREC=2500

* PROCESS RECORDS 23, 48, 73
  OUTFIL FNAMES=OUT3,STARTREC=23,ENDREC=75,SAMPLE=25

* PROCESS RECORDS 1001, 1002, 1003, 1101, 1102, 1103, ...
  OUTFIL FNAMES=OUT4,STARTREC=1001,SAMPLE=(100,3)
```

Default for SAMPLE: None; must be specified.

INCLUDE

```
>> INCLUDE=
  (logical expression)

ALL
NONE
```

Selects the records to be included in the data sets for this OUTFIL group. The INCLUDE parameter operates in the same way as the INCLUDE statement, except that:

- The INCLUDE statement applies to all input records; the INCLUDE parameter applies only to the OUTFIL input records for its OUTFIL group.
- FORMAT=f can be specified with the INCLUDE statement, but not with the INCLUDE parameter. Thus, you can use FORMAT=f and p,m or p,m,f fields with the INCLUDE statement, but you must only use p,m,f fields with the INCLUDE parameter. For example:
OUTFIL Control Statements

INCLUDE FORMAT=B1,
    COND=(5,4,LT,11,4,OR,21,4,EQ,31,4,OR,
         61,20,SS,EQ,'FLY')

OUTFIL INCLUDE=(5,4,B1,LT,11,4,B1,OR,21,4,B1,EQ,31,4,B1,OR,
                 61,20,SS,EQ,'FLY')

• D2 format can be specified with the INCLUDE statement, but not with the INCLUDE parameter.

See “INCLUDE Control Statement” on page 98 for complete details.

logical expression

specifies one or more relational conditions logically combined based on fields in the OUTFIL input record. If the logical expression is true for a given record, the record is included in the data sets for this OUTFIL group.

ALL

specifies that all of the OUTFIL input records are to be included in the data sets for this OUTFIL group.

NONE

specifies that none of the OUTFIL input records are to be included in the data sets for this OUTFIL group.

Sample Syntax:

OUTFIL FNAMES=J69,INCLUDE=(5,3,CH,EQ,C'J69')
OUTFIL FNAMES=J82,INCLUDE=(5,3,CH,EQ,C'J82')

Default for INCLUDE: ALL.

OMIT

Selects the records to be omitted from the data sets for this OUTFIL group.

The OMIT parameter operates in the same way as the OMIT statement, except that:

• The OMIT statement applies to all input records; the OMIT parameter applies only to the OUTFIL input records for its OUTFIL group.

• FORMAT=f can be specified with the OMIT statement, but not with the OMIT parameter. Thus, you can use FORMAT=f and p,m or p,m,f fields with the OMIT statement, but you must only use p,m,f fields with the OMIT parameter. For example:

    OMIT FORMAT=B1,
        COND=(5,4,LT,11,4,OR,21,4,EQ,31,4,OR,
             61,20,SS,EQ,'FLY')

    OUTFIL OMIT=(5,4,B1,LT,11,4,B1,OR,21,4,B1,EQ,31,4,B1,OR,
                 61,20,SS,EQ,'FLY')

• The D2 format can be specified with the OMIT statement, but not with the OMIT parameter.

See “OMIT Control Statement” on page 169 and “INCLUDE Control Statement” on page 98 for complete details.
OUTFIL Control Statements

**Logical expression**

specifies one or more relational conditions logically combined based on fields in the OUTFIL input record. If the logical expression is true for a given record, the record is omitted from the data sets for this OUTFIL group.

**ALL**

specifies that all of the OUTFIL input records are to be omitted from the data sets for this OUTFIL group.

**NONE**

specifies that none of the OUTFIL input records are to be omitted from the data sets for this OUTFIL group.

*Sample Syntax:*

```
OUTFIL FILES=01, OMIT=NONE
OUTFIL OMIT=(5,1,BI,EQ,B'110.....')
OUTFIL FNAMES=(OUT1,OUT2),
   OMIT=(7,2,CH,EQ,C'32',OR,18,3,CH,EQ,C'XYZ')
```

*Default for OMIT: NONE.*

**SAVE**

Specifies that OUTFIL input records not included by STARTREC, ENDREC, ACCEPT, SAMPLE, INCLUDE or OMIT for any other OUTFIL group are to be included in the data sets for this OUTFIL group. SAVE operates in a global fashion over all of the other OUTFIL statements for which SAVE is not specified, enabling you to keep any OUTFIL input records that would not be kept otherwise. SAVE will include the same records for each group for which it is specified.

*Sample Syntax:*

```
OUTFIL INCLUDE=(8,6,CH,EQ,C'ACCTNG'), FNAMES=GP1
OUTFIL INCLUDE=(8,6,CH,EQ,C'DVPMNT'), FNAMES=GP2
OUTFIL SAVE, FNAMES=NOT1OR2
```

*Default for SAVE: None; must be specified.*

**ACCEPT**

specifies the number of OUTFIL input records to be accepted for processing for this OUTFIL group. A record is accepted if it is not deleted by STARTREC, ENDREC, SAMPLE, INCLUDE or OMIT processing for the group. After n OUTFIL input records have been accepted, additional OUTFIL input records are not included in the data sets for this OUTFIL group.

* n specifies the number of records to be accepted. The value for n starts at 1 and is limited to 28 digits (15 significant digits).*
OUTFIL Control Statements

ACCEPT=n operates in a similar way to the ENDREC=n option. However, whereas ENDREC=n stops processing OUTFIL input records for a group at relative record n, ACCEPT=n stops processing OUTFIL input records for a group after n records have been "accepted". If both ACCEPT=n and ENDREC=n are specified, processing will stop when the first criteria is met.

Sample Syntax:
```
OUTFIL FNames=OUT1,Include=(11,3,CH,eq,'D51'),Accept=3
OUTFIL FNames=OUT2,StartRec=5,SampLe=1000,Accept=12
```

Default for ACCEPT: None; must be specified.

PARSE

This operand allows you to extract variable position/length fields into fixed parsed fields. Parsed fields (%nn) can be used where fixed position/length fields (p,m) can be used in the BUILD (or OUTREC) or OVERLAY operands as described later in this section.

PARSE can be used for many different types of variable fields including delimited fields, comma separated values (CSV), tab separated values, blank separated values, keyword separated fields, null-terminated strings, and so on. You can assign up to 100 %nn parsed fields (%00-%99) to the variable fields you want to extract.

Note that if all of the fields in your records have fixed positions and lengths, you don't need to use PARSE. But if any of the fields in your records have variable positions or lengths, you can use PARSE to treat them as fixed parsed fields in BUILD or OVERLAY. You can mix p,m fields (fixed fields) and %nn fields (parsed fields) in BUILD and OVERLAY.

For each %nn parsed field, you define where the data to be extracted starts and ends, and the length (m) of the fixed field to contain the extracted data. For example, if your input records contained CSV data as follows:
and you wanted to reformat the data into fixed positions like this:

```
AA  BBBB  C   DDDDD
EEE F  GG
HHH  I1IIII  JJ  K
```

you could use this OUTFIL statement:

```
OUTFIL PARSE=(%01=(ENDBEFR=C',',FIXLEN=5),
            %02=(ENDBEFR=C',',FIXLEN=5),
            %03=(ENDBEFR=C',',FIXLEN=5),
            %04=(FIXLEN=5)),
            BUILD=(1:%01,11:%02,21:%03,31:%04)
```

The PARSE operand:

- assigns %01 to the first parsed field, and defines it as starting at position 1 and ending before the next (first) comma with a fixed length of 5 bytes
- assigns %02 to the second parsed field, and defines it as starting after the (first) comma and ending before the next (second) comma with a fixed length of 5 bytes
- assigns %03 to the third parsed field, and defines it as starting after the (second) comma and ending before the next (third) comma with a fixed length of 5 bytes
- assigns %04 to the fourth parsed field, and defines it as starting after the (third) comma and ending after 5 bytes with a fixed length of 5 bytes

You can start extracting data at a specific position (ABSPOS=p), a relative position (ADDPOS=x or SUBPOS=y), after the start of one or more specific strings (STARTAFT=string) or blanks (STARTAFT=BLANKS), or at the start of one or more specific strings (STARTAT=string) or blanks (STARTAT=BLANKS) or a nonblank (STARTAT=NONBLANK). You can end extracting data before the start of one or more specific strings (ENDBEFR=string) or blanks (ENDBEFR=BLANKS), at the end of one or more specific strings (ENDAT=string) or blanks (ENDAT=BLANKS), or after a specified number of bytes (FIXLEN=m without ENDBEFR or ENDAT).

For each record, each %nn and % parsed field you define is processed according to the suboperands you define, in the following order:

- ABSPOS or ADDPOS or SUBPOS
- STARTAFT, STARTAT and PAIR
- ENDBEFR, ENDAT and PAIR
- FIXLEN

As each %nn parsed field is processed, data is extracted according to the suboperands you specify.

In addition, as each %nn or % parsed field is processed, the Start Pointer for the next parsed field advances through the record according to the suboperands you specify. By default, for the first parsed field, the Start Pointer is set to position 1 for fixed-length records or to position 5 for variable-length records, and the Start Pointer for each subsequent %nn parsed field uses the Start Pointer as set by the previous %nn parsed field. For any parsed field, the Start Pointer advances as follows depending on the suboperands specified, and may advance more than once (for example, if STARTAFT and ENDBEFR are both specified, or if STARTAT and FIXLEN are both specified):
OUTFIL Control Statements

- if ABSPOS=p is specified, the Start Pointer is set to position p.
- if ADDPOS=x is specified, the Start Pointer is incremented by x.
- if SUBPOS=y is specified, the Start Pointer is decremented by y.
- if STARTAFT=string or STARTAT=string is specified, the search for string starts at the Start Pointer. If string is found, the Start Pointer is set to the byte after the end of the string. If string is not found, the current parsed field and any subsequent parsed fields contain all blanks.
- if STARTAFT=BLANKS or STARTAT=BLANKS is specified, the search for blanks starts at the Start Pointer. If a blank is found, the Start Pointer is set to the next nonblank. If a blank is not found, the current parsed field and any subsequent parsed fields contain all blanks.
- if STARTAT=NONBLANK is specified, the search for a nonblank starts at the Start Pointer. If a nonblank is found, the Start Pointer is set to the nonblank. If a nonblank is not found, the current parsed field and any subsequent parsed fields contain all blanks.
- if ENDBEFR=string or ENDAT=string is specified, the search for string starts at the Start Pointer. If string is found, the Start Pointer is set to the byte after the end of the string. If string is not found, data for this parsed field is extracted up to the end of the record. Subsequent parsed fields contain all blanks.
- if ENDBEFR=BLANKS or ENDAT=BLANKS is specified, the search for blanks starts at the Start Pointer. If a blank is found, the Start Pointer is set to the next nonblank. If a blank is not found, data for this parsed field is extracted up to the end of the record. Subsequent parsed fields contain all blanks.
- if ENDBEFR and ENDAT are not specified and FIXLEN=m is specified, the Start Pointer is set m bytes past the start of the extracted data.
- if the Start Pointer advances past the end of the record, PARSE processing stops.

For example, if you had these records as input:

```
11*+23 NEW MAXCC=00 (Monica) 18
1*-6 OLD MAXCC=04 (Joey) -2735
232*+86342 SHR MAXCC=04 (Rachel) 0
```

and you wanted this output:

```
Monica MAXCC=00 +000023 011 18
Joey MAXCC=04 -000006 001 -2735
Rachel MAXCC=04 +086342 232 0
```

you could use this OUTFIL statement:

```
OUTFIL FNAME=OUT1,
   PARSE=(%00=(ENDBEFR=C'*',FIXLEN=3),
   %01=(ENDBEFR=BLANKS,FIXLEN=6),
   %02=(STARTAT=C'MAX',FIXLEN=0),
   %03=(STARTAFT=C'(',ENDBEFR=C')',FIXLEN=6),
   %04=(STARTAFT=BLANKS,FIXLEN=5)),
   BUILD=(%03,11:%02,21:%01,SFF,M26,LENGTH=7,
      30:%00,UFF,M11,LENGTH=3,35:%04,JFY=(SHIFT=RIGHT))
```

For this example, the Start Pointer advances as follows for the first record:

- For %00: Set Start Pointer to position 1. Start searching for '*' end string at position 1. Extract '11' (per ENDBEFR=C'*'). Set Start Pointer after '*' (at '+').
- For %01: Start searching for end blank at the Start Pointer (at '+'). Extract '+23' (per ENDBEFR=BLANKS). Set Start Pointer after the blanks (at 'N').
OUTFIL Control Statements

- For %02: Start searching for 'MAX' start string at the Start Pointer (at 'N').
  Extract 'MAXC=00' (per FIXLEN=8). Increment Start Pointer by m (8) bytes from the start of the extracted string (at blank after '00').
- For %03: Start searching for '(' start string at Start Pointer (at blank after '00').
  Set Start Pointer after '(' (at 'M'). Start searching for ')' end string at Start Pointer (at 'M'). Extract 'Monica' (per ENDBEFR=C')). Set Start Pointer after ')' (at blank after ')').
- For %04: Start searching for start blank at the Start Pointer (at blank after ')').
  Extract '18' (per FIXLEN=5).

If the Start Pointer advances past the end of the record, PARSE processing stops. For example, if you had these input records:

First=George Last=Washington
First=John Middle=Quincy Last=Adams

and you used this OUTFIL statement:

```plaintext
OUTFIL FNames=OUT1,
   PARSE=(%00=(STARTAFT=C'First=',ENDBEFR=C' ',FIXLEN=12),
          %01=(STARTAFT=C'Middle=',ENDBEFR=C' ',FIXLEN=12),
          %02=(STARTAFT=C'Last=',ENDBEFR=C' ',FIXLEN=12)),
   BUILD=(%00,%01,%02)
```

the %01 parsed field (middle name) is not found in the first record, so PARSE processing stops and the %02 parsed field is set to blanks. You can handle this kind of possible missing field situation by using IFTHEN PARSE instead of PARSE. For example:

```plaintext
OUTFIL FNames=OUT1,
   IFTHEN=(WHEN=INIT,
            PARSE=(%00=(STARTAFT=C'First=',ENDBEFR=C' ',FIXLEN=12)),
            IFTHEN=(WHEN=INIT,
                    PARSE=(%01=(STARTAFT=C'Middle=',ENDBEFR=C' ',FIXLEN=12)),
                    IFTHEN=(WHEN=INIT,
                            PARSE=(%02=(STARTAFT=C'Last=',ENDBEFR=C' ',FIXLEN=12)),
                            BUILD=(%00,%01,%02))
```

By default, the Start Pointer is set to 1 (F) or 5 (V) for each IFTHEN PARSE, so the missing middle name in the first record does not prevent the last name from being extracted.

See the discussion of "IFTHEN" for more information on IFTHEN PARSE.

You must define each %nn field with PARSE before you use it in BUILD or OVERLAY, so generally you would want to specify PARSE before BUILD or OVERLAY. If you define a %nn field with PARSE, but do not use it in BUILD or OVERLAY, data will not be extracted for that parsed field.

Each %nn parsed field (%00-%99) can only be defined once per run with PARSE, but can be used as many times as needed in BUILD or OVERLAY.

The %nn parsed fields defined for a particular source (INREC, OUTREC or OUTFIL) can only be used in the BUILD or OVERLAY operands for that source. Generally, you will only use PARSE for one source (for example, INREC) per run. But you could define a separate set of %nn parsed fields for each source, if needed. For example, you could define %21 and %22 for the INREC statement, %01, %02 and %03 for the OUTREC statement, %40 and %45 for OUTFIL statement 1, and %30, %31 and %32 for OUTFIL statement 2. You could then use %21 and %22 for INREC BUILD or OVERLAY, %02 and %03 for OUTREC BUILD or OVERLAY, %40 and %45 for OUTFIL statement 1.
OUTFIL Control Statements

BUILD or OVERLAY, and %30, %31 and %32 for OUTFIL statement 2 BUILD or OVERLAY. Note that you could not, for example, use %21 and %22 for OUTREC BUILD or OVERLAY.

If you specify PARSE=(...),IFTHEN=(...) or IFTHEN=(...), PARSE=(...), DFSORT will terminate. If you need to specify PARSE with IFTHEN, specify it within one or more individual IFTHEN clauses, as appropriate. For details, see the description of "IFTHEN".

%nn

Assigns %nn to a parsed field. The variable-length data defined for the parsed field is extracted to a fixed length area (padded with blanks or truncated as appropriate) and can be used where a p,m field can be used in BUILD or OVERLAY.

nn can be 00 to 99, but each %nn value can only be defined once per run. This gives you a maximum of 100 parsed fields per run.

%0 to %9 can be used, but will be treated as equivalent to %00 to %09. You can use %n and %0n interchangeably, but you cannot define both %n and %0n in the same run.

Sample Syntax

OUTFIL PARSE=(%99=(ABSPOS=6,STARTAT=C'KW=',ENDAT=C')',FIXLEN=20),
%03=(STARTAFT=BLANKS,FIXLEN=10)),
OVERLAY=(1:1,5,%03,C'=',%99,1:1,36,SQZ=(SHIFT=LEFT))

% Specifies a parsed field to be ignored. No data is extracted, but the starting point for the next parsed field advances according to the suboperands specified. Use % when you don't need the data from a particular field, but you do need to get to the next field. For example, if we had the four CSV fields shown earlier as input, but we only wanted to extract the first and fourth fields, we could use this OUTFIL statement:

OUTFIL PARSE=(%01=(ENDBEFR=C',',FIXLEN=5),
%=(ENDBEFR=C','),
%=(ENDBEFR=C','),
%04=(FIXLEN=5)),
BUILD=(1:%=01,11:%=04,21:%=01,HEX)

Data is extracted for %01 (first field) and %04 (fourth field), but not for % (second and third fields).

FIXLEN=m

Specifies the length (m) of the fixed area to contain the extracted variable-length data for this %nn fixed parsed field. m can be 1 to 32752. You must specify FIXLEN=m for each %nn parsed field. FIXLEN=m is optional for a % ignored field.

When %nn is specified in BUILD or OVERLAY, the variable-length data is extracted to the fixed area and then used for BUILD or OVERLAY processing. The fixed area always contains m bytes. If the extracted data is longer than m, the fixed area contains the first m bytes of the extracted data (the data is truncated on the right to m bytes). If the extracted data is shorter than m, the fixed area contains the extracted data padded with blanks on the right to m bytes. If no data is extracted, the fixed area contains all blanks.

The length m from FIXLEN=m for fixed parsed fields (%nn) corresponds to the length (m) for fixed fields (p,m). Keep in mind that %nn fields are left-aligned and may be padded on the right with blanks. You must ensure
that the data in each %nn field and its length (m) are valid for the way you want to use that %nn field in BUILD or OVERLAY. For example, if you had these records as input:

```
123,8621
1,302
18345,17
```

and you wanted this output:

```
1.23 86.21
0.01 3.02
183.45 0.17
```

you could use this OUTFIL statement:

```
OUTFIL PARSE=(%00=(ENDBEFR=C',',FIXLEN=5),
                %01=(FIXLEN=5)),
         BUILD=(%00,UFF,EDIT=(IIT.TT),2X,%01,UFF,EDIT=(IIT.TT))
```

Note that the 5-byte extracted parsed fields for %00 are left-aligned and padded with blanks (b) like this:

```
123bb
1bbbb
18345
```

and the 5-byte extracted parsed fields for %01 are left-aligned and padded with blanks (b) like this:

```
8621b
302bb
17bbb
```

Thus, you cannot use numeric formats like ZD or FS for these parsed fields, but you can use UFF. Note also that you must ensure that m from FIXLEN=m for each %nn parsed field is valid for the specific BUILD or OVERLAY item in which you use %nn. For example, you could use 1-44 as m for UFF, but you couldn't use 45 as m.

If ENDBEFR and ENDAT are not specified, the Start Pointer is set m bytes past the start of the extracted data. For example, if you had this record as input:

```
MAX=(ABCDEF)
```

and you specified:

```
OUTFIL PARSE=(%00=(STARTAT=C'MAX',FIXLEN=8),
             %01=(FIXLEN=3),%02=(FIXLEN=1)),
         BUILD=(%00,12:%01,20:%02)
```

The output record would be:

```
MAX=(ABC DEF )
```

Sample Syntax

```
OUTFIL PARSE=(%00=(STARTAFT=C'KW=',FIXLEN=12)),
         BUILD=(%00)
```

ABSPOS=p

Sets the Start Pointer for this parsed field to p. p can be 1 to 32752. By default, the Start Pointer for the first %nn parsed field is position 1 for fixed-length records or position 5 for variable-length records, and the Start Pointer for each subsequent %nn parsed field is the Start Pointer set by the previous %nn field. You can use ABSPOS=p to set the Start Pointer to
OUTFIL Control Statements

position p to override the default Start Pointer. If the resulting Start Pointer is less than position 5 for variable length records, it will be set to position 5.

Example

If your input is:

```
****|BB|CCCC|
****|EEEE|FF|
```

and you wanted to reformat the data into fixed positions like this:

```
**** BB CCCC
**** EEEE FF
```

you could use this OUTFIL statement:

```
OUTFIL PARSE=(%01=(ABSPOS=6,ENDBEFR=C'|',FIXLEN=4),
             %02=(ENDBEFR=C'|',FIXLEN=4)),
BUILD=(1,4,X,%01,X,%02)
```

The initial Start Pointer for the %01 parsed field is set to position 6 instead of to position 1.

`ADDPOS=x`

Increments the Start Pointer for this parsed field by x. x can be 1 to 32752. By default, the Start Pointer for the first %nn parsed field is position 1 for fixed-length records or position 5 for variable-length records, and the Start Pointer for each subsequent %nn parsed field is the Start Pointer set by the previous %nn field. You can use ADDPOS=x to increment the Start Pointer by x to override the default Start Pointer.

Sample Syntax

```
OUTFIL PARSE=(%00=(ENDAT=C'||',FIXLEN=10),
              %01=(ADDPOS=5,STARTAFT=C'|',FIXLEN=6)),
BUILD=(%00,TRAN=ALTSEQ,%01)
```

`SUBPOS=y`

Decrements the Start Pointer for this parsed field by y. y can be 1 to 32752. By default, the Start Pointer for the first %nn parsed field is position 1 for fixed-length records or position 5 for variable-length records, and the Start Pointer for each subsequent %nn parsed field is the Start Pointer set by the previous %nn field. You can use SUBPOS=y to decrement the Start Pointer by y to override the default Start Pointer. If the resulting Start Pointer is less than position 1 for fixed-length records, it will be set to position 1. If the resulting Start Pointer is less than position 5 for variable-length records, it will be set to position 5.

Sample Syntax

```
OUTFIL PARSE=(%00=(ENDBEFR=C'|;',FIXLEN=10),
              %01=(SUBPOS=1,STARTAT=C'|',ENDAT=C'|',FIXLEN=12)),
BUILD=(%00,TRAN=ALTSEQ,%01)
```

`STARTAFT=string`

Data is to be extracted for this parsed field starting after the last byte of the specified string. The search for the string begins at the Start Pointer. If the specified string is not found, data is not extracted for this parsed field or any subsequent parsed fields. If the specified string is found, data is extracted to the fixed area for this parsed field starting at the byte after the end of the string, and the Start Pointer is set to the byte after the end of the string.
OUTFIL Control Statements

string can be 1 to 256 characters specified using a character string constant (C'xx...x') or a hexadecimal string constant (X'yy...yy'). See "INCLUDE Control Statement" on page 98 for details of coding character and hexadecimal string constants.

Example

If your input is:

```
MAX=25,832 MIN=2,831 $4
MAX=1,275 MIN=17 %3
```

and you wanted your output to contain MAX-MIN, you could use this OUTFIL statement:

```
OUTFIL PARSE=(%00=(STARTAFT=C'MAX=',ENDBEFR=X'40',FIXLEN=6),
%01=(STARTAFT=C'MIN=',ENDBEFR=X'40',FIXLEN=6)),
OVERLAY=(50:C'DELTA: ',%00,UFF,SUB,%01,UFF,TO=ZD,LENGTH=8)
```

STARTAFT=BLANKS

Data is to be extracted for this parsed field starting at the first nonblank after one or more blanks. The search for a blank begins at the Start Pointer. If a blank is not found, data is not extracted for this parsed field or any subsequent parsed fields. If a blank is found, data is extracted to the fixed area for this parsed field starting at the first nonblank, and the Start Pointer is set to the first nonblank.

Example

If your input is:

```
Frank D28
Vicky D52
```

and you wanted your output to be:

```
Frank D28
Vicky D52
```

you could use this OUTFIL statement:

```
OUTFIL PARSE=(%00=(STARTAFT=BLANKS,FIXLEN=8),
%01=(STARTAFT=BLANKS,FIXLEN=3)),
BUILD=(%00,14:%01)
```

STARTAT=string

Data is to be extracted for this parsed field starting at the first byte of the specified string. The search for the string begins at the Start Pointer. If the specified string is not found, data is not extracted for this parsed field or any subsequent parsed fields. If the specified string is found, data is extracted to the fixed area for this parsed field starting at the first byte of the string, and the Start Pointer is set to the byte after the end of the string.

string can be 1 to 256 characters specified using a character string constant (C'xx...x') or a hexadecimal string constant (X'yy...yy'). See "INCLUDE Control Statement" on page 98 for details of coding character and hexadecimal string constants.

Example

If your input is:

```
MAX=58321 MIN=00273
MAX=01275 MIN=00017
```

and you wanted your output to be:
OUTFIL Control Statements

you could use this OUTFIL statement:

```
OUTFIL PARSE=(%00=(STARTAT=C'MAX=',FIXLEN=9),
             %01=(STARTAT=C'MIN=',FIXLEN=9)),
             BUILD=(%00,X,%01)
```

STARTAT=BLANKS
Data is to be extracted for this parsed field starting at the first blank. The search for a blank begins at the Start Pointer. If a blank is not found, data is not extracted for this parsed field or any subsequent parsed fields. If a blank is found, data is extracted to the fixed area for this parsed field starting at the first blank, and the Start Pointer is set to the first nonblank.

STARTAT=NONBLANK
Data is to be extracted for this parsed field starting at the first nonblank. The search for a nonblank begins at the Start Pointer. If a nonblank is not found, data is not extracted for this parsed field or any subsequent parsed fields. If a nonblank is found, data is extracted to the fixed area for this parsed field starting at the nonblank, and the Start Pointer is set to the nonblank.

Example
If your input is:

```
Frank D28
Victoria D52
Holly D15
Roberta D52
```

and you wanted your output to be:

```
Frank D28
Victoria D52
Holly D15
Roberta D52
```

you could use this OUTFIL statement:

```
OUTFIL PARSE=(%00=(STARTAT=NONBLANK,ENDBEFR=BLANKS,FIXLEN=8),
              %01=(FIXLEN=3)),
              BUILD=(%00,14:%01)
```

Note: Multiple STARTAFT/STARTAT strings, BLANKS or NONBLANK can be used for a %nn parsed field to search for more than one string, blanks or a nonblank. The first search satisfied is used.

Example
If your input is:

```
12 MAXCC=08
58 MINCC=00
```

and you wanted your output to be:

```
MAXCC=08
MINCC=00
```

you could use this OUTFIL statement:

```
OUTFIL PARSE=(%00=(STARTAT=C'MAXCC=',STARTAT=C'MINCC=',
               FIXLEN=8)),BUILD=(%00)
```

```
MAX=58321 MIN=00273
MAX=01275 MIN=00017
you could use this OUTFIL statement:

```
OUTFIL PARSE=(%00=(STARTAT=C'MAX=',FIXLEN=9),
             %01=(STARTAT=C'MIN=',FIXLEN=9)),
             BUILD=(%00,X,%01)
```

STARTAT=BLANKS
Data is to be extracted for this parsed field starting at the first blank. The search for a blank begins at the Start Pointer. If a blank is not found, data is not extracted for this parsed field or any subsequent parsed fields. If a blank is found, data is extracted to the fixed area for this parsed field starting at the first blank, and the Start Pointer is set to the first nonblank.

STARTAT=NONBLANK
Data is to be extracted for this parsed field starting at the first nonblank. The search for a nonblank begins at the Start Pointer. If a nonblank is not found, data is not extracted for this parsed field or any subsequent parsed fields. If a nonblank is found, data is extracted to the fixed area for this parsed field starting at the nonblank, and the Start Pointer is set to the nonblank.

Example
If your input is:

```
Frank D28
Victoria D52
Holly D15
Roberta D52
```

and you wanted your output to be:

```
Frank D28
Victoria D52
Holly D15
Roberta D52
```

you could use this OUTFIL statement:

```
OUTFIL PARSE=(%00=(STARTAT=NONBLANK,ENDBEFR=BLANKS,FIXLEN=8),
              %01=(FIXLEN=3)),
              BUILD=(%00,14:%01)
```

Note: Multiple STARTAFT/STARTAT strings, BLANKS or NONBLANK can be used for a %nn parsed field to search for more than one string, blanks or a nonblank. The first search satisfied is used.

Example
If your input is:

```
12 MAXCC=08
58 MINCC=00
```

and you wanted your output to be:

```
MAXCC=08
MINCC=00
```

you could use this OUTFIL statement:

```
OUTFIL PARSE=(%00=(STARTAT=C'MAXCC=',STARTAT=C'MINCC=',
               FIXLEN=8)),BUILD=(%00)
```
OUTFIL Control Statements

**ENDBEFR=string**

Data is to be extracted for this parsed field ending before the first byte of the specified string. The search for the string begins at the Start Pointer. If the specified string is not found, data is extracted to the fixed area for this parsed field up to the end of the record, but data is not extracted for any subsequent parsed fields. If the specified string is found, data is extracted to the fixed area for this parsed field up to the byte before the start of the string, and the Start Pointer is set to the byte after the end of the string.

String can be 1 to 256 characters specified using a character string constant (C'xx...x') or a hexadecimal string constant (X'yy...yy'). See "INCLUDE Control Statement" on page 98 for details of coding character and hexadecimal string constants.

**Example**

If your input is:

Morgan Hill;California;5000:
San Jose;California;2000:
Austin;Texas;8000:

and you wanted your output to be:

Morgan Hill California 5000
San Jose California 2000
Austin Texas 8000

you could use this OUTFIL statement:

```
OUTFIL PARSE=(%00=(ENDBEFR=C';',FIXLEN=14),
    %01=(ENDBEFR=C';',FIXLEN=12),
    %02=(ENDBEFR=C':',FIXLEN=4)),
    BUILD=(%00,%01,%02)
```

ENDBEFR=X'00' can be used to extract null-terminated strings to fixed parsed fields.

**Example**

If your input contains null-terminated strings that look like this in hex:

```
F0F5F800
F1F2F3F4F500
F9F7F2F000
F500
F0F0F3F700
```

and you wanted to convert the null-terminated strings to right-aligned numeric values like this:

```
58
12345
9720
5
37
```

you could use this OUTFIL statement:

```
OUTFIL PARSE=(%01=(ENDBEFR=X'00',FIXLEN=5)),
    BUILD=(%01,UFF,EDIT=(IIIIT))
```

**ENDBEFR=BLANKS**

Data is to be extracted for this parsed field ending before the first blank. The search for a blank begins at the Start Pointer. If a blank is not found, data is extracted to the fixed area for this parsed field up to the end of the record, but data is not extracted for any subsequent parsed fields. If a
**OUTFIL Control Statements**

blank is found, data is extracted to the fixed area for this parsed field up to the byte before the blank, and the Start Pointer is set to the first nonblank.

*Example*

If your input is:

```
1  Frank  D28  123  No
2 Loretta  D52  58  Yes
```

and you wanted your output to be:

```
0123 Frank  D28
0058 Loretta D52
```

you could use this OUTFIL statement:

```
OUTFIL PARSE=(%00=(STARTAFT=BLANKS,ENDBEFR=BLANKS,FIXLEN=8),
  %01=(ENDBEFR=BLANKS,FIXLEN=3),
  %02=(ENDBEFR=C' ',FIXLEN=4)),
BUILD=(%02,UFF,EDIT=(TTTT),X,%00,%01)
```

**ENDAT=string**

Data is to be extracted for this parsed field ending at the last byte of the specified string. The search for the string begins at the Start Pointer. If the specified string is not found, data is extracted to the fixed area for this parsed field up to the end of the record, but data is not extracted for any subsequent parsed fields. If the specified string is found, data is extracted to the fixed area for this parsed field up to the last byte of the string, and the Start Pointer is set to the byte after the end of the string.

string can be 1 to 256 characters specified using a character string constant (C'xx...x') or a hexadecimal string constant (X'yy...yy'). See "INCLUDE Control Statement" on page 98 for details of coding character and hexadecimal string constants.

*Example*

If your input is:

```
12,(June)
5852,(Gracie)
```

and you wanted your output to be:

```
(June)
(Gracie)
```

you could use this OUTFIL statement:

```
OUTFIL PARSE=(%00=(STARTAT=C'(','ENDAT=C')',FIXLEN=12)),
BUILD=(%00)
```

**ENDAT=BLANKS**

Data is to be extracted for this parsed field ending at the last blank before a nonblank. The search for a blank begins at the Start Pointer. If a blank is not found, data is extracted to the fixed area for this parsed field up to the end of the record, but data is not extracted for any subsequent parsed fields. If a blank is found, data is extracted to the fixed area for this parsed field up to the byte before the first nonblank, and the Start Pointer is set to the first nonblank.

*Note:* Multiple ENDBEFR/ENDAT strings or BLANKS can be used for a %nn parsed field to search for more than one string or blanks. The first search satisfied is used.
OUTFIL Control Statements

Example

If your input is:

12;
58:
04/

and you wanted your output to be:

12
58
04

you could use this OUTFIL statement:

```
OUTFIL PARSE=(%01=(ENDBEFR=C';',ENDBEFR=C':',ENDBEFR=C'/',
  FIXLEN=10)),
  BUILD=(%01,UFF,TO=ZD,LENGTH=2,80:X)
```

PAIR=APOST

Do not search for strings or blanks between apostrophe (') pairs. Use
POST=APOST when you might have strings you are searching for within
literals that should not satisfy the search.

Once an apostrophe is found, searching is discontinued until another
apostrophe is found. Searching then continues after the second apostrophe
of the pair. If an unpaired apostrophe is found, strings or BLANKS will not
be recognized from that point on, so be careful not to set the Start Pointer
in the middle of an apostrophe pair.

Do not specify PAIR=APOST if you want to search for a string containing
an apostrophe, because the string will not be searched for within the
paired apostrophes.

Example

If your input is:

'23','12,567,823','5,032'
'9,903','18,321','8'

and you wanted your output to be:

23 12,567,823 5,032
9,903 18,321 8

you could use this OUTFIL statement:

```
OUTFIL PARSE=(%00=(ENDBEFR=C',',FIXLEN=12,PAIR=APOST),
  %01=(ENDBEFR=C',',FIXLEN=12,PAIR=APOST),
  %02=(FIXLEN=12)),
  BUILD=(%00,UFF,EDIT=(II,III,IIIT),X,
  %01,UFF,EDIT=(II,III,IIIT),X,
  %02,UFF,EDIT=(II,III,IIIT))
```

With PAIR=APOST, the commas outside the apostrophe pairs satisfy the
search, but the commas within the apostrophe pairs do not satisfy the
search.

PAIR=QUOTE

Do not search for strings or blanks between quote (") pairs. Use
POST=QUOTE when you might have strings you are searching for within
literals that should not satisfy the search.

Once a quote is found, searching is discontinued until another quote is
found. Searching then continues after the second quote of the pair. If an
unpaired quote is found, strings or BLANKS will not be recognized from that point on, so be careful not to set the Start Pointer in the middle of a quote pair.

Do not specify PAIR=QUOTE if you want to search for a string containing a quote, because the string will not be searched for within the paired quotes.

Example
If your input is:
"23","12,567,823","5,032"
"9,903","18,321","8"

and you wanted your output to be:

23 12,567,823 5,032
9,903 18,321 8

you could use this OUTFIL statement:

```
OUTFIL PARSE=(%00=(ENDBEFR=C',',FIXLEN=12,PAIR=QUOTE),
%01=(ENDBEFR=C',',FIXLEN=12,PAIR=QUOTE),
%02=(FIXLEN=12)),
BUILD=(%00,UFF,EDIT=(II,III,IIT),X,
%01,UFF,EDIT=(II,III,IIT),X,
%02,UFF,EDIT=(II,III,IIT))
```

With PAIR=QUOTE, the commas outside the quote pairs satisfy the search, but the commas within the quote pairs do not satisfy the search.

Default for PARSE: None; must be specified.

`OUTREC, BUILD, OVERLAY, FINDREP, or IFTHEN`

These operands allow you to reformat the OUTFIL input records in this OUTFIL group.

You can create the reformatted OUTFIL records in one of the following ways using unedited, edited, or converted input fields (p,m for fixed fields, or %nn for parsed fields - see PARSE) and a variety of constants:

- **BUILD or OUTREC**: Reformat each record by specifying all of its items one by one. Build gives you complete control over the items you want in your reformatted OUTFIL records and the order in which they appear. You can delete, rearrange and insert fields and constants. Examples:
OUTFIL FNAMES=OUT1,BUILD=(1,20,C'ABC',15,3,PD,EDIT=(TTT.TT),21,30,80:X)

OUTFIL FNAMES=OUT2,
PARSE=,%00=(ENDBEFR=C',',FIXLEN=6),
%01=(ENDBEFR=C',',FIXLEN=5),
%=(ENDBEFR=C','),
%02=(FIXLEN=6),
BUILD=(C'|',%01,SFF,ADD,%02,SFF,M4,LENGTH=12,
C'|',%00,C'|')

- **OVERLAY**: Reformat each record by specifying just the items that overlay specific columns. Overlay lets you change specific existing columns without affecting the entire record. Example:
  
  OUTFIL OVERLAY=(45:45,8,TRAN=LTOU)

- **FINDREP**: Reformat each record by doing various types of find and replace operations. Example:
  
  OUTFIL FINDREP=(INOUT=(C'Pigeon',C'Dove',C'Hawk',C'Eagle'))

- **IFTHEN clauses**: Reformat different records in different ways by specifying how build, overlay, find/replace, or group operation items are applied to records that meet given criteria. IFTHEN clauses let you use sophisticated conditional logic to choose how different record types are reformatted. Example:
  
  OUTFIL IFTHEN=(WHEN=(1,5,CH,EQ,C'TYPE1'),
  BUILD=(1,40,C'*=',+1,TO=PD)),
  IFTHEN=(WHEN=(1,5,CH,EQ,C'TYPE2'),
  BUILD=(1,40,+2,TO=PD,X'FFFF')),
  IFTHEN=(WHEN=NONE,OVERLAY=(45:C'NONE'))

You can choose to include any or all of the following items in your reformatted OUTFIL records:

- Fixed position/length fields or variable position/length fields. For fixed fields, you specify the starting position and length of the field directly. For variable fields, such as delimited fields, comma separated values (CSV), tab separated values, blank separated values, keyword separated fields, null-terminated strings (and many other types), you define rules that allow DFSORT to extract the relevant data into fixed parsed fields, and then use the parsed fields as you would use fixed fields.
- Blanks, binary zeros, character strings, and hexadecimal strings.
- Current date, future date, past date, and current time in various forms.
- Replaced or removed strings.
- Unedited input fields aligned on byte, halfword, fullword, and doubleword boundaries.
- Hexadecimal or bit representations of binary input fields.
- Characters translated from uppercase to lowercase, lowercase to uppercase, ASCII to EBCDIC or EBCDIC to ASCII.
- Left-justified, right-justified, left-squeezed or right-squeezed input fields.
- Numeric input fields of various formats converted to different numeric formats, or to character format edited to contain signs, thousands separators, decimal points, leading zeros or no leading zeros, and so on.
- Decimal constants converted to different numeric formats, or to character format edited to contain signs, thousands separators, decimal points, leading zeros or no leading zeros, and so on.
- The results of arithmetic expressions combining fields, decimal constants, operators (MIN, MAX, MUL, DIV, MOD, ADD and SUB) and parentheses.
OUTFIL Control Statements

- Converted to different numeric formats, or to character format edited to contain signs, thousands separators, decimal points, leading zeros or no leading zeros, and so on.
- SMF, TOD, and ETOD date and time fields converted to different numeric formats, or to character format edited to contain separators, leading zeros or no leading zeros, and so on.
- The results of various types of arithmetic operations for input date fields.
- Input date fields of one type (CH, ZD, PD, 2-digit year, 4-digit year, Julian, Gregorian) converted to corresponding output date fields of another type or to a corresponding day of the week.
- Sequence numbers in various formats.
- A character constant, hexadecimal constant or input field selected from a lookup table, based on a character, hexadecimal or bit constant as input.
- A zoned decimal group identifier, a zoned decimal group sequence number, or a field propagated from the first record of a group to all of the records of a group.

OUTREC or BUILD
OUTFIL Control Statements

Specifies all of the items in the reformatted OUTFIL record in the order in which they are to be included. The reformatted OUTFIL record consists of the separation fields, edited and unedited input fields (p,m for fixed fields, or %nn for parsed fields - see PARSE), edited decimal constants, edited results of arithmetic expressions, and sequence numbers you select, in the order in which you select them, aligned on the boundaries or in the columns you indicate.

For variable-length records, the first item in the BUILD or OUTREC parameter must specify or include the unedited 4-byte record descriptor word (RDW), that is, you must start with 1,m with m equal to or greater than 4. If you want to include the bytes from a specific position to the end of each input record at the end of each reformatted output record, you can specify that starting position (p) as the last item in the BUILD or OUTREC parameter. For example:
OUTFIL Control Statements

```
OUTFIL OUTREC=(1,4,
  1,2,B,TO=ZD,LENGTH=5,
  C'|',
  5) display RDW length in decimal
  display input positions 5 to end
```

For fixed-length records, the first input and output data byte starts at position 1. For variable-length records, the first input and output data byte starts at position 5, after the RDW in positions 1-4.

You can use the BUILD or OUTREC parameter to produce multiple reformatted output records for each OUTFIL input record, with or without intervening blank output records.

You can use the BUILD or OUTREC parameter in conjunction with the VTOF or CONVERT parameter to convert variable-length record data sets to fixed-length record data sets.

You can use the BUILD or OUTREC parameter with the FTOV parameter to convert fixed-length record data sets to variable-length record data sets.

You can use the VLFILL parameter to allow processing of variable-length input records which are too short to contain all specified BUILD or OUTREC fields.

You can use the VLTRIM parameter in conjunction with the BUILD or OUTREC parameter to remove specified trailing bytes from the end of variable-length records.

The BUILD or OUTREC parameter can be used with any or all of the report parameters (LINES, HEADER1, TRAILER1, HEADER2, TRAILER2, SECTIONS, BLKCCH1, BLKCCH2, BLKCCT1, and NODETAIL) to produce reports. The report parameters specify the report records to be produced, while the BUILD or OUTREC parameter specifies the reformatted data records to be produced. DFSORT uses ANSI carriage control characters to control page ejects and the placement of the lines in your report, according to your specifications. You can use the REMOVECC parameter to remove the ANSI carriage control characters.

When you create an OUTFIL report, the length for the longest or only data record must be equal to or greater than the maximum report record length. You can use the BUILD or OUTREC parameter to force a length for the data records that is longer than any report record; you can then either let DFSORT compute and set the LRECL, or ensure that the computed LRECL is equal to the existing or specified LRECL. Remember to allow an extra byte in the LRECL for the ANSI carriage control character.

For example, if your data records are 40 bytes, but your longest report record is 60 bytes, you can use a BUILD or OUTREC parameter such as:

```
OUTREC=(1,40,80:X)
```

DFSORT will then set the LRECL to 81 (1 byte for the ANSI carriage control character plus 80 bytes for the length of the data records), and pad the data records with blanks on the right.

If you don’t want the ANSI carriage control characters to appear in the output data set, use the REMOVECC parameter to remove them. For example, if you specify:

```
OUTREC=(1,40,80:X),REMOVECC
```

DFSORT will set the LRECL to 80 instead of 81 and remove the ANSI carriage control character from each record before it is written.

The BUILD or FIELDS parameter of the OUTREC statement differs from the BUILD or OUTREC parameter of the OUTFIL statement in the following ways:
OUTFIL Control Statements

- The BUILD or FIELDS parameter of the OUTREC statement applies to all input records; the BUILD or OUTREC parameter of the OUTFIL statement only applies to the OUTFIL input records for its OUTFIL group.
- The BUILD or OUTREC parameter of the OUTFIL statement supports the slash (/) separator for creating blank records and new records; the BUILD or FIELDS parameter of the OUTREC statement does not.

The reformatted OUTFIL output record consists of the separation fields, edited and unedited input fields, (p,m for fixed fields, or %nn for parsed fields - see PARSE), edited decimal constants, edited results of arithmetic expressions, and sequence numbers you select, in the order in which you select them, aligned on the boundaries or in the columns you indicate.

**c**: specifies the position (column) for a separation field, input field, decimal constant, arithmetic expression, or sequence number, relative to the start of the reformatted OUTFIL output record. Count the RDW (variable-length output records only) but not the carriage control character (for reports) when specifying c. That is, 1: indicates the first byte of the data in fixed-length output records and 5: indicates the first byte of the data in variable-length output records.

Unused space preceding the specified column is padded with EBCDIC blanks.

The following rules apply:
- c must be a number between 1 and 32752.
- c: must be followed by a separation field, input field, decimal constant, or arithmetic expression.
- c must not overlap the previous input field or separation field in the reformatted OUTFIL output record.
- For variable-length records, c: must not be specified before the first input field (the record descriptor word) nor after the variable part of the OUTFIL input record.
- The colon (:) is treated like the comma (,) or semicolon (;) for continuation to another line.

See Table 25 on page 130 for examples of valid and invalid column alignment.

**s** specifies that a separation field (blanks, zeros, character string, hexadecimal string, current date, future date, past date, or current time) is to appear in the reformatted OUTFIL output record, or that a new output record is to be started, with or without intervening blank output records. These separation elements (separation fields, new record indicators, and blank record indicators) can be specified before or after any input field. Consecutive separation elements may be specified. For variable-length records, separation elements must not be specified before the first input field (the record descriptor word) or after the variable part of the OUTFIL input record. Permissible values are nX, nZ, nC\textasciicircum{x...x}, nX'yy...yy', various date and time constants, /.../ and n/.

**nX**
Blank separation. n bytes of EBCDIC blanks (X'40') are to appear in the reformatted OUTFIL output records. n can range from 1 to 4095. If n is omitted, 1 is used.

See Table 26 on page 131 for examples of valid and invalid blank separation.

**nZ**
Binary zero separation. n bytes of binary zeros (X'00') are to appear in the reformatted OUTFIL output records. n can range from 1 to 4095. If n is omitted, 1 is used.
OUTFIT Control Statements

See Table 27 on page 131 for examples of valid and invalid binary zero separation.

\text{nC'xx...x'}\par
Character string separation. \text{n} repetitions of the character string constant (C'xx...x') are to appear in the reformatted OUTFIL output records. \text{n} can range from 1 to 4095. If \text{n} is omitted, 1 is used. \text{x} can be any EBCDIC character. You can specify from 1 to 256 characters.

If you want to include a single apostrophe in the character string, you must specify it as two single apostrophes:

\text{Required: O'NEILL Specify: C'O''NEILL'}

See Table 28 on page 131 for examples of valid and invalid character string separation.

\text{nX'yy...yy'}\par
Hexadecimal string separation. \text{n} repetitions of the hexadecimal string constant (X'yy...yy') are to appear in the reformatted OUTFIL output records. \text{n} can range from 1 to 4095. If \text{n} is omitted, 1 is used.

The value \text{yy} represents any pair of hexadecimal digits. You can specify from 1 to 256 pairs of hexadecimal digits.

See Table 29 on page 132 for examples of valid and invalid hexadecimal string separation.

\text{DATEn, DATEN(c), DATEnP}\par
Constant for current date. The current date of the run is to appear in the reformatted OUTFIL output records.

\text{DATE1, \&DATE1, DATE1(c), \&DATE1(c), DATE2, \&DATE2, DATE2(c), \&DATE2(c), DATE3, \&DATE3, DATE3(c) or \&DATE3(c) can be used to generate a character constant for the current date of the run. DATE1P, \&DATE1P, DATE2P, \&DATE2P, DATE3P or \&DATE3P can be used to generate a packed decimal constant for the current date of the run.}

Table 35 shows the form of the constant generated for each current date operand and an example of the actual constant generated when the date of the run is June 21, 2005 at 4:42:45 PM, using (/) for (c) where relevant. \text{yyyy} represents the year, \text{mm} (for date) represents the month (01-12), \text{dd} represents the day (01-31), \text{ddd} represents the day of the year (001-366), \text{hh} represents the hour (00-23), \text{mm} (for time) represents the minutes (00-59), \text{ss} represents the seconds (00-59), and \text{c} can be any character except a blank.

\begin{table}[h]
\centering
\begin{tabular}{|l|l|l|l|}
\hline
\text{Format of} & \text{Format of Constant} & \text{Length (bytes)} & \text{Example of Constant} \\
\text{Operand} & & & \\
\hline
\text{DATE1} & C'yyyyymmdd' & 8 & C'20050621' \\
\hline
\text{DATE1(c)} & C'yyyyymmdcd' & 10 & C'2005/06/21' \\
\hline
\text{DATE1P} & P'yyyyymmdd' & 5 & P'20050621' \\
\hline
\text{DATE2} & C'yyyyymm' & 6 & C'200506' \\
\hline
\text{DATE2(c)} & C'yyyyymmm' & 7 & C'2005/06' \\
\hline
\text{DATE2P} & P'yyyyymm' & 4 & P'200506' \\
\hline
\text{DATE3} & C'yyyyddd' & 7 & C'2005172' \\
\hline
\end{tabular}
\end{table}
OUTFIL Control Statements

Table 35. Current date constants (continued)

<table>
<thead>
<tr>
<th>Format of Operand</th>
<th>Format of Constant</th>
<th>Length (bytes)</th>
<th>Example of Constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATE3(c)</td>
<td>C‘yyyycddd’</td>
<td>8</td>
<td>C’2005/172’</td>
</tr>
<tr>
<td>DATE3P</td>
<td>P‘yyyyyddd’</td>
<td>4</td>
<td>P’2005172’</td>
</tr>
<tr>
<td>DATE4</td>
<td>C‘yyyy-mm-dd-hh.mm.ss’</td>
<td>19</td>
<td>C’2005-06-21-16.52.45’</td>
</tr>
<tr>
<td>DATE5</td>
<td>C‘yyyy-mm-dd-hh.mm.ss.nnnnnn’</td>
<td>26</td>
<td>C’2005-06-21-16.52.45.602837’</td>
</tr>
</tbody>
</table>

Note: You can precede each of the operands in the table with an & with identical results.

&DATEn, &DATEn(c), &DATEnP
Can be used instead of DATEn, DATEn(c) and DATEnP, respectively

DATEn+r, DATEn(c)+r, DATEnP+r
Constant for future date. A future date relative to the current date of the run is to appear in the reformatted OUTFIL output records.

DATE1+d, &DATE1+d, DATE1(c)+d, &DATE1(c)+d, DATE2+m, &DATE2+m, DATE2(c)+m, &DATE2(c)+m, DATE3+d, &DATE3+d, DATE3(c)+d or &DATE3(c)+d can be used to generate a character constant for a future date relative to the current date of the run. DATE1P+d, &DATE1P+d, DATE2P+m, &DATE2P+m, DATE3P+d or &DATE3P+d can be used to generate a packed decimal constant for a future date relative to the current date of the run. d is days in the future and m is months in the future. d and m can be 0 to 9999.

Table 36 shows the form of the constant generated for each future date operand and an example of the actual constant generated when the date of the run is June 21, 2005, using (/) for (c) where relevant. yyyy represents the year, mm (for date) represents the month (01-12), dd represents the day (01-31), ddd represents the day of the year (001-366), and c can be any character except a blank.

Table 36. Future Date Constants

<table>
<thead>
<tr>
<th>Format of Operand</th>
<th>Format of Constant</th>
<th>Length (bytes)</th>
<th>Example of Operand</th>
<th>Example of Constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATE1+d</td>
<td>C‘yyyyymmd’</td>
<td>8</td>
<td>DATE1+11</td>
<td>C’20050702’</td>
</tr>
<tr>
<td>DATE1(c)+d</td>
<td>C‘yyyyyymmd’</td>
<td>10</td>
<td>DATE1(+)90</td>
<td>C’2005/09/19’</td>
</tr>
<tr>
<td>DATE1P+d</td>
<td>P‘yyyyymmd’</td>
<td>5</td>
<td>DATE1P+11</td>
<td>P’20050702’</td>
</tr>
<tr>
<td>DATE2+m</td>
<td>C‘yyyyym’</td>
<td>6</td>
<td>DATE2+2</td>
<td>C’200508’</td>
</tr>
<tr>
<td>DATE2(c)+m</td>
<td>C‘yyyyym’</td>
<td>7</td>
<td>DATE2(+25)</td>
<td>C’2007.07’</td>
</tr>
<tr>
<td>DATE2P+m</td>
<td>P‘yyyyym’</td>
<td>4</td>
<td>DATE2P+2</td>
<td>P’200508’</td>
</tr>
<tr>
<td>DATE3+d</td>
<td>C‘yyyyyddd’</td>
<td>7</td>
<td>DATE3+200</td>
<td>C’2006007’</td>
</tr>
<tr>
<td>DATE3(c)+d</td>
<td>C‘yyyymmd’</td>
<td>8</td>
<td>DATE3(+1)</td>
<td>C’2005-171’</td>
</tr>
<tr>
<td>DATE3P+d</td>
<td>P‘yyyyyddd’</td>
<td>4</td>
<td>DATE3P+200</td>
<td>P’2006007’</td>
</tr>
</tbody>
</table>
Note: You can precede each of the operands in the table with an & with identical results.

&DATEn+r, &DATEn(c)+r, &DATEnP+r
Can be used instead of DATEn+r, DATEn(c)+r and DATEnP+r, respectively.

DATE-r, DATEn-c-r, DATEnP-r
Constant for past date. A past date relative to the current date of the run is to appear in the reformatted OUTFIL output records.

DATE1-d, &DATE1-d, DATE1(c)-d, &DATE1(c)-d, DATE2-m, &DATE2-m, DATE2(c)-m, &DATE2(c)-m, DATE3-d, &DATE3-d, DATE3(c)-d or &DATE3(c)-d can be used to generate a character constant for a past date relative to the current date of the run. DATE1P-d, &DATE1P-d, DATE2P-m, &DATE2P-m, DATE3P-d or &DATE3P-d can be used to generate a packed decimal constant for a past date relative to the current date of the run. d is days in the past and m is months in the past. d and m can be 0 to 9999.

Table 37 shows the form of the constant generated for each past date operand and an example of the actual constant generated when the date of the run is June 21, 2005, using (/) for (c) where relevant. yyyy represents the year, mm (for date) represents the month (01-12), dd represents the day (01-31), ddd represents the day of the year (001-366), and c can be any character except a blank.

Table 37. Past Date Constants

<table>
<thead>
<tr>
<th>Format of Operand</th>
<th>Format of Constant</th>
<th>Length (bytes)</th>
<th>Example of Operand</th>
<th>Example of Constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATE1-d</td>
<td>C’yyyyMMdd’</td>
<td>8</td>
<td>DATE1-1</td>
<td>C’20050620’</td>
</tr>
<tr>
<td>DATE1(c)-d</td>
<td>C’yyyyMMddmmcd’</td>
<td>10</td>
<td>DATE1(c)-60</td>
<td>C’2005-04-22’</td>
</tr>
<tr>
<td>DATE1P-d</td>
<td>P’yyyyMMdd’</td>
<td>5</td>
<td>DATE1P-30</td>
<td>P’20050522’</td>
</tr>
<tr>
<td>DATE2-m</td>
<td>C’yyyyym’</td>
<td>6</td>
<td>DATE2-6</td>
<td>C’200412’</td>
</tr>
<tr>
<td>DATE2(c)-m</td>
<td>C’yyyyycmm’</td>
<td>7</td>
<td>DATE2(/)-1</td>
<td>C’2005/05’</td>
</tr>
<tr>
<td>DATE2P-m</td>
<td>P’yyyyym’</td>
<td>4</td>
<td>DATE2P-12</td>
<td>P’200406’</td>
</tr>
<tr>
<td>DATE3-d</td>
<td>C’yyyyydd’</td>
<td>7</td>
<td>DATE3-300</td>
<td>C’2004238’</td>
</tr>
<tr>
<td>DATE3(c)-d</td>
<td>C’yyyyycddd’</td>
<td>8</td>
<td>DATE3(.)-21</td>
<td>C’2005.151’</td>
</tr>
<tr>
<td>DATE3P-d</td>
<td>P’yyyyydd’</td>
<td>4</td>
<td>DATE3P-172</td>
<td>P’2004366’</td>
</tr>
</tbody>
</table>

Note: You can precede each of the operands in the table with an & with identical results.

&DATEn-r, &DATEn(c)-r, &DATEnP-r
Can be used instead of DATEn-r, DATEn(c)-r and DATEnP-r, respectively.

TIMEn, TIMEn(c), TIMEnP
Constant for current time. The time of the run is to appear in the reformatted OUTFIL output records. Table 38 on page 263 shows the constant generated for each separation field you can specify along with its length and an example using (c) for (c)
where relevant. hh represents the hour (00-23), mm represents
the minutes (00-59), ss represents the seconds (00-59), and c can
be any character except a blank.

Table 38. Current time constants

<table>
<thead>
<tr>
<th>Separation Field</th>
<th>Constant</th>
<th>Length (bytes)</th>
<th>01:55:43 PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIME1</td>
<td>C’hhmmss’</td>
<td>6</td>
<td>C’135543’</td>
</tr>
<tr>
<td>TIME1(c)</td>
<td>C’hhcmcss’</td>
<td>8</td>
<td>C’13:55:43’</td>
</tr>
<tr>
<td>TIME1P</td>
<td>P’hhmmss’</td>
<td>4</td>
<td>P’135543’</td>
</tr>
<tr>
<td>TIME2</td>
<td>C’hhmm’</td>
<td>4</td>
<td>C’1355’</td>
</tr>
<tr>
<td>TIME2(c)</td>
<td>C’hhcmm’</td>
<td>5</td>
<td>C’13:55’</td>
</tr>
<tr>
<td>TIME2P</td>
<td>P’hhmm’</td>
<td>3</td>
<td>P’1355’</td>
</tr>
<tr>
<td>TIME3</td>
<td>C’hh’</td>
<td>2</td>
<td>C’13’</td>
</tr>
<tr>
<td>TIME3P</td>
<td>P’hh’</td>
<td>2</td>
<td>P’13’</td>
</tr>
</tbody>
</table>

&TIMEn, &TIMEn(c), &TIMEnP
Can be used instead of TIMEn, TIMEn(c), and TIMEnP,
respectively.

DATE specifies that the current date is to appear in the reformatted
OUTFIL output records in the form ‘mm/dd/yy’, where mm
represents the month (01-12), dd represents the day (01-31),
and yy represents the last two digits of the year (for example,
04).

&DATE can be used instead of DATE.

DATE=(abcd) specifies that the current date is to appear in the reformatted
OUTFIL output records in the form ‘adbdc’, where a, b, and c
indicate the order in which the month, day, and year are to
appear and whether the year is to appear as two or four digits,
and d is the character to be used to separate the month, day
and year.

For a, b, and c, use M to represent the month (01-12), D to
represent the day (01-31), Y to represent the last two digits of
the year (for example, 04), or 4 to represent the four digits of
the year (for example, 2004). M, D, and Y or 4 can each be
specified only once. Examples: DATE=(DMY.) would produce a
date of the form ‘dd.mm.yy’, which on March 29, 2004, would
appear as ‘29.03.04’. DATE=(4MD-) would produce a date of
the form ‘yyyy-mm-dd’, which on March 29, 2004, would
appear as ‘’2004-03-29’.

a, b, c, and d must be specified.

&DATE=(abcd)
can be used instead of DATE=(abcd).

DATENS=(abc)
specifies that the current date is to appear in the reformatted
OUTFIL output record in the form ‘abc’, where a, b and c
indicate the order in which the month, day, and year are to
appear and whether the year is to appear as two or four digits.
OUTFIL Control Statements

For a, b and c, use M to represent the month (01-12), D to represent the day (01-31), Y to represent the last two digits of the year (for example, 04), or 4 to represent the four digits of the year (for example, 2004). M, D, and Y or 4 can each be specified only once. Examples: DATENS=(DMY) would produce a date of the form 'ddmmyy', which on March 29, 2004, would appear as '290304'. DATENS=(4MD) would produce a date of the form 'yyyyymmdd', which on March 29, 2004, would appear as '20040329'.

a, b and c must be specified.

&DATENS=(abc)
can be used instead of DATENS=(abc).

YDDD=(abc) specifies that the current date is to appear in the reformatted OUTFIL output records in the form 'acb', where a and b indicate the order in which the year and day of the year are to appear and whether the year is to appear as two or four digits, and c is the character to be used to separate the year and day of the year.

For a and b, use D to represent the day of the year (001-366), Y to represent the last two digits of the year (for example, 04), or 4 to represent the four digits of the year (for example, 2004). D, and Y or 4 can each be specified only once. Examples: YDDD=(DY-) would produce a date of the form 'ddd-yy', which on April 7, 2004, would appear as '098-04'. YDDD=(4D/) would produce a date of the form 'yyyy/ddd', which on April 7, 2004, would appear as '2004/098'.

a, b and c must be specified.

&YDDD=(abc)
can be used instead of YDDD=(abc).

YDDDNS=(ab) specifies that the current date is to appear in the reformatted OUTFIL output records in the form 'ab', where a and b indicate the order in which the year and day of the year are to appear and whether the year is to appear as two or four digits.

For a and b, use D to represent the day of the year (001-366), Y to represent the last two digits of the year (for example, 04), or 4 to represent the four digits of the year (for example, 2004). D, and Y or 4 can each be specified only once. Examples: YDDDNS=(DY) would produce a date of the form 'dddyy', which on April 7, 2004, would appear as '09804'. YDDDNS=(4D) would produce a date of the form 'yyyyddd', which on April 7, 2004, would appear as '2004098'.

a and b must be specified.

&YDDDNS=(ab)
can be used instead of YDDDNS=(ab).

TIME specifies that the current time is to appear in the reformatted OUTFIL output records in the form 'hh:mm:ss', where hh represents the hour (00-23), mm represents the minutes (00-59), and ss represents the seconds (00-59).

&TIME can be used instead of TIME.
OUTFIL Control Statements

**TIME=(abc)** specifies that the current time is to appear in the reformatted OUTFIL output records in the form 'hhmmcss' (24-hour time) or 'hhcmcss xx' (12-hour time).

If ab is 24, the time is to appear in the form 'hhcmcss' (24-hour time) where hh represents the hour (00-23), mm represents the minutes (00-59), ss represents the seconds (00-59), and c is the character used to separate the hours, minutes, and seconds. Example: TIME=(24.) would produce a time of the form 'hh.mm.ss', which at 08:25:13 pm would appear as '20.25.13'.

If ab is 12, the time is to appear in the form 'hhcmcss xx' (12-hour time) where hh represents the hour (01-12), mm represents the minutes (00-59), ss represents the seconds (00-59), xx is am or pm, and c is the character used to separate the hours, minutes, and seconds. Example: TIME=(12.) would produce a time of the form 'hh.mm.ss xx', which at 08:25:13 pm would appear as '08.25.13 pm'.

ab and c must be specified.

**&TIME=(abc)** can be used instead of TIME=(abc).

**TIMENS=(ab)** specifies that the current time is to appear in the reformatted OUTFIL output record in the form 'hhmms' (24-hour time) or 'hhmmss xx' (12-hour time).

If ab is 24, the time is to appear in the form 'hhmms' (24-hour time) where hh represents the hour (00-23), mm represents the minutes (00-59), and ss represents the seconds (00-59). Example: TIMENS=(24) would produce a time of the form 'hhmms', which at 08:25:13 pm would appear as '202513'.

If ab is 12, the time is to appear in the form 'hhmmss xx' (12-hour time) where hh represents the hour (01-12), mm represents the minutes (00-59), and ss represents the seconds (00-59). Example: TIMENS=(12) would produce a time of the form 'hhmmss xx', which at 08:25:13 pm would appear as '082513 pm'.

ab must be specified.

**&TIMENS=(ab)** can be used instead of TIMENS=(ab).

**/.../ or n/** Blank records or a new record. A new output record is to be started with or without intervening blank output records. If /.../ or n/ is specified at the beginning or end of OUTREC, n blank output records are to be produced. If /.../ or n/ is specified in the middle of OUTREC, n−1 blank output records are to be produced (thus, / or 1/ indicates a new output record with no intervening blank output records).

At least one input field or separation field must be specified if you use /.../ or n/. For example, OUTREC=(//) is not allowed, whereas OUTREC=(//X) is allowed.

Either n/ (for example, 5/) or multiple /'s (for example, //////) can be used. n can range from 1 to 255. If n is omitted, 1 is used.
OUTFIL Control Statements

As an example, if you specify:

```
OUTFIL OUTREC=(2/,C'Field 2 contains ',4,3,/,C'Field 1 contains ',1,3)
```

an input record containing:
```
111222
```

would produce the following four output records:
```
Blanks
Blanks
Field 2 contains 222
Field 1 contains 111
```

Note that four OUTFIL output records are produced for each OUTFIL input record.

**p,m,a**

specifies that an unedited input field is to appear in the reformatted OUTFIL output record.

- **p** specifies the first byte of the input field relative to the beginning of the OUTFIL input record. The first data byte of a fixed-length record has relative position 1. The first data byte of a variable-length record has relative position 5, because the first four bytes are occupied by the RDW. All fields must start on a byte boundary, and no field can extend beyond byte 32752. See "OUTFIL Statements Notes" on page 375 for special rules concerning variable-length records.

- **m** specifies the length in bytes of the input field.

- **a** specifies the alignment (displacement) of the input field in the reformatted OUTFIL output record relative to the start of the reformatted OUTFIL output record. The permissible values of **a** are:

  - **H** Halfword aligned. The displacement (p−1) of the field from the beginning of the reformatted OUTFIL input record, in bytes, is a multiple of 2 (that is, position 1, 3, 5, and so forth).

  - **F** Fullword aligned. The displacement is a multiple of 4 (that is, position 1, 5, 9, and so forth).

  - **D** Doubleword aligned. The displacement is a multiple of 8 (that is, position 1, 9, 17, and so forth).

Alignment can be necessary if, for example, the data is used in a COBOL application program where items are aligned through the SYNCHRONIZED clause. Unused space preceding aligned fields are always padded with binary zeros.

**%nn**

specifies that an unedited parsed input field is to appear in the reformatted OUTFIL output record. See PARSE for details of parsed fields. See **p,m,a** for further details. Note that alignment (H, F, D) is not permitted for %nn fields (for example, %nn,F results in an error message and termination).

**p** specifies the unedited variable part of the OUTFIL input record (that part beyond the minimum record length) is to appear in the reformatted OUTFIL output record as the last field. **p** without **m** can only be used for variable-length records; not for fixed-length records.
OUTFIL Control Statements

Attention: If 1,4,p is specified (only RDW and variable part of record), "null" records containing only an RDW will result if the record length is less than p.

A value must be specified for p that is less than or equal to the minimum OUTFIL input record length plus 1 byte.

p,m,TRAN=keyword
Specifies that an input field is to be translated as indicated by the keyword.

Attention: If TRAN=keyword is used for non-character data (for example, PD), it may have unintended consequences.

p
See p under p,m,a

m specifies the length in bytes of the numeric field and depends on the keyword used as indicated.

TRAN=keyword
specifies the type of translation to be performed. The keyword can be one of the following:

TRAN=LTOU
translates lowercase EBCDIC letters (that is, a-z) to uppercase EBCDIC letters (that is, A-Z). Other characters are not changed. For example, the characters 'Vicky-123,x' would be replaced by 'VICKY-123,X'.

m can be 1 to 32752. The output length will be m bytes.

TRAN=UTOL
translates uppercase EBCDIC letters (that is, A-Z) to lowercase EBCDIC letters (that is, a-z). Other characters are not changed. For example, the characters 'CARRIE-005, CA' would be replaced by 'carrie-005, ca'.

m can be 1 to 32752. The output length will be m bytes.

TRAN=ALTSEQ
translates characters according to the ALTSEQ translation table in effect. For example, the characters X'5B5C' would be replaced by X'4040' if ALTSEQ CODE=(5B40,5C40) was in effect.

m can be 1 to 32752. The output length will be m bytes.

TRAN=ATOE
translates characters from ASCII to EBCDIC using the default standard TCP/IP service ASCII-to-EBCDIC translation table. For example, with TRAN=ATOE, the ASCII characters aB2 (X'614232') would be replaced by the EBCDIC characters aB2 (X'81C2F2').

m can be 1 to 32752. The output length will be m bytes.

Table 39 is the default standard TCP/IP table used for TRAN=ATOE. Each column shows the ASCII (A) character value on the left and its equivalent EBCDIC (E) character value on the right.

Table 39. TRAN=ATOE ASCII-to-EBCDIC translation

| Part 1 - TRAN=ATOE ASCII-to-EBCDIC Translation |
Table 39. TRAN=ATOE ASCII-to-EBCDIC translation (continued)

<table>
<thead>
<tr>
<th>A</th>
<th>E</th>
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</table>

Part 2 - TRAN=ATOE ASCII-to-EBCDIC Translation

<table>
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<td>8A 0A 9A 2A 2A 4A 8A 3A 7A CA D1 DA E9 EA 91 FA A9</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>8B 0B 9B 2B 2B 4B 8B 3B 7B CB DB E8 EB 92 FB B0</td>
<td></td>
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<tr>
<td>8C 0C 9C 2C 2C 4C 8C 3C 7C CC DC EC EB 93 FC 4F</td>
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</tr>
<tr>
<td>8D 0D 9D 2D 2D 4D 8D 3D 7D CD DD ED EB 94 FD 50</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>8E 0E 9E 3E 3E 4E 8E 3F 6F DF 6D EE 95 FE A1</td>
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<tr>
<td>8F 0F 9F 1F 1F 2F 8F 1F 2F 61 3F 6F 4F D6 5F 6D 96 7F 07</td>
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</tr>
</tbody>
</table>

TRAN=ETOA

translates characters from EBCDIC to ASCII using the default standard TCP/IP service EBCDIC-to-ASCII translation table. For example, with TRAN=ETOA, the EBCDIC characters aB2 (X'81C2F2') would be replaced by the ASCII characters aB2 (X'614232').

m can be 1 to 32752. The output length will be m bytes.

Table 40 is the default standard TCP/IP table used for TRAN=ETOA. Each column shows the EBCDIC (E) character value on the left and its equivalent ASCII (A) character value on the right.

Table 40. TRAN=ETOA ASCII-to-EBCDIC translation

Part 1 - TRAN=ETOA ASCII-to-EBCDIC Translation
## TRAN=ETOA ASCII-to-EBCDIC Translation (continued)

<table>
<thead>
<tr>
<th>E A</th>
<th>E A</th>
<th>E A</th>
<th>E A</th>
<th>E A</th>
<th>E A</th>
<th>E A</th>
<th>E A</th>
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<tbody>
<tr>
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<td>23</td>
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<td>59</td>
<td>5A</td>
<td>5B</td>
<td>5C</td>
<td>5D</td>
<td>5E</td>
</tr>
<tr>
<td>5F</td>
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<td>61</td>
<td>62</td>
<td>63</td>
<td>64</td>
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<td>7B</td>
<td>7C</td>
<td>7D</td>
<td>7E</td>
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<tr>
<td>7F</td>
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<td>81</td>
<td>82</td>
<td>83</td>
<td>84</td>
<td>85</td>
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<td>88</td>
<td>89</td>
<td>8A</td>
<td>8B</td>
<td>8C</td>
<td>8D</td>
<td>8E</td>
</tr>
<tr>
<td>8F</td>
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<td>91</td>
<td>92</td>
<td>93</td>
<td>94</td>
<td>95</td>
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<td>A1</td>
<td>A2</td>
<td>A3</td>
<td>A4</td>
<td>A5</td>
<td>A6</td>
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<tr>
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<td>A8</td>
<td>A9</td>
<td>AA</td>
<td>AB</td>
<td>AC</td>
<td>AD</td>
<td>AE</td>
</tr>
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<td>B1</td>
<td>B2</td>
<td>B3</td>
<td>B4</td>
<td>B5</td>
<td>B6</td>
</tr>
<tr>
<td>B7</td>
<td>B8</td>
<td>B9</td>
<td>BA</td>
<td>BB</td>
<td>BC</td>
<td>BD</td>
<td>BE</td>
</tr>
<tr>
<td>BF</td>
<td>C0</td>
<td>C1</td>
<td>C2</td>
<td>C3</td>
<td>C4</td>
<td>C5</td>
<td>C6</td>
</tr>
<tr>
<td>C7</td>
<td>C8</td>
<td>C9</td>
<td>CA</td>
<td>CB</td>
<td>CC</td>
<td>CD</td>
<td>CE</td>
</tr>
<tr>
<td>CF</td>
<td>D0</td>
<td>D1</td>
<td>D2</td>
<td>D3</td>
<td>D4</td>
<td>D5</td>
<td>D6</td>
</tr>
<tr>
<td>D7</td>
<td>D8</td>
<td>D9</td>
<td>DA</td>
<td>DB</td>
<td>DC</td>
<td>DD</td>
<td>DE</td>
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<tr>
<td>DF</td>
<td>E0</td>
<td>E1</td>
<td>E2</td>
<td>E3</td>
<td>E4</td>
<td>E5</td>
<td>E6</td>
</tr>
<tr>
<td>E7</td>
<td>E8</td>
<td>E9</td>
<td>EA</td>
<td>EB</td>
<td>EC</td>
<td>ED</td>
<td>EE</td>
</tr>
<tr>
<td>EF</td>
<td>F0</td>
<td>F1</td>
<td>F2</td>
<td>F3</td>
<td>F4</td>
<td>F5</td>
<td>F6</td>
</tr>
<tr>
<td>F7</td>
<td>F8</td>
<td>F9</td>
<td>FA</td>
<td>FB</td>
<td>FC</td>
<td>FD</td>
<td>FE</td>
</tr>
</tbody>
</table>
| FF  | **TRAN=HEX**

translates binary values to their equivalent EBCDIC hexadecimal values. For example, with TRAN=HEX, X'C1F1' (C'A1') would be replaced by C'C1F1'.

m can be 1 to 16376. The output length will be m*2 bytes

**TRAN=UNHEX**

translates EBCDIC hexadecimal values to their equivalent binary values. For example, with TRAN=UNHEX, C'C1F1' would be replaced by X'C1F1' (C'A1').

m can be 1 to 32752. The output length will be (m+1)/2 bytes.

If m is odd, the last nibble will be 0. As an example, C'C1F1F' would translate to X'C1F1F0' (C'A10').

If an input character is not 0-9 or A-F, the equivalent nibble will be set to 0. As an example, C'G2' will be translated to X'02'.

**TRAN=BIT**

translates binary values to their equivalent EBCDIC bit values. For example, with TRAN=BIT, X'C1F1' (C'A1') would be replaced by C'1100000111110001'.

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m can be 1 to 4094. The output length will be m*8 bytes

**TRAN=UNBIT**

translates EBCDIC bit values to their equivalent binary values. For example, with TRAN=UNBIT, C'1100000111110001' would be replaced by X'C1F1' (C'A1').

m can be 1 to 32752. The output length will be (m+7)/8 bytes
If m is not a multiple of 8, the missing bits on the right will be set to 0. As an example, C'1100000111111' would translate to X'C1F8'.
If an input character is not 0 or 1, the equivalent bit will be set to 0. As an example, C'11100005' will be translated to X'E0'.

*Sample Syntax:*

```plaintext
OUTFIL FNAMES=OUT1,
     BUILD=(5,6,TRAN=UNHEX,2X,20,15,TRAN=UTOL)
```

**%nn,TRAN=keyword**

Specifies that a parsed input field is to be translated as indicated by the keyword. See PARSE for details of PARSED fields. See p,m,TRAN=keyword for details of the translation functions.

**p,TRAN=keyword**

Specifies that the variable part of the input record is to be translated as indicated by the keyword. p,TRAN=keyword must be the last item and can only be used for variable-length records; not for fixed-length records. A value must be specified for p that is less than or equal to the minimum input record length plus 1 byte. See p,m,TRAN=keyword for details of the translation functions.

**Attention:** If 1,4,p,TRAN=keyword is specified (only RDW and variable part of record), “null” records containing only an RDW will result if the record length is less than p.

*Sample Syntax:*

```plaintext
OUTFIL FNAMES=OUT2,BUILD=(1,4,5,TRAN=ETOA)
```

**p,m,HEX**

Can be used instead of p,m,TRAN=HEX. See p,m,TRAN=HEX for details.

**%nn,HEX**

Can be used instead of %nn,TRAN=HEX. See %nn,TRAN=HEX for details.

**p,HEX**

Can be used instead of p,TRAN=HEX. See p,TRAN=HEX for details.

**p,m,f,edit or (p,m,f),edit**

specifies that an edited numeric input field is to appear in the reformatted OUTFIL output record. You can edit BI, FI, PD, PD0, ZD, FL, CSF, FS, UFF, SFF, DC1, DC2, DC3, DE1, DE2, DE3, DT1, DT2, DT3, TC1, TC2, TC3, TC4, TE1, TE2, TE3, TE4, TM1, TM2, TM3 or TM4 fields using either pre-defined edit masks (M0-M26) or specific edit patterns you define. You can control the way the edited fields look with respect to length, leading or suppressed zeros, thousands separators, decimal points, leading and trailing positive and negative signs, and so on.

**p**

See p under p,m,a.
OUTFIL Control Statements

$m$ specifies the length in bytes of the numeric field. The length must include the sign, if the data is signed. See Table 41 for permissible length values.

$f$ specifies the format of the numeric field:

<table>
<thead>
<tr>
<th>Format Code</th>
<th>Length</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BI</td>
<td>1 to 8 bytes</td>
<td>Unsigned binary</td>
</tr>
<tr>
<td>FI</td>
<td>1 to 8 bytes</td>
<td>Signed fixed-point</td>
</tr>
<tr>
<td>PD</td>
<td>1 to 16 bytes</td>
<td>Signed packed decimal</td>
</tr>
<tr>
<td>PD0</td>
<td>2 to 8 bytes</td>
<td>Packed decimal with sign and first digit ignored</td>
</tr>
<tr>
<td>ZD</td>
<td>1 to 31 bytes</td>
<td>Signed zoned decimal</td>
</tr>
<tr>
<td>FL</td>
<td>4 or 8 bytes</td>
<td>Signed hexadecimal floating-point converted to signed integer</td>
</tr>
<tr>
<td>CSF or FS</td>
<td>1 to 32 bytes (31 digit limit)</td>
<td>Signed numeric with optional leading floating sign</td>
</tr>
<tr>
<td>UFF</td>
<td>1 to 44 bytes (31 digit limit)</td>
<td>Unsigned free form numeric</td>
</tr>
<tr>
<td>SFF</td>
<td>1 to 44 bytes (31 digit limit)</td>
<td>Signed free form numeric</td>
</tr>
<tr>
<td>DT1</td>
<td>4 bytes</td>
<td>SMF date interpreted as $Z'yyyyymmdd'$</td>
</tr>
<tr>
<td>DT2</td>
<td>4 bytes</td>
<td>SMF date interpreted as $Z'yyyymm'$</td>
</tr>
<tr>
<td>DT3</td>
<td>4 bytes</td>
<td>SMF date interpreted as $Z'yyyyyddd'$</td>
</tr>
<tr>
<td>DC1</td>
<td>8 bytes</td>
<td>TOD date interpreted as $Z'yyyyymmmdd'$</td>
</tr>
<tr>
<td>DC2</td>
<td>8 bytes</td>
<td>TOD date interpreted as $Z'yyyyymm'$</td>
</tr>
<tr>
<td>DC3</td>
<td>8 bytes</td>
<td>TOD date interpreted as $Z'yyyyyddd'$</td>
</tr>
<tr>
<td>DE1</td>
<td>8 bytes</td>
<td>ETOD date interpreted as $Z'yyyyymmmdd'$</td>
</tr>
<tr>
<td>DE2</td>
<td>8 bytes</td>
<td>ETOD date interpreted as $Z'yyyyymm'$</td>
</tr>
<tr>
<td>DE3</td>
<td>8 bytes</td>
<td>ETOD date interpreted as $Z'yyyyyddd'$</td>
</tr>
<tr>
<td>TM1</td>
<td>4 bytes</td>
<td>SMF time interpreted as $Z'hhmmss'$</td>
</tr>
<tr>
<td>TM2</td>
<td>4 bytes</td>
<td>SMF time interpreted as $Z'hhmmss'$</td>
</tr>
<tr>
<td>TM3</td>
<td>4 bytes</td>
<td>SMF time interpreted as $Z'hhmmssxxx'$</td>
</tr>
<tr>
<td>TM4</td>
<td>4 bytes</td>
<td>SMF time interpreted as $Z'hhmmssxxx'$</td>
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<tr>
<td>TC1</td>
<td>8 bytes</td>
<td>TOD time interpreted as $Z'hhmmss'$</td>
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<td>TC2</td>
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<td>TOD time interpreted as $Z'hhmm'$</td>
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<td>8 bytes</td>
<td>ETOD time interpreted as $Z'hhmmss'$</td>
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<tr>
<td>TE2</td>
<td>8 bytes</td>
<td>ETOD time interpreted as $Z'hhmmss'$</td>
</tr>
<tr>
<td>TE3</td>
<td>8 bytes</td>
<td>ETOD time interpreted as $Z'hhmm'$</td>
</tr>
<tr>
<td>TE4</td>
<td>8 bytes</td>
<td>ETOD time interpreted as $Z'hhmmssxxx'$</td>
</tr>
</tbody>
</table>
**Table 41. Edit Field Formats and Lengths (continued)**

<table>
<thead>
<tr>
<th>Format Code</th>
<th>Length</th>
<th>Description</th>
</tr>
</thead>
</table>

**Note:** See Appendix C, "Data Format Descriptions" for detailed format descriptions.

For a CSF or FS format field:
- A maximum of 31 digits is allowed. If a CSF or FS value with 32 digits is found, the leftmost digit will be treated as a positive sign indicator.

For a UFF or SFF format field:
- A maximum of 31 digits is allowed. If a UFF or SFF value with more than 31 digits is found, the leftmost digits will be ignored.

For a ZD or PD format field:
- An invalid digit results in a data exception (0C7 ABEND) or incorrect numeric output; A-F are invalid digits. ICETOOL’s VERIFY or DISPLAY operator can be used to identify decimal values with invalid digits.
  - A value is treated as positive if its sign is F, E, C, A, 8, 6, 4, 2, or 0.
  - A value is treated as negative if its sign is D, B, 9, 7, 5, 3, or 1.

For a PD0 format field:
- The first digit is ignored.
- An invalid digit other than the first results in a data exception (0C7 ABEND) or incorrect numeric output; A-F are invalid digits.
  - The sign is ignored and the value is treated as positive.

For an FL format field:
- The normalized or unnormalized FL (hexadecimal floating-point) value is converted to a signed integer in the range -9223372036854775808 to 9223372036854775807. The fractional part of the FL value is lost, and in some cases the signed integer may be one of a number of possible signed integers for the FL value depending on its precision. Converted values less than -9223372036854775808 are set to -9223372036854775808. Converted values greater than 9223372036854775807 are set to 9223372036854775807.
  - If you are not running in z/Architecture mode, specifying an FL format field results in an error message and termination.

For a DT1, DT2, or DT3 format field:
- An invalid SMF date can result in a data exception (0C7 ABEND) or an incorrect ZD date.
  - SMF date values are always treated as positive.

For a DC1, DC2, DC3, DE1, DE2, or DE3 format field:
- TOD and ETOD date values are always treated as positive.

For a TM1, TM2, TM3, or TM4 format field:
- An invalid SMF time can result in an incorrect ZD time.
  - SMF time values are always treated as positive.

For a TC1, TC2, TC3, TC4, TE1, TE2, TE3, or TE4 format field:
- TOD and ETOD time values are always treated as positive.
OUTFIL Control Statements

**edit**

```
  Mn
  EDIT= (pattern)
  EDxy=(pattern)

  SIGNS= (lp,ln,tp,tn)
  LENGTH=n
```

Specifies how the numeric field is to be edited for output. If an Mn, EDIT, or EDxy parameter is not specified:

- a DC1, DC2, DC3, DE1, DE2, DE3, DT1, DT2, DT3, TC1, TC2, TC3, TC4, TE1, TE2, TE3, TE4, TM1, TM2, TM3, or TM4 field is edited using the M11 edit mask.
- a BI, FI, PD, PD0, ZD, FL, CSF, FS, UFF, or SFF field is edited using the M0 edit mask.

**Mn** specifies one of twenty-seven pre-defined edit masks (M0-M26) for presenting numeric data. If these pre-defined edit masks are not suitable for presenting your numeric data, the EDIT parameter gives you the flexibility to define your own edit patterns.

The twenty-seven pre-defined edit masks can be represented as follows:

**Table 42. Edit Mask Patterns**

<table>
<thead>
<tr>
<th>Mask</th>
<th>Pattern</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Value</td>
<td>Result</td>
</tr>
<tr>
<td>M0</td>
<td>I…………………TTS</td>
<td>+01234 1234</td>
</tr>
<tr>
<td></td>
<td></td>
<td>−00001  1−</td>
</tr>
<tr>
<td>M1</td>
<td>T…………………TTS</td>
<td>−00123 00123−</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+00123  00123</td>
</tr>
<tr>
<td>M2</td>
<td>II,III,III,III,III,III,III,II,TTTTS</td>
<td>+123450 1,234.50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>−000020 0.20−</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+123450 1,234.50</td>
</tr>
<tr>
<td>M4</td>
<td>SII,III,III,III,III,III,III,III,TTT</td>
<td>+0123456 +1,234.56</td>
</tr>
<tr>
<td></td>
<td></td>
<td>−1234567 −12,345.67</td>
</tr>
<tr>
<td>M5</td>
<td>SII,III,III,III,III,III,III,III,TTTTS</td>
<td>−001234 (12.34)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+123450 1,234.50</td>
</tr>
<tr>
<td>M6</td>
<td>III-TTT-TTTT</td>
<td>00123456 012-3456</td>
</tr>
<tr>
<td></td>
<td>12345678 1-234-56788</td>
<td></td>
</tr>
</tbody>
</table>
OUTFIL Control Statements
Table 42. Edit Mask Patterns (continued)
Mask

M7

M8

M9

M10

M11

M12

M13

M14

Pattern

TTT-TT-TTTT

IT:TT:TT

IT/TT/TT

IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIT

TTTTTTTTTTTTTTTTTTTTTTTTTTTTTTT


SI.III.III.III.III.III.III.III.III.III.IIT

SI III III III III III III III III III IITS

Examples
Value

Result

00123456

000-12-3456

12345678

012-34-5678

030553

3:05:53

121736

12:17:36

123004

12/30/04

083104

8/31/04

01234

1234

00000

0

00010

00010

01234

01234

+1234567

1,234,567

−0012345

−12,345

+1234567

1.234.567

−0012345

−12.345

+1234567
−0012345

M15

M16

M17

M18

M19

M20

M21

M22

M23

M24

M25

274

I III III III III III III III III III IITS

SI III III III III III III III III III IIT

SI'III'III'III'III'III'III'III'III'III'IIT

SII,III,III,III,III,III,III,III,III,IIT.TT

SII.III.III.III.III.III.III.III.III.IIT,TT

SI III III III III III III III III IIT,TTS

II III III III III III III III III IIT,TTS

SI III III III III IIII III III III IIT,TT

SII'III'III'III'III'III'III'III'III'IIT.TT

SII'III'III'III'III'III'III'III'III'IIT,TT

SIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIT

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+1234567

1 234 567
(12 345)
1 234 567

−0012345

12 345−

+1234567

1 234 567

−0012345

−12 345

+1234567

1'234'567

−0012345

−12'345

+0123456

1,234.56

−1234567

−12,345.67

+0123456

1.234,56

−1234567

−12.345,67

+0123456

1 234,56

−1234567

(12 345,67)

+0123456

1 234,567

−1234567

12 345,67−

+0123456

1 234,56

−1234567

−12 345,67

+0123456

1'234.56

−1234567

−12'345.67

+0123456

1'234,56

−1234567

−12'345,67

+01234

1234

−00001

−1


The elements used in the representation of the edit masks in Table 42 on page 273 are as follows:

- **I** indicates a leading insignificant digit. If zero, this digit will not be shown.
- **T** indicates a significant digit. If zero, this digit will be shown.
- **CR** (in M3) is printed to the right of the digits if the value is negative; otherwise, two blanks are printed to the right of the digits.
- **S** indicates a sign. If it appears as the first character in the pattern, it is a leading sign. If it appears as the last character in the pattern, it is a trailing sign. If S appears as both the first and last characters in a pattern (example: M5), the first character is a leading sign and the last character is a trailing sign. Four different sign values are used: leading positive sign (lp), leading negative sign (ln), trailing positive sign (tp) and trailing negative sign (tn). Their applicable values for the Mn edit masks are:

### Table 43. Edit Mask Signs

<table>
<thead>
<tr>
<th>Mask</th>
<th>lp</th>
<th>ln</th>
<th>tp</th>
<th>tn</th>
</tr>
</thead>
<tbody>
<tr>
<td>M0</td>
<td>none</td>
<td>none</td>
<td>blank</td>
<td>–</td>
</tr>
<tr>
<td>M1</td>
<td>none</td>
<td>none</td>
<td>blank</td>
<td>–</td>
</tr>
<tr>
<td>M2</td>
<td>none</td>
<td>none</td>
<td>blank</td>
<td>–</td>
</tr>
<tr>
<td>M3</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>M4</td>
<td>+</td>
<td>–</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>M5</td>
<td>blank</td>
<td>(</td>
<td>blank</td>
<td>)</td>
</tr>
<tr>
<td>M6</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>M7</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>M8</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>M9</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>M10</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>M11</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>M12</td>
<td>blank</td>
<td>–</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>M13</td>
<td>blank</td>
<td>–</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>M14</td>
<td>blank</td>
<td>(</td>
<td>blank</td>
<td>)</td>
</tr>
<tr>
<td>M15</td>
<td>none</td>
<td>none</td>
<td>blank</td>
<td>–</td>
</tr>
<tr>
<td>M16</td>
<td>blank</td>
<td>–</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>M17</td>
<td>blank</td>
<td>–</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>M18</td>
<td>blank</td>
<td>–</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>M19</td>
<td>blank</td>
<td>–</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>M20</td>
<td>blank</td>
<td>(</td>
<td>blank</td>
<td>)</td>
</tr>
<tr>
<td>M21</td>
<td>none</td>
<td>none</td>
<td>blank</td>
<td>–</td>
</tr>
<tr>
<td>M22</td>
<td>blank</td>
<td>–</td>
<td>none</td>
<td>none</td>
</tr>
</tbody>
</table>
OUTFIL Control Statements

Table 43. Edit Mask Signs (continued)

<table>
<thead>
<tr>
<th>Mask</th>
<th>lp</th>
<th>ln</th>
<th>tp</th>
<th>tn</th>
</tr>
</thead>
<tbody>
<tr>
<td>M23</td>
<td>blank</td>
<td>−</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>M24</td>
<td>blank</td>
<td>−</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>M25</td>
<td>blank</td>
<td>−</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>M26</td>
<td>+</td>
<td>−</td>
<td>none</td>
<td>none</td>
</tr>
</tbody>
</table>

- any other character (for example, /) will be printed as shown, subject to certain rules to be subsequently discussed.

The implied length of the edited output field depends on the number of digits and characters needed for the pattern of the particular edit mask used. The LENGTH parameter can be used to change the implied length of the edited output field.

The number of digits needed depends on the format and length of the numeric field as follows:

Table 44. Digits Needed for Numeric Fields

<table>
<thead>
<tr>
<th>Format</th>
<th>Input Length</th>
<th>Digits Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZD</td>
<td>m</td>
<td>m</td>
</tr>
<tr>
<td>PD</td>
<td>m</td>
<td>2m−1</td>
</tr>
<tr>
<td>PD0</td>
<td>m</td>
<td>2m−2</td>
</tr>
<tr>
<td>BI, FI</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>BI, FI</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>BI, FI</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>BI, FI</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>BI, FI</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>BI, FI</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>BI, FI</td>
<td>7</td>
<td>17</td>
</tr>
<tr>
<td>BI, FI</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>FL</td>
<td>4 or 8</td>
<td>20</td>
</tr>
<tr>
<td>CSF or FS</td>
<td>32</td>
<td>31</td>
</tr>
<tr>
<td>CSF or FS</td>
<td>m (less than 32)</td>
<td>m</td>
</tr>
<tr>
<td>UFF, SFF</td>
<td>32 to 44</td>
<td>31</td>
</tr>
<tr>
<td>UFF, SFF</td>
<td>m (less than 32)</td>
<td>m</td>
</tr>
</tbody>
</table>

The length of the output field can be represented as follows for each pattern, where d is the number of digits needed, as shown in Table 44, and the result is rounded down to the nearest integer:

Table 45. Edit Mask Output Field Lengths

<table>
<thead>
<tr>
<th>Mask</th>
<th>Output Field Length</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>M0</td>
<td>d + 1</td>
<td>ZD,3</td>
</tr>
<tr>
<td>M1</td>
<td>d + 1</td>
<td>PD,10</td>
</tr>
<tr>
<td>M2</td>
<td>d + 1 + d/3</td>
<td>BI,4</td>
</tr>
</tbody>
</table>
### Table 45. Edit Mask Output Field Lengths (continued)

<table>
<thead>
<tr>
<th>Mask</th>
<th>Output Field Length</th>
<th>Input (f,m)</th>
<th>Output Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>M3</td>
<td>( d + 2 + d/3 )</td>
<td>UFF,20</td>
<td>28</td>
</tr>
<tr>
<td>M4</td>
<td>( d + 1 + d/3 )</td>
<td>PD,8</td>
<td>21</td>
</tr>
<tr>
<td>M5</td>
<td>( d + 2 + d/3 )</td>
<td>FI,3</td>
<td>12</td>
</tr>
<tr>
<td>M6</td>
<td>12</td>
<td>ZD,10</td>
<td>12</td>
</tr>
<tr>
<td>M7</td>
<td>11</td>
<td>PD,5</td>
<td>11</td>
</tr>
<tr>
<td>M8</td>
<td>8</td>
<td>ZD,6</td>
<td>8</td>
</tr>
<tr>
<td>M9</td>
<td>8</td>
<td>PD,4</td>
<td>8</td>
</tr>
<tr>
<td>M10</td>
<td>d</td>
<td>BI,6</td>
<td>15</td>
</tr>
<tr>
<td>M11</td>
<td>d</td>
<td>PD,5</td>
<td>9</td>
</tr>
<tr>
<td>M12</td>
<td>( d + 1 + (d - 1)/3 )</td>
<td>PD,3</td>
<td>7</td>
</tr>
<tr>
<td>M13</td>
<td>( d + 1 + (d - 1)/3 )</td>
<td>FS,5</td>
<td>7</td>
</tr>
<tr>
<td>M14</td>
<td>( d + 2 + (d - 1)/3 )</td>
<td>ZD,5</td>
<td>8</td>
</tr>
<tr>
<td>M15</td>
<td>( d + 1 + (d - 1)/3 )</td>
<td>FI,3</td>
<td>11</td>
</tr>
<tr>
<td>M16</td>
<td>( d + 1 + (d - 1)/3 )</td>
<td>SFF,41</td>
<td>42</td>
</tr>
<tr>
<td>M17</td>
<td>( d + 1 + (d - 1)/3 )</td>
<td>FI,4</td>
<td>14</td>
</tr>
<tr>
<td>M18</td>
<td>( d + 1 + d/3 )</td>
<td>BI,4</td>
<td>14</td>
</tr>
<tr>
<td>M19</td>
<td>( d + 1 + d/3 )</td>
<td>PD,8</td>
<td>21</td>
</tr>
<tr>
<td>M20</td>
<td>( d + 2 + d/3 )</td>
<td>FI,3</td>
<td>12</td>
</tr>
<tr>
<td>M21</td>
<td>( d + 1 + d/3 )</td>
<td>ZD,3</td>
<td>5</td>
</tr>
<tr>
<td>M22</td>
<td>( d + 1 + d/3 )</td>
<td>BI,2</td>
<td>7</td>
</tr>
<tr>
<td>M23</td>
<td>( d + 1 + d/3 )</td>
<td>PD,6</td>
<td>15</td>
</tr>
<tr>
<td>M24</td>
<td>( d + 1 + d/3 )</td>
<td>ZD,21</td>
<td>29</td>
</tr>
<tr>
<td>M25</td>
<td>( d + 1 )</td>
<td>CSF,16</td>
<td>17</td>
</tr>
<tr>
<td>M26</td>
<td>( d + 1 )</td>
<td>FL,4</td>
<td>21</td>
</tr>
</tbody>
</table>

To illustrate conceptually how DFSORT produces the edited output from the numeric value, consider the following example:

```
OUTFIL OUTREC=(5,7,ZD,M5)
with ZD values of C'0123456'(+0123456)
and C'000302J' (-0003021)
```

As shown in the preceding tables, it is determined that:

- The general pattern for M5 is: SI,III,...,IIT.TTS
- The signs to be used are blank for leading positive sign, C'(' for leading negative sign, blank for trailing positive sign and C')' for trailing negative sign
- The number of digits needed is 7
- The length of the output field is 11 (7 + 2 + 7/3)
- The specific pattern for the output field is thus: C'SII,IIT.TTS'

The digits of C'0123456' are mapped to the pattern, resulting in C'S01,234.56S'. Because the value is positive, the leading sign is replaced with blank and the
trailing sign is replaced with blank, resulting in C’01,234.56’. Finally, all digits before the first non-zero digit (1 in this case), are replaced with blanks, resulting in the final output of C’1,234.56’.

The digits of C’000302J’ are mapped to the pattern, resulting in C’S00,030.21S’. Because the value is negative, the leading sign is replaced with C’(’ and the trailing sign is replaced with C’)’ resulting in C’(00,030.21)’. All digits before the first non-zero digit (3 in this case), are replaced with blanks, resulting in C’( 30.21)’. Finally, the leading sign is “floated” to the right, next to the first non-zero digit, resulting in the final output of C’(30.21)’.

To state the rules in more general terms, the steps DFSORT takes conceptually to produce the edited output from the numeric value are as follows:
- Determine the specific pattern and its length, using the preceding tables.
- Map the digits of the numeric value to the pattern.
- If the value is positive, replace the leading and trailing signs (if any) with the characters for positive values shown in Table 43 on page 279. Otherwise, replace the leading and trailing signs (if any) with the characters for negative values shown in that same table.
- Replace all digits before the first non-zero (I) or significant digit (T) with blanks.
- Float the leading sign (if any) to the right, next to the first non-zero (I) or significant digit (T).

The following additional rule applies to edit masks:
- The specific pattern is determined from the general pattern by including signs, the rightmost digits needed as determined from the input format and length, and any characters in between those rightmost digits. This may unintentionally truncate significant digits (T). As an example, if you specify 5,1,ZD,M4, the length of the output field will be 2 (1 + 1 + 1/3). The general pattern for M4 is SI,III,...,IIT.TT, but the specific pattern will be ST (the leading sign and the rightmost digit).

EDIT specifies an edit pattern for presenting numeric data. If the pre-defined edit masks (M0-M26) are not suitable for presenting your numeric data, EDIT gives you the flexibility to define your own edit patterns. The elements you use to specify the pattern are the same as those used for the edit masks: I, T, S, and printable characters. However, S will not be recognized as a sign indicator unless the SIGNS parameter is also specified.

pattern specifies the edit pattern to be used. Not enclosing the pattern in single apostrophes restricts you from specifying the following characters in the pattern: blank, apostrophe, unbalanced left or right parentheses, and hexadecimal digits 20, 21, and 22. For example, EDIT=((IIT.TT)) is valid, whereas EDIT=(C)IIT.TT), EDIT=(I / T) and EDIT=(SIIT) are not.

The maximum number of digits (I’s and T’s) you specify in the pattern must not exceed 31. The maximum length of the pattern must not exceed 44 characters.

'pattern' specifies the edit pattern to be used. Enclosing the pattern in single apostrophes allows you to specify any character in the pattern except hexadecimal digits 20, 21, or 22. If you want to include a single
apostrophe in the pattern, you must specify it as two single apostrophes, which will be counted as a single character in the pattern. As examples, EDIT=(C)ITT.TT), EDIT=(I / T), and EDIT=(S)II.T) are all valid.

The maximum number of digits (I's and T's) you specify in the pattern must not exceed 31. The maximum length of the pattern must not exceed 44 characters.

The implied length of the edited output field is the same as the length of the pattern. The LENGTH parameter can be used to change the implied length of the edited output field.

To illustrate conceptually how DFSORT produces the edited output from the numeric value, consider the following example:

```
OUTFIL OUTREC=(1,5,ZD,EDIT=('**I/ITTTCR'))
```

with ZD values of C'01230' (+1230)
and C'0004J' (-41)

The digits of C'01230' are mapped to the pattern, resulting in C'**0/1230CR'. Because the value is positive, the characters (C'CR') to the right of the last digit are replaced with blanks, resulting in C'**0/1230 '. All digits before the first non-zero digit (1 in this case) are replaced with blanks, resulting in C'** /1230 '. Finally, all characters before the first digit in the pattern are floated to the right, next to the first non-zero digit, resulting in C' **1230 '.

The digits of C'0004J' are mapped to the pattern, resulting in C'**0/0041CR'. Because the value is negative, the characters (C'CR') to the right of the last digit are kept. All digits before the first T digit are replaced with blanks, resulting in C'** / 041CR'. Finally, all characters before the first digit in the pattern are floated to the right, next to the first non-zero digit, resulting in C' **041CR'.

In general terms, the steps DFSORT takes conceptually to produce the edited output from the numeric value are as follows:

- Map the digits of the numeric value to the pattern, padding on the left with zeros, if necessary.
- If the value is positive, replace the leading and trailing signs (if any) with the characters for positive values specified by the SIGNS parameter and replace any characters between the last digit and the trailing sign (if any) with blanks. Otherwise, replace the leading and trailing signs (if any) with the characters for negative values specified by the SIGNS parameter and keep any characters between the last digit and the trailing sign (if any).
- Replace all digits before the first non-zero (I) or significant digit (T) with blanks.
- Float all characters (if any) before the first digit in the pattern to the right, next to the first non-zero (I) or significant digit (T).

The following additional rules apply to edit patterns:

- An insignificant digit (I) after a significant digit (T) is treated as a significant digit.
- If SIGNS is specified, an S in the first or last character of the pattern is treated as a sign; an S anywhere else in the pattern is treated as the letter S. If SIGNS is not specified, an S anywhere in the pattern is treated as the letter S.
- If the pattern contains fewer digits than the value, the leftmost digits of the value will be lost, intentionally or unintentionally. As an example, if you
specify 5,5,ZD,EDIT=(IIT) for a value of '12345', the result will be '345'. As another example, if you specify 1,6,ZD,EDIT=(SIIT.T) for a value of '100345', the result will be '34.5'.

EDxy
specifies an edit pattern for presenting numeric data. EDxy is a special variation of EDIT that allows other characters to be substituted for I and T in the pattern. For example, if you use EDAB instead of EDIT, you must use A in the pattern instead of I and use B instead of T to represent digits. x and y must not be the same character. If SIGNS is specified, x and y must not be S. If SIGNz is specified, x and y must not be the same character as z. You can select x and y from: A-Z, #, $, @, and 0-9.

SIGNS
specifies the sign values to be used when editing numeric values according to the edit mask (Mn) or pattern (EDIT or EDxy). You can specify any or all of the four sign values. Any value not specified must be represented by a comma. Blank will be used for any sign value you do not specify. As examples, SIGNS=(+,−) specifies + for lp, − for ln, blank for tp, and blank for tn; SIGNS=(+−) specifies blank for lp, blank for ln, + for tp, and − for tn.

lp specifies the value for the leading positive sign. If an S is specified as the first character of the edit mask or pattern and the value is positive, the lp value will be used as the leading sign.

ln specifies the value for the leading negative sign. If an S is specified as the first character of the edit mask or pattern and the value is negative, the ln value will be used as the leading sign.

tp specifies the value for the trailing positive sign. If an S is specified as the last character of the edit mask or pattern and the value is positive, the tp value will be used as the trailing sign.

tn specifies the value for the trailing negative sign. If an S is specified as the last character of the edit mask or pattern and the value is negative, the tn value will be used as the trailing sign.

If you want to use any of the following characters as sign values, you must enclose them in single apostrophes: comma, blank, or unbalanced left or right parentheses. A single apostrophe must be specified as four single apostrophes (that is, two single apostrophes enclosed in single apostrophes).

A semicolon cannot be substituted for a comma as the delimiter between sign characters.

SIGNz
specifies the sign values to be used when editing numeric values according to the edit pattern (EDIT or EDxy). SIGNz is a special variation of SIGNS which allows another character to be substituted for S in the pattern. For example, if you use SIGNX instead of SIGNS, you must use X in the pattern instead of S to identify a sign. If EDIT is specified, z must not be I or T. If EDxy is specified, z must not be the same character as either x or y. You can select z from: A-Z, #, $, @, and 0-9.

LENGTH
specifies the length of the edited output field. If the implied length of the edited output field produced using an edit mask or edit pattern is not suitable for presenting your numeric data, LENGTH can be used to make the edited output field shorter or longer.
n specifies the length of the edited output field. The value for n must be between 1 and 44.

LENGTH does not change the pattern used, only the length of the resulting edited output field. For example, as discussed previously for Mn, if you specify:

```
OUTFIL OUTREC=(5,1,ZD,M4)
```

the pattern will be C'ST' rather than C'ST.TT' because the digit length is 1. Specifying:

```
OUTFIL OUTREC=(5,1,ZD,M4,LENGTH=5)
```

will change the pattern to C'ST', not to C'ST.TT'.

If you specify a value for n that is shorter than the implied length, truncation will occur on the left after editing. For example, if you specify:

```
OUTFIL OUTREC=(1,5,ZD,EDIT=($I1T.TT),LENGTH=5)
```

with a value of C'12345', editing according to the specified $I1T.TT pattern will produce C'$123.45', but the specified length of 5 will truncate this to C'23.45'.

If you specify a value for n that is longer than the implied length, padding on the left with blanks will occur after editing. For example, if you specify:

```
OUTFIL OUTREC=(1,5,ZD,EDIT=($I1T.TT),LENGTH=10)
```

with a value of C'12345', editing according to the specified $I1T.TT pattern will produce C'$123.45', but the specified length of 10 will pad this to C'$123.45'.

Sample Syntax:

```
OUTFIL FNAME=OUT1,OUTREC=(5:21,19,ZD,M19,35:46,5,ZD,M13)
```

```
OUTFIL FILES=1,OUTREC=(4,8,BI,C' * ',13,8,B1,80:X),
ENDREC=10,OMIT=(4,8,BI,EQ,13,8,BI)
OUTFIL FILES=(2,3),
OUTREC=(11:55,6,FS,SIGN=(,,+,-),LENGTH=10,
31:(41,4,PD),EDIT=(*$II,II1T.TTXS),SIGN=(,,+,-))
```

%nn,f,edit or (%nn,f),edit

specifies that an edited numeric parsed input field is to appear in the reformatted OUTFIL output record. See PARSE for details of parsed fields. See p,m,f,edit or (p,m,f),edit for further details.

p,m,f,to or (p,m,f),to

specifies that a converted numeric input field is to appear in the reformatted OUTFIL output record. You can convert BI, FI, PD, PD0, ZD, FL, CSF, FS, UFF, SFF, DC1, DC2, DC3, DE1, DE2, DE3, DT1, DT2, DT3, TC1, TC2, TC3, TC4, TE1, TE2, TE3, TE4, TM1, TM2, TM3, or TM4 fields to BI, FI, PD, PDC, PDF, ZD, ZDF, ZDC, or CSF/FS fields.

p See p under p,m,f,edit.

m See m under p,m,f,edit.

f See f under p,m,f,edit.

to
OUTFIL Control Statements

specifies how the numeric field is to be converted for output.

**fo** specifies the format for the output field, which can be BI, FI, PD, PDC, PDF, ZD, ZDE, ZDC, CSF or FS. Any one of these output field formats (fo) can be used with any one of the input field formats (f).

If you do not specify the LENGTH parameter, DFSORT will determine the implied length of the output field from the length (m) and format (f) of the input field and the format (fo) of the output field. The implied length of the output field can be represented as follows for each output format, where d is the number of digits needed for the input field as shown in Table 44 on page 276 and the result is rounded down to the nearest integer:

<table>
<thead>
<tr>
<th>Output Format</th>
<th>Output Length</th>
<th>Example Input (f,m)</th>
<th>Example Output Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>BI with d &lt;= 9</td>
<td>4</td>
<td>FS,9</td>
<td>4</td>
</tr>
<tr>
<td>BI with d &gt; 9</td>
<td>8</td>
<td>FS,10</td>
<td>8</td>
</tr>
<tr>
<td>FI with d &lt;= 9</td>
<td>4</td>
<td>ZD,7</td>
<td>4</td>
</tr>
<tr>
<td>FI with d &gt; 9</td>
<td>8</td>
<td>ZD,12</td>
<td>8</td>
</tr>
<tr>
<td>PD, PDC, or PDF</td>
<td>d/2 + 1</td>
<td>BI</td>
<td>6</td>
</tr>
<tr>
<td>ZD, ZDE, or ZDC</td>
<td>d</td>
<td>PD,9</td>
<td>17</td>
</tr>
<tr>
<td>CSF or FS</td>
<td>d + 1</td>
<td>FI</td>
<td>21</td>
</tr>
</tbody>
</table>

For ZD or ZDF output, F is used as the positive sign and D is used as the negative sign. For ZDC output, C is used as the positive sign.

For PD or PDC output, C is used as the positive sign and D is used as the negative sign. For PDF output, F is used as the positive sign.

For CSF or FS output, blank is used as the positive sign, − is used as the negative sign and leading zeros are suppressed.

For ZD, ZDF, ZDC, PD, PDC, PDF, CSF, or FS output, the maximum output value is 9999999999999999999999999999999 (31 digits) and the minimum output value is -9999999999999999999999999999999 (31 digits), which correspond to the maximum and minimum input values, respectively.

For BI output:
- An input value greater than 18446744073709551615 (X'FFFFFFFFFFFFFFFFF') produces an output value of 18446744073709551615 (X'FFFFFFFFFFFFFFFF').
- An input value less than zero produces an absolute output value. For example, an input value of P'−5000' produces a BI output value of 5000 (X'1388').

For FI output, an input value greater than 9223372036854775807 (X'7FFFFFFFFFFFFFFF') produces an output value of 9223372036854775807 (X'7FFFFFFFFFFFFFFF'), and an input value less than -9223372036854775808 (X'8000000000000000') produces an output value of -9223372036854775808 (X'8000000000000000').
OUTFIL Control Statements

fo, TO=fo and TO=(fo) are interchangeable except that:
- fo must be specified before the LENGTH parameter whereas TO can be
  specified before or after the LENGTH parameter.
- TO=fo or TO=(fo) should be used after a symbol rather than fo to prevent
  the misinterpretation of fo as f. See the discussion of OUTFIL OUTREC in
  Chapter 7 for details.

LENGTH
specifies the length of the converted output field. If the implied length of the
output field is not suitable, LENGTH can be used to make the output field
shorter or longer.

n specifies the length of the converted output field. The value for n must be
between 1 and 44.

If you specify a value for n that is shorter than the implied length,
truncation on the left will occur after conversion. For example, if you
specify:

```
OUTFIL OUTREC=(1,8,ZD,TO=PD,LENGTH=3)
```

with values of ZL8'−12345678' (X'F1F2F3F4F5F6F7D8') and ZL8'58'
(X'F0F0F0F0F0F0F5F88'), conversion with the implied length (5) will produce
PL5'−12345678' (X'012345678D') and PL5'58' (X'000000058C'). The specified
length of 3 will then result in truncation to PL3'−45678' (X'45678D') and
PL3'58' (X'00058C').

If you specify a value for n that is longer than the implied length, padding
on the left will occur after conversion using:
- Blanks for CSF and FS output values
- Character zeros for ZD output values
- Binary zeros for PD and BI output values
- Binary zeros for positive FI output values
- Binary ones for negative FI output values

For example, if you specify:

```
OUTFIL OUTREC=(1,4,ZD,TO=FI,LENGTH=6)
```

with values of ZL4'−1234' (X'F1F2F3D4') and ZL4'58' (X'F0F0F5F8'),
conversion with the implied length (4) will produce FL4'−1234'
(X'FFFFFB2E') and FL4'58' (X'000004D2'). The specified length of 6 will then
result in padding to FL6'−1234' (X'FFFFFFFFFB2E') and FL6'58'
(X'00000000003A').

Sample Syntax:

```
OUTFIL OUTREC=((21,5,ZD),PD,X,8,4,ZD,TO=FI,LENGTH=2)
```

%nn,f,to or (%nn,f),to
specifies that a converted numeric parsed input field is to appear in the
reformatted OUTFIL output record. See PARSE for details of parsed fields. See
p,m,f,to or (p,m,f),to for further details.

decon,edit or (decon),edit
specifies that an edited decimal constant is to appear in the reformatted
OUTFIL output record. The decimal constant must be in the form +n or −n
where n is 1 to 31 decimal digits. The sign (+ or −) must be specified. A
decimal constant produces a signed, 31-digit zoned decimal (ZD) result to be
edited as specified. If an Mn, EDIT, or EDxy parameter is not specified, the
decimal constant is edited using the M0 edit mask.
OUTFIL Control Statements

The default number of digits (d) used for editing is 15 for a decimal constant with 1 to 15 significant digits, or 31 for a decimal constant with 16 to 31 significant digits. If EDIT or EDxy is specified, the number of digits in the pattern (I's and T's) is used.

See edit under p,m,f,edit for further details on the edit fields you can use.

Sample Syntax:

```plaintext
OUTFIL OUTREC=(5,8,+4096,2X,-17,M18,LENGTH=7,2X,
(+2000000),EDIT=(STTTTT.TT),SIGNS=(+))
```

deccon,to or (deccon),to

specifies that a converted decimal constant is to appear in the reformatted OUTFIL output record. The decimal constant must be in the form +n or −n where n is 1 to 31 decimal digits. The sign (+ or −) must be specified. A decimal constant produces a signed, 31-digit zoned decimal (ZD) result to be converted as specified.

The default number of digits (d) used for conversion is 15 for a decimal constant with 1 to 15 significant digits, or 31 for a decimal constant with 16 to 31 significant digits.

See to under p,m,f,to for further details on the to fields you can use.

Sample Syntax:

```plaintext
OUTFIL FNAMES=OUT1,
OUTREC=(6:+0,TO=PD,LENGTH=6,+0,TO=PD,LENGTH=6,/,6:(-4096),ZD,LENGTH=12)
```

arexp,edit or (arexp),edit

Specifies that the edited result of an arithmetic expression is to appear in the reformatted OUTFIL output record. An arithmetic expression takes the form:

```
term,operator,term<,operator,...>
```

where:

- **term** is a field (p,m,f), a parsed field (%nn,f), or a decimal constant (+n or −n). See p,m,f under p,m,f,edit for details on the fields you can use. See decon under decon,edit for details on the decimal constants you can use.

- **operator** is MIN (minimum), MAX (maximum), MUL (multiplication), DIV (division), MOD (modulus), ADD (addition) or SUB (subtraction).

The order of evaluation precedence for the operators is as follows unless it is changed by parentheses:

1. MIN and MAX
2. MUL, DIV and MOD
3. ADD and SUB

The intermediate or final result of a DIV operation is rounded down to the nearest integer. The intermediate or final result of a MOD operation is an integer remainder with the same sign as the dividend. If an intermediate or final result of an arithmetic expression overflows 31 digits, the overflowing intermediate or final result will be truncated to 31 digits, intentionally or unintentionally. If an intermediate or final result of an arithmetic expression requires division or modulus by 0, the intermediate or final result will be set to 0, intentionally or unintentionally.

An arithmetic expression produces a signed, 31-digit zoned decimal (ZD) result to be edited as specified. If an Mn, EDIT, or EDxy parameter is not specified, the result is edited using the M0 edit mask.
The default number of digits (d) used for editing is 15 if every term in the expression is one of the following:

- a 1-4 byte BI or FI field
- a 1-8 byte PD field
- a 1-15 byte ZD, FS, CSF, UFF or SFF field
- a decimal constant with 1-15 significant digits.

The default number of digits (d) used for editing is 31 if any term in the expression is one of the following:

- a 5-8 byte BI or FI field
- a 9-16 byte PD field
- a 16-31 byte ZD field
- a 4-byte or 8-byte FL field
- a 16-32 byte FS or CSF field
- a 16-44 byte UFF or SFF field
- a decimal constant with 16-31 significant digits.

If EDIT or EDxy is specified, the number of digits in the pattern (I's and T's) is used.

See edit under p,m,f,edit for further details on the edit fields you can use.

Sample Syntax:

```
OUTFIL OUTREC=(5:C'\% REDUCTION FOR ','21,8,C' IS ',
(11,6,ZD,SUB,31,6,ZD),MUL,+1000),DIV,11,6,ZD,
EDIT=(SIIT.T),SIGNS=(+,-))
```

arexp,to or (arexp),to

specifies that the converted result of an arithmetic expression is to appear in the reformatted OUTFIL output record. See arexp under arexp,edit for further details on arithmetic expressions.

An arithmetic expression produces a signed, 31-digit zoned decimal (ZD) result to be converted as specified.

The default number of digits (d) used for conversion is 15 if every term in the expression is one of the following:

- a 1-4 byte BI or FI field
- a 1-8 byte PD field
- a 1-15 byte ZD, FS, CSF, UFF or SFF field
- a decimal constant with 1-15 significant digits.

The default number of digits (d) used for conversion is 31 if any term in the expression is one of the following:

- a 5-8 byte BI or FI field
- a 9-16 byte PD field
- a 16-31 byte ZD field
- a 4-byte or 8-byte FL field
- a 16-32 byte FS or CSF field
- a 16-44 byte UFF or SFF field
- a decimal constant with 16-31 significant digits.

See to under p,m,f,to for further details on the to fields you can use.

Sample Syntax:

```
OUTFIL FNAMES=OUT,
OUTREC=(61,3,X,
35,6,FS,ADD,45,6,FS,ADD,55,6,FS,TO=FS,LENGTH=7,X,
(5,11,PD,MIN,112,11,PD),PD,LENGTH=11,X,
64,5,SEQNUM,5,ZD)
```
OUTFIL Control Statements

**p,m,Y2x or p,m,Y4x**

Specifies that an input date field is to be edited. Real Y2x dates are edited using the century window established by the Y2PAST option in effect. Y2x and Y4x dates with special indicators are expanded appropriately (for example, p,6,Y2T transforms C’000000’ to C’00000000’).

Editing involving an input date with an invalid digit (A-F) can result in a data exception (0C7 ABEND) or an incorrect output value. Editing involving an invalid input date can result in an invalid output value.

- **p**  
  See p under p,m,a.

- **m**  
  Specifies the length in bytes of the Y2x (two-digit year) or Y4x (four-digit year) date field.

- **Y2x or Y4x**  
  Specifies the Y2 or Y4 format for the date field. See Appendix C, “Data Format Descriptions,” on page 885 for detailed format descriptions.

Sample Syntax:

```
OUTFIL BUILD=(21,3,Y2U,X,3,8,Y4W)
```

Table 47 shows the output produced for each type of edited date.

**Table 47. Input and result fields for Yxx date editing**

<table>
<thead>
<tr>
<th>m,Yxx</th>
<th>Input date</th>
<th>Output for p,m,Yxx</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,Y2T</td>
<td>C’yyx’ or Z’yyx’</td>
<td>C’ccyyx’</td>
</tr>
<tr>
<td>4,Y2T</td>
<td>C’yyxx’ or Z’yyxx’</td>
<td>C’ccyyxx’</td>
</tr>
<tr>
<td>5,Y2T</td>
<td>C’yyddd’ or Z’yyddd’</td>
<td>C’ccyyddd’</td>
</tr>
<tr>
<td>6,Y2T</td>
<td>C’yymmdd’ or Z’yymmdd’</td>
<td>C’ccyymmdd’</td>
</tr>
<tr>
<td>7,Y4T</td>
<td>C’ccyyddd’ or Z’ccyyddd’</td>
<td>C’ccyyddd’</td>
</tr>
<tr>
<td>8,Y4T</td>
<td>C’ccyymmdd’ or Z’ccyymmdd’</td>
<td>C’ccyymmdd’</td>
</tr>
<tr>
<td>2,Y2U</td>
<td>P’yyx’</td>
<td>C’ccyx’</td>
</tr>
<tr>
<td>3,Y2V</td>
<td>P’yyxx’</td>
<td>C’ccyyxx’</td>
</tr>
<tr>
<td>3,Y2U</td>
<td>P’yyddd’</td>
<td>C’ccyyddd’</td>
</tr>
<tr>
<td>4,Y2V</td>
<td>P’yymmmd’</td>
<td>C’ccyymmmd’</td>
</tr>
<tr>
<td>4,Y4U</td>
<td>P’ccyyddd’</td>
<td>C’ccyyddd’</td>
</tr>
<tr>
<td>5,Y4V</td>
<td>P’ccyymmdd’</td>
<td>C’ccyymmdd’</td>
</tr>
<tr>
<td>3,Y2W</td>
<td>C’xxy’ or Z’xxy’</td>
<td>C’ccxy’</td>
</tr>
<tr>
<td>4,Y2W</td>
<td>C’xxyy’ or Z’xxyy’</td>
<td>C’ccxxyy’</td>
</tr>
<tr>
<td>5,Y2W</td>
<td>C’ddxyy’ or Z’ddxyy’</td>
<td>C’ccddxyy’</td>
</tr>
<tr>
<td>6,Y2W</td>
<td>C’mmddxyy’ or Z’mmddxyy’</td>
<td>C’ccmmddxyy’</td>
</tr>
<tr>
<td>7,Y4W</td>
<td>C’ddcxyy’ or Z’ddcxyy’</td>
<td>C’ccddcxyy’</td>
</tr>
<tr>
<td>8,Y4W</td>
<td>C’mmddcxyy’ or Z’mmddcxyy’</td>
<td>C’ccmmddcxyy’</td>
</tr>
<tr>
<td>2,Y2X</td>
<td>P’xyy’</td>
<td>C’ccxyy’</td>
</tr>
<tr>
<td>3,Y2Y</td>
<td>P’xxxy’</td>
<td>C’ccxxxy’</td>
</tr>
<tr>
<td>3,Y2X</td>
<td>P’dxyy’</td>
<td>C’ccdxyy’</td>
</tr>
<tr>
<td>4,Y2Y</td>
<td>P’mmddxyy’</td>
<td>C’ccmmddxyy’</td>
</tr>
<tr>
<td>4,Y4X</td>
<td>P’ddcxyy’</td>
<td>C’ccddcxyy’</td>
</tr>
<tr>
<td>5,Y4Y</td>
<td>P’mmddcxyy’</td>
<td>C’ccmmddcxyy’</td>
</tr>
<tr>
<td>2,Y2C</td>
<td>C’yxy’</td>
<td>C’ccyy’</td>
</tr>
<tr>
<td>2,Y2Z</td>
<td>Z’yy’</td>
<td>C’ccyy’</td>
</tr>
<tr>
<td>2,Y2S</td>
<td>C’y’</td>
<td>C’ccyy’</td>
</tr>
<tr>
<td>2,Y2P</td>
<td>P’y’</td>
<td>C’ccyy’</td>
</tr>
<tr>
<td>1,Y2D</td>
<td>X’y’</td>
<td>C’ccyy’</td>
</tr>
<tr>
<td>1,Y2B</td>
<td>B’y’</td>
<td>C’ccyy’</td>
</tr>
</tbody>
</table>

**%nn,Y2x or %nn,Y4x**

Specifies that a parsed input date field is to be edited. See PARSE for details of parsed fields. See “p,m,Y2x or p,m,Y4x” for further details.
OUTFILE Control Statements

\texttt{p,m,Yx,\textit{edit} or p,m,Yx,\textit{edit}}

Specifies that the output for a \texttt{p,m,Yx} input date field as shown in Table 47 on page 286 is to be further edited according to the edit parameters you specify. For example, if you specify:

\[ \text{OUTFILE BUILD=(28,5,Yx,EDIT=(TTTT-TT-TT)} \]

The \texttt{P''cyymmdd' (X'0ccyymmddC')} date value will be transformed to a \texttt{C''ccyymmdd'' date value and then edited to a C''ccyy-mm-dd'' date value.}

See "\texttt{p,m,Yx or p,m,Yx}" and "\texttt{p,m,f,\textit{edit}}" for related details.

\texttt{\%nn,Yx,\textit{edit} or \%nn,Yx,\textit{edit}}

Specifies that the output for a parsed \texttt{Yx} input date field as shown in Table 47 on page 286 is to be further edited according to the edit parameters you specify. See PARSE for details of parsed fields. See "\texttt{p,m,Yx,\textit{edit} or p,m,Yx,\textit{edit}}" for further details.

\texttt{p,m,Yx,\textit{to} or p,m,Yx,\textit{to}}

Specifies that an input date field as shown in Table 47 on page 286 is to be converted according to the to parameters you specify. For example, if you specify:

\[ \text{OUTFILE BUILD=(5,6,Y2W,TO=P\text{D},LENGTH=5)} \]

The \texttt{C''mmddyy'' date value will be transformed to a Z''mmddc\text{cyy'' date value and then converted to a P''mmddc\text{cyyC'' date value.}}}

See "\texttt{p,m,Yx or p,m,Yx}" and "\texttt{p,m,f,\textit{to}}" for related details.

\texttt{\%nn,Yx,\textit{to} or \%nn,Yx,\textit{to}}

Specifies that a parsed input date field as shown in Table 47 on page 286 is to be converted according to the to parameters you specify. See PARSE for details of parsed fields. See "\texttt{p,m,Yx,\textit{to} or p,m,Yx,\textit{to}}" for further details.

\texttt{p,m,Yx,\textit{todate} or p,m,Yx,\textit{todate}}

Specifies that an input date field of one type is to be converted to a corresponding output date field of another type. You can convert date fields between combinations of 2-digit and 4-digit year dates, CH/ZD and PD dates, and Julian and Gregorian dates. You can also convert a date field to a corresponding day of the week in several forms.

Each type of date field you can use as input for date conversions is shown in Table 48 on page 288.
OUTFIL Control Statements

Table 48. Input fields for p,m,Yxx date conversion

<table>
<thead>
<tr>
<th>m,Yxx</th>
<th>Input date</th>
</tr>
</thead>
<tbody>
<tr>
<td>5,Y2T</td>
<td>C'yyddd' or Z'yyddd'</td>
</tr>
<tr>
<td>6,Y2T</td>
<td>C'yymmdd' or Z'yymmdd'</td>
</tr>
<tr>
<td>7,Y4T</td>
<td>C'ccyyddd' or Z'ccyyddd'</td>
</tr>
<tr>
<td>8,Y4T</td>
<td>C'ccyymmdd' or Z'ccyymmdd'</td>
</tr>
<tr>
<td>3,Y2U</td>
<td>P'yyddd'</td>
</tr>
<tr>
<td>4,Y2V</td>
<td>P'ymmmdd'</td>
</tr>
<tr>
<td>4,Y4U</td>
<td>P'ccyddd'</td>
</tr>
<tr>
<td>5,Y4V</td>
<td>P'ccyymmdd'</td>
</tr>
<tr>
<td>5,Y2W</td>
<td>C'dddyy' or Z'dddyy'</td>
</tr>
<tr>
<td>6,Y2W</td>
<td>C'mmddyy' or Z'mmddyy'</td>
</tr>
<tr>
<td>7,Y4W</td>
<td>C'dddccyy' or Z'dddccyy'</td>
</tr>
<tr>
<td>8,Y4W</td>
<td>C'mmddccyy' or Z'mmddccyy'</td>
</tr>
<tr>
<td>3,Y2X</td>
<td>P'dddyy'</td>
</tr>
<tr>
<td>4,Y2Y</td>
<td>P'mmddyy'</td>
</tr>
<tr>
<td>4,Y4X</td>
<td>P'dddccyy'</td>
</tr>
<tr>
<td>5,Y4Y</td>
<td>P'mmddccyy'</td>
</tr>
</tbody>
</table>

p See p under p,m,a.

m Specifies the length in bytes of the Y2x (two-digit year) or Y4x (four-digit year) date field.

Y2x or Y4x Specifies the Y2 or Y4 format for the date field. See Appendix C, “Data Format Descriptions,” on page 885 for detailed format descriptions.

todate Specifies the type of date conversion to be performed.

p,m,Yxx,TOJUL=Yaa
  Converts the input date to a Julian output date.

p,m,Yxx,TOJUL=Yaa(s)
  Converts the input date to a Julian output date with s separators. s can be any character except a blank.

p,m,Yxx,TOGREG=Yaa
  Converts the input date to a Gregorian output date.

p,m,Yxx,TOGREG=Yaa(s)
  Converts the input date to a Gregorian output date with s separators. s can be any character except a blank.

The output date field created by each valid TOJUL and TOGREG combination is shown in Table 49 on page 289.
Table 49. TOJUL and TOGREG output date fields

<table>
<thead>
<tr>
<th>Yaa</th>
<th>TOJUL=Yaa</th>
<th>TOJUL=Yaa(s)</th>
<th>TOGREG=Yaa</th>
<th>TOGREG=Yaa(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y2T</td>
<td>C'yysdd'</td>
<td>C'yysdd'</td>
<td>C'yymmd'</td>
<td>C'yysmsdd'</td>
</tr>
<tr>
<td>Y2W</td>
<td>C'dddsy'</td>
<td>C'dddsy'</td>
<td>C'mmddy'</td>
<td>C'mmsdssy'</td>
</tr>
<tr>
<td>Y2U</td>
<td>P'yyydd'</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Y2V</td>
<td>n/a</td>
<td>n/a</td>
<td>P'yymmd'</td>
<td>n/a</td>
</tr>
<tr>
<td>Y2X</td>
<td>P'dddy`</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Y2Y</td>
<td>n/a</td>
<td>n/a</td>
<td>P'mmddy'</td>
<td>n/a</td>
</tr>
<tr>
<td>Y4T</td>
<td>C'ccyysdd'</td>
<td>C'ccyysdd'</td>
<td>C'ccymmd'</td>
<td>C'ccysmsdd'</td>
</tr>
<tr>
<td>Y4W</td>
<td>C'dddccyy'</td>
<td>C'dddccyy'</td>
<td>C'mmdccyy'</td>
<td>C'mmsdccyy'</td>
</tr>
<tr>
<td>Y4U</td>
<td>P'ccyysdd'</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Y4V</td>
<td>n/a</td>
<td>n/a</td>
<td>P'ccymmd'</td>
<td>n/a</td>
</tr>
<tr>
<td>Y4X</td>
<td>P'dddccyy'</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Y4Y</td>
<td>n/a</td>
<td>n/a</td>
<td>P'mmdccyy'</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Sample Syntax:
* Convert a P'dddyy' input date to a C'ccyy/mm/dd' output date
  OUTFIL BUILD=(21,3,Y2X,TOGREG=Y4T(/),X,
* Convert a C'ccyy/ddd' input date to a P'ccyyddd' output date
  42,8,Y4T,TOJUL=Y4U,X,
* Convert a C'mmdy/ddd' input date to a C'yymmd' output date
  11,6,Y2W,TOGREG=Y2T)

p,m,Yxx,WEKDAY=CHAR3|CHAR9|DIGIT1
Converting an input date field to a corresponding output day of
the week in one of several forms.

Each type of input date field you can use is shown in Table 48
on page 288. The different types of output you can display are
shown in Table 50.

Table 50. Output for weekdays

<table>
<thead>
<tr>
<th>Day</th>
<th>CHAR3</th>
<th>CHAR9</th>
<th>DIGIT1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunday</td>
<td>C'SUN'</td>
<td>C'SUNDAY'</td>
<td>C'1'</td>
</tr>
<tr>
<td>Monday</td>
<td>C'MON'</td>
<td>C'MONDAY'</td>
<td>C'2'</td>
</tr>
<tr>
<td>Tuesday</td>
<td>C'TUE'</td>
<td>C'TUESDAY'</td>
<td>C'3'</td>
</tr>
<tr>
<td>Wednesday</td>
<td>C'WED'</td>
<td>C'WEDNESDAY'</td>
<td>C'4'</td>
</tr>
<tr>
<td>Thursday</td>
<td>C'THU'</td>
<td>C'THURSDAY'</td>
<td>C'5'</td>
</tr>
<tr>
<td>Friday</td>
<td>C'FRI'</td>
<td>C'FRIDAY'</td>
<td>C'6'</td>
</tr>
<tr>
<td>Saturday</td>
<td>C'SAT'</td>
<td>C'SATURDAY'</td>
<td>C'7'</td>
</tr>
</tbody>
</table>

Sample Syntax:
* Convert a P'mmdccyy' input date to a 3-character weekday
  OUTFIL BUILD=(5:15,5,Y4Y,WEKDAY=CHAR3,
* Convert a C'yysdd' input date to a 1-digit weekday
  18:27,5,Y2T,WEKDAY=DIGIT1,
* Convert a P'dddccyy' input date to a 9-character weekday
  41:121,4,Y4X,WEKDAY=CHAR9)

p,m,Yxx,DT=(abcd) or p,m,Yxx,DTNS=(abc)
Converting an input date field of one type to a corresponding
Gregorian output date field of another type.

Each type of input date field you can use is shown in Table 48
on page 288.

DT=(abcd) creates an output date in the form C'adbdcc', where
a, b, and c indicate the order in which the month, day, and
year are to appear and whether the year is to appear as two or
four digits, and d is the character to be used to separate the

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month, day and year. For a, b, and c, use M to represent the month (01-12),  D to represent the day (01-31),  Y to represent the last two digits of the year (for example, 09), or  4 to represent the four digits of the year (for example, 2009). M, D, and Y or 4 can each be specified only once.

DTNS=(abc) creates an output date in the form C'abc', where a, b and c indicate the order in which the month, day, and year are to appear and whether the year is to appear as two or four digits. For a, b and c, use M to represent the month (01-12), D to represent the day (01-31), Y to represent the last two digits of the year (for example, 09), or  4 to represent the four digits of the year (for example, 2009). M, D, and Y or 4 can each be specified only once.

Sample Syntax:

* Convert a C'yyddd' input date to a C'dd/mm/ccyy' output date  
OUTFIL BUILD=(92,5,Y2T,DT=(DM4/),X, 
* Convert a P'ccyyddd' input date to a C'mmddyy' output date  
  53:32,4,Y4U,DTNS=(MDY))

Conversion of Real Dates, Special Indicators and Invalid Dates
For CH/ZD dates (Y2T, Y4T, Y2W, Y4W), the zone and sign are ignored; only the digits are used. For example, X'F2F0F0F9F1F2F3D0' and X'A2B0C0D9E1F21320' are treated as 20091230. For PD dates (Y2U, Y4U, Y2V, Y4V, Y2X, Y4X, Y2Y, Y4Y), the sign is ignored; only the relevant digits are used. For example, X'120091230D' is treated as 20091230.

For CH/ZD dates (Y2T, Y4T, Y2W, Y4W), the special indicators are X'00...00' (BI zeros), X'40...40' (blanks), C'0...0' (CH zeros), Z'0...0' (ZD zeros), C'9...9' (CH nines), Z'9...9' (ZD nines) and X'FF...FF' (BI ones). For PD dates (Y2U, Y4U, Y2V, Y4V, Y2X, Y4X, Y2Y, Y4Y), the special indicators are P'0...0' (PD zeros) and P'9...9' (PD nines).

yy for real 2-digit year dates is transformed to ccyy when appropriate using the century window established by the Y2PAST option in effect. ccyy for real 4-digit year dates is transformed to yy when appropriate by removing cc.

Date conversion is not performed for special indicators; the special indicator is just used appropriately for the output date field. For example, if p,5,Y2T,TOGREG=Y4T(/) is used, an input yydde special indicator of C'99999' results in an output date field of C'9999/99/99'. However, CH/ZD special indicators of BI zeros, blanks and BI ones cannot be converted to PD special indicators.

Conversion involving an input date with an invalid digit (A-F) will result in a data exception (0C7 ABEND) or an incorrect output value.

Conversion involving an invalid input date or invalid output date will result in an output value of asterisks and an informational message (issued once). A date is considered invalid if any of the following range conditions are not met:

* yy must be between 00 and 99
* ccyy must be between 0001 and 9999
* mm must be between 01 and 12
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- dd must be between 01 and 31, and must be valid for the year and month
- ddd must be 001 to 366 for a leap year, or between 001 and 365 for a non-leap year

A date is also considered invalid if the input field is a CH/ZD special indicator of binary zeros, blanks or binary ones, and the output field is PD.

`%nn,Y2x,todate or %nn,Y4x,todate`

Specifies that an input date field of one type is to be converted to a corresponding output date field of another type. See PARSE for details of parsed fields. See "p,m,Y2x,todate or p,m,Y4x,todate" for further details.

`p,m,Y2x,dateop or p,m,Y4x,dateop`

Specifies an arithmetic operation for an input date field. The available operations are as follows:

- **ADDDAYS, ADDMONS** or **ADDDYERS** can be used to add days, months or years to a date field. As a simple example, you could use the following to add 10 days to a C'ccymmd' date and produce the resulting C'ccyy/mm/dd' date:
  
  15,8,Y4T,ADDDAYS,+10,TOGREG=Y4T(/)

- **SUBDAYS, SUBMONS** or **SUBYEARS** can be used to subtract days, months or years from a date field. As a simple example, you could use the following to subtract 3 months from a P'ddyy' date and produce the resulting P'ccyyddd' date:
  
  21,3,Y2X,SUBMONS,+3,TOJUL=Y4U

- **DATEDIFF** can be used to calculate the number of days between two date fields. As a simple example, you could use the following to calculate the difference in days between two C'ccyymmd' dates:
  
  41,8,Y4T,DATEDIFF,31,8,Y4T

- **NEXTDday** can be used to calculate the next specified day for a date field. As a simple example, you could use the following to calculate the next Friday for a C'ccyyddd' date as a C'ccyy.ddd' date:
  
  3,7,Y4T,NEXTDFRI,TOJUL=Y4T(.)

- **PREVDday** can be used to calculate the previous specified day for a date field. As a simple example, you could use the following to calculate the previous Wednesday for a P'yyddd' date as a C'ccymmd' date:
  
  51,3,Y2U,PREVWED,TORREG=Y4T

- **LASTDAYW, LASTDAYM, LASTDAYQ** or **LASTDAYY** can be used to calculate the last day of the week, month, quarter or year for a date field. As a simple example, you could use the following to calculate the last day of the month for a C'mmddccyy' date as a C'mmddccyy' date:
  
  28,8,Y4W,LASTDAYM,TORREG=Y4W

`%nn,Y2x,dateop or %nn,Y4x,dateop`

Specifies an arithmetic operation for a parsed input date field.

**Adding or Subtracting Days, Months or Years**
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p,m,Yxx,keyword,numeric,todate

Can be used to add n days, months or years to an input date field, or subtract n days, months or years from an input date field. The valid keywords are ADDDAYS, ADDMONS, ADDYEARS, SUBDAYS, SUBMONS and SUBYEARS.

The numeric value specifies the number of days, months or years to be added to or subtracted from the input date field. The resulting output date field is converted to the form indicated by todate.

p,m,Yxx specifies the starting position (p), length (m) and format (Yxx) of a 2-digit or 4-digit year input date field. The valid length and format for each type of date field you can use is shown in Table 51.

Table 51. p,m,Yxx fields for date arithmetic

<table>
<thead>
<tr>
<th>m,Yxx</th>
<th>Type of date</th>
</tr>
</thead>
<tbody>
<tr>
<td>5,Y2T</td>
<td>C'yyddd' or Z'yyddd'</td>
</tr>
<tr>
<td>6,Y2T</td>
<td>C'yymmdd' or Z'yymmdd'</td>
</tr>
<tr>
<td>7,Y4T</td>
<td>C'ccyyddd' or Z'ccyyddd'</td>
</tr>
<tr>
<td>8,Y4T</td>
<td>C'ccymmmdd' or Z'ccymmmdd'</td>
</tr>
<tr>
<td>5,Y2W</td>
<td>C'dddy' or Z'dddy'</td>
</tr>
<tr>
<td>6,Y2W</td>
<td>C'mmddyy' or Z'mmddyy'</td>
</tr>
<tr>
<td>7,Y4W</td>
<td>C'dddccyy' or Z'dddccyy'</td>
</tr>
<tr>
<td>8,Y4W</td>
<td>C'mmdccyy' or Z'mmdccyy'</td>
</tr>
<tr>
<td>3,Y2U</td>
<td>P'yyddd'</td>
</tr>
<tr>
<td>4,Y2V</td>
<td>P'yymmdd'</td>
</tr>
<tr>
<td>4,Y4U</td>
<td>P'ccyyddd'</td>
</tr>
<tr>
<td>5,Y4V</td>
<td>P'ccymmmdd'</td>
</tr>
<tr>
<td>3,Y2X</td>
<td>P'dddy'</td>
</tr>
<tr>
<td>4,Y2Y</td>
<td>P'mmdddyy'</td>
</tr>
<tr>
<td>4,Y4X</td>
<td>P'ddccccy'</td>
</tr>
<tr>
<td>5,Y4Y</td>
<td>P'mmddccyy'</td>
</tr>
</tbody>
</table>

ADDDAYS adds n days to the p,m,Yxx date field.

ADDMONS adds n months to the p,m,Yxx date field. If necessary, the resulting date is adjusted backwards to the last valid day of the month. For example, if 1 month is added to 20101031, the resulting date will be 20101130 rather than 20101131.

ADDYEARS adds n years to the p,m,Yxx date field. If the resulting date is February 29 of a non-leap year, it will be adjusted backwards to a valid date of February 28.

SUBDAYS subtracts n days from the p,m,Yxx date field.

SUBMONS subtracts n months from the p,m,Yxx date field. If necessary, the resulting date is adjusted backwards to the last valid day of the month. For example, if 1 month is subtracted from 20101031, the resulting date will be 20100930 rather than 20100931.
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**SUBYEARS** subtracts n years from the p,m,Yxx date field. If the resulting date is February 29 of a non-leap year, it will be adjusted backwards to a valid date of February 28.

*numeric* can be a decimal constant (+n or -n), or a valid numeric field (p,m,f) with BI, FI, ZD, PD, FS, UFF or SFF format and an appropriately corresponding length.

For **ADDDAYS** or **SUBDAYS**, the numeric constant or field value can be from -3652058 to +3652058.

For **ADDMONS** or **SUBMONS**, the numeric constant or field value can be from -119987 to +119987.

For **ADDYEARS** or **SUBYEARS**, the numeric constant or field value can be from -9998 to +9998.

**TOJUL** and **TOGREG**
- See TOJUL and TOGREG under "p,m,Y2x,todate or p,m,Y4x,todate" for details.

%nn,Yxx,keyword,numeric,todate
- Can be used to add n days, months or years to a parsed input date field, or subtract n days, months or years from a parsed input date field. See PARSE for details of parsed fields. See "p,m,Yxx,keyword,numeric,todate" for further details.

%nn cannot be used for the numeric field.

Calculating Difference in Days

\[ p,m,Yxx,\text{DATEDIFF},p,m,Yxx \]
- Can be used to calculate the number of days difference between two input date fields. The result is an 8-byte value consisting of a sign and 7 digits (sddddddd). If the first date is greater than or equal to the second date, the sign is + (plus). If the first date is less than the second date, the sign is - (minus).

\[ p,m,Yxx \] specifies the starting position (p), length (m) and format (Yxx) of a 2-digit or 4-digit year input date field. The valid length and format for each type of date field you can use is shown in Table 51 on page 292.

DATEDIFF calculates the number of days that result when the second date is subtracted from the first date. The result is in the form sddddddd with + or - for s as appropriate and leading zeros. The result can be between -3652058 and +3652058 days.

%nn,Yxx,DATEFILL,pm,Yxx
- Can be used to calculate the number of days difference between a parsed input date field and another input date field. See PARSE for details of parsed fields. See "p,m,Yxx,DATEDIFF,p,m,Yxx" for further details.

%nn cannot be used for the second date field.

Next, Previous or Last Day
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\[ p,m,Yxx,keyword,todate \]
Can be used to specify the next specified day, previous specified day, or last
day of the week, month, quarter or year for an input date. The valid keywords
are NEXTDday, PREVDday or LASTDAYx (where day can be SUN, MON,
TUE, WED, THU, FRI or SAT and x can be W, M, Q or Y).
The result is an output date field which is converted to the form indicated by
todate.

\[ p,m,Yxx \]
specifies the starting position (p), length (m) and format (Yxx) of a
2-digit or 4-digit year input date field. The valid length and format for each
type of date field you can use is shown in Table 51 on page 292.

NEXTDSUN calculates the next Sunday for a date field.
NEXTDMON calculates the next Monday for a date field.
NEXTDTUE calculates the next Tuesday for a date field.
NEXTDWED calculates the next Wednesday for a date field.
NEXTDTHU calculates the next Thursday for a date field.
NEXTDFRI calculates the next Friday for a date field.
NEXTDSAT calculates the next Saturday for a date field.
PREVDSUN calculates the previous Sunday for a date field.
PREVDMON calculates the previous Monday for a date field.
PREVDTUE calculates the previous Tuesday for a date field.
PREVDWED calculates the previous Wednesday for a date field.
PREVDTHU calculates the previous Thursday for a date field.
PREVDFRI calculates the previous Friday for a date field.
PREVDSAT calculates the previous Saturday for a date
LASTDAYW calculates the last day of the week (Friday) for a date field.
LASTDAYM calculates the last day of the month for a date field.
LASTDAYQ calculates the last day of the quarter for a date field.
LASTDAYY calculates the last day of the year for a date field.

TOJUL and TOGREG
See TOJUL and TOGREG under "p,m,Y2x,todate or p,m,Y4x,todate" for
details.

\%nn,Yxx,keyword,todate
Can be used to specify the next specified day, previous specified day, or last
day of the week, month, quarter or year for a parsed input date. See PARSE
for details of parsed fields. See “p,m,Yxx,keyword,todate” for further details.

Arithmetic with Real Dates, Special Indicators and Invalid Dates
For CH/ZD dates (Y2T, Y4T, Y2W, Y4W), the zone and sign are ignored; only
the digits are used. For example, X'F2F0F0F9F1F2F3D0' and
X'A2B0C0D9E1F21320' are treated as 20091230. For PD dates (Y2U, Y4U, Y2V,
Y4V, Y2X, Y4X, Y2Y, Y4Y), the sign is ignored; only the relevant digits are used.
For example, X'120091230D' is treated as 20091230.

For CH/ZD dates (Y2T, Y4T, Y2W, Y4W), the special indicators are X'00...00' (BI
zeros), X'40...40' (blanks), C'0...0' (CH zeros), Z'0...0' (ZD zeros), C'9...9' (CH
nines), Z'9...9' (ZD nines) and X'FF...FF' (BI ones). For PD dates (Y2U, Y4U,
Y2V, Y4V, Y2X, Y4X, Y2Y, Y4Y), the special indicators are P'0...0' (PD zeros) and
P'9...9' (PD nines).

yy for real 2-digit year dates is transformed to ccyy when appropriate using
the century window established by the Y2PAST option in effect. ccyy for real
4-digit year dates is transformed to yy when appropriate by removing cc.

If a special indicator is used for DATEDIFF, the result will be an output value
of asterisks and an informational message (issued once).

Date arithmetic is not performed for special indicators; the special indicator is
just used appropriately for the output date field. For example, if
p,5,Y2T,ADDDAYS,+10,TOGREG=Y4T(/) is used, an input yyddd special
indicator of C'99999' results in an output date field of C'9999/99/99'. However,
CH/ZD special indicators of BI zeros, blanks and BI ones cannot be converted
to PD special indicators.

Arithmetic involving an input date with an invalid digit (A-F) will result in a
data exception (0C7 ABEND) or an incorrect output value.

Arithmetic involving an invalid input date or invalid output date will result in
an output value of asterisks and an informational message (issued once). A
date is considered invalid if any of the following range conditions are not met:
• yy must be between 00 and 99
• ccyy must be between 0001 and 9999
• mm must be between 01 and 12
• dd must be between 01 and 31, and must be valid for the year and month
• ddd must be between 001 and 366 for a leap year, or between 001 and 365
  for a non-leap year.

A date is also considered invalid if the input field is a CH/ZD special indicator
of binary zeros, blanks or binary ones, and the output field is PD.

p,m,Y2x(s) or p,m,Y4x(s)
Specifies that an input date field is to be edited with separators. s can be any
character except a blank. Real Y2x dates are edited using the century window
established by the Y2PAST option in effect. Y2x and Y4x dates with special
indicators are expanded appropriately (for example, p,8,Y4T(s) transforms
C'00000000' to C'0000/00/00').

Editing involving an input date with an invalid digit (A-F) can result in a data
exception (0C7 ABEND) or an incorrect output value. Editing involving an
invalid input date can result in an invalid output value.

p
  See p under p,m,a.

m
  Specifies the length in bytes of the Y2x (two-digit year) or Y4x
  (four-digit year) date field.

Y2x(s) or Y4x(s)
Specifies the Y2 or Y4 format for the date field and the separator
character(s). See Appendix C, “Data Format Descriptions,” on page 885
for detailed format descriptions.
Table 52 shows the output produced for each type of edited date.

Table 52. Input and result fields for Yxx(s) date editing

<table>
<thead>
<tr>
<th>m,Yxx(s)</th>
<th>Input date</th>
<th>Output for p,m,Yxx(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,Y2T(s)</td>
<td>C'yyx' or Z'yyx'</td>
<td>C'cyyysx'</td>
</tr>
<tr>
<td>4,Y2T(s)</td>
<td>C'yxxc or Z'yxxc</td>
<td>C'cyyxsx'</td>
</tr>
<tr>
<td>5,Y2T(s)</td>
<td>C'yyydd' or Z'yyydd'</td>
<td>C'cyyysdd'</td>
</tr>
<tr>
<td>6,Y2T(s)</td>
<td>C'zyymdd' or Z'zyymmd'</td>
<td>C'cyyysmdd'</td>
</tr>
<tr>
<td>7,Y4T(s)</td>
<td>C'ccyydd' or Z'ccyydd'</td>
<td>C'cyyysdd'</td>
</tr>
<tr>
<td>8,Y4T(s)</td>
<td>C'ccymmd' or Z'ccymmd'</td>
<td>C'cyyysmdd'</td>
</tr>
<tr>
<td>2,Y2U(s)</td>
<td>P'yyyy'</td>
<td>C'cyyysx'</td>
</tr>
<tr>
<td>3,Y2V(s)</td>
<td>P'yyyxx'</td>
<td>C'cyyysxx'</td>
</tr>
<tr>
<td>5,Y2U(s)</td>
<td>P'yyyy'</td>
<td>C'cyyysdd'</td>
</tr>
<tr>
<td>4,Y2V(s)</td>
<td>P'yyyydd'</td>
<td>C'cyyysmdd'</td>
</tr>
<tr>
<td>4,Y4U(s)</td>
<td>P'ccyydd'</td>
<td>C'cyyysdd'</td>
</tr>
<tr>
<td>5,Y4V(s)</td>
<td>P'ccymmd'</td>
<td>C'cyyysmdd'</td>
</tr>
<tr>
<td>3,Y2W(s)</td>
<td>C'xxyy' or Z'xxyy'</td>
<td>C'xxyy'</td>
</tr>
<tr>
<td>4,Y2W(s)</td>
<td>C'xxyy' or Z'xxyy'</td>
<td>C'xxyy'</td>
</tr>
<tr>
<td>5,Y2W(s)</td>
<td>C'ddyy' or Z'ddyy'</td>
<td>C'ddscyy'</td>
</tr>
<tr>
<td>6,Y2W(s)</td>
<td>C'mmddy' or Z'mmddy'</td>
<td>C'mmsdscyy'</td>
</tr>
<tr>
<td>7,Y4W(s)</td>
<td>C'ddcccyy' or Z'ddcccyy'</td>
<td>C'dddscyy'</td>
</tr>
<tr>
<td>8,Y4W(s)</td>
<td>C'mmddccyy' or Z'mmddccyy'</td>
<td>C'mmsddscyy'</td>
</tr>
<tr>
<td>2,Y2X(s)</td>
<td>P'xxy'</td>
<td>C'xxyy'</td>
</tr>
<tr>
<td>3,Y2Y(s)</td>
<td>P'xxyy'</td>
<td>C'xxyy'</td>
</tr>
<tr>
<td>3,Y2X(s)</td>
<td>P'ddddy'</td>
<td>C'dddscyy'</td>
</tr>
<tr>
<td>4,Y2Y(s)</td>
<td>P'mmdddy'</td>
<td>C'mmsdscyy'</td>
</tr>
<tr>
<td>4,Y4X(s)</td>
<td>P'dddccyy'</td>
<td>C'dddscyy'</td>
</tr>
<tr>
<td>5,Y4Y(s)</td>
<td>P'mmddccyy'</td>
<td>C'mmsddscyy'</td>
</tr>
</tbody>
</table>

%nn,Y2x(s) or %nn,Y4x(s)

Specifies that a parsed input date field is to be edited with separators. See PARSE for details of parsed fields. See "p,m,Y2x(s) or p,m,Y4x(s)" for further details.

p,m,Y2XP

Specifies that an input date field is to be converted to a packed decimal output date field. Real Y2x dates are edited using the century window established by the Y2PAST option in effect. Y2x and Y4x dates with special indicators are expanded appropriately (for example, p,6,Y2TP transforms C'000000' to P'00000000').

Editing involving an input date with an invalid digit (A-F) can result in a data exception (0C7 ABEND) or an incorrect output value. Editing involving an invalid input date can result in an invalid output value.

p  See p under p,m,a.

m  Specifies the length in bytes of the Y2x (two-digit year) or Y4x (four-digit year) date field.

Y2xP  Specifies the Y2 format for the date field. See Appendix C, “Data Format Descriptions,” on page 885 for detailed format descriptions.

Sample Syntax:

```
OUTFIL BUILD=(11,3,Y2XP,X,21,4,Y2WP)
```
Table 53 shows the output produced for each type of date.

**Table 53. Input and result fields for Yxx(s) date editing**

<table>
<thead>
<tr>
<th>m,Y2xP</th>
<th>Input date</th>
<th>Output for p,m,Y2xP</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,Y2TP</td>
<td>C’yyx’ or Z’yxx’</td>
<td>P’ccyyx’</td>
</tr>
<tr>
<td>4,Y2TP</td>
<td>C’yyxx’ or Z’yxx’</td>
<td>P’ccyyxx’</td>
</tr>
<tr>
<td>5,Y2TP</td>
<td>C’ydd’ or Z’yddd’</td>
<td>P’ccyydd’</td>
</tr>
<tr>
<td>6,Y2TP</td>
<td>C’yymmd’ or Z’yymmd’d</td>
<td>P’ccyymmd’d</td>
</tr>
<tr>
<td>2,Y2UP</td>
<td>P’yxx’</td>
<td>P’ccyyx’</td>
</tr>
<tr>
<td>3,Y2VP</td>
<td>P’yxxx’</td>
<td>P’ccyyxx’</td>
</tr>
<tr>
<td>3,Y2UP</td>
<td>P’yyydd’</td>
<td>C’ccyydd’</td>
</tr>
<tr>
<td>4,Y2VP</td>
<td>P’yymmd’d</td>
<td>C’ccyyymmd’d</td>
</tr>
<tr>
<td>3,Y2WP</td>
<td>C’xxy’ or Z’xxy’</td>
<td>C’xcxy’</td>
</tr>
<tr>
<td>4,Y2WP</td>
<td>C’xxy’ or Z’xxy’</td>
<td>C’xxccyy’</td>
</tr>
<tr>
<td>5,Y2WP</td>
<td>C’dddy’ or Z’dddy’</td>
<td>C’dddccyy’</td>
</tr>
<tr>
<td>6,Y2WP</td>
<td>C’mmdddy’ or Z’mmdddy’</td>
<td>C’mmdccyy’</td>
</tr>
<tr>
<td>2,Y2XP</td>
<td>P’xxy’</td>
<td>C’xcxy’</td>
</tr>
<tr>
<td>3,Y2YP</td>
<td>P’xxyy’</td>
<td>C’xxccyy’</td>
</tr>
<tr>
<td>3,Y2XP</td>
<td>P’dddy’y’</td>
<td>C’dddccyy’</td>
</tr>
<tr>
<td>4,Y2YP</td>
<td>P’mmdddy’</td>
<td>C’mmdccyy’</td>
</tr>
<tr>
<td>2,Y2PP</td>
<td>P’y’y’</td>
<td>C’ccyy’</td>
</tr>
<tr>
<td>1,Y2DP</td>
<td>X’y’</td>
<td>C’ccyy’</td>
</tr>
</tbody>
</table>

%nn,Y2xP

Specifies that a parsed input date field is to be converted to a packed decimal output date field. See PARSE for details of parsed fields. See "p,m,Y2xP" for further details.

p,m,lookup or %nn,lookup

specifies that a character constant, hexadecimal constant, input field (p,m), or parsed input field (%nn) from a lookup table is to appear in the reformatted OUTFIL output record. You can use p,m,lookup or %nn,lookup to select a specified set constant (that is, a character or hexadecimal string) or set field (that is, an input field or parsed input field) based on matching an input value against find constants (that is, character, hexadecimal, or bit constants).

p  
See p under p,m,a.

m  
specifies the length in bytes of the input field to be compared to the find constants. The value for m must be 1 to 64 if character or hexadecimal find constants are used, or 1 if bit find constants are used.

%nn  
specifies a parsed input field to be compared to the find constants. See PARSE for details of parsed fields.

lookup

Specifies how the input field or parsed input field is to be changed to the output field, using a lookup table.

CHANGE

```
CHANGE=(-v,find,set),NOMATCH=(set)
```
OUTFIL Control Statements

specifies a list of change pairs, each consisting of a find constant to be compared to the input field value or parsed input field value and a set constant or set field to use as the output field when a match occurs.

\textbf{v} specifies the length in bytes of the output field to be inserted in the reformatted OUTFIL output record. The value for \textbf{v} must be between 1 and 64.

\textbf{find}

specifies a find constant to be compared to the input field value or parsed input field value. If the input field value or parsed input field value matches the find constant, the corresponding set constant or set field is used for the output field.

The find constants can be either character string constants, hexadecimal string constants, or bit constants:

- Character string constants (C’xx…x’) and hexadecimal string constants (X’yy…yy’) can be 1 to \textit{m} bytes and can be intermixed with each other, but not with bit constants. See “INCLUDE Control Statement” on page 98 for details of coding character and hexadecimal string constants.

If the string is less than \textit{m} bytes, it will be padded on the right to a length of \textit{m} bytes, using blanks (X’40’) for a character string constant or zeros (X’00’) for a hexadecimal string constant.

- Bit constants (B’bbbbbbbb’) must be 1 byte and cannot be intermixed with character or string constants. See “INCLUDE Control Statement” on page 98 for details of coding bit constants.

For bit constants, because of the specification of bits to be ignored, more than one find constant can match an input field value; the set constant for the first match found will be used as the output field.

For example, if you specify:

\begin{verbatim}
OUTFIL OUTREC=(5,1,
  CHANGE=(1,B'1111111',C'A',B'1111111',C'B'))
\end{verbatim}

input field value X’C0’ (B'11000000’) matches both bit constants, but C’A’ will be used for the set constant, because its find constant is the first match.

\textbf{set}

specifies a set constant or set field to be used as the output field if the corresponding find constant matches the input field value or parsed input field value. Set constants and set fields can be intermixed.

Set constants can be either character string constants (C’xx…x’) or hexadecimal string constants (X’yy…yy’) of 1 to \textit{v} bytes. See “INCLUDE Control Statement” on page 98 for details of coding character and hexadecimal string constants.

If the string is less than \textit{v} bytes, it will be padded on the right to a length of \textit{v} bytes, using blanks (X’40’) for a character string constant or zeros (X’00’) for a hexadecimal string constant.

Set fields are specified as q,n or %nn. q specifies the input position. See \texttt{p,m,a} for details of coding q. n specifies the input length of 1 to \textit{v} bytes. %nn specifies a parsed input field. See PARSE for details of parsed fields. If the set field length is less than \textit{v}, the input field or parsed input field will be padded on the right to a length of \textit{v} bytes, using blanks (X’40’).
OUTFIL Control Statements

NOMATCH
specifies the action to be taken if an input field value or parsed input field value does not match any of the find constants. If you do not specify NOMATCH, and a match is not found for any input value, DFSORT terminates processing.

If you specify NOMATCH, it must follow CHANGE.

set
specifies a set constant or set field to be used as the output field if a match is not found.

Set constants can be either character string constants (C'xx...x') or hexadecimal string constants (X'yy...yy') of 1 to v bytes and can be intermixed. See "INCLUDE Control Statement" on page 98 for details of coding character and hexadecimal string constants.

If the string is less than v bytes, it will be padded on the right to a length of v bytes, using blanks (X'40') for a character string constant or zeros (X'00') for a hexadecimal string constant.

Set fields are specified as q,n or %nn. q specifies the input position. See p under p,m,a for details of coding q. n specifies the input length of 1 to v bytes. %nn specifies a parsed input field. See PARSE for details of parsed fields. If the set field length is less than v, the input field or parsed input field will be padded on the right to a length of v bytes, using blanks (X'40').

Sample Syntax:

```
OUTFIL FILES=1,
OUTREC=(11,1,
  CHANGE=(6,
    C'R',C'READ',
    C'U',C'UPDATE',
    X'FF',C'EMPTY',
    C'X',35.6,
    C'A',C'ALTER'),
  NOMATCH=(11,6),
  4X,
  21,1,
  CHANGE=(10,
    B'.1......',C'VSAM',
    B'.0......',C'NON-VSAM'))
```

p,m,justify
specifies that a left-justified or right-justified input field is to appear in the reformatted OUTFIL output record. For a left-justified field, leading blanks are removed and the characters from the first nonblank to the last nonblank are shifted left, with blanks inserted on the right if needed. For a right-justified field, trailing blanks are removed and the characters from the last nonblank to the first nonblank are shifted right, with blanks inserted on the left if needed.

Optionally:
- specific leading and trailing characters can be changed to blanks before justification begins
- a leading string can be inserted
- a trailing string can be inserted
- the output length can be changed (it is equal to the input length by default)

p See p under p,m,a.
OUTFIL Control Statements

m  See m under p,m,a.

**justify**

specifies how the input field is to be justified for output.

**JFY**

![Diagram of JFY](image)

**Note:** For clarity, in the examples below, b is used to represent a blank in the input fields.

**SHIFT=LEFT**

specifies that a left-justified input field is to appear in the reformatted OUTFIL output record. Leading blanks are removed and the characters from the first nonblank to the last nonblank are shifted left, with blanks inserted on the right if needed. For example, with:

1,15,JFY=(SHIFT=LEFT)

an input field of:

```
bbbbABbCDbbEFbb
```

results in an output field of:

```
ABbCDbbEFbbbbbb
```

m is used for the output field length unless LENGTH=n is specified. If the left-justified input field is shorter than the output field length, blanks are inserted on the right. If the left-justified input field is longer than the output field length, characters are truncated on the right. You can use LENGTH=n to prevent padding or truncation.

**SHIFT=RIGHT**

specifies that a right-justified input field is to appear in the reformatted OUTFIL output record. Trailing blanks are removed and the characters from the last nonblank to the first nonblank are shifted right, with blanks inserted on the left if needed. For example, with:

1,15,JFY=(SHIFT=RIGHT)

an input field of:

```
bbbbABbCDbbEFbb
```

results in an output field of:

```
bbbbbbABbCDbbEF
```
m is used for the output field length unless LENGTH=n is specified. If the right-justified input field is shorter than the output field length, blanks are inserted on the left. If the right-justified input field is longer than the output field length, characters are truncated on the left. You can use LENGTH=n to prevent padding or truncation.

**LENGTH=n**

specifies the length of the justified output field. The value for n must be between 1 and 32752. If LENGTH=n is not specified, m (the input field length) is used for the length of the justified output field. You can use LENGTH=n to prevent padding or truncation.

**PREBLANK=list**

specifies a list of one or more characters to be changed to blanks before justify processing begins. Only leading and trailing characters are changed to blanks. Scanning from left to right, each nonblank character at the start of the input field that matches a character in the list is replaced by a blank character, until a nonblank character not in the list is found. Scanning from right to left, each nonblank character at the end of the input field that matches a character in the list will be replaced by a blank character, until a nonblank character not in the list is found.

list can be 1 to 10 characters specified using a character string constant (C‘xx...x’) or a hexadecimal string constant (X‘yy...yy’). See "INCLUDE Control Statement" on page 98 for details of coding character and hexadecimal string constants.

Each character in the list is treated as one character to be preblanked. Thus PREBLANK=C‘*’ specifies an asterisk is to be preblanked, and PREBLANK=C‘,;$’ specifies a comma, a semicolon and a dollar sign are each to be preblanked.

For example, let’s say we have an input field of:

**b**<ABBbCD+bEF>*b**

If we specify:

1,19,IFY=(SHIFT=LEFT,PREBLANK=C‘*’)

each leading or trailing asterisk is changed to a blank before left-justify processing begins. So the output field is:

<ABBbCD+bEF>bbbbbb

If we specify:

1,19,IFY=(SHIFT=RIGHT,PREBLANK=C‘<>’)

each leading or trailing asterisk, less than sign and greater than sign is changed to a blank before right-justify processing begins. So the output field is:

bbbbbbABBbCD+bEF

**LEAD=string**

specifies a string to be inserted in the output field before the first nonblank character in the input field.

string can be 1 to 50 characters specified using a character string constant (C‘xx...x’) or a hexadecimal string constant (X‘yy...yy’). See


OUTFIL Control Statements

“INCLUDE Control Statement” on page 98 for details of coding character and hexadecimal string constants.

For example, let’s say we have an input field of:

bABCbEbbbbb

If we specify:

1,11,JFY=(SHIFT=RIGHT,LEAD=C'XYZ')

the output field is:

bbbXYZABCbE

When we add characters with LEAD=string, it’s often necessary to specify LENGTH=n to avoid truncation. For example, let’s say we have an input field of:

AbBbC

If we specify:

1,5,JFY=(SHIFT=LEFT,LEAD=C'XYZ')

the output field is:

XYZAb

Since the output field length is defaulted to the input field length of 5, the resulting 8 characters (XYZAbBbC) are truncated on the right to 5 characters (XYZAb) for output. If we instead specify:

1,5,JFY=(SHIFT=LEFT,LEAD=C'XYZ',LENGTH=8)

the output field is:

XYZAbBbC

LENGTH=8 increases the output field by the 3 LEAD characters and truncation is prevented.

TRAIL=string specifies a string to be inserted in the output field after the last nonblank character in the input field.

string can be 1 to 50 characters specified using a character string constant (C'xx...x') or a hexadecimal string constant (Xyy...yy'). See “INCLUDE Control Statement” on page 98 for details of coding character and hexadecimal string constants.

For example, let’s say we have an input field of:

bABCbEbbbbb

If we specify:

1,11,JFY=(SHIFT=LEFT,TRAIL=C'XYZ')

the output field is:

ABCbEXYZbb

When we add characters with TRAIL=string, it’s often necessary to specify LENGTH=n to avoid truncation. For example, let’s say we have an input field of:

AbBbC
If we specify:
1,5,JFY=(SHIFT=RIGHT,TRAIL=C'XYZ')

the output field is:
bCXYZ

Since the output field length is defaulted to the input field length of 5, the resulting 8 characters (AbBbCXYZ) are truncated on the left to 5 characters (bCXYZ) for output. If we instead specify:
1,5,JFY=(SHIFT=RIGHT,TRAIL=C'XYZ',LENGTH=8)

the output field is:
AbBbCXYZ

LENGTH=8 increases the output field by the 3 TRAIL characters and truncation is prevented.

Sample Syntax:
OUTFIL BUILD=(5:16,20,JFY=(SHIFT=LEFT,PREBLANK=C'*', LEAD=C'<A>',TRAIL=C'</A>',LENGTH=22))

\%nn,justify
specifies that a left-justified or right-justified parsed input field is to appear in the reformatted OUTFIL output record. See PARSE for details of parsed fields. See p,m,justify for further details.

p,m,squeeze
specifies that a left-squeezed or right-squeezed input field is to appear in the reformatted OUTFIL output record. For a left-squeezed field, all blanks are removed and the characters from the first nonblank to the last nonblank are shifted left, with blanks inserted on the right if needed. For a right-squeezed field, all blanks are removed and the characters from the last nonblank to the first nonblank are shifted right, with blanks inserted on the left if needed. Optionally:
- specific characters can be changed to blanks before squeezing begins
- a leading string can be inserted
- a trailing string can be inserted
- a string (for example, a comma delimiter) can be inserted wherever a group of blanks is removed between the first nonblank and the last nonblank
- blanks can be kept as is between paired apostrophes ('AB CD EF') or paired quotes ("AB CD EF")
- the output length can be changed (it is equal to the input length by default)

\%p
See p under p,m,a.

\%m
See m under p,m,a.

\%squeeze
Specifies how the input field is to be squeezed for output.

\%SQZ
**Note:** For clarity, in the examples below, b is used to represent a blank in the input fields.

**SHIFT=LEFT**

specifies that a left-squeezed input field is to appear in the reformatted OUTFIL output record. All blanks are removed and the characters from the first nonblank to the last nonblank are shifted left, with blanks inserted on the right if needed. For example, with:

1,15,SQZ=(SHIFT=LEFT)

an input field of:

```
bbbbABbCDbbEFbb
```

results in an output field of:

```
ABCDEFbbbbbbbb
```

m is used for the output field length unless LENGTH=n is specified. If the left-squeezed input field is shorter than the output field length, blanks are inserted on the right. If the left-squeezed input field is longer than the output field length, characters are truncated on the right.

**SHIFT=RIGHT**

specifies that a right-squeezed input field is to appear in the reformatted OUTFIL output record. All blanks are removed and the characters from the last nonblank to the first nonblank are shifted right, with blanks inserted on the left if needed. For example, with:

1,15,SQZ=(SHIFT=RIGHT)

an input field of:

```
bbbbABbCDbbEFbb
```

results in an output field of:

```
bbbbbbbbABCDEFGHIJKLMNOPQRSTUVWXYZ
```

m is used for the output field length unless LENGTH=n is specified. If the right-squeezed input field is shorter than the output field length, blanks are inserted on the left. If the right-squeezed input field is longer than the output field length, characters are truncated on the left.
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**LENGTH=n**
specifies the length of the squeezed output field. The value for n
must be between 1 and 32752. If LENGTH=n is not specified, m
(the input field length) is used for the length of the squeezed
output field.

**PREBLANK=list**
specifies a list of one or more characters to be changed to blanks
before squeeze processing begins. Each nonblank character in the
input field that matches a character in the list is replaced by a
blank character.

list can be 1 to 10 characters specified using a character string
constant (C'xx...x') or a hexadecimal string constant (X'yy...yy'). See
"INCLUDE Control Statement" on page 98 for details of coding
character and hexadecimal string constants.

Each character in the list is treated as one character to be
preblanked. Thus PREBLANK=C"" specifies an asterisk is to be
preblanked, and PREBLANK=C","$" specifies a comma, a semicolon
and a dollar sign are each to be preblanked.

For example, let's say we have an input field of:
**b<*ABbC<>D*bEF>*b**

If we specify:
1,21,SQZ=(SHIFT=LEFT,PREBLANK=C'*',LENGTH=12)

each asterisk is changed to a blank before left-squeeze processing
begins. The output field is:
<ABC<>DEF>bb

If we specify:
1,21,SQZ=(SHIFT=RIGHT,PREBLANK=C'<>',)

each asterisk, less than sign and greater than sign is changed to a
blank before right-squeeze processing begins. The output field is:
bbbbbbbbbbbbbbABCDEF

**LEAD=string**
specifies a string to be inserted in the output field before the first
nonblank character in the input field.

string can be 1 to 50 characters specified using a character string
constant (C'xx...x') or a hexadecimal string constant (X'yy...yy'). See
"INCLUDE Control Statement" on page 98 for details of coding
character and hexadecimal string constants.

For example, let's say we have an input field of:
bABCbEbbbbb

If we specify:
1,11,SQZ=(SHIFT=RIGHT,LEAD=C'XYZ')

the output field is:
bbbbXYZABCE
OUTFIL Control Statements

When we add characters with LEAD=string, it's often necessary to specify LENGTH=n to avoid truncation. For additional information on this, see "LEAD=string" for JFY above.

**MID=string**

specifies a string to be inserted in the output field wherever one or more blanks is removed between the first nonblank and the last nonblank.

String can be 1 to 10 characters specified using a character string constant (C'xx...x') or a hexadecimal string constant (X'yy...yy'). See "INCLUDE Control Statement” on page 98 for details of coding character and hexadecimal string constants.

For example, let's say we have an input field of:

```
bABbcCbbbDbE
```

If we specify:

```
1,12,SQZ=(SHIFT=LEFT,MID=C',')
```

the output field is:

```
AB,C,D,Ebbbb
```

When we add characters with MID=string, it's often necessary to specify LENGTH=n to avoid truncation. For example, let's say we have an input field of:

```
AbBbC
```

If we specify:

```
1,5,SQZ=(SHIFT=LEFT,MID=C'XY')
```

the output field is:

```
AXYBX
```

Since the output field length is defaulted to the input field length of 5, the resulting 7 characters (AXYBXC) are truncated on the right to 5 characters (AXYBX) for output. If we instead specify:

```
1,5,SQZ=(SHIFT=LEFT,MID=C'XY',LENGTH=7)
```

the output field is:

```
AXYBXYC
```

LENGTH=7 increases the output field to accommodate the MID strings and truncation is prevented.

**TRAIL=string**

specifies a string to be inserted in the output field after the last nonblank character in the input field.

String can be 1 to 50 characters specified using a character string constant (C'xx...x') or a hexadecimal string constant (X'yy...yy'). See "INCLUDE Control Statement” on page 98 for details of coding character and hexadecimal string constants.

For example, let's say we have an input field of:

```
bABbcCbbbDbE
```
If we specify:
1,11,SQZ=(SHIFT=LEFT, LEAD=X'7D', TRAIL=X'7D')

the output field is:
'ABCE'bbbb

When we add characters with TRAIL=string, it's often necessary to specify LENGTH=n to avoid truncation. For additional information on this, see "TRAIL=string" for JFY above.

PAIR=APOST

specifies that blanks and PREBLANK characters between apostrophe (') pairs are to be kept as is. Use PAIR=APOST when you have literals that should not be squeezed.

For example, let's say we have an input field of:
b*b'ABbb*''*C'bbb'D*Ebb'*

If we specify:
1,25,SQZ=(SHIFT=LEFT, PREBLANK=C'*', MID=C', ')

all of the blanks and asterisks, including those inside the apostrophe pairs, are squeezed out. The output field is:
'AB,'',C','D*Ebb'bbbbbb

However, if we specify:
1,25,SQZ=(SHIFT=LEFT, PREBLANK=C'*', MID=C', ', PAIR=APOST)

only the blanks and asterisks outside of the apostrophe pairs are squeezed out. The output field is:
'ABbb*''*C', 'D=Ebb'bbbbbb

If an apostrophe is specified in the PREBLANK list (for example, PREBLANK=C''' or PREBLANK=X'7D'), it is ignored, that is, an apostrophe in the input field is not replaced by a blank. So if you want each apostrophe to be replaced by a blank, do not specify PAIR=APOST.

For SHIFT=LEFT, scanning is left to right. If an apostrophe is found with no subsequent apostrophe, all of the characters from the apostrophe to the end of the input field are ignored. For example, let's say we have an input field of:
bbXbY'ABCbbbDbb

If we specify:
1,15,SQZ=(PAIR=APOST)

there's an unpaired apostrophe, so all of the characters from the apostrophe to the end of the input field are ignored. The output field is:
XY'ABCbbbDbbbbbb

For SHIFT=RIGHT, scanning is right to left. If an apostrophe is found with no previous apostrophe, all of the characters from the
OUTFIL Control Statements

apostrophe to the beginning of the input field are ignored. For example, let’s say we have an input field of:

bbXbY'ABCbbDbb

If we specify:

1,15,SQZ=(SHIFT=RIGHT,PAIR=APOST)

there’s an unpaired apostrophe, so all of the characters from the apostrophe to the beginning of the input field are ignored. The output field is:

bbbbbbXbY'ABCD

PAIR=QUOTE

specifies that blanks and PREBLANK characters between quote (") pairs are to be kept as is. Use PAIR=QUOTE when you have literals that should not be squeezed.

For example, let’s say we have an input field of:

b*b"ABbb**"+C"bb"D=Ebb"

If we specify:

1,25,SQZ=(SHIFT=LEFT,PREBLANK=C'*',MID=C',')

all of the blanks and asterisks, including those inside the quote pairs, are squeezed out. The output field is:

"AB,**",D,E,"bbbbbbbbb

However, if we specify:

1,25,SQZ=(SHIFT=LEFT,PREBLANK=C'*',MID=C',',PAIR=QUOTE)

only the blanks and asterisks outside of the quote pairs are squeezed out. The output field is:

"ABbb**"+C",D=Ebb'bbbbb

If a quote is specified in the PREBLANK list (for example, PREBLANK=C"" or PREBLANK=X7F), it is ignored, that is, a quote in the input field is not replaced by a blank. So if you want each quote to be replaced by a blank, do not specify PAIR=QUOTE.

For SHIFT=LEFT, scanning is left to right. If a quote is found with no subsequent quote, all of the characters from the quote to the end of the input field are ignored. For example, let’s say we have an input field of:

bbXbY*ABCbbDbb

If we specify:

1,15,SQZ=(SHIFT=LEFT,PAIR=QUOTE)

there’s an unpaired quote, so all of the characters from the quote to the end of the input field are ignored. The output field is:

XY"ABCbbDbbbbb
OUTFIL Control Statements

For SHIFT=RIGHT, scanning is right to left. If a quote is found with no previous quote, all of the characters from the quote to the beginning of the input field are ignored. For example, let's say we have an input field of:

bbXbY"ABCbbbDbb

If we specify:

1,15,SQZ=(SHIFT=RIGHT,PAIR=QUOTE)

there's an unpaired quote, so all of the characters from the quote to the beginning of the input field are ignored. The output field is:

bbbbbbbbXbY"ABCD

Sample Syntax:

OUTFIL BUILD=(5:16,20,SQZ=(SHIFT=LEFT,PAIR=QUOTE,PREBLANK=C'<>'))

%nn,squeeze

specifies that a left-squeezed or right-squeezed parsed input field is to appear in the reformatted OUTFIL output record. See PARSE for details of parsed fields. See p,m,squeeze for further details.

seqnum

specifies that a sequence number is to appear in the reformatted OUTFIL output record. The sequence numbers are assigned in the order in which the records are received for OUTFIL OUTREC processing. You can create BI, PD, ZD, CSF, or FS sequence numbers and control their lengths, starting values and increment values. You can restart the sequence number at the start value each time a specified OUTFIL input field (p,m) or parsed input field (%nn) changes.

n specifies the length of the sequence number. The value for n must be between 1 and 16.

fs specifies the format for the sequence number, which can be BI, PD, ZD, CSF, or FS.

For a ZD format sequence number, F is used as the sign.

For a PD format sequence number, C is used as the sign.

For a CSF or FS format sequence number, blank is used as the sign and leading zeros are suppressed.

For a PD, ZD, CSF, or FS format sequence number, the maximum value DFSORT can create is limited to the lesser of 15 decimal digits or the output field length (n). If a sequence number overflows this limit, it will be truncated to the lesser of 15 decimal digits or the output field length, and then subsequently incremented as usual.

For a BI format sequence number, the maximum value DFSORT can create is limited to the lesser of 8 bytes of ones (X'FFFFFFFFFFFFFFF') or the number of ones that will fit in the specified output field length.
(n). If a sequence number overflows this limit, it will be truncated to the lesser of 8 bytes or the output field length, and then subsequently incremented as usual.

**START**
specifies the starting value for the sequence number.

j specifies the starting value. The value for j must be between 0 and 10000000000. The default for j is 1.

**INCR**
specifies the increment value for the sequence number.

i specifies the increment value. The value for i must be between 1 and 1000000. The default for i is 1.

**RESTART**
specifies that DFSORT is to restart the sequence number at the starting value (START=j) when the binary value for the specified OUTFIL input field or parsed input field changes. This allows you to sequence each set of records with the same value (that is, duplicate records) separately. For example: Without RESTART, if you had six OUTFIL input records with 'A', 'A', 'A', 'B', 'B' and 'C', respectively, in position 1, the output records would be given the sequence numbers 1, 2, 3, 4, 5 and 6. But with RESTART=(1,1), the output records are given the sequence numbers 1, 2, 3, 1, 2 and 1; DFSORT restarts at the starting value (1, by default) when the input value at position 1 changes from 'A' to 'B' and again when it changes from 'B' to 'C'.

p,m or %nn
specifies the OUTFIL input field or parsed input field to be used to determine when the sequence number is to be restarted at the starting value. If a variable-length OUTFIL input record is too short to contain a specified restart field, binary zeros (or blanks for a parsed field) will be used for the missing bytes, intentionally or unintentionally.

p See p under p, m,a
m specifies the length in bytes of the input field. The value for m must be between 1 and 256.

%nn
specifies the parsed input field. See PARSE for details of parsed fields.

Sample Syntax:
```
OUTFIL FNAMES=O1,OUTREC=(SEQNUM,6,ZD,START=1000,INCR=50,
X,22,8,X,13,5)
OUTFIL FNAMES=O2,OUTREC=\(1,12,SEQNUM,4,BI\)
OUTFIL FNAMES=O3,OUTREC=\(1,80,81:SEQNUM,8,ZD,START=21,INCR=20,
RESTART=(35,8))\)
```

Default for BUILD or OUTREC: None; must be specified.

**OVERLAY**
OUTFIL Control Statements

Specifies each item that is to overlay specific columns in the reformatted record. Columns that are not overlaid remain unchanged. If you want to insert, rearrange, or delete fields, use BUILD or OUTREC rather than OVERLAY. Use OVERLAY only to overlay existing columns or to add fields at the end of every record. OVERLAY can be easier to use than BUILD or OUTREC when you just want to change a few fields without rebuilding the entire record.

For fixed-length records, the first input and output data byte starts at position 1. For variable-length records, the first input and output data byte starts at position 5, after the RDW in positions 1-4.

Use c: (column) to specify the output positions to be overlaid. If you do not specify c: for the first item, it defaults to 1:. If you do not specify c: for any other item, it starts after the previous item. For example, if you specify:

```plaintext
OUTFIL OVERLAY=(25,2,11:C'A',15,3,C'*')
```
Input positions 25-26 are placed at output positions 1-2; C‘A’ is placed at output position 11; input positions 15-17 are placed at output positions 12-14; and C‘**’ is placed at output positions 15-16. The rest of the record remains unchanged.

You can specify items in any order, you can change the same item multiple times and you can overlap output columns. Changes to earlier items affect changes to later items. For example, say you specify:

```
OUTFIL OVERLAY=(21:8,4,ZD,MUL,+10,TO=2D,LENGTH=6, 5:5,1,TRAN=UTOL, 5:5,1,CHANGE=(1,C‘a’,C‘X’,C‘b’,C‘Y’),NOMATCH=(5,1))
```

and input position 5 has 'A'. The second item (UTOL) would change 'A' to 'a' and the third item (CHANGE) would change 'a' again to 'X'.

If you specify an OVERLAY item that extends the overlay record beyond the end of the input record, the reformatted record length is automatically increased to that length, and blanks are filled in on the left as needed. For variable-length records, the RDW length is increased to correspond to the larger reformatted record length after all of the OVERLAY items are processed. For example, if your OUTFIL input record has a length of 40 and you specify:

```
OUTFIL OVERLAY=(16:C‘ABC’,51:5C‘*’,35:15,2)
```

the OUTFIL output record is given a length of 55. Blanks are filled in from columns 41-50. For variable-length records, the length in the RDW is changed from 40 to 55 after all of the OVERLAY items are processed.

Missing bytes in specified input fields are replaced with blanks so the padded fields can be processed.

You can use the OVERLAY parameter with the FTOV parameter to convert fixed-length record data sets to variable-length record data sets.

You can use the VLTRIM parameter with the OVERLAY parameter to remove specified trailing bytes from the end of variable-length records.

You can use the OVERLAY parameter with any or all of the report parameters in the same way as for the BUILD or OUTREC parameter.

The OVERLAY parameter of the OUTREC statement applies to all input records whereas the OVERLAY parameter of the OUTFIL statement only applies to the OUTFIL input records for its OUTFIL group.

See OUTFIL OUTREC for details of the items listed in the OVERLAY syntax diagram above. You can specify all of the items for OVERLAY in the same way that you can specify them for BUILD or OUTREC with the following exceptions:

- You cannot specify p or p,HEX or p,TRAN=keyword for OVERLAY.
- You cannot specify / for OVERLAY.
- For p,m,H or p,m,F or or p,m,D fields specified for OVERLAY, fields are aligned as necessary without changing the preceding bytes.
- For variable-length records, you must not overlay positions 1-4 (the RDW) for OVERLAY, so be sure to specify the first column (c:) as 5 or greater. Do not specify 1:, 2:, 3: or 4: anywhere in your OVERLAY parameter. If you do not specify the first column, it will default to 1: which is invalid for variable-length records with OVERLAY. Whereas OUTREC=(1,m,..) is required, OVERLAY=(1,m) is not allowed since it would overlay the RDW.

Sample Syntax:

Fixed input records:
OUTFIL Control Statements

```
OUTFIL FNAMES=FLR,
   OVERLAY=(21:21,4,ZD,TO=PD,LENGTH=4,
            2:5,8,HEX,45:C'*',32,4,C'*',81:SEQNUM,5,ZD)

Variable input records:
OUTFIL FNAMES=VLR,
   OVERLAY=(5:X'0001',28:C'Date is ',YDDDNS=(4D),
            17:5C'*')
```

*Default for OVERLAY:* None; must be specified.

**FINDREP**

You can use FINDREP to find constants anywhere in a record and replace them with other constants of the same or different lengths. You can find character or hexadecimal input constants anywhere in your records and replace them with character, hexadecimal or null output constants. As appropriate, bytes can be shifted left or right, blank padding can be added for fixed-length records, and the length can be changed for variable-length records.

Various options of FINDREP allow you to define one or more input constants and a corresponding output constant, define one or more pairs of input and output constants, start and end the find scan at specified positions, stop after a specified number of constants are replaced, increase or decrease the length of the output record, define the action to be taken if nonblank characters overrun the end of the record, and specify whether output constants are to replace or overlay input constants.

You can use the FINDREP parameter with the FTOV parameter to convert fixed-length record data sets to variable-length record data sets.

You can use the VLTRIM parameter with the FINDREP parameter to remove specified trailing bytes from the end of variable-length records.

You can use the FINDREP parameter with any or all of the report parameters in the same way as for the BUILD or OUTREC parameter.
OUTFIL Control Statements

The FINDREP parameter of the OUTREC statement applies to all input records whereas the FINDREP parameter of the OUTFIL statement only applies to the OUTFIL input records for its OUTFIL group.

Input and output constants for find and replace processing are defined as follows:

**input constant**
An input constant can be specified as a single character string, a repeated character string, a single hexadecimal string, or a repeated hexadecimal string. The syntax is: C’string’, nC’string’, X’string’ or nX’string’; n can be 1 to 256. The string can be 1 to 256 characters, or 1 to 256 pairs of hexadecimal digits. The total length of the constant must not exceed 256 bytes. Use two apostrophes for a single apostrophe.

**output constant**
An output constant can be specified as a null string, a single character string, a repeated character string, a single hexadecimal string, or a repeated hexadecimal string. The syntax is: C’’ (null), C’string’, nC’string’, X’string’ or nX’string’. n can be 1 to 256. The string can be a null, or 1 to 256 characters, or 1 to 256 pairs of hexadecimal digits. The total length of the constant must not exceed 256 bytes. Use two apostrophes for a single apostrophe. A null string can be used to remove input constants.

You must specify the input and output constants to be used for find and replace processing in one of the following ways. The default processing for each method described below can be changed with various options described later.

**IN=incon,OUT=outcon**
Specifies one input constant and one output constant. Position 1 (for fixed-length records) or 5 (for variable-length records) will be set as the current position. The current position of the input record will be checked for the input constant. If a match is not found at the current position, the current position will be incremented by 1, and the process will be repeated. If a match is found at the current position, the output constant will replace the input constant, the current position will be incremented past the input constant, and the process will be repeated. Bytes after the replaced constants up to the end of the record will be shifted left or right as needed. Processing will stop when the current position is beyond the end of the input record.

Example:
```
OUTFIL IFTHEN=(WHEN=(11,1,CH,EQ,C'3'),
              FINDREP=(IN=C'YES',OUT=C'NO'))
```
Replaces every C’YES’ input constant in records with a C’3’ in position 11 with a C’NO’ output constant, and shifts the bytes after each replaced constant to the left.

**IN=(incon1,incon2,...,inconx),OUT=outcon**
Specifies multiple input constants and one output constant. Position 1 (for fixed-length records) or 5 (for variable-length records) will be set as the current position. The current position of the input record will be checked for each input constant in turn until a match is found or all of the input constants have been checked. If a match is not found at the current position for any input constant, the current position will be
OUTFIL Control Statements

incremented by 1, and the process will be repeated. If a match is found at
the current position, the output constant will replace the input
constant, the current position will be incremented past the input
constant, and the process will be repeated. Bytes after the replaced
constants up to the end of the record will be shifted left or right as
needed. Processing will stop when the current position is beyond the
end of the input record.

Example:

```
OUTFIL FINDREP=(IN=(X'FF',3X'00'),OUT=C'')
```

Removes every X'FF' and X'000000' input constant, and shifts the bytes
after each removed constant to the left.

**INOUT=(incon1,outcon1,incon2,outcon2,...,inconx,outconx)**

Specifies one or more pairs of input and output constants. Position 1
(for fixed-length records) or 5 (for variable-length records) will be set
as the current position. The current position of the input record will be
checked for each input constant in turn until a match is found or all of
the input constants have been checked. If a match is not found at the
current position for any input constant, the current position will be
incremented by 1, and the process will be repeated. If a match is found
at the current position for an input constant, the corresponding output
constant will replace the input constant, the current position will be
incremented past the input constant, and the process will be repeated.
Bytes after the replaced constants up to the end of the record will be
shifted left or right as needed. Processing will stop when the current
position is beyond the end of the input record.

Example:

```
OUTFIL FINDREP=(INOUT=(C'SAT',C'SATURDAY',C'SUN',C'SUNDAY'))
```

Replaces every C'SAT' input constant with a C'SATURDAY' output
constant, and every C'SUN' input constant with a C'SUNDAY' output
constant, and shifts the bytes after each replaced constant to the right.

You can specify any or all of the following options to change the default
processing described earlier:

**STARTPOS=p**

Specifies the starting position in the input record for the find scan,
overriding the default of position 1 for a fixed-length record or
position 5 for a variable-length record. Use STARTPOS=p if you want
to start your find scan at a particular position. p can be 1 to 32752. If p
is less than 5 for a variable-length record, 5 will be used for p. If p is
beyond the end of the input record, find and replace processing will
not be performed for the record.

Example:

```
OUTFIL FINDREP=(IN=C'Yes',OUT=C'YES',STARTPOS=11)
```

Replaces every C'Yes' input constant found starting at or after position
11 with a C'YES' output constant.

**ENDPOS=q**

Specifies the ending position in the input record for the find scan,
overriding the default of the end of the record. Use ENDPOS=q if you
want to end your find scan at a particular position. ENDPOS=q only
applies to the end of the find scan; bytes will still be shifted up to the
end of the record as needed. q can be 1 to 32752. If q is less than 5 for
a variable-length record, 5 will be used for q. If q is beyond the end of
the input record, the end of the record will be used for q. If
STARTPOS=p and ENDPOS=q are both specified, and p is greater than
q, find and replace processing will not be performed for the record.

Example:
```
OUTFIL FINDREP=(IN=(C'D27',C'A52',C'X31'),OUT=C'INVALID',
ENDPOS=2015)
```

Replaces every C'D27', C'A52' and C'X31' input constant found before
or at position 2015 with a C'INVALID' output constant, and shifts the
bytes after each replaced constant to the right (past 2015 up to the end
of the record).

**DO=n** Specifies the maximum number of times find and replace is to be
performed for a record, overriding the default of every time. Scanning
for the input constant stops when n input constants have been found
and replaced. Use DO=n if you want to stop after a particular number
of constants have been replaced. n can be 1 to 1000.

Example:
```
OUTFIL FNAME=out1,FINDREP=(IN=X'015C',OUT=X'015D',DO=3)
```

Replaces the first three X'015C' input constants found with X'015D'
output constants.

**MAXLEN=n**
Specifies the maximum length to be used for the output record created
by find and replace processing, overriding the default of using the
maximum length of the input record. Use MAXLEN=n if you want to
increase or decrease the output record length. (For IFTHEN FINDREP,
MAXLEN=n can only be used to increase the output record length, not
decrease it. See "Notes" below for more information.)

If an output constant is larger than a corresponding input constant,
MAXLEN=n can be used to increase the size of the output record to
allow for shifting characters to the right. n can be 1 to 32752.
MAXLEN=n will be used to set the LRECL of the output data set,
when appropriate.

Example:
```
OUTFIL FINDREP=(INOUT=(C'01',C'January',C'02',C'February',
C'03',C'March'),MAXLEN=150)
```

Replaces every C'01' input constant with a C'January' output constant,
every C'02' input constant with a C'February' output constant, and
every C'03' input constant with a C'March' output constant, and shifts
the bytes after each replaced constant to the right, allowing the record
to expand to 150 bytes.

**OVERRUN=ERROR or OVERRUN=TRUNC**
Specifies the action DFSORT is to take if an overrun occurs, that is:
• if nonblank bytes are shifted to the right past the end of the output
record as specified by MAXLEN=n, or as defaulted to the input
record length, or
• if MAXLEN=n is used to make the output record smaller than the
input record, and nonblank bytes are found in the input record past
the end of the output record.
OUTFIL Control Statements

OVERRUN=ERROR is the default; it tells DFSORT to issue an error message and terminate if an overrun occurs.

Use OVERRUN=TRUNC if you want DFSORT to truncate the output record to the MAXLEN=n or input record length if an overrun occurs, rather than terminating. Bytes beyond the end of the output record are lost.

Example:
```
OUTFIL FINDREP=(IN='FFFF',OUT='INVALID',MAXLEN=50,OVERRUN=TRUNC)
```

Replaces every X'FFFF' input constant with a C'INVALID' output constant, and shifts the bytes after the replaced constants to the right. 50 byte output records are created. Bytes shifted past position 50 are lost. Without OVERRUN=TRUNC, if nonblank characters were shifted past position 50, an overrun error message would be issued and the job would terminate.

SHIFT=YES or SHIFT=NO

Specifies the action DFSORT is to take if an input constant is to be replaced by an output constant of a different length.

SHIFT=YES is the default; it tells DFSORT to shift the bytes after each replaced input constant to the left or right as needed.

Use SHIFT=NO if you want DFSORT to overlay the input constant with the output constant instead of shifting bytes. If a matching input constant is found and the output constant is smaller than the input constant, the current position will be incremented past the output constant rather than past the input constant before processing continues.

Example:
```
OUTFIL FINDREP=(IN=(C'KW1=YES,','C'KW1=NO,'),OUT=C'KW2',SHIFT=NO)
```

Replaces every C'KW1=YES,' input constant with a C'KW2=YES,' output constant. Replaces every C'KW1=NO,' input constant with a C'KW2=NO,' output constant. SHIFT=NO ensures that C'KW1' is replaced with C'KW2' and the '='YES,' and '='NO,' bytes are kept. Without SHIFT=NO, the '='YES,' and '='NO,' bytes would be removed.

Default for FINDREP: None; must be specified.

FINDREP notes:

- For a single FINDREP operand, when a constant is replaced at the current position, no further checks are performed at that position. So a single FINDREP cannot be used to change a constant and then change it again. For example, if you had an input record with:

  ABC

  and used this OUTFIL statement:

  `OUTFIL FINDREP=(IN=\"C'AB',C'XY',C'XYC',C'RST'\")`

  the output record would be:

  XYC

  After C'AB' is changed to C'XY', the current pointer is advanced to C'C' so C'XYZ' is not found. However, since each IFTHEN clause starts at the beginning of the record, multiple IFTHEN clauses with FINDREP can be used to change a constant and then change it again. If you used:
for the ABC record, the output would be:

RST

The first IFTHEN clause would change C'AB' to C'XY'. The second IFTHEN clause would start over from the first position and change C'XYC' to C'RST'.

- Duplicates and supersets of the same input constant after the first are effectively ignored, whereas subsets of the same input constant after the first are processed. For example, if you had this input record:

  ABCD ABQ

and you used this OUTFIL statement:

  OUTFIL FINDREP=(INOUT=(C'AB',C'XY',C'ABCD',C'RSTU'))

the output record would be:

  XYCD XYQ

Since C'AB' is changed to C'XY', C'ABCD' is not found. If you wanted to change C'ABCD' to C'RSTU' and other instances of C'AB' to C'XY', you would need to specify C'ABCD' first. If you used this OUTFIL statement:

  OUTFIL FINDREP=(INOUT=(C'ABCD',C'RSTU',C'AB',C'XY'))

the output record would be:

  RSTU XYQ

If C'ABCD' is found, it is changed to C'RSTU'. Otherwise, if C'AB' is found, it is changed to C'XY'.

- For fixed-length records, FINDREP in an IFTHEN clause operates against the maximum record padded with blanks on the right as needed. If a blank constant is being replaced, the blanks on the right will be replaced. For example, if we have an 80 byte FB input record and use:

  OUTFIL IFTHEN=(WHEN=INIT,BUILD=(1,20)),
  IFTHEN=(WHEN=(2,1,CH,EQ,C'R'),
  FINDREP=(IN=C' ',OUT=C'ABC'))

Although in this case BUILD=(1,20) will result in a 20-byte output record, IFTHEN FINDREP will operate against the maximum 80-byte record padded with 60 blanks on the right. For a record with 'R' in position 2, each of those 60 blanks on the right will be replaced with C'ABC'. This will cause an overrun of the 80 byte record, thus resulting in termination (OVERRUN=ERROR) or truncation (OVERRUN=TRUNC). ENDPOS=20 could be used to stop FINDREP from replacing the 60 blanks on the right.

Note that if we have an 80-byte input record with 'ABC' in positions 1-3 and we use:

  OUTFIL IFTHEN=(WHEN=INIT,BUILD=(1,3)),
  IFTHEN=(WHEN=INIT,FINDREP=(IN=C'ABC',OUT=C'12345'))

an overrun will not occur because IFTHEN FINDREP will operate against an 80-byte record padded with 77 blanks on the right, rather than against a 3-byte record even though the output record will be 3 bytes.

- For FINDREP in an IFTHEN clause, MAXLEN=n can be used to increase the maximum output length, but cannot be used to decrease the maximum output length. For example, with:

  OUTFIL IFTHEN=(WHEN=INIT,BUILD=(1,100)),
  IFTHEN=(WHEN=INIT,FINDREP=(IN=C'A',OUT=C'B',MAXLEN=150))

the output length will be set to 150, whereas with:
OUTFIL Control Statements

OUTFIL IFTHEN=(WHEN=INIT,BUILD=(1,100)),
    IFTHEN=(WHEN=INIT,
              FINDREP=(IN=C'A',OUT=C'B',MAXLEN=70))
the output length will be set to 100.

IFTHEN clauses allow you to reformat different records in different ways by specifying how build, overlay, find/replace or group operation items are to be applied to records that meet given criteria. IFTHEN clauses let you use simple or complex conditional logic to choose how different record types are reformatted.

If you want to insert, rearrange, or delete fields in the same way for every record, use BUILD or OUTREC rather than IFTHEN. If you want to do find and replace operations in the same way for every record, use FINDREP rather than IFTHEN. Use IFTHEN clauses if you want to insert, rearrange, delete, or overlay fields, or perform find/replace operations in different ways for different records, or if you want to perform operations on groups of records.

You can use five types of IFTHEN clauses as follows:

- **WHEN=INIT**: Use one or more WHEN=INIT clauses to apply build, overlay, or find/replace items to all of your input records. WHEN=INIT clauses and WHEN=GROUP clauses are processed before any of the other IFTHEN clauses.

- **WHEN=GROUP**: Use one or more WHEN=GROUP clauses to propagate fields, identifiers and sequence numbers within specified groups of records. WHEN=INIT clauses and WHEN=GROUP clauses are processed before any of the other IFTHEN clauses.

- **WHEN=(logexp)**: Use one or more WHEN=(logexp) clauses to apply build, overlay or find/replace items to your input records that meet specified criteria. A WHEN=(logexp) clause is satisfied when the logical expression evaluates as true.
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- **WHEN=ANY**: Use a WHEN=ANY clause after multiple WHEN=(logexp) clauses to apply additional build, overlay or find/replace items to your input records if they satisfied the criteria for any of the preceding WHEN=(logexp) clauses.

- **WHEN=NONE**: Use one or more WHEN=NONE clauses to apply build, overlay or find/replace items to your input records that did not meet the criteria for any of the WHEN=(logexp) clauses. WHEN=NONE clauses are processed after any of the other IFTHEN clauses. If you do not specify a WHEN=NONE clause, only the WHEN=INIT and WHEN=GROUP changes (if any) are applied to input records that do not meet the criteria for any of the WHEN=(logexp) clauses.

**IFTHEN clauses are processed in the following order:**
- WHEN=INIT clauses and WHEN=GROUP clauses
- WHEN=(logexp) clauses and WHEN=ANY clauses
- WHEN=NONE clauses

Processing of IFTHEN clauses continues unless one of the following occurs:
- A WHEN=(logexp) or WHEN=ANY clause is satisfied, and HIT=NEXT is not specified.
- A WHEN=(logexp), WHEN=ANY or WHEN=NONE clause is satisfied, and BUILD with / is specified (multiple output records).
- There are no more IFTHEN clauses to process. When processing of IFTHEN clauses stops, the IFTHEN record created so far is used as the output record.

**Example:**
```
OUTFIL IFTHEN=(WHEN=(12,1,B1,ALL,X'3F'),OVERLAY=(18:C'Yes')),
  IFTHEN=(WHEN=(35,2,PD,EQ,+14),BUILD=(1,40,45,3,HEX),HIT=NEXT),
  IFTHEN=(WHEN=(35,2,PD,GT,+17),BUILD=(1,40,41,5,HEX),HIT=NEXT),
  IFTHEN=(WHEN=ANY,BUILD=(1,55,C'ABC',70:X)),
  IFTHEN=(WHEN=(35,2,PD,EQ,+8),BUILD=(1,40,2/,45,10)),
  IFTHEN=(WHEN=(63,2,CH,EQ,C'AB'),OVERLAY=(18:C'No')),
  IFTHEN=(WHEN=NONE,BUILD=(1,40,51,8,TRAN=LTOU))
```

For this example, the IFTHEN clauses are processed as follows:
- If IFTHEN clause 1 is satisfied, its overlay item is applied and IFTHEN processing stops.
- If IFTHEN clause 1 is not satisfied, its overlay item is not applied and IFTHEN processing continues.
- If IFTHEN clause 2 is satisfied, its build items are applied and IFTHEN processing continues.
- If IFTHEN clause 2 is not satisfied, its build items are not applied and IFTHEN processing continues.
- If IFTHEN clause 3 is satisfied, its build items are applied and IFTHEN processing continues.
- If IFTHEN clause 3 is not satisfied, its build items are not applied and IFTHEN processing continues.
- If IFTHEN clause 4 is satisfied, its build items are applied and IFTHEN processing stops.
- If IFTHEN clause 4 is not satisfied, its build items are not applied and IFTHEN processing continues.
- If IFTHEN clause 5 is satisfied, its build items are applied and IFTHEN processing continues.
- If IFTHEN clause 5 is not satisfied, its build items are not applied and IFTHEN processing continues.
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- If IFTHEN clause 6 is satisfied, its overlay item is applied and IFTHEN processing stops.
- If IFTHEN clause 6 is not satisfied, its overlay item is not applied and IFTHEN processing continues.
- If IFTHEN clause 7 is satisfied, its build items are applied and IFTHEN processing stops.
- If IFTHEN clause 7 is not satisfied, its build items are not applied and IFTHEN processing stops.

All of the IFTHEN clauses operate sequentially on an IFTHEN record. The IFTHEN record is created initially from the input record. Each IFTHEN clause tests and changes the IFTHEN record, as appropriate. Thus, changes made by earlier IFTHEN clauses are "seen" by later IFTHEN clauses. For example, if you have a 40-byte input record and specify:

   OUTFIL IFTHEN=(WHEN=INIT,OVERLAY=(8:8,4,ZD,ADD,+1,TO=ZD,LENGTH=4)),
   IFTHEN=(WHEN=(8,4,ZD,EQ,+27),OVERLAY=(28:C'Yes')),
   IFTHEN=(WHEN=NONE,OVERLAY=(28:C'No'))

The WHEN=INIT clause adds 1 to the ZD value and stores it in the IFTHEN record. The WHEN=(8,4,ZD,EQ,+27) clause tests the incremented ZD value in the IFTHEN record rather than the original ZD value in the input record.

The IFTHEN record is adjusted as needed for the records created or changed by the IFTHEN clauses. For fixed-length records, blanks are filled in on the left as needed. For variable-length records, the RDW length is adjusted as needed each time the IFTHEN record is changed.

Missing bytes in specified input fields are replaced with blanks so the padded fields can be processed.

DFSORT sets an appropriate LRECL for the OUTFIL output records based on the build, overlay, find/replace and group operation items specified by the IFTHEN clauses. However, DFSORT does not analyze the possible results of WHEN=(logexp) conditions when determining an appropriate LRECL. When you use OUTFIL IFTHEN clauses, you can override the OUTFIL LRECL determined by DFSORT with the OUTFIL IFOUTLEN parameter.

If SEQNUM is used in multiple IFTHEN clauses, the sequence number will be incremented for each record that satisfies the IFTHEN clause, that is, a separate SEQNUM counter will be kept for each IFTHEN clause. For example, if your input is:

   RECORD A 1
   RECORD B 1
   RECORD B 2
   RECORD C 1
   RECORD A 2
   RECORD C 2
   RECORD B 3
   RECORD D 1

and you specify:

   OUTFIL IFTHEN=(WHEN=(8,1,CH,EQ,'C\'A'),OVERLAY=(15:SEQNUM,4,ZD)),
   IFTHEN=(WHEN=(8,1,CH,EQ,'C\'B'),OVERLAY=(16:SEQNUM,4,ZD)),
   IFTHEN=(WHEN=NONE,OVERLAY=(17:SEQNUM,4,ZD))

your output will be:

   RECORD A 1 0001
   RECORD B 1 0001
   RECORD B 2 0002
   RECORD C 1 0001
Separate SEQNUM counters are kept for the 'A' record, for the 'B' record, and for the NONE records.

You can use IFTHEN clauses with the FTOV parameter to convert fixed-length record data sets to variable-length record data sets.

You can use the VLTRIM parameter with IFTHEN clauses to remove specified trailing bytes from the end of variable-length records.

You can use IFTHEN clauses with any or all of the report parameters (LINES, HEADER1, TRAILER1, HEADER2, TRAILER2, SECTIONS, BLKCCH1, BLKCCH2, BLKCCT1, and NODETAIL) in the same way as for the BUILD or OUTREC parameter.

The IFTHEN clauses of the OUTREC statement apply to all input records whereas the IFTHEN clauses of the OUTFIL statement only apply to the OUTFIL input records for its OUTFIL group.

**WHEN=INIT clause**

Specifies build, overlay or find/replace items to be applied to all records. Multiple WHEN=INIT clauses and WHEN=GROUPE clauses may be intermixed. They are processed before any other type of IFTHEN clauses and in the order in which they are specified.

**WHEN=INIT**

Identifies a WHEN=INIT clause.

**PARSE=(definitions)**

Defines %nn fixed parsed fields into which variable position/length fields are extracted for all records. See OUTFIL PARSE for details. You can use the %nn parsed fields defined in a WHEN=INIT clause in the BUILD or OVERLAY operand of that clause and all subsequent IFTHEN clauses.

**Sample Syntax:**

```
OUTFIL IFOUTLEN=50,
  IFTHEN=(WHEN=INIT,
    PARSE=(%01=(ABSPOS=11,STARTAT=NONBLANK,
                                        ENDBEFR=C',',FIXLEN=12),
           %02=(ENDBEFR=C',',FIXLEN=10),
           %03=(FIXLEN=12)),
    IFTHEN=(WHEN=(5,2,CH,EQ,C'US'),BUILD=(%02,%03)),
    IFTHEN=(WHEN=(5,2,CH,EQ,C'UK'),BUILD=(%01,%02)),
    IFTHEN=(WHEN=NONE,BUILD=(%03,%01))
```

**BUILD=(items)**

Specifies the build items to be applied to each record. See OUTFIL BUILD for details. You can specify all of the items in the same way that you can specify them for OUTFIL BUILD, except that you cannot specify / to create blank records or new records.

**OVERLAY=(items)**

Specifies the overlay items to be applied to each record. See OUTFIL OVERLAY for details. You can specify all of the items in the same way that you can specify them for OUTFIL OVERLAY.

**Sample Syntax:**
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OUTFIL FNAMES=OUT1,
  IFTHEN=(WHEN=INIT,BUILD=(1,20,21:C'Department',31:3X,21,60)),
  IFTHEN=(WHEN=(5,2,CH,EQ,C'D1'),OVERLAY=(31:8,3)),
  IFTHEN=(WHEN=(5,2,CH,EQ,C'D2'),OVERLAY=(31:12,3))

FINDREP=(items)
  Specifies find and replace operations to be applied to each record. See OUTFIL FINDREP for details. You can specify all of the items in the same way that you can specify them for OUTFIL FINDREP.

Sample Syntax
  OUTFIL FNAMES=OUT2,
    IFTHEN=(WHEN=INIT,FINDREP=(IN=X'00',OUT=X'40')),
    IFTHEN=(WHEN=INIT,OVERLAY=(81:SEQNUM,8,ZD))

WHEN=GROUP clause
  Identifies groups of records in various ways and propagates fields, identifiers and sequence numbers to the records of each group. Fields, identifiers and sequence numbers are not propagated to records before, between or after identified groups. Multiple WHEN=INIT clauses and WHEN=GROUP clauses may be intermixed. They are processed before any other type of IFTHEN clauses and in the order in which they are specified.

  You can specify the BEGIN, KEYBEGIN, END and RECORDS operands in any combination to define the groups, but you must specify at least one of these operands.

BEGIN=(logexp)
  Specifies the criteria to be tested to determine if a record starts a group. See the INCLUDE statement for details of the logical expressions you can use. You can specify all of the logical expressions in the same way that you can specify them for the INCLUDE statement except that:
  • You cannot specify FORMAT=f with BEGIN=(logexp).
  • You cannot specify D2 format in BEGIN=(logexp).
  • Locale processing is not used for BEGIN=(logexp).
  • VLSCMP and VLSHRT are not used with BEGIN=(logexp). Instead, missing bytes in specified input fields are replaced with blanks so the padded fields can be processed.

  A new group starts with a record that satisfies the BEGIN condition, that is, when the specified logical expression is true for that record. If BEGIN is specified without END or RECORDS, all of the records from the begin record up to but not including the next begin record belong to a group. Here's an example of groups with

BEGIN=(1,1,CH,EQ,C'A'):

<p>| |</p>
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
</tr>
<tr>
<td>R</td>
</tr>
</tbody>
</table>
| A | group 1
| B | group 1
| C | group 1
| A | group 2
| A | group 3
| B | group 3

Example:
  OUTFIL IFTHEN=(WHEN=GROUP,
    BEGIN=(1,40,SS,EQ,C'J82',OR,1,40,SS,EQ,C'M72'),
    PUSH=(41:ID=5))
OUTFIL Control Statements

Starts a new group each time 'CJ82' or 'M72' is found anywhere in positions 1-40 of a record. OVERLAYS positions 41-45 of each record of a group with a 5-byte ZD identifier. The records before the first group are not changed.

**KEYBEGIN=(p,m)**

Specifies a field to be used to determine if a record starts a group. A new group starts when the binary value in the specified key field (p,m) changes. The first input record will start a group. KEYBEGIN=(p,m) operates in a similar way to BEGIN=(logexp) but uses a key change as a trigger rather than a condition to be satisfied. Use KEYBEGIN=(p,m) if you want to start a new group for each consecutive set of key values in your records.

- **p** is the starting position of the key and can be from 1 to 32752.
- **m** is the length of the key and can be from 1 to 256.

If KEYBEGIN=(p,m) is specified, the first input record will start a group.

Here is an example of groups with

```
KEYBEGIN=(1,1)
```

```
A group 1
A group 1
A group 1
B group 2
B group 2
C group 3
```

Example:

```
OUTFIL IFTHEN=(WHEN=GROUP,
    KEYBEGIN=(11,5),PUSH=(81:21,8))
```

Starts a new group each time the value in positions 11-15 changes. OVERLAYS positions 81-88 of each record of a group with positions 21-28 from the first record of that group.

**END=(logexp)**

Specifies the criteria to be tested to determine if a record ends a group. See the INCLUDE statement for details of the logical expressions you can use. You can specify all of the logical expressions in the same way that you can specify them for the INCLUDE statement except that:

- You cannot specify FORMAT=f with END=(logexp).
- You cannot specify D2 format in END=(logexp).
- Locale processing is not used for END=(logexp).
- VLSCMP and VLSHRT are not used with END=(logexp). Instead, missing bytes in specified input fields are replaced with blanks so the padded fields can be processed.

A group ends whenever a record satisfies the END condition, that is, whenever the specified logical expression is true for that record. If END is specified without BEGIN or KEYBEGIN, all of the records up to the end record (or the last record of the data set) belong to a group.

Here's an example of groups with

```
END=(1,1,CH,EQ,C'T')
```

```
A group 1
B group 1
T group 1
```
OUTFIL Control Statements

T group 2
A group 3
T group 3
M group 4

If END is specified with BEGIN or KEYBEGIN, all of the records from the begin record up to the end record (or the last record of the data set) belong to a group. Here's an example of groups with
BEGIN=(1,1,CH,EQ,C'H'),END=(1,1,CH,EQ,C'T')

H group 1
B group 1
T group 1
H group 2
T group 2
M
N
H group 3
A group 3

Example:

OUTFIL IFTHEN=(WHEN=GROUP,
BEGIN=(1,2,CH,EQ,C'O2',AND,8,3,CH,EQ,C'YES'),
END=(11,5,CH,EQ,C'PAGE:'),PUSH=(61:SEQ=3))

Starts a new group each time C'02' is found in positions 1-2 and C'YES' is found in positions 8-10 of a record. Ends the group when C'PAGE:' is found in positions 11-15 of a record. Overlays positions 61-63 of each record of a group with a 3-byte ZD sequence number. The records between the groups are not changed.

RECORDS=n

Specifies the maximum number of records in a group. n can be 1 to 2000000000. If RECORDS is specified without BEGIN, KEYBEGIN or END, a new group starts after n records. Here's an example of groups with
RECORDS=3

H group 1
B group 1
T group 1
H group 2
B group 2
T group 2
M group 3
N group 3

If RECORDS is specified with BEGIN or KEYBEGIN, up to n records starting with the begin record belong to a group. Here's an example of groups with
BEGIN=(1,1,CH,EQ,C'H'),RECORDS=3

H group 1
B group 1
T group 1
A
H group 2
B group 2
H group 3
M group 3
N group 3
P
OUTFIL Control Statements

The records between and after the groups are not changed.

If RECORDS is specified with END, the group ends after up to n records or with the end record (or the last record of the data set), whichever comes first. Here's an example of groups with

BEGIN=(1,1,CH,EQ,C'H'), END=(1,1,CH,EQ,C'T'), RECORDS=4

H group 1
B group 1
T group 1
A
H group 2
B group 2
C group 2
D group 2
E
H group 3
M group 3

The records between the groups are not changed.

You must specify the PUSH operand to define at least one field, identifier or sequence number to be added to the records of each group. You can specify any combination or number of fields, identifiers and sequence numbers.

PUSH=(c: item,...)

Specifies the position where each field, identifier or sequence number is to be overlaid in the records of each group.

For fixed-length records, the first input and output data byte starts at position 1. For variable-length records, the first input and output data byte starts at position 5, after the RDW in positions 1-4.

You can use the following in PUSH:

c: Specifies the output position (column) to be overlaid. If you do not specify c: for the first item, it defaults to 1:. If you do not specify c: for any other item, it starts after the previous item. You can specify items in any order and overlap output columns. c can be 1 to 32752.

If you specify an item that extends the output record beyond the end of the input record, the record length is automatically increased to that length, and blanks are filled in on the left as needed. For variable-length records, the RDW length is increased to correspond to the larger record length after all of the items are processed. Missing bytes in specified input fields are replaced with blanks so the padded fields can be processed.

p,m

Specifies a field in the first input record of each group to be propagated to every record of the group. p specifies the starting position of the field in the input record and m specifies its length. A field must not extend beyond position 32752.

ID=n

Specifies a ZD identifier of length n is to be added to every record of each group. The identifier starts at 1 for the first group and is incremented by 1 for each subsequent group. n can be 1 to 15.

SEQ=n

Specifies a ZD sequence number of length n is to be added to
every record of each group. The sequence number starts at 1 for
the first record of each group and is incremented by 1 for each
subsequent record of the group. n can be 1 to 15.

Sample Syntax
OUTFIL IFTHEN=(WHEN=GROUP,
    BEGIN=(1,5,CH,EQ,C'DATE:'),
    RECORDS=3,
    PUSH=(15:ID=3,31:21,8))

WHEN=(logexp) clause
Specifies build, overlay or find/replace items to be applied to records for
which the specified logical expression is true. If multiple WHEN=(logexp)
clauses are specified, they are processed in the order in which they are
specified.

WHEN=(logexp)
Identifies a WHEN=(logexp) clause and specifies the criteria to be
tested to determine if the build, overlay or find/replace items are to be
applied to the record. See the INCLUDE statement for details of the
logical expressions you can use. You can specify all of the logical
expressions in the same way that you can specify them for the
INCLUDE statement except that:
• You cannot specify FORMAT=f with WHEN=(logexp).
• You cannot specify D2 format in WHEN=(logexp).
• Locale processing is not used for WHEN=(logexp).
• VLSCMP and VLSHRT are not used with WHEN=(logexp). Instead,
  missing bytes in specified input fields are replaced with blanks so
  the padded fields can be processed.

PARSE=(definitions)
Defines %nn fixed parsed fields into which variable position/length
fields are extracted for each record for which the logical expression is
true. See OUTFIL PARSE for details. You can only use the %nn parsed
fields defined in a WHEN=(logexp) clause in the BUILD or OVERLAY
operand of that WHEN=(logexp) clause.

Sample Syntax:
OUTFIL IFTHEN=(WHEN=(45,2,CH,EQ,C'AL'),
    PARSE=(%01=(ENDBEFR=C',',FIXLEN=12),
             %02=(FIXLEN=10)),
    OVERLAY=(21:%02,51:%01))

BUILD=(items)
Specifies the build items to be applied to each record for which the
logical expression is true. See OUTFIL BUILD for details. You can
specify all of the items in the same way that you can specify them for
OUTFIL BUILD.

OVERLAY=(items)
Specifies the overlay items to be applied to each record for which the
logical expression is true. See OUTFIL OVERLAY for details. You can
specify all of the items in the same way that you can specify them for
OUTFIL OVERLAY.

FINDREP=(items)
Specifies find and replace operations to be applied to each record for
OUTFIL Control Statements

which the logical expression is true. See OUTFIL FINDREP for details. You can specify all of the items in the same way that you can specify them for OUTFIL FINDREP.

Sample Syntax

OUTFIL IFTHEN=(WHEN=(11,2,CH,EQ,C'**'),
FINDREP=(IN=C'**',OUT=C''))

HIT=NEXT

Specifies that IFTHEN processing should continue even if the logical expression is true. By default (if HIT=NEXT is not specified), IFTHEN processing stops if the logical expression is true.

Sample Syntax:

OUTFIL FNAMES=OUT2,
IFTHEN=(WHEN=(1,3,CH,EQ,C'T01',AND,
18,4,ZD,LE,+2000),OVERLAY=(42:C'Type1 <= 2000'),HIT=NEX),
IFTHEN=(WHEN=(1,3,CH,EQ,C'T01',AND,6,1,BI,BO,X'03'),
BUILD=(1,21,42,13)),
IFTHEN=(WHEN=(1,3,CH,EQ,C'T01',AND,
18,4,ZD,GT,+2000),OVERLAY=(42:C'Type1 > 2000'),HIT=NEXT),
IFTHEN=(WHEN=(1,3,CH,EQ,C'T01',AND,6,1,BI,BO,X'01'),
BUILD=(1,25,42,13))

WHEN=ANY clause

Specifies build, overlay or find/replace items to be applied to records for which the logical expression in any "preceding" WHEN=(logexp) clause is true. For the first WHEN=ANY clause, the "preceding" WHEN=(logexp) clauses are those before this WHEN=ANY clause. For the second or subsequent WHEN=ANY clause, the "preceding" WHEN=(logexp) clauses are those between the previous WHEN=ANY clause and this WHEN=ANY clause. At least one WHEN=(logexp) clause must be specified before a WHEN=ANY clause. A WHEN=ANY clause can be used without any build, overlay or find/replace items to just stop IFTHEN processing if any preceding WHEN=(logexp) clause is satisfied.

PARSE=(definitions)

Defines %nn fixed parsed fields into which variable position/length fields are extracted for each record for which the logical expression in any preceding WHEN=(logexp) clause is true. See OUTFIL PARSE for details. You can only use the %nn parsed fields defined in a WHEN=ANY clause in the BUILD or OVERLAY operand of that WHEN=ANY clause.

BUILD=(items)

Specifies the build items to be applied to each record for which the logical expression in any preceding WHEN=(logexp) clause is true. See OUTFIL BUILD for details. You can specify all of the items in the same way that you can specify them for OUTFIL BUILD.

OVERLAY=(items)

Specifies the overlay items to be applied to each record for which the logical expression in any preceding WHEN=(logexp) clause is true. See OUTFIL OVERLAY for details. You can specify all of the items in the same way that you can specify them for OUTFIL OVERLAY.

FINDREP=(items)

Specifies find and replace operations to be applied to each record for which the logical expression in any preceding WHEN=(logexp) clause
OUTFIL Control Statements

is true. See OUTFIL FINDREP for details. You can specify all of the items in the same way that you can specify them for OUTFIL FINDREP.

HIT=NEXT
Specifies that IFTHEN processing should continue even if the logical expression in a preceding WHEN=(logexp) clause is true. By default (if HIT=NEXT is not specified), IFTHEN processing stops if the logical expression in a preceding WHEN=(logexp) clause is true.

Sample Syntax:
OUTFIL FNAMES=OUT3,
  IFTHEN=(WHEN=(1,3,SS,EQ,C'T01,T02,T03'),
    BUILD=(C'Group A',X,1,80),HIT=NEXT),
  IFTHEN=(WHEN=(1,3,SS,EQ,C'T04,T05,T06'),
    BUILD=(C'Group B',X,1,80),HIT=NEXT),
  IFTHEN=(WHEN=(1,3,SS,EQ,C'T07,T08,T09,T10'),
    BUILD=(C'Group C',X,1,80),HIT=NEXT),
  IFTHEN=(WHEN=ANY,OVERLAY=(16:C'Group Found'))

WHEN=NONE clause
Specifies build, overlay or find/replace items to be applied to records for which none of the logical expressions in any WHEN=(logexp) clause is true. If there are no WHEN=(logexp) clauses, the build, overlay or find/replace items are applied to all of the records. If multiple WHEN=NONE clauses are specified, they are processed in the order in which they are specified. WHEN=NONE clauses are processed after any other type of IFTHEN clauses.

PARSE=(definitions)
Defines %nn fixed parsed fields into which variable position/length fields are extracted for each record for which no logical expression was true. See OUTFIL PARSE for details. You can only use the %nn parsed fields defined in a WHEN=NONE clause in the BUILD or OVERLAY operand of that WHEN=NONE clause.

Sample Syntax:
OUTFIL IFTHEN=(WHEN=(5,2,ZD,GT,+5),
  PARSE=(%01=(STARTAT=C'<',ENDAT=C'>',FIXLEN=12),
    %02=(STARTAFT=BLANKS,FIXLEN=10)),
  BUILD=(5,2,21:%01,X,%02,HEX)),
IFTHEN=(WHEN=NONE,
  PARSE=(%03=(STARTAFT=C'(',ENDBEFR=C')',FIXLEN=8)),
  BUILD=(5,2,%03,SFF,M12))

BUILD=(items)
Specifies the build items to be applied to each record for which no logical expression was true. See OUTFIL BUILD for details. You can specify all of the items in the same way that you can specify them for OUTFIL BUILD.

OVERLAY=(items)
Specifies the overlay items to be applied to each record for which no logical expression was true. See OUTFIL OVERLAY for details. You can specify all of the items in the same way that you can specify them for OUTFIL OVERLAY.

Sample Syntax:
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OUTFIL FNAMES=OUT4,
   IFTHEN=(WHEN=INIT,BUILD=(1,20,21:C'\text{Department}',31:3X,21,60)),
   IFTHEN=(WHEN=(5,2,CH,\text{EQ},C'D1'),OVERLAY=(31:8,3)),
   IFTHEN=(WHEN=(5,2,CH,\text{EQ},C'D2'),OVERLAY=(31:12,3)),
   IFTHEN=(WHEN=NONE,OVERLAY=(31:C'***'))

\text{FINDREP}=(\text{items})

Specifies find and replace operations to be applied to each record for which no logical expression was true. See OUTFIL FINDREP for details. You can specify all of the items in the same way that you can specify them for OUTFIL FINDREP.

Default for IFTHEN clauses: None; must be specified.

\text{IFOUTLEN}

Overrides the OUTFIL LRECL determined by DFSORT from your OUTFIL IFTHEN clauses. DFSORT sets an appropriate LRECL for the output records based on the build, overlay, find/replace and group operation items specified by the IFTHEN clauses. However, DFSORT does not analyze the possible results of WHEN=(\text{logexp}) conditions when determining an appropriate OUTFIL LRECL. When you use OUTFIL IFTHEN clauses, you can override the OUTFIL LRECL determined by DFSORT with the OUTFIL IFOUTLEN parameter.

Fixed-length records longer than the IFOUTLEN length are truncated to the IFOUTLEN length. Fixed-length records shorter than the IFOUTLEN are padded with blanks to the IFOUTLEN length. Variable-length records longer than the IFOUTLEN length are truncated to the IFOUTLEN length.

\text{n} specifies the length to use for the OUTFIL LRECL. The value for \text{n} must be between 1 and 32767, but must not be larger than the maximum LRECL allowed for the RECFM, and must not conflict with the specified or retrieved LRECL for the fixed-length OUTFIL data set.

Sample Syntax:

\begin{verbatim}
OUTFIL FNAMES=OUT5,IFOUTLEN=70,
   IFTHEN=(WHEN=(5,1,CH,\text{EQ},C'1',AND,8,3,ZD,\text{EQ},+10),
            BUILD=(1,40,C'T01-\text{GROUP-A}',65)),
   IFTHEN=(WHEN=(5,1,CH,\text{EQ},C'2',AND,8,3,ZD,\text{EQ},+12),
            BUILD=(1,40,C'T02-\text{GROUP-B}',65))
\end{verbatim}

Default for IFOUTLEN: The LRECL determined from the IFTHEN clauses.

\text{VTOF} or \text{CONVERT}

Specifies that variable-length OUTFIL input records are to be converted to fixed-length OUTFIL output records for this OUTFIL group.
You must specify a BUILD or OUTREC parameter. The items you specify produce a reformatted fixed-length OUTFIL output record without an RDW (the data starts at position 1). Any BUILD or OUTREC fields you specify apply to the variable-length OUTFIL input records (the data starts at position 5 after the 4-byte RDW). However, you cannot specify the variable-part of the OUTFIL input records (for example, p or p,HEX). Any BUILD or OUTREC columns you specify apply to the reformatted fixed-length OUTFIL output records.

By default, VTOF or CONVERT automatically uses VLFILL=X'40' (blank fill byte) to allow processing of variable-length input records which are too short to contain all specified BUILD or OUTREC fields. You can specify VLFILL=byte to change the fill byte.

If you do not specify a RECFM for the OUTFIL data set, it will be given a record format of FB.

If you specify a RECFM for the OUTFIL data set, it must have a fixed-length record format (for example, FB).

If VTOF or CONVERT is specified for fixed-length input records, it will not be used.

If VTOF or CONVERT is specified with FTOV, IFTRAIL, IFTHEN, FINDREP or OVERLAY, DFSORT will terminate.

Sample Syntax:

```
OUTFIL FNAMES=FIXOUT,VTOF,
    OUTREC=(1:5,14,35:32,8,50:22,6,7c'*')
```

Default for VTOF or CONVERT: None; must be specified.

**VLFILL**

```
VLFILL=byte
```

Allows DFSORT to continue processing if a variable-length OUTFIL input record is found to be too short to contain all specified OUTFIL BUILD or OUTREC fields for this OUTFIL group. Without VLFILL=byte, a short record causes DFSORT to issue message ICE218A and terminate. With VLFILL=byte, missing bytes in OUTFIL BUILD or OUTREC fields are replaced with fill bytes so the filled fields can be processed.

If VLFILL=byte is specified for fixed-length input records, it will not be used.

If VLFILL=byte is specified with FTOV, IFTRAIL, IFTHEN, FINDREP or OVERLAY, DFSORT will terminate.

**byte** specifies the fill byte. Permissible values are C'x' and X'yy'.

**C'x'** Character byte: The value x must be one EBCDIC character. If you want to use an apostrophe as the fill byte, you must specify it as C'"'.

**X'yy'** Hexadecimal byte: The value yy must be one pair of hexadecimal digits (00-FF).

Sample Syntax:

```
OUTFIL FNAMES=FIXOUT,VTOF,OUTREC=(5,20,2X,35,10),VLFILL=C'*'
OUTFIL FNAMES=OUT1,VLFILL=X'FF',OUTREC=(1,4,15,5,52)
```
OUTFIL Control Statements

Default for VLFILL: VLFILL=X’40’ (blank fill byte) if VTOF or CONVERT is specified. Otherwise, none; must be specified.

FTOV

Specifies that fixed-length OUTFIL input records are to be converted to variable-length OUTFIL output records for this OUTFIL group.

If you do not specify an OUTREC, BUILD, OVERLAY, FINDREP or IFTHEN parameter, the fixed-length OUTFIL input record is converted to a variable-length OUTFIL output record. A 4-byte RDW is prepended to the fixed-length record before it is written.

If you specify an OUTREC, BUILD, OVERLAY, FINDREP or IFTHEN parameter, the items you specify produce a reformatted fixed-length record that is converted to a variable-length OUTFIL output record. Any OUTREC, BUILD, OVERLAY, FINDREP or IFTHEN fields you specify apply to the fixed-length OUTFIL input records (the data starts at position 1). A 4-byte RDW is prepended to the reformatted fixed-length record before it is written.

If you do not specify a RECFM for the OUTFIL data set, it will be given a record format of VB.

If you specify a RECFM for the OUTFIL data set, it must have a variable-length record format (for example, VB or VBS).

If you do not specify an LRECL for the OUTFIL data set, it will be given an LRECL that can contain the largest variable-length output record to be produced, up to a maximum of 32756 for an unspanned record format (for example, VB) or up to 32767 for a spanned record format (for example, VBS).

If you specify an LRECL for the OUTFIL data set, it must be big enough to contain the largest variable-length output record to be produced.

If your largest variable-length output record is between 32757 and 32767 bytes, you'll need to specify a spanned record format (for example, VBS) for the output data set.

If FTOV is specified for variable-length input records, it will not be used.

If FTOV is specified with VTOF, IFTRAIL, CONVERT or VLFILL=byte, DFSORT will terminate.

Sample Syntax:

```
OUTFIL FNames=VAROUT,FTOV
OUTFIL FNames=V1,FTOV,OUTREC=(1,20,26:21,10,6C'*')
OUTFIL FNames=V2,FTOV,
  IFTHEN=(WHEN=(12,5,2D,GT,+20000),OVERLAY=(25:C'Yes')),
  IFTHEN=(WHEN=NONE,OVERLAY=(25:C'No'))
```

Default for FTOV: None; must be specified.

VLTRIM
VLTRIM=byte specifies that the trailing bytes are to be removed from the end of variable-length OUTFIL output records for this OUTFIL group before the records are written.

The trim byte can be any value, such as blank, binary zero, or asterisk. If DFSORT finds one or more trim bytes at the end of a variable-length OUTFIL data record or report record, it will decrease the length of the record accordingly, effectively removing the trailing trim bytes. However, VLTRIM=byte will not remove the RDW, the ANSI carriage control character (if produced), or the first data byte.

For example, say that you have the following 17-byte fixed-length data records that you want to convert to variable-length data records:

```
123456***********
0003*************
ABCDEFGHIJ*****22
*****************
```

If you use:

```
OUTFIL FTOV
```

the following variable-length output records will be written (4-byte RDW followed by data):

<table>
<thead>
<tr>
<th>Length</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>123456***********</td>
</tr>
<tr>
<td>21</td>
<td>0003*************</td>
</tr>
<tr>
<td>21</td>
<td>ABCDEFGH1J*****22</td>
</tr>
<tr>
<td>21</td>
<td>*****************</td>
</tr>
</tbody>
</table>

but if you use:

```
OUTFIL FTOV, VLTRIM=C'*'
```

the following variable-length output records will be written (4-byte RDW followed by data):

<table>
<thead>
<tr>
<th>Length</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>123456</td>
</tr>
<tr>
<td>8</td>
<td>0003</td>
</tr>
<tr>
<td>21</td>
<td>ABCDEFGH1J*****22</td>
</tr>
<tr>
<td>5</td>
<td>*</td>
</tr>
</tbody>
</table>

VLTRIM=C'*' removed the trailing asterisks from the first and second records. The third record did not have any trailing asterisks to remove. The fourth record had all asterisks, so one asterisk was kept.

If VLTRIM=byte is specified for fixed-length output records, it will not be used.

If VLTRIM is specified with IFTRAIL, DFSORT will terminate.

**byte** specifies the trim byte. Permissible values are C'x' and X'yy'.

- **C'x'**: Character byte: The value x must be one EBCDIC character. If you want to use an apostrophe as the trim byte, you must specify it as C'"'.
- **X'yy'**: Hexadecimal byte: The value yy must be one pair of hexadecimal digits (00-FF)

*Sample Syntax:*
OUTFIL Control Statements

Fixed input:
OUTFIL FNAME=TRIM1,FOV,VLTRIM=C' ' 

Variable input:
OUTFIL FNAME=TRIM2,VLTRIM=X'00'
OUTFIL FNAME=TRIM3,VLTRIM=C'*',
OUTREC=(1,15,5X,16,8,5X,28)

Default for VLTRIM: None; must be specified.

REPEAT

Specifies the number of times each OUTFIL output record is to be repeated for this OUTFIL group. Each OUTFIL output record is written n times.

If SEQNUM is used in the OUTREC, BUILD, OVERLAY, or IFTHEN parameter for this OUTFIL group, the sequence number will be incremented for each repeated record. For example, if your input is:

RECORD A
RECORD B

and you specify:
OUTFIL OUTREC=(1,8,X,SEQNUM,5,ZD),REPEAT=2

your output will be:
RECORD A 00001
RECORD A 00002
RECORD B 00003
RECORD B 00004

If SEQNUM is used in multiple IFTHEN clauses for this OUTFIL group, the sequence number will be incremented for each repeated record that satisfies the IFTHEN clause. For example, if your input is:

RECORD A 1
RECORD B 1
RECORD C 1
RECORD A 2
RECORD C 2
RECORD B 2
RECORD B 3

and you specify:
OUTFIL REPEAT=2,
IFTHEN=(WHEN=(8,1,CH,EQ,C'A'),OVERLAY=(15:SEQNUM,4,ZD)),
IFTHEN=(WHEN=(8,1,CH,EQ,C'B'),OVERLAY=(15:SEQNUM,4,ZD)),
IFTHEN=(WHEN=NONE,OVERLAY=(15:SEQNUM,4,ZD))

your output will be:
RECORD A 1 0001
RECORD A 1 0002
RECORD B 1 0001
RECORD B 1 0002
RECORD C 1 0001
RECORD C 1 0002
RECORD A 2 0003
RECORD A 2 0004
OUTFIL Control Statements

If you specify REPEAT=n with / in the OUTREC, BUILD, or IFTHEN BUILD parameter for this OUTFIL group, the first line is written n times, then the second line is written n times, and so on. (For IFTHEN, this means each record that has the SEQNUM item applied to it.) If SEQNUM is used, all lines for the same record are given the same sequence number. For example, if your input is:

```
RECORD A
RECORD B
```

and you specify:

```
OUTFIL OUTREC=(C'P1>',X,1,6,X,SEQNUM,4,ZD,/,C'P2>',X,8,1,X,SEQNUM,4,ZD),REPEAT=2
```

your output will be:

```
P1> RECORD 0001
P1> RECORD 0002
P2> A 0001
P2> A 0002
P1> RECORD 0003
P1> RECORD 0004
P2> B 0003
P2> B 0004
```

The REPEAT parameter cannot be used with any of the following parameters: IFTRAIL, LINES, HEADER1, TRAILER1, HEADER2, TRAILER2, SECTIONS, and NODETAIL.

\( n \) specifies the number of times each OUTFIL output record is to be repeated. The value for \( n \) starts at 2 (write record twice) and is limited to 28 digits (15 significant digits).

**Sample Syntax:**

* WRITE EACH OUTPUT RECORD 12 TIMES.
  
  OUTFIL FNAMES=OUT1,REPEAT=12

* WRITE EACH INCLUDED AND REFORMATTED OUTPUT RECORD 50 TIMES.
  
  (THE SEQUENCE NUMBER WILL BE INCREMENTED FOR EACH REPETITION.)
  OUTFIL FNAMES=OUT2,INCLUDE=(5,2,SS,SEQ,C'B2,C5,M3'),

**Default for REPEAT:** None; must be specified.

**SPLIT**

Splits the output records one record at a time in rotation among the data sets of this OUTFIL group until all of the output records have been written. As a result, the records will be split as evenly as possible among all of the data sets in the group.

As an example, for an OUTFIL group with three data sets:
OUTFIL Control Statements

- the first OUTFIL data set in the group will receive records 1, 4, 7, and so on.
- the second OUTFIL data set in the group will receive records 2, 5, 8, and so on.
- the third OUTFIL data set in the group will receive records 3, 6, 9, and so on.

The records are not contiguous in each OUTFIL data set.

SPLIT is equivalent to SPLITBY=1.

The SPLIT parameter cannot be used with any of the following parameters: IFTRAIL, LINES, HEADER1, TRAILER1, HEADER2, TRAILER2, SECTIONS, and NODETAIL.

Sample Syntax:
- WRITE RECORD 1 TO PIPE1, RECORD 2 TO PIPE2, RECORD 3 TO PIPE3, RECORD 4 TO PIPE4, RECORD 5 TO PIPE1, RECORD 6 TO PIPE2, AND SO ON.
  OUTFIL FNAMES=(PIPE1,PIPE2,PIPE3,PIPE4),SPLIT

- SPLIT THE INCLUDED AND REFORMATTED OUTPUT RECORDS EVENLY BETWEEN TAPE1 AND TAPE2.
  OUTFIL FNAMES=(TAPE1,TAPE2),SPLIT,
  INCLUDE=(8,2,ZD,EQ,27),OUTREC=(5X,1,75)

Default for SPLIT: None; must be specified.

SPLITBY

Splits the output records n records at a time in rotation among the data sets of this OUTFIL group until all of the output records have been written.

As an example, if SPLITBY=10 is specified for an OUTFIL group with three data sets:
- the first OUTFIL data set in the group will receive records 1-10, 31-40, and so on.
- the second OUTFIL data set in the group will receive records 11-20, 41-50, and so on.
- the third OUTFIL data set in the group will receive records 21-30, 51-60, and so on.

The records are not contiguous in each OUTFIL data set.

SPLITBY=1 is equivalent to SPLIT.

The SPLITBY parameter cannot be used with any of the following parameters: IFTRAIL, LINES, HEADER1, TRAILER1, HEADER2, TRAILER2, SECTIONS, and NODETAIL.

n specifies the number of records to split by. The value for n starts at 1 and is limited to 28 digits (15 significant digits).

Sample Syntax:
- WRITE RECORDS 1-5 TO PIPE1, RECORDS 6-10 TO PIPE2, RECORDS 11-15 TO PIPE3, RECORDS 16-20 TO PIPE4, RECORDS 21-25 TO PIPE1, RECORDS 26-30 TO PIPE2, AND SO ON.
  OUTFIL FNAMES=(PIPE1,PIPE2,PIPE3,PIPE4),SPLITBY=5
OUTFIL Control Statements

* SPLIT THE INCLUDED AND REFORMATTED OUTPUT RECORDS 100 AT A TIME
* BETWEEN TAPE1 AND TAPE2.
  OUTFIL FNAMES=(TAPE1,TAPE2),SPLITBY=100,
   INCLUDE=(8,2,2D,EQ,27),OUTREC=(5X,1,75)

  Default for SPLITBY: None; must be specified.

SPLIT1R

  \[ \text{SPLIT1R=n} \]

Splits the output records n records at a time for one rotation among the data sets of this OUTFIL group until all of the output records have been written.

As an example, if SPLIT1R=10 is specified for an input data set with 35 records and an OUTFIL group with three data sets:

• the first OUTFIL data set in the group will receive records 1-10.
• the second OUTFIL data set in the group will receive records 11-20.
• the third OUTFIL data set in the group will receive records 21-35.

The records are contiguous in each OUTFIL data set.

The SPLIT1R parameter cannot be used with any of the following parameters:
IFTRAIL, LINES, HEADER1, TRAILER1, HEADER2, TRAILER2, SECTIONS, and NODETAIL.

\( n \) specifies the number of records to split by. The value for \( n \) starts at 1 and is limited to 28 digits (15 significant digits).

Sample Syntax:

* WRITE RECORDS 1-20 TO PIPE1, RECORDS 21-40 TO PIPE2,
  RECORDS 41-60 TO PIPE3 AND RECORDS 61-85 TO PIPE4.
  OUTFIL FNAMES=(PIPE1,PIPE2,PIPE3,PIPE4),SPLIT1R=20
* SPLIT THE INCLUDED AND REFORMATTED OUTPUT RECORDS ONCE
  CONTIGUOUSLY BETWEEN TAPE1 AND TAPE2.
  OUTFIL FNAMES=(TAPE1,TAPE2),SPLITBY=100,
   INCLUDE=(8,2,2D,EQ,27),OUTREC=(5X,1,75)

  Default for SPLIT1R: None; must be specified.

NULLOFL

  \[ \text{NULLOFL} \]

specifies the action to be taken by DFSORT when there are no data records for a data set associated with this OUTFIL statement, as indicated by a DATA count of 0 in message ICE227I. OUTFIL report records have no affect on the action taken as a result of this option.

\( \text{RC0} \) specifies that DFSORT should issue message ICE174I, set a return code of 0, and continue processing when there are no data records for a data set associated with this OUTFIL statement.
OUTFIL Control Statements

RC4 specifies that DFSORT should issue message ICE174I, set a return code of 4, and continue processing when there are no data records for the data set associated with this OUTFIL statement.

RC16 specifies that DFSORT should issue message ICE209A, terminate, and give a return code of 16 when there are no data records for a data set associated with this OUTFIL statement.

Default for NULLOFL: The NULLOFL installation default.

Notes:
1. The NULLOFL value specified for each OUTFIL statement applies to the data sets associated with that OUTFIL statement. If a NULLOFL value is not specified for an OUTFIL statement, the NULLOFL installation default value applies to the data sets associated with that OUTFIL statement. For example, if the installation default is NULLOFL=RC0 (IBM's shipped default) and the following is specified:

OUTFIL FNAMES=OUT1,NULLOFL=RC16,INCLUDE=(5,3,CH,EQ,C'D01')
OUTFIL FNAMES=OUT2,OUT3,INCLUDE=(5,3,CH,EQ,C'D02')
OUTFIL FNAMES=OUT4,NULLOFL=RC4,SAVE

then NULLOFL=RC16 applies to the data set for OUT1, NULLOFL=RC0 (the installation default) applies to the data sets for OUT2 and OUT3, and NULLOFL=RC4 applies to the data set for OUT4.

2. If you receive message ICE174I or ICE209A, a DATA count of 0 in message ICE227I identifies an OUTFIL data set for which there are no data records.

3. The return code of 0 or 4 resulting from NULLOFL=RC0 or NULLOFL=RC4, respectively, can be overridden by a higher return code set for some other reason, including a return code of 16 resulting from NULLOFL=RC16.

4. NULLOUT applies to the SORTOUT data set. NULLOFL applies to OUTFIL data sets.

LINES

|---LINES=n---|

Specifies the number of lines per page to be used for the reports produced for this OUTFIL group. DFSORT uses ANSI carriage control characters to control page ejects and the placement of the lines in your report, according to your specifications.

The LINES parameter cannot be used with the IFTRAIL parameter.

n specifies the number of lines per page. The value for n must be between 1 and 255. However, n—or the default for n if LINES is not specified—must be greater than or equal to the number of lines needed for each of the following:

• The HEADER1 lines
• The TRAILER1 lines
• The sum of all lines for HEADER2, TRAILER2, HEADER3s, TRAILER3s, and the data lines and blank lines produced from an input record.
Sample Syntax:
OUTFIL FNAMES=RPT1,LINES=50

Default for LINES: None; must be specified, unless HEADER1, TRAILER1, HEADER2, TRAILER2, SECTIONS, or NODETAIL is specified, in which case the default for LINES is 60.

**HEADER1**

Specifies the report header to be used for the reports produced for this OUTFIL group. The report header appears by itself as the first page of the report. DFSORT uses ANSI carriage control characters to control page ejects and the placement of the lines in your report, according to your specifications. You can use BLKCCH1 to replace the '1' (page eject) for the ANSI carriage control character in the first line of the report header with a blank, thus avoiding forcing a page eject. You can use REMOVECC to remove the ANSI carriage control characters from a report.

You can choose to include any or all of the following report elements in your report header:

- Blanks, character strings, and hexadecimal strings
- Unedited input fields from the first OUTFIL input record
- Current date in a variety of different forms
- Current time in a variety of different forms
- Page number, converted to different numeric formats, or edited to contain signs, decimal points, leading zeros or no leading zeros, and so on.

The HEADER1 parameter cannot be used with the IFTRAIL parameter.
The report header consists of the elements you select, in the order in which
you specify them, and in the columns or lines you specify.

c: specifies the column in which the first position of the associated report
element is to appear, relative to the start of the data in the report record.
Ignore the RDW (variable-length report records only) and carriage control
character when specifying c. That is, 1: indicates the first byte of the data
in the report record for both fixed-length and variable-length report
records.

Unused space preceding the specified column is padded with EBCDIC
blanks. The following rules apply:
• c must be a number between 1 and 32752.
• c: must be followed by a report element, but must not precede / or n/.
• c must not overlap the previous report element in the report record.
• The colon (:) is treated like the comma (,) or semicolon (;) for
  continuation to another line.

r specifies that blanks, a character string, or a hexadecimal string are to
appear in the report record, or that a new report record is to be started in
the header, with or without intervening blank lines. These report elements
can be specified before or after any other report elements. Consecutive
report elements can be specified. Permissible values are nX, n'xx...x',
nC'xx...x', nXyy...yy', /.../ and n/.

nX Blanks. n bytes of EBCDIC blanks (X'40') are to appear in the report
record. n can range from 1 to 4095. If n is omitted, 1 is used.

n'xx...x'
Character string. n repetitions of the character string constant ('xx...x')
are to appear in the report record. n can range from 1 to 4095. If n is
omitted, 1 is used. x can be any EBCDIC character. You can specify 1
to 256 characters.

nC'xx...x' can be used instead of n'xx...x'.

If you want to include a single apostrophe in the character string,
you must specify it as two single apostrophes:
Required: O'NEILL Specify: 'O''NEILL' or C'O''NEILL'

nX'yy...yy'
Hexadecimal string. n repetitions of the hexadecimal string constant
(X'yy...yy') are to appear in the report record. n can range from 1 to
4095. If n is omitted, 1 is used.

The value yy represents any pair of hexadecimal digits. You can
specify from 1 to 256 pairs of hexadecimal digits

/.../ or n/
Blank lines or a new line. A new report record is to be started in the
header with or without intervening blank lines. If /.../ or n/ is
specified at the beginning or end of the header, n blank lines are to
appear in the header. If /.../ or n/ is specified in the middle of the
header, n−1 blank lines are to appear in the header (thus, / or 1/
indicates a new line with no intervening blank lines).

Either n/ (for example, 5/) or multiple /'s (for example, ////) can
be used. n can range from 1 to 255. If n is omitted, 1 is used.

As an example, if you specify:
OUTFIL Control Statements

OUTFIL HEADER1=(Z,'First line of text',Z,
                'Second line of text',Z,
                'Third line of text',Z)

the report header appears as follows when printed:
  blank line
  blank line
  First line of text
  Second line of text
  blank line
  Third line of text
  blank line
  blank line

p,m specifies that an unedited input field, from the first OUTFIL input record
for which a data record appears in the report, is to appear in the report
record.

p specifies the first byte of the input field relative to the beginning of the
OUTFIL input record. The first data byte of a fixed-length record has
relative position 1. The first data byte of a variable-length record has
relative position 5, because the first four bytes are occupied by the
RDW. All fields must start on a byte boundary, and no field can extend
beyond byte 32752. See "OUTFIL Statements Notes" on page 375 for
special rules concerning variable-length records.

m specifies the length in bytes of the input field. The value for m must be
between 1 and 32752.

DATE specifies that the current date is to appear in the report record in the form
'mm/dd/yy', where mm represents the month (01-12), dd represents the
day (01-31), and yy represents the last two digits of the year (for example,
95).

&DATE can be used instead of DATE.

DATE=(abcd) specifies that the current date is to appear in the report record in the form
'adbdc', where a, b, and c indicate the order in which the month, day, and
year are to appear and whether the year is to appear as two or four digits,
and d is the character to be used to separate the month, day and year.

For a, b, and c, use M to represent the month (01-12), D to represent the
day (01-31), Y to represent the last two digits of the year (for example, 05),
or 4 to represent the four digits of the year (for example, 2005). M, D, and
Y or 4 can each be specified only once. Examples: DATE=(DMY.) would
produce a date of the form 'dd.mm.yy', which on March 29, 2005, would
appear as '29.03.05'. DATE=(4MD−) would produce a date of the form
'yyyy-mm-dd', which on March 29, 2005, would appear as '2005-03-29'.
a, b, c, and d must be specified.

&DATE=(abcd) can be used instead of DATE=(abcd).

DATENS=(abc) specifies that the current date is to appear in the report record in the form
'abc', where a, b and c indicate the order in which the month, day, and
year are to appear and whether the year is to appear as two or four digits.
OUTFIL Control Statements

For a, b and c, use M to represent the month (01-12), D to represent the
day (01-31), Y to represent the last two digits of the year (for example, 02),
or 4 to represent the four digits of the year (for example, 2002). M, D, and
Y or 4 can each be specified only once. Examples: DATENS=(DMY) would
produce a date of the form 'ddmmyy', which on March 29, 2002, would
appear as '290302'. DATENS=(4MD) would produce a date of the form
'yyyyymdd', which on March 29, 2002, would appear as '20020329'.

a, b and c must be specified.

&DATENS=(abc)
can be used instead of DATENS=(abc).

YDDD= (abc)
specifies that the current date is to appear in the report record in the form
'acb', where a and b indicate the order in which the year and day of the
year are to appear and whether the year is to appear as two or four digits,
and c is the character to be used to separate the year and day of the year.

For a and b, use D to represent the day of the year (001-D366), Y to
represent the last two digits of the year (for example, 04), or 4 to represent
the four digits of the year (for example, 2004). D, and Y or 4 can each be
specified only once. Examples: YDDD=(DY-) would produce a date of the
form 'ddd-yy' which on April 7, 2004, would appear as '098-04'.
YDDD=(4D/) would produce a date of the form 'yyyy/ddd' which on
April 7, 2004, would appear as '2004/098'.

a, b and c must be specified.

&YDDD= (abc)
can be used instead of YDDD=(abc).

YDDDNS= (ab)
specifies that the current date is to appear in the report record in the form
'ab', where a and b indicate the order in which the year and day of the
year are to appear and whether the year is to appear as two or four digits.

For a and b, use D to represent the day of the year (001-366), Y to
represent the last two digits of the year (for example, 04), or 4 to represent
the four digits of the year (for example, 2004). D, and Y or 4 can each be
specified only once. Examples: YDDDNS=(DY) would produce a date of the
form 'dddyy' which on April 7, 2004, would appear as '09804'.
YDDDNS=(4D) would produce a date of the form 'yyyyddd' which on
April 7, 2004, would appear as '2004098'.

a and b must be specified.

&YDDDNS= (ab)
can be used instead of YDDDNS=(ab).

TIME
specifies that the current time is to appear in the report record in the form
'hh:mm:ss', where hh represents the hour (00-23), mm represents the
minutes (00-59), and ss represents the seconds (00-59).

&TIME
can be used instead of TIME.

TIME=(abc)
specifies that the current time is to appear in the report record in the form
'hhmcss' (24-hour time) or 'hhmcss xx' (12-hour time).
OUTFIL Control Statements

If ab is 24, the time is to appear in the form 'hhmmcss' (24-hour time) where hh represents the hour (00-23), mm represents the minutes (00-59), ss represents the seconds (00-59), and c is the character used to separate the hours, minutes, and seconds. Example: TIME=(24.) would produce a time of the form 'hh.mm.ss' which at 08:25:13 pm would appear as '20.25.13'.

If ab is 12, the time is to appear in the form 'hhmmcss xx' (12-hour time) where hh represents the hour (01-12), mm represents the minutes (00-59), ss represents the seconds (00-59), xx is am or pm, and c is the character used to separate the hours, minutes, and seconds. Example: TIME=(12.) would produce a time of the form 'hh.mm.ss xx' which at 08:25:13 pm would appear as '08.25.13 pm'.

ab and c must be specified.

&TIME=(abc)
can be used instead of TIME=(abc).

TIMENS=(ab)
specifies that the current time is to appear in the report record in the form 'hhmmss' (24-hour time) or 'hhmmss xx' (12-hour time).

If ab is 24, the time is to appear in the form 'hhmmss' (24-hour time) where hh represents the hour (00-23), mm represents the minutes (00-59), and ss represents the seconds (00-59). Example: TIMENS=(24) would produce a time of the form 'hhmmss' which at 08:25:13 pm would appear as '202513'.

If ab is 12, the time is to appear in the form 'hhmmss xx' (12-hour time) where hh represents the hour (01-12), mm represents the minutes (00-59), and ss represents the seconds (00-59). Example: TIMENS=(12) would produce a time of the form 'hhmmss xx' which at 08:25:13 pm would appear as '082513 pm'.

ab must be specified.

&TIMENS=(ab)
can be used instead of TIMENS=(ab).

PAGE
specifies that the page number is to appear in the report record. The page number for the report header appears as ' 1'.

If HEADER1 is specified with PAGE, PAGE for the report header (first page) will be ' 1' and PAGE for the next page (second page) will be ' 2'. If HEADER1 is specified without PAGE, PAGE for the page after the report header (second page) will be ' 1' (typical of a report with a cover sheet).

&PAGE
can be used instead of PAGE.

PAGE=(edit) or PAGE=(to)
same as PAGE except that the 15-digit page number appears edited or converted as specified. See p,m,f,edit under OUTREC for further details on the edit fields you can use. See p,m,f,to under OUTREC for further details on the to fields you can use.

&PAGE=(edit) or &PAGE=(to)
can be used instead of PAGE=(edit) or PAGE=(to).

Sample Syntax:
OUTFIL Control Statements

```
OUTFIL FNAME=(RPT1,RPT2),
   HEADER1=(30:'January Report', 4/,
            28:'Prepared on ',DATE, 4/
            32:'at ',TIME, 4/,
            28:'using DFSORT''S OUTFIL', 5/,
            10:'Department: ', 12, 8, 50:'Page:',PAGE=(EDIT=(TTT)))

Default for HEADER1: None; must be specified.
```

TRAILER1
OUTFIL Control Statements

Additional Parameters for TRAILER1

Specifies the report trailer to be used for the reports produced for this OUTFIL group. The report trailer appears by itself as the last page of the report. DFSORT uses ANSI carriage control characters to control page ejects and the placement of the lines in your report, according to your specifications. You can use BLKCCT1 to replace the '1' (page eject) for the ANSI carriage control character in the first line of the report trailer with a blank, thus avoiding forcing a page eject. You can use REMOVECC to remove the ANSI carriage control characters from a report.

You can choose to include any or all of the following report elements in your report trailer:

- Blanks, character strings, and hexadecimal strings
- Unedited input fields from the last OUTFIL input record
- Current date in a variety of different forms
- Current time in a variety of different forms
- Page number, converted to different numeric formats, or edited to contain signs, decimal points, leading zeros or no leading zeros, and so on
- Any or all of the following statistics:
  - Count of data records in the report, converted to different numeric formats, or edited to contain signs, decimal points, leading zeros or no leading zeros, and so on. You can add a decimal number to the count before converting or editing it (for example, add 1 to account for writing a trailer record, or add 2 to account for writing a header and trailer record).
  - Total, minimum, maximum, or average for each specified ZD, PD, BI, FI, FL, CSF, FS, UFF, or SFF numeric input field in the data records of the report, converted to different numeric formats, or edited to contain signs, decimal points, leading zeros or no leading zeros, and so on.

The TRAILER1 parameter cannot be used with the IFTRAIL parameter.

The report trailer consists of the elements you select, in the order in which you specify them, and in the columns or lines you specify.

- **c**: See c: under HEADER1.
- **r** specifies that blanks, a character string, or a hexadecimal string are to appear in the report record, or that a new report record is to be started in the trailer, with or without intervening blank lines. These report elements
can be specified before or after any other report elements. Consecutive report elements can be specified. Permissible values are \texttt{nX}, \texttt{n'xx...x'}, \texttt{nC'xx...x'}, \texttt{nX'yy...yy'}, /.../, and \texttt{n/}.

\textbf{nX} Blanks. See \texttt{nX} under \texttt{r} for \texttt{HEADER1}.

\texttt{n'xx...x'}

Character string. See \texttt{n'xx...x'} under \texttt{r} for \texttt{HEADER1}. \texttt{nC'xx...x'} can be used instead of \texttt{n'xx...x'}

\texttt{nX'xx...x'}

Hexadecimal string. See \texttt{nX'xx...x'} under \texttt{r} for \texttt{HEADER1}.

/.../ or \texttt{n/}

Blank lines or a new line. A new report record is to be started in the trailer, with or without intervening blank lines. If /.../ or \texttt{n/} is specified at the beginning or end of the trailer, \(n\) blank lines are to appear in the trailer. If /.../ or \texttt{n/} is specified in the middle of the trailer, \(n-1\) blank lines are to appear in the trailer (thus, / or 1/ indicates a new line with no intervening blank lines).

Either \texttt{n/} (for example, 5/) or multiple /'s (for example, /////) can be used. \(n\) can range from 1 to 255. If \(n\) is omitted, 1 is used.

\textbf{p,m}

specifies that an unedited input field, from the last OUTFIL input record for which a data record appears in the report, is to appear in the report record.

\textbf{p} See \texttt{p} under \texttt{HEADER1}.

\textbf{m} See \texttt{m} under \texttt{HEADER1}.

\textbf{DATE}

See \texttt{DATE} under \texttt{HEADER1}.

\textbf{&DATE}

can be used instead of \texttt{DATE}.

\texttt{DATE=(abcd)}

See \texttt{DATE=(abcd)} under \texttt{HEADER1}.

\textbf{&DATE=(abcd)}

can be used instead of \texttt{DATE=(abcd)}.

\texttt{DATENS=(abc)}

See \texttt{DATENS=(abc)} under \texttt{HEADER1}.

\textbf{&DATENS=(abc)}

can be used instead of \texttt{DATENS=(abc)}.

\texttt{YDDD=(abc)}

See \texttt{YDDD=(abc)} under \texttt{HEADER1}.

\textbf{&YDDD=(abc)}

can be used instead of \texttt{YDDD=(abc)}.

\texttt{YDDDNS=(ab)}

See \texttt{YDDDNS=(ab)} under \texttt{HEADER1}.

\textbf{&YDDDNS=(ab)}

can be used instead of \texttt{YDDDNS=(ab)}.

\textbf{TIME}

See \texttt{TIME} under \texttt{HEADER1}. 

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OUTFIL Control Statements

&TIME
  can be used instead of TIME.

TIME=(abc)
  See TIME=(abc) under HEADER1.

&TIME=(abc)
  can be used instead of TIME=(abc).

TIMENS=(ab)
  See TIMENS=(ab) under HEADER1.

&TIMENS=(ab)
  can be used instead of TIMENS=(ab).

PAGE
  specifies that the current page number is to appear in the report record. The page number for the trailer appears as 6 digits, right-justified, with leading zeros suppressed. For example, if the page is numbered 12, it appears as '12'.

&PAGE
  can be used instead of PAGE.

PAGE=(edit) or PAGE=(to)
  same as PAGE except that the 15-digit page number appears edited or converted as specified. See p,m,f,edit under OUTREC for further details on the edit fields you can use. See p,m,f,to under OUTREC for further details on the to fields you can use.

&PAGE=(edit) or &PAGE=(to)
  can be used instead of PAGE=(edit) or PAGE=(to).

COUNT
  specifies that the count of data records in the report is to appear in the report record as 8 digits, right-justified, with leading zeros suppressed. For example, if there are 6810 input records in the report, the count appears as '6810'.

If slash (/) is used in OUTREC or BUILD to produce multiple data records, COUNT only counts the number of data records processed as input to OUTREC or BUILD. For example, if OUTREC processes 3 input records and creates 2 output records for each input record, the count is 3, not 6

COUNT15
  same as COUNT except that the count appears as 15 digits.

COUNT=(edit) or COUNT=(to)
  same as COUNT except that the 15-digit count appears edited or converted as specified. See p,m,f,edit under OUTREC for further details on the edit fields you can use. See p,m,f,to under OUTREC for further details on the to fields you can use. For example, if there are 6810 input records, COUNT=(M11,LENGTH=6) produces a count of '006810'.

COUNT+n=(edit) or COUNT+n=(to)
  same as COUNT=(edit) or COUNT=(to) except that n is added to the 15-digit count before it is edited or converted. n can be 1 to 3 decimal digits. For example, if there are 6810 input records, COUNT+2=(M11,LENGTH=6) produces a count of '006812'. One important use for this parameter is to add 1 for the TRAILER1 record to the count of data records.
OUTFIL Control Statements

COUNT-\(n=(\text{edit})\) or COUNT-\(n=(\text{to})\)

same as COUNT-=(\text{edit}) or COUNT-=(\text{to}) except that \(n\) is subtracted from the 15-digit count before it is edited or converted. \(n\) can be 1 to 3 decimal digits. For example, if there are 6810 input records, COUNT-1=(M11,LENGTH=6) produces a count of '006809'. One important use for this parameter is to subtract 1 for a header record from the count of all records.

SUBCOUNT

specifies that the running count of input records in the report is to appear in the report record as 8 digits, right-justified, with leading zeros suppressed.

For TRAILER1, the running count is the same as the count, so SUBCOUNT produces the same value as COUNT.

If slash (/) is used in OUTREC or BUILD to produce multiple data records, SUBCOUNT counts only the number of data records processed as input to OUTREC or BUILD. For example, if OUTREC processes 3 input records and creates 2 output records for each input record, the running count is 3, not 6.

SUBCOUNT15

same as SUBCOUNT except that the running count appears as 15 digits.

SUBCOUNT=(\text{edit}) or SUBCOUNT=(\text{to})

same as SUBCOUNT except that the 15-digit running count appears edited or converted as specified. See \(p,m,f,\text{edit}\) under OUTREC for further details on the edit fields you can use. See \(p,m,f,\text{to}\) under OUTREC for further details on the to fields you can use.

TOTAL

specifies that an edited or converted total, for the values of a numeric input field in all data records of the report, is to appear in the report record.

TOT can be used instead of TOTAL.

\(p,m,f,\text{edit} \) or \(p,m,f,\text{to}\)

specifies the numeric input field for which the total is to be produced and how the output field (that is, the total) is to be edited or converted.

See \(p,m,f,\text{edit}\) under OUTREC for further details. However, note that PD0, DC1, DC2, DC3, DE1, DE2, DE3, DT1, DT2, DT3, TC1, TC2, TC3, TC4, TE1, TE2, TE3, TE4, TM1, TM2, TM3, and TM4 are not allowed for TOTAL and that for TOTAL, the default number of digits (\(d\)) used for editing or conversion is as follows:

<table>
<thead>
<tr>
<th>Format (f)</th>
<th>Length (m)</th>
<th>Digits (d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZD</td>
<td>1-15</td>
<td>15</td>
</tr>
<tr>
<td>ZD</td>
<td>16-31</td>
<td>31</td>
</tr>
<tr>
<td>PD</td>
<td>1-8</td>
<td>15</td>
</tr>
<tr>
<td>PD</td>
<td>9-16</td>
<td>31</td>
</tr>
<tr>
<td>BI</td>
<td>1-4</td>
<td>10</td>
</tr>
<tr>
<td>BI</td>
<td>5-8</td>
<td>20</td>
</tr>
<tr>
<td>FI</td>
<td>1-4</td>
<td>10</td>
</tr>
</tbody>
</table>
OUTFIL Control Statements

Table 54. Digits for TOTAL Fields (continued)

<table>
<thead>
<tr>
<th>Format (f)</th>
<th>Length (m)</th>
<th>Digits (d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FI</td>
<td>5-8</td>
<td>20</td>
</tr>
<tr>
<td>FL</td>
<td>4 or 8</td>
<td>20</td>
</tr>
<tr>
<td>CSF or FS</td>
<td>1-15</td>
<td>15</td>
</tr>
<tr>
<td>CSF or FS</td>
<td>16-32</td>
<td>31</td>
</tr>
<tr>
<td>UFF</td>
<td>1-15</td>
<td>15</td>
</tr>
<tr>
<td>UFF</td>
<td>16-44</td>
<td>31</td>
</tr>
<tr>
<td>SFF</td>
<td>1-15</td>
<td>15</td>
</tr>
<tr>
<td>SFF</td>
<td>16-44</td>
<td>31</td>
</tr>
</tbody>
</table>

If EDIT or EDxy is specified, the number of digits in the pattern (I's and T's) is used.

MIN

specifies that an edited or converted minimum, for the values of a numeric input field in all data records of the report, is to appear in the report record.

\texttt{p,m,f,edit or p,m,f,to}

specifies the numeric input field for which the minimum is to be produced and how the output field (that is, the minimum) is to be edited or converted.

See \texttt{p,m,f,edit or p,m,f,to} under OUTREC for further details. However, note that PD0, DC1, DC2, DC3, DE1, DE2, DE3, DT1, DT2, DT3, TC1, TC2, TC3, TC4, TE1, TE2, TE3, TE4, TM1, TM2, TM3 and TM4 are not allowed for MIN.

MAX

specifies that an edited or converted maximum, for the values of a numeric input field in all data records of the report, is to appear in the report record.

\texttt{p,m,f,edit or p,m,f,to}

specifies the numeric input field for which the maximum is to be produced and how the output field (that is, the maximum) is to be edited or converted.

See \texttt{p,m,f,edit or p,m,f,to} under OUTREC for further details. However, note that PD0, DC1, DC2, DC3, DE1, DE2, DE3, DT1, DT2, DT3, TC1, TC2, TC3, TC4, TE1, TE2, TE3, TE4, TM1, TM2, TM3 and TM4 are not allowed for MAX.

AVG

specifies that an edited or converted average, for the values of a numeric input field in all data records of the report, is to appear in the report record. The average (or mean) is calculated by dividing the total by the count and rounding down to the nearest integer. For example:

\[
\frac{+2305}{152} = +15 \\
\frac{-2305}{152} = -15
\]

\texttt{p,m,f,edit or p,m,f,to}

specifies the numeric input field for which the average is to be produced and how the output field (that is, the average) is to be edited or converted.
OUTFIL Control Statements

See p,m,f,edit or p,m,f,to under OUTREC for further details. However, note that PD0, DC1, DC2, DC3, DE1, DE2, DE3, DT1, DT2, DT3, TC1, TC2, TC3, TC4, TE1, TE2, TE3, TE4, TM1, TM2, TM3 and TM4 are not allowed for AVG.

SUBTOTAL
specifies that an edited or converted running total, for the values of a numeric input field in all data records of the report, is to appear in the report record.

SUBTOT or SUB can be used instead of SUBTOTAL.
For TRAILER1, the running total is the same as the total, so SUBTOTAL produces the same value as TOTAL.

p,m,f,edit or p,m,f,to
specifies the numeric input field for which the running total is to be produced and how the output field (that is, the running total) is to be edited or converted.

See p,m,f,edit or p,m,f,to under TOTAL for further details.

SUBMIN
specifies that an edited or converted running minimum, for the values of a numeric input field in all data records of the report, is to appear in the report record.

For TRAILER1, the running minimum is the same as the minimum, so SUBMIN produces the same value as MIN.

p,m,f,edit or p,m,f,to
specifies the numeric input field for which the running minimum is to be produced and how the output field (that is, the running minimum) is to be edited or converted.

See p,m,f,edit or p,m,f,to under OUTREC for further details.
However, note that PD0, DC1, DC2, DC3, DE1, DE2, DE3, DT1, DT2, DT3, TC1, TC2, TC3, TC4, TE1, TE2, TE3, TE4, TM1, TM2, TM3 and TM4 are not allowed for SUBMIN.

SUBMAX
specifies that an edited or converted running maximum, for the values of a numeric input field in all data records of the report, is to appear in the report record.

For TRAILER1, the running maximum is the same as the maximum, so SUBMAX produces the same value as MAX.

p,m,f,edit or p,m,f,to
specifies the numeric input field for which the running maximum is to be produced and how the output field (that is, the running maximum) is to be edited or converted.

See p,m,f,edit or p,m,f,to under OUTREC for further details.
However, note that PD0, DC1, DC2, DC3, DE1, DE2, DE3, DT1, DT2, DT3, TC1, TC2, TC3, TC4, TE1, TE2, TE3, TE4, TM1, TM2, TM3 and TM4 are not allowed for SUBMAX.

SUBAVG
specifies that an edited or converted running average, for the values of a numeric input field in all data records of the report, is to appear in the report record.
OUTFILE Control Statements

For TRAILER1, the running average is the same as the average, so SUBAVG produces the same value as AVG.

\**p,m,f,edit or p,m,f,to**

specifies the numeric input field for which the running average is to be produced and how the output field (that is, the running average) is to be edited or converted.

See \*p,m,f,edit or p,m,f,to\* under OUTREC for further details. However, note that PD0, DC1, DC2, DC3, DE1, DE2, DE3, DT1, DT2, DT3, TC1, TC2, TC3, TC4, TE1, TE2, TE3, TE4, TM1, TM2, TM3 and TM4 are not allowed for SUBAVG.

Sample Syntax:

```
OUTFIL FNAMES=RPT1,
   TRAILER1=(5/,
     10:'Summary of Report for Division Revenues',3/,
     10:'Number of divisions reporting: ',COUNT,2/,
     10:'Total revenue: ',TOTAL=(25,5,PD,M5),2/,
     10:'Lowest revenue: ',MIN=(25,5,PD,M5),2/,
     10:'Highest revenue: ',MAX=(25,5,PD,M5),2/,
     10:'Average revenue: ',AVG=(25,5,PD,M5))
```

```
OUTFIL FNAMES=RPT2,BLKCCT1,
   TRAILER1=(/,10:'Grand Total: ',TOTAL=(25,5,PD,M5))
```

Default for TRAILER1: None; must be specified.

\**HEADER2**

Specifies the page header to be used for the reports produced for this OUTFIL group. The page header appears at the top of each page of the report, except
OUTFIL Control Statements

for the report header page (if any) and report trailer page (if any). DFSORT uses ANSI carriage control characters to control page ejects and the placement of the lines in your report, according to your specifications. You can use BLKCCH2 to replace the '1' (page eject) for the ANSI carriage control character in the first line of the first page header with a blank, thus avoiding forcing a page eject. You can use REMOVECC to remove the ANSI carriage control characters from a report.

You can choose to include any or all of the following report elements in your page header:

- Blanks, character strings, and hexadecimal strings
- Unedited input fields from the first OUTFIL input record for which a data record appears on the page
- Current date in a variety of different forms
- Current time in a variety of different forms
- Page number, converted to different numeric formats, or edited to contain signs, decimal points, leading zeros or no leading zeros, and so on.

The HEADER2 parameter cannot be used with the IFTRAIL parameter.

The page header consists of the elements you select, in the order in which you specify them, and in the columns or lines you specify.

c: See c: under HEADER1.

r: See r under HEADER1.

p,m specifies that an unedited input field, from the first OUTFIL input record for which a data record appears on the page, is to appear in the report record. See p,m under HEADER1 for further details.

DATE See DATE under HEADER1.

&DATE can be used instead of DATE.

DATE=(abcd)

See DATE=(abcd) under HEADER1.

&DATE=(abcd)
can be used instead of DATE=(abcd).

DATENS=(abc)

See DATENS=(abc) under HEADER1.

&DATENS=(abc)
can be used instead of DATENS=(abc).

YDDD=(abc)

See YDDD=(abc) under HEADER1.

&YDDD=(abc)
can be used instead of YDDD=(abc).

YDDDNS=(ab)

See YDDDNS=(ab) under HEADER1.

&YDDDNS=(ab)
can be used instead of YDDDNS=(ab).

TIME See TIME under HEADER1.

&TIME can be used instead of TIME.
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*TIME=(abc)*

See TIME=(abc) under HEADER1.

*TIME=(abc)*

&TIME=(abc) can be used instead of TIME=(abc).

*TIMENS=(ab)*

See TIMENS=(ab) under HEADER1.

&TIMENS=(ab) can be used instead of TIMENS=(ab).

*PAGE*

specifies that the current page number is to appear in the OUTFIL report record. The page number for the header appears as 6 digits, right-justified, with leading zeros suppressed. For example, if the page is numbered 3, it appears as ‘ 3’.

If HEADER1 is specified with PAGE and HEADER2 is specified with PAGE, the page number for the first page header will be ‘ 2’. If HEADER1 is not specified or is specified without PAGE and HEADER2 is specified with PAGE, the page number for the first page header will be ‘ 1’.

&PAGE can be used instead of PAGE.

*PAGE=(edit)* or *PAGE=(to)*

same as PAGE except that the 15-digit page number appears edited or converted as specified. See p,m,f,edit under OUTREC for further details on the edit fields you can use. See p,m,f,to under OUTREC for further details on the to fields you can use.

&PAGE=(edit) or &PAGE=(to) can be used instead of PAGE=(edit) or PAGE=(to).

Sample Syntax:

```
OUTFIL FNAMES=STATUS,
   HEADER2=(5:'Page ',PAGE,' of Status Report for ',DATE=(MD4/),
     ' at ',TIME=(12:),2/,
     10:'Item ',20:'Status ',35:'Count',/,
     10:'-----',20:'------------',35:'-----'),
OUTREC=(10:6,5,
     20:14,1,CHANGE=(12,
     C'S','C'Ship',
     C'H','C'Hold',
     C'T','C'Transfer'),
     NOMATCH=('C'*Check Code*'),
     36:39,A,ZD,M10,
     132:X)
```

*Default for HEADER2: None; must be specified.*

**TRAILER2**
Specifies the page trailer to be used for the reports produced for this OUTFIL group. The page trailer appears at the very bottom of each page of the report.
OUTFIL Control Statements

(as specified or defaulted by the LINES value), except for the report header page (if any) and report trailer page (if any). DFSORT uses ANSI carriage control characters to control page ejects and the placement of the lines in your report, according to your specifications.

You can choose to include any or all of the following report elements in your page trailer:

- Blanks, character strings, and hexadecimal strings
- Unedited input fields from the last OUTFIL input record for which a data record appears on the page
- Current date in a variety of different forms
- Current time in a variety of different forms
- Page number, converted to different numeric formats, or edited to contain signs, decimal points, leading zeros or no leading zeros, and so on
- Any or all of the following statistics:
  - Count of data records on the page, converted to different numeric formats, or edited to contain signs, decimal points, leading zeros or no leading zeros, and so on. You can add a decimal number to the count before converting or editing it (for example, add 1 to account for writing a trailer record, or add 2 to account for writing a header and trailer record).
  - Total, minimum, maximum, or average for each specified ZD, PD, BI, FI, FL, CSF, FS, UFF, or SFF numeric input field in the data records on the page, converted to different numeric formats, or edited to contain signs, decimal points, leading zeros or no leading zeros, and so on.
  - Running total, minimum, maximum, or average for each specified ZD, PD, BI, FI, FL, CSF, FS, UFF, or SFF numeric input field in the data records up to this point, converted to different numeric formats, or edited to contain signs, decimal points, leading zeros or no leading zeros, and so on.

The TRAILER2 parameter cannot be used with the IFTRAIL parameter.

The page trailer consists of the elements you select, in the order in which you specify them, and in the columns or lines you specify.

c:  See c: under HEADER1.

r  See r under TRAILER1.

p,m  specifies that an unedited input field, from the last OUTFIL input record for which a data record appears on the page, is to appear in the report record. See p,m under TRAILER1 for further details.

DATE  See DATE under HEADER1.

&DATE  can be used instead of DATE.

DATE=(abcd)  See DATE=(abcd) under HEADER1.

&DATE=(abcd)  can be used instead of DATE=(abcd).

DATENS=(abc)  See DATENS=(abc) under HEADER1.

&DATENS=(abc)  can be used instead of DATENS=(abc).
YDDD=(abc)
See YDDD=(abc) under HEADER1.

&YDDD=(abc)
can be used instead of YDDD=(abc).

YDDDNS=(ab)
See YDDDNS=(ab) under HEADER1.

&YDDDNS=(ab)
can be used instead of YDDDNS=(ab).

TIME
See TIME under HEADER1.

&TIME
can be used instead of TIME.

TIME=(abc)
See TIME=(abc) under HEADER1.

&TIME=(abc)
can be used instead of TIME=(abc).

TIMENS=(ab)
See TIMENS=(ab) under HEADER1.

&TIMENS=(ab)
can be used instead of TIMENS=(ab).

PAGE
See PAGE under TRAILER1.

&PAGE
can be used instead of PAGE.

PAGE=(edit) or PAGE=(to)
See PAGE=(edit) or PAGE=(to) under TRAILER1.

&PAGE=(edit) or &PAGE=(to)
can be used instead of PAGE=(edit) or PAGE=(to).

COUNT
specifies that the count of data records on the page is to appear in the report record as 8 digits, right-justified, with leading zeros suppressed. For example, if page 1 has 40 input records, page 2 has 40 input records, and page 3 has 26 input records, COUNT will show ' 40' for page 1, ' 40' for page 2, and ' 26' for page 3.

If slash (/) is used in OUTREC or BUILD to produce multiple data records, COUNT counts only the number of data records processed as input to OUTREC or BUILD. For example, if OUTREC processes 3 input records and creates 2 output records for each input record, the count is 3, not 6.

COUNT15
same as COUNT except that the count appears as 15 digits.

COUNT=(edit) or COUNT=(to)
same as COUNT except that the 15-digit count appears edited or converted as specified. See p,m,f,edit under OUTREC for further details on the edit fields you can use. See p,m,f,to under OUTREC for further details on the to fields you can use.

COUNT+n=(edit) or COUNT+n=(to)
same as COUNT=(edit) or COUNT=(to) except that n is added to the 15-digit count before it is edited or converted. n can be 1 to 3 decimal digits.
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**COUNT-n=(edit) or COUNT-n=(to)**
same as COUNT=(edit) or COUNT=(to) except that n is subtracted from the 15-digit count before it is edited or converted. n can be 1 to 3 decimal digits.

**SUBCOUNT**
specifies that the count of input records up to this point in the report is to appear in the report record as 8 digits, right-justified, with leading zeros suppressed. The running count accumulates the count for all pages up to and including the current page. For example, if page 1 has 40 input records, page 2 has 40 input records, and page 3 has 26 input records, SUBCOUNT will show ' 40' for page 1, ' 80' for page 2, and ' 106' for page 3.

If slash (/) is used in OUTREC or BUILD to produce multiple data records, SUBCOUNT counts only the number of data records processed as input to OUTREC or BUILD. For example, if OUTREC processes 3 input records and creates 2 output records for each input record, the running count is 3, not 6.

**SUBCOUNT15**
same as SUBCOUNT except that the running count appears as 15 digits.

**SUBCOUNT=(edit) or SUBCOUNT=(to)**
same as SUBCOUNT except that the 15-digit running count appears edited or converted as specified. See p,m,f,edit under OUTREC for further details on the edit fields you can use. See p,m,f,to under OUTREC for further details on the to fields you can use.

**TOTAL**
specifies that an edited or converted total, for the values of a numeric input field in the data records on the page, is to appear in the report record.

TOT can be used instead of TOTAL.

**p,m,f,edit or p,m,f,to**
See p,m,f,edit or p,m,f,to under TOTAL for TRAILER1.

**MIN**
specifies that an edited or converted minimum, for the values of a numeric input field in the data records on the page, is to appear in the report record.

**p,m,f,edit or p,m,f,to**
See p,m,f,edit or p,m,f,to under MIN for TRAILER1.

**MAX**
specifies that an edited or converted maximum, for the values of a numeric input field in the data records on the page, is to appear in the report record.

**p,m,f,edit or p,m,f,to**
See p,m,f,edit or p,m,f,to under MAX for TRAILER1.

**AVG**
specifies that an edited or converted average, for the values of a numeric input field in the data records on the page, is to appear in the report record.

**p,m,f,edit or p,m,f,to**
See p,m,f,edit or p,m,f,to under AVG for TRAILER1.

**SUBTOTAL**
specifies that an edited or converted running total, for the values of a numeric input field in the data records up to this point in the report, is
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to appear in the report record. The running total accumulates the total for all pages up to and including the current page. For example, if the total for a selected numeric field is +200 for page 1, −250 for page 2, and +90 for page 3, SUBTOTAL will be +200 for page 1, −50 for page 2, and +40 for page 3.

SUBTOT or SUB can be used instead of SUBTOTAL.

\textbf{p,m,f,edit or p,m,f,to}

See \texttt{p,m,f,edit or p,m,f,to} under SUBTOTAL for TRAILER1.

\textbf{SUBMIN}

specifies that an edited or converted running minimum, for the values of a numeric input field in the data records up to this point in the report, is to appear in the report record. The running minimum selects the minimum from all pages up to and including the current page. For example, if the minimum for a selected numeric field is +200 for page 1, −250 for page 2, and +90 for page 3, SUBMIN will be +200 for page 1, −250 for page 2, and −250 for page 3.

\textbf{p,m,f,edit or p,m,f,to}

See \texttt{p,m,f,edit or p,m,f,to} under SUBMIN for TRAILER1.

\textbf{SUBMAX}

specifies that an edited or converted running maximum, for the values of a numeric input field in the data records up to this point in the report, is to appear in the report record. The running maximum selects the maximum from all pages up to and including the current page. For example, if the maximum for a selected numeric field is −100 for page 1, +250 for page 2, and +90 for page 3, SUBMAX will be −100 for page 1, +250 for page 2, and +250 for page 3.

\textbf{p,m,f,edit or p,m,f,to}

See \texttt{p,m,f,edit or p,m,f,to} under SUBMAX for TRAILER1.

\textbf{SUBAVG}

specifies that an edited or converted running average, for the values of a numeric input field in the data records up to this point in the report, is to appear in the report record. The running average computes the average for all pages up to and including the current page. For example, if the count of data records and total for a selected numeric field are 60 and +2205 for page 1, respectively, 60 and −6252 for page 2, respectively, and 23 and −320 for page 3, respectively, SUBAVG will be +36 for page 1, −33 for page 2, and −30 for page 3.

\textbf{p,m,f,edit or p,m,f,to}

See \texttt{p,m,f,edit or p,m,f,to} under SUBAVG for TRAILER1.

\textit{Sample Syntax:}

\begin{verbatim}
OUTFIL FNAME=STATS,
STARTREC=3,
OUTREC=(20:23,3,PD,M16,
30:40,3,PD,M16,
80:X),
TRAILER2=('/',2:'Average on page:',
20:AVG=(23,3,PD,M16),
30:AVG=(40,3,PD,M16),'/,
2:'Average so far:',
20:SUBAVG=(23,3,PD,M16),
30:SUBAVG=(40,3,PD,M16))
\end{verbatim}

\textit{Default for TRAILER2: None; must be specified.}
Specifies the section break processing to be used for the reports produced for this OUTFIL group. A section break field divides the report into sets of sequential OUTFIL input records with the same binary value for that field, which result in corresponding sets of data records (that is, sections) in the report. A break is said to occur when the binary value changes. Of course, because a break can occur in any record, the data records of a section can be split across pages in your report.

For each section break field you specify, you can choose to include any or all of the following:

- A page eject between sections.
- Zero, one or more blank lines to appear between sections on the same page.
- A section header to appear before the first data record of each section and optionally, at the top of each page. When a page header and section header are both to appear at the top of a page, the section header will follow the page header.
- A section trailer to appear after the last data record of each section. When a page trailer and section trailer are both to appear at the bottom of a page, the page trailer will follow the section trailer.

The SECTIONS parameter cannot be used with the IFTRAIL parameter.

DFSORT uses ANSI carriage control characters to control page ejects and the placement of the lines in your report, according to your specifications.

If multiple section break fields are used, they are processed in first-to-last order, in the same way they would be sorted by these fields. In fact, the input data set is generally sorted by the section break fields, to group the records with the same section break values together for the report. This sorting can be done by the same application that produces the report or by a previous application.

A break in section break field 1 results in a break in section break fields 2 through n. A break in section break 2 results in a break in section break fields 3 through n, and so on. The section headers appear before each section in first-to-last order, whereas the section trailers appear in last-to-first order. For example, if section break fields represented by B1 with header H3A and trailer
T3A, B2 with header H3B and trailer T3B, and B3 with header H3C and trailer T3C are specified in order, the following can appear:

H3A (header for B1=1 section)
H3B (header for B2=1 section)
H3C (header for B3=1 section)
T3C (trailer for B3=1 section)
H3C (header for B3=2 section)
T3C (trailer for B3=2 section)
T3B (trailer for B2=1 section)
H3B (header for B2=2 section)
H3C (header for B3=1 section)
T3C (trailer for B3=1 section)
T3B (trailer for B2=2 section)
T3A (trailer for B1=1 section)
H3A (header for B1=2 section)
H3B (header for B2=2 section)
H3C (header for B3=0 section)
T3C (trailer for B3=0 section)
H3C (header for B3=1 section)
T3C (trailer for B3=1 section)
T3B (trailer for B2=2 section)
T3A (trailer for B1=2 section)

\( p, m \)

specifies a section break field in the OUTFIL input records to be used to divide the report into sections. Each set of sequential OUTFIL input records, with the same binary value for the section break field, results in a corresponding set of data records. Each such set of data records is treated as a section in the report. A break is said to occur when the binary value changes.

\( p \)

specifies the first byte of the input field relative to the beginning of the OUTFIL input record. The first data byte of a fixed-length record has relative position 1. The first data byte of a variable-length record has relative position 5, because the first four bytes are occupied by the RDW. All fields must start on a byte boundary, and no field can extend beyond byte 32752. See “OUTFIL Statements Notes” on page 375 for special rules concerning variable-length records.

\( m \)

specifies the length in bytes of the input field. The value for \( m \) must be between 1 and 256.

You can specify any, all or none of SKIP, HEADER3 and TRAILER3 after \( p, m \). If you do not specify SKIP, HEADER3 or TRAILER3 after \( p, m \), \( \text{SKIP}=0L \) is used as the default.

**SKIP**

```
 Skipping section when field value changes.
```

Specifies, for reports produced for this OUTFIL group, that either:
OUTFIL Control Statements

- Each section for the associated section break field is to appear on a new page, or
- Zero, one or more blank lines to appear after each section associated with this section break field, when it is followed by another section on the same page.

Thus, you can use SKIP to specify how sections will be separated from each other.

P specifies that each section is to appear on a new page.

L specifies that one blank line is to appear between sections on the same page. L is the same as 1L.

nL specifies that n blank lines are to appear between sections on the same page. You can specify from 0 to 255 for n.

Sample Syntax:

```
OUTFIL FNAMES=(PRINT,TAPE),
   SECTIONS=(10,20,SKIP=P,
              110,20,SKIP=3L)
```

HEADER3

```
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```

Specifies the section header to be used with the associated section break field for the reports produced for this OUTFIL group. The section header appears before the first data record of each section. DFSORT uses ANSI carriage control characters to control page ejects and the placement of the lines in your report, according to your specifications.
You can choose to include any or all of the following report elements in your section header:

- Blanks, character strings, and hexadecimal strings
- Unedited input fields from the first OUTFIL input record for which a data record appears in the section
- Current date in a variety of different forms
- Current time in a variety of different forms
- Page number, converted to different numeric formats, or edited to contain signs, decimal points, leading zeros or no leading zeros, and so on.

The section header consists of the elements you select, in the order in which you specify them, and in the columns or lines you specify.

c: See c: under HEADER1.

r See r under HEADER1.

p,m specifies that an unedited input field, from the first OUTFIL input record for which a data record appears in the section, is to appear in the report record. See p,m under HEADER1 for further details.

DATE See DATE under HEADER1.

&DATE can be used instead of DATE.

DATE=(abcd) See DATE=(abcd) under HEADER1.

&DATE=(abcd) can be used instead of DATE=(abcd).

DATENS=(abc) See DATENS=(abc) under HEADER1.

&DATENS=(abc) can be used instead of DATENS=(abc).

YDDD=(abc) See YDDD=(abc) under HEADER1.

&YDDD=(abc) can be used instead of YDDD=(abc).

YDDDNS=(ab) See YDDDNS=(ab) under HEADER1.

&YDDDNS=(ab) can be used instead of YDDDNS=(ab).

TIME See TIME under HEADER1.

&TIME can be used instead of TIME.

TIME=(abc) See TIME=(abc) under HEADER1.

&TIME=(abc) can be used instead of TIME=(abc).

TIMENS=(ab) See TIMENS=(ab) under HEADER1.

&TIMENS=(ab) can be used instead of TIMENS=(ab).
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**PAGE** specifies that the current page number is to appear in the OUTFIL report record. The page number for the header appears as 6 digits, right-justified, with leading zeros suppressed. For example, if the page is numbered 3, it appears as ‘000003’.

**&PAGE** can be used instead of PAGE.

**PAGE=(edit) or PAGE=(to)**

same as PAGE except that the 15-digit page number appears edited or converted as specified. See p,m,f,edit under OUTREC for further details on the edit fields you can use. See p,m,f,to under OUTREC for further details on the to fields you can use.

**&PAGE=(edit) or &PAGE=(to)**

can be used instead of PAGE=(edit) or PAGE=(to).

*Sample Syntax:*

```plaintext
OUTFIL FNAMES=STATUS1,
   HEADER2=(10:'Status Report for all departments',5X,
             '- ',&PAGE,' -'),
   SECTIONS=(10,8,
             HEADER3=(2/,10:'Report for department ',10,8,' on ',&DATE,2/,  
                      10:' Number',25:'Average Time',/,
                      10:'Completed',25:' (in days)',/,
                      10:'--------',25:'----------')
OUTREC=(10:21,5,ZD,M10,LENGTH=9,
           25:38,4,ZD,EDIT=(III.T),LENGTH=12,
           132:X)
```

**PAGEHEAD**

Specifies that the section header to be used with the associated section break field is to appear at the top of each page of the report, except for the report header page (if any) and report trailer page (if any), as well as before each section. If you do not specify PAGEHEAD, the section header appears only before each section; so if a section is split between pages, the section header appears only in the middle of the page. PAGEHEAD can be used when you want HEADER3 to be used as a page header as well as a section header.

If PAGEHEAD is specified for a section break field for which HEADER3 is not also specified, PAGEHEAD will not be used.

*Sample Syntax:*

```plaintext
OUTFIL FNAMES=STATUS2,
   HEADER2=(10:'Status Report for all departments',5X,
             '- ',&PAGE,' -'),
   SECTIONS=(10,8,
             HEADER3=(2/,10:'Report for department ',10,8,' on ',&DATE,2/,  
                      10:' Number',25:'Average Time',/,
                      10:'Completed',25:' (in days)',/,
                      10:'--------',25:'----------')
OUTREC=(10:21,5,ZD,M10,LENGTH=9,
           25:38,4,ZD,EDIT=(III.T),LENGTH=12,
           132:X)
```

**TRAILER3**

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Specifies the section trailer to be used with the associated section break field for the reports produced for this OUTFIL group. The section trailer appears
after the last data record of each section. DFSORT uses ANSI carriage control
characters to control page ejects and the placement of the lines in your report,
according to your specifications.

You can choose to include any or all of the following report elements in your
section trailer:

- Blanks, character strings, and hexadecimal strings
- Unedited input fields from the last OUTFIL input record for which a data
record appears in the section
- Current date in a variety of different forms
- Current time in a variety of different forms
- Page number, converted to different numeric formats, or edited to contain
signs, decimal points, leading zeros or no leading zeros, and so on
- Any or all of the following statistics:
  - Count of data records in the section, converted to different numeric
    formats, or edited to contain signs, decimal points, leading zeros or no
    leading zeros, and so on. You can add a decimal number to the count
    before converting or editing it (for example, add 1 to account for writing
    a trailer record, or add 2 to account for writing a header and trailer
    record).
  - Total, minimum, maximum, or average for each specified ZD, PD, BI, FI,
    FL, CSF, FS, UFF, or SFF numeric input field in the data records in the
    section, converted to different numeric formats, or edited to contain signs,
    decimal points, leading zeros or no leading zeros, and so on
  - Running total, minimum, maximum, or average for each specified ZD,
    PD, BI, FI, FL, CSF, FS, UFF, or SFF numeric input field in the data
    records up to this point, converted to different numeric formats, or edited
to contain signs, decimal points, leading zeros or no leading zeros, and so on.

The section trailer consists of the elements you select, in the order in which
you specify them, and in the columns or lines you specify.

c: See c: under HEADER1.
r See r under TRAILER1.
p,m specifies that an unedited input field, from the last OUTFIL
input record for which a data record appears in the section, is
to appear in the report record. See p,m under TRAILER1 for
further details.

DATE See DATE under HEADER1.
&DATE can be used instead of DATE.
DATE=(abcd) See DATE=(abcd) under HEADER1.
&DATE=(abcd) can be used instead of DATE=(abcd).
DATENS=(abc) See DATENS=(abc) under HEADER1.
&DATENS=(abc) can be used instead of DATENS=(abc).
YDDD=(abc) See YDDD=(abc) under HEADER1.
&YDDD=(abc) can be used instead of YDDD=(abc).
YDDDNS=(ab) See YDDDNS=(ab) under HEADER1.
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&YDDDNS=(ab) can be used instead of YDDDNS=(ab).

TIME
See TIME under HEADER1.

&TIME
can be used instead of TIME.

TIME=(abc)
See TIME=(abc) under HEADER1.

&TIME=(abc)
can be used instead of TIME=(abc).

TIMENS=(ab)
See TIMENS=(ab) under HEADER1.

&TIMENS=(ab)
can be used instead of TIMENS=(ab).

PAGE
See PAGE under TRAILER1.

&PAGE
can be used instead of PAGE.

PAGE=(edit) or PAGE=(to)
See PAGE=(edit) or PAGE=(to) under TRAILER1.

&PAGE=(edit) or &PAGE=(to)
can be used instead of PAGE=(edit) or PAGE=(to).

COUNT
specifies that the count of data records in the section is to appear in the report record as 8 digits, right-justified, with leading zeros suppressed. For example, if the first section has 40 input records, the second section has 40 input records, and the third section has 26 input records, COUNT will show ' 40' for the first section, ' 40' for the second section, and ' 26' for the third section.

If slash (/) is used in OUTREC or BUILD to produce multiple data records, COUNT counts only the number of data records processed as input to OUTREC or BUILD. For example, if OUTREC or BUILD processes 3 input records and creates 2 output records for each input record, the count is 3, not 6.

COUNT15
same as COUNT except that the count appears as 15 digits.

COUNT=(edit) or COUNT=(to)
same as COUNT except that the 15-digit count appears edited or converted as specified. See p,m,f,edit under OUTREC for further details on the edit fields you can use. See p,m,f,to under OUTREC for further details on the to fields you can use.

COUNT+n=(edit) or COUNT+n=(to)
same as COUNT=(edit) or COUNT=(to) except that n is added to the 15-digit count before it is edited or converted. n can be 1 to 3 decimal digits.

COUNT-n=(edit) or COUNT-n=(to)
same as COUNT=(edit) or COUNT=(to) except that n is subtracted from the 15-digit count before it is edited or converted. n can be 1 to 3 decimal digits.

SUBCOUNT
specifies that the running count of input records up to this point in the report is to appear in the report record 8 digits, right-justified, with leading zeros suppressed. The running count accumulates the count for all sections up to and including the current section. For example, if the first section has 40 input records, the second section has 40 input records, and the third section has 26 input records, SUBCOUNT will
OUTFIL Control Statements

show ' 40' for the first section, ' 80' for the second
section, and ' 106' for the third section.

If slash (/) is used in OUTREC or BUILD to produce multiple
data records, SUBCOUNT counts only the number of data
records processed as input to OUTREC or BUILD. For example,
if OUTREC or BUILD processes 3 input records and creates 2
output records for each input record, the running count is 3,
not 6

SUBCOUNT15 same as SUBCOUNT except that the running count appears as
15 digits.

SUBCOUNT=(edit) or SUBCOUNT=(to)
same as SUBCOUNT except that the 15-digit running count
appears edited or converted as specified. See p,m,f,edit under
OUTREC for further details on the edit fields you can use. See
p,m,f,to under OUTREC for further details on the to fields you
can use.

TOTAL specifies that an edited or converted total, for the values of a
numeric input field in the data records in the section, is to
appear in the report record.

TOT can be used instead of TOTAL.

p,m,f,edit or p,m,f,to
See p,m,f,edit or p,m,f,to under TOTAL for TRAILER1.

MIN specifies that an edited or converted minimum, for the values
of a numeric input field in the data records in the section, is to
appear in the report record.

p,m,f,edit or p,m,f,to
See p,m,f,edit or p,m,f,to under MIN for TRAILER1.

MAX specifies that an edited or converted maximum, for the values
of a numeric input field in the data records in the section, is to
appear in the report record.

p,m,f,edit or p,m,f,to
See p,m,f,edit or p,m,f,to under MAX for TRAILER1.

AVG specifies that an edited or converted average, for the values of
a numeric input field in the data records in the section, is to
appear in the report record.

p,m,f,edit or p,m,f,to
See p,m,f,edit or p,m,f,to under AVG for TRAILER1.

SUBTOTAL specifies that an edited or converted running total, for the
values of a numeric input field in the data records up to this
point in the report, is to appear in the report record. The
running total accumulates the total for all sections up to and
including the current section. For example, if the total for a
selected numeric field is +200 for the first section, −250 for the
second section and +90 for the third section, SUBTOTAL will
be +200 for the first section, −50 for the second section and +40
for the third section.

SUBTOT or SUB can be used instead of SUBTOTAL.
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p,m,f,edit or p,m,f,to
See p,m,f,edit or p,m,f,to under SUBTOTAL for TRAILER1.

SUBMIN specifies that an edited or converted running minimum, for the values of a numeric input field in the data records up to this point in the report, is to appear in the report record. The running minimum selects the minimum from all sections up to and including the current section. For example, if the minimum for a selected numeric field is +200 for the first section, −250 for the second section and +90 for the third section, SUBMIN will be +200 for the first section, −250 for the second section and −250 for the third section.

p,m,f,edit or p,m,f,to
See p,m,f,edit or p,m,f,to under SUBMIN for TRAILER1.

SUBMAX specifies that an edited or converted running maximum, for the values of a numeric input field in the data records up to this point in the report, is to appear in the report record. The running maximum selects the maximum from all sections up to and including the current section. For example, if the maximum for a selected numeric field is −100 for the first section, +250 for the second section and +90 for the third section, SUBMAX will be −100 for the first section, +250 for the second section and +250 for the third section.

p,m,f,edit or p,m,f,to
See p,m,f,edit or p,m,f,to under SUBMAX for TRAILER1.

SUBAVG specifies that an edited or converted running average, for the values of a numeric input field in the data records up to this point in the report, is to appear in the report record. The running average computes the average for all sections up to and including the current section. For example, if the count of data records and total for a selected numeric field are 60 and +2205 for the first section, respectively, 60 and −6252 for the second section, respectively, and 23 and −320 for the third section, respectively, SUBAVG will be +36 for the first section, −33 for the second section and −30 for the third section.

p,m,f,edit or p,m,f,to
See p,m,f,edit or p,m,f,to under SUBAVG for TRAILER1.

Sample Syntax:

```
OUTFIL FNAME=SECRPT,
  INCLUDE=(11,4,CH,EQ,C'SSD'),
  SECTIONS=(3,5,SKIP=P,
    HEADER3=(2:'Department: ',3,5,'Date: ',&DATE,2/),
    TRAILER3=(2/,2:'The average for ',3,5,' is ',
      AVG=(40,3,PD,M12),/,  
      2:'The overall average so far is ',
      SUBAVG=(40,3,PD,M12)),
  45,8,SKIP=3L,
  HEADER3=(4:'Week Ending ',45,8,2/, 
   4:'Item Number',20:'Completed',/,
   4:'-',20:'-'),
```

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TRAILER3=(4:'The item count for week ending ',45,8,' is ',COUNT=(EDIT=(II,IIT))),
OUTREC=(11:16,4,22:40,3,P0,M12,120:X)

Default for SECTIONS: None; must be specified.

NODETAIL

Specifies that data records are not to be output for the reports produced for this OUTFIL group. With NODETAIL, the data records are completely processed with respect to input fields, statistics, counts, sections breaks, and so on, but are not written to the OUTFIL data set and are not included in line counts for determining the end of a page. You can use NODETAIL to summarize the data records without actually showing them.

The NODETAIL parameter cannot be used with the IFTRAIL parameter.

Sample Syntax:

```
OUTFIL FNAMES=SUMMARY,NODETAIL,
   HEADER2=(' Date: ',DATENS=(DMY.),4X,'Page: ',PAGE,2/,  
          10:'Division',25:' Total Revenue$/,
          10:'--------',25:'-----------------'),
   SECTIONS=(3,5,
            TRAILER3=(10:3,5,
                     25:TOTAL=(25,4,FI,M19,
                              LENGTH=17))),
   TRAILER1=(5/,10:'Summary of Revenue $',4/,  
             12:'Number of divisions reporting is ',  
             COUNT,/,  
             12:'Total revenue is ',  
             TOTAL=(25,4,F1,M19))
```

Default for NODETAIL: None; must be specified.

Default for OUTFIL Statements: None; must be specified. Multiple OUTFIL statements can be specified in the same and different sources; override is at the ddname level.

Applicable Functions for OUTFIL Statements: Sort, merge, and copy.

BLKCCH1

specifies that the ANSI carriage control character of '1' (page eject) in the first line of the report header (HEADER1) is to be replaced with a blank. You can use BLKCCH1 to avoid forcing a page eject at the start of the report header. If BLKCCH1 is specified without HEADER1, it will not be used.

Sample Syntax:

```
OUTFIL FNAMES=RPT1,BLKCCH1,
   HEADER1=(30:'January Report',4/)  
```

Default for BLKCCH1: None; must be specified.

BLKCCH2

specifies that the ANSI carriage control character of '1' (page eject) in the first line of the first page header (HEADER2) is to be replaced with a blank. You can use BLKCCH2 to avoid forcing a page eject at the start of the first page header. BLKCCH2 does not prevent a page eject for the second and subsequent page headers. If BLKCCH2 is specified without HEADER2, it will not be used.
Sample Syntax:

```plaintext
OUTFIL FNAMES=RPT2,
  * Do page eject for HEADER1, but not for first HEADER2.
  HEADER1=(30:'January Report',27),
  BLKCCH2,HEADER2=(5:Account Number',25:Name')
```

Default for BLKCCH2: None; must be specified.

**BLKCCT1**

specifies that the ANSI carriage control character of '1' (page eject) in the first line of the report trailer (TRAILER1) is to be replaced with a blank. You can use BLKCCT1 to avoid forcing a page eject at the start of the report trailer. If BLKCCT1 is specified without TRAILER1, it will not be used.

Sample Syntax:

```plaintext
OUTFIL FNAMES=RPT3,BLKCCT1,
  TRAILER1=(5:'Grand Total is ',TOT=(21,10,ZD,M5))
```

Default for BLKCCT1: None; must be specified.

**REMOVECC**

Specifies that the ANSI carriage control character is to be removed from OUTFIL output records for this OUTFIL group before the records are written. In addition, blank lines are not used to position the page trailer (TRAILER2) at the bottom of the page.

If REMOVECC is specified without any of the following report parameters, it will not be used: LINES, HEADER1, TRAILER1, HEADER2, TRAILER2, SECTIONS, or NODETAIL.

Sample Syntax:

```plaintext
OUTFIL FNAMES=RPTWOCC,
  TRAILER1=(3/,'Number of records is ',COUNT=(TO=ZD,LENGTH=6)),
  REMOVECC
```

Default for REMOVECC: None; must be specified.

**IFTRAIL**

IFTRAIL allows you to update count and total values in an existing trailer (last) record to reflect the actual data records in an OUTFIL data set. Whereas TRAILER1 lets you build a new trailer record, IFTRAIL lets you update an existing trailer record using the COUNT and TOTAL features of TRAILER1. When you add, delete or modify input data records to create an OUTFIL data set, you can use IFTRAIL to ensure that the trailer record has accurate updated count and total values.
The count and total values are determined using the data records processed as input to OUTFIL. If slash (/) is used in OUTFIL BUILD to produce multiple output data records, the count and total values are determined using the data records processed as input to OUTFIL. For example, if you use OUTFIL BUILD=(1,80,/,1,80) to create 6 OUTFIL output records from 3 OUTFIL input records, the count is 3, not 6.

You must identify the trailer record using a unique condition (for example, 'TRL' in positions 1-3). You then specify how count and total values in the identified trailer record are to be updated. The trailer record will NOT be treated as a data record, that is, no other OUTFIL processing will be performed against the trailer record. You can optionally specify that the header (first) record will NOT be treated as a data record.

As a simple example, you could use the following OUTFIL statement to write the header (first) record, data records with 'D1', and trailer record (identified by '9' in position 1) in the OUTFIL data set, and set an accurate count and total in the trailer record for the included input data records.

```c
OUTFIL FNAMES=OUT1, INCLUDE=(10,2,CH,EQ,C'D1'), IFTRAIL=(HD=YES,TRLID=(1,1,CH,EQ,C'9'), TRLUPD=(11:COUNT=(M11,LENGTH=8), 25:TOTAL=(15,6,ZD,EDIT=(IIIIIT)))
```

The trailer record will not be treated as a data record; it will not be subject to INCLUDE processing, and will not be used for the updated count or total values.

Since HD=YES is specified, the header record will not be treated as a data record; it will not be subject to INCLUDE processing, and will not be used for the updated count or total values.

**IFTRAIL**

Allows you to update count and total fields in the trailer record of the data sets for an OUTFIL group. You can use IFTRAIL to identify a trailer record and indicate count and total fields to be updated in that record. The identified trailer record will not be used to determine the count or totals. If you specify HD=YES, the header (first) record will not be used to determine the count or totals.

You cannot specify IFTRAIL with any of the following operands in an OUTFIL statement: HEADER1, TRAILER1, HEADER2, TRAILER2, NODETAIL, SECTIONS, LINES, SPLIT, SPLITBY, SPLITR, REPEAT, FTOV, VTOF, VLTRIM or VLFILL.

You must specify the TRLID and TRLUPD operands. The HD=YES operand is optional.

**TRLID=(logexp)**

Specifies the criteria to be tested to determine if a record is the trailer record. When a record is found that meets the criteria, it will be treated as the last record, and subsequent records will not be processed for the OUTFIL group. Thus if you use TRLID=(1,1,CH,EQ,C'9') to identify the trailer record and you have three records with '9' in position 1, the first record with '9' in position 1 will be treated as the trailer record, and records after that will not appear in the OUTFIL data sets.

See the discussion of INCLUDE statement in "INCLUDE Control Statement" on page 98 for details of the logical expressions that you can use. You can specify all of the logical expressions for TRLID in the same way that you can specify them for the INCLUDE statement, except that:
OUTFIL Control Statements

- You cannot specify FORMAT=f
- You cannot specify D2 format
- Locale processing is not used
- VLSCMP and VLSHRT are not used. The trailer record must be long enough to contain all fields in the logical expression. Trailer record checking will be skipped for any variable-length record that is too short to contain a field in the TRLID logical expression.

The trailer record will not be treated as a data record; all other OUTFIL processing (for example, INCLUDE, OMIT, BUILD, OVERLAY, and so on) will be bypassed for the trailer record. The updated count and total values will not include the trailer record.

TRLUPD=(c:item,...)

Specifies the position where each count or total is to be updated in the trailer record.

For fixed-length records, the first input and output data byte starts at position 1. The trailer record will be truncated or padded with blanks to the length of the data records, if appropriate. You cannot change the length of the trailer record using TRLUPD.

For variable-length records, the first input and output data byte starts at position 5, after the RDW in positions 1-4. The original length of the trailer record will not be changed for output. You cannot change the length of the trailer record using TRLUPD. If you specify an item beyond the end of the trailer record, it will not be updated.

c: specifies the output position (column) in the trailer record to be updated. If you do not specify c: for the first item, it defaults to 1:. If you do not specify c: for any other item, it starts after the previous item. You must specify items in ascending output column order, and an item must not overlap a previous item in the trailer record. For a variable-length trailer record, you must not specify columns 1-4.

item specifies the count or total you want to update. Any of the following count and total items can be used as described for TRAILER1:
  • COUNT=(edit)
  • COUNT=(to)
  • COUNT+n=(edit)
  • COUNT+n=(to)
  • COUNT-n=(edit)
  • COUNT-n=(to)
  • TOTAL=(p,m,f,edit)
  • TOTAL=(p,m,f,to)
  • TOT=(p,m,f,edit)
  • TOT=(p,m,f,to)

The count and total values are determined using the data records processed as input to OUTFIL.

If TOT or TOTAL is used, the specified p,m,f field from each data record will be totalled, even if the trailer record is not found. OUTFIL BUILD, OVERLAY or IFTHEN processing does NOT affect
OUTFIL Control Statements

the values that are totalled; the values in the original OUTFIL
input records are used for the totals.

An invalid field amount can result in a data exception (0C7
ABEND) or incorrect numeric output. Be careful to use HD=YES if
the header record does not have valid total fields. For example, if
the input file has these records:

H***
0001
0002
T***

and this IFTRAIL operand is specified:

IFTRAIL=(TRLID=(1,1,CH,EQ,C'T'),
       TRLUPD=(5:TOT=(1,4,ZD,TO=ZD,LENGTH=5))

an 0C7 ABEND will result when DFSORT attempts to total the
invalid 1,4,ZD field in the header (H*** record. The use of
HD=YES would prevent this.

An invalid total field can also be encountered if the trailer record is
not found due to erroneous TRLID conditions. For example, if the
input file has these records:

H***
0001
0002
T***

and this IFTRAIL operand is specified:

IFTRAIL=(TRLID=(1,2,CH,EQ,C'TR'),
       TRLUPD=(5:TOT=(1,4,ZD,TO=ZD,LENGTH=5))

the last (T***) record will not be identified as the trailer record
since it does not have 'TR' in positions 1-2. Thus, an 0C7 ABEND
will result when DFSORT attempts to total the invalid 1,4,ZD field
in the last (T*** record. The use of the correct condition for
identifying the trailer (T***) record would prevent this.

If slash (/) is used in OUTFIL BUILD to produce multiple output
data records, the count and total values are determined using the
data records processed as input to OUTFIL. For example, if you
use OUTFIL BUILD=(1,80,/,1,80) to create 6 OUTFIL output
records from 3 OUTFIL input records, the count is 3, not 6.

HD=YES

Specify HD=YES if you want the first record treated as a header record
rather than as a data record. With HD=YES, OUTFIL processing (for
example, INCLUDE, OMIT, BUILD, OVERLAY, and so on) will be
bypassed for the header record. The updated count and total values
will not include the header record.

If HD=YES is specified, the TRLID test will not be applied to the first
record.

Sample Syntax:

OUTFIL IFTRAIL=(HD=YES,
                TRLID=(1,3,CH,EQ,C'TRL'),
                TRLUPD=(11:COUNT=(M11,LENGTH=4),
                        21:TOT=(M11,LENGTH=6)))

Default for IFTRAIL: None; must be specified.
OUTFIL Statements Notes

- OUTFIL processing is supported for sort, merge, and copy applications, but only by the Blockset technique.
- The ODMAXBF value in effect specifies the maximum buffer space to be used for each OUTFIL data set. ODMAXBF can be specified as an installation or run-time option, or in an ICEIEXIT routine. The default value of 2M is recommended for the ODMAXBF option in effect. Lowering ODMAXBF can cause performance degradation for the application, but might be necessary if you consider the amount of storage used for OUTFIL processing to be a problem. Raising ODMAXBF can improve EXCPs for the application, but can also increase the amount of storage needed.
- The storage used for OUTFIL processing will be adjusted automatically according to the total storage available, the storage needed for non-OUTFIL processing, and the number of OUTFIL data sets and their attributes (for example, block size). OUTFIL processing will be subject to the ODMAXBF limit in effect and the system storage limits (for example, IEFUSI), but not to the DFSORT storage limits (that is, SIZE, MAXLIM, and TMAXLIM). DFSORT attempts to use storage above 16MB virtual for OUTFIL processing whenever possible.
- The VSAMBSP option applies to SORTOUT data sets, but not to OUTFIL data sets. The NOBLKSET option will be ignored if OUTFIL data sets are being processed. An E39 exit routine is entered for the SORTOUT data set, but not for OUTFIL data sets.
- For fixed-format OUTFIL data sets: DFSORT will determine each OUTFIL data set LRECL based on the length of the reformatted records for the group, or the length of the OUTFIL input records (if OUTREC, BUILD, OVERLAY, FINDREP and IFTHEN are not specified for the group). For VSAM data sets, the maximum record size defined in the cluster is equivalent to the LRECL. If an OUTFIL data set LRECL is not specified or available, DFSORT will set it to the determined LRECL. If an OUTFIL data set LRECL is specified or available, it must not be less than the determined LRECL, or more than the determined LRECL if the OUTREC, BUILD, OVERLAY, FINDREP or IFTHEN parameter is specified. In other words, the LRECL value cannot be used to pad the output records, or to truncate the records produced by OUTREC, BUILD, OVERLAY, FINDREP or IFTHEN parameter processing. In general, OUTREC, BUILD, OVERLAY, or IFTHEN processing should be used to pad the records and OUTREC, BUILD, or IFTHEN processing should be used to truncate the records. In either case, the LRECL should either not be specified or set to the length of the reformatted records.
- For variable-format OUTFIL data sets: DFSORT will determine each OUTFIL data set maximum LRECL based on the length of the reformatted records for the group, or the length of the OUTFIL input records (if OUTREC, BUILD, OVERLAY, FINDREP and IFTHEN are not specified for the group). If an OUTFIL data set maximum LRECL is not specified or available, DFSORT will set it to the determined maximum LRECL. For VSAM data sets, the maximum record size defined in the cluster is four bytes more than the maximum LRECL.
- When you create an OUTFIL report, the length for the longest or only data record must be equal to or greater than the maximum report record length. You can use the OUTREC, BUILD, OVERLAY, FINDREP or IFTHEN parameter to force a length for the data records that is longer than any report record; you can then either let DFSORT compute and set the LRECL, or ensure that the computed LRECL is equal to the existing or specified LRECL. Remember to allow an extra byte in the LRECL for the ANSI carriage control character.
OUTFIL Control Statements

For example, if your data records are 40 bytes, but your longest report record is 60 bytes, you can use an OUTREC parameter such as:

```plaintext
OUTREC=(1,40,80:X)
```

DFSORT will then set the LRECL to 81 (1 byte for the ANSI carriage control character plus 80 bytes for the length of the data records), and pad the data records with blanks on the right.

If you don't want the ANSI carriage control characters to appear in the output data set, use the REMOVECC parameter to remove them. For example, if you specify:

```plaintext
OUTREC=(1,40,80:X),REMOVECC
```

DFSORT will set the LRECL to 80 instead of 81 and remove the ANSI carriage control character from each record before it is written.

System errors can result if you print an OUTFIL report containing records longer than your printer can handle.

- DFSORT uses appropriate ANSI carriage controls (for example, C'-' for triple space) in header and trailer records when possible to reduce the number of report records written. DFSORT always uses the single space carriage control (C' ') in data records. Although these carriage control characters may not be shown when you view an OUTFIL data set (depending on how you view it), they will be used if you print the report. If you are creating a report for viewing and want blank lines to appear in headers and trailers, specify a line of blanks instead of using n/. For example, instead of specifying:

```plaintext
OUTFIL FNAME=RPT,
    HEADER2=(2/, 'start of header', 2/, 'next line')
```

which will result in blank lines for the printer, but not for viewing, specify:

```plaintext
OUTFIL FNAME=RPT,
    HEADER2=(X/, X/, 'start of header', X/, 'next line')
```

If you don't want the ANSI carriage control characters to appear in the output data set, use the REMOVECC parameter to remove them.

- For variable-length records, the first entry in the OUTREC, BUILD or IFTHEN BUILD parameter must specify or include the unedited 4-byte record descriptor word (RDW), that is, the first field must be 1,4 or 1,m with m greater than 4. DFSORT sets the length of the reformatted record in the RDW.

  If the first field in the data portion of the input record is to appear unedited in the reformatted record immediately following the RDW, the entry in the OUTREC, BUILD, or IFTHEN BUILD parameter can specify both RDW and data field in one (1,m,...). Otherwise, the RDW must be specifically included in the reformatted record (for example, 1,4,1,4,HEX).

For variable-length OUTFIL header or trailer records, you must not specify the 4-byte RDW at the beginning of the record.

- For variable-length records, OVERLAY, IFTHEN OVERLAY or IFTHEN PUSH items must not overlay the RDW in bytes 1-4. You must ensure that 1:, 2:, 3: or 4: is not specified or defaulted for any OVERLAY or PUSH item. Note that the default for the first OVERLAY or PUSH item is 1:, so you must override it.

- With FIELDS, BUILD or IFTHEN BUILD, the variable part of the input record (that part beyond the minimum record length) can be included in the reformatted record and, if included, must be the last part. For example:

```plaintext
OUTFIL BUILD=(1,8,20C' *', 9)
```
OUTIL Control Statements

With OVERLAY, the variable part of the input record must not be included in the reformatted record.

- For variable-length records, the FIELDS or BUILD parameter of the INREC and OUTREC statement and the OUTREC or FIELDS parameter of the OUTFIL statement must all specify position-only for the last part, or all not specify position-only for the last part. OVERLAY or IFTHEN, and FIELDS, OUTREC or BUILD, can differ with respect to position-only. See "INREC Statement Notes" on page 148 for more details.

- If there are no OUTFIL input records for an OUTFIL group, the headers and trailers appear without any data records. Blanks will be used for any specified unedited input fields, and zero values will be used for any specified statistics fields.

- If a variable-length OUTFIL input record is too short to contain a specified unedited input field for a report header or trailer, blanks will be used for the missing bytes. If a variable-length OUTFIL input record is too short to contain a specified section break field or statistics field, zeros will be used for the missing bytes, intentionally or unintentionally.

- If a variable-length OUTFIL input record is too short to contain an OUTFIL INCLUDE or OMIT compare field, the action DFSORT takes depends on the settings for VLSCMP/NOVLSCMP and VLSHRT/NOVLSHRT. For details, see the discussion of the VLSCMP and NOVLSCMP options in "OPTION Control Statement" on page 173.

- If a variable-length OUTFIL input record is too short to contain an OUTFIL OUTREC or BUILD field, DFSORT will terminate unless the VLFILL=byte parameter is specified.

- If a variable-length OUTFIL input record is too short to contain an OUTFIL OVERLAY or IFTHEN field, blanks will be used for the missing bytes.

- If a variable-length OUTFIL output data record is longer than the LRECL of its OUTFIL data set, the action DFSORT takes depends on the settings for VLLONG/NOVLLONG. For details, see the discussion of the VLLONG and NOVLLONG options in "OPTION Control Statement" on page 173. Note that VLLONG can be used to truncate long OUTFIL data records, but has no effect on long OUTFIL header or trailer records.

- If an unedited page number overflows 6 digits, an edited page number overflows 15 digits, a count or running count overflows 15 digits, or a total or running total overflows 31 digits, the overflowing value will be truncated to the number of digits allowed, intentionally or unintentionally.

- Multiple OUTFIL statements can be specified in the same and different sources. If a ddname occurs more than once in the same source, the ddname is associated with the first OUTFIL group in which it appears. For example, if the following is specified in SYSIN:

  OUTFILE FAMES=(OUT1,OUT2),INCLUDE=(1,1,CH,EQ,C'A')
  OUTFILE FAMES=(OUT3,OUT1),SAVE

OUT1 and OUT2 are processed as part of the first OUTFIL group, that is, with INCLUDE. OUT3 is processed as part of the second OUTFIL group, that is, with SAVE; but OUT1 is not because it is a duplicate ddname.

If a ddname occurs in more than one source, the ddname is associated with the highest source OUTFIL group in which it appears. For example, if the following is specified in DFS Parm:

  OUTFILE FAMES=(OUT1,OUT2),INCLUDE=(1,1,CH,EQ,C'A')

and the following is specified in SYSIN:
OUTFIL Control Statements

```plaintext
OUTFIL FNames=(OUT3,OUT1),SAVE
```

OUT1 and OUT2 are processed as part of the DFSPARM OUTFIL group, that is, with INCLUDE. OUT3 is processed as part of the SYSIN OUTFIL group, that is, with SAVE; but OUT1 is not because it is an overridden ddname.

- OUTFIL statements cannot be passed to or returned from an EFS program. The D2 format cannot be specified in the INCLUDE or OMIT parameter of an OUTFIL statement.
- If SZERO is in effect, −0 is treated as negative and +0 is treated as positive for edited or converted input fields, minimums, maximums, decimal constants and the results of arithmetic expressions. If NOSZERO is in effect, −0 and +0 are treated as positive for edited or converted input fields, minimums, maximums, decimal constants, and the results of arithmetic expressions.
- If SZERO is in effect, −0 compares as less than +0 when numeric fields and constants are used. If NOSZERO is in effect, −0 compares as equal to +0 when numeric fields and constants are used.

**Note:** OPTION SZERO or OPTION NOSZERO is ignored for OUTFIL INCLUDE=(logexp) or OMIT=(logexp), or for OUTFIL IFTHEN=(WHEN=(logexp),...) unless the OPTION statement is found in a higher source (for example, DFSPARM is a higher source than SYSIN) or before the OUTFIL statement in the same source. For example, NOSZERO will be used in both of the following cases:

Case 1:
```plaintext
//DFSPARM DD *
   OPTION COPY,NOSZERO
/*
//SYSIN DD *
   OUTFIL INCLUDE=(1,2,FS,EQ,+0)
/*
```

Case 2:
```plaintext
//SYSIN DD *
   OPTION COPY,NOSZERO
   OUTFIL IFTHEN=(WHEN=(1,2,FS,EQ,+0),OVERLAY=(28:C'A')),
                WHEN=NONE,OVERLAY=(28:C'B'))
/*
```

**OUTFIL Features—Examples**

**Example 1**
```plaintext
OPTION COPY
OUTFIL INCLUDE=(15,6,CH,EQ,'MSG005'),FNames=M005
OUTFIL INCLUDE=(15,6,CH,EQ,'MSG022'),FNames=M022
OUTFIL INCLUDE=(15,6,CH,EQ,'MSG028'),FNames=M028
OUTFIL INCLUDE=(15,6,CH,EQ,'MSG115'),FNames=M115
OUTFIL SAVE,FNames=UNKNOWN
```

This example illustrates how records can be distributed to different OUTFIL data sets based on criteria you specify:

- Input records with MSG005 in bytes 15 through 20 will be written to the OUTFIL data set associated with ddname M005.
- Input records with MSG022 in bytes 15 through 20 will be written to the OUTFIL data set associated with ddname M022.
OUTFILE Control Statements

- Input records with MSG028 in bytes 15 through 20 will be written to the OUTFIL data set associated with ddname M028.
- Input records with MSG115 in bytes 15 through 20 will be written to the OUTFIL data set associated with ddname M115.
- Input records with anything else in bytes 15 through 20 will be written to the OUTFIL data set associated with ddname UNKNOWN

Example 2

```plaintext
SORT FIELDS=(18,5,ZD,D)
OUTFIL FNAMES=(V,VBU1,VBU2)
OUTFIL FNAMES=(F,FBU1),
    CONV,OUTREC=(11,3,X,18,5,X,'0000000F')
OUTFIL FNAMES=VINF,OUTREC=(1,4,C*' ',5,20,C*' ',25)
```

This example illustrates how multiple sorted output data sets can be created and how a variable-length record data set can be converted to a fixed-length record data set:
- The first OUTFIL statement writes the variable-length input records to the variable-length OUTFIL data sets associated with ddnames V, VBU1, and VBU2.
- The second OUTFIL statement reformats the variable-length input records to fixed-length output records and writes them to the fixed-length OUTFIL data sets associated with ddnames F and FBU1. CONVERT is used to indicate that a variable-length data set is to be converted to a fixed-length data set; OUTREC is used to describe how the variable-length input records are to be reformatted as fixed-length output records.
- The third OUTFIL statement reformats the variable-length input records and writes them to the variable-length OUTFIL data set associated with ddname VINF. OUTREC is used to insert asterisks between fields. 1,4 represents the RDW. 25 represents the variable part at the end of the input record.

Example 3

```plaintext
SORT FIELDS=(15,6,ZD,A)
OUTFIL FNAMES=USA,
    HEADER2=(5:'Parts Completion Report for USA',2/, 5:'Printed on ',DATE, 5:' at ',TIME=(12:),3/, 5:'Part ',20:'Completed',35:' Value ($)', 5:'-------',20:'--------',35:'---------'),
    OUTREC=(5:15,6,ZD,M11, 20:3,4,ZD,M12,LENGTH=9, 35:38,8,ZD,M18,LENGTH=12, 132:X)
OUTFIL FNAMES=FRANCE,
    HEADER2=(5:'Parts Completion Report for France',2/, 5:'Printed on ',DATE=(DM4/), 5:' at ',TIME,3/, 5:'Part ',20:'Completed',35:' Value (F)', 5:'-------',20:'--------',35:'---------'),
    OUTREC=(5:15,6,ZD,M11, 20:3,4,ZD,M16,LENGTH=9, 35:38,8,ZD,M22,LENGTH=12, 132:X)
OUTFIL FNAMES=DENMARK,
    HEADER2=(5:'Parts Completion Report for Denmark',2/, 5:'Printed on ',DATE=(DMY-), 5:' at ',TIME=(24.),3/, 5:'Part ',20:'Completed',35:' Value (kr)', 5:'-------',20:'--------',35:'---------'),
```

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This example illustrates how reports for three different countries can be produced from sorted fixed-length input records. The reports differ only in the way that date, time, and numeric formats are specified:

1. The first OUTFIL statement produces a report that has the date, time, and numeric formats commonly used in the United States.
2. The second OUTFIL statement produces a report that has the date, time, and numeric formats commonly used in France.
3. The third OUTFIL statement produces a report that has the date, time, and numeric formats commonly used in Denmark.

Of course, any one of the three reports can be produced by itself using a single OUTFIL statement instead of three OUTFIL statements. (This may be necessary if you are sorting character data according to a specified locale for that country.)

The FNAMES parameter specifies the ddname (USA, FRANCE, DENMARK) associated with the fixed-length data set for that report.

The HEADER2 parameter specifies the page header to appear at the top of each page for that report, which will consist of:

- A line of text identifying the report. Note that all English text in the report can be replaced by text in the language of that country.
- A blank line (2/).
- A line of text showing the date and time. Note that variations of the DATE, DATE=(abcd), TIME, and TIME=(abc) operands are used to specify the date and time in the format commonly used in that country.
- Two blank lines (3/).
- Two lines of text showing headings for the columns of data. Note that the appropriate currency symbol can be included in the text.

The OUTREC parameter specifies the three columns of data to appear for each input record as follows:

- A 6-byte edited numeric value produced by transforming the ZD value in bytes 15 through 20 according to the pattern specified by M11. M11 is a pattern for showing integers with leading zeros.
- A 9-byte (LENGTH=9) edited numeric value produced by transforming the ZD value in bytes 3 through 6 according to the pattern for integer values with thousands separators commonly used in that country. M12 uses a comma for the thousands separator. M16 uses a blank for the thousands separator. M13 uses a period for the thousands separator.
- A 12-byte (LENGTH=12) edited numeric value produced by transforming the ZD value in bytes 38 through 45 according to the pattern for decimal values with thousands separators and decimal separators commonly used in that country. M18 uses a comma for the thousands separator and a period for the decimal separator. M22 uses a blank for the thousands separator and a comma for the decimal separator. M19 uses a period for the thousands separator and a comma for the decimal separator.

Table 42 on page 273 shows the twenty-seven pre-defined edit masks (M0-M26) from which you can choose.
OUTFIL Control Statements

132:X is used at the end of the OUTREC parameter to ensure that the data records are longer than the report records. This will result in an LRECL of 132 for the fixed-length OUTFIL data sets (1 byte for the ANSI control character and 131 bytes for the data).

The three reports might look as follows:

<table>
<thead>
<tr>
<th>Parts Completion Report for USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Printed on 03/25/05 at 01:56:20 pm</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parts Completion Report for France</th>
</tr>
</thead>
<tbody>
<tr>
<td>Printed on 25/03/2005 at 13:56:20</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parts Completion Report for Denmark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Printed on 25-03-05 at 13.56.20</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
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</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Example 4

SORT FIELDS=(3,10,A,16,13,A),FORMAT=CH
OUTFIL FNAMES=WEST,
INCLUDE=(42,6,CH,EQ,'West'),
HEADER1=(5,18,'Western Region',3,,
18:'Profit and Loss Report',3,,
18:'for ',&DATE,3,,
18:'Page',&PAGE),
OUTREC=(6:16,13,24:31,10,ZD,M5,LENGTH=20,75:X),
SECTIONS=(3,10,SKIP=P,
HEADER3=(2:'Division: ',3,10,5X,'Page:',&PAGE,2,,
6:'Branch Office',24:' Profit/(Loss)',/,
6:--------------------------',24:'---------------------',/),
TRAILER3=(6:'=============',24:'====================',/
6:'Total',24:TOTAL=(31,10,ZD,M5,LENGTH=20),/,
6:'Lowest',24:MIN=(31,10,ZD,M5,LENGTH=20),/,
6:'Highest',24:MAX=(31,10,ZD,M5,LENGTH=20),/,
6:'Average',24:AVG=(31,10,ZD,M5,LENGTH=20),/,
3/,2:'Average for all Branch Offices so far:',
X,SUBAVG=(31,10,ZD,M5)),

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OUTFIL Control Statements

```
TRAILER1=(8:'Page ',&PAGE,5X,'Date: ',&DATE,5/, 8:'Total Number of Branch Offices Reporting: ', COUNT,2/, 8:'Summary of Profit/(Loss) for all', 12:'Western Division Branch Offices',2/, 12:'Total:', 22:TOTAL=(31,10,ZD,M5,LENGTH=20),/, 12:'Lowest:', 22:MIN=(31,10,ZD,M5,LENGTH=20),/, 12:'Highest:', 22:MAX=(31,10,ZD,M5,LENGTH=20),/, 12:'Average:', 22:AVG=(31,10,ZD,M5,LENGTH=20))
```

This example illustrates how a report can be produced with a header and trailer page and sections of columns of data, from a sorted subset of fixed-length input records.

The FNames parameter specifies the ddname (WEST) associated with the fixed-length data set for the report.

The INCLUDE parameter specifies the records to be selected for the report.

The HEADER1 parameter specifies the report header to appear as the first page of the report, which will consist of five blank lines (5/) followed by four lines of text, each separated by 2 blank lines (3/). The last two lines of text will show the date (&DATE) and page number (&PAGE), respectively.

The OUTREC parameter specifies the two columns of data to appear for each selected input record as follows:

- The character string from bytes 16 through 28 of the input record.
- A 20-byte (LENGTH=20) edited numeric value produced by transforming the ZD value in bytes 31 through 40 according to the pattern specified by M5.

The SECTIONS parameter specifies the section break field (3,10), page ejects between sections (SKIP=P), the header (HEADER3) to appear before each section and the trailer (TRAILER3) to appear after each section. The section header will consist of a line of text showing the page number, a blank line (2/) and two lines of text showing the headings for the columns of data. The section trailer will consist of a line of text separating the data from the trailer, lines of text showing the total (TOTAL), minimum (MIN), maximum (MAX) and average (AVG) for the data in the section as edited numeric values, two blank lines, and a line of text showing the running average (SUBAVG) for all of the data records in the report up to this point.

The TRAILER1 parameter specifies the report trailer to appear as the last page of the report, which will consist of a line of text showing the page and date, four blank lines (5/), a text line showing the count of data records in the report, a blank line, a line of text, a blank line, and lines of text showing the total, minimum maximum and average for all of the data in the report as edited numeric values.

75:X is used at the end of the OUTREC parameter to ensure that the data records are longer than the report records. This will result in an LRECL of 76 for the fixed-length OUTFIL data set (1 byte for the ANSI control character and 75 bytes for the data).

The report might look as follows:
## Western Region

### Profit and Loss Report

for 08/20/05

<table>
<thead>
<tr>
<th>Branch Office</th>
<th>Profit/(Loss)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gilroy</td>
<td>554,843.42</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>(22,340.14)</td>
</tr>
<tr>
<td>Morgan Hill</td>
<td>987,322.32</td>
</tr>
<tr>
<td>Oakland</td>
<td>234,124.32</td>
</tr>
<tr>
<td>San Francisco</td>
<td>(32,434.31)</td>
</tr>
<tr>
<td>San Jose</td>
<td>1,232,133.35</td>
</tr>
<tr>
<td>San Martin</td>
<td>889,022.03</td>
</tr>
</tbody>
</table>

**Total** 3,842,670.99

**Lowest** (32,434.31)

**Highest** 1,232,133.35

**Average** 548,952.99

Average for all Branch Offices so far: 548,952.99

### Division: Chips

<table>
<thead>
<tr>
<th>Branch Office</th>
<th>Profit/(Loss)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marin</td>
<td>542,341.23</td>
</tr>
<tr>
<td>Napa</td>
<td>857,342.83</td>
</tr>
<tr>
<td>San Francisco</td>
<td>922,312.45</td>
</tr>
<tr>
<td>San Jose</td>
<td>(234.55)</td>
</tr>
<tr>
<td>San Martin</td>
<td>1,003,467.30</td>
</tr>
</tbody>
</table>

**Total** 3,325,229.26

**Lowest** (234.55)

**Highest** 1,003,467.30

**Average** 665,045.85

Average for all Branch Offices so far: 597,325.02

### Division: Ice Cream

<table>
<thead>
<tr>
<th>Branch Office</th>
<th>Profit/(Loss)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marin</td>
<td>5,343,323.44</td>
</tr>
<tr>
<td>Morgan Hill</td>
<td>843,843.40</td>
</tr>
<tr>
<td>Napa</td>
<td>5,312,348.56</td>
</tr>
<tr>
<td>San Francisco</td>
<td>5,412,300.05</td>
</tr>
<tr>
<td>San Jose</td>
<td>1,234,885.34</td>
</tr>
<tr>
<td>San Martin</td>
<td>(2,343.82)</td>
</tr>
</tbody>
</table>

**Total** 18,144,356.97

**Lowest** (2,343.82)

**Highest** 5,412,300.05

**Average** 3,024,059.49

Average for all Branch Offices so far: 1,406,236.51

### Division: Pretzels

<table>
<thead>
<tr>
<th>Branch Office</th>
<th>Profit/(Loss)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marin</td>
<td>5,343,323.44</td>
</tr>
<tr>
<td>Morgan Hill</td>
<td>843,843.40</td>
</tr>
<tr>
<td>Napa</td>
<td>5,312,348.56</td>
</tr>
<tr>
<td>San Francisco</td>
<td>5,412,300.05</td>
</tr>
<tr>
<td>San Jose</td>
<td>1,234,885.34</td>
</tr>
<tr>
<td>San Martin</td>
<td>(2,343.82)</td>
</tr>
</tbody>
</table>

**Total** 18,144,356.97

**Lowest** (2,343.82)

**Highest** 5,412,300.05

**Average** 3,024,059.49

Average for all Branch Offices so far: 1,406,236.51

---

Chapter 3. Using DFSORT Program Control Statements 383
Example 5

SORT FIELDS=(6,5,CH,A)
OUTFIL FNames=STATUS,
  HEADER2=(1:C'PAGE ',&PAGE,C' OF STATUS REPORT FOR ',&DATE,2/,
    6:C'ITEM ',16:C'STATUS ',31:C'PARTS',/,
    6:C'-----',16:C'------------',31:C'-----'),
OUTREC=(1,4,
    10:6,5,
    20:14,1,CHANGE=(12,
      C'1',C'SHIP',
      C'2',C'HOLD',
      C'3',C'TRANSFER'),
    NOMATCH=C'*CHECK CODE*'),
37:39,1,BI,M10,
120:X)

This example illustrates how a report can be produced with a page header and columns of data from sorted variable-length input records, using a lookup table.

The FNames parameter specifies the ddname (STATUS) associated with the variable-length data set for the report.

The HEADER2 parameter specifies the page header to appear at the top of each page, which will consist of a line of text showing the page number (&PAGE) and date (&DATE), a blank line (2/), and two lines of text showing headings for the columns of data.

The OUTREC parameter specifies the RDW and three columns of data to appear for each input record as follows (remember that byte 5 is the first byte of data for variable-length records):

- The character string from bytes 6 through 10 of the input record
- A character string produced by finding a match for byte 14 of the input record in the table defined by CHANGE (lookup and change). NOMATCH indicates the character string to be used if byte 14 does not match any of the entries in the CHANGE table.
- An edited numeric value produced by transforming the BI value in byte 39 according to the pattern specified by M10.

With variable-length input records, you must account for the RDW when specifying the c: values for OUTREC, but not for headers or trailers. The 1: used for the first line of HEADER2 causes it to start in the first data byte (by contrast, 5: must be used to specify the first OUTREC data byte for variable-length records). Also, because 6: is used for the ITEM heading, 10: must be used for the ITEM data to get the heading and data to line up in columns.
OUTFIL Control Statements

120:X is used at the end of the OUTREC parameter to ensure that the data records are longer than the report records. This will result in a maximum LRECL of 121 for the variable-length OUTFIL data set (1 byte for the ANSI control character and a maximum of 120 bytes for the data).

The first page of the printed report might start as follows:

```
PAGE 1 OF STATUS REPORT FOR 07/18/05

<table>
<thead>
<tr>
<th>ITEM</th>
<th>STATUS</th>
<th>PARTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>-----</td>
<td>--------</td>
<td>-------</td>
</tr>
<tr>
<td>00082</td>
<td>HOLD</td>
<td>36</td>
</tr>
<tr>
<td>00123</td>
<td>SHIP</td>
<td>106</td>
</tr>
<tr>
<td>00300</td>
<td><em>CHECK CODE</em></td>
<td>95</td>
</tr>
<tr>
<td>10321</td>
<td>TRANSFER</td>
<td>18</td>
</tr>
<tr>
<td>12140</td>
<td>SHIP</td>
<td>120</td>
</tr>
</tbody>
</table>
```

Example 6

```
OPTION COPY
OUTFIL FNAMES=(A1,A2,A3),SPLIT
OUTFIL FNAMES=(B1,B2,B3),SPLITBY=25
OUTFIL FNAMES=(C1,C2,C3),SPLIT1R=25
```

This example illustrates different ways to split 77 input records among three OUTFIL data sets.

The first OUTFIL statement uses SPLIT to rotate the records among the three OUTFIL data sets one record at a time. A1 will have records 1, 4, ...,76. A2 will have records 2, 5, ...,77. A3 will have records 3, 6, ...,75. A1 will have 26 records. A2 will have 26 records. A3 will have 25 records. A1, A2 and A3 will each have non-contiguous records.

The second OUTFIL statement uses SPLITBY=25 to rotate the records among the three OUTFIL data sets 25 records at a time. B1 will have records 1-25 and 76-77. B2 will have records 26-50. B3 will have records 51-75. B1 will have 27 records. B2 will have 25 records. B3 will have 25 records. B1 will have non-contiguous records. B2 and B3 will have contiguous records.

The third OUTFIL statement uses SPLIT1R=25 to rotate the records once among the three OUTFIL data sets 25 records at a time. C1 will have records 1-25. C2 will have records 26-50. C3 will have records 51-77. C1 will have 25 records. C2 will have 25 records. C3 will have 27 records. C1, C2 and C3 will have contiguous records.

Example 7

```
OPTION COPY
OUTFIL FNAMES=RANGE1,ENDREC=1000000
OUTFIL FNAMES=RANGE2,STARTREC=1000001,ENDREC=2000000
OUTFIL FNAMES=RANGE3,STARTREC=2000001,ENDREC=3000000
OUTFIL FNAMES=RANGE4,STARTREC=3000001,ENDREC=4000000
OUTFIL FNAMES=(RANGE5,EXTRA),STARTREC=4000001
```

This example illustrates how specific ranges of output records can be written to different output data sets. A typical application might be database partitioning.

The first 1 million records will be written to the data set associated with RANGE1, the second million to RANGE2, the third million to RANGE3, and the fourth million to RANGE4. The remaining records will be written to both the data set
associated with RANGE5 and the data set associated with EXTRA (SAVE or STARTREC=4000001 will accomplish the same purpose in this case).

Note that the INCLUDE, OMIT, and SAVE parameters of OUTFIL can also be used to select records to be written to different output data sets, based on criteria you specify.

**Example 8**

```
OPTION COPY,Y2PAST
OUTFIL FNAMES=Y4,
    OUTREC=(1,19,
        21,2,P00,M11,C'/', transform mm
        22,2,P00,M11,C'/', transform dd
        20,2,Y2P, transform yy to yyyy
        24,57)
```

This example illustrates how to transform an existing data set with a packed decimal date field of the form P'yymmdd' (X'0yymmddC') in bytes 20-23 into a new data set with a character date field of the form C'mm/dd/yyyy' in bytes 20-29. yy represents the two-digit year, yyyy represents the four-digit year, mm represents the month, dd represents the day, and C represents a positive sign.

The input data set has an LRECL of 80 and the Y4 data set will have an LRECL of 86.

The Y2PAST=26 option sets the century window to be used to transform two-digit years into four-digit years. If the current year is 2006, the century window will be 1980 to 2079. Using this century window, the input and output fields might be as follows:

<table>
<thead>
<tr>
<th>Input Field (HEX)</th>
<th>Output Field (CH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>0020505F</td>
<td>05/05/2002</td>
</tr>
<tr>
<td>0950823C</td>
<td>08/23/1995</td>
</tr>
<tr>
<td>0980316C</td>
<td>03/16/1998</td>
</tr>
<tr>
<td>0000316F</td>
<td>03/16/2000</td>
</tr>
</tbody>
</table>

**Example 9**

```
OPTION COPY,Y2PAST=1996
OUTFIL FNAMES=SPCL,
    OUTREC=(1,14, copy positions 1-14
        15,6,Y2T, transform yy to yyyy - allow blanks
        21,20) copy positions 21 - 40
```

This example illustrates how to transform an existing data set with a character date field of the form C'yymmdd' and blank special indicators in bytes 15-20, into a new data set with a character date field of the form C'yyymmdd' and blank special indicators in bytes 15-22.

The input data set has an LRECL of 40 and the SPCL data set will have an LRECL of 42.

The Y2PAST=1996 option sets the century window to 1996-2095. The century window will be used to transform the two-digit years into four-digit years, but will not be used for the special blank indicators.

The input records might be as follows:
MORGAN HILL CA
SAN JOSE 960512 CA
BOCA RATON 000628 FL
DENVER 951115 CO

The output records would be as follows:
MORGAN HILL CA
SAN JOSE 19960512 CA
BOCA RATON 20000628 FL
DENVER 20951115 CO

Example 10
OPTION COPY
OUTFIL FNames=ALL,OUTREC=(C'US ','1,10,C' is in ','11,15,/, 
C'WW ','1,10,C' is in ','26,20,2/)
OUTFIL FNames=(US,WW),SPLIT,
OUTREC=(1,10,C' is in ','11,15,/, 
1,10,C' is in ','26,20)

This example illustrates how multiple OUTFIL output and blank records can be produced from each OUTFIL input record. The input data set has an LRECL of 50 and contains the following three records:
Finance San Francisco Buenos Aires
Research New York Amsterdam
Marketing Los Angeles Mexico City

The first OUTFIL statement creates the data set associated with ddname ALL. This data set will have an LRECL of 40 (the length of the longest output record; the one that includes the 26,20 input field). Each input record will result in two data records followed by two blank records as follows:

ALL data set
US Finance is in San Francisco
WW Finance is in Buenos Aires

US Research is in New York
WW Research is in Amsterdam

US Marketing is in Los Angeles
WW Marketing is in Mexico City

The second OUTFIL statement creates the two data sets associated with ddnames US andWW. These data sets will have an LRECL of 37 (the length of the longest output record; the one that includes the 26,20 input field). Each input record will result in two data records. SPLIT will cause the first data record to be written to the US data set and the second data record to be written to the WW data set. Thus, each input record will create one record in each OUTFIL data set as follows:

US data set
Finance is in San Francisco
Research is in New York
Marketing is in Los Angeles

WW data set
Finance is in Buenos Aires
Research is in Amsterdam
Marketing is in Mexico City
OUTFIL Control Statements

Example 11

SORT FIELDS=(6,3,CH,D)
OUTFIL FNAMES=SET60,BUILD=(1,60),VLFILL=C'
OUTFIL FNAMES=VARFIX,VTOF,BUILD=(5,20,5X,28,20),VLFILL=C'*'

This example illustrates how variable-length records that are too short to contain all OUTFIL BUILD fields can be processed successfully.

The input data set has RECFM=VB and LRECL=80. The records in this data set have lengths that vary from 15 bytes to 75 bytes.

The first OUTFIL statement creates the data set associated with ddname SET60. This data set will have RECFM=VB and LRECL=60. Every record in this data set will have a length of 60. The 1,60 field truncates records longer than 60 bytes to 60 bytes. Because VLFILL=C' ' is specified, the 1,60 field pads records shorter than 60 bytes to 60 bytes using a blank (C' ') as the fill byte.

Note: Without VLFILL=byte, this OUTFIL statement would terminate with an ICE218A message because some of the input records are too short to contain the BUILD field.

The second OUTFIL statement creates the data set associated with ddname VARFIX. This data set will have RECFM=FB and LRECL=45. VTOF changes the variable-length input records to fixed-length output records according to the fields specified by BUILD. VLFILL=C'*' allows short input records to be processed. Each missing byte in an OUTFIL BUILD field is replaced with an asterisk (C'*') fill byte.

Notes:
1. CONVERT can be used instead of VTOF.
2. VLFILL=C'*' overrides the default of VLFILL=X'40' for VTOF or CONVERT.

Example 12

OPTION COPY
OUTFIL OUTREC=(SEQNUM,4,BI,Z,8,5,ZD,TO=PD,Z,31,2,PD,TO=FI,LENGTH=2),Z,16,3,ZD,ADD,+1,TO=FI,LENGTH=2,Z,(16,3,ZD,MUL,+2,TO=ZD,LENGTH=4)

This example illustrates how a sequence number can be generated, how values in one numeric format can be converted to another numeric format, and how arithmetic expressions involving fields and decimal constants can be used.

The input data set has an LRECL of 50 and the SORTOUT data set will have an LRECL of 19.

The OUTFIL statement creates output records with the following fields:
- A binary sequence number in bytes 1-4 that starts at 1 and increments by 1.
- X'00' in byte 5.
- A PD field in bytes 6-8 containing the converted ZD field from input bytes 8-12
- X'00' in position 9.
- An FI field in bytes 10-11 containing the converted PD field from input bytes 31-32.
- X'00' in position 12.
- An FI field in bytes 13-14 containing the converted result of the ZD field from input bytes 16-18 incremented by 1.
• X'00' in position 15.
• A ZD field in bytes 16-19 containing the converted result of the maximum of the
  ZD field from input bytes 16-18 and the PD field from input bytes 31-32,
  multiplied by 2.

Example 13

SORT FIELDS=COPY
OUTFIL FNAMES=VAROUT1,FTOV
OUTFIL FNAMES=VAROUT2,FTOV,
  OUTREC=(20,8,35,10),
OUTFIL FNAMES=VAROUT3,FTOV,VLTRIM=X'40'

This example illustrates several ways to convert a fixed-length record data set to a
variable-length record data set using the FTOV parameter of OUTFIL.

The input data set has an RECFM=FB and LRECL=60.
• The first OUTFIL statement converts the fixed-length input data set to a
  variable-length OUTFIL data set associated with ddname VAROUT1. VAROUT1
  will have RECFM=VB and LRECL=64. All of its records will be 64 bytes long
  (4-byte RDW plus 60-byte input record).
• The second OUTFIL statement converts the fixed-length input data set to a
  variable-length OUTFIL data set associated with ddname VAROUT2. OUTREC is
  used to select two input fields for the output records, bytes 20-27 and bytes
  35-44. VAROUT2 will have RECFM=VB and LRECL=22. All of its records will be
  22 bytes long (4-byte RDW plus 8-byte input field plus 10-byte input field).
• The third OUTFIL statement converts the fixed-length input data set to a
  variable-length OUTFIL data set associated with ddname VAROUT3. VAROUT3
  will have RECFM=VB and LRECL=64. VLTRIM=X'40' is used to remove the
  trailing blanks from the variable-length output records. The records can vary
  from 5 bytes long to 64 bytes long depending on the number of trailing blanks
  in each record.

Example 14

OPTION COPY
OUTFIL FNAMES=OUT1,OUTREC=(DATE1(/),X,TIME1(:),X,1,80)
OUTFIL FNAMES=OUT2,OUTREC=(DATE2P,TIME3P,1,80)
OUTFIL FNAMES=OUT3,OUTREC=(DATE3(.),X,TIME2,X,1,80)

This example illustrates several different ways to insert timestamps into your
records.

The input data set has RECFM=FB and LRECL=80.

The first OUTFIL statement creates the data set associated with ddname OUT1.
This data set will have LRECL=100. Each output record will have a timestamp
consisting of the date and time of the run in the form C'yyyy/mm/dd hh:mm:ss '
(20 bytes), followed by the original input record (80 bytes).

The second OUTFIL statement creates the data set associated with ddname OUT2.
This data set will have LRECL=86. Each output record will have a timestamp
consisting of the date of the run in the form P'yyyymm' (4 bytes) and the time of
the run in the form P'hh' (2 bytes), followed by the original input record (80 bytes).

The third OUTFIL statement creates the data set associated with ddname OUT3.
This data set will have LRECL=94. Each output record will have a timestamp
OUTFIT Control Statements

consisting of the date and time of the run in the form C'yyyy.ddd hhmm' (14 bytes), followed by the original input record (80 bytes).

Example 15

```plaintext
OPTION COPY
OUTREC FIELDS=(1,4,11,4,DT1,7,4,TM1,60:X)
OUTFIT NODetail,
TRAILER1=(//, 3:'Earliest SMF timestamp is ',
  MIN=(5,14,ZD,EDIT=('TTTT/TT/TT TT:TT:TT'))/, 3:'Latest SMF timestamp is ',
  MAX=(5,14,ZD,EDIT=('TTTT/TT/TT TT:TT:TT')))"
```

This example illustrates how the earliest and latest timestamps from a set of SMF records can be displayed.

The OUTREC statement uses the DT1 format to convert the SMF date in input bytes 11-15 to a Z'yyyymmdd' value in bytes 5-12, and uses the TM1 format to convert the SMF time in input bytes 7-10 to a Z'hhmmss' value in bytes 13-18.

The OUTFIL statement uses the Z'yyyymmddhhmmss' value created by OUTREC in bytes 5-18 to determine the minimum (earliest) and maximum (latest) timestamp, and displays those timestamps in a trailer record in the form C'yyyy/mm/dd hh:mm:ss'.

The report might look as follows:

```
Earliest SMF timestamp is 2001/01/09 10:27:04
Latest SMF timestamp is 2001/04/24 06:13:22
```

Example 16

```plaintext
SORT FIELDS=(1,20,B1,A)
OUTFIT FNAMES=FUPPER,OUTREC=(1,80,TRAN=LTOU)
OUTFIT FNAMES=FHEX,OUTREC=(1,80,HEX)
```

This example illustrates two types of conversion for fixed length records: lowercase to uppercase conversion and hex conversion.

The input data set has RECFM = FB and LRECL = 80.

The first OUTFIL statement creates the data set associated with ddname FUPPER. This data set will have RECFM = FB and LRECL = 80. All of the lowercase EBCDIC characters (a-z) from byte 1 to byte 80 will be converted to uppercase EBCDIC characters (A-Z). Other characters will remain unchanged. For example, the characters ‘san jose, ca 95193’ will be converted to ‘SAN JOSE, CA 95193’.

The second OUTFIL statement creates the data set associated with ddname FHEX. This data set will have RECFM = FB and LRECL = 160 (2 * 80 data bytes). Each byte from 1 to 80 will be converted to the two bytes representing its hex value. For example, the three characters ‘A12’ will be converted to the six characters ‘C1F1F2’.

Example 17

```plaintext
OPTION COPY
OUTFIT FNAMES=VUPPER,OUTREC=(1,4,5,TRAN=UTOL)
OUTFIT FNAMES=VHEX,OUTREC=(1,4,5,HEX)
```

This example illustrates two types of conversion for variable-length records: uppercase to lowercase conversion and hex conversion.
OUTFIL Control Statements

The input data set has RECFM = VB and LRECL = 5000.

The first OUTFIL statement creates the data set associated with ddname VUPPER. This data set will have RECFM = VB and LRECL = 5000. All of the uppercase EBCDIC characters (A-Z) from bytes 5 (after the RDW) to the end of each record will be converted to lowercase EBCDIC characters (a-z). Other characters will remain unchanged. For example, the characters 'SAN JOSE, CA 95193' will be converted to 'san jose, ca 95193'.

The second OUTFIL statement creates the data set associated with ddname VHEX. This data set will have RECFM = VB and LRECL = 9996 (4 for RDW plus 2 * 4996 data bytes). Each byte from 5 (after the RDW) to the end of each record will be converted to the two bytes representing its hex value. For example, the three characters 'A12' will be converted to the six characters 'C1F1F2'.

**Example 18**

```
SORT FIELDS=(22,8,CH,A)
OUTFIL FNAMES=SAMP1,REMOVECC,HEADER1=('Sample 1',2/),
     STARTREC=120,SAMPLE=(20,4),
     OUTREC=(1,8,9,5,PD,ZD,C'***',14,50)
OUTFIL FNAMES=SAMP2,REMOVECC,HEADER1=('Sample 2',2/),
     SAMPLE=1000,ENDREC=5001
```

This example illustrates how to take different "samples" of sorted output records. Sorted records 120, 121, 122, 123, 140, 141, 142, 143, and so on will be reformatted as indicated by the OUTREC parameter and written to the output data set associated with SAMP1. The heading 'Sample 1' will appear before the sample output records.

Sorted records 1, 1001, 2001, 3001, 4001 and 5001 will be written to the output data set associated with SAMP2. The heading 'Sample 2' will appear before the sample output records.

**Example 19**

```
OPTION COPY
OUTFIL FNAMES=R500,REPEAT=500
OUTFIL FNAMES=R100,OUTREC=(SEQNUM,4,ZD,80X'FF'),REPEAT=100
```

This example illustrates how one record can be used to generate many records.

The first OUTFIL statement writes each output record 500 times to the data set associated with R500. Each set of 500 records will be identical.

The second OUTFIL statement writes each reformatted output record 100 times to the data set associated with R100. Each set of 100 records will be identical except for the sequence number. The 100 records written from the first output record will have sequence numbers 1-100, the 100 records written from the second output record will have sequence numbers 101-200, and so on.

**Example 20**

```
OPTION COPY
OUTFIL OMIT=(56,6,CH,EQ,C'******'),
OVERLAY=(121:SEQNUM,8,ZD,56:56,6,TRAN=UTOL)
```

This example illustrates how you can use the OVERLAY parameter with OUTFIL to add sequence numbers at the end of your records, and to convert uppercase EBCDIC characters to lowercase EBCDIC characters in certain columns, without affecting the rest of the record.
OUTFIL Control Statements

The input data set has RECFM=FB and LRECL=120. The output data set will have RECFM=FB and LRECL=128.

The OMIT parameter removes records which have asterisks in positions 56-61.

121:SEQNUM,8,ZD in the OVERLAY parameter adds an 8-byte sequence number in positions 121-128 of every record. The LRECL is increased from 120 to 128 to hold the sequence number.

56:56,6,TRAN=UTOL in the OVERLAY parameter converts uppercase EBCDIC characters in positions 56-61 to lowercase EBCDIC characters in positions 56-61.

Only the two overlaid fields are changed; all of the other data in the records is unaffected.

Example 21

```
OPTION COPY
OUTFIL FNAMES=RPT1,
  HEADER2=(1:'Type',9:'Date',21:'Time',/,
  1:'-----',9:'--------',21:'-------'),
  IFTHEN=(WHEN=(5,2,BI,EQ,X'0001'),
  BUILD=(1,4,5:5,2,BI,M11,LENGTH=4,
  13:8,4,DT1,25:15:4,TM1)),
  IFTHEN=(WHEN=(5,2,BI,EQ,X'0002'),
  BUILD=(1,4,5:5,2,BI,M11,LENGTH=4,
  13:12,8,DC1,25:12:8,TC1)),
  IFTHEN=(WHEN=(5,2,BI,EQ,X'0003'),
  BUILD=(1,4,5:5,2,BI,M11,LENGTH=4,
  13:17,8,DE1,25:17:8,TE1)),
  IFTHEN=(WHEN=NONE,
  BUILD=(1,4,5:5,2,BI,M11,LENGTH=4,
  13:C'n/a',25:C'n/a'))

OUTFIL FNAMES=RPT2,
  HEADER2=(1:'Type',9:'Date',21:'Time',/,
  1:'-----',9:'--------',21:'-------'),
  IFTHEN=(WHEN=(5,2,BI,EQ,X'0001'),
  BUILD=(1,4,5:5,2,BI,M11,LENGTH=4,
  13:8,4,DT3,25:15:4,TM4)),
  IFTHEN=(WHEN=(5,2,BI,EQ,X'0002'),
  BUILD=(1,4,5:5,2,BI,M11,LENGTH=4,
  13:12,8,DC3,25:12:8,TC4)),
  IFTHEN=(WHEN=(5,2,BI,EQ,X'0003'),
  BUILD=(1,4,5:5,2,BI,M11,LENGTH=4,
  13:17,8,DE3,25:17:8,TE4)),
  IFTHEN=(WHEN=NONE,
  BUILD=(1,4,5:5,2,BI,M11,LENGTH=4,
  13:C'n/a',25:C'n/a'))
```

This example illustrates how you can use IFTHEN clauses to reformat different records in different ways.

The input data set has RECFM=VB and consists of several different types of input records as follows:

- **Type1**: Has X'0001' in positions 5-6, a 4-byte SMF date in positions 8-11 and a 4-byte SMF time in positions 15-18.
- **Type2**: Has X'0002' in positions 5-6 and an 8-byte TOD date and time in positions 12–19.
- **Type3**: Has X'0003' in positions 5-6 and an 8-byte ETOD date and time in positions 17–24.
OUTFIL Control Statements

- Other types: Do not have X'0001', X'0002' or X'0003' in positions 5-6, and do not have a date or time value.

The first OUTFIL statement produces a report with RECFM=VBA and LRECL=31 that might look like this:

<table>
<thead>
<tr>
<th>Type</th>
<th>Date</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>0001</td>
<td>20040827</td>
<td>124531</td>
</tr>
<tr>
<td>0003</td>
<td>20040907</td>
<td>230603</td>
</tr>
<tr>
<td>0008</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>0002</td>
<td>20040901</td>
<td>061559</td>
</tr>
<tr>
<td>0001</td>
<td>20040731</td>
<td>152201</td>
</tr>
<tr>
<td>0004</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

The first IFTHEN clause operates only against Type1 records; it converts the SMF date using DT1 and the SMF time using TM1. The second IFTHEN clause only operates against Type2 records; it converts the TOD date using DC1 and the TOD time using TC1. The third IFTHEN clause only operates against Type3 records; it converts the ETOD date using DE1 and the ETOD time using TE1. The fourth IFTHEN clause operates against all other types of records; it uses 'n/a' for the date and time.

The second OUTFIL statement produces a report with RECFM=VBA and LRECL=33 that looks like this:

<table>
<thead>
<tr>
<th>Type</th>
<th>Date</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>0001</td>
<td>200420</td>
<td>12453184</td>
</tr>
<tr>
<td>0003</td>
<td>200425</td>
<td>23060373</td>
</tr>
<tr>
<td>0008</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>0002</td>
<td>200425</td>
<td>06155903</td>
</tr>
<tr>
<td>0001</td>
<td>200421</td>
<td>15220150</td>
</tr>
<tr>
<td>0004</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

The first IFTHEN clause operates only against Type1 records; it converts the SMF date using DT3 and the SMF time using TM4. The second IFTHEN clause operates only against Type2 records; it converts the TOD date using DC3 and the TOD time using TC4. The third IFTHEN clause operates only against Type3 records; it converts the ETOD date using DE3 and the ETOD time using TE4. The fourth IFTHEN clause operates against all other types of records; it uses 'n/a' for the date and time.

Example 22

OPTION COPY
OUTFIL BUILD=(1,80,SQZ=(SHIFT=LEFT,PAIR=APOST,MID=C','))

This example illustrates how you can create FB output records with comma separated values from FB input records containing fields in fixed positions.

The 80-byte FB input records might look like this:

- 'John Lewis' -12.83 'Research'
- 'Ted Blank' +128.37 'Manufacturing'
- 'Marilyn Carlson' -282.83 'Technical Support'
- 'Rex Otis' +2.83 'Marketing'

Note that the data has three fields in fixed positions. The first field is a character string surrounded by apostrophes. The second field is a numeric value. The third field is another character string surrounded by apostrophes.
The 80-byte FB output records are in the form of comma separated values as follows:

'John Lewis',-12.83,'Research'
'Ted Blank',+128.37,'Manufacturing'
'Marilyn Carlson',-282.83,'Technical Support'
'Rex Otis',+2.83,'Marketing'

We use OUTFIL BUILD to build the output records with comma separated values. We use SQZ to squeeze out the blanks between the fields, shift the remaining characters to the left and insert commas between the fields. SHIFT=LEFT shifts the characters to the left. PAIR=APOST ensures that blanks within paired apostrophes are not squeezed out (for example, we want to keep the blank in the 'John Lewis' field.) MID=C',' inserts a comma for each group of blanks removed between the fields (for example, between 'John Lewis' and -12.83).

**Example 23**

```
OPTION COPY
OUTFIL IFTHEN=(WHEN=INIT,
   OVERLAY=(5:5,18,JFY=(SHIFT=LEFT,LEAD=C''',TRAIL=C'''),
   34:34,19,JFY=(SHIFT=LEFT,LEAD=C''',TRAIL=C'''))),
   IFTHEN=(WHEN=INIT,
   BUILD=(1,4,5,60,SQZ=(SHIFT=LEFT,PAIR=APOST,MID=C',')),
   VLTRIM=C ''
```

This example illustrates how you can create VB output records with comma separated values from VB input records containing fields in fixed positions.

The 84-byte VB input records might look like this (4-byte RDW followed by data):

<table>
<thead>
<tr>
<th>Length</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>John Lewis</td>
</tr>
<tr>
<td>50</td>
<td>Ted Blank</td>
</tr>
<tr>
<td>54</td>
<td>Marilyn Carlson</td>
</tr>
<tr>
<td>51</td>
<td>Rex Otis</td>
</tr>
</tbody>
</table>

Note that the data has three fields in fixed positions. The first field is a character string. The second field is a numeric value. The third field is another character string. (In the previous example, the character strings were surrounded by apostrophes; in this example the apostrophes must be added around the character strings.)

The 84-byte VB output records are in the form of comma separated values as follows:

<table>
<thead>
<tr>
<th>Length</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>34</td>
<td>'John Lewis',-12.83,'Research'</td>
</tr>
<tr>
<td>39</td>
<td>'Ted Blank',+128.37,'Manufacturing'</td>
</tr>
<tr>
<td>49</td>
<td>'Marilyn Carlson',-282.83,'Technical Support'</td>
</tr>
<tr>
<td>32</td>
<td>'Rex Otis',+2.83,'Marketing'</td>
</tr>
</tbody>
</table>

We use OUTFIL IFTHEN to ensure that short records are padded on the right with blanks. (OUTFIL BUILD would terminate due to the short records.) WHEN=INIT reformats every record. OVERLAY surrounds the character strings with apostrophes. BUILD builds the output records with comma separated values.

We use JFY to surround the character strings with apostrophes without removing embedded blanks (for example, John Lewis is changed to 'John Lewis'). After the first IFTHEN, the records look like this:
We then use SQZ to squeeze out the blanks between the fields, shift the remaining characters to the left and insert commas between the fields. SHIFT=LEFT shifts the characters to the left. PAIR=APOST ensures that blanks within paired apostrophes are not squeezed out (for example, we want to keep the blank in the 'John Lewis' field.) MID=C', inserts a comma for each group of blanks removed between the fields (for example, between 'John Lewis' and -12.83).

Finally, we use VLRTIM=C' ' to remove trailing blanks at the end of each VB record by adjusting its length appropriately.

**Example 24**

```
OPTION COPY
OUTFIL REMOVECC,
  HEADER1=(C'<?xml version="1.0"?>',/,,
     3:C'<!booklist>'),
  BUILD=(5:C'<book>','/,,
     7:1,20,JFY=(SHIFT=LEFT,LEAD=C'<title>',TRAIL=C'</title>',
       LENGTH=36),/,,
     7:24,15,SQZ=(SHIFT=LEFT,LEAD=C'<author>',MID=C',',
       TRAIL=C'</author>',LENGTH=33),/,,
     5:C'</book>'),
  TRAILER1=(3:C'</booklist>')
```

This example illustrates how you can generate XML statements from FB input records containing fields in fixed positions.

The 40-byte FB input records might look like this:

<table>
<thead>
<tr>
<th>Modern Poetry</th>
<th>Friedman</th>
<th>KR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intro to Computers</td>
<td>Chatterjee</td>
<td>CL</td>
</tr>
<tr>
<td>Marketing</td>
<td>Maxwell</td>
<td>G</td>
</tr>
</tbody>
</table>

Note that the data has three character fields in fixed positions.

The 42-byte FB output records look like this:

```
<?xml version="1.0"?>
<booklist>
  <book>
    <title>Modern Poetry</title>
    <author>Friedman, KR</author>
  </book>
  <book>
    <title>Intro to Computers</title>
    <author>Chatterjee, CL</author>
  </book>
  <book>
    <title>Marketing</title>
    <author>Maxwell, G</author>
  </book>
</booklist>
```

We use OUTFIL HEADER1 to generate the xml and booklist starting tags that precede the set of tags for each record. We use OUTFIL BUILD to generate the set of tags for each record as follows:

- A constant is used to generate the book starting tag,
OUTFIL Control Statements

- JFY is used to generate the title tags and data from the first input field. LEAD generates the title starting tag before the input field from the record. TRAIL generates the title ending tag after the last nonblank character from the input field. JFY keeps embedded blanks between the first nonblank character and the last nonblank character of the input field. LENGTH ensures that the addition of the LEAD and TRAIL strings does not cause truncation by increasing the output length to 36 bytes (overriding the default of 20 bytes from the input field).

- SQZ is used to generate the author tags and data from the second and third input fields. LEAD generates the author starting tag before the input field from the record. MID replaces the blanks between the second and third input fields with a comma and one blank. TRAIL generates the author ending tag after the last nonblank character from the input fields. LENGTH ensures that the addition of the LEAD, MID and TRAIL strings does not cause truncation by increasing the output length to 33 bytes (overriding the default of 15 bytes from the input field).

We use OUTFIL TRAILER1 to generate the booklist ending tag that follows the set of tags for each record.

Example 25

OPTION COPY
OUTFIL HEADER2=(1:'First',13:'Initial',22:'Last',37:'Score',/,
1:10'-'1,13:7'-'2,22:11'-'3,35:7'-'4),
PARSE=(%00=(STARTAFT=C'LAST-> ',ENDBEFR=C' ',FIXLEN=11),
%01=(STARTAFT=C'FIRST-> ',ENDBEFR=C' ',FIXLEN=11),
%02=(STARTAFT=C'INITIAL-> ',ENDBEFR=C' ',FIXLEN=7),
%03=(STARTAFT=C'SCORE-> ',FIXLEN=7)),
BUILD=(1:%01,13:%02,22:%00,
35:%03,SFF,EDIT=(SIIIT.T),SIGNS=(,-))

This example illustrates how you can create a report from FB input records with variable position/length fields, such as keyword delimited values.

The 70-byte input records might look like this:

LAST-> Clark FIRST-> Oscar INITIAL-> D SCORE-> +98.2
LAST-> Roberts FIRST-> Harriet INITIAL-> V SCORE-> -152.6
LAST-> Stein FIRST-> Gertrude INITIAL-> V SCORE-> +5.1

Note that each record has four variable fields each identified by a specific keyword. The fields do not start and end in the same position in every record and they have different lengths in different records.

The output report has RECFM=FBA and LRECL=42 and looks like this:

<table>
<thead>
<tr>
<th>First</th>
<th>Initial</th>
<th>Last</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oscar</td>
<td>D</td>
<td>Clark</td>
<td>98.2</td>
</tr>
<tr>
<td>Harriet</td>
<td>Roberts</td>
<td></td>
<td>-152.6</td>
</tr>
<tr>
<td>Gertrude</td>
<td>V</td>
<td>Stein</td>
<td>5.1</td>
</tr>
</tbody>
</table>

In order to create a report like this from variable position/length fields, we use HEADER2 to create the page header, and PARSE and BUILD to create a fixed parsed field from each variable field. We use %00 to create an 11-byte fixed parsed field with the extracted 'LAST-> ' value. We use %01 to create an 11-byte fixed parsed field with the extracted 'FIRST-> ' value. We use %02 to create a 7-byte fixed parsed field with the extracted 'INITIAL-> ' value. We use %03 to create a 7-byte fixed parsed field with the extracted 'SCORE-> ' value. Since the fourth field (%03) is extracted as signed and padded on the right with blanks, we treat it as SFF format in order to edit it.
Example 26

INREC IFTHEN=(WHEN=INIT,
   PARSE=(%1=(FIXLEN=10,STARTAFT=C'First='",ENDBEFR=C''))),
IFTHEN=(WHEN=INIT,
   PARSE=(%2=(FIXLEN=10,STARTAFT=C'Middle='",ENDBEFR=C''))),
IFTHEN=(WHEN=INIT,
   PARSE=(%3=(FIXLEN=10,STARTAFT=C'Last='",ENDBEFR=C''))),
IFTHEN=(WHEN=INIT,
   PARSE=(%4=(FIXLEN=10,STARTAFT=C'Wife='",ENDBEFR=C''))),
BUILD=(%1,13:%2,25:%3,37:%4))

SORT FIELDS=(25,10,CH,A,1,10,CH,A,13,10,CH,A)
OUTFIL HEADER2=('First',13:'Middle',
   25:'Last',{',10C'-',13:10C'-',
   25:10C'-',37:10C'-'})

This example illustrates how you can create a sorted report from FB input records
with keyword values that can occur in any order or not occur at all.

The 80-byte input records might look like this:

Last="Buchanan" First="James"
Wife="Louisa" First="John" Middle="Quincy" Last="Adams"
First="George" Last="Washington" Wife="Martha"
Last="Clinton" Wife="Hillary" Middle="Jefferson" First="William"
First="John" Wife="Abigail" Last="Adams"

Note that each record has up to four variable fields each identified by a specific
keyword (First, Middle, Last, Wife). In each record, the fields can be in any order,
do not start and end in the same position and can have different lengths.

We want to sort the records by last name, first name and middle name, and create
a report with fixed headings and values for the first name, middle name, last name
and wife’s name that looks like this:

First       Middle      Last       Wife
----------   ----------   ----------
John        Adams       Abigail
John        Quincy      Adams       Louisa
James       Buchanan
William      Jefferson   Clinton     Hillary
George       Washington  Martha

In order to extract and sort variable fields like these, we use a separate IFTHEN
PARSE clause for each keyword. This allows us to find a particular keyword
anywhere in the record or ignore it if it is not in the record. If we used PARSE
instead of IFTHEN PARSE, a missing keyword would cause any keywords that
followed to be ignored. But because each IFTHEN PARSE starts scanning at
position 1 by default, we can look for each keyword independently of the others. If
a keyword is missing, the parsed field is set to all blanks (for example, %2 and %4
are set to blanks for the James Buchanan record).

We use %1 to create a 10-byte fixed parsed field into which we extract the first
name. We use %2 to create a 10-byte fixed parsed field into which we extract the
middle name. We use %3 to create a 10-byte fixed parsed field into which we
extract the last name. We use %4 to create a 10-byte fixed parsed field into which
we extract the wife’s name. We use BUILD to reformat the records to contain the
fixed parsed fields. Then we SORT on the fixed parsed fields. Finally, we use
OUTFIL to create the headings.
OUTFIL Control Statements

Example 27

```
OPTION COPY
OUTFIL FINDREP=('INOUT=('C'AM',C'IN THE MORNING',
  C'PM',C'IN THE EVENING'),MAXLEN=70)
```

This example illustrates how you can replace values in FB or VB records with larger values and shift the rest of the bytes to the right.

The 40 byte FB input records might look like this:

```
COFFEE AT 12:28 AM, TOAST AT 06:15 PM
MILK AT 03:17 PM, BAGELS AT 05:03 PM
PUDDING AT 09:32 AM
```

We want to replace each instance of 'AM' with 'IN THE MORNING' and each instance of 'PM' with 'IN THE EVENING' and shift the bytes after 'AM' or 'PM' to the right. We use INOUT to indicate find and replace pairs. Since replacing the smaller values with the larger values can cause the remaining bytes to be shifted beyond the end of the 40 byte record, we use MAXLEN to set the output record to 70 bytes to allow for the expansion, overriding the default of using the input length for the output record.

The 70 byte FB output records look like this:

```
COFFEE AT 12:28 IN THE MORNING, TOAST AT 06:15 IN THE EVENING
MILK AT 03:17 IN THE EVENING, BAGELS AT 05:03 IN THE EVENING
PUDDING AT 09:32 IN THE MORNING
```

Example 28

```
OPTION COPY
OUTREC IFTHEN=(WHEN=INIT,BUILD=(1,4,8:5)),
  IFTHEN=(WHEN=GROUP,BEGIN=(8,5,CH,EQ,C'PAGE:'),
    PUSH=(5:SEQ=3))
OUTFIL INCLUDE=(5,3,ZD,EQ,2,OR,5,3,ZD,EQ,3),
  BUILD=(1,4,5:8)
```

This example illustrates how you can INCLUDE specific relative records from groups of VB records. We insert a sequence number between the RDW and the first data byte of each record. The sequence number restarts at 1 for the first record in each group. We INCLUDE on the sequence number and then remove it.

The VB input records might look like this:

```
<table>
<thead>
<tr>
<th>Len</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>PAGE: 1</td>
</tr>
<tr>
<td>22</td>
<td>LINE 1 OF REPORT A</td>
</tr>
<tr>
<td>22</td>
<td>LINE 2 OF REPORT A</td>
</tr>
<tr>
<td>22</td>
<td>LINE 3 OF REPORT A</td>
</tr>
<tr>
<td>22</td>
<td>LINE 4 OF REPORT A</td>
</tr>
<tr>
<td>...</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>PAGE: 2</td>
</tr>
<tr>
<td>23</td>
<td>LINE 66 OF REPORT A</td>
</tr>
<tr>
<td>23</td>
<td>LINE 67 OF REPORT A</td>
</tr>
<tr>
<td>23</td>
<td>LINE 68 OF REPORT A</td>
</tr>
<tr>
<td>23</td>
<td>LINE 69 OF REPORT A</td>
</tr>
<tr>
<td>...</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>PAGE: 3</td>
</tr>
<tr>
<td>24</td>
<td>LINE 131 OF REPORT A</td>
</tr>
<tr>
<td>24</td>
<td>LINE 132 OF REPORT A</td>
</tr>
<tr>
<td>24</td>
<td>LINE 133 OF REPORT A</td>
</tr>
<tr>
<td>24</td>
<td>LINE 134 OF REPORT A</td>
</tr>
</tbody>
</table>
```
OUTFIL Control Statements

We use an IFTHEN WHEN=INIT clause to reformat each record so it has room for the 3-byte sequence number between the RDW and the first data byte. After the WHEN=INIT clause is executed, the intermediate records look like this:

<table>
<thead>
<tr>
<th>Len</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>PAGE: 1</td>
</tr>
<tr>
<td>25</td>
<td>LINE 1 OF REPORT A</td>
</tr>
<tr>
<td>25</td>
<td>LINE 2 OF REPORT A</td>
</tr>
<tr>
<td>25</td>
<td>LINE 3 OF REPORT A</td>
</tr>
<tr>
<td>25</td>
<td>LINE 4 OF REPORT A</td>
</tr>
<tr>
<td></td>
<td>...</td>
</tr>
<tr>
<td>15</td>
<td>PAGE: 2</td>
</tr>
<tr>
<td>25</td>
<td>LINE 66 OF REPORT A</td>
</tr>
<tr>
<td>25</td>
<td>LINE 67 OF REPORT A</td>
</tr>
<tr>
<td>25</td>
<td>LINE 68 OF REPORT A</td>
</tr>
<tr>
<td>25</td>
<td>LINE 69 OF REPORT A</td>
</tr>
<tr>
<td></td>
<td>...</td>
</tr>
<tr>
<td>15</td>
<td>PAGE: 3</td>
</tr>
<tr>
<td>25</td>
<td>LINE 131 OF REPORT A</td>
</tr>
<tr>
<td>25</td>
<td>LINE 132 OF REPORT A</td>
</tr>
<tr>
<td>25</td>
<td>LINE 133 OF REPORT A</td>
</tr>
<tr>
<td>25</td>
<td>LINE 134 OF REPORT A</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note that positions 5-7 are blank and the 'PAGE:' characters have been shifted over to positions 8-12.

We use an IFTHEN WHEN=GROUP clause to put a 3-byte sequence number in each record. BEGIN indicates a group starts with a record that has 'PAGE:' in positions 8-12. PUSH overlays a 3-byte sequence number at positions 5-7 of each record. The sequence number starts at 1 for the first record of a group and is incremented by 1 for each subsequent record of the group. After the IFTHEN GROUP clause is executed, the intermediate records look like this:

<table>
<thead>
<tr>
<th>Len</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>001PAGE: 1</td>
</tr>
<tr>
<td>25</td>
<td>002LINE 1 OF REPORT A</td>
</tr>
<tr>
<td>25</td>
<td>003LINE 2 OF REPORT A</td>
</tr>
<tr>
<td>25</td>
<td>004LINE 3 OF REPORT A</td>
</tr>
<tr>
<td>25</td>
<td>005LINE 4 OF REPORT A</td>
</tr>
<tr>
<td></td>
<td>006...</td>
</tr>
<tr>
<td>15</td>
<td>001PAGE: 2</td>
</tr>
<tr>
<td>25</td>
<td>002LINE 66 OF REPORT A</td>
</tr>
<tr>
<td>25</td>
<td>003LINE 67 OF REPORT A</td>
</tr>
<tr>
<td>25</td>
<td>004LINE 68 OF REPORT A</td>
</tr>
<tr>
<td>25</td>
<td>005LINE 69 OF REPORT A</td>
</tr>
<tr>
<td></td>
<td>006...</td>
</tr>
<tr>
<td>15</td>
<td>001PAGE: 3</td>
</tr>
<tr>
<td>25</td>
<td>002LINE 131 OF REPORT A</td>
</tr>
<tr>
<td>25</td>
<td>003LINE 132 OF REPORT A</td>
</tr>
<tr>
<td>25</td>
<td>004LINE 133 OF REPORT A</td>
</tr>
<tr>
<td>25</td>
<td>005LINE 134 OF REPORT A</td>
</tr>
<tr>
<td></td>
<td>006...</td>
</tr>
</tbody>
</table>

Note that the records in each group are numbered starting with 001 for the first record of each group. The records we want have sequence numbers 002 and 003.

We use an OUTFIL statement to only INCLUDE the records with sequence number 002 or 003, and to remove the sequence numbers so the included output records will be identical to the input records. After the OUTFIL statement is executed, the final output records look like this:

<table>
<thead>
<tr>
<th>Len</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>LINE 1 OF REPORT A</td>
</tr>
<tr>
<td>22</td>
<td>LINE 2 OF REPORT A</td>
</tr>
</tbody>
</table>
OUTFIL Control Statements

Example 29

```plaintext
OPTION COPY
OUTFIL FNAMES=OUT1, INCLUDE=(11,3,CH,EQ,'D51'), ACCEPT=3
OUTFIL FNAMES=OUT2, STARTREC=2, ACCEPT=5
```

This example illustrates how you can stop processing OUTFIL input records for various groups in different ways.

The input data set has these records:

- HEADER 2010/06/30
- FRANK  D51
- ED      D52
- VICKY   D51
- MARTIN  D52
- LILY    D50
- MARC    D51
- JUNE    D51
- LUCY    D51
- TRAILER 8

The first OUTFIL statement uses INCLUDE to extract the D51 records and ACCEPT=3 to only write the first three D51 records to OUT1. Thus, OUT1 will have these records:

- FRANK  D51
- VICKY  D51
- MARC   D51

The second OUTFIL statement uses STARTREC=2 to skip the HEADER record and ACCEPT=5 to only write the next five records to OUT2. Thus, OUT2 will have these records:

- FRANK  D51
- ED     D52
- VICKY  D51
- MARTIN D52
- LILY   D50

Example 30

```plaintext
OPTION COPY
OUTFIL FNAMES=OUT1,
  INCLUDE=(3,4,CH,EQ,'key1'),
  IFTAIL=(HD=YES,TRLID=(1,1,CH,EQ,'T'),
   TRLUPD=(6:COUNT=(M11,LENGTH=4),
      14:TOT=(10,4,ZD,TO=ZD,LENGTH=6))
OUTFIL FNAMES=OUT2,
  INCLUDE=(3,4,CH,EQ,'key2'),
  IFTAIL=(HD=YES,TRLID=(1,1,CH,EQ,'T'),
   TRLUPD=(6:COUNT=(M11,LENGTH=4),
      14:TOT=(10,4,ZD,TO=ZD,LENGTH=6))
```

This example illustrates how you can split an input file with a header, and a trailer containing a count and total for the input data records, into two output files each of which has the header and a trailer with accurate count and total for the included data records.

The input data set has RECFM=FB and LRECL=80 with these input records:
The first record is a header record with a date. The records with D in position 1 are data records; they have key1 or key2 in positions 3-6 and an amount field in positions 10-13.

The trailer record is identified by a 'T' in position 1. Positions 6-9 contain a count (0007) of the data records, and positions 14-19 contain a total (001903) for the amount fields in the data records. In addition, there are other static fields in the trailer record that must not be changed. Note that IFTRAIL with HD=YES does not process the header or trailer records as data records, so they are not included in the count or total.

The first OUTFIL statement writes the header record, data records with key1, and trailer record, in the OUT1 data set. The IFTRAIL operand is used to identify the trailer (TRLID), indicate the first record is a header (HD=YES), and update the count and total in the trailer (TRLUPD) to reflect the input data records included in this output data set.

OUT1 will have these records:

```
H 2010/07/06
D key1 0100
D key1 0150
D key1 0025
D key2 1000
D key2 0310
T X 0007 QR 001903 D52-007-321-7526
```

The second OUTFIL statement writes the header record, data records with key2, and trailer record, in the OUT2 data set. The IFTRAIL operand is used to identify the trailer (TRLID), indicate the first record is a header (HD=YES), and update the count and total in the trailer (TRLUPD) to reflect the input data records included in this output data set. Note that IFTRAIL with HD=YES does not process the header or trailer records as data records, so they are not included in the count or total.

OUT2 will have these records:

```
H 2010/07/06
D key2 0200
D key2 0118
D key2 1000
D key2 0310
T X 0004 QR 001628 D52-007-321-7526
```

**Example 31**

```
OPTION Y2PAST=1990
SORT FIELDS=(1,6,Y2W,A)
OUTFIL REMOVECC,
  HEADER1=(1:'Input',15:'NEXTDFRI',25:'PREVDSUN',35:'LASTDAYQ'),
  BUILD=(1:1.6,Y2W,TOJUL=Y4W(-),
         15:1.6,Y2W,NEXTDFRI,TOJUL=Y4W(-),
         25:1.6,Y2W,PREVDSUN,TOJUL=Y4W(-),
         35:1.6,Y2W,LASTDAYQ,TOJUL=Y4W(-))
```
This example illustrates how you can sort by a date, and calculate a specific day
after and before a date, and the last day of the quarter for a date. The input date is
in the form 'C'mmddyy' and the output dates will be in the form 'ddd-yyyy'.

The SORTIN data set has these input records with a 'C'mmddyy' date field in
positions 1-6:

010105
120699
021610
999999
092810
031500
000000
032505
110210

The SORT statement sorts by the 'C'mmddyy' date. We use 1,6,Y2W for the sort
field to match the 'C'mmddyy' date.

The OUTFIL statement writes a heading and performs four operations on each
date. It converts the input date to 'C'ddd-yyyy' form, gets the next Friday date in
'C'ddd-yyyy' form, gets the previous Sunday date in 'C'ddd-yyyy' form, and gets
the end of the quarter date in 'C'ddd-yyyy' form. We use 1,6,Y2W for the input
field to match the 'C'mmddyy' date, and we use TOJUL=Y4W(-) to give us a
'C'ddd-yyyy' output date.

SORTOUT will have these records:

<table>
<thead>
<tr>
<th>Input</th>
<th>NEXTDFRI</th>
<th>PREVDSUN</th>
<th>LASTDAYQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>000-0000</td>
<td>000-0000</td>
<td>000-0000</td>
<td>000-0000</td>
</tr>
<tr>
<td>001-2005</td>
<td>007-2005</td>
<td>361-2004</td>
<td>090-2005</td>
</tr>
<tr>
<td>084-2005</td>
<td>091-2005</td>
<td>079-2005</td>
<td>090-2005</td>
</tr>
<tr>
<td>647-2010</td>
<td>050-2010</td>
<td>045-2010</td>
<td>090-2010</td>
</tr>
<tr>
<td>271-2010</td>
<td>274-2010</td>
<td>269-2010</td>
<td>273-2010</td>
</tr>
<tr>
<td>386-2010</td>
<td>390-2010</td>
<td>304-2010</td>
<td>365-2010</td>
</tr>
<tr>
<td>999-9999</td>
<td>999-9999</td>
<td>999-9999</td>
<td>999-9999</td>
</tr>
</tbody>
</table>

Note that the '000000' and '999999' input values are treated as special indicators for
output.
The OUTREC control statement allows you to reformat the input records after they are sorted, merged or copied.

The OUTREC control statement supports a wide variety of parsing, editing, and reformatting tasks, including:

- The use of fixed position/length fields or variable position/length fields. For fixed fields, you specify the starting position and length of the field directly. For variable fields, such as delimited fields, comma separated values (CSV), tab separated values, blank separated values, keyword separated fields, null-terminated strings (and many other types), you define rules that allow DFSORT to extract the relevant data into fixed parsed fields, and then use the parsed fields as you would use fixed fields.

- Insertion of blanks, zeros, strings, current date, future date, past date, current time, sequence numbers, decimal constants, and the results of arithmetic expressions before, between, and after the input fields in the reformatted records.

- Sophisticated conversion capabilities, such as find and replace, hexadecimal display, bit display, translation of EBCDIC letters from lowercase to uppercase or uppercase to lowercase, translation of characters from EBCDIC to ASCII and from ASCII to EBCDIC, translation of characters using the ALTSEQ translation table, conversion of numeric values from one format to another, left-justify or left-squeeze (remove leading blanks or all blanks and shift left), and right-justify or right-squeeze (remove trailing blanks or all blanks and shift right).

- Sophisticated editing capabilities, such as control of the way numeric fields are presented with respect to length, leading or suppressed zeros, thousands separators, decimal points, leading and trailing positive and negative signs, and so on.

Twenty-seven pre-defined editing masks are available for commonly used numeric editing patterns, encompassing many of the numeric notations used throughout the world. In addition, a virtually unlimited number of numeric editing patterns are available via the user-defined editing masks.
OUTREC Control Statement

- Transformation of SMF, TOD, and ETOD date and time values to more usable forms.
- Various types of arithmetic operations for input date fields.
- Conversion of input date fields of one type (CH, ZD, PD, 2-digit year, 4-digit year, Julian, Gregorian) to corresponding output date fields of another type or to a corresponding day of the week.
- Selection of a character constant, hexadecimal constant, or input field from a lookup table, based on a character, hexadecimal, or bit string as input (that is, lookup and change).

You can create the reformatted OUTREC records in one of the following three ways using unedited, edited, or converted input fields (p,m for fixed fields, or %nn for parsed fields - see PARSE), and a variety of constants:

- **BUILD or FIELDS**: Reformat each record by specifying all of its items one by one. Build gives you complete control over the items you want in your reformatted OUTREC records and the order in which they appear. You can delete, rearrange and insert fields and constants. Example:
  
  ```
  OUTREC BUILD=(1,20,C'ABC',26:5C'*',
  15,3,PD,EDIT=(TTT.TT),21,30,80:X)
  ```

- **OVERLAY**: Reformat each record by specifying just the items that overlay specific columns. Overlay lets you change specific existing columns without affecting the entire record. Example:
  
  ```
  OUTREC OVERLAY=(45:45,8,TRAN=LTOU)
  ```

- **FINDREP**: Reformat each record by doing various types of find and replace operations. Example:
  
  ```
  OUTREC FINDREP=(IN=C'Mr.',OUT=C'Mister')
  ```

- **IFTHEN clauses**: Reformat different records in different ways by specifying how build, overlay, find/replace, or group operation items are applied to records that meet given criteria. IFTHEN clauses let you use sophisticated conditional logic to choose how different record types are reformatted. Example:
  
  ```
  OUTREC IFTHEN=(WHEN=(1,5,CH,EQ,C'TYPE1'),
  BUILD=(1,40,C'**',+1,TO=PD)),
  IFTHEN=(WHEN=(1,5,CH,EQ,C'TYPE2'),
  BUILD=(1,40,+2,TO=PD,X'FFFF')),
  IFTHEN=(WHEN=NONE,OVERLAY=(45:C'NONE'))
  ```

You can choose to include any or all of the following items in your reformatted OUTREC records:

- Fixed position/length fields or variable position/length fields. For fixed fields, you specify the starting position and length of the field directly. For variable fields, such as delimited fields, comma separated values (CSV), tab separated values, blank separated values, keyword separated fields, null-terminated strings (and many other types), you define rules that allow DFSORT to extract the relevant data into fixed parsed fields, and then use the parsed fields as you would use fixed fields.
- Blanks, binary zeros, character strings, and hexadecimal strings
- Current date, future date, past date and current time in various forms
- Unedited input fields aligned on byte, halfword, fullword, and doubleword boundaries
- Replaced or removed strings.
- Hexadecimal or bit representations of binary input fields
- Characters translated from uppercase to lowercase, lowercase to uppercase, ASCII to EBCDIC or EBCDIC to ASCII.
OUTREC Control Statement

- Left-justified, right-justified, left-squeezed, or right-squeezed input fields.
- Numeric input fields of various formats converted to different numeric formats, or to character format edited to contain signs, thousands separators, decimal points, leading zeros or no leading zeros, and so on.
- Decimal constants converted to different numeric formats, or to character format edited to contain signs, thousands separators, decimal points, leading zeros or no leading zeros, and so on.
- The results of arithmetic expressions combining fields, decimal constants, operators (MIN, MAX, MUL, DIV, MOD, ADD and SUB) and parentheses converted to different numeric formats, or to character format edited to contain signs, thousands separators, decimal points, leading zeros or no leading zeros, and so on.
- SMF, TOD and ETOD date and time fields converted to different numeric formats, or to character format edited to contain separators, leading zeros or no leading zeros, and so on.
- Input date fields of one type (CH, ZD, PD, 2-digit year, 4-digit year, Julian, Gregorian) converted to corresponding output date fields of another type or to a corresponding day of the week.
- The results of various types of arithmetic operations for input date fields.
- Sequence numbers in various formats.
- A character constant, hexadecimal constant or input field selected from a lookup table, based on a character, hexadecimal or bit constant as input.
- A zoned decimal group identifier, a zoned decimal group sequence number, or a field propagated from the first record of a group to all of the records of a group.

For information concerning the interaction of INREC and OUTREC, see “INREC Statement Notes” on page 148 and “OUTREC Statement Notes” on page 424.

See “OUTFIL Control Statements” on page 229 for complete details on the OUTFIL OUTREC parameter.

PARSE
OUTREC Control Statement

This operand allows you to extract variable position/length fields into fixed parsed fields. Parsed fields (%nn) can be used where fixed position/length fields (p,m) can be used in the BUILD (or FIELDS) or OVERLAY operands as described later in this section.

PARSE can be used for many different types of variable fields including delimited fields, comma separated values (CSV), tab separated values, blank separated values, keyword separated fields, null-terminated strings, and so on. You can assign up to 100 %nn parsed fields (%00-%99) to the variable fields you want to extract.

Note that if all of the fields in your records have fixed positions and lengths, you don't need to use PARSE. But if any of the fields in your records have variable positions or lengths, you can use PARSE to treat them as fixed parsed fields in BUILD or OVERLAY. You can mix p,m fields (fixed fields) and %nn fields (parsed fields) in BUILD and OVERLAY.

See PARSE under "OUTFIL Control Statements" for complete details.

Sample Syntax:

```
OUTREC PARSE=(%00=(ENDBEFR=C'*',FIXLEN=3),
 %01=(ENDBEFR=BLANKS,FIXLEN=6),
 %02=(STARTAT=C'MAX',FIXLEN=8),
 %03=(STARTAFT=C'(',ENDBEFR=C')',FIXLEN=6),
 %04=(STARTAFT=BLANKS,FIXLEN=5)),
 BUILD=(%03,X,%03,HEX,21:%02,31:%01,SFF,M26,LENGTH=7,18,6,%00,UFF,M11,LENGTH=3,%04,JFY=(SHIFT=RIGHT))
```

Default for PARSE: None; must be specified. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.

Specifies all of the items in the reformatted OUTREC record in the order in which they are to be included. The reformatted OUTREC record consists of the separation fields, edited and unedited input fields (p,m for fixed fields, or %nn for parsed fields - see PARSE), edited decimal constants, edited results of arithmetic expressions, and sequence numbers you select, in the order in which you select them, aligned on the boundaries or in the columns you indicate.

For variable-length records, the first item in the BUILD or FIELDS parameter must specify or include the unedited 4-byte record descriptor word (RDW), that is, you must start with 1,m with m equal to or greater than 4. If you want to include the bytes from a specific position to the end of each input record at the end of each reformatted output record, you can specify that starting position (p) as the last item in the BUILD or FIELDS parameter. For example:
OUTREC Control Statement

```
OUTREC FIELDS=(1,4, unedited RDW
1,2,8I,TO=ZD,LENGTH=5, display RDW length in decimal
C'|', separator
5) display input positions 5 to end.
```

For fixed-length records, the first input and output data byte starts at position 1. For variable-length records, the first input and output data byte starts at position 5, after the RDW in positions 1-4.

The BUILD or FIELDS parameter of the OUTREC statement differs from the BUILD or OUTREC parameter of the OUTFIL statement in the following ways:

- The BUILD or FIELDS parameter of the OUTREC statement applies to all input records; the BUILD or OUTREC parameter of the OUTFIL statement only applies to the OUTFIL input records for its OUTFIL group.
- The BUILD or OUTREC parameter of the OUTFIL statement supports the slash (/) separator for creating blank records and new records; the BUILD or FIELDS parameter of the OUTREC statement does not.

```
c: specifies the position (column) for a separation field, input field decimal constant, arithmetic expression, or sequence number, relative to the start of the reformatted output record. Unused space preceding the specified column is padded with EBCDIC blanks. The following rules apply:
```

- `c` must be a number between 1 and 32752.
- `c:` must be followed by a separation field, input field, decimal constant, or arithmetic expression.
- `c` must not overlap the previous input field or separation field in the reformatted output record.
- For variable-length records, `c:` must not be specified before the first input field (the record descriptor word) nor after the variable part of the input record.
- The colon (:) is treated like the comma (,) or semicolon (;) for continuation to another line.

See [Table 25 on page 130](#) for examples of valid and invalid column alignment.

```
s specifies that a separation field (blanks, zeros, character string, hexadecimal string, current date, future date, past date, or current time) is to appear in the reformatted output record. It can be specified before or after any input field. Consecutive separation fields may be specified. For variable-length records, separation fields must not be specified before the first input field (the record descriptor word) or after the variable part of the input record. Permissible values are nX, nZ, nC’xx…x’, nX'y..yy', and various date and time constants.
```

```
nX: Blank separation. n bytes of EBCDIC blanks (X'40') are to appear in the reformatted output records. n can range from 1 to 4095. If n is omitted, 1 is used.
```

See [Table 26 on page 131](#) for examples of valid and invalid blank separation.

```
nZ: Binary zero separation. n bytes of binary zeros (X'00') are to appear in the reformatted output records. n can range from 1 to 4095. If n is omitted, 1 is used.
```

See [Table 27 on page 131](#) for examples of valid and invalid binary zero separation.

```
nC'xx…x': Character string separation. n repetitions of the character
```


string constant (C’xx...x’) are to appear in the reformatted output records. n can range from 1 to 4095. If n is omitted, 1 is used. x can be any EBCDIC character. You can specify from 1 to 256 characters.

If you want to include a single apostrophe in the character string, you must specify it as two single apostrophes:

Required: O'NEILL Specify: C'O''NEILL'

See Table 28 on page 131 for examples of valid and invalid character string separation.

nX'yy...yy'
Hexadecimal string separation. n repetitions of the hexadecimal string constant (X'yy...yy') are to appear in the reformatted output records. n can range from 1 to 4095. If n is omitted, 1 is used.

The value yy represents any pair of hexadecimal digits. You can specify from 1 to 256 pairs of hexadecimal digits.

See Table 29 on page 132 for examples of valid and invalid hexadecimal string separation.

DATEn, DATEn(c), DATEnP
Constant for current date. The date of the run is to appear in the reformatted output records. See DATEn, DATEn(c), DATEnP under OUTFIL OUTREC for details.

&DATEn, &DATEn(c), &DATEnP can be used instead of DATEn, DATEn(c), and DATEnP, respectively.

DATEn+r, DATEn(c)+r, DATEnP+r
Constant for future date. A future date relative to the current date of the run is to appear in the reformatted output records. See DATEn+r, DATEn(c)+r, DATEnP+r under OUTFIL OUTREC for details.

&DATEn+r, &DATEn(c)+r, &DATEnP+r can be used instead of DATEn+r, DATEn(c)+r, and DATEnP+r, respectively.

DATEn-r, DATEn(c)-r, DATEnP-r
Constant for past date. A past date relative to the current date of the run is to appear in the reformatted output records. See DATEn-r, DATEn(c)-r, DATEnP-r under OUTFIL OUTREC for details.

&DATEn-r, &DATEn(c)-r, &DATEnP-r can be used instead of DATEn-r, DATEn(c)-r, and DATEnP-r, respectively.

TIMEn, TIMEn(c), TIMEnP
Constant for current time. The time of the run is to appear in the reformatted output records. See TIMEn, TIMEn(c), TIMEnP under OUTFIL OUTREC for details.

&TIMEn, &TIMEn(c), &TIMEnP can be used instead of TIMEn, TIMEn(c), and TIMEnP, respectively.

DATE specifies that the current date is to appear in the
OUTREC Control Statement

reformatted output records in the form 'mm/dd/yy'. See DATE under OUTFIL OUTREC for details.

&DATE

can be used instead of DATE.

DATE=(abcd)
specifies that the current date is to appear in the reformatted output records in the form 'adxbc'. See DATE=(abcd) under OUTFIL OUTREC for details.

&DATE=(abcd)
can be used instead of DATE=(abcd).

DATENS=(abc)
specifies that the current date is to appear in the reformatted output records in the form 'abc'. See DATENS=(ab) under OUTFIL OUTREC for details.

&DATENS=(abc)
can be used instead of DATENS=(abc).

YDDD=(abc)
specifies that the current date is to appear in the reformatted output records in the form 'acb'. See YDDD=(ab) under OUTFIL OUTREC for details.

&YDDD=(abc)
can be used instead of YDDD=(abc).

YDDDNS=(ab)
specifies that the current date is to appear in the reformatted output records in the form 'ab'. See YDDDNS=(ab) under OUTFIL OUTREC for details.

&YDDDNS=(ab)
can be used instead of YDDDNS=(ab).

TIME
specifies that the current time is to appear in the reformatted output records in the form 'hh:mm:ss'. See TIME under OUTFIL OUTREC for details.

&TIME

can be used instead of TIME.

TIME=(abc)
specifies that the current time is to appear in the reformatted output records in the form 'hh:mm:ss' (24-hour time) or 'hh:mm:ss xx' (12-hour time). See TIME=(abc) under OUTFIL OUTREC for details.

&TIME=(abc)
can be used instead of TIME=(abc).

TIMENS=(ab)
specifies that the current time is to appear in the reformatted output record in the form 'hh:mm:ss' (24-hour time) or 'hh:mm:ss xx' (12-hour time). See TIMENS=(ab) under OUTFIL OUTREC for details.

&TIMENS=(ab)
can be used instead of TIMENS=(ab).

p,m,a

specifies that an unedited input field is to appear in the reformatted output record.

p
specifies the first byte of the input field relative to the beginning of the input record. The first data byte of a fixed-length record has relative position 1. The first data byte of a variable-length record has relative position 5, because the first four bytes are occupied by the RDW. All fields must start on a byte boundary, and no field may extend beyond byte 32752. See "OUTREC Statement Notes" on page 424 for special rules concerning variable-length records.

12. If INREC is specified, p must refer to the record as reformatted by INREC. If your E15 user exit reformats the record, and INREC is not specified, p must refer to the record as reformatted by your E15 user exit.
m specifies the length of the input field. It must include the sign if the data is signed and must be a whole number of bytes. See "OUTREC Statement Notes" on page 424 for more information.

a specifies the alignment (displacement) of the input field in the reformatted output record relative to the start of the reformatted output record.

The permissible values of a are:

H Halfword aligned. The displacement (p-1) of the field from the beginning of the reformatted input record, in bytes, is a multiple of 2 (that is, position 1, 3, 5, and so forth).

F Fullword aligned. The displacement is a multiple of 4 (that is, position 1, 5, 9, and so forth).

D Doubleword aligned. The displacement is a multiple of 8 (that is, position 1, 9, 17, and so forth).

Alignment can be necessary if, for example, the data is to be used in a COBOL application program where items are aligned through the SYNCHRONIZED clause. Unused space preceding aligned fields are always padded with binary zeros.

%nn specifies that an unedited parsed input field is to appear in the reformatted output record. See PARSE for details of parsed fields. See p,m,a for further details. Note that alignment (H, F, D) is not permitted for %nn fields (for example, %nn,F results in an error message and termination).

p specifies that the unedited part of the variable input record (that part beyond the minimum record length), is to appear in the reformatted output record, as the last field. p without m can only be used for variable-length records; not for fixed-length records.

Attention: If 1,4,p is specified (only RDW and variable part of record), “null” records containing only an RDW will result if the record length is less than p.

A value must be specified for p that is less than or equal to the minimum record length (RECORD statement L4 value) plus 1 byte.

p,m,TRAN=keyword
Specifies that an input field is to be translated as indicated by the keyword. See p,m,TRAN=keyword under OUTFIL OUTREC for details.

%nn,TRAN=keyword
Specifies that a parsed input field is to be translated as indicated by the keyword. See %nn,TRAN=keyword under OUTFIL OUTREC for details.

p,TRAN=keyword
Specifies that the variable part of the input record is to be translated as indicated by the keyword. See p,TRAN=keyword under OUTFIL OUTREC for details.

p,m,HEX
Can be used instead of p,m,TRAN=HEX. See p,m,HEX under OUTFIL OUTREC for details.

%nn,HEX
Can be used instead of %nn,TRAN=HEX. See %nn,HEX under OUTFIL OUTREC for details.
OUTREC Control Statement

p,HEX
Can be used instead of p,TRAN=HEX. See p,HEX under OUTFIL OUTREC for details.

p,m,f,edit or (p,m,f),edit
specifies that an edited numeric input field is to appear in the reformatted output record. You can edit BI, FI, PD, PD0, ZD, FL, CSF, FS, UFF, SFF, DC1, DC2, DC3, DE1, DE2, DE3, DT1, DT2, DT3, TC1, TC2, TC3, TC4, TE1, TE2, TE3, TE4, TM1, TM2, TM3 or TM4 fields using either pre-defined edit masks (M0-M26) or specific edit patterns you define. You can control the way the edited fields look with respect to length, leading or suppressed zeros, thousands separators, decimal points, leading and trailing positive and negative signs, and so on.

See p,m,f,edit under OUTFIL OUTREC for details.

Sample Syntax:
```
OUTREC FIELDS=(5:(21,8,ZD),M19,X,46,5,ZD,M13,
31:35,4,FL,SIGNS=(,,+,-),LENGTH=10,
51:8,4,PD,EDIT=(**II,IIT.TTXS),SIGNS=(,,+,-))
```

%nn,f,edit or (%nn,f),edit
specifies that an edited numeric parsed input field is to appear in the reformatted output record. See PARSE for details of parsed fields. See p,m,f,edit or (p,m,f),edit for further details.

%nn,f,to or (%nn,f),to
specifies that a converted numeric parsed input field is to appear in the reformatted output record. See PARSE for details of parsed fields. See p,m,f,to or (p,m,f),to for further details.

deccon,edit or (deccon),edit
specifies that an edited decimal constant is to appear in the reformatted output record. The decimal constant must be in the form +n or −n where n is 1 to 31 decimal digits. The sign (+ or −) must be specified. A decimal constant produces a signed, 31-digit zoned decimal (ZD) result to be edited as specified.

See deccon,edit under OUTFIL OUTREC for details.

Sample Syntax:
```
OUTREC FIELDS=(-5000,EDIT=(-T,TT.T),21:(+0),M11,LENGTH=7)
```

deccon,to or (deccon),to
specifies that a converted decimal constant is to appear in the reformatted output record. The decimal constant must be in the form +n or −n where n is 1 to 31 decimal digits. The sign (+ or −) must be specified. A decimal constant produces a signed, 31-digit zoned decimal (ZD) result to be converted as specified.

See deccon,to under OUTFIL OUTREC for details.
OUTREC Control Statement

Sample Syntax:

```
OUTREC FIELDS= (+1,PD,LENGTH=6,(-1),PD,LENGTH=6, -50,T0=ZD,LENGTH=8)
```

arexp,edit or (arexp),edit

specifies that the edited result of an arithmetic expression is to appear in the reformatted output record. The arithmetic expression can consist of input fields, decimal constants, operators and parentheses. An arithmetic expression produces a signed, 31-digit zoned decimal (ZD) result to be edited as specified.

See arexp,edit under OUTFIL OUTREC for details.

Sample Syntax:

```
OUTREC FIELDS=(C'**',27,2,FI,SUB, 83,4,PD,EDIT=(STTTTTTT),SIGNS=(+,-), 25:(((15,5,ZD,MUL,+2),ADD,+100),MAX,62,2,PD),M25,LENGTH=12)
```

arexp,to or (arexp),to

specifies that the converted result of an arithmetic expression is to appear in the reformatted output record. The arithmetic expression can consist of input fields, decimal constants, operators and parentheses. An arithmetic expression produces a signed, 31-digit zoned decimal (ZD) result to be converted as specified.

See arexp,to under OUTFIL OUTREC for details.

Sample Syntax:

```
OUTREC FIELDS=((15,6,FS,DIV,+5),ADD,(-1,ADD,36,6,FS),TO=FI,X, 3,2,FI,MAX,-6,LENGTH=4,TO=FS)
```

p,m,Y2x or p,m,Y4x

Specifies that an input date field is to be edited. Real Y2x dates are edited using the century window established by the Y2PAST option in effect. Y2x and Y4x dates with special indicators are expanded appropriately (for example, p,6,Y2T transforms C'000000' to C'00000000').

See "p,m,Y2x or p,m,Y4x" under OUTFIL OUTREC for details.

Sample Syntax:

```
OUTREC BUILD=(21,3,Y2U,X,3,8,Y4W)
```

%nn,Y2x or %nn,Y4x

Specifies that a parsed input date field is to be edited. See PARSE for details of parsed fields. See "p,m,Y2x or p,m,Y4x" for further details.

p,m,Y2x,edit or p,m,Y4x,edit

Specifies that the output for a p,m,Yxx input date field is to be edited according to the edit parameters you specify. For example, if you specify:

```
OUTREC BUILD=(28,5,Y4V,EDIT=(T T T T-T T))
```

The P'ccyymmdd' (X'0ccyymmddC') date value will be transformed to a C'ccyymmdd' date value and then edited to a C'ccyy-mm-dd' date value.

See "p,m,Y2x or p,m,Y4x" and "p,m,f,edit" for related details.

%nn,Y2x,edit or %nn,Y4x,edit

Specifies that the output for a parsed Yxx input date field is to be edited according to the edit parameters you specify. See PARSE for details of parsed fields. See "p,m,Y2x,edit or p,m,Y4x,edit" for further details.

p,m,Y2x,to or p,m,Y4x,to

Specifies that an input date field is to be converted according to the to parameters you specify. For example, if you specify:
OUTREC Control Statement

OUTREC BUILD=(5,6,Y2W,TO=PD,LENGTH=5)

The 'mmddyy' date value will be transformed to a 'yyyyMMdd' date value and then converted to a 'P'yyyyMMdd' (X'0mmddccyyC') date value.

See "p,m,Y2x or p,m,Y4x" and "p,m,f,to" for related details.

%nn,Y2x,to or %nn,Y4x,to
Specifies that a parsed input date field is to be converted according to the to parameters you specify. See PARSE for details of parsed fields. See "p,m,Y2x,to or p,m,Y4x,to" for further details.

p,m,Y2x,todate or p,m,Y4x,todate
Specifies that an input date field of one type is to be converted to a corresponding output date field of another type. You can convert date fields between combinations of 2-digit and 4-digit year dates, CH/ZD and PD dates, and Julian and Gregorian dates. You can also convert a date field to a corresponding day of the week in several forms.

See "p,m,Y2x,todate or p,m,Y4x,todate" under OUTFIL OUTREC for details.

Sample Syntax:

* Convert a P'dddyy' input date to a C'ccyy/mm/dd' output date
OUTREC BUILD=(21,3,Y2X,TOGREG=Y4T(/),X,
* Convert a C'ccyymmdd' input date to a P'ccyymmd' output date
42,8,Y4T,TOJUL=Y4U,X,
* Convert a C'mmddyy' input date to a C'yymmdd' output date
11,6,Y2W,TOGREG=Y2T)

%nn,Y2x,todate or %nn,Y4x,todate
Specifies that an input date field of one type is to be converted to a corresponding output date field of another type. You can convert date fields between combinations of 2-digit and 4-digit year dates, CH/ZD and PD dates, and Julian and Gregorian dates. You can also convert a date field to a corresponding day of the week in several forms.

See "p,m,Y2x,todate or p,m,Y4x,todate" under OUTFIL OUTREC for details.

Sample Syntax:

* Convert a P'dddyy' input date to a C'ccyy/mm/dd' output date.
OUTREC BUILD=(21,3,Y2X,TOGREG=Y4T(/),X,
* Convert a C'ccyymmdd' input date to a P'ccyymmd' output date.
42,8,Y4T,TOJUL=Y4U,X,
* Convert a C'mmddyy' input date to a C'yymmdd' output date.
11,6,Y2W,TOGREG=Y2T)

%nn,Y2x,odate or %nn,Y4x,odate
Specifies an arithmetic operation for a parsed input date field. See "%nn,Y2x,odate or %nn,Y4x,odate" under OUTFIL OUTREC for details.

%nn,Y2x,dateop or %nn,Y4x,dateop
Specifies an arithmetic operation for a parsed input date field. See "%nn,Y2x,odate or %nn,Y4x,odate" under OUTFIL OUTREC for details.

p,m,Y2x(s) or p,m,Y4x(s)
Specifies that an input date field is to be edited with separators. s can be any character except a blank. Real Y2x dates are edited using the century window established by the Y2PAST option in effect. Y2x and Y4x dates with special indicators are expanded appropriately (for example, p,8,Y4T(s) transforms C'00000000' to C'0000/00/00').

See "p,m,Y2x(s) or p,m,Y4x(s)" under OUTFIL OUTREC for details.

Sample Syntax:

* Convert a Z'dddccyy' date to a C'ddd/ccyy' date.
OUTREC BUILD=(19,7,Y4N(/),X,
* Convert a P'ccyymmdd' date to a C'ccyy-mm-dd' date.
43,5,Y4V(-))

%nn,Y2x(s) or %nn,Y4x(s)
Specifies that a parsed input date field is to be edited with separators. See PARSE for details of parsed fields. See "p,m,Y2x(s) or p,m,Y4x(s)" for further details.

p,m,Y2xP
Specifies that an input date field is to be converted to a packed decimal output
OUTREC Control Statement

date field. Real Y2x dates are edited using the century window established by the Y2PAST option in effect. Y2x and Y4x dates with special indicators are expanded appropriately (for example, p,6,Y2TP transforms C'000000' to P'00000000').

See "p,m,Y2xP" under OUTFILE OUTREC for details.

Sample Syntax:

```
OUTREC BUILD=(11,3,Y2XP,X,21,4,Y2WP)
```

%nn,Y2xP

Specifies that a parsed input date field is to be converted to a packed decimal output date field. See PARSE for details of parsed fields. See "p,m,Y2xP" for further details.

Sample Syntax:

```
%nn,Y2xP
```

Sample Syntax:

```
OUTREC BUILD=(11,3,Y2XP,X,21,4,Y2WP)
```

%nn,Y2xP

Specifies that a parsed input date field is to be converted to a packed decimal output date field. See PARSE for details of parsed fields. See "p,m,Y2xP" for further details.

Sample Syntax:

```
%nn,Y2xP
```

Sample Syntax:

```
OUTREC BUILD=(11,3,Y2XP,X,21,4,Y2WP)
```

p,m,lookup or %nn,lookup

specifies that a character constant, hexadecimal constant, input field (p,m) or parsed input field (%nn) from a lookup table is to appear in the reformatted output record. You can use p,m,lookup or %nn,lookup to select a specified character set constant (that is, a character or hexadecimal string) or set field (that is, an input field or parsed input field) based on matching an input value against find constants (that is, character, hexadecimal, or bit constants).

See p,m,lookup or %nn,lookup under OUTFILE OUTREC for details.

Sample Syntax:

```
p,m,lookup or %nn,lookup

OUTREC FIELDS=(11,1,
CHANGE=(6,
C'R',C'READ',
C'U',C'UPDATE',
X'FF',C'EMPTY',
C'A',C'ALTER'),
NOMATCH=(11,6),
4X,
21,1,
CHANGE=(10,
B'.1......',C'VSAM',
B'.0......',C'NON-VSAM'))
```

p,m,justify

specifies that a left-justified or right-justified input field is to appear in the reformatted output record. For a left-justified field, leading blanks are removed and the characters from the first nonblank to the last nonblank are shifted left, with blanks inserted on the right if needed. For a right-justified field, trailing blanks are removed and the characters from the last nonblank to the first nonblank are shifted right, with blanks inserted on the left if needed.

Optionally:

- specific leading and trailing characters can be changed to blanks before justification begins
- a leading string can be inserted
- a trailing string can be inserted
- the output length can be changed (it's equal to the input length by default)

See p,m,justify under OUTFILE OUTREC for details.

Sample Syntax:

```
p,m,justify

OUTREC FIELDS=(1,10,
21,20,JFY=(SHIFT=LEFT),5X,
52,12,JFY=(SHIFT=RIGHT,PREBLANK=C'+',LEAD=C'$',TRAIL=C'.'))
```
OUTREC Control Statement

%nn,justify
specifies that a left-justified or right-justified parsed input field is to appear in
the reformatted output record. See PARSE for details of parsed fields. See
p,m,justify for further details.

p,m,squeeze
specifies that a left-squeezed or right-squeezed input field is to appear in the
reformatted output record. For a left-squeezed field, all blanks are removed
and the characters from the first nonblank to the last nonblank are shifted left,
with blanks inserted on the right if needed. For a right-justified field, all blanks
are removed and the characters from the last nonblank to the first nonblank
are shifted right, with blanks inserted on the left if needed. Optionally:
• specific characters can be changed to blanks before squeezing begins
• a leading string can be inserted
• a trailing string can be inserted
• a string (for example, a comma delimiter) can be inserted wherever a group
  of blanks is removed between the first nonblank and the last nonblank.
• blanks can be kept as is between paired apostrophes ('AB CD EF') or paired
  quotes ('"AB CD EF")
• the output length can be changed (it's equal to the input length by default)
See p,m,squeeze under OUTFIL OUTREC for details.

Sample Syntax:

OUTREC FIELDS=(21,20,SQZ=(SHIFT=RIGHT),5X,
152,18,SQZ=(SHIFT=LEFT,PREBLANK=X'05',
LEAD=C'VOL=SER=',MID=C',',PAIR=QUOTE,LENGTH=30))

%nn,squeeze
specifies that a left-squeezed or right-squeezed parsed input field is to appear
in the reformatted output record. See PARSE for details of parsed fields. See
p,m,squeeze for further details.

seqnum
specifies that a sequence number is to appear in the reformatted output record.
The sequence numbers are assigned in the order in which the records are
received for OUTREC processing. You can create BI, PD, ZD, CSF, or FS
sequence numbers and control their lengths, starting values and increment
values. You can restart the sequence number at the start value each time a
specified input field (p,m) or parsed input field (%nn) changes.

See seqnum under OUTFIL OUTREC for details.

Sample Syntax:

OUTREC FIELDS=(SEQNUM,6,ZD,START=1000,INCR=50,RESTART=(21,5),1,60)

Default for BUILD or FIELDS: None; must be specified. See Appendix B,
“Specification/Override of DFSORT Options,” on page 857 for full override
details.

Applicable Functions: See Appendix B, “Specification/Override of DFSORT
Options,” on page 857.

OVERLAY
OUTREC Control Statement

Specifies each item that is to overlay specific columns in the reformatted record. Columns that are not overlaid remain unchanged. If you want to insert, rearrange, or delete fields, use BUILD or FIELDS rather than OVERLAY. Use OVERLAY only to overlay existing columns or to add fields at the end of every record. OVERLAY can be easier to use than BUILD or FIELDS when you just want to change a few fields without rebuilding the entire record.

For fixed-length records, the first input and output data byte starts at position 1. For variable-length records, the first input and output data byte starts at position 5, after the RDW in positions 1-4.

Use c: (column) to specify the output positions to be overlaid. If you do not specify c: for the first item, it defaults to 1:. If you do not specify c: for any other item, it starts after the previous item. For example, if you specify:

OUTREC OVERLAY=(25,2,11:C'A',15,3,C'**')
OUTREC Control Statement

Input positions 25-26 are placed at output positions 1-2; C’A’ is placed at output position 11; input positions 15-17 are placed at output positions 12-14; and C’**’ is placed at output positions 15-16. The rest of the record remains unchanged.

You can specify items in any order, you can change the same item multiple times and you can overlap output columns. Changes to earlier items affect changes to later items. For example, say you specify:

```
OUTREC OVERLAY=(21:8,4,ZD,MUL,+10,TO=ZD,LENGTH=6,
              5:5,1,TRAN=UTOL,
              5:5,1,CHANGE=(1,C'a',C'X',C'b',C'Y'),NOMATCH=(5,1))
```

and input position 5 has 'A'. The second item (UTOL) would change 'A' to 'a' and the third item (CHANGE) would change 'a' again to 'X'.

If you specify an OVERLAY item that extends the overlay record beyond the end of the input record, the reformatted record length is automatically increased to that length, and blanks are filled in on the left as needed. For variable-length records, the RDW length is also increased to correspond to the larger reformatted record length after all of the OVERLAY items are processed. For example, if your input record has a length of 40 and you specify:

```
OUTREC OVERLAY=(16:C'ABC',51:5C'*',35:15,2)
```

the output record is given a length of 55. Blanks are filled in from columns 41-50. For variable-length records, the length in the RDW is changed from 40 to 55 after all of the OVERLAY items are processed.

Missing bytes in specified input fields are replaced with blanks so the padded fields can be processed.

The OVERLAY parameter of the OUTREC statement applies to all input records whereas the OVERLAY parameter of the OUTFIL statement only applies to the OUTFIL input records for its OUTFIL group.

See OUTREC FIELDS for details of the items listed in the OVERLAY syntax diagram above. You can specify all of the items for OVERLAY in the same way that you can specify them for BUILD or FIELDS with the following exceptions:

- You cannot specify p or p,HEX or p,TRAN=keyword for OVERLAY.
- For p,m,H or p,m,F or p,m,D specified for OVERLAY, fields are aligned as necessary without changing the preceding bytes.
- For variable-length records, you must not overlay positions 1-4 (the RDW) for OVERLAY, so be sure to specify the first column (c:) as 5 or greater. If you do not specify the first column, it will default to 1: which is invalid for variable-length records with OVERLAY. Whereas FIELDS=(1,m,...) is required, OVERLAY=(1,m) is not allowed since it would overlay the RDW.

Sample Syntax:

Fixed input records:
```
OUTREC OVERLAY=(21:21,4,ZD,TO=PD,LENGTH=4,
                 2:5,8,HEX,45:C'*',32,4,C'**',81:SEQNUM,5,ZD)
```

Variable input records:
```
OUTREC OVERLAY=(5:X'0001',28:C'Date is ',YDDDNS=(4D),
                17:5C'*')
```

Default for OVERLAY: None; must be specified.

You can use FINDREP to find constants anywhere in a record and replace them with other constants of the same or different lengths. You can find character or hexadecimal input constants anywhere in your records and replace them with character, hexadecimal or null output constants. As appropriate, bytes can be shifted left or right, blank padding can be added for fixed-length records, and the length can be changed for variable-length records.

Various options of FINDREP allow you to define one or more input constants and a corresponding output constant, define one or more pairs of input and output constants, start and end the find scan at specified positions, stop after a specified number of constants are replaced, increase or decrease the length of the output record, define the action to be taken if nonblank characters overrun the end of the record, and specify whether output constants are to replace or overlay input constants.

See FINDREP under "OUTFIL Control Statements" for complete details.

Sample Syntax:
```
OUTREC FINDREP=(INOUT=(C'Goodbye',C'Bye',C'Hello',C'Hi'))
```

Default for FINDREP: None; must be specified. See Appendix B, "Specification/Override of DFSORT Options".

IFTHEN clauses allow you to reformat different records in different ways by specifying how build, overlay, find/replace or group operation items are to be applied to records that meet given criteria. IFTHEN clauses let you use simple or complex conditional logic to choose how different record types are reformatted.

If you want to insert, rearrange, or delete fields in the same way for every record, use BUILD or FIELDS rather than IFTHEN. If you want to do find and replace operations in the same way for every record, use FINDREP rather than IFTHEN. Use IFTHEN clauses if you want to insert, rearrange, delete or overlay fields, or perform find/replace operations in different ways for different records, or if you want to perform operations on groups of records.

You can use five types of IFTHEN clauses as follows:

- **WHEN=INIT**: Use one or more WHEN=INIT clauses to apply build, overlay or find/replace items to all of your input records. WHEN=INIT clauses and WHEN=GROUP clauses are processed before any of the other IFTHEN clauses.

- **WHEN=GROUP**: Use one or more WHEN=GROUP clauses to propagate fields, identifiers and sequence numbers within specified groups of records. WHEN=INIT clauses and WHEN=GROUP clauses are processed before any of the other IFTHEN clauses.

- **WHEN=(logexp)**: Use one or more WHEN=(logexp) clauses to apply build, overlay or find/replace items to your input records that meet specified criteria. A WHEN=(logexp) clause is satisfied when the logical expression evaluates as true.

- **WHEN=ANY**: Use a WHEN=ANY clause after multiple WHEN=(logexp) clauses to apply additional build, overlay or find/replace items to your input records if they satisfied the criteria for any of the preceding WHEN=(logexp) clauses.

- **WHEN=NONE**: Use one or more WHEN=NONE clauses to apply build, overlay or find/replace items to your input records that did not meet the criteria for any of the WHEN=(logexp) clauses. WHEN=NONE clauses are processed after any of the other IFTHEN clauses. If you do not specify a
WHEN=NONE clause, only the WHEN=INIT and WHEN=GROUP changes (if any) are applied to input records that do not meet the criteria for any of the WHEN=(logexp) clauses.

IFTHEN clauses are processed in the following order:
- WHEN=INIT clauses or WHEN=GROUP clauses
- WHEN=(logexp) clauses and WHEN=ANY clauses
- WHEN=NONE clauses

Processing of IFTHEN clauses continues unless one of the following occurs:
- A WHEN=(logexp) or WHEN=ANY clause is satisfied, and HIT=NEXT is not specified.
- There are no more IFTHEN clauses to process. When processing of IFTHEN clauses stops, the IFTHEN record created so far is used as the output record.

Example:
```
OUTREC IFTHEN=(WHEN=(12,1,BI,ALL,X'3F'),OVERLAY=(18:C'Yes')), IFTHEN=(WHEN=(35,2,PD,EQ,+14),BUILD=(1,40,45,3,HEX),HIT=NEXT), IFTHEN=(WHEN=(35,2,PD,GT,+17),BUILD=(1,40,41,5,HEX),HIT=NEXT), IFTHEN=(WHEN=ANY,BUILD=(1,55,C'ABC',70:X)), IFTHEN=(WHEN=(63,2,CH,EQ,C'AB'),OVERLAY=(18:C'No')), IFTHEN=(WHEN=NONE,BUILD=(1,40,51,8,TRAN=LTOU))
```

For this example, the IFTHEN clauses are processed as follows:
- If IFTHEN clause 1 is satisfied, its overlay item is applied and IFTHEN processing stops.
- If IFTHEN clause 1 is not satisfied, its overlay item is not applied and IFTHEN processing continues.
- If IFTHEN clause 2 is satisfied, its build items are applied and IFTHEN processing continues.
- If IFTHEN clause 2 is not satisfied, its build items are not applied and IFTHEN processing continues.
- If IFTHEN clause 3 is satisfied, its build items are applied and IFTHEN processing continues.
- If IFTHEN clause 3 is not satisfied, its build items are not applied and IFTHEN processing continues.
- If IFTHEN clause 4 is satisfied, its build items are applied and IFTHEN processing stops.
- If IFTHEN clause 4 is not satisfied, its build items are not applied and IFTHEN processing continues.
- If IFTHEN clause 5 is satisfied, its overlay item is applied and IFTHEN processing stops.
- If IFTHEN clause 5 is not satisfied, its overlay item is not applied and IFTHEN processing continues.
- If IFTHEN clause 6 is satisfied, its build items are applied and IFTHEN processing stops.
- If IFTHEN clause 6 is not satisfied, its build items are not applied and IFTHEN processing stops.

All of the IFTHEN clauses operate sequentially on an IFTHEN record. The IFTHEN record is created initially from the input record. Each IFTHEN clause tests and changes the IFTHEN record, as appropriate. Thus, changes made by earlier IFTHEN clauses are "seen" by later IFTHEN clauses. For example, if you have a 40-byte input record and specify:
The WHEN=INIT clause adds 1 to the ZD value and stores it in the IFTHEN record. The WHEN=(8,4,ZD,EQ,+27) clause tests the incremented ZD value in the IFTHEN record rather than the original ZD value in the input record.

The IFTHEN record is adjusted as needed for the records created or changed by the IFTHEN clauses. For fixed-length records, blanks are filled in on the left as needed. For variable-length records, the RDW length is adjusted as needed each time the IFTHEN record is changed.

Missing bytes in specified input fields are replaced with blanks so the padded fields can be processed.

DFSORT sets an appropriate LRECL (or reformatted record length if the OUTREC record is further modified) for the output records based on the build, overlay, find/replace and group operation items specified by the IFTHEN clauses. However, DFSORT does not analyze the possible results of WHEN=(logexp) conditions when determining an appropriate LRECL. When you use OUTREC IFTHEN clauses, you can override the OUTREC LRECL determined by DFSORT with the OUTREC IFOUTLEN parameter.

If SEQNUM is used in multiple IFTHEN clauses, the sequence number will be incremented for each record that satisfies the IFTHEN clause, that is, a separate SEQNUM counter will be kept for each IFTHEN clause. For example, if your input is:

```
RECORD A 1
RECORD B 1
RECORD B 2
RECORD C 1
RECORD A 2
RECORD C 2
RECORD B 3
RECORD D 1
```

and you specify:

```
OUTREC IFTHEN=(WHEN=(8,1,CH,EQ,C'A'),OVERLAY=(15:SEQNUM,4,ZD)),
            IFTHEN=(WHEN=(8,1,CH,EQ,C'B'),OVERLAY=(16:SEQNUM,4,ZD)),
            IFTHEN=(WHEN=NONE,OVERLAY=(17:SEQNUM,4,ZD))
```

your output will be:

```
RECORD A 1     0001
RECORD B 1     0001
RECORD B 2     0002
RECORD C 1     0001
RECORD A 2     0002
RECORD C 2     0002
RECORD B 3     0003
RECORD D 1     0003
```

Separate SEQNUM counters are kept for the 'A' record, for the 'B' record, and for the NONE records.

The IFTHEN clauses of the OUTREC statement apply to all input records whereas the IFTHEN clauses of the OUTFIL statement only apply to the OUTFIL input records for its OUTFIL group.

WHEN=INIT clause

See "WHEN=INIT clause" under OUTFIL IFTHEN for details. Note that / cannot be used to create blank records or new records.
OUTREC Control Statement

Sample Syntax:

```
OUTREC IFTHEN=(WHEN=INIT,
    BUILD=(1,20,21:C'Department ',31:3X,21,60),
    IFTHEN=(WHEN=(5,2,CH,EQ,C'D1'),OVERLAY=(31:8,3)),
    IFTHEN=(WHEN=(5,2,CH,EQ,C'D2'),OVERLAY=(31:12,3))
```

**WHEN=GROUP clause**
See "WHEN=GROUP clause" under OUTFIL IFTHEN for details.

Sample Syntax

```
OUTREC IFTHEN=(WHEN=GROUP,
    BEGIN=(1,40,SS,EQ,C'J82',OR,1,40,SS,EQ,C'M72'),
    PUSH=(41,ID=5))
```

**WHEN=(logexp) clause**
See "WHEN=(logexp) clause" under OUTFIL IFTHEN for details. Note that although / can be used to create blank records and new records with OUTFIL, it cannot be used with OUTREC.

Sample Syntax:

```
OUTREC IFTHEN=(WHEN=(1,3,CH,EQ,C'T01',AND,
    18,4,ZD,LE,+2000),OVERLAY=(42:C'Type1 <= 2000'),HIT=NEXT),
    IFTHEN=(WHEN=(1,3,CH,EQ,C'T01',AND,6,1,BI,BO,X'03'),
        BUILD=(1,25,42,13)),
    IFTHEN=(WHEN=(1,3,CH,EQ,C'T01',AND,
    18,4,ZD,GT,+2000),OVERLAY=(42:C'Type1 > 2000'),HIT=NEXT),
    IFTHEN=(WHEN=(1,3,CH,EQ,C'T01',AND,6,1,BI,BO,X'01'),
        BUILD=(1,25,42,13))
```

**WHEN=ANY clause**
See "WHEN=ANY clause" under OUTFIL IFTHEN for details. Note that although / can be used to create blank records and new records with OUTFIL, it cannot be used with OUTREC.

Sample Syntax:

```
OUTREC IFTHEN=(WHEN=(1,3,SS,EQ,C'T01,T02,T03'),
    BUILD=(C'Group A ',X,1,80),HIT=NEXT),
    IFTHEN=(WHEN=(1,3,SS,EQ,C'T04,T05,T06'),
        BUILD=(C'Group B ',X,1,80),HIT=NEXT),
    IFTHEN=(WHEN=(1,3,SS,EQ,C'T07,T08,T09,T10'),
        BUILD=(C'Group C ',X,1,80),HIT=NEXT),
    IFTHEN=(WHEN=ANY,OVERLAY=(16:C'Group Found'))
```

**WHEN=NONE clause**
See "WHEN=NONE clause" under OUTFIL IFTHEN for details. Note that although / can be used to create blank records and new records with OUTFIL, it cannot be used with OUTREC.

Sample Syntax:

```
OUTREC IFTHEN=(WHEN=INIT,BUILD=(1,20,21:C'Department ',31:3X,21,60),
    IFTHEN=(WHEN=(5,2,CH,EQ,C'D1'),OVERLAY=(31:8,3)),
    IFTHEN=(WHEN=(5,2,CH,EQ,C'D2'),OVERLAY=(31:12,3)),
    IFTHEN=(WHEN=NONE,OVERLAY=(31:C'')
```

Default for IFTHEN clauses: None; must be specified.

**Applicable Functions:** See Appendix B, "Specification/Override of DFSORT Options," on page 857.

**IFOUTLEN**
OUTREC Control Statement

\[ \text{IFOUTLEN}=n \]

Overrides the OUTREC LRECL (or reformatted record length if the OUTREC record is further modified) determined by DFSORT from your OUTREC IFTHEN clauses. DFSORT sets an appropriate LRECL for the output records based on the build, overlay, find/replace and group operation items specified by the IFTHEN clauses. However, DFSORT does not analyze the possible results of WHEN=(logexp) conditions when determining an appropriate OUTREC LRECL. When you use OUTREC IFTHEN clauses, you can override the OUTREC LRECL determined by DFSORT with the OUTREC IFOUTLEN parameter.

Fixed-length records longer than the IFOUTLEN length are truncated to the IFOUTLEN length. Fixed-length records shorter than the IFOUTLEN are padded with blanks to the IFOUTLEN length. Variable-length records longer than the IFOUTLEN length are truncated to the IFOUTLEN length.

\( n \) specifies the length to use for the OUTREC LRECL (or for the reformatted record length if the OUTREC record is further modified). The value for \( n \) must be between 1 and 32767, but must not be larger than the maximum LRECL allowed for the RECFM, and must not conflict with the specified or retrieved LRECL for the fixed-length output data set.

Sample Syntax:

```plaintext
OUTREC IFOUTLEN=70,
  IFTHEN=(WHEN=(5,1,CH,EQ,'C'1',AND,8,3,ZD,EQ,+10),
          BUILD=(1,40,C'T01-GROUP-A',65)),
  IFTHEN=(WHEN=(5,1,CH,EQ,'C'2',AND,8,3,ZD,EQ,+12),
          BUILD=(1,40,C'T02-GROUP-B',65))
```

Default for IFOUTLEN: The LRECL determined from the IFTHEN clauses.

OUTREC Statement Notes

- If input records are reformatted by INREC or E15, OUTREC must refer to fields in the appropriate reformatted record (see “INREC Statement Notes” on page 148).
- When you specify OUTREC, you must be aware of the change in record size and layout of the resulting reformatted output records.
- If the SORTOUT LRECL is specified or available, DFSORT will use it even if it does not match the reformatted OUTREC record length; this can cause padding or truncation of the reformatted OUTREC records, or termination. If the SORTOUT LRECL is not specified or available, DFSORT can automatically use the reformatted OUTREC record length as the SORTOUT LRECL, when appropriate. See the discussion of the SOLRF and NOSOLRF options in “OPTION Control Statement” on page 173 for details.
- For VSAM data sets, the maximum record size defined in the cluster is equivalent to the LRECL when processing fixed-length records, and is four bytes more than the LRECL when processing variable-length records. See “VSAM Considerations” on page 15 for more information.
- For variable-length records, the first entry in the FIELDS, BUILD, or IFTHEN BUILD parameter must specify or include the unedited 4-byte RDW, that is, the first field must be 1,4 or 1,m with m greater than 4. DFSORT sets the length of the reformatted record in the RDW.
OUTREC Control Statement

If the first field in the data portion of the input record is to appear unedited in the reformatted record immediately following the RDW, the entry in the FIELDS, BUILD, or IFTHEN BUILD parameter can specify both RDW and data field in one. (1,m,...). Otherwise, the RDW must be specifically included in the reformatted record (for example, 1,4,1,4,HEX).

- For variable-length records, OVERLAY, IFTHEN OVERLAY or IFTHEN PUSH items must not overlay the RDW in bytes 1-4. You must ensure that 1:, 2:, 3: or 4: is not specified or defaulted for any OVERLAY or PUSH item. Note that the default for the first OVERLAY or PUSH item is 1:, so you must override it.
- With FIELDS, BUILD or IFTHEN BUILD, the variable part of the input record (that part beyond the minimum record length) can be included in the reformatted record as the last part. In this case, a value must be specified for pm that is less than or equal to the minimum record length (RECORD statement L4 value) plus 1 byte, and mp and am must be omitted. For example,

\[
\text{OUTREC } \text{FIELDS}=(1,8,20C'\ast',9)
\]

With OVERLAY, the variable part of the input record must not be included in the reformatted record.

- If INREC with FIELDS or BUILD and OUTREC with FIELDS and BUILD are specified, either both must specify position-only for the last part, or neither must specify position-only for the last part. OVERLAY or IFTHEN, and FIELDS or BUILD, can differ with respect to position-only. See "INREC Statement Notes" on page 148 for more details.
- If the reformatted record includes only the RDW and the variable part of the input record, “null” records containing only an RDW may result.
- The reformatted output records are in the format specified by OUTREC regardless of whether INREC was specified.
- Fields referenced in OUTREC statements can overlap each other or control fields.
- If input is variable records, the output is also variable. This means that each record is given the correct RDW by DFSORT before output.
- When OUTREC is specified, your E35 user exit routine must refer to fields in the reformatted output record.
- DFSORT issues a message and terminates processing if an OUTREC statement is specified for a tape work data set sort or conventional merge application.
- When you specify OUTREC, VLSHRT is not used. If VLSHRT is specified, it is ignored.
- If SZERO is in effect, −0 is treated as negative and +0 is treated as positive for edited or converted input fields, decimal constants, and the results of arithmetic expressions. If NOSZERO is in effect, −0 and +0 are treated as positive for edited or converted input fields, decimal constants, and the results of arithmetic expressions.
- If SZERO is in effect, −0 compares as less than +0 when numeric fields and constants are used. If NOSZERO is in effect, −0 compares as equal to +0 when numeric fields and constants are used.

**Note:** OPTION SZERO or OPTION NOSZERO is ignored for OUTREC IFTHEN=(WHEN=(logexp),...) unless the OPTION statement is found in a higher source (for example, DFSPARM is a higher source than SYSIN) or before the OUTREC statement in the same source. For example, NOSZERO will be used in both of the following cases:

Case 1:
Reformatting Records After Processing — Examples

Both INREC and OUTREC can be used to reformat records, either separately or together. The two control statements perform similar functions, although INREC reformats records before sort, merge, or copy processing, whereas OUTREC reformats records after sort, merge, or copy processing. This section shows OUTREC examples. See "Reformatting Records Before Processing — Examples" on page 150 for INREC examples.

Example 1

OUTREC FIELDS=(11,32)

This statement specifies that the output record is to contain 32 bytes beginning with byte 11 of the input record. This statement can be used only with fixed-length input records, because it does not include the first 4 bytes.

Example 2

OUTREC FIELDS=(1,4,11,32,D,101)

This statement is for variable-length records of minimum length 100 bytes, and specifies that the output record is to contain an RDW plus 32 bytes of the input record starting at byte 11 (aligned on a doubleword boundary, relative to the start of the record) plus the entire variable portion of the input record.

Example 3

OUTREC FIELDS=(1,42,D,101)

This statement is for variable-length records of minimum length 100 bytes, and specifies that the output record should contain an RDW plus the first 38 data bytes of the input record plus the entire variable portion of the input record.

The 'D' parameter has no effect because the first field is always placed at the beginning of the output record.

Example 4

SORT FIELDS=(20,4,CH,D,10,3,CH,D)
OUTREC FIELDS=(7:20,4,C' FUTURE ',20,2,10,3,1Z,1,9,13,7,24,57,TRAN=LTOU,6X'FF')

This example illustrates how a fixed-length input data set can be sorted and reformatted for output. The SORTIN LRECL is 80 bytes.

The reformatted output records are fixed length with a record size of 103 bytes. SOLRF (the IBM-supplied default) is in effect, so unless the SORTOUT LRECL is
specified or available, it will automatically be set to the reformatted record length of 103. The reformatted records look as follows:

<table>
<thead>
<tr>
<th>Position</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-6</td>
<td>EBCDIC blanks for column alignment</td>
</tr>
<tr>
<td>7-10</td>
<td>Input positions 20 through 23</td>
</tr>
<tr>
<td>11-18</td>
<td>Character string: C' FUTURE '</td>
</tr>
<tr>
<td>19-20</td>
<td>Input positions 20 through 21</td>
</tr>
<tr>
<td>21-23</td>
<td>Input positions 10 through 12</td>
</tr>
<tr>
<td>24</td>
<td>Binary zero</td>
</tr>
<tr>
<td>25-33</td>
<td>Input positions 1 through 9</td>
</tr>
<tr>
<td>34-40</td>
<td>Input positions 13 through 19</td>
</tr>
<tr>
<td>41-97</td>
<td>Input positions 24 through 80 with lowercase EBCDIC letters converted to uppercase EBCDIC letters</td>
</tr>
<tr>
<td>98-103</td>
<td>Hexadecimal string: X'FFFFFFFFFFFF'</td>
</tr>
</tbody>
</table>

**Example 5**

SORT FIELDS=(12,4,PD,D)
RECORD TYPE=V,LENGTH=(,,100)
OUTREC FIELDS=(1,7,5Z,5X,28,8,6X,101)

This example illustrates how a variable-length input data set can be sorted and reformatted for output. The variable part of the input records is included in the output records. The minimum input record size is 100 bytes and the maximum input record size (SORTIN LRECL or maximum record size for VSAM) is 200 bytes.

The reformatted output records are variable-length with a maximum record size of 131 bytes. The reformatted records look as follows:

<table>
<thead>
<tr>
<th>Position</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-4</td>
<td>RDW (input positions 1 through 4)</td>
</tr>
<tr>
<td>5-7</td>
<td>Input positions 5 through 7</td>
</tr>
<tr>
<td>8-12</td>
<td>Binary zeros</td>
</tr>
<tr>
<td>13-17</td>
<td>EBCDIC blanks</td>
</tr>
<tr>
<td>18-25</td>
<td>Input positions 28 through 35</td>
</tr>
<tr>
<td>26-31</td>
<td>EBCDIC blanks</td>
</tr>
<tr>
<td>32-n</td>
<td>Input positions 101 through n (variable part of input records)</td>
</tr>
</tbody>
</table>

**Example 6**

MERGE FIELDS=(28,4,BI,A)
OUTREC BUILD=(1,4,5Z,5X,5,3,28,8,6Z,DATE3-1)

This example illustrates how input files can be merged and reformatted for output, with yesterday’s date included. The variable part of the input records is not to be included in the output records. The SORTINnn LRECL is 50 bytes.

The reformatted output records are variable-length with a maximum record size of 38 bytes. The reformatted records look as follows:

<table>
<thead>
<tr>
<th>Position</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-4</td>
<td>RDW (input positions 1 through 4)</td>
</tr>
<tr>
<td>5-9</td>
<td>Binary zeros</td>
</tr>
<tr>
<td>10-14</td>
<td>EBCDIC blanks</td>
</tr>
<tr>
<td>15-17</td>
<td>Input positions 5 through 7</td>
</tr>
<tr>
<td>18-25</td>
<td>Input positions 28 through 35</td>
</tr>
<tr>
<td>26-31</td>
<td>Binary zeros</td>
</tr>
<tr>
<td>32-38</td>
<td>Yesterday's date in the form C'yyyyyddd'</td>
</tr>
</tbody>
</table>
**OUTREC Control Statement**

**Example 7**

```
OPTION COPY,Y2PAST=1985
OUTREC FIELDS=(SEQNUM,8,ZD,START=1000,INCR=100,
11:8,4,PD,M12,
31:15,4,Y2V(/),
51:2,1,CHANGE=(3,
  X'01',C'L92',X'02',C'M72',X'03',C'J42'),
NOMATCH=(C'???' ))
```

This example illustrates how a sequence number can be generated, how numeric and date values can be edited, and how a lookup table can be used.

The reformatted output records look as follows:

<table>
<thead>
<tr>
<th>Position</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-8</td>
<td>A zoned decimal sequence number that starts at 1000 and increments by 100.</td>
</tr>
<tr>
<td>11-20</td>
<td>A CH field containing the PD field from input positions 8 through 11 edited according to the M12 edit mask.</td>
</tr>
<tr>
<td>31-40</td>
<td>A C’yymm/dd’ date field containing the P’yymmdd’ date field from input positions 15-18 transformed according to the specified century window of 1985-2084.</td>
</tr>
<tr>
<td>51-53</td>
<td>A CH field containing C’L92’, C’M72’, C’J42’ or C’???’ as determined by using a lookup table for the input field in position 2.</td>
</tr>
</tbody>
</table>

**Example 8**

```
SORT FIELDS=(11,4,CH,D)
OUTREC FIELDS=(1,20,
(5,4,FI,ADD,3,2,FI,ADD,23,2,FI),DIV,+1000,
EDIT=(STTTTTTT),SIGNS=(,-),ZX,
9,5,ZD,MIN,16,5,FS,TO=ZD,LENGTH=5,ZX,
21,40)
```

This example illustrates how input records can be reformatted for output to contain the results of arithmetic expressions involving input fields, decimal constants, operators and parentheses.

The reformatted output records look as follows:

<table>
<thead>
<tr>
<th>Position</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-20</td>
<td>Input positions 1 through 20</td>
</tr>
<tr>
<td>21-28</td>
<td>A CH field containing the total of the FI fields from positions 5 through 8, 3 through 4 and 23 through 24, divided by 1000, and edited according to the specified edit pattern.</td>
</tr>
<tr>
<td>29-30</td>
<td>EBCDIC blanks</td>
</tr>
<tr>
<td>31-35</td>
<td>A ZD field containing the minimum of the ZD field in positions 9 through 13 and the FS field in positions 16 through 20.</td>
</tr>
<tr>
<td>36-37</td>
<td>EBCDIC blanks</td>
</tr>
<tr>
<td>38-77</td>
<td>Input positions 21-60</td>
</tr>
</tbody>
</table>

**Example 9**

```
OPTION COPY
OUTREC IFTHEN=(WHEN=(3,2,SS,EQ,C’FR,MX,GR’),
OVERLAY=(11:DATE=(DMM.),TIME1(.))),
  IFTHEN=(WHEN=(3,2,SS,EQ,C’CN,US,EN’),
    OVERLAY=(11:DATE=(4MD/),TIME1(:)))
```

This example illustrates how you can use IFTHEN clauses with OUTREC to reformat different records in different ways.
OUTREC Control Statement

For records with 'FR', 'GR' or 'MX' in positions 3-4, positions 11-20 of the reformatted output records are overlaid with a date of the form 'dd.mm.yyyy' and positions 21-28 are overlaid with a time of the form 'hh:mm:ss'. The data before positions 11-28 and after positions 11-28 are not affected.

For records with 'CN', 'US' or 'EN' in positions 3-4, positions 11-20 of the reformatted output records are overlaid with a date of the form 'yyyy/mm/dd' and positions 21-28 are overlaid with a time of the form 'hh:mm:ss'. The data before positions 11-28 and after positions 11-28 are not affected.

Since an IFTHEN clause with WHEN=NONE is not specified, records without 'FR', 'GR', 'MX', 'CN', 'US' or 'EN' in positions 3-4 are not changed.

Example 10

```
OPTION COPY
OUTREC OVERLAY=(31:11,10,ZD,DIV,+1200,TO=PD,LENGTH=6,
37:11,10,ZD,MOD,+1200,TO=PD,LENGTH=4)
```

This example illustrates how you can use the OVERLAY parameter with OUTREC to change certain columns in your records without affecting other columns.

Positions 31-36 of the reformatted input records are overlaid with a 6-byte PD value equal to the quotient of the 10-byte ZD value at positions 11-20 divided by +1200. Positions 37-40 of the reformatted input records are overlaid with a 4-byte PD value equal to the remainder of the 10-byte ZD value at positions 11-20 divided by +1200. The data before positions 31-40 and after positions 31-40 are not affected.

Example 11

```
OPTION COPY
OUTREC IFTHEN=(WHEN=INIT,
OVERLAY=(81:11,10,
11:81,10,ZD,DIV,+1200,TO=PD,LENGTH=6,
17:81,10,ZD,MOD,+1200,TO=PD,LENGTH=4)),
IFOUTLEN=80
```

In the previous example (Example 10), we used OVERLAY to overlay positions 31-40 with PD fields for the quotient and remainder of the 10-byte ZD value at positions 11-20 divided by +1200. In this example, we want to overlay positions 11-20 with the quotient and remainder. The input records are 80 bytes and fixed-length and we want the output records to be 80 bytes and fixed-length as well.

If we just overlaid the fields directly as before, we would “ruin” the ZD value before we could use it to get the remainder; the PD quotient would overlay positions 11-16, so positions 11-20 would no longer contain the ZD value we need to get the remainder.

In order to overlay the ZD value itself with the PD values, we make a copy of the 10 byte ZD value after the end of the record, and then overlay the original ZD value with the quotient and remainder derived from the copy of the ZD value.

By making a copy of the 10 byte ZD value at the end of the record, we extend the record length from 80 bytes to 90 bytes. Since we want the final record length to be 80 bytes, we must remove the extra 10 bytes. So instead of just using the OVERLAY parameter, we use an IFTHEN WHEN=INIT clause with OVERLAY, and
OUTREC Control Statement

IFOUTLEN=80. Alternatively, we could use an OVERLAY parameter on the OUTREC statement, followed by an OUTFIL statement, to remove the extra 10 bytes like this:

```
OPTION COPY
OUTREC OVERLAY=(81:11,10,
               11:81,10,2D,DIV,+1200,TO=PD,LENGTH=6,
               17:81,10,2D,MOD,+1200,TO=PD,LENGTH=4)
```

OUTFIL OUTREC=(1,80)

**Example 12**

```
OPTION COPY
OUTREC OVERLAY=(11:11,16,JFY=(SHIFT=RIGHT,LEAD=C'(',
               TRAIL=C')',LENGTH=18))
```

This example illustrates how you can right-justify fields within your records.

The 50-byte FB input records might look like this:

```
0001  9-1-632-731
0002  011-276-321-7836
0003  753-218-307
0004  528-314
```

Note that the second field has left-justified numeric values in various forms. We want to right-justify these values and surround them with a left parenthesis and right parenthesis.

The 50-byte FB output records look like this:

```
0001  (9-1-632-731)
0002  (011-276-321-7836)
0003  (753-218-307)
0004  (528-314)
```

We use OUTFIL OVERLAY to limit the changes to the second field. We use JFY to right-justify the second field with surrounding parentheses. SHIFT=RIGHT shifts the characters to the right. LEAD=C'(' adds a left parenthesis before the first non-blank character. TRAIL=C')' adds a right parenthesis after the last non-blank character. LENGTH=18 increases the output length by 2 bytes to allow for the parentheses (overriding the default of 16 from the input length).

**Example 13**

```
OPTION COPY
OUTREC PARSE=(%01=(ABSPOS=2,FIXLEN=13,ENDBEFR=C'"'),
               %=(ENDBEFR=C'"'),
               %03=(FIXLEN=6,ENDBEFR=C'"'),
               %04=(FIXLEN=6,ENDBEFR=C'"'),
               %05=(FIXLEN=12,ENDBEFR=C'"')),
            BUILD=(%01,20:%03,SFF,ADD,%04,SFF,EDIT=(SIIT.T),SIGNS=(,-),
                   31:%05)
```

This example illustrates how you can reformat records containing variable position/length fields, such as comma separated values.

The 80-byte input records might look like this:

```
"Buffy Summers","F","+725.8","-27.3","Sunnydale"
"Bruce Wayne","M","-5.3","-173.2","Gotham City"
"Clark Kent","M","+21.3","-15.8","Metropolis"
"Diana Prince","F","-16.4","+128.9","Gateway City"
```
Note that each record has five variable fields, each enclosed in quotes and separated by a comma. The fields do not start and end in the same position in every record and they have different lengths in different records.

The 42-byte output records should look like this:

- Buffy Summers 698.5 Sunnydale
- Bruce Wayne -178.5 Gotham City
- Clark Kent 5.5 Metropolis
- Diana Prince 112.5 Gateway City

The first fixed-length output field corresponds to the first variable input field. The second fixed-length output field corresponds to the total of the third and fourth variable input fields. The third fixed-length output field corresponds to the fifth variable input field.

In order to reformat the input records for output, we use PARSE and BUILD to create the fixed parsed fields we need from the variable position/length fields; the quotes around each value are removed. %00 is used for the first input field. % is used to ignore the second input field. %03 and %04 are used for the third and fourth input fields which are added together using SFF format. %05 is used for the fifth input field.

**Example 14**

```plaintext
OPTION COPY
OUTREC IFTHEN=(WHEN=INIT,
    PARSE=(%00=(FIXLEN=3,ENDBEFR=C'.'),
            %01=(FIXLEN=3,ENDBEFR=C'.'),
            %02=(FIXLEN=3,ENDBEFR=C'.'),
            %03=(FIXLEN=3)),
    BUILD=(%00,4:C'.',5:%01,8:C'.',9:%02,12:C'.',13:%03)),
    IFTHEN=(WHEN=(1,3,CH,EQ,C'167',AND,13,3,CH,EQ,C'99'),
            OVERLAY=(5:C'113',9:C'75',1:15,SQZ=(SHIFT=LEFT))),
    IFTHEN=(WHEN=NONE,
            BUILD=(1:1,15,SQZ=(SHIFT=LEFT)))
```

This example illustrates how you can modify variable position/length fields, such as ftp addresses.

The 15-byte input records might look like this:

- 167.113.117.99
- 167.90.18.99
- 167.80.118.98
- 165.250.89.562
- 167.125.890.99
- 168.250.89.99
- 167.125.890.99
- 0.0.0.0
- 167.90.580.99

We want to convert each FTP address of the form 167.x.y.99 to 167.113.75.99. x and y can be any 1-3 digit value. Thus, the 15-byte output records should look like this:

- 167.113.75.99
- 167.113.75.99
- 167.80.118.98
- 165.250.89.562
- 167.125.890.99
- 168.250.89.99
- 167.113.75.99
- 0.0.0.0
- 167.113.75.99

---

**OUTREC Control Statement**
In order to reformat the input records for output, we use IFTHEN clauses as follows:

- **IFTHEN WHEN=INIT clause**: We PARSE the four variable numeric values into four 3-byte fixed parsed fields using %00, %01, %02 and %03 respectively. We reformat the record with %00, a period, %01, a period, %02, a period and %03. At this point, the reformatted records look like this:
  
  | 167.113.117.99 |
  | 167.90 .18 .99 |
  | 167.80 .118.98 |
  | 165.250.89 .562 |
  | 167.125.890.95 |
  | 168.250.89 .99 |
  | 167.125.890.99 |
  | 0 .0 .0 .0 |
  | 167.90 .580.99 |

- **IFTHEN WHEN=(logexp) clause**: If the first fixed-length field is '167' and the fourth fixed-length field is '99', we overlay the second fixed-length field with '113' and the third fixed-length field with '75'. Then we squeeze the fields to the left to remove the blanks.

- **IFTHEN WHEN=NONE clause**: If the first fixed-length field is not '167' or the fourth fixed-length field is not '99', we squeeze the fields to the left to remove the blanks.

**Example 15**

SORT FIELDS=(1,2,CH,A)
OUTREC FINDREP=(IN=C'*',OUT=C' ')

This example illustrates how you can replace a character with another character anywhere in FB or VB records.

The FB input records might look like this:

| 05 ***** JUNE **************  |
| 02 * APRIL *                 |
| 01* * * * DAISY * * * *     |
| 03BETTY ***********          |

We want to replace every asterisk with a blank. We use IN=C'\*\' to indicate we want to find each asterisk, and OUT=C'\ ' to indicate we want to replace it with a blank.

The sorted output records look like this:

| 01 DAISY            |
| 02 APRIL           |
| 03BETTY            |
| 05 JUNE            |

**Example 16**

OPTION COPY
OUTREC IFTHEN=(WHEN=GROUP,BEGIN=(1,3,CH,EQ,C'HDR'),
               END=(1,3,CH,EQ,C'TRL'),PUSH=(31:ID=1))
OUTFIL INCLUDE=(31,1,CH,NE,C' '),BUILD=(1,30)

This example illustrates how you can INCLUDE groups of FB records between a header and a trailer. We add an ID after the end of each record to indicate whether it's part of a group or not, INCLUDE on the ID, and then remove it.

The 30-byte FB input records might look like this:
In the output data set we only want to include groups of records that start with ‘HDR’ and end with ‘TRL’.

We use an IFTHEN WHEN=GROUP clause to put a non-blank character in each record that is part of a group. BEGIN indicates a group starts with a record that has ‘HDR’ in positions 1-3. END indicates a group ends with a record that has ‘TRL’ in positions 1-3. PUSH overlays a 1-byte ID character at position 31 in each record of a group (after the end of the record). After the IFTHEN GROUP clause is executed, the intermediate records look like this:

C33 Not in a group
HDR Start Group 1
A01 Group 1 record
B02 Group 1 record
C03 Group 1 record
TRL End Group 1
R24 Not in a group
T02 Not in a group
HDR Start Group 2
D04 Group 2 record
E05 Group 2 record
TRL End Group 2
F97 Not in a group

Note that the records within a group have a non-blank character in position 31 whereas the records outside groups have a blank character in position 31. The ID starts at 1 for the first group and is incremented by 1 for each subsequent group. Since we are only allowing one character for the ID, when the ID counter gets to 10, a ‘0’ will appear in position 31. That’s fine since we are just looking for a non-blank to indicate a record within a group, or a blank to indicate a record outside of a group.

We use an OUTFIL statement to only INCLUDE records with a non-blank in position 31, and to remove the ID character so the included output records will be identical to the input records. After the OUTFIL statement is executed, the final output records look like this:

HDR Start Group 1
A01 Group 1 record
B02 Group 1 record
C03 Group 1 record
TRL End Group 1
HDR Start Group 2
D04 Group 2 record
E05 Group 2 record
TRL End Group 2
OUTREC Control Statement

Example 17

OPTION COPY
OUTREC IFTHEN=(WHEN=INIT,BUILD=(1,4,6:5)),
  IFTHEN=(WHEN=GROUP,BEGIN=(6,3,CH,EQ,'HDR'),
  END=(6,3,CH,EQ,'TRL'),PUSH=(5:ID=1))
OUTFIL INCLUDE=(5,1,CH,NE,C' '),BUILD=(1,4,5:6)

This example illustrates how you can INCLUDE groups of VB records between a
header and a trailer. It's similar to Example 16, but here the records are
variable-length. For the FB records, we could add the ID after the end of each
record and then remove it without changing the records. But we can't add the ID
at the end of each VB record because that would pad all of the records to a fixed
length. So, instead we insert the ID between the RDW and the first data byte of
each record, and later remove it.

The VB input records might look like this:

<table>
<thead>
<tr>
<th>Len</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>C33</td>
</tr>
<tr>
<td>23</td>
<td>HDR</td>
</tr>
<tr>
<td>25</td>
<td>A01</td>
</tr>
<tr>
<td>25</td>
<td>B02</td>
</tr>
<tr>
<td>25</td>
<td>C03</td>
</tr>
<tr>
<td>21</td>
<td>TRL</td>
</tr>
<tr>
<td>23</td>
<td>R24</td>
</tr>
<tr>
<td>23</td>
<td>T02</td>
</tr>
<tr>
<td>24</td>
<td>HDR</td>
</tr>
<tr>
<td>25</td>
<td>D04</td>
</tr>
<tr>
<td>25</td>
<td>E05</td>
</tr>
<tr>
<td>21</td>
<td>TRL</td>
</tr>
<tr>
<td>25</td>
<td>F97</td>
</tr>
</tbody>
</table>

In the output data set we only want to include groups of records that start with
'HDR' and end with 'TRL'.

We use an IFTHEN WHEN=INIT clause to reformat each record so it has room for
the ID byte between the RDW and the first data byte. After the WHEN=INIT
clause is executed, the intermediate records look like this:

<table>
<thead>
<tr>
<th>Len</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>C33</td>
</tr>
<tr>
<td>24</td>
<td>HDR</td>
</tr>
<tr>
<td>26</td>
<td>A01</td>
</tr>
<tr>
<td>26</td>
<td>B02</td>
</tr>
<tr>
<td>26</td>
<td>C03</td>
</tr>
<tr>
<td>22</td>
<td>TRL</td>
</tr>
<tr>
<td>24</td>
<td>R24</td>
</tr>
<tr>
<td>24</td>
<td>T02</td>
</tr>
<tr>
<td>24</td>
<td>HDR</td>
</tr>
<tr>
<td>26</td>
<td>D04</td>
</tr>
<tr>
<td>26</td>
<td>E05</td>
</tr>
<tr>
<td>22</td>
<td>TRL</td>
</tr>
<tr>
<td>26</td>
<td>F97</td>
</tr>
</tbody>
</table>

Note that position 5 is blank and the 'HDR' and 'TRL' characters have been shifted
over to positions 6-8.

We use an IFTHEN WHEN=GROUP clause to put a non-blank character in each
record that is part of a group. BEGIN indicates a group starts with a record that
has 'HDR' in positions 6-8. END indicates a group ends with a record that has
'TRL' in positions 6-8. PUSH overlays a 1-byte ID character at position 5 in each record of a group. After the IFTHEN GROUP clause is executed, the intermediate records look like this:

<table>
<thead>
<tr>
<th>Len</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>C33 Not in a group</td>
</tr>
<tr>
<td>24</td>
<td>1HDR Start Group 1</td>
</tr>
<tr>
<td>26</td>
<td>1A01 Group 1 record</td>
</tr>
<tr>
<td>26</td>
<td>1B02 Group 1 record</td>
</tr>
<tr>
<td>26</td>
<td>1C03 Group 1 record</td>
</tr>
<tr>
<td>22</td>
<td>TRL End Group 1</td>
</tr>
<tr>
<td>24</td>
<td>R24 Not in a group</td>
</tr>
<tr>
<td>24</td>
<td>T02 Not in a group</td>
</tr>
<tr>
<td>24</td>
<td>2HDR Start Group 2</td>
</tr>
<tr>
<td>26</td>
<td>2D04 Group 2 record</td>
</tr>
<tr>
<td>26</td>
<td>2E05 Group 2 record</td>
</tr>
<tr>
<td>22</td>
<td>2TRL End Group 2</td>
</tr>
<tr>
<td>26</td>
<td>F97 Not in a group</td>
</tr>
</tbody>
</table>

Note that the records within a group have a non-blank character in position 5 whereas the records outside groups have a blank character in position 5. The ID starts at 1 for the first group and is incremented by 1 for each subsequent group. Since we are only allowing one character for the ID, when the ID counter gets to 10, a '0' will appear in position 5. That's fine since we are just looking for a non-blank to indicate a record within a group, or a blank to indicate a record outside of a group.

We use an OUTFIL statement to only INCLUDE records with a non-blank in position 5, and to remove the ID character so the included output records will be identical to the input records. After the OUTFIL statement is executed, the final output records look like this:

<table>
<thead>
<tr>
<th>Len</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>HDR Start Group 1</td>
</tr>
<tr>
<td>25</td>
<td>A01 Group 1 record</td>
</tr>
<tr>
<td>25</td>
<td>B02 Group 1 record</td>
</tr>
<tr>
<td>25</td>
<td>C03 Group 1 record</td>
</tr>
<tr>
<td>21</td>
<td>TRL End Group 1</td>
</tr>
<tr>
<td>23</td>
<td>HDR Start Group 2</td>
</tr>
<tr>
<td>25</td>
<td>D04 Group 2 record</td>
</tr>
<tr>
<td>25</td>
<td>E05 Group 2 record</td>
</tr>
<tr>
<td>21</td>
<td>TRL End Group 2</td>
</tr>
</tbody>
</table>

**Example 18**

```
SORT FIELDS=(1,12,CH,A)
OUTREC OVERLAY=(30:16,8,Y4T,TOGREG=Y4T)
OUTFIL INCLUDE=(30,1,CH,EQ,C'*')
```

This example illustrates how to list records with dates outside of the valid range (for example, a month not between 01-12).

**Note:** Dates with an invalid digit (A-F) can result in a data exception (0C7 ABEND).

The input records might be as follows:

<table>
<thead>
<tr>
<th>Name</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Betten</td>
<td>20091021</td>
</tr>
<tr>
<td>Vezinaw</td>
<td>20091101</td>
</tr>
<tr>
<td>Casad</td>
<td>00000000</td>
</tr>
<tr>
<td>Boenig</td>
<td>20091325</td>
</tr>
<tr>
<td>Kolusu</td>
<td>20090931</td>
</tr>
<tr>
<td>Yaeger</td>
<td>20090731</td>
</tr>
</tbody>
</table>
The SORT statement sorts the records by the name in positions 1-12. After the SORT statement is processed, the sorted records will look like this:

```
Betten  20091021
Boenig  20091325
Casad   00000000
Kolusu  20090931
Vezinaw 20091101
Yaeger  20090731
```

The OUTREC statement uses TOGREG to convert each ccymmd value in positions 16-23 to a ccymmd value in positions 30-37; the third column will be identical to the second column for valid dates and special indicators, but will contain asterisks for invalid dates. After the OUTREC statement is processed, the reformatted records will look like this:

```
Betten  20091021  20091021
Boenig  20091325  ********
Casad   00000000  00000000
Kolusu  20090931  ********
Vezinaw 20091101  20091101
Yaeger  20090731  20090731
```

The OUTFIL statement selects the records that have an asterisk in position 30, that is, the records with an invalid date. The Boenig record is invalid because mm is 13, and the Kolusu record is invalid because mm is 09 but dd is 31 (September only has 30 days). Note that the special indicator of all 0s for the Casad record is valid. The output records would be as follows:

```
Boenig  20091325  ********
Kolusu  20090931  ********
```

**Example 19**

```
OPTION COPY,Y2PAST=1990
OUTREC IFTHEN=(WHEN=INIT,
    BUILD=(1:1,8,UFF,TO=ZD,LENGTH=6,8:11,6,UFF,TO=ZD,LENGTH=5)),
    IFTHEN=(WHEN=INIT,
        BUILD=(1,6,Y2W,DATEDIFF,8,5,Y2T))
```

This example illustrates how you can calculate the difference in days between two different types of date fields, each of which has separators.

The SORTIN data set has these input records with a C'mm/dd/yy' date field in positions 1-8 and a C'yy/ddd' date field in positions 11-16:

```
03/05/07  07/052
12/13/07  08/193
02/19/08  08/365
09/01/08  09/001
11/22/09  09/015
07/22/98  01/121
01/15/09  09/015
09/15/10  09/322
06/30/10  08/050
```

The OUTREC statement calculates the number of days for date1-date2 and puts the result in the output record in positions 1-8.

The first IFTHEN clause removes the / separators from date1 and date2 so we can use them in DATEDIFF. After the first IFTHEN clause, the records look like this, with the C'mmddyy' date in positions 1-6 and the C'yyddd' date in positions 8-12:
The second IFTHEN clause uses DATEDIFF to get the number of days between date1 and date2. We use 1,6,Y2W to match the C’mmddyy’ date and 8,5,Y2T to match the C’yyddd’ date.

SORTOUT will have these records:
+0000012
-0000211
-0000315
-0000122
+0000311
-0001014
+0000000
+0000301
+0000862

Note that when date1>=date2, the result is a positive value, and when date1<date2, the result is a negative value.

**RECORD Control Statement**
The RECORD control statement can be used to specify the type and lengths of the records being processed, and the minimum and average record lengths for a variable-length sort.

The RECORD control statement is required when:
- A user exit changes record lengths.
- A user exit supplies all of the input records.
- A Conventional merge or tape work data set sort uses VSAM input.

**TYPE**

Can be used to specify the record type when input is VSAM, or an E15 or E32 exit supplies all of the input records. The record type can be:
- **Fixed-length (F).** The records are processed without an RDW, so the data starts in position 1. Control statement positions should be specified accordingly.
  
  An RRDS can always be processed as fixed-length. A KSDS, ESDS or VRRDS used for input should only be processed as fixed-length if all of its records have a length equal to the maximum record size defined for the cluster. Otherwise, input records which are shorter than the maximum record size are padded with bytes that may or may not be zeros (that is, "garbage" bytes).

- **Variable-length (V).** The records are processed with an RDW in positions 1-4, so the data starts in position 5. Control statement positions should be specified accordingly.
  
  An RRDS, KSDS, ESDS or VRRDS can always be processed as variable-length. For VSAM input, DFSORT reads each record and prepends an RDW to it. For VSAM output, DFSORT removes the RDW before writing each record.

**Notes:**
- If the selected record type is not what you want DFSORT to use, specify RECORD TYPE=F or RECORD TYPE=V as appropriate.
b. For a Conventional merge or tape work data set sort, you must specify
RECORD TYPE=F or RECORD TYPE=V as appropriate.

x can be one of the following:

- **F**: fixed-length record processing.
  
  **Note**: FB can be used instead of F.

- **V**: variable-length record processing.
  
  **Note**: VB can be used instead of V.

- **D**: ASCII variable-length record processing.
  
  **Note**: DB can be used instead of D.

*Default*: F or V as described above. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.


---

**LENGTH**

Can be used to specify various record lengths. L1 through L3 apply to fixed-length and variable-length record processing. L4 and L5 apply to variable-length record processing. L6 and L7 are accepted, but not used.

**LENGTH** is required only if:

- A user exit changes record lengths.
- A user exit supplies all of the input records.

**L1**: Input record length. For variable-length records, maximum input record length.

**Notes:**

1. L1 is ignored if the input record length is available from SORTIN.
2. L1 is required if there is no SORTIN or SORTINnn data set, unless L2 is specified.

*Default*: The SORTIN or SORTINnn record length. For VSAM data sets, the maximum record size (RECSZ value).
**RECORD Control Statement**

**L2**  Record length after E15. For variable-length records, maximum record length after E15.

**Notes:**
1. L2 is ignored if E15 is not used.
2. An accurate value for L2 must be specified if E15 changes the record length.
3. L2 must be at least 18 bytes if tape work data sets are used.
4. L2 is ignored if there is no SORTIN or SORTINnn data set, unless L1 is not specified.

*Default:* L1.

**L3**  Output record length. For variable—length records, maximum output record length.

**Note:** L3 is ignored if the record length (LRECL or VSAM RECSZ) is available from SORTOUT, or if NOSOLRF is in effect and E35, INREC, OUTREC, and OUTFIL are *not* used.

*Default:* One of the following, in the order listed:
1. SORTOUT record length if available
2. OUTREC record length if SOLRF is in effect
3. INREC record length if SOLRF is in effect
4. L2 if specified providing an E15 is used
5. SORTIN or SORTINnn record length if available
6. L1

**L4**  Minimum record length.

**Notes:**
1. L4 is not used if the Blockset technique is selected
2. L4 is only used for variable-length record sort applications.
3. Specifying L4 may improve performance, but if L4 is too large, DFSORT could fail with message ICE015A.

*Default:* The minimum length needed to contain all control fields. This number must be at least 18 bytes if the maximum input record length is greater than 18 bytes; otherwise, DFSORT sets L4 to 18 bytes.

**L5**  Average record length.

**Notes:**
1. L5 is not used if the Blockset technique is selected
2. L5 is overridden by the AVGRLEN parameter if both are specified
3. L5 is only used for variable-length sorts.

*Default:* None; optional.

**L6, L7**  Record lengths that are accepted but are reserved for future use.

**Notes:**
1. You can drop values from the right. For example, LENGTH=(80,70,70,70).
2. You can omit values from the middle or left, provided you indicate their omission by a comma or semicolon. For example, LENGTH=(,,30,80).
3. Parentheses are optional when L1 alone is specified. If any of L2 through L7 is specified, with or without L1, parentheses are required.


Describing the Record Format and Length—Examples

Example 1
MODS E15=(INEX,1000,EXIT),E35=(OUTEX,2000,EXIT)
RECORD LENGTH=(),175,180)

This example illustrates how the RECORD statement can be used to indicate that E15 and E35 exits change the record length. The record type (F) and input record length (200) are obtained automatically from the RECFM and LRECL of the input data set, respectively.

LENGTH
L2 specifies that the E15 exit passes back 175 byte records. L3 specifies that the E35 exit passes back 180 byte records.

Example 2
MODS E15=(E15ONLY,1000,EXIT)
RECORD TYPE=V,LENGTH=60

This example illustrates how the RECORD statement can be used to set the record type and maximum input record length when an E15 exit supplies all of the input as variable-length records.

TYPE
V specifies that the E15 exit inserts variable-length records, that is, the inserted records contain an RDW in positions 1-4 and the data starts in position 5.

LENGTH
L1 specifies that the E15 exit inserts records with a maximum length of 60 bytes.

REFORMAT Control Statement

Used only for a JOINKEYS application. See Chapter 4, “Using a JOINKEYS Application for Joining Two Files,” on page 457 for details.
The SORT control statement must be used when a sorting application is performed; this statement describes the control fields in the input records on which the program sorts. A SORT statement can also be used to specify a copy application. User labels will not be copied to the output data sets.

The way in which DFSORT processes short SORT control fields depends on the setting for VLSHRT/NOVLSHRT. A short field is one where the variable-length record is too short to contain the entire field, that is, the field extends beyond the record. For details about sorting short records, see the discussion of the VLSHRT and NOVLSHRT options in the OPTION Control Statement on page 173.

The options available on the SORT statement can be specified in other sources as well. A table showing all possible sources for these options and the order of override is given in Appendix B, “Specification/Override of DFSORT Options,” on page 857.

When an option can be specified on either the SORT or OPTION statement, it is preferable to specify it on the OPTION statement.
DFSORT accepts but does not process the following SORT operands: WORK=value and ORDER=value.

DFSORT’s collating behavior can be modified according to your cultural environment. The cultural environment is established by selecting the active locale. The active locale’s collating rules affect SORT processing as follows:

- DFSORT produces sorted records for output according to the collating rules defined in the active locale. This provides sorting for single- or multi-byte character data, based on defined collating rules that retain the cultural and local characteristics of a language.

If locale processing is to be used, the active locale will only be used to process character (CH) control fields.

For more information on locale processing, see “Cultural Environment Considerations” on page 7 or LOCALE in “OPTION Control Statement” on page 173.

**FIELDS**

Requires four facts about each control field in the input records: the position of the field within the record, the length of the field, the format of the data in the field, and the sequence into which the field is to be sorted. These facts are communicated to DFSORT by the values of the FIELDS operand, represented by p, m, f, and s.

The value for f can optionally be specified by the FORMAT=f parameter as explained later in this section.

All control fields must be located within the first 32752 bytes of a record.

The maximum length of the collected control fields for which Blockset can be used is 4088 bytes. However, the maximum length can be less than 4088 for various situations, such as the use of certain formats (for example, PD), the EQUALS option, and so on. If this maximum is exceeded, Blockset cannot be used.

The FIELDS operand can be written in two ways.

The program examines the major control field first, and it must be specified first. The minor control fields are specified following the major control field. p, m, f, and s describe the control fields. The text that follows gives specifications in detail.

- **p** specifies the first byte of a control field relative to the beginning of the input record. ¹³

  The first data byte of a fixed-length record has relative position 1. The first data byte of a variable-length record has relative position 5. The first 4

¹³. If INREC is specified, p must refer to the record as reformatted by INREC. If your E15 user exit reformat the record, and INREC is not specified, p must refer to the record as reformatted by your E15 user exit.
SORT Control Statement

bytes contain the record descriptor word. All control fields, except binary, must begin on a byte boundary. The first byte of a floating-point field is interpreted as a signed exponent; the rest of the field is interpreted as the fraction.

Fields containing binary values are described in a “bytes.bits” notation as follows:

1. First, specify the byte location relative to the beginning of the record and follow it with a period.
2. Then, specify the bit location relative to the beginning of that byte.
   Remember that the first (high-order) bit of a byte is bit 0 (not bit 1); the remaining bits are numbered 1 through 7.

Thus, 1.0 represents the beginning of a record. A binary field beginning on the third bit of the third byte of a record is represented as 3.2. When the beginning of a binary field falls on a byte boundary (say, for example, on the fourth byte), you can write it in one of three ways:

\[
\begin{align*}
4.0 \\
4. \\
4
\end{align*}
\]

Other examples of this notation are shown in Figure 14.

\[
\begin{array}{cccc}
\text{byte 1} & \text{byte 2} & \text{byte 3} \\
\text{bits 0 - 7} & \text{bits 0 - 7} & \text{bits 0 - 7} \\
\end{array}
\]

\[
\begin{align*}
1.0 & & 1.6 & & 2.2 & & 3.0 & & 3.1 \\
1. & & 1. & & 1. & & 3. & & 3.1 \\
\end{align*}
\]

Figure 14. Examples of Notation for Binary Fields

\[\text{m}\]

specifies the length of the control field. Values for all control fields except binary fields must be expressed in integer numbers of bytes. Binary fields can be expressed in the notation “bytes.bits”. The length of a binary control field that is an integer value (d) can be expressed in one of three ways:

\[
\begin{align*}
d.0 \\
d. \\
d
\end{align*}
\]

The number of bits specified must not exceed 7. A control field 2 bits long would be represented as 0.2.
The total number of bytes occupied by all control fields must not exceed 4092 (or, when the EQUALS option is in operation, 4088 bytes). When you determine the total, count a binary field as occupying an entire byte if it occupies any part of it. For example, a binary field that begins on byte 2.6 and is 3 bits long occupies two bytes. All fields must be completely contained within the first 32752 bytes of the record.

`f` specifies the format of the data in the control field. Acceptable control field lengths (in bytes) and available formats are shown in Table 55.

<table>
<thead>
<tr>
<th>Format</th>
<th>Length</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH</td>
<td>1 to 4092 bytes</td>
<td>Character</td>
</tr>
<tr>
<td>AQ</td>
<td>1 to 4092 bytes</td>
<td>Character with alternate collating sequence</td>
</tr>
<tr>
<td>ZD</td>
<td>1 to 256 bytes</td>
<td>Signed zoned decimal</td>
</tr>
<tr>
<td>PD</td>
<td>1 to 256 bytes</td>
<td>Signed packed decimal</td>
</tr>
<tr>
<td>PD0</td>
<td>2 to 8 bytes</td>
<td>Packed decimal with sign and first digit ignored</td>
</tr>
<tr>
<td>FI</td>
<td>1 to 256 bytes</td>
<td>Signed fixed-point</td>
</tr>
<tr>
<td>BI</td>
<td>1 bit to 4092 bytes</td>
<td>Unsigned binary</td>
</tr>
<tr>
<td>FL</td>
<td>1 to 256 bytes</td>
<td>Signed hexadecimal floating-point</td>
</tr>
<tr>
<td>AC</td>
<td>1 to 4092 bytes</td>
<td>ASCII character</td>
</tr>
<tr>
<td>CSF or FS</td>
<td>1 to 32 bytes</td>
<td>Signed numeric with optional leading floating sign</td>
</tr>
<tr>
<td>UFF</td>
<td>1 to 44 bytes</td>
<td>Unsigned free form numeric</td>
</tr>
<tr>
<td>SFF</td>
<td>1 to 44 bytes</td>
<td>Signed free form numeric</td>
</tr>
<tr>
<td>CSL or LS</td>
<td>2 to 256 bytes</td>
<td>Signed numeric with leading separate sign</td>
</tr>
<tr>
<td>CST or TS</td>
<td>2 to 256 bytes</td>
<td>Signed numeric with trailing separate sign</td>
</tr>
<tr>
<td>CLO or OL</td>
<td>1 to 256 bytes</td>
<td>Signed numeric with leading overpunch sign</td>
</tr>
<tr>
<td>CTO or OT</td>
<td>1 to 256 bytes</td>
<td>Signed numeric with trailing overpunch sign</td>
</tr>
<tr>
<td>ASL</td>
<td>2 to 256 bytes</td>
<td>Signed ASCII numeric with leading separate sign</td>
</tr>
<tr>
<td>AST</td>
<td>2 to 256 bytes</td>
<td>Signed ASCII numeric with trailing separate sign</td>
</tr>
<tr>
<td>D1</td>
<td>1 to 4092 bytes</td>
<td>User-defined data type (requires an EPS program)</td>
</tr>
<tr>
<td>Y2T</td>
<td>3 to 6 bytes</td>
<td>Character or zoned yyx...x full date format with special indicators</td>
</tr>
<tr>
<td>Y2U</td>
<td>2 or 3 bytes</td>
<td>Packed decimal yyx and yyyyy full date format with special indicators</td>
</tr>
</tbody>
</table>

14. If CHALT is in effect, CH is treated as AQ.
Table 55. Control Field Formats and Lengths (continued)

<table>
<thead>
<tr>
<th>Format</th>
<th>Length</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y2V</td>
<td>3 or 4 bytes</td>
<td>Packed decimal yyxx and yyyyyy full date format with special indicators</td>
</tr>
<tr>
<td>Y2W</td>
<td>3 to 6 bytes</td>
<td>Character or zoned x...xyy full date format with special indicators</td>
</tr>
<tr>
<td>Y2X</td>
<td>2 or 3 bytes</td>
<td>Packed decimal xyy and xxxxyy full date format with special indicators</td>
</tr>
<tr>
<td>Y2Y</td>
<td>3 or 4 bytes</td>
<td>Packed decimal xxyy and xxxxyy full date format with special indicators</td>
</tr>
<tr>
<td>Y2C or Y2Z</td>
<td>2 bytes</td>
<td>Two-digit character or zoned-decimal year data</td>
</tr>
<tr>
<td>Y2P</td>
<td>2 bytes</td>
<td>Two-digit packed-decimal year data</td>
</tr>
<tr>
<td>Y2D</td>
<td>1 byte</td>
<td>Two-digit decimal year data</td>
</tr>
<tr>
<td>Y2S</td>
<td>2 bytes</td>
<td>Two-digit character or zoned-decimal year data with special indicators</td>
</tr>
<tr>
<td>Y2B</td>
<td>1 byte</td>
<td>Two-digit binary year data</td>
</tr>
</tbody>
</table>

Note: See Appendix C, “Data Format Descriptions,” on page 885 for detailed format descriptions.

CSF, FS, UFF, SFF, Y2 and PD0 format fields can only be used if Blockset is selected.

For Y2 format fields, real dates are collated using the century window established by the Y2PAST option in effect, but the century window is not used for special indicators. Thus the Y2 formats will collate real dates and special indicators as follows:

- Y2T and Y2W:
  **Ascending:**
  BI zeros, blanks, CH/ZD zeros, lower century dates (for example, 19yy), upper century dates (for example, 20yy), CH/ZD nines, BI ones.
  **Descending:**
  BI ones, CH/ZD nines, upper century dates (for example, 20yy), lower century dates (for example, 19yy), CH/ZD zeros, blanks, BI zeros.

- Y2U, Y2V, Y2X and Y2Y:
  **Ascending:**
  PD zeros, lower century dates (for example, 19yy), upper century dates (for example, 20yy), PD nines.
  **Descending:**
  PD nines, upper century dates (for example, 20yy), lower century dates (for example, 19yy), PD zeros.

- Y2C, Y2Z, Y2P, Y2D and Y2B:
SORT Control Statement

Ascending:
Lower century years (for example, 19yy), upper century years (for example, 20yy).

Descending:
Upper century years (for example, 20yy), lower century years (for example, 19yy).

Y2S:

Ascending:
BI zeros, blanks, lower century years (for example, 19yy), upper century years (for example, 20yy), BI ones.

Descending:
BI ones, upper century years (for example, 20yy), lower century years (for example, 19yy), blanks, BI zeros.

The AC format sequences **EBCDIC data** using the ASCII collating sequence shown in Appendix D. For example, if AC is used with ascending sequence, the EBCDIC numbers (0-9) will collate before the EBCDIC uppercase letters (A-Z) which in turn will collate before the EBCDIC lowercase letters (a-z).

You can use p,m,s rather than p,m,f,s if you use FORMAT=f to supply the format for the field, as described later in this section.

All floating-point data must be normalized before the program can collate it properly. You can use an E15 or E61 user exit to do this during processing. If you use E61, specify the E option for the value of s in the FIELDS operand for each control field you are going to modify with this user exit.

s specifies how the control field is to be ordered. The valid codes are:

- A ascending order
- D descending order
- E control fields to be modified

Specify E if you include an E61 user exit to modify control fields before the program sorts them. After an E61 user exit modifies the control fields, DFSORT collates the records in ascending order using the formats specified.  

For information on how to add a user exit, see Chapter 5, “Using Your Own User Exit Routines,” on page 489.

Default: None; must be specified. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.


**FORMAT**

```
FORMAT=f
```

---

15. With a conventional merge or a tape work data set sort, control fields for which E is specified are treated as binary byte format regardless of the actual formats specified.
**SORT Control Statement**

FORMAT=f can be used to specify a particular format for one or more control fields. f from FORMAT=f is used for p,m,s fields. f from FORMAT=f is ignored for p,m,f,s fields. For example, the following are all equivalent:

```
SORT FIELDS=(5,5,ZD,A,12,6,PD,D,21,3,PD,A,35,7,ZD,A)
SORT FORMAT=ZD,FIELDS=(5,5,A,12,6,PD,D,21,3,PD,A,35,7,A)
SORT FIELDS=(5,5,ZD,A,12,6,D,21,3,A,35,7,ZD,A),FORMAT=PD
```

The permissible field formats are shown under the description of ‘f’ for fields.

If you have specified the COPY operand, FORMAT=f cannot be specified.

**Default:** None; FORMAT=f must be specified if any field is specified as p,m,s rather than p,m,f,s. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.

**Applicable Functions:** See Appendix B, “Specification/Override of DFSORT Options,” on page 857.

**Note:** DFSORT issues an informational message and ignores FORMAT=f if all of the fields are specified as p,m,f,s.

**FIELDS=COPY**

See the discussion of the COPY option discussed in “OPTION Control Statement” on page 173.

**CKPT**

See the discussion of this option discussed in “OPTION Control Statement” on page 173.

**DYNALLOC**

See the discussion of this option in “OPTION Control Statement” on page 173.

**EQUALS or NOEQUALS**
SORT Control Statement

EQUALS
NOEQUALS

See the discussion of these options in "OPTION Control Statement" on page 173.

FILSZ or SIZE

FILSZ=x
SIZE=y

See the discussion of these options in "OPTION Control Statement" on page 173.

SKIPREC

SKIPREC=z

See the discussion of this option in "OPTION Control Statement" on page 173.

STOPAFT

STOPAFT=n

See the discussion of this option in "OPTION Control Statement" on page 173.

Y2PAST

Y2PAST=s

See the discussion of this option in "OPTION Control Statement" on page 173.

Note: CENTURY=value and CENTWIN=value can be used instead of Y2PAST=value.
SORT Control Statement

SORT/MERGE Statement Notes

- If records are reformatted by INREC (SORT and MERGE) or E15 (SORT), FIELDS must refer to fields in the appropriate reformatted records.
- If SZERO is in effect, −0 collates before +0 in ascending order and after +0 in descending order when numeric fields are sorted or merged. If NOSZERO is in effect, −0 collates equally with +0 when numeric fields are sorted or merged. However, SZERO is always used for a conventional merge or tape work data set sort application.

Specifying a SORT or COPY—Examples

Example 1
SORT FIELDS=(2,5,FS,A),FILSZ=29483

FIELDS
The control field begins on the second byte of each record in the input data set, is five bytes long, and contains floating sign data. It is to be sorted in ascending order.

FILSZ
The data set to be sorted contains exactly 29483 records.

Example 2
SORT FIELDS=(7,3,CH,D,1,5,FI,A,398.4,7.6,BI,D,99.0,230.2,BI,A,452,8,FL,A),DYNALLOC=(3390,4)

FIELDS
The first four values describe the major control field. It begins on byte 7 of each record, is 3 bytes long, and contains character (EBCDIC) data. It is to be sorted in descending order.

The next four values describe the second control field. It begins on byte 1, is 5 bytes long, contains fixed-point data, and is to be sorted in ascending order.

The third control field begins on the fifth bit (bits are numbered 0 through 7) of byte 398. The field is 7 bytes and 6 bits long (occupies 9 bytes), and contains binary data to be placed in descending order.

The fourth control field begins on byte 99, is 230 bytes and 2 bits long, and contains binary data. It is to be sorted in ascending order.

The fifth control field begins on byte 452, is 8 bytes long and contains normalized hexadecimal floating-point data, which is to be sorted in ascending order. If the data in this field were not normalized, you could specify E instead of A and include your own E61 user exit routine to normalize the field before the program examined it.

DYNALLOC
Four work data sets are allocated on 3390.

Example 3
SORT FIELDS=(3,8,ZD,E,40,6,CH,D)

FIELDS
The first four values describe the major control field. It begins on byte 3 of each record, is 8 bytes long, and contains zoned decimal data that is modified by your routine before sort examines the field.
The second field begins on byte 40, is 6 bytes long, contains character (EBCDIC) data, and is sorted in descending sequence.

**Example 4**

```plaintext
SORT FIELDS=(7025,4,A,5048,8,A),FORMAT=ZD,EQUALS
```

**FIELDS**
The major control field begins on byte 7025 of each record, is 4 bytes long, contains zoned decimal data (FORMAT=ZD), and is to be sorted in ascending sequence.

The second control field begins on byte 5048, is 8 bytes long, has the same data format as the first field, and is also to be sorted in ascending order.

**FORMAT**
FORMAT=ZD is used to supply ZD format for the p,m,s fields and is equivalent to specifying p,m,ZD,s for these fields.

With FORMAT=f, you can mix p,m,s and p,m,f,s fields when that's convenient such as when all or most of the fields have the same format (although you can always code p,m,f,s for all fields and not use FORMAT=f, if you prefer). For example, the following are also valid uses of the FORMAT=f parameter:

```plaintext
SORT FORMAT=B1,FIELDS=(21,4,A,5,4,PD,A,31.3,1.4,A,52,20,A)
```

```plaintext
SORT FIELDS=(16,4,A,22,8,BI,D,3,2,A),FORMAT=FI
```

**EQUALS**
specifies that the sequence of equal collating records is to be preserved from input to output.

**Example 5**

```plaintext
SORT FIELDS=COPY
```

**FIELDS**
The input data set is copied to the output data set without sorting or merging.

**Example 6**

```plaintext
OPTION Y2PAST=1950
SORT FIELDS=(21,6,Y2T,A,13,3,Y2X,D)
```

**Y2PAST**

**FIELDS**
Sorts on a C'yymmdd' (or Z'yymmdd') date in positions 21-26 in ascending order, and on a P'dddyy' date in positions 13-15 in descending order. "Real" dates are sorted using the century window of 1950-2049. Special indicators are sorted correctly relative to the "real" dates.
The SUM control statement specifies that, whenever two records are found with equal sort or merge control fields, the contents of their summary fields are to be added, the sum is to be placed in one of the records, and the other record is to be deleted. If the EQUALS option is in effect the first record of summed records is kept. If the NOEQUALS option is in effect, the record to be kept is unpredictable. For further details, see “SUM Statement Notes” on page 454.

If the ZDPRINT option is in effect, positive summed ZD values are printable. If the NZDPRINT option is in effect, positive summed ZD values are not printable. For further details, see “SUM Statement Notes” on page 454.

The way in which DFSORT processes short SUM summary fields depends on whether the VLSHRT or NOVLSHRT option is in effect. A short field is one where the variable-length record is too short to contain the entire field; that is, the field extends beyond the record. For details about sorting, merging and summing short records, see the discussion of the VLSHRT and NOVLSHRT options in “OPTION Control Statement” on page 173.

**FIELDS**

Designates numeric fields in the input record as summary fields.

- **p** specifies the first byte of the field relative to the beginning of the input record. The first data byte of a fixed-length record has relative position 1. The first data byte of a variable-length record has relative position 5, as the first four bytes are occupied by the RDW. All fields must start on a byte boundary and no field can extend beyond byte 32752.

- **m** specifies the length in bytes of the summary fields to be added. See below for permissible length values.

- **f** specifies the format of the data in the summary field:

---

16. If INREC is specified, p must refer to the record as reformatted by INREC. If your E15 user exit reformats the record, and INREC is not specified, p must refer to the record as reformatted by your E15 user exit.
Table 56. Summary Field Formats and Lengths

<table>
<thead>
<tr>
<th>Format Code</th>
<th>Length</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BI</td>
<td>2, 4, or 8 bytes</td>
<td>Unsigned binary</td>
</tr>
<tr>
<td>FI</td>
<td>2, 4, or 8 bytes</td>
<td>Signed fixed-point</td>
</tr>
<tr>
<td>FL</td>
<td>4, 8, or 16 bytes</td>
<td>Signed hexadecimal floating-point</td>
</tr>
<tr>
<td>PD</td>
<td>1 to 16 bytes</td>
<td>Signed packed decimal</td>
</tr>
<tr>
<td>ZD</td>
<td>1 to 31 bytes</td>
<td>Signed zoned decimal</td>
</tr>
</tbody>
</table>

The value for \( f \) can optionally be specified by the FORMAT=\( f \) parameter as explained later in this section.

Note: See Appendix C, “Data Format Descriptions,” on page 885 for detailed format descriptions.

NONE

eliminates records with duplicate keys. Only one record with each key is kept and no summing is performed.

Note: The FIRST operand of ICETOOL’s SELECT operator can be used to perform the same function as SUM FIELDS=NONE with OPTION EQUALS. Additionally, SELECT’s FIRSTDUP, ALLDUPS, NODUPS, HIGHER(\( x \)), LOWER(\( y \)), EQUAL(\( v \)), LASTDUP, and LAST operands can be used to select records based on other criteria related to duplicate and non-duplicate keys. SELECT’s DISCARD(savedd) operand can be used to save the records discarded by FIRST, FIRSTDUP, ALLDUPS, NODUPS, HIGHER(\( x \)), LOWER(\( y \)), EQUAL(\( v \)), LASTDUP, or LAST. See “SELECT Operator” on page 664 for complete details on the SELECT operator.

Default: None; must be specified.


FORMAT

FORMAT=\( f \) can be used to specify a particular format for one or more summary fields. \( f \) from FORMAT=\( f \) is used for p,m fields. \( f \) from FORMAT=\( f \) is ignored for p,m,f fields. For example, the following are all equivalent:

\[
\text{SUM } \text{FIELDS}=(5,5,\text{ZD},12,6,\text{PD},21,3,\text{PD},35,7,\text{ZD})
\]

\[
\text{SUM } \text{FORMAT=ZD,FIELDS}=(5,5,12,6,\text{PD},21,3,\text{PD},35,7)
\]

\[
\text{SUM } \text{FIELDS}=(5,5,\text{ZD},12,6,21,3,35,7,\text{ZD}),\text{FORMAT=PD}
\]

The permissible field formats are shown under the description of \( f \) for fields.

Default: None. FORMAT=\( f \) must be specified if any field is specified as p,m rather than p,m,f. See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for full override details.
Note: DFSORT issues an informational message and ignores FORMAT=f if all of the fields are specified as p,m,f.

**SUM Statement Notes**

- If overflow might occur during summation, INREC can be used to create a larger SUM field in the reformatted input record (perhaps resulting in a larger record for sorting or merging) so that overflow does not occur. “Example 5” on page 456 illustrates this technique.

- An invalid PD or ZD sign or digit results in a data exception (0C7 ABEND); 0-9 are invalid for the sign and A-F are invalid for the digit. For example, a ZD value such as 3.5 (XF34BF5') results in an 0C7 because '.' (X'4B') is treated as an invalid digit. ICETOOL’s DISPLAY or VERIFY operator can be used to identify decimal values with invalid digits. ICETOOL’s VERIFY operator can be used to identify decimal values with invalid signs.

- Whether or not positive summed ZD results have printable numbers depends on whether NZDPRINT or ZDPRINT is in effect (as set by the ZDPRINT installation option and the NZDPRINT and ZDPRINT parameters of the OPTION statement):
  - If NZDPRINT is in effect, positive summed ZD results do not consist of printable numbers, regardless of whether the original values consisted of printable numbers or not. For example, if XF2F3F1' (prints as '231') and XF3F0F6' (prints as '306') are summed, the result with NZDPRINT in effect is XF5F3C7' (prints as '53G').
  - If ZDPRINT is in effect, positive summed ZD results consist of printable numbers, regardless of whether the original values consisted of printable numbers or not. For example, if XF2F3C1' (prints as '23A') and XF3F0F6' (prints as '306') are summed, the result with ZDPRINT in effect is XF5F3F7' (prints as '537').

Thus, ZDPRINT must be in effect to ensure that positive summed ZD results are printable.

Unsummed positive ZD values retain their original signs, regardless of whether NZDPRINT or ZDPRINT is in effect. For example, if XF2F8C5' is not summed, it remains X'F2F8C5' (prints as '28E'). OUTFIL's OUTREC parameter can be used to ensure that all summed or unsummed ZD values are printable, as illustrated by Example 4 below.

- If input records are reformatted by INREC or E15, SUM must refer to fields in the appropriate reformatted record (see the preceding description of p).

- Summary fields must not be control fields. They must not overlap control fields, or each other, and must not overlap the RDW.

- FL (hexadecimal floating-point) values to be summed can be normalized or unnormalized. However, the resulting FL values are always normalized. Normalization processing by the hardware can produce different sums for FL values summed in different orders.

- Exponent overflow for summed FL values results in an exponent overflow exception (0CC ABEND)

- Exponent underflow for summed FL values results in a true zero result.

- When records are summed, you can predict which record is to receive the sum (and be retained) and which record is to be deleted only when EQUALS is in effect, overflow does not occur, and the BLOCKSET technique is used. In this
SUM Control Statement

case, the first record (based on the sequence described under the discussion of
the EQUALS or NOEQUALS parameter of the OPTION Control Statement” on
page 173) is chosen to contain the sum.

Fields other than summary fields remain unchanged and are taken from the
record that receives the sum.

• You can control the action that DFSORT takes when overflow occurs for BL, FI,
PD or ZD values with the OVFLO parameter as described in “OPTION Control
Statement” on page 173.

• DFSORT issues a message and terminates processing if a SUM statement is
specified for a tape work data set sort or Conventional merge.

• DFSORT does not support the XSUM parameter provided by a competitive sort
product to write records deleted by SUM processing to a SORTXSUM DD data
set. However, ICETOOL’s SELECT operator can perform the same function as
XSUM with FIELDS=NONE. For example, this ICETOOL job:
```
//S1EXEC PGM=ICETOOL
//TOOLMSG DD SYSOUT=*  
//DFSMSG DD SYSOUT=*  
//SORTIN DD DSN=...  
//SORTOUT DD DSN=...  
//SORTXSUM DD DSN=...  
//TOOLIN DD *  
SELECT FROM(SORTIN) TO(SORTOUT)-  
  ON(5,4,CH) FIRST DISCARD(SORTXSUM)  
/*  
is equivalent to this XSUM job:
```
```
//S1 EXEC PGM=ICEMAN
//SYSOUT DD SYSOUT=*  
//SORTIN DD DSN=...  
//SORTOUT DD DSN=...  
//SORTXSUM DD DSN=...  
//SYSIN DD *  
SORT FIELDS=(5,4,CH,A)
SUM FIELDS=NONE,XSUM  
/*  
```

Tip: You can also perform additional functions with ICETOOL’s SELECT
operator that are not available with XSUM. See Chapter 7, “Using
ICETOOL” on page 555 for complete details of ICETOOL’s SELECT
operator.

Adding Summary Fields—Examples

Example 1
SUM FIELDS=(15021,8,PD,15011,4,FI)

This statement designates an 8-byte packed decimal field at byte 15021, and a
4-byte fixed-integer field at byte 15011, as summary fields.

Example 2
SUM FIELDS=NONE

This statement illustrates the elimination of duplicate records.

Example 3
SUM FIELDS=(41,8,49,4),FORMAT=ZD
OPTION ZDPRINT
These statements illustrate the use of the FORMAT operand and the ZDPRINT option. The SUM statement designates two zoned decimal fields, one 8 bytes long starting at byte 41, and the other 4 bytes long starting at byte 49. As a result of the ZDPRINT option, the positive summed ZD values will be printable. Note, however, that the ZDPRINT option does not affect ZD values which are not summed due to overflow or unique keys. The next example shows how to use OUTFIL to make all summary fields printable.

**Example 4**

```plaintext
SUM FIELDS=(41,8,49,4),FORMAT=ZD
OUTFIL OUTREC=(1,40,41,8,ZD,M11,49,4,ZD,M11,53,28)
```

These statements illustrate the use of the OUTFIL statement to ensure that all positive ZD summary fields in the output data set are printable. Whereas the ZDPRINT option affects only positive summed ZD fields, OUTFIL can be used to edit positive or negative BI, FI, PD, or ZD values, whether they are summed or not. OUTFIL can also be used to produce multiple output data sets, reports, and so on. See "OUTFIL Control Statements" on page 229 for complete details about OUTFIL processing.

**Note:** For purposes of illustration, this example assumes that the input records are 80 bytes long.

**Example 5**

```plaintext
* Add Z'0' before the ZD SUM field to prevent overflow.
* Add P'0' before the PD SUM field to prevent overflow.
INREC FIELDS=(1,10, Copy bytes before ZD SUM field
 11:C'0',12:11, Add Z'0' before ZD SUM field
 16:15,6, Copy bytes after ZD SUM field
 22:X'00',23:21,2, Add P'0' before PD SUM field
 25:23,5, Copy SORT field
 30:28,53) Copy bytes after SORT field
* Sort on key in its new position.
SORT FIELDS=(25,5,CH,A)
* Sum on the expanded ZD and PD fields in
  * their new positions.
SUM FIELDS=(11,5,ZD,22,3,PD)
```

These statements illustrate a technique for preventing overflow of summed fields by using INREC to make the fields larger before they are summed.

The fields that might overflow when they are summed are a 4 byte ZD field starting at position 11 and a 2 byte PD field starting at position 21. In order to prevent them from overflowing, we expand each field on the left with an appropriate zero byte; C'0' (Z'0') for the ZD field and P'0' (X'00') for the PD field. We can then sum on the new 5 byte ZD field and on the new 3 byte PD field.

Note that adding these extra bytes increases the length of the record and changes the starting position of various fields. In the SORT and SUM statements, we must specify the starting positions of the fields in the reformatted record rather than the starting positions of the fields in the input record. For example, although the SORT field starts in position 23 in the input record, we must use its starting position of 25 in the reformatted record.
Chapter 4. Using a JOINKEYS Application for Joining Two Files

Overview

You can perform various types of "join" applications on two files (F1 and F2) by one or more keys with DFSORT using the following statements:

JOINKEYS

You must specify two JOINKEYS statements; one for the F1 file and another for the F2 file. A separate subtask will be used to process each file and a main task will be used to process the joined records from the two files.

Each JOINKEYS statement must specify the ddname of the file it applies to and the starting position, length and sequence of the keys in that file. You can also optionally specify if the file is already sorted by the keys and if sequence checking of the keys is not needed; if the file has fixed-length or variable-length records; to stop reading the file after n records; a 2-byte id to be used for the message and control data set for the subtask used to process the file, and if a subset of the records is to be processed based on a logical expression.

JOIN

If you don't specify a JOIN statement, only paired records from F1 and F2 are kept and processed by the main task as the joined records (inner join). You can optionally specify a JOIN statement to have the main task keep and process: unpaired F1 records as well as paired records (left outer join); unpaired F2 records as well as paired records (right outer join); unpaired F1 and F2 records as well as paired records (full outer join); only unpaired F1 records; only unpaired F2 records, or only unpaired F1 and F2 records.

REFORMAT

You would normally specify a REFORMAT statement to indicate the F1 and/or F2 fields you want in the joined records. You can optionally specify an indicator of where the key was found, and a FILL character to be used for missing bytes. If a JOIN statement with ONLY is specified, the REFORMAT statement is optional.

F1 and F2 can be any type of sequential or VSAM file supported by DFSORT for SORTIN and can have different attributes (for example, F1 can have RECFM=FB and LRECL=100 and F2 can have RECFM=VB and LRECL=254, or F1 can be a VSAM ESDS and F2 can be a PDS member).
Overview

F1 will be sorted or copied by "subtask1". An E35 exit will be used to pass the needed fields from the F1 records to the "main task" (an intermediate output data set is not used or required). A subset of the DFSORT statements, such as INCLUDE, OMIT, INREC, SUM and OPTION, will be available for processing the F1 records.

F2 will be sorted or copied by "subtask2". An E35 exit will be used to pass the needed fields from the F2 records to the "main task" (an intermediate output data set is not used or required). A subset of the DFSORT statements, such as INCLUDE, OMIT, INREC, SUM and OPTION, will be available for processing the F2 records.

The "main task" will use an E15 to join the records passed from the E35 of subtask1 and E35 of subtask2. The joined records will be processed as the input records for a sort or copy application. Most of the control statements and options available for a DFSORT sort or copy application will be available for processing the joined records.

Note: Since a JOINKEYS application uses three tasks, it can require more storage than a regular DFSORT application. You may need to use REGION=0M for some JOINKEYS applications.

JOINKEYS Application Processing

Figure 15 on page 459 is a pictorial representation of the processing performed for a JOINKEYS application, and the order in which the various functions are performed.
Figure 15. JOINKEYS Application Processing

Legend for Figure 15

- (1) COPY is used automatically for subtask1 if the SORTED operand is specified in the F1 JOINKEYS statement. Otherwise, SORT is used automatically with the binary keys specified in the FIELDS operand of the F1 JOINKEYS statement.
- (2) COPY is used automatically for subtask2 if the SORTED operand is specified in the F2 JOINKEYS statement. Otherwise, SORT is used automatically with the binary keys specified in the FIELDS operand of the F2 JOINKEYS statement.
- (3) An E35 exit is used for subtask1 automatically. (An intermediate output file is not required or used.)
- (4) An E35 exit is used for subtask2 automatically. (An intermediate output file is not required or used.)
- (5) An E15 exit is used for the main task automatically. (Intermediate input files are not required or used.)
JOINKEYS Application Processing

For direct invocation of DFSORT (for example, PGM=SORT), the JOINKEYS, JOIN and REFORMAT statements can be specified in SYSIN or DFSPARM. For program invocation of DFSORT (for example, LINK EP=SORT), the JOINKEYS, JOIN and REFORMAT statements can be specified in the caller's parameter list, in SORTCNTL or in DFSPARM.

Subtask1 reads the F1 file. It uses COPY or SORT, and an E35 exit (with no output data set) automatically to pass the needed F1 fields to the main task's E15 exit. Subtask1 can optionally use the other listed control statements from JNF1CNTL. Subtask1 messages are displayed in JNF1JMSG.

Subtask2 reads the F2 file. It uses COPY or SORT, and an E35 exit (with no output data set) automatically to pass the needed F2 fields to the main task's E15 exit. Subtask2 can optionally use the other listed control statements from JNF2CNTL. Subtask2 messages are displayed in JNF2JMSG.

The main task uses an E15 exit automatically. The E15 creates the joined records by accessing the F1 fields passed by subtask1's E35 and the F2 fields passed by subtask2's E35. The main task writes the output to SORTOUT and/or OUTFIL or uses a supplied E35 exit to "delete" all of the records. For direct invocation of DFSORT, the main task can optionally use the other listed control statements from SYSIN or DFSPARM. For program invocation of DFSORT, the main task can optionally use the other listed control statements from the caller's parameter list, in SORTCNTL or in DFSPARM. The main task's messages are displayed in SYSOUT.

The starting position in the fields you specify for the subtasks or main task must reflect any reformatting of the records you do at each stage. This includes using the starting positions of the joined records for main task functions.

Examples:

- If you specify INREC and SUM statements in JNF1CNTL for subtask1, the FIELDS operands in the JOINKEYS, REFORMAT, and SUM statements must specify the starting positions in the F1 records as reformatted by INREC.
- If you specify an INCLUDE statement in SYSIN for the main task, the COND operand must specify the starting positions in the joined records as reformatted by REFORMAT.

Sample JOINKEYS Applications

Here are the JCL and control statements for a simple JOINKEYS application to do an inner join (also known as a cartesian join) which joins all paired records.

```
//S1 EXEC PGM=SORT
//SYSOUT DD SYSOUT=*  
//SORTJNF1 DD DSN=INPUT1,DISP=SHR
//SORTJNF2 DD DSN=INPUT2,DISP=SHR
//SORTOUT DD SYSOUT=*  
//SYSIN DD *

* Control statements for JOINKEYS application
JOINKEYS FILE=F1,FIELDS=(15,2,A,7,4,A)
JOINKEYS FILE=F2,FIELDS=(21,2,A,23,4,A)
REFORMAT FIELDS=(F2:1,70,F1:1,60)
* Control statements for main task (joined records)
SORT FIELDS=COPY
/*
```

Here are the JCL and control statements for a JOINKEYS application which omits certain records and normalizes keys for F1 and F2, and retains only sorted,
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non-duplicate, unpaired records from F1. The F1 and F2 files are already in order by the specified JOINKEYS FIELDS. DFSORT symbols are used for various fields and constants.

```
//S2 EXEC PGM=SORT
//SYSOUT DD SYSOUT=* 
//SYMNAMES DD *
IN1_dept,11,3,ch
IN1_target,'J82'
IN1_normal_key,27,5,ZD
IN1_output,1,60
IN2_dept,14,3,ch
IN2_target,'M25'
IN2_PD_key,21,3,PD
IN2_normal_key,=,5,ZD
join_sort_key,45,8,UFF
//FIX DD DSN=F.INPUT,DISP=SHR
//VAR DD DSN=V.INPUT,DISP=SHR
//SORTOUT DD DSN=FIXOUT1,DISP=(NEW,CATLG,DELETE),
// SPACE=(CYL,(5,5)),UNIT=SYSDA
//JNF1CNTL DD *
* Control statements for subtask1 (F1)
OMIT COND=(IN1_dept,EQ,IN1_target)
INREC OVERLAY=(IN1_normal_key:IN1_normal_key,TO=ZDF,LENGTH=5)
//JNF2CNTL DD *
* Control statements for subtask2 (F2)
OMIT COND=(IN2_dept,EQ,IN2_target)
INREC OVERLAY=(IN2_PD_key:IN2_PD_key,TO=ZDF,LENGTH=5)
//SYSIN DD *
* Control statements for JOINKEYS application
JOINKEYS F1=FIX,FIELDS=(IN1_normal_key,D),SORTED
JOINKEYS F2=VAR,FIELDS=(IN2_normal_key,D),SORTED
JOIN UNPAIRED,F1,ONLY
REFORMAT FIELDS=(F1:IN1_output)
* Control statements for main task (joined records)
SORT FIELDS=(join_sort_key,A)
SUM FIELDS=NONE
/* 
```

JCL for a JOINKEYS Application

The required JCL statements used for a JOINKEYS application are as follows. See z/OS DFSORT Application Programming Guide for general information on DFSORT message, control, input, output, work and symbols data sets.

```
//stepname EXEC PGM=SORT
 Invokes DFSORT. PGM=ICEMAN can also be used.

 Note: Since a JOINKEYS application uses three tasks, it can require more storage than a regular DFSORT application. You may need to use REGION=0M for some JOINKEYS applications.

//SYSOUT DD
 Messages from the main task. An alternate ddname can be supplied with MSGDDN=ddname in //DFSPARM.

//SORTJNF1 DD
 F1 input file (read by subtask1). The ddname is SORTJNF1 (or ccccJNF1 if SORTDD=cccc is in effect) if FILE=F1 or FILES=F1 is specified on the JOINKEYS statement. An alternate ddname can be supplied with F1=ddname on the JOINKEYS statement.
```
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Note: The F1 data set is treated as a SORTIN data set by subtask1 and is subject to the rules for a SORTIN data set documented in Chapter 2, "Invoking DFSORT with Job Control Language," on page 25.

//SORTJNF2 DD
F2 input file (read by subtask2). The ddname is SORTJNF2 (or ccccJNF2 if SORTDD=cccc is in effect) if FILE=F2 or FILES=F2 is specified on the JOINKEYS statement. An alternate ddname can be supplied with F2=ddname on the JOINKEYS statement.

Note: The F2 data set is treated as a SORTIN data set by subtask2 and is subject to the rules for a SORTIN data set documented in Chapter 2, "Invoking DFSORT with Job Control Language," on page 25.

//SORTOUT DD or //outfil DD
Output of joined records (written by main task). An alternate ddname can be supplied with SORTOUT=ddname or SORTDD=cccc in //DFSPARM or with the OUTFIL statement in //SYSIN or //DFSPARM.

//DFSPARM DD, //SYSIN DD or //SORTCNTL DD
Control statements for the main task including JOINKEYS, JOIN, REFORMAT, OPTION, SORT, INCLUDE or OMIT, SUM, OUTREC, RECORD, ALTSEQ, MODS and OUTFIL. If SKIPREC or E15 is specified, it will not be used.

DFSPARM can be used if DFSORT is invoked directly or called from a program. SYSIN can be used if DFSORT is invoked directly. SORTCNTL can be used if DFSORT is called from a program; an alternate ddname of ccccCNTL can be supplied with SORTDD=cccc in DFSPARM.

Note: If DFSORT is called from a program, the control statements for the main task can be supplied using the parameter list.

The optional JCL statements used for a JOINKEYS application are as follows:

SYMNAMES DD
DFSORT symbols for the main task, subtask1 and subtask2.

SYMNOT DD
Listing of symbols supplied via the SYMNAMES DD.

JNF1JMSG DD
Messages from subtask1. This message data set will be dynamically allocated with SYSOUT=*, RECFM=FBA, LRECL=121 and BLKSIZE=121 if a JNF1JMSG DD statement is not supplied. If a JNF1JMSG DD statement is supplied, this message data set will be given the same attributes as a //SYSOUT message data set. An alternate ddname of idF1JMSG can be supplied with TASKID=id on the JOINKEYS statement for F1.

JNF2JMSG DD
Messages from subtask2. This message data set will be dynamically allocated with SYSOUT=*, RECFM=FBA, LRECL=121 and BLKSIZE=121 if a JNF2JMSG DD statement is not supplied. If a JNF2JMSG DD statement is supplied, this message data set will be given the same attributes as a //SYSOUT message data set. An alternate ddname of idF2JMSG can be supplied with TASKID=id on the JOINKEYS statement for F2.

JNF1CNTL DD
Control statements for subtask1 including INCLUDE or OMIT, OPTION, MODS, RECORD, ALTSEQ, INREC and SUM. If E35 is specified, it will not be
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used. The following control statements must not be specified: JOINKEYS, JOIN, REFORMAT, MERGE, OUTFIL, OUTREC or SORT.

An alternate ddname of idF1CNTL can be supplied with TASKID=id on the JOINKEYS statement for F1.

JNF2CNTL DD
Control statements for subtask2 including INCLUDE or OMIT, OPTION, MODS, RECORD, ALTSEQ, INREC and SUM. If E35 is specified, it will not be used. The following control statements must not be specified: JOINKEYS, JOIN, REFORMAT, MERGE, OUTFIL, OUTREC or SORT.

An alternate ddname of idF2CNTL can be supplied with TASKID=id on the JOINKEYS statement for F2.

SORTWKdd DD
Work data sets for the main task. Not recommended since dynamic allocation of work data sets is preferred. Alternate ddnames of ccccWKdd can be supplied with SORTDD=cccc in //DFSPARM.

JNF1WKdd DD
Work data sets for subtask1. Not recommended since dynamic allocation of work data sets will be enabled. Alternate ddnames of idF1WKdd can be supplied with TASKID=id on the JOINKEYS statement for F1.

JNF2WKdd DD
Work data sets for subtask2. Not recommended since dynamic allocation of work data sets will be enabled. Alternate ddnames of idF2WKdd can be supplied with TASKID=id on the JOINKEYS statement for F2.
Two JOINKEYS statements are required for a JOINKEYS application; one for the F1 file and the other for the F2 file:

- FILE=F1 or F1=ddname must be used to indicate that the JOINKEYS statement applies to the F1 input file. FILE=F1 associates the F1 file with a ddname of SORTJNF1. You can use a different ddname for the F1 file by specifying F1=ddname. For simplicity, we will use SORTJNF1 when referring to the ddname for the F1 file.

- FILE=F2 or F2=ddname must be used to indicate that the JOINKEYS statement applies to the F2 input file. FILE=F2 associates the F2 file with a ddname of SORTJNF2. You can use a different ddname for the F2 file by specifying F2=ddname. For simplicity, we will use SORTJNF2 when referring to the ddname for the F2 file.

**FILE=F1, FILES=F1 or F1=ddname**
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Must be used for the JOINKEYS statement associated with the F1 file. FILE=F1 (or FILES=F1) specifies a ddname of SORTJNF1 for the F1 file. F1=ddname can be used to specify any valid ddname for the F1 file. Do not use the same ddname for the F1 file and the F2 file.

When FILE=F1, FILES=F1 or F1=ddname is specified, the other operands of the JOINKEYS statement apply to the F1 file.

FILE=F2, FILES=F2 or F2=ddname

Must be used for the JOINKEYS statement associated with the F2 file. FILE=F2 (or FILES=F2) specifies a ddname of SORTJNF2 for the F2 file. F2=ddname can be used to specify any valid ddname for the F2 file. Do not use the same ddname for the F1 file and the F2 file.

When FILE=F2, FILES=F2 or F2=ddname is specified, the other operands of the JOINKEYS statement apply to the F2 file.

FIELDS

Must be specified to indicate the starting position, length and order (ascending or descending) of the keys in the input file. The keys will be treated as binary, so they must be "normalized". For example, if the keys are actually zoned decimal, they must have all C and D signs, or all F and D signs. You can use an INREC statement in JNF1CNTL and/or JNF2CNTL to normalize the keys for the F1 file and/or F2 file, respectively, if appropriate.

Each pair of keys for the F1 and F2 files must match with respect to length and order, but can start in different positions. For example, if the first key for the F1 file is 5 bytes ascending and the second key for the F1 file is 3 bytes descending, the first key for the F2 file must be 5 bytes ascending and the second key for the F2 file must be 3 bytes descending.

If a variable-length record is too short to contain a key you specify, the short key value will be compared using binary zeros for the missing bytes.

\[ p \] specifies the starting position of the key. The first data byte of a fixed-length record is in position 1. The first data byte of a variable-length record is in position 5 after the 4-byte RDW. \( p \) can be 1 to 32752 but all fields must be completely contained within the first 32752 bytes of the record.

\[ m \] specifies the length of the key. The total length of all keys must not exceed 4080 bytes. All fields must be completely contained within the first 32752 bytes of the record.
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The length for each pair of F1 and F2 keys must match.
s specifies the order of the key. Use A for ascending or D for descending.
The order for each pair of F1 and F2 keys must match.

For example, if you specify:
JOINKEYS F1=IN1,FIELDS=(22,3,A,55,9,D)
JOINKEYS F2=IN2,FIELDS=(15,3,A,1,9,D)
File F1 is processed using the ddname IN1, the ascending key in positions 22-24 and the descending key in positions 55-63. File F2 is processed using the ddname IN2, the ascending key in positions 15-17 and the descending key in positions 1-9.

SORTED

By default, DFSORT will sort the input file by the specified keys. If the records of the input file are already in sorted order by the specified keys, you can use the SORTED operand to tell DFSORT to copy the records rather than sort them. This can improve performance. DFSORT will terminate if the copied records are not in the order specified by the keys unless you specify the NOSEQCK operand.

For example, if you specify:
JOINKEYS FILE=F1,FIELDS=(22,3,A),SORTED
JOINKEYS FILE=F2,FIELDS=(15,3,A)
File F1 is copied using the ddname SORTJNF1 and the ascending key in positions 22-24. The SORTJNF1 records will be checked for the correct key order. File F2 is sorted using the ddname SORTJNF2 and the ascending key in positions 15-17.

If you use the SORTED operand, statements and options only available for a sort application, such as SUM, will be ignored for the subtask that copies the input file.

NOSEQCK

If you specify the SORTED operand and know that the records of the input file are already in sorted order by the specified keys, you can use the NOSEQCK operand to tell DFSORT not to check the order of the records. This can improve performance.

For example, if you specify:
JOINKEYS FILE=F1,FIELDS=(22,3,A),SORTED,NOSEQCK
JOINKEYS FILE=F2,FIELDS=(15,3,A),SORTED
File F1 is copied using the ddname SORTJNF1 and the ascending key in positions 22-24. The SORTJNF1 records will be not be checked for the correct
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key order. File F2 is copied using the ddname SORTJNF2 and the ascending key in positions 15-17. The SORTJNF2 records will be checked for the correct key order.

If the records are not actually in order by the specified keys and you use NOSEQCK, the output may be incorrect.

The NOSEQCK operand is ignored if the SORTED operand is not specified.

**TYPE**

```
  TYPE=n
```

TYPE=V can be used to tell DFSORT to use variable-length processing for a VSAM input file. TYPE=F (the default) can be used to tell DFSORT to use fixed-length processing for a VSAM input file.

For example, if you specify:

```
JOINKEYS F1=VSAM1,FIELDS=(22,3,A),TYPE=V
JOINKEYS F2=VSAM2,FIELDS=(15,3,A),TYPE=F
```

VSAM file F1 is sorted as variable-length records using the ddname VSAM1 and the ascending key in positions 22-24. (Remember that for TYPE=V VSAM processing, DFSORT adds an RDW in positions 1-4 which you must account for when specifying the starting position.) VSAM file F2 is sorted as fixed-length records using the ddname VSAM2 and the ascending key in positions 15-17. (Remember that for TYPE=F VSAM processing, DFSORT does not add an RDW.)

**STOPAFT**

```
  STOPAFT=n
```

Can be used to specify the maximum number of records (n) you want the subtask for the input file to accept for sorting or copying (accepted means read from the input file and not deleted by INCLUDE or OMIT).

n can be up to 28 digits with up to 15 significant digits.

For example, if you specify:

```
JOINKEYS FILE=F1,STOPAFT=5,FIELDS=(32,4,A)
JOINKEYS FILE=F2,STOPAFT=10,FIELDS=(32,4,A)
```

The first 5 input records from SORTJNF1 and the first 10 input records from SORTJNF2 will be processed.

You can use STOPAFT=n on the OPTION statement in JNF1CNTL (for the F1 file) or JNF2CNTL (for the F2 file) instead of specifying STOPAFT=n on the JOINKEYS statement.

For example, instead of the STOPAFT operands in the JOINKEYS statements above, you could specify:
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//SYSIN DD *
JOINKEYS FILE=F1,FIELDS=(32,4,A)
JOINKEYS FILE=F2,FIELDS=(32,4,A)

//JNF1CNTL DD *
OPTION STOPAFT=5
//JNF2CNTL DD *
OPTION STOPAFT=10

TASKID

--- TASKID=id ---

By default, DFSORT uses the following ddnames for the subtasks:
- JNF1JMSG for the subtask1 (F1 file) message data set.
- JNF1CNTL for the subtask1 (F1 file) control data set.
- JNF1WKdd for the subtask1 (F1 file) work data sets.
- JNF2JMSG for the subtask2 (F2 file) message data set.
- JNF2CNTL for the subtask2 (F2 file) control data set.
- JNF2WKdd for the subtask2 (F2 file) work data sets.

The TASKID=id operand can be used to change the first two characters from JN to the specified id characters. The same id can be used for the F1 and F2 ddnames, or a different id can be used for each.

For example, if you specify:
JOINKEYS F1=IN1,FIELDS=(1,10,A),TASKID=C1
JOINKEYS F2=IN2,FIELDS=(22,10,A),TASKID=C1

C1F1JMSG, C1F1CNTL and C1F1WKdd will be used for subtask1 (F1 file).
C1F2JMSG, C1F2CNTL and C1F2WKdd will be used for subtask2 (F2 file).

If you specify:
JOINKEYS F1=IN1,FIELDS=(1,10,A),TASKID=I1
JOINKEYS F2=IN2,FIELDS=(22,10,A),TASKID=I2

I1F1JMSG, I1F1CNTL and I1F1WKdd will be used for subtask1 (F1 file).
I2F2JMSG, I2F2CNTL and I2F2WKdd will be used for subtask2 (F2 file).

The TASKID=id operand can be useful when you are doing multiple JOINKEYS applications and want to separate the messages for each application and/or specify different control statements or work data sets for different subtasks.

INCLUDE or OMIT

--- INCLUDE (logical expression) ---

Can be used to specify criteria for the records you want the subtask for the input file to include or omit for sorting or copying. You can use the same logical expressions, ALL or NONE in the same way as for the INCLUDE or OMIT operand of the OUTFIL statement. See "OUTFIL Control Statements" on page 229 for details.
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For example, if you specify:

JOINKEYS FILE=F1,FIELDS=(35,8,A),
OMIT=(5,4,CH,EQ,C'ABCD')
JOINKEYS FILE=F2,FIELDS=(37,8,A),
INCLUDE=(1,20,SS,EQ,C'NO')

Only records without 'ABCD' in positions 5-8 will be processed from file F1. Only records with 'NO' somewhere in positions 1-20 will be processed from file F2.

Although the INCLUDE and OMIT operands are available on the JOINKEYS statement, it is recommended that you specify an INCLUDE or OMIT statement in JNF1CNTL or JNF2CNTL instead for ease of use.

For example, instead of the OMIT and INCLUDE operands in the JOINKEYS statements above, you could specify:

//SYSIN DD *
JOINKEYS FILE=F1,FIELDS=(35,8,A)
JOINKEYS FILE=F2,FIELDS=(37,8,A)
...
//JNF1CNTL DD *
OMIT COND=(5,4,CH,EQ,C'ABCD')
//JNF2CNTL DD *
INCLUDE COND=(1,20,SS,EQ,C'NO')

JOIN Statement

If you don't specify a JOIN statement for a JOINKEYS application, only paired records from F1 and F2 are kept and processed by the main task as the joined records. This is known as an inner join.

You can change which records are kept and processed by the main task as the joined records by specifying a JOIN statement. You must specify the UNPAIRED operand. The F1, F2 and ONLY operands are optional. The JOIN operands you specify indicate the joined records to be kept and processed by the main task as follows:

**UNPAIRED,F1,F2 or UNPAIRED**

Unpaired records from F1 and F2 as well as paired records. This is known as a full outer join.

**UNPAIRED,F1**

Unpaired records from F1 as well as paired records. This is known as a left outer join.

**UNPAIRED,F2**

Unpaired records from F2 as well as paired records. This is known as a right outer join.
UNPAIRED,F1,F2,ONLY or UNPAIRED,ONLY
Unpaired records from F1 and F2.

UNPAIRED,F1,ONLY
Unpaired records from F1.

UNPAIRED,F2,ONLY
Unpaired records from F2.

REFORMAT Statement

A REFORMAT statement can always be used for a JOINKEYS application, and is required unless a JOIN statement with the ONLY operand is specified. The REFORMAT statement indicates the fields from the F1 file and/or the F2 file you want to include in the joined records, and the order in which you want the fields to appear. You can also include an indicator of where the key was found in the joined records (‘B’ for key found in F1 and F2, ‘1’ for key found in F1 only, or ‘2’ for key found in F2 only).

If the REFORMAT statement only defines position with length (p,m) fields, each joined record will be fixed-length (TYPE=F) with a LENGTH equal to the total length of all of the p,m fields. The maximum length for TYPE=F joined records is 32760 bytes. The F1 and F2 files can both be fixed-length, both be variable-length, or can be mixed fixed-length and variable-length.

If the REFORMAT statement defines a position without a length (p without m) field, each joined record will be variable-length (TYPE=V) with a LENGTH equal to the total length of all of the p,m fields plus the variable length of each p field (one for F1 and/or one for F2). The maximum length for TYPE=V joined records is 32767 bytes. The F1 and F2 files can both be variable-length or can be mixed fixed-length and variable-length. However:

- The first field must contain the RDW (1,n with n equal to or greater than 4) and must be from a variable-length file (F1 or F2).
- The position without length fields (one from the F1 file and/or one from the F2 file) must be the last fields specified and must be from a variable-length file (F1 and/or F2).
For joined records created from paired records, any F1 fields specified will be extracted from the F1 record and any F2 fields specified will be extracted from the F2 record.

For joined records created from unpaired F1 records, any F1 fields specified will be extracted from the F1 record and any F2 fields specified will be filled with the specified FILL character or blanks by default. However, if the F2 file is variable-length, any specified F2 RDW fields (1,n with n equal to or less than 4) will be filled with binary zeros.

For joined records created from unpaired F2 records, any F2 fields specified will be extracted from the F2 record and any F1 fields specified will be filled with the specified FILL character or blanks by default. However, if the F1 file is variable-length, any specified F1 RDW fields (1,n with n equal to or less than 4) will be filled with binary zeros.

If a JOIN statement with the ONLY operand is specified, the REFORMAT statement does not have to be specified. In this case, the layout of the joined records will depend on the specified JOIN statement operands as follows:

**JOIN UNPAIRED,F1,ONLY**
- The joined records will be the original unpaired F1 records. If the F1 records are fixed-length, the joined records will be fixed-length. If the F1 records are variable-length, the joined records will be variable-length.

**JOIN UNPAIRED,F2,ONLY**
- The joined records will be the original unpaired F2 records. If the F2 records are fixed-length, the joined records will be fixed-length. If the F2 records are variable-length, the joined records will be variable-length.

**JOIN UNPAIRED,F1,F2,ONLY or JOIN UNPAIRED,ONLY**
- The joined records will be variable-length. If the F1 records are fixed-length, each unpaired F1 record will be variable-length with an RDW followed by the original F1 record. If the F1 records are variable-length, each unpaired F1 record will be the original F1 record. If the F2 records are fixed-length, each unpaired F2 record will be variable-length with an RDW followed by the original F2 record. If the F2 records are variable-length, each unpaired F2 record will be the original F2 record.

In all cases, the TYPE and LENGTH will be set as appropriate for the joined records.

For joined records with TYPE=F, the maximum LENGTH is 32760.

For joined records with TYPE=V, the maximum LENGTH is 32767. Note that the RECFM of the output file must be VS or VBS in order to allow output records greater than 32756.

**FIELDS**
Must be specified to indicate the starting position and length of each field from the F1 file and/or the F2 file to be included in the joined records, and optionally an indicator of where the key was found. The fields and indicator will be included in the joined records in the order in which they are specified.

**F1:** indicates the following fields up to the next Fn: or end of the FIELDS operand are from the F1 file.

**F2:** indicates the following fields up to the next Fn: or end of the FIELDS operand are from the F2 file.

**p,m** specifies the starting position and length of a fixed field. p specifies the starting position of the field. The first data byte of a fixed-length record is in position 1. The first data byte of a variable-length record is in position 5 after the 4-byte RDW. p can be 1 to 32767. m specifies the length of the field. m can be 1 to 32760. All fields must be completely contained within the first 32767 bytes of the record.

**?** indicates a 1-byte indicator is to be included in each joined record. The indicator will be set to one of the following values in each paired or unpaired joined record, as appropriate:

- 'B' - the key was found in F1 and F2.
- '1' - the key was found in F1, but not in F2.
- '2' - the key was found in F2, but not in F1.

Only one ? can be specified in the FIELDS operand. If ? is not the last item, it must be followed by F1: or F2:.

For TYPE=F joined records, the indicator can appear anywhere in the record. For example, each of the following is valid:

- Put indicator in position 1 of each joined record.
  REFORMAT FIELDS=(?,F1:1,20,F2:5,8)
- Put indicator in position 21 of each joined record.
  REFORMAT FIELDS=(F1:1,20,?,F1:31,9)
- Put indicator in position 25 of each joined record.
  REFORMAT FIELDS=(F2:11,20,6,4,?)

For TYPE=V joined records, the indicator must appear in the fixed part of the record, that is, after the RDW and before the position without length fields. For example, the following is valid:

- Put indicator in position 5 of each joined record.
  REFORMAT FIELDS=(F1:1,4,?,F1:11)

**p** p without m gives the starting position of a variable field. Only one p without m field can be specified for F1 and only one p without m field can be specified for F2.
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If either or both p without m fields are specified, they must be the last fields in the FIELDS operand. In this case, the first field in the FIELDS operand must be from a variable-length file (F1 or F2) and must include the RDW (1,n where n is equal to or greater than 4).

Example with just p,m fields:
```
REFORMAT FIELDS=(F1:27,5,1,8,F2:19,28,F1:1201,15)
```

Example with one p without m field:
```
REFORMAT FIELDS=(F1:1,4,F2:6,25,92,2,F1:8,9,32)
```

Example with two p without m fields:
```
REFORMAT FIELDS=(F2:1,9,21,3,F1:101,7,28,9,122,F2:26)
```

The FILL operand can be used to override DFSORT's default fill byte of a blank (X'40'). The fill byte is used in the following situations:

- A p,m (fixed) field is specified for a file (F1 or F2) with variable-length records, and the field extends beyond the end of a record. Each missing byte is replaced with the fill byte. For example, if a variable-length F1 record is 20 bytes long and the REFORMAT statement has:
  ```
  REFORMAT FIELDS=(F1:1,30,41),FILL=C'*'
  ```
  bytes 21-30 of the joined record are filled with asterisks.

- The REFORMAT statement has a p,m (fixed) field from the F1 file and a joined record is being created from an unpaired F2 record. For example if the following are specified:
  ```
  JOIN UNPAIRED,F2
  REFORMAT FIELDS=(F1:21,5,F2:1,10),FILL=X'00'
  ```
  and an unpaired F2 record is found, the joined record will have 5 binary zero bytes followed by bytes 1-10 from the F2 record.

- The REFORMAT statement has a p,m (fixed) field from the F2 file and a joined record is being created from an unpaired F1 record. For example if the following are specified:
  ```
  JOIN UNPAIRED,F1,F2
  REFORMAT FIELDS=(F1:21,5,F2:1,10),FILL=X'00'
  ```
  and an unpaired F1 record is found, the joined record will have bytes 21-25 of the F1 record followed by 10 binary zero bytes. (Since UNPAIRED,F1,F2 is specified, if an unpaired F2 record is found, the joined record will have 5 binary zero bytes followed by bytes 1-10 of the F2 record.)

`byte` specifies the fill byte. Permissible values are C'x' and X'yy'.

C'x' Character fill byte. x must be one EBCDIC character. If you want to use an apostrophe as the fill byte, you must specify it as C'''.

X'yy' Hexadecimal fill byte. yy must be one pair of hexadecimal digits (00-FF).

JOINKEYS Application Notes

In the notes below, "subtaskn" refers to subtask1 for the F1 file or subtask2 for the F2 file.
JOINKEYS Application Processing

- Since a JOINKEYS application uses three tasks, it can require more storage than a regular DFSORT application. You may need to use REGION=0M for some JOINKEYS applications.
- DFSORT's normal syntax and continuation rules are used for the JOINKEYS, JOIN and REFORMAT statements. See Chapter 3, “Using DFSORT Program Control Statements,” on page 81 for details.
- Control statements from DFSPARM, SYSIN (direct invocation) or SORTCNTL (program invocation) will be used for the main task, but not for the subtasks. Control statements from JNFCNTL will be used for subtask1. Control statements from JNF2CNTL will be used for subtask2.
- For the main task, the normal options in effect for a DFSORT run will be used. The run-time options will be those from DFSPARM, SYSIN, SORTCNTL, EXEC PARM or the caller's parameter list, as appropriate. The installation options will be those for direct invocation or program invocation of DFSORT, as appropriate.
- For subtaskn, the options in effect for the subtask will be used with the exceptions noted below. The run-time options will be those from JNFCNTL. The installation options will be those for a calling program (INV, TSOINV, TD1-TD4).
- TYPE=F processing is used for a VSAM F1 or F2 file by default. TYPE=V can be specified in JNFCNTL, or on the JOINKEYS statement for Fn, to override the default of TYPE=F.
- For subtaskn, if an INCLUDE or OMIT statement or a STOPAFT or TYPE option is specified in JNFCNTL, it will override the corresponding option in a JOINKEYS statement for Fn. For ease of use, it is recommended that you use an INCLUDE or OMIT statement, and a STOPAFT or TYPE option, in JNFCNTL rather than an INCLUDE, OMIT, STOPAFT or TYPE operand in a JOINKEYS statement.
- For the main task, override of statements and options is done in the normal way, that is, DFSPARM overrides SYSIN for direct invocation of DFSORT, and DFSPARM overrides SORTCNTL overrides the caller's parameter list for program invocation of DFSORT. See Chapter 3, “Using DFSORT Program Control Statements,” on page 81 for details.
- The following options will be used for subtaskn and cannot be overridden: LIST, MSGPRT=ALL, NOABEND, ESTAE, NOCHECK, EQUALS and RESINV=0. DYNALLOC will be used automatically for subtaskn, but can be overridden by a DYNALLOC option in JNFCNTL.
- If an INCLUDE or OMIT statement is specified in JNFCNTL, DFSORT will use the following options in effect for subtaskn processing: ALTSEQ, CHALT or NOCHALT, SZERO or NOSZERO and VLSCMP or NOVLSCMP. These options can be specified in JNFCNTL. The subtaskn LOCALE installation option in effect will also be used if appropriate.
- If an INCLUDE or OMIT operand is specified on the JOINKEYS statement for Fn, DFSORT will use these main task options in effect for subtaskn processing: ALTSEQ, CHALT or NOCHALT, SZERO or NOSZERO and VLSCMP or NOVLSCMP. If these options are specified in JNFCNTL, they will be ignored for subtask processing. LOCALE will not be used.
- For subtaskn, the following statements are not allowed in JNFCNTL: JOINKEYS, JOIN, MERGE, OUTFIL, OUTREC, REFORMAT and SORT.
- For the main task, a MERGE statement other than MERGE FIELDS=COPY is not allowed in any source.
- If appropriate, options such as FILSZ, DYNALLOC, AVGRLEN, and so on can be specified in JNFCNTL for subtaskn, or in DFSPARM for the main task.
JOINKEYS Application Processing

- If tape data sets are used for the F1 and F2 files, they must be on different drives so DFSORT can read them in parallel.

JOINKEYS Application Examples

Example 1 - Paired F1/F2 records without duplicates

JOINKEYS Application Processing

Chapter 4. Using a JOINKEYS Application for Joining Two Files 475
The first JOINKEYS statement defines the ddname and keys for the F1 file. FILE=F1 tells DFSORT that the ddname for the F1 file is SORTJNF1. FIELDS=(1,15,A,20,8,A) tells DFSORT that the first binary key is in positions 1-15 ascending and the second binary key is in positions 20-27 ascending. Since SORTED is not specified, DFSORT will sort the SORTJNF1 records by the specified binary keys.

The second JOINKEYS statement defines the ddname and keys for the F2 file. FILE=F2 tells DFSORT that the ddname for the F2 file is SORTJNF2. FIELDS=(10,15,A,1,8,A) tells DFSORT that the first binary key is in positions 10-24 ascending and the second binary key is in positions 1-8 ascending. Since SORTED is not specified, DFSORT will sort the SORTJNF2 records by the specified binary keys.

Note that corresponding keys for the two files match in length and order.

The REFORMAT statement defines the fields to be extracted for the joined records in the order in which they are to appear. FIELDS=(F1:20,8,1,15,F2:26,10,F1:16,2) tells DFSORT to create the joined records as follows:

<table>
<thead>
<tr>
<th>Joined Record Positions</th>
<th>Extracted from</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-8</td>
<td>F1 positions 20-27</td>
</tr>
<tr>
<td>9-23</td>
<td>F1 positions 1-15</td>
</tr>
<tr>
<td>24-33</td>
<td>F2 positions 26-35</td>
</tr>
<tr>
<td>34-35</td>
<td>F1 positions 16-17</td>
</tr>
</tbody>
</table>

Since there is no JOIN statement, only paired records are joined by default.

The OPTION COPY statement tells DFSORT to copy the joined records. The OUTFIL statement tells DFSORT to reformat the joined records, display a header at the top of each page and remove the carriage control characters. Note that the BUILD operand of the OUTFIL statement must reference the positions of fields in the joined records.

Conceptually, JOINKEYS application processing proceeds as follows:

- Subtask1 sorts the SORTJNF1 (F1 file) records as directed by its JOINKEYS statement. As a result, it passes the following records to the main task:

  Daisies 12 Lilac
  Daisies 06 Orange
  Daisies 02 Yellow
  Roses 09 Blue
  Roses 04 Pink
  Roses 03 Red
  Roses 06 Yellow

- Subtask2 sorts the SORTJNF2 (F2 file) records as directed by its JOINKEYS statement. As a result, it passes the following records to the main task:

  Lilac Daisies SoldOut
  Orange Daisies SoldOut
  White Daisies InStock
  Yellow Daisies InStock
  Red Lilies InStock
  Pink Roses SoldOut
  Red Roses InStock
  Yellow Roses Ordered

- The main task joins the records passed from subtask1 and subtask2 as directed by the specified JOINKEYS and REFORMAT statements, resulting in the following joined records:
JOINKEYS Application Processing

Lilac Daisies SoldOut 12
Orange Daisies SoldOut 06
Yellow Daisies InStock 02
Pink Roses SoldOut 04
Red Roses InStock 03
Yellow Roses Ordered 06

* Finally, the main task copies and reformats the joined records according to the
  OUTFIL statement, and writes the resulting records to SORTOUT. Thus,
  SORTOUT contains these records:

<table>
<thead>
<tr>
<th>Color</th>
<th>Flower</th>
<th>Status</th>
<th>Per Pot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lilac</td>
<td>Daisies</td>
<td>SoldOut</td>
<td>12</td>
</tr>
<tr>
<td>Orange</td>
<td>Daisies</td>
<td>SoldOut</td>
<td>6</td>
</tr>
<tr>
<td>Yellow</td>
<td>Daisies</td>
<td>InStock</td>
<td>2</td>
</tr>
<tr>
<td>Pink</td>
<td>Roses</td>
<td>SoldOut</td>
<td>4</td>
</tr>
<tr>
<td>Red</td>
<td>Roses</td>
<td>InStock</td>
<td>3</td>
</tr>
<tr>
<td>Yellow</td>
<td>Roses</td>
<td>Ordered</td>
<td>6</td>
</tr>
</tbody>
</table>

Example 2 - Paired F1/F2 records with duplicates (cartesian)

//JKE2 EXEC PGM=SORT
//SYSOUT DD SYSOUT=*  
//VBIN DD DSN=MY.VBFILE,DISP=SHR  
//FBIN DD DSN=MY.FBFILE,DISP=SHR  
//SORTOUT DD DSN=MY.FB.OUTPUT,DISP=(NEW,CATLG,DELETE),  
// SPACE=(CYL,(5,5)),UNIT=SYSDA

* Control statements for JOINKEYS application
JOINKEYS F1=VBIN,FIELDS=(18,16,A),SORTED
JOINKEYS F2=FBIN,FIELDS=(1,16,A)
REFORMAT FIELDS=(F2:22,I2,F1:5,I2,F2:1,16)
* Control statements for main task (joined records)
OPTION EQUALS
SORT FIELDS=(13,I2,CH,A)
/

This example illustrates how you can join paired records from two files, both of
which have duplicate records. The result will be a cartesian join. The paired
records are the records in F1 and F2 with matching keys (for example, key=Cats).

Input file1 has RECFM=VB and LRECL=50. It contains the following records:

<table>
<thead>
<tr>
<th>Len</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>Eliot Cats Musical</td>
</tr>
<tr>
<td>40</td>
<td>Lloyd-Webber Cats Musical</td>
</tr>
<tr>
<td>48</td>
<td>Hart Pal Joey Musical, Comedy</td>
</tr>
<tr>
<td>48</td>
<td>Rodgers Pal Joey Musical, Comedy</td>
</tr>
<tr>
<td>47</td>
<td>Hammerstein South Pacific Musical, Drama</td>
</tr>
<tr>
<td>47</td>
<td>Rodgers South Pacific Musical, Drama</td>
</tr>
</tbody>
</table>

The output file will have RECFM=FB and LRECL=40. It will contain the paired
cartesian product of the two files sorted as follows:

Start: 1982 Eliot Cats
End: 2000 Eliot Cats
Start: 1949 Hammerstein South Pacific
End: 1954 Hammerstein South Pacific
Start: 1940 Hart Pal Joey
End: 1941 Hart Pal Joey
Start: 1982 Lloyd-Webber Cats
End: 2000 Lloyd-Webber Cats
Start: 1940 Rodgers Pal Joey
End: 1941 Rodgers Pal Joey
Start: 1949 Rodgers South Pacific
End: 1954 Rodgers South Pacific
JOINKEYS Application Processing

The first JOINKEYS statement defines the ddname and key for the F1 file. F1=VBIN tells DFSORT that the ddname for the F1 file is VBIN. FIELDS=(18,16,A) tells DFSORT that the key is in positions 18-33 ascending. Note that since VBIN is a VB file, the starting position of its key must take the RDW in positions 1-4 into account. Since SORTED is specified, indicating that the records are already in order by the specified binary key, DFSORT will copy the VBIN records.

The second JOINKEYS statement defines the ddname and binary key for the F2 file. F2=FBIN tells DFSORT that the ddname for the F2 file is FBIN. FIELDS=(1,16,A) tells DFSORT that the binary key is in positions 1-16 ascending. Since SORTED is not specified, DFSORT will sort the FBIN records by the specified binary key.

The REFORMAT statement defines the fields to be extracted for the joined records in the order in which they are to appear. FIELDS=(F2:22,12,F1:5,12,F2:1,16) tells DFSORT to create the joined records as follows:

<table>
<thead>
<tr>
<th>Joined Record Positions</th>
<th>Extracted from</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-12</td>
<td>F2 positions 22-33</td>
</tr>
<tr>
<td>13-24</td>
<td>F1 positions 5-16</td>
</tr>
<tr>
<td>25-40</td>
<td>F2 positions 1-16</td>
</tr>
</tbody>
</table>

Note that since VBIN (F1) is a VB file, the starting position of its REFORMAT field must take the RDW in positions 1-4 into account.

Since there is no JOIN statement, only paired records are joined by default. Since there are duplicates in each input file, a cartesian join is performed.

The SORT FIELDS=(13,12,CH,A) statement tells DFSORT to sort the joined records by a different key than the one used for the join of F1 and F2 records. Note that the FIELDS operand of the SORT statement must reference the positions of fields in the joined records.

Conceptually, JOINKEYS application processing proceeds as follows:

- Subtask1 copies the VBIN (F1 file) records as directed by its JOINKEYS statement. As a result, it passes the following records to the main task:

<table>
<thead>
<tr>
<th>Len</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>Eliot Cats Musical</td>
</tr>
<tr>
<td>40</td>
<td>Lloyd-Webber Cats Musical</td>
</tr>
<tr>
<td>48</td>
<td>Hart Pal Joey Musical, Comedy</td>
</tr>
<tr>
<td>48</td>
<td>Rodgers Pal Joey Musical, Comedy</td>
</tr>
<tr>
<td>47</td>
<td>Hammerstein South Pacific Musical, Drama</td>
</tr>
<tr>
<td>47</td>
<td>Rodgers South Pacific Musical, Drama</td>
</tr>
</tbody>
</table>

- Subtask2 sorts the FBIN (F2 file) records as directed by its JOINKEYS statement. As a result, it passes the following records to the main task:

| Cats                      | Start: 1982 50 |
| Cats                      | End: 2000     |
| Pal Joey                 | Start: 1940 22|
| Pal Joey                 | End: 1941     |
| South Pacific            | Start: 1949 13|
| South Pacific            | End: 1954     |

- The main task joins the records passed from subtask1 and subtask2 as directed by the specified JOINKEYS and REFORMAT statements, resulting in the following joined records:

Start: 1982 Eliot Cats
End: 2000 Eliot Cats
Start: 1982 Lloyd-Webber Cats
End: 2000 Lloyd-Webber Cats
Finally, the main task sorts the joined records according to the SORT statement, and writes the resulting records to SORTOUT. Thus, SORTOUT contains these records:

- Start: 1940 Hart Pal Joey
  End: 1941 Hart Pal Joey
- Start: 1940 Rodgers Pal Joey
  End: 1941 Rodgers Pal Joey
- Start: 1949 Hammerstein South Pacific
  End: 1954 Hammerstein South Pacific
- Start: 1949 Rodgers South Pacific
  End: 1954 Rodgers South Pacific

Example 3 - Paired F1 records

This example illustrates how you can select only paired records from one of two files. In this case, we will select the F1 records that have a match in F2 on the specified keys (for example, key1=Development and key2=Master). The F1 records are in comma delimited form so we will parse them to get the binary keys we need.

Input file1 (F1) has RECFM=FB and LRECL=35. It contains the following records:

- Marketing,William,Master
- Development,John,Bachelor
- Manufacturing,Louis,Master
- Development,Carol,Master
- Research,Angela,Master
- Research,Anne,Doctorate
- Development,Sara,Doctorate
- Marketing,Joseph,Master
JOINKEYS Application Processing

Input file2 (F2) has RECFM=FB and LRECL=30. It contains the following records:
- Master Development
- Master Manufacturing
- Bachelor Development
- Doctorate Research

The output file will have RECFM=FB and LRECL=35. It will contain the paired F1 records, that is, the records from F1 that have a match in F2 for the specified keys (the first and third fields):
- Development,John,Bachelor
- Development,Carol,Master
- Development,Susan,Master
- Manufacturing,Louis,Master
- Manufacturing,Nick,Master
- Research,Anne,Doctorate
- Research,Howard,Doctorate

The first JOINKEYS statement defines the ddname and keys for the F1 file.
F1=MASTER tells DFSORT that the ddname for the F1 file is MASTER.

The control statements in JNF1CNTL will be used to process the F1 file before it is sorted. The input records are in comma delimited form, so to use the first and third fields as binary keys, while preserving the original data, we use an INREC statement to parse out the fields we want and add them to the end of the record. The parsed first key will be in positions 36-50 and the parsed second key will be in positions 52-61. For example, the first reformatted record will look like this:
Marketing,William,Master Marketing Master

FIELDS=(36,15,A,52,10,A) in the JOINKEYS statement (referring to the reformatted INREC positions) tells DFSORT that the first key is in positions 36-50 ascending and the second key is in positions 52-61 ascending.

The second JOINKEYS statement defines the ddname and keys for the F2 file.
F2=PULL tells DFSORT that the ddname for the F2 file is PULL.

FIELDS=(12,15,A,1,10,A) in the JOINKEYS statement tells DFSORT that the first key is in positions 12-26 ascending and the second key is in positions 1-10 ascending.

The REFORMAT statement defines the fields to be extracted for the joined records in the order in which they are to appear. FIELDS=(F1:1,35) tells DFSORT to create the joined records from the original F1 input records (positions 1-35 of the F1 records). Since we only needed the added parsed fields for sorting, we don't need to include them in the joined records. Of course, if we wanted the main task to "see" the parsed fields in the joined records, we could include the parsed fields in the REFORMAT FIELDS operand.

Since there is no JOIN statement, only paired records are joined by default.

The OPTION COPY statement tells DFSORT to copy the joined records.

Conceptually, JOINKEYS application processing proceeds as follows:
JOINKEYS Application Processing

- Subtask1 performs INREC processing for the MASTER (F1 file) records as directed by the control statement in JNF1CNTL and sorts the resulting records as directed by its JOINKEYS statement. As a result, it passes the following records to the main task:

  | Development, John, Bachelor | Development, Bachelor |
  | Development, Sara, Doctorate | Development, Doctorate |
  | Development, Carol, Master | Development, Master |
  | Development, Susan, Master | Development, Master |
  | Manufacturing, Donna, Bachelor | Manufacturing, Bachelor |
  | Manufacturing, Louis, Master | Manufacturing, Master |
  | Manufacturing, Nick, Master | Manufacturing, Master |
  | Marketing, William, Master | Marketing, Master |
  | Marketing, Joseph, Master | Marketing, Master |
  | Research, Howard, Doctorate | Research, Doctorate |
  | Research, Angela, Master | Research, Master |

- Subtask2 sorts the PULL (F2 file) records as directed by its JOINKEYS statement. As a result, it passes the following records to the main task:

  | Bachelor Development |
  | Master Development |
  | Master Manufacturing |
  | Doctorate Research |

- The main task joins the records passed from subtask1 and subtask2 as directed by the specified JOINKEYS and REFORMAT statements, resulting in the following joined records:

  | Development, John, Bachelor |
  | Development, Carol, Master |
  | Development, Susan, Master |
  | Manufacturing, Louis, Master |
  | Manufacturing, Nick, Master |
  | Research, Anne, Doctorate |
  | Research, Howard, Doctorate |

- Finally, the main task copies the joined records to SORTOUT. Thus, SORTOUT contains these records:

  | Development, John, Bachelor |
  | Development, Carol, Master |
  | Development, Susan, Master |
  | Manufacturing, Louis, Master |
  | Manufacturing, Nick, Master |
  | Research, Anne, Doctorate |
  | Research, Howard, Doctorate |

Example 4 - Unpaired F2 records

```plaintext
//JKE4 EXEC PGM=SORT
//SYSOUT DD SYSOUT=* 
//IN1 DD DSN=FILE1.IN,DISP=SHR 
//IN2 DD DSN=FILE2.IN,DISP=SHR 
//SORTOUT DD DSN=FILE3.OUT,DISP=OLD 
//JNF1CNTL DD *
* Control statements for subtask1 (F1)
OMIT COND=(10,5,UFF,EQ,99999)
INREC BUILD=(1,8,9:10,5,UFF,TO=ZD,LENGTH=5)
*/
//JNF2CNTL DD *
* Control statements for subtask2 (F2)
OMIT COND=(14,5,UFF,EQ,99999)
INREC BUILD=(1,4,5:14,5,UFF,TO=ZD,LENGTH=5,10:5)
*/
//SYSIN DD *
* Control statements for JOINKEYS application
JOINKEYS F1=IN1,FIELDS=(1,8,9,5,D)
```
JOINKEYS Application Processing

JOINKEYS F2=IN2,FIELDS=(10,8,A,5,5,D)
JOIN UNPAIRED,F2,ONLY
REFORMAT FIELDS=(F2:1,4,10)
* Control statement for main task
OPTION COPY
/*

This example illustrates how you can select only unpaired records from one of two files. In this case, we will select the F2 records that do not have a match in F1 on the specified keys (for example, key1=Molly and key2=2100). We will also omit certain records from each input file and handle unnormalized keys.

Input file1 has RECFM=FB and LRECL=15. It contains the following records:
Molly 145
Molly 99999
Molly 2143
Jasmine 1292
Jasmine 5
Jasmine 28
Jasmine 99999

Input file2 has RECFM=VB and LRECL=35. It contains the following records:
  Len|Data
  30|Molly 145 Thursday
  31|Molly 2100 Wednesday
  28|Molly 18 Sunday
  28|Jasmine 99999 Monday
  28|Jasmine 5 Sunday
  30|Jasmine 28 Saturday
  29|Jasmine 103 Tuesday
  31|Jasmine 99999 Wednesday

The output file will have RECFM=VB and LRECL=35. F1 records with 99999 in positions 10-14 and F2 records with 99999 in positions 14-18 will be removed before join processing. The output file will contain unpaired F2 records (that is, records from F2 that do not have a match in F1 for the specified keys) as follows:
  Len|Data
  29|Jasmine 103 Tuesday
  31|Molly 2100 Wednesday
  28|Molly 18 Sunday

The first JOINKEYS statement defines the ddname and keys for the F1 file. F1=IN1 tells DFSORT that the ddname for the F1 file is IN1.

The control statements in JNF1CNTL will be used to process the F1 file before it is sorted. The OMIT statement removes records that have 99999 in positions 10-14. We want to use the numeric field as our key. However, the numeric field is unnormalized since it is left aligned instead of right aligned, so sorting it as a binary key will not work. To handle this, we use the INREC statement to reformat the numeric field as ZD values in positions 9-13 (positive ZD values with the same sign can be sorted as binary). For example, the first reformatted FB record will look like this:
Molly 00145

Since we don’t need the F1 records for output, we don’t need to keep the original left aligned numeric value.

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JOINKEYS Application Processing

FIELDS=(1,8,A,9,5,D) in the JOINKEYS statement (referring to the reformatted INREC positions) tells DFSORT that the first key is in positions 1-8 ascending and the second key is in positions 9-13 descending.

The second JOINKEYS statement defines the ddname and keys for the F2 file. F2=IN2 tells DFSORT that the ddname for the F2 file is IN2.

The control statements in JNF2CNTL will be used to process the F2 file before it is sorted. The OMIT statement removes records that have 99999 in positions 14-18. Again, we need a ZD version of the left aligned numeric value to use for the binary key. But in this case, since we want the original F2 records for output, we need to keep the original numeric value as well. Using the INREC statement, we add the ZD value at positions 5-9 between the RDW and the first data field. That shifts the original data to start at position 10. For example, the first reformatted VB record will look like this:

<table>
<thead>
<tr>
<th>Len</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>35</td>
<td>00145Molly 145 Thursday</td>
</tr>
</tbody>
</table>

In this case, since the input is a VB file, we specify the RDW (1,4), then the converted field, and then the rest of the record (5 without a length) in the INREC statement.

FIELDS=(10,8,A,5,5,D) in the JOINKEYS statement (referring to the reformatted INREC positions) tells DFSORT that the first key is in positions 10-17 ascending and the second key is in positions 5-9 descending.

Note that since IN2 is a VB file, all of its starting positions must take the RDW in positions 1-4 into account.

The JOIN statement tells DFSORT that the joined records should be the F2 records that do not have a match in F1 on the specified keys.

The REFORMAT statement defines the fields to be extracted for the joined records in the order in which they are to appear. We need the RDW (1,4) and the original data which starts in position 10 of the reformatted F2 records. So we use FIELDS=(F2:1,4,10). Since the last field (10) is a position without a length, it tells DFSORT to create VB records. The joined records are created as follows from the reformatted F2 records:

<table>
<thead>
<tr>
<th>Joined Record Positions</th>
<th>Extracted from</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-4</td>
<td>RDW (not extracted)</td>
</tr>
<tr>
<td>5 to end</td>
<td>Reformatted F2 position 10 to end</td>
</tr>
</tbody>
</table>

Conceptually, JOINKEYS application processing proceeds as follows:

- Subtask1 performs OMIT and INREC processing for the IN1 (F1 file) records as directed by the control statements in JNF1CNTL and sorts the resulting records as directed by its JOINKEYS statement. As a result, it passes the following records to the main task:
  - Jasmine 01292
  - Jasmine 00028
  - Jasmine 00005
  - Molly 02143
  - Molly 00145
JOINKEYS Application Processing

- Subtask2 performs OMIT and INREC processing for the IN2 (F2 file) records as directed by the control statements in JNF2CNTL and sorts the resulting records as directed by its JOINKEYS statement. As a result, it passes the following records to the main task:

<table>
<thead>
<tr>
<th>Len</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>34</td>
<td>00103Jasmine 103 Tuesday</td>
</tr>
<tr>
<td>35</td>
<td>00028Jasmine 28 Saturday</td>
</tr>
<tr>
<td>33</td>
<td>00005Jasmine 5 Sunday</td>
</tr>
<tr>
<td>36</td>
<td>02100Molly 2100 Wednesday</td>
</tr>
<tr>
<td>35</td>
<td>00145Molly 145 Thursday</td>
</tr>
<tr>
<td>33</td>
<td>00018Molly 18 Sunday</td>
</tr>
</tbody>
</table>

- The main task joins the records passed from subtask1 and subtask2 as directed by the specified JOINKEYS, JOIN and REFORMAT statements, resulting in the following joined records (unmatched F2 records):

<table>
<thead>
<tr>
<th>Len</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>29</td>
<td>Jasmine 103 Tuesday</td>
</tr>
<tr>
<td>31</td>
<td>Molly 2100 Wednesday</td>
</tr>
<tr>
<td>28</td>
<td>Molly 18 Sunday</td>
</tr>
</tbody>
</table>

- Finally, the main task copies the joined records, and writes them to SORTOUT. Thus, SORTOUT contains these records:

<table>
<thead>
<tr>
<th>Len</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>29</td>
<td>Jasmine 103 Tuesday</td>
</tr>
<tr>
<td>31</td>
<td>Molly 2100 Wednesday</td>
</tr>
<tr>
<td>28</td>
<td>Molly 18 Sunday</td>
</tr>
</tbody>
</table>

Example 5 - Paired and unpaired F1/F2 records (indicator method)

```
//JKE5 EXEC PGM=SORT
//SYSOUT DD SYSOUT=*  
//SORTJNF1 DD DSN=FIRST.FILE,DISP=SHR  
//SORTJNF2 DD DSN=SECOND.FILE,DISP=SHR  
//F1ONLY DD SYSOUT=*  
//F2ONLY DD SYSOUT=*  
//BOTH DD SYSOUT=*  
//SYSIN DD *  
  * Control statements for JOINKEYS application  
JOINKEYS FILE=F1,FIELDS=(1,10,A),SORTED,NOSEQCK  
JOINKEYS FILE=F2,FIELDS=(7,10,A),SORTED,NOSEQCK  
JOIN UNPAIRED,F1,F2  
REFORMAT FIELDS=(F1:1,14,F2:1,20,?)  
  * Control statements for main task (joined records)  
OPTION COPY  
OUTFIL FNAME=F1ONLY,INCLUDE=(35,1,CH,EQ,C'1'),  
          BUILD=(1,14)  
OUTFIL FNAME=F2ONLY,INCLUDE=(35,1,CH,EQ,C'2'),  
          BUILD=(15,20)  
OUTFIL FNAME=BOTH,INCLUDE=(35,1,CH,EQ,C'B'),  
          BUILD=(1,14,/,15,20)  
/*  
```

This example illustrates how you can create three output files; with paired F1/F2 records, unpaired F1 records and unpaired F2 records. In this case:

- F1 records which do not have a match in F2 on the specified keys (for example, key=David) will be written to the F1ONLY output file.
- F2 records which do not have a match in F1 on the specified keys (for example, key=Karen) will be written to the F2ONLY output file.
- F1 and F2 records which have a match in F1 and F2 on the specified keys (for example, key=Carrie) will be written to the BOTH output file.
JOINKEYS Application Processing

Input file1 has RECFM=FB and LRECL=14. It contains the following records:

Carrie F101
David F102
Frank F103
Holly F104
Vicky F105

Input file2 has RECFM=FB and LRECL=20. It contains the following records:

No Carrie F201
Yes Holly F202
Yes Karen F203
No Sri Hari F204
Yes Vicky F205

The F1ONLY file will have RECFM=FB and LRECL=14. It will contain the unpaired F1 records as follows:

David F102
Frank F103

The F2ONLY file will have RECFM=FB and LRECL=20. It will contain the unpaired F2 records as follows:

Yes Karen F203
No Sri Hari F204

The BOTH file will have RECFM=FB and LRECL=20. It will contain the paired F1 and F2 records as follows:

Carrie F101
No Carrie F201
Holly F104
Yes Holly F202
Vicky F105
Yes Vicky F205

The first JOINKEYS statement defines the ddname and key for the F1 file. FILE=F1 tells DFSORT that the ddname for the F1 file is SORTJNF1. FIELDS=(1,10,A) tells DFSORT that the key is in positions 1-10 ascending. Since SORTED is specified, indicating that the records are already in order by the specified binary key, DFSORT will copy the SORTJNF1 records. Since NOSEQCK is specified, DFSORT will not check that the records are in order by the key. (Only use NOSEQCK if you know for sure that the records are in order by the key.)

The second JOINKEYS statement defines the ddname and key for the F2 file. FILE=F2 tells DFSORT that the ddname for the F2 file is SORTJNF2. FIELDS=(7,10,A) tells DFSORT that the key is in positions 7-16 ascending. Since SORTED is specified, indicating that the records are already in order by the specified binary key, DFSORT will copy the SORTJNF2 records. Since NOSEQCK is specified, DFSORT will not check that the records are in order by the key. (Only use NOSEQCK if you know for sure that the records are in order by the key.)

The JOIN statement tells DFSORT that the joined records should include the unpaired F1 and F2 records as well as the paired F1/F2 records.

The REFORMAT statement defines the fields to be extracted for the joined records in the order in which they are to appear, and includes an indicator in the last position that will be set to '1' if the key is found only in the F1 file, '2' if the key is found only in the F2 file, or 'B' if the key is found in the F1 file and in the F2 file. FIELDS=(F1:1,14,F2:1,20,?) tells DFSORT to create the joined records as follows:
JOINKEYS Application Processing

<table>
<thead>
<tr>
<th>Joined Record Positions</th>
<th>Extracted from</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-14</td>
<td>F1 positions 1-14</td>
</tr>
<tr>
<td>15-34</td>
<td>F2 positions 1-20</td>
</tr>
<tr>
<td>35</td>
<td>Indicator of where key was found</td>
</tr>
</tbody>
</table>

The OPTION COPY statement tells DFSORT to copy the joined records. The OUTFIL statements use the indicator in position 35 to determine where to find the F1 or F2 fields in the joined records and where to write the fields (F1ONLY, F2ONLY or BOTH).

Conceptually, JOINKEYS application processing proceeds as follows:

- Subtask1 copies the SORTJNF1 (F1) records as directed by the JOINKEYS statement. As a result, it copies the unchanged SORTJNF1 records to the main task.
- Subtask2 copies the SORTJNF2 (F2) records as directed by the JOINKEYS statement. As a result, it copies the unchanged SORTJNF2 records to the main task.
- The main task joins the records passed from subtask1 and subtask2 as directed by the specified JOINKEYS, JOIN and REFORMAT statements, resulting in the following joined records (paired and unpaired):

```
Carrie F101No Carrie F201B
David F102 1
Frank F103 1
Holly F104Yes Holly F202B
            Yes Karen F2032
            No Sri Hari F2042
Vicky F105Yes Vicky F205B
```

For F1 records without a match in F2 (for example, the F102 record), the indicator in position 35 has a '1'. For F2 records without a match in F1 (for example, the F203 record), the indicator in position 35 has a '2'. For F1 records with a match in F2 (for example, the F101 and F201 records), the indicator in position 35 has a 'B'.

- The first OUTFIL statement finds records with a '1' in position 35. These are the F1 records without a match in F2. The F1 field is in positions 1-14 of the joined record, so those positions are written to the F1ONLY file. Thus, F1ONLY contains these records:

```
David F102
Frank F103
```

- The second OUTFIL statement finds records with a '2' in position 35. These are the F2 records without a match in F1. The F2 field is in positions 15-34 of the joined record, so those positions are written to the F2ONLY file. Thus, F2ONLY contains these records:

```
Yes Karen F203
No Sri Hari F204
```

- The third OUTFIL statement finds records with 'B' in position 35. These are the F1 and F2 records with a match. The F1 field is in positions 1-14 of the joined record and the F2 field is in positions 15-34 of the joined record, so each joined record is split into those two records and written to the BOTH file. The shorter F1 record is padded with blanks on the right to the length of the F2 record. Thus, BOTH contains these records:
JOINKEYS Application Processing

Carrie  F101
No Carrie  F201
Holly  F104
Yes Holly  F202
Vicky  F105
Yes Vicky  F205

Note: If you only want one record per key in BOTH, you can have the BUILD for FNames=BOTH specify the positions for just that record. For example, BUILD=(1,14) for the F1 records or BUILD=(15,20) for the F2 records.

Example 6 - Paired and unpaired F1/F2 records (FILL method)

```
//JKE6 EXEC PGM=SORT
//SYSOUT DD SYSOUT=*  
//SORTJNF1 DD DSN=FIRST.FILE,DISP=SHR
//SORTJNF2 DD DSN=SECOND.FILE,DISP=SHR
//F1ONLY DD SYSOUT=*
//F2ONLY DD SYSOUT=*
//BOTH DD SYSOUT=*  
//SYSIN DD *

* Control statements for JOINKEYS application
JOINKEYS FILE=F1,FIELDS=(1,10,A),SORTED,NOSEQCK
JOINKEYS FILE=F2,FIELDS=(7,10,A),SORTED,NOSEQCK
JOIN UNPAIRED,F1,F2
REFORMAT FIELDS=(F1:1,14,F2:1,20),FILL=C'$'

* Control statements for main task (joined records)
OPTION COPY
OUTFIL FNAMES=F1ONLY,INCLUDE=(15,1,CH,EQ,C'$'),BUILD=(1,14)
OUTFIL FNAMES=F2ONLY,INCLUDE=(1,1,CH,EQ,C'$'),BUILD=(15,20)
OUTFIL FNAMES=BOTH,INCLUDE=(15,1,CH,NE,C'$',AND,1,1,CH,NE,C'$'),BUILD=(1,14,/,15,20)
```

This example illustrates an alternate way to create three output files; with paired F1/F2 records, unpaired F1 records and unpaired F2 records. It produces the same output as Example 5. Whereas Example 5 uses an indicator in one position to determine where the key was found, Example 6 uses a fill character in different positions to determine where the key was found. Another drawback of the Example 6 method is that you must use a FILL character that does not appear in either input record. The Explanation for Example 6 is the same as for Example 5 up to the REFORMAT statement and then it differs as follows:

The REFORMAT statement defines the fields to be extracted for the joined records in the order in which they are to appear. FIELDS=(F1:1,14,F2:1,20) tells DFSORT to create the joined records as follows:

```
Joined Record Positions  Extracted from
----------------------- -----------------
1-14 F1 positions 1-14
15-34 F2 positions 1-20
```

FILL=C'$' tells DFSORT to use $ as the fill character for the F1 field in an unpaired F2 record and for the F2 field in an unpaired F1 record. We use the FILL character to identify the unpaired records from each file; when used for this purpose, the default of FILL=X'40' is usually not a good choice. You must select a FILL character that will not appear in either input file.

The OPTION COPY statement tells DFSORT to copy the joined records. The OUTFIL statements use the presence or absence of the $ fill character in certain
JOINKEYS Application Processing

positions to determine where to find the F1 or F2 fields in the joined records and where to write the fields (F1ONLY, F2ONLY or BOTH).

Conceptually, JOINKEYS application processing proceeds as follows:

- Subtask1 copies the SORTJNF1 (F1) records as directed by the JOINKEYS statement. As a result, it copies the unchanged SORTJNF1 records to the main task.
- Subtask2 copies the SORTJNF2 (F2) records as directed by the JOINKEYS statement. As a result, it copies the unchanged SORTJNF2 records to the main task.
- The main task joins the records passed from subtask1 and subtask2 as directed by the specified JOINKEYS, JOIN and REFORMAT statements, resulting in the following joined records (paired and unpaired):

```
Carrie  F101  No  Carrie  F201
David   F102
Frank   F103
Holly   F104  Yes  Holly  F202
      $$$$$$$$$$$$$$$Yes  Karen  F203
      $$$$$$$$$$$$$$$No   Sri Hari F204
Vicky   F105  Yes  Vicky  F205
```

For F1 records without a match in F2 (for example, the F102 record), the F2 field is filled with the FILL character. For F2 records without a match in F1 (for example, the F203 record), the F1 field is filled with the FILL character. For F1 records with a match in F2 (for example, the F101 and F201 records), no FILL characters are used.

- The first OUTFIL statement finds records with the FILL character in position 15. These are the F1 records without a match in F2. The F1 field is in positions 1-14 of the joined record, so those positions are written to the F1ONLY file. Thus, F1ONLY contains these records:

```
David   F102
Frank   F103
```

- The second OUTFIL statement finds records with the FILL character in position 1. These are the F2 records without a match in F1. The F2 field is in positions 15-34 of the joined record, so those positions are written to the F2ONLY file. Thus, F2ONLY contains these records:

```
Yes  Karen  F203
No   Sri Hari F204
```

- The third OUTFIL statement finds records without the FILL character in position 1 or position 15. These are the F1 and F2 records with a match. The F1 field is in positions 1-14 of the joined record and the F2 field is in positions 15-34 of the joined record, so each joined record is split into those two records and written to the BOTH file. The shorter F1 record is padded with blanks on the right to the length of the F2 record. Thus, BOTH contains these records:

```
Carrie  F101  No  Carrie  F201
Holly   F104
Yes  Holly  F202
Vicky   F105
Yes  Vicky  F205
```

Note: If you only want one record per key in BOTH, you can have the BUILD for FNAMES=BOTH specify the positions for just that record. For example, BUILD=(1,14) for the F1 records or BUILD=(15,20) for the F2 records.
Chapter 5. Using Your Own User Exit Routines

User Exit Routine Overview

DFSORT can pass program control to your own routines at points in the executable code called user exits. Your user exit routines can perform a variety of functions including deleting, inserting, altering, and summarizing records.
**User Exit Routine Overview**

If you need to perform these tasks, you should be aware that DFSORT already provides extensive facilities for working with your data in the various DFSORT program control statements. See the discussions of the INCLUDE, OMIT, INREC, OUTFIL, OUTREC, and SUM program control statements in Chapter 3, “Using DFSORT Program Control Statements,” on page 81. You might decide that using a program control statement to work with your records is more appropriate to your needs.

Although this chapter discusses only routines written in assembler or COBOL, you can write your exit routines in any language that can:
- Pass and accept the address into general register 1 of a:
  - Record
  - Full word of zeros
  - Parameter list.
- Pass a return code in register 15.

You can easily activate user exit routines at run-time with the MODS program control statement (see “MODS Control Statement” on page 166). Alternatively, under certain circumstances you can also activate a user exit routine by passing the address of your exit routine in the invocation parameter list. See Chapter 6, “Invoking DFSORT from a Program,” on page 537 for details.

Parameters that affect the way user exit routines are handled include:
- The MODS statement, explained in “MODS Control Statement” on page 166
- The E15=COB and E35=COB PARM options of the EXEC statement, explained in “Specifying EXEC/DFSPARM PARM Options” on page 29
- The COBEXIT option of the OPTION statement, explained in “OPTION Control Statement” on page 173
- The EXITCK option of the OPTION statement, explained in “OPTION Control Statement” on page 173.

**Note:** To avoid ambiguity in this chapter, it is assumed that the IBM default, EXITCK=STRONG, was selected at your site.

Certain user exit routines can be written in COBOL, using a special interface. If you write your exit routines in PL/I, you must use the PL/I subroutine facilities.

You might need to reserve space to be used by your exits. See “Use Main Storage Efficiently” on page 805 for more information about storage.

---

**DFSORT Program Phases**

A DFSORT program phase is a large DFSORT component designed to perform a specific task such as writing the output file. Various user exits are contained in the input and output phases and are activated at a particular time during DFSORT processing. The input phase is used only for a sort or copy. When the output phase is completed, DFSORT returns control to the operating system or invoking program. Figure 16 on page 491 is a representation of DFSORT input/output logic.
Figure 16. Examples of DFSORT Input/User Exit/Output Logic
You can use exit routines to accomplish a variety of tasks:

- Open and initialize data sets
- Modify control fields
- Insert, delete, or alter records
- Sum records
- Handle special I/O conditions
- Determine action when intermediate storage is insufficient
- Close data sets
- Terminate DFSORT.

Figure 16 on page 491, Table 57 on page 493, and Table 58 on page 493 summarize the functions of user exit routines and the exits and phases with which they can be associated.

The following restrictions apply to the applications for which specific user exits can be used:

- E11, E16, E17, E18, and E19 can be used for sort applications, but are ignored for copy or merge applications.
- E15 can be used for sort or copy applications, but is ignored for merge applications.
- E32 can be used for merge applications, but is ignored for copy or sort applications.
- E61 can be used for sort or merge applications, but is ignored for copy applications.
- E31, E35, E37, E38, and E39 can be used for sort, copy, or merge applications.

DFSORT Input/User Exit/Output Logic Examples

Figure 16 on page 491 gives examples of the logic flow for sort, copy, and merge applications as it relates to SORTINnn, E15 or E35 user exits, and SORTOUT. The intent is to show how your E15 and E35 user exits fit into the logic of an application. All possible paths are not covered. For simplicity, it is assumed that all of the applicable data sets and exits are present and that records are not inserted or deleted. (For a merge, similar logic would be used if an E32 user exit supplied the records rather than SORTINnn data sets.)

Figure 16 on page 491 illustrates the following logic:

- E15 and E35 user exits continue to be entered until they pass back a return code of 8. If your user exit passes a return code of 8 to DFSORT when input records still remain to be processed, the records are processed by DFSORT without being passed to your exit.
- During a sort, each record is read from SORTIN and passed to E15 user exit. When all of the records have been processed in this manner, they are sorted by DFSORT, then each sorted record is passed to E35 and written to the output data sets.
- During a copy, each record is read from SORTIN, passed to E15 and E35 user exits, and written to the output data sets.
- During a merge, one record is initially read from each SORTINnn data set. The record to be output is chosen, passed to E35, and written to the output data sets. The chosen record is then replaced by reading a record from the same SORTINnn data set and the process continues.
Functions of Routines at User Exits

**Note:** For a merge application, records deleted during an E35 user exit routine are not sequence-checked. If you use an E35 user exit routine without an output data set, sequence checking is not performed at the time the records are passed to the E35 user exit; therefore, you must ensure that input records are in correct sequence.

<table>
<thead>
<tr>
<th>Functions</th>
<th>Sort Input Phase</th>
<th>Sort Output Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open/Initialize</td>
<td>E11, E15 user exits</td>
<td>E31 user exit</td>
</tr>
<tr>
<td>Modify control fields</td>
<td>E61 user exit</td>
<td>N/A</td>
</tr>
<tr>
<td>Insert, Delete/Alter</td>
<td>E15 user exit</td>
<td>E35 user exit</td>
</tr>
<tr>
<td>Sum records</td>
<td></td>
<td>E35 user exit</td>
</tr>
<tr>
<td>Handle special I/O conditions:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>QSAM/BSAM and VSAM SORTIN</td>
<td>E18 user exit</td>
<td>E38 user exit</td>
</tr>
<tr>
<td>QSAM/BSAM SORTOUT</td>
<td>E19 user exit</td>
<td>E39 user exit</td>
</tr>
<tr>
<td>VSAM SORTOUT</td>
<td>N/A</td>
<td>E39 user exit</td>
</tr>
<tr>
<td>Determine action when intermediate storage is insufficient</td>
<td>E16 user exit</td>
<td>N/A</td>
</tr>
<tr>
<td>Close/housekeeping</td>
<td>E15, E17 user exits</td>
<td>E35, E37 user exits</td>
</tr>
<tr>
<td>Terminate DFSORT</td>
<td>E15 user exit</td>
<td>E35 user exit</td>
</tr>
</tbody>
</table>

**Notes:**
1. The SUM control statement can be used instead of your own routine to sum records.
2. Applies only to a tape work data set sort.
3. E39 can be used for SORTOUT, but not for OUTFIL data sets.
4. Applies only to a tape work data set sort or a Peerage/Vale sort without work data sets.

<table>
<thead>
<tr>
<th>Functions</th>
<th>Copy</th>
<th>Merge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open/Initialize</td>
<td>E15, E31 user exits</td>
<td>E31 user exit</td>
</tr>
<tr>
<td>Modify control fields</td>
<td>N/A</td>
<td>E61 user exit</td>
</tr>
<tr>
<td>Insert</td>
<td>E15, E35 user exits</td>
<td>E32, E35 user exits</td>
</tr>
<tr>
<td>Delete/alter</td>
<td>E15, E35 user exits</td>
<td>E35 user exit</td>
</tr>
<tr>
<td>Sum records</td>
<td>E35 user exit</td>
<td>E35 user exit</td>
</tr>
<tr>
<td>Handle special I/O conditions:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>QSAM/BSAM and VSAM SORTIN(nn)</td>
<td>E38 user exit</td>
<td>E38 user exit</td>
</tr>
<tr>
<td>QSAM/BSAM and VSAM SORTOUT</td>
<td>E39 user exit</td>
<td>E39 user exit</td>
</tr>
<tr>
<td>Close/housekeeping</td>
<td>E35, E37 user exits</td>
<td>E35, E37 user exits</td>
</tr>
<tr>
<td>Terminate DFSORT</td>
<td>E15, E35 user exits</td>
<td>E32, E35 user exits</td>
</tr>
</tbody>
</table>

**Note:**
1. The SUM control statement can be used instead of your own routine to sum records.

Opening and Initializing Data Sets

You can write your own routines to open data sets and perform other forms of initialization; you must associate these routines with the E11, E15, E31 and E35 user exits.
Modifying Control Fields

You can write a routine to alter control fields before DFSORT compares them. This allows you, for example, to normalize floating-point control fields. It also allows you to modify the order in which the records are finally sorted or merged, a function for which you would usually use DFSORT's ALTSEQ program control statement. You must associate this routine with the E61 user exit.

When an E61 user exit is used, the subsequent comparisons always arrange the modified control fields in ascending order.

Note: Although you are altering control fields before a compare, your original records are not altered.

Inserting, Deleting, and Altering Records

You can write your own routines to delete, insert, or alter records. You must associate these routines with the E15, E32, and E35 user exits.

Note: DFSORT also provides INCLUDE and OMIT statements, and OUTFIL INCLUDE and OMIT parameters that automatically include or delete records based on your field criteria. For more information on these control statements, refer to Chapter 3, “Using DFSORT Program Control Statements,” on page 81.

Summing Records

You can sum records for output by using the E35 user exit. However, you can also use DFSORT's SUM program control statement to accomplish this without a user exit. See “SUM Control Statement” on page 452.

Handling Special I/O

DFSORT contains four exits to handle special I/O conditions: E18 and E38 user exits for SORTIN and SORTINnn, and E19 and E39 user exits for SORTOUT (but not for OUTFIL data sets). They are particularly useful for a tape work data set sort. With all disk work data set sorts, E19 and E38 user exits are ignored.

You can use these exits to incorporate your own or your site's I/O error recovery routines into DFSORT. Your read and write error routines must reside in a partitioned data set (library). Your library routines are brought into main storage with their associated phases. When DFSORT encounters an uncorrectable I/O error, it passes the same parameters as those passed by QSAM/BSAM or VSAM. If no user routines are supplied and an uncorrectable read or write error is encountered, DFSORT issues an error message and then terminates.

With QSAM/BSAM, the following information is passed to your synchronous error routine:

- General registers 0 and 1 are unchanged; they contain the information passed by QSAM/BSAM, as documented in the data management publications.
- General register 14 contains the return address of DFSORT.
- General register 15 contains the address of your error routine.
Functions of Routines at User Exits

VSAM will go directly to any routine specified in the EXLST macro you passed to DFSORT via the E18, E38, or E39 user exit, as appropriate. Your routine must return to VSAM via register 14. For details, see z/OS DFSMS Macro Instructions for Data Sets or z/OS DFSMS Using Data Sets.

Routines for Read Errors
You must associate these routines with the E18 and E38 user exits. They must pass certain control block information back to DFSORT to tell it whether to accept the record as it is, skip the block, or request termination. They can also attempt to correct the error.

Routines for Write Errors
You must associate these routines with the E19 and E39 user exits. These routines can perform any necessary abnormal end-of-task operations for SORTOUT before DFSORT is terminated.

VSAM User Exit Functions
There are three user exits that can be used with VSAM SORTIN, SORTINnn, and SORTOUT data sets (but not with OUTFIL data sets), to supply passwords or a user exit list to journal a VSAM data set. They can carry out other VSAM exit functions except EODAD. The user exits are E18 for sort SORTIN, E38 for merge SORTINnn or copy SORTIN, and E39 for SORTOUT.

Determining Action when Intermediate Storage Is Insufficient
You can write a routine to direct DFSORT program action if DFSORT determines that insufficient intermediate storage is available to handle the input data set. You must associate this routine with the E16 user exit for sorts using tape work data sets. For a sort that uses tape data sets, you can choose between sorting current records only, trying to complete the sort, or terminating DFSORT. For more details, see “Exceeding Tape Work Space Capacity” on page 855.

Closing Data Sets
You can write your own routines to close data sets and perform any necessary housekeeping: you must associate these routines with the E15, E17, E35, and E37 user exits. To write SORTOUT labels, use the E19 and E39 user exits. If you have an end-of-file routine you want to use for SORTIN, include it at the E18 user exit.

Terminating DFSORT
You can write an exit routine to terminate DFSORT before all records have been processed. You must associate these routines with the E15, E16, E32, and E35 user exits.

Addressing and Residence Modes for User Exits
To allow user exits called by Blockset or Peerage/Vale to reside above or below 16MB virtual, use either 24-bit or 31-bit addressing, and use a user exit address constant, DFSORT supplies these features:

• To ensure that DFSORT enters your user exit with the correct addressing mode, you must observe these rules:
  – If the user exit name is specified in a MODS control statement, the user exit is entered with the addressing mode indicated by the linkage editor attributes of the routine (for example, 31-bit addressing in effect if AMODE 31 is specified).
Addressing and Residence Modes for User Exits

- If the address of the exit is passed to DFSORT (preloaded exit) via the 24-bit list, the user exit is entered with 24-bit addressing in effect.
- If the address of the user exit is passed to DFSORT via the extended parameter list (preloaded exit), the user exit is entered with 24-bit addressing in effect if bit 0 of the user exit address in the list is 0 or with 31-bit addressing in effect if bit 0 of the user exit address in the list is 1.
- User exits can return to DFSORT with either 24-bit or 31-bit addressing in effect. The return address that DFSORT placed in register 14 must be used.
- Except for the user exit address constant (which is passed to either the assembler E15, E32, or E35 user exit unchanged), DFSORT handles the user exit parameter list addresses (that is, the pointer to the parameter list and the addresses in the parameter list) as follows:
  - If the user exit is entered with 24-bit addressing in effect, DFSORT passes clean (zeros in the first 8 bits) 24-bit addresses to the user exit. Such a user exit must pass 24-bit addresses back to DFSORT. These must be clean 24-bit addresses if the user exit returns to DFSORT with 31-bit addressing in effect.
  - If the user exit is entered with 31-bit addressing in effect, DFSORT passes clean 24-bit addresses to the user exit. Such a user exit must pass 31-bit addresses or clean 24-bit addresses back to DFSORT. The only exception is when the high-order byte is used to identify an optional address being passed (for example, E18 SYNAD address). In this case, DFSORT cleans the 24-bit address.

Note: For a conventional merge or tape work data set sort application, user exits:
  - must reside below 16MB virtual
  - must use 24-bit addressing mode
  - must not use a user exit address constant.

How User Exit Routines Affect DFSORT Performance

Before writing a user exit routine, consider the following factors:
- Your routines occupy main storage that would otherwise be available to DFSORT. Because its main storage is restricted, DFSORT might need to perform extra passes to sort the data. This, of course, increases sorting time.
- User exit routines increase the overall run-time.
  Attention: Several of the user exits give your routine control once for each record until you pass a “do not return” return code to DFSORT. You must remember this when designing your routines.
- Using INCLUDE, OMIT, INREC, OUTFIL, OUTREC, and SUM instead of user exit routines allows DFSORT to perform more efficiently.

Summary of Rules for User Exit Routines

When preparing your routines, remember that:
- User-written routines must follow standard linkage conventions and use the required interfaces. COBOL E15 and E35 user exits must use the special interface provided.
- To use an E32 user exit, your invoking program must pass its address to DFSORT in the parameter list.
Summary of Rules for User Exit Routines

- To use any other user exit, you must associate your routine with the appropriate user exits using the MODS control statement. See "MODS Control Statement" on page 166.
- Your invoking program can alternatively pass the address of an E15, E18, E35, and E39 user exit to DFSORT in the parameter list.
- When Blockset or Peerage/Vale is used and your user exits are reenterable, the entire DFSORT program is reenterable.
- If you are using ASCII input, remember that data presented to your user exits at user exits are in EBCDIC format. If the E61 user exit is used to resolve ASCII collating for special alphabetic characters, substituted characters must be in EBCDIC, but the sequencing result depends on the byte value of the ASCII translation for the substituted character.

Loading User Exit Routines

You must assemble or compile each user exit as a separate program. If your user exit operates independently, link-edit it separately into a partitioned data set (library) with the member name to be used in the MODS statement. If your user exit operates in conjunction with other user exits in the same phase (for example, E11, E15, and E17 user exits all use the same DCB), you can request DFSORT to dynamically link-edit them together (see MODS statement). Alternatively, you can link-edit them together into a partitioned data set following these rules:

1. Specify RENT as a linkage editor parameter.
2. Include an ALIAS statement for each user exit using the external entry name of the routine (for example, the CSECT name).
3. Specify the appropriate ALIAS name for each user exit on the MODS statement.

DFSORT includes the names and locations of your user exits in the list of modules to be run during each phase. No user exit is loaded more than once in a program phase, but the same user exit can appear in different phases. For example, you can use the same Read Error user exit in both phases, but not twice in one phase.

The length you specify for a user exit must include storage for the user exit itself as well as any storage used by the user exit outside of the load modules such as I/O buffers or COBOL library subroutines. If you specify a ddname for a user exit in the MODS statement, it must match the DD statement that defines the library containing that user exit. For example:

```
//MYLIB DD DSNAME=MYRTN, etc.
.
.
MODS E15=(MODNAME,500,MYLIB,N)
```

User Exit Linkage Conventions

To enter a user exit, DFSORT loads the address of the DFSORT return point in register 14 and the address of the user exit routine in register 15. A branch to the address in register 15 is then performed.

The general registers used by DFSORT for linkage and communication of parameters observe operating system conventions. When your routine gets control, the general registers have the following contents:

<table>
<thead>
<tr>
<th>Register</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Summary of Rules for User Exit Routines

1. DFSORT places the address of a parameter list in this register.
2. DFSORT places the address of a standard save area in this register. The area can be used to save contents of registers used by your user exit. The first word of the area contains the characters SM1 in its three low-order bytes.
3. Contains the address of DFSORT return point.
4. Contains the address of your user exit. This register can be used as a base register for your user exit; your user exit can also use it to pass return codes to DFSORT.

You can return control to DFSORT by performing a branch to the DFSORT return point address in register 14 or by using a RETURN macro instruction. The RETURN instruction can also be used to set return codes when multiple actions are available at a user exit.

Your user exit must save all the general registers it uses. You can use the SAVE macro instruction to do this. If you save registers, you must also restore them; you can do this with the RETURN macro instruction.

Linkage Examples

When calling your user exit, DFSORT places the return address in general register 14 and your routine’s entry point address in general register 15. DFSORT has already placed the register’s save area address in general register 13. DFSORT then makes a branch to your routine.

Your routine for the E15 user exit might incorporate the following assembler instructions:

```
ENTRY E15

E15 SAVE (5,9)

RETURN (5,9)
```

This coding saves and restores the contents of general registers 5 through 9. The macro instructions are expanded into the following assembler language code:

```
ENTRY E15

E15 STM 5,9,40(13)

LM 5,9,40(13)

LM 14
```

If multiple actions are available at a user exit, your routine sets a return code in general register 15 to inform DFSORT of the action it is to take. The following macro instruction can be used to return to DFSORT with a return code of 12 in register 15:

```
RETURN RC=12
```

A full explanation of linkage conventions and the macro instructions discussed in this section is in "z/OS MVS Programming: Assembler Services Guide."
Summary of Rules for User Exit Routines

Dynamically Link-Editing User Exit Routines

You can dynamically link-edit any user exit routine written in any language that has the ability to pass the location or address of a record or parameter in general register 1 and a return code in register 15 (see MODS statement). This does not include E15 and E35 user exits written in COBOL.

Dynamic link-editing does not support AMODE 31 or RMODE 31 for the link-edit option T. The user exits that are link-edited together by DFSORT are not loaded above 16MB virtual and cannot be entered in 31-bit addressing mode. User exits link-edited with the S option retain the AMODE and RMODE attributes of the object modules and are loaded above or below 16MB virtual depending upon the load module's RMODE; they are entered in the addressing mode of the user exit.

Notes:
1. The Blockset technique is not used for dynamic link-editing.
2. Dynamic link-editing cannot be used with copy.

When the link-edit option T is specified for a user exit routine, that routine must contain an entry point whose name is that of the associated program user exit. This is to accommodate special DFSORT dynamic link-edit requirements. For example, when the link-edit option T is specified on the MODS statement for E35, the following assembler instructions must be included in the user exit routine associated with the E35 user exit:

```assembly
ENTRY E35
E35
.
```

or

```assembly
E35 CSECT
.
```

In all other circumstances, the user exit is not required to have an entry point that has the same name as that of the associated program user exit.

Assembler User Exit Routines (Input Phase User Exits)

You can use these program user exits in the DFSORT input phase:

- E11
- E15
- E16
- E17
- E18
- E19
- E61

These user exits are discussed in sequence. To determine whether a particular user exit can be used for your application, refer to Table 57 on page 493 and Table 58 on page 493.

E11 User Exit: Opening Data Sets/Initializing Routines

You might use routines at this user exit to open data sets needed by your other routines in the input phase. It can also be used to initialize your other routines. Return codes are not used, however.
Assembler User Exit Routines (Input Phase User Exits)

Note: To avoid special linkage editor requirements (see "Summary of Rules for User Exit Routines" on page 496), you can include these functions in your E15 user exit rather than in a separate E11 user exit routine.

E15 User Exit: Passing or Changing Records for Sort and Copy Applications

If you write your E15 user exit in COBOL, see "COBOL User Exit Routines" on page 519 and "COBOL E15 User Exit: Passing or Changing Records for Sort" on page 521.

The EXITCK option affects the way DFSORT interprets certain return codes from user exit E15. To avoid ambiguity, this section assumes that the IBM default, EXITCK=STRONG, was selected at your site. For complete information about E15 return codes in various situations with EXITCK=STRONG and EXITCK=WEAK, see "E15/E35 Return Codes and EXITCK" on page 534.

DFSORT enters the E15 user exit routine each time a new record is brought into the input phase. DFSORT continues to enter E15 (even when there are no input records) until the user exit tells DFSORT, with a return-code of 8, not to return.

See Figure 16 on page 491 for logic flow details.

Some uses for the E15 user exit are:
- Adding records to an input data set
- Passing an entire input data set to DFSORT
- Deleting records from an input data set
- Changing records in an input data set.

Notes:

1. If your E15 user exit is processing variable-length records, include a 4-byte RDW at the beginning of each record you change or insert, before you pass it back to DFSORT. The format of an RDW is described in z/OS DFSMS Using Data Sets or System Programming Reference. (Alternatively, you can pad records to the maximum length and process them as fixed-length.)

2. DFSORT uses the specified or defaulted value for L2 in the RECORD statement to determine the length of the records your E15 user exit passes back to DFSORT. For fixed-length records, be sure that the length of each record your E15 user exit changes or inserts corresponds to the specified or defaulted L2 value. For variable-length records, be sure that the RDW of each record your E15 user exit changes or inserts indicates a length that is less than or equal to the specified or defaulted L2 value. Unwanted truncation or abends may occur if DFSORT uses the wrong length for the records passed to it by your E15 user exit.

For details of the L2 value, see "RECORD Control Statement" on page 437.

3. If you use the E15 user exit to pass all your records to DFSORT, you can omit the SORTIN DD statement, in which case you must include a RECORD statement in the program control statements.

4. If you invoke DFSORT from an assembler program and pass the address of your E15 user exit in the parameter list, DFSORT ignores the SORTIN data set and terminates if you specify E15 in a MODS statement.

5. If you omit the SORTIN DD statement, or it is ignored, all input records are passed to DFSORT through your routine at user exit E15. The address of each input record in turn is placed in general register 1, and you return to DFSORT with a return code of 12. When DFSORT returns to the E15 user exit after the
Assembler User Exit Routines (Input Phase User Exits)

last record has been passed, you return to DFSORT with a return code of 8 in register 15, which indicates "do not return."

6. DFSORT continues to reenter your E15 user exit until a return code of 8 is received. However, if STOPAFT is in effect, no additional records are inserted to DFSORT after the STOPAFT count is satisfied (even if you pass back a return code of 12).

7. An RDW must be built for variable-length VSAM records (see z/OS DFSMS Using Data Sets).

Information DFSORT Passes to Your Routine at E15 User Exit

Your E15 user exit routine is entered each time a new record is brought into the input phase. DFSORT passes two words to your routine each time it is entered:

- **The address of the new record.** End of input is reached when there are no more records to pass to your E15 user exit; DFSORT indicates end of input by setting this address to zero before entering your E15 user exit. If there are no records in the input data set (or no input data set), this address is zero the first time your E15 is entered.

  After end of input is reached, DFSORT continues to enter your user exit routine until you pass back a return code of 8.

  Your E15 user exit must not change the address of the new record.

- **The user exit address constant.** If you invoked DFSORT with a user exit address constant in the parameter list, the address constant is passed to your E15 user exit the first time it is entered. This address constant can be changed by your E15 user exit any time it is entered; the address constant is passed along on subsequent entries to your E15 user exit and also on the first entry to your E35 user exit. For example, you can obtain a dynamic storage area, use it in your E15 user exit, and pass its address to your E35 user exit.

  Note: The user exit address constant must not be used for a tape work data set sort application.

In general register 1, DFSORT places the address of a parameter list that contains the record address and the user address constant. The list is two fullwords long and begins on a fullword boundary. The format of the parameter list is:

<table>
<thead>
<tr>
<th>Bytes 1 through 4</th>
<th>Address of the new record</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bytes 5 through 8</td>
<td>User exit address constant</td>
</tr>
</tbody>
</table>

E15 Return Codes

Your E15 routine must pass a return code to DFSORT. Following are the return codes for the E15 user exit:

<table>
<thead>
<tr>
<th>Return Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>00 (X’00’)</td>
<td>No Action/Record Altered</td>
</tr>
<tr>
<td>04 (X’04’)</td>
<td>Delete Record</td>
</tr>
<tr>
<td>08 (X’08’)</td>
<td>Do Not Return</td>
</tr>
<tr>
<td>12 (X’0C’)</td>
<td>Insert Record</td>
</tr>
<tr>
<td>16 (X’10’)</td>
<td>Terminate DFSORT</td>
</tr>
</tbody>
</table>

0: No Action

If you want DFSORT to retain the record unchanged, place the address of the record in general register 1 and return to DFSORT with a return code of 0 (zero).
Assembler User Exit Routines (Input Phase User Exits)

0: Record Altered
 If you want to change the record before passing it back to DFSORT, your
routine must move the record into a work area, perform whatever modification
you want, place the address of the modified record in general register 1, and
return with a return code of 0 (zero).

4: Delete Record
 If you want DFSORT to delete the record from the input data set, return to
DFSORT with a return code of 4. You need not place the address of the record
in general register 1.

8: Do Not Return
 DFSORT continues to return control to the user routine until it receives a
return code of 8. After that, the user exit is not used again during the DFSORT
application. You need not place an address in general register 1 when you
return with a return code of 8. Unless you are inserting records after the end of the
data set, you must pass a return code of 8 when the program indicates the end of the
data set. It does this by passing your routine a zero address in the parameter
list.

If your user exit routine passes a return code of 8 to DFSORT when input
records still remain to be processed, the remaining records are processed by
DFSORT, but are not passed to your user exit.

12: Insert Record
 To add a record before the record whose address was just passed to your
routine, place the address of the record to be added in general register 1 and
return to DFSORT with a return code of 12. DFSORT keeps returning to your
routine with the same record address as before so that your routine can insert
more records at that point or alter the current record. You can make insertions
after the last record in the input data set (after DFSORT places a zero address
in the parameter list). DFSORT keeps returning to your routine until you pass a
return code of 8.

16: Terminate DFSORT
 If you want to terminate DFSORT, return with a code of 16. DFSORT then
returns to its calling program or to the system with a return code of 16.

See “E15/E35 Return Codes and EXITCK” on page 534 for complete details of the
meanings of return codes in various situations.

Storage Usage for E15 User Exit
 DFSORT obtains storage (using GETMAIN or STORAGE OBTAIN) for the
parameter list and the records it passes to your E15 user exit routine. You must not
attempt to modify or free the storage obtained by DFSORT.

If you need to obtain storage for use by your E15 user exit routine, such as to pass
altered records to DFSORT, you can use the following strategy:
1. The first time your exit is called, obtain the storage you need
2. Use the storage you obtained each time your exit is called
3. Free the storage before you pass back return code 8 to DFSORT

Note: When you obtain your storage you can save its address in the user exit
address constant and restore it on each subsequent call to your exit.
Assembler User Exit Routines (Input Phase User Exits)

E16 User Exit: Handling Intermediate Storage Miscalculation

For a tape work data set sort or a Peerage/Vale sort without work data sets, you would use a routine at this user exit to decide what to do if the sort exceeds its calculated estimate of the number of records it can handle for a given amount of main storage and intermediate storage. This user exit is ignored for a sort with work data sets because DFSORT uses the WRKSEC option to determine whether secondary allocation is allowed. See "SORTWKdd DD Statement" on page 72. See also "Exceeding Tape Work Space Capacity" on page 855.

Note: When using magnetic tape, remember that the system uses an assumed tape length of 2400 feet. If you use tapes of a different length, the Nmax figure is not accurate; for shorter tapes, capacity can be exceeded before "NMAX EXCEEDED" is indicated.

E16 Return Codes

Your E16 routine must pass a return code to DFSORT. Following are the return codes for the E16 user exit:

<table>
<thead>
<tr>
<th>Return Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>00 (X'00')</td>
<td>Sort Current Records Only</td>
</tr>
<tr>
<td>04 (X'04')</td>
<td>Try to Sort Additional Records</td>
</tr>
<tr>
<td>08 (X'08')</td>
<td>Terminate DFSORT</td>
</tr>
</tbody>
</table>

0: Sort Current Records Only

If you want DFSORT to continue with only that part of the input data set it estimates it can handle, return with a return code of 0 (zero). Message ICE054I contains the number of records with which sort is continuing. You can sort the remainder of the data set on one or more subsequent runs, using SKIPREC to skip over the records already sorted. Then you can merge the sort outputs to complete the operation.

4: Try to Sort Additional Records

If you want DFSORT to continue with all of the input data set, return with a return code of 4. If tapes are used, enough space might be available for DFSORT to complete processing. If enough space is not available, DFSORT generates a message and terminates. Refer to "Exceeding Tape Work Space Capacity" on page 855.

8: Terminate DFSORT

If you want DFSORT to terminate, return with a return code of 8. DFSORT then returns to its calling program or to the system with a return code of 16.

E17 User Exit: Closing Data Sets

Your E17 user exit routine is entered once at the end of the input phase. It can be used to close data sets used by your other routines in the phase or to perform any housekeeping functions for your routines.

Note: To avoid special linkage editor requirements (see "Summary of Rules for User Exit Routines" on page 496), you can include these functions in your E15 user exits rather than in a separate E17 user exit routine.

E18 User Exit: Handling Input Data Sets

You can use this user exit to handle special I/O conditions for QSAM/BSAM and VSAM input data sets.
Assembler User Exit Routines (Input Phase User Exits)

Using E18 User Exit with QSAM/BSAM

Your routines at this user exit can pass DFSORT a parameter list containing the specifications for three data control block (DCB) fields: SYNAD, EXLST, and EROPT. Your E18 user exit routine can also pass a fourth DCB field (EODAD) to DFSORT.

Note: If you are using a disk sorting technique, the EROPT option is ignored.

Your routines are entered at the beginning of each phase so that DFSORT can obtain the parameter lists. The routines are entered again during processing of the phase at the points indicated in the parameter lists. For example, if you choose the EXLST option, DFSORT enters your E18 user exit routine early in the sort (input) phase. DFSORT picks up the parameter list including the EXLST address. Later in the phase, DFSORT enters your routine again at the EXLST address when the data set is opened.

Information Your Routine Passes to DFSORT at E18 User Exit: Before returning control to DFSORT, your routine passes the DCB fields in a parameter list by placing the parameter list address in general register 1. The parameter list must begin on a fullword boundary and be a whole number of fullwords long. The high-order byte of each word must contain a character code that identifies the parameter. One or more of the words can be omitted. A word of all zeros marks the end of the list.

If VSAM parameters are specified, they are accepted but ignored.

The format of the list is shown as follows:

<table>
<thead>
<tr>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>SYNAD field</td>
<td></td>
<td></td>
</tr>
<tr>
<td>02</td>
<td>EXLST field</td>
<td></td>
<td></td>
</tr>
<tr>
<td>03</td>
<td>00</td>
<td>00</td>
<td>EROPT code</td>
</tr>
<tr>
<td>04</td>
<td>EODAD field</td>
<td></td>
<td></td>
</tr>
<tr>
<td>00</td>
<td>00</td>
<td>00</td>
<td></td>
</tr>
</tbody>
</table>

SYNAD
Contains the location of your read synchronous error routine. This routine is entered only after the operating system has tried unsuccessfully to correct the error. The routine must be assembled as part of your E18 user exit routine. When the routine receives control, it must not store registers in the save area pointed to by register 13.

EXLST
Contains the location of a list of pointers to routines that you want used to check labels and accomplish other tasks not handled by data management. The list, and the routines to which it points, must be included in your read error routine. This parameter can only be used for EXLST routines associated with opening the first SORTIN data set.

EROPT
Indicates what action DFSORT must take when it encounters an uncorrectable read error. The three possible actions and the codes associated with them are:

X'80' Accept the record (block) as is
X'40' Skip the record (block)
X'20' Terminate the program.
Assembler User Exit Routines (Input Phase User Exits)

If you include this parameter in the DCB field list, you must place one of the above codes in byte 4 of the word. Bytes 2 and 3 of the word must contain zeros.

When you use the EROPT option, the SYNAD field and the EODAD field must contain the appropriate address in bytes 2 through 4. Or, if no routine is available, bytes 2 and 3 must contain zeros, and byte 4 must contain X’01’. You can use the assembler instruction DC AL3(1) to set up bytes 2 through 4.

**EODAD**
Contains the address of your end-of-file routine. If you specify EODAD, you must include the end-of-file routine in your own routine.

A full description of these DCB fields is contained in z/OS DFSMS Macro Instructions for Data Sets.

**Using E18 User Exit with VSAM**

If input to DFSORT is a VSAM data set, you can use the E18 user exit to perform various VSAM user exit functions and to insert passwords in VSAM input ACBs.

**E18 User Exit Restrictions:** If passwords are to be entered through a user exit and Blockset is not selected, the data set cannot be opened during the initialization phase. This means that MAINSIZE|SIZE=MAX must not be used because the program cannot make the necessary calculations.

**Information Your Routine Passes to DFSORT at E18 User Exit:** When you return to DFSORT, you must place the address of a parameter list in general register 1:

<table>
<thead>
<tr>
<th>Byte 1</th>
<th>Bytes 2 through 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>05</td>
<td>Address of VSAM user exit list</td>
</tr>
<tr>
<td>06</td>
<td>Address of password list</td>
</tr>
<tr>
<td>00</td>
<td>000000</td>
</tr>
</tbody>
</table>

If QSAM parameters are passed instead, they are accepted but ignored.

Either address entry can be omitted; if they both are included, they can be in any order.

**E18 Password List:** A password list included in your routine must have the following format:

Two bytes on a halfword boundary:

Number of entries in list

Followed by the 16-byte entries:

8 bytes: ddname

8 bytes: Password

The last byte of the ddname field is destroyed by DFSORT. This list must not be altered at any time during the program. MAINSIZE|SIZE=MAX must not be used if this function is used.
E18 User Exit List: The VSAM user exit list must be built using the VSAM EXLST macro instruction giving the addresses of your routines handling VSAM user exit functions. VSAM branches directly to your routines which must return to VSAM via register 14.

Any VSAM user exit function available for input data sets can be used except EODAD. If you need to do EODAD processing, write a LERAD user exit and check for X'04' in the FDBK field of the RPL. This will indicate input EOD. This field must not be altered when returning to VSAM because it is also needed by DFSORT.

For details, see z/OS DFSMS Macro Instructions for Data Sets.
Figure 17 shows an example of code your program can use to return control to DFSORT.

```
ENTRY E18
    LA 1,PARMLST
    RETURN
PARMLST
    DC X'01'
    DC AL3(SER)
    DC X'02'
    DC AL3(LST)
    DC X'03'
    DC X'000080' EROPT CODE
    DC A(0)
    DC X'04'
    DC AL3(VSAMEED)
    DC X'05'
    DC AL3(VSAMEXL)
    DC X'06'
    DC AL3(PWDLST)
    DC A(0)
    ...
    ...
VSAMEXL EXLST SYNAD=USYNAD,LERAD=ULERAD
PWDLST DC H'1'
    DC CLB'SORTIN' SORTIN DDNAME
    DC CLB'INPASS' SORTIN PASSWORD
USYNAD ... VSAM SYNCH ERROR RTN
ULERAD ... VSAM LOGIC ERROR RTN
SER ... QSAM ERROR RTN
LST DC X'05',AL3(RTN) EXLST ADDRESS LST1
RTN ... EXLST ROUTINE
VSAMEED ... QSAM END OF FILE ROUTINE
```

For more information, refer to [z/OS DFSMS Using Data Sets](https://www.ibm.com/support/docview.wss?uid=swg21222886)

### E19 User Exit: Handling Output to Work Data Sets

This user exit is used to handle write error conditions in the input phase when DFSORT is unable to correct a write error to a work data set. It is used only for a tape work data set sort.

#### Using E19 User Exit with QSAM/BSAM

Your routines at this user exit can pass DFSORT a parameter list containing the specifications for two DCB fields (SYNAD and EXLST). Your routines are entered first early in the input phase so that DFSORT can obtain the parameter lists. The routines are entered again later in the phase at the points indicated by the options in the parameter lists.

#### Information Your Routine Passes to DFSORT at E19 User Exit:

Before returning control to DFSORT, your routine passes the DCB fields in a parameter list by placing the parameter list address in general register 1. The list must begin on a fullword boundary and must be a whole number of fullwords long. The first byte of each word must contain a character code that identifies the parameter. Either word can be omitted. A word of all zeros indicates the end of the list.

If VSAM parameters are passed, they are accepted but ignored.
Assembler User Exit Routines (Input Phase User Exits)

The format of the list is shown below.

<table>
<thead>
<tr>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td></td>
<td>SYNAD field</td>
<td></td>
</tr>
<tr>
<td>02</td>
<td></td>
<td>EXLST field</td>
<td></td>
</tr>
<tr>
<td>00</td>
<td>00</td>
<td>00</td>
<td>00</td>
</tr>
</tbody>
</table>

**SYNAD**

This field contains the location of your write synchronous error routine. This routine is entered only after the operating system has unsuccessfully tried to correct the error. It must be assembled as part of your own routine.

**EXLST**

The EXLST field contains the location of a list of pointers. These pointers point to routines that are used to process labels and accomplish other tasks not handled by data management. This list, and the routines to which it points, must be included as part of your own routine.

A full description of these DCB fields can be found in z/OS DFSMS Macro Instructions for Data Sets.

**E61 User Exit: Modifying Control Fields**

You can use a routine at this user exit to lengthen, shorten, or alter any control field within a record. The E option for the s parameter on the SORT or MERGE control statement must be specified for control fields changed by this routine as described in "MERGE Control Statement" on page 162 and "SORT Control Statement" on page 442. After your routine modifies the control field, DFSORT collates the records in ascending order using the format(s) specified.17

Notes:

1. Routine E61 will not be used with EFS fields that have a D1 format.
2. Although your E61 routine alters control fields before a compare, your original records are not altered.
3. If locale processing is used for SORT or MERGE fields, an E61 user exit must not be used. DFSORT’s locale processing may eliminate the need for an E61 user exit. See "OPTION Control Statement" on page 173 for information related to locale processing.
4. DFSORT may automatically increase the storage it uses for a MERGE when an E61 is specified.

**Some Uses of E61 User Exit**

Your routine can normalize floating-point control fields or change any other type of control field in any way that you desire. You need to be familiar with the standard data formats used by the operating system before modifying control fields.

If you want to modify the collating sequence of EBCDIC data, for example, to permit the alphabetic collating of national characters, you can do so without the need for an E61 user exit routine by using the ALTSEQ control statement (as described in "ALTSEQ Control Statement" on page 90).

17. With a conventional merge or a tape work data set sort, control fields for which E is specified are treated as binary byte format regardless of the actual format(s) specified.
Information DFSORT Passes to Your Routine at E61 User Exit

DFSORT places the address of a parameter list in general register 1. The list begins on a fullword boundary and is three fullwords long. The parameter list for the E61 user exit is as follows:

<table>
<thead>
<tr>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>00</td>
<td>00</td>
<td>Control Field No.</td>
</tr>
<tr>
<td>00</td>
<td></td>
<td>Address of Control Field Image</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not Used</td>
<td>Control Field Length</td>
<td></td>
</tr>
</tbody>
</table>

The control field length allows you to write a more generalized modification routine.

To alter the control field, change the control field image at the indicated address (changing the address itself will have no effect).

The control field number is relative to all fields in the SORT or MERGE statement. For example, if you specify:

```
SORT FIELDS=(4,2,CH,A,8,10,CH,E,25,2,BI,E)
```

field numbers 2 and 3 will be passed to user exit E61.

For all fields except binary, the total number of bytes DFSORT passes to your routine is equal to the length specified in the \( m \) parameter of the SORT or MERGE statement.

All binary fields passed to your routine contain a whole number of bytes; all bytes that contain any bits of the control field are passed. If the control field is longer than 256 bytes, DFSORT splits it into fields of 256 bytes each and passes them one at a time to your routine.

Your routine cannot physically change the length of the control field. If you must increase the length for collating purposes, you must previously specify that length in the \( m \) parameter of the SORT or MERGE statement. If you must shorten the control field, you must pad it to the specified length before returning it to DFSORT. Your routine must return the field to DFSORT with the same number of bytes that it contained when your routine was entered.

When user exit E61 is used, records are always ordered into ascending sequence. If you need some other sequence, you can modify the fields further; for example, if after carrying out your planned modification for a binary control field, and before handing back control to DFSORT, you reverse all bits, the field is, in effect, collated in descending order as illustrated by the E61 example in Figure 23 on page 519.

Note that if E61 is used to resolve ASCII collating for special alphabetic characters, substituted characters must be in EBCDIC, but the sequencing depends upon the byte value of the ASCII translation for the substituted character.

Assembler User Exit Routines (Input Phase User Exits)

Assembler User Exit Routines (Output Phase User Exits)

You can use these program user exits located in the DFSORT output phase:

- E31
- E32
- E35
Assembler User Exit Routines (Output Phase User Exits)

E37
E38
E39

The functions of these user exits are discussed in sequence.

E31 User Exit: Opening Data Sets/Initializing Routines
You might use routines at this user exit to open data sets needed by your other routines in the output phase or to initialize your other routines. Return codes are not used.

Note: To avoid special linkage editor requirements (see "Summary of Rules for User Exit Routines" on page 496), you can include these functions in your E35 user exit rather than in a separate E31 routine.

E32 User Exit: Handling Input to a Merge Only
This user exit can be used only in a merge operation invoked from a program and cannot be specified on the MODS statement. When an E32 user exit is activated, it must supply all input to the merge. DFSORT ignores SORTIN\(\text{nn}\) data sets when an E32 user exit is used.

You must indicate the number of input files you want to merge using either (1) the FILES=n option on the MERGE control statement, or (2) the X’04’ entry in the 24-bit parameter list. Your E32 user exit routine must insert records for these files as DFSORT requests them.

If input is variable-length records, you must be sure the beginning of each record contains a 4-byte RDW before merged. The format of an RDW is described in DFSMS Macro Instructions for Data Sets (Alternatively, you can declare the records as fixed-length and pad them to the maximum length.)

See Figure 16 on page 491 for logic flow details.

Information DFSORT Passes to Your Routine at E32 User Exit
Your E32 user exit routine is entered each time the merge program requires a new input record. DFSORT passes three words to your routine:

- The increment of the next file to be used for input. The file increment is 0,4,8,...,N–4, where N is four times the number of input files. Thus, the increment 0 (zero) represents the first input file, 4 the second file, 8 the third, and so on.

- The address of the next input record. Your routine must provide a separate input buffer for each input file used. An input buffer containing the first record for a file must not be altered until you have passed the first record from each file to DFSORT.

- The user exit address constant. If you invoked DFSORT with a user exit address constant in the parameter list, the address constant is passed to your E32 user exit the first time it is entered. This address constant can be changed by your E32 user exit any time it is entered; the address constant is passed along on subsequent entries to your E32 user exit and E35 user exit. For example, you can obtain a dynamic storage area, use it in your E32 user exit, and pass its address to your E35 user exit.

Note: The user exit address constant must not be used for a Conventional merge application.
Assembler User Exit Routines (Output Phase User Exits)

In general register 1, DFSORT places the address of a parameter list that contains the file increment, the record address and the user address constant. The list is three fullwords long and begins on a fullword boundary. The format of the parameter list is:

Table 60. E32 User Exit Parameter List

<table>
<thead>
<tr>
<th>Bytes 1 through 4</th>
<th>Increment of next file to be used for input</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bytes 5 through 8</td>
<td>Address of next input record</td>
</tr>
<tr>
<td>Bytes 9 through 12</td>
<td>User exit address constant</td>
</tr>
</tbody>
</table>

Before returning control to DFSORT, you must:

- Place the address of the next input record from the requested input file in the second word of the parameter list
- Put the return code in register 15.

**E32 Return Codes**

Your E32 routine must pass a return code to DFSORT. Following are the return codes for the E32 user exit:

<table>
<thead>
<tr>
<th>Return Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>08 (X'08')</td>
<td>End of input for requested file</td>
</tr>
<tr>
<td>12 (X'0C')</td>
<td>Insert record</td>
</tr>
<tr>
<td>16 (X'10')</td>
<td>Terminate DFSORT</td>
</tr>
</tbody>
</table>

**8: End of input for requested file**

DFSORT continues to return control to the user routine until it receives a return code of 8 for every input file. After that, the user exit is not used again during the DFSORT application. You need not place an address in the second word of the parameter list when you return with a return code of 8.

**12: Insert Record**

To add a record from the requested input file, place the address of the record to be added in the second word of the parameter list and return to DFSORT with a return code of 12. DFSORT keeps returning to your routine until you pass a return code of 8 for every input file.

**16: Terminate DFSORT**

If you want to terminate DFSORT, return with a code of 16. DFSORT then returns to its calling program with a return code of 16.

**E35 User Exit: Changing Records**

If you write your E35 user exit in COBOL, see "COBOL User Exit Routines" on page 519 and "COBOL E35 User Exit: Changing Records" on page 527.

The EXITCK option affects the way DFSORT interprets certain return codes from user exit E35. To avoid ambiguity, this section assumes that the IBM default, EXITCK=STRONG, was selected at your site. For complete details of the meaning of E35 return codes in various situations with EXITCK=STRONG and EXITCK=WEAK, see "E15/E35 Return Codes and EXITCK" on page 534.

DFSORT enters the E35 user exit routine each time it prepares to place a record in the output area.

See Figure 16 on page 491 for logic flow details.

Some uses for the E35 user exit are:
Assembler User Exit Routines (Output Phase User Exits)

- Adding records for output data sets
- Omitting records for output data sets
- Changing records for output data sets

Notes:
1. If your E35 user exit is processing variable-length records, include a 4-byte RDW at the beginning of each record you change or insert, before you pass it back to DFSORT. The format of an RDW is described in z/OS DFSMS Using Data Sets or System Programming Reference. (Alternatively, you can pad records to the maximum length and process them as fixed-length.)

2. DFSORT uses the specified or defaulted value for L3 in the RECORD statement to determine the length of the records your E35 user exit passes back to DFSORT. For fixed-length records, be sure that the length of each record your E35 user exit changes or inserts corresponds to the specified or defaulted L3 value. For variable-length records, be sure that the RDW of each record your E35 user exit changes or inserts indicates a length that is less than or equal to the specified or defaulted L3 value. Unwanted truncation or abends may occur if DFSORT uses the wrong length for the records passed to it by your E35 user exit.

   For details of the L3 value, see “RECORD Control Statement” on page 437.

3. If you use the E35 user exit to dispose of all your output records, you can omit the SORTOUT DD statement.

4. If you invoke DFSORT from a program and you pass the address of your E35 user exit in the parameter list:
   • DFSORT ignores the SORTOUT data set (but not any OUTFIL data sets).
   • DFSORT terminates if you specify E35 in a MODS statement.

5. If you omit the SORTOUT DD statement or it is ignored, and you do not specify any OUTFIL data sets, your E35 user exit routine must dispose of each output record and return to DFSORT with a return code of 4. When DFSORT returns to your routine after you have disposed of the last record, return to DFSORT with a return code of 8 to indicate “do not return.”

6. Remember that if input records are variable-length from a VSAM data set, they will have been prefixed by a 4-byte RDW.

7. After records have been put into the output area, their lengths cannot be increased.

8. For a merge application, records deleted by an E35 user exit routine are not sequence-checked. If you use an E35 user exit routine without an output data set, sequence checking is not performed. In this case, you must ensure that the records are sequenced correctly.

Information DFSORT Passes to Your Routine at E35 User Exit

Your E35 user exit routine is entered each time DFSORT prepares to place a record (including the first record) in the output area. DFSORT passes three words to your routine:

- The address of the record leaving DFSORT, which usually follows the record in the output area. End of input is reached when there are no more records to pass to your E35 user exit; DFSORT indicates end of input by setting this address to zero before entering your E35 user exit.

   After end of input is reached, DFSORT continues to enter your user exit routine until a return code of 8 is passed back.

   Your E35 user exit must not change the address of the record leaving DFSORT.
Assembler User Exit Routines (Output Phase User Exits)

- **The address of a record in the output area** is zero the first time your routine is entered because there is no record in the output area at that time. It remains zero provided you pass a return code of 4 (delete record) to DFSORT.

  **Note:** If the record pointed to is variable-length, it has an RDW at this point even if output is to a VSAM data set.

- **The user exit address constant** is passed to your user exit exactly as it was set by your E15 or E32 user exit or invoking program's parameter list.

  **Note:** The user exit address constant must not be used for a Conventional merge or tape work data set sort application.

In general register 1, DFSORT places the address of a parameter list that contains the two record addresses and the user address constant. The list is three fullwords long and begins on a fullword boundary. The format of the parameter list is:

<table>
<thead>
<tr>
<th>Bytes 1 through 4</th>
<th>Address of record leaving DFSORT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bytes 5 through 8</td>
<td>Address of record in output area</td>
</tr>
<tr>
<td>Bytes 9 through 12</td>
<td>User exit address constant</td>
</tr>
</tbody>
</table>

**Table 61. E35 User Exit Parameter List**

**E35 Return Codes**

Your E35 routine must pass a return code to DFSORT. Following are the return codes for the E35 user exit:

<table>
<thead>
<tr>
<th>Return Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>00 (X'00')</td>
<td>No Action/Record Altered</td>
</tr>
<tr>
<td>04 (X'04')</td>
<td>Delete Record</td>
</tr>
<tr>
<td>08 (X'08')</td>
<td>Do Not Return</td>
</tr>
<tr>
<td>12 (X'0C')</td>
<td>Insert Record</td>
</tr>
<tr>
<td>16 (X'10')</td>
<td>Terminate DFSORT</td>
</tr>
</tbody>
</table>

**0: No Action**

If you want DFSORT to retain the record unchanged, load the address of the record leaving DFSORT in general register 1 and return to DFSORT with a return code of 0 (zero).

**0: Record Altered**

If you want to change the record before having it placed in the output data set, move the record to a work area, make the change, load the address of the modified record into general register 1, and return to DFSORT with a return code of 0 (zero).

**4: Delete Record**

Your routine can delete the record leaving DFSORT by returning to DFSORT with a return code of 4. You need not place an address in general register 1.

**8: Do Not Return**

DFSORT keeps returning to your routine until you pass a return code of 8. After that, the user exit is not used again during the DFSORT application. When you return with a return code of 8, you need not place an address in general register 1. **Unless you are inserting records after the end of the data set, you must pass a return code of 8 when DFSORT indicates the end of the data set.** This is done by passing a zero as the address of the record leaving DFSORT.

If you do not have an output data set and would usually return with a return code of 8 before EOE, you can avoid getting the ICE025A message by
specifying NOCHECK on the OPTION control statement (if installation option CHECK=NO had not already been specified).

If your user exit routine passes a return code of 8 to DFSORT when input records still remain to be processed, the remaining records are processed by DFSORT, but are not passed to your user exit.

12: Insert Record
To add an output record ahead of the record leaving DFSORT, place the address of the new record in general register 1 and return to DFSORT with a return code of 12. DFSORT returns to your routine with the same address as passed on the previous call to the user exit for the record leaving DFSORT. DFSORT passes the address of the inserted record as the address of the record in the output area. You can make more insertions at that point, or delete the record leaving DFSORT.

DFSORT does not perform sequence checking for disk work data set sorts. For tape work data set sorts, DFSORT does not perform sequence checking on records that you insert unless you delete the record leaving DFSORT and insert a record to replace it. DFSORT keeps returning to your routine until you pass a return code of 8.

16: Terminate DFSORT
If you want to terminate DFSORT, return with a code of 16. DFSORT then returns to its calling program or to the system with a return code of 16.

See "E15/E35 Return Codes and EXITCK" on page 534 for complete details of the meanings of return codes in various situations.

Summing Records at E35 User Exit: You can use the SUM control statement to sum records. However, you can sum records for output by changing the record in the output area and then, if you want, by deleting the record leaving DFSORT. DFSORT returns to your routine with the address of a new record leaving DFSORT, and the same record remains in the output area, so that you can continue summing. If you do not delete the record leaving DFSORT, that record is added to the output area, and its address replaces the address of the previous record in the output area. DFSORT returns with the address of a new record leaving DFSORT.

Storage Usage for E35 User Exit
DFSORT obtains storage (using GETMAIN or STORAGE OBTAIN) for the parameter list and the records it passes to your E35 user exit routine. You must not attempt to modify or free the storage obtained by DFSORT.

If you need to obtain storage for use by your E35 user exit routine, such as to pass altered records to DFSORT, you can use the following strategy:
1. The first time your exit is called, obtain the storage you need
2. Use the storage you obtained each time your exit is called
3. Free the storage before you pass back return code 8 to DFSORT.

Note: When you obtain your storage you can save its address in the user exit address constant and restore it on each subsequent call to your exit.

E37 User Exit: Closing Data Sets
Your E37 user exit routine is entered once at the end of the output phase. It can be used to close data sets used by your other routines in the phase or to perform any housekeeping functions for your routines.
Assembler User Exit Routines (Output Phase User Exits)

Note: To avoid special linkage editor requirements (see "Summary of Rules for User Exit Routines" on page 496), you can include these functions in your E35 user exit rather than in a separate E37 user exit.

E38 User Exit: Handling Input Data Sets
The routine here is the same as for E18. If the Blockset or Peerage/Vale technique is selected, I/O error conditions cannot be handled through the E38 user exit.

Using E38 User Exit with VSAM
This user exit can be used during a merge or copy to insert VSAM passwords into VSAM input ACBs and to perform various VSAM user exit functions. The following example shows code your program can use to return control to DFSORT.

```
ENTRY E38

E38 LA 1,PARMLST
RETURN CNOP 0,4
PARMLST DS 0H
DC X'05'
DC AL3(VSAMEXL)
DC X'06'
DC AL3(PWDLST)
DC A(0)

VSAMEXL EXLST SYNAD=USYNAD,LERAD=ULERAD
PWDLST DC H'2'
DC CL8'SORTIN01' SORTIN01 DDNAME
DC CL8'INPASS1' SORTIN01 PASSWORD
DC CL8'SORTIN02' SORTIN02 DDNAME
DC CL8'INPASS2' SORTIN02 PASSWORD
USYNAD ... VSAM SYNCH ERROR RTN
ULERAD ... VSAM LOGIC ERROR RTN
```

Figure 18. E38 User Exit Example

E39 User Exit: Handling Output Data Sets
Your E39 user exit routine is entered for the SORTOUT data set, but not for OUTFIL data sets.

Using E39 User Exit with QSAM/BSAM
The technique is the same as for E19 for QSAM/BSAM. See "E19 User Exit: Handling Output to Work Data Sets" on page 507 for details.

Using E39 User Exit with VSAM
For VSAM, this user exit can be used to insert VSAM passwords into the VSAM SORTOUT ACB and to perform various VSAM user exit functions. The example below shows code your program can use to return control to DFSORT.
Sample Routines Written in Assembler

ENTRY E39
  LA 1,PARMLST
  RETURN
  CNOP 0,4

PARMLST DS 0H
  DC X'05'
  DC AL3(VSAMEXL)
  DC X'06'
  DC AL3(PWDLST)
  DC A(0)

VSAMEXL EXLST SYNAD=USYNAD,LERAD=ULERAD
PWDLST DC H'1'
  DC 'SORTOUT' SORTOUT DDNAME
  DC 'OUTPASS' SORTOUT PASSWORD
USYNAD ... VSAM SYNCH ERROR RTN
ULERAD ... VSAM LOGIC ERROR RTN

Figure 19. E39 User Exit Example

Sample Routines Written in Assembler

This section provides some sample program user exits written in assembler.

**E15 User Exit: Altering Record Length**

This routine changes the variable-length input records making them all the same length.
Sample Routines Written in Assembler

**E15 CSECT**

* IF A RECORD IS GREATER THAN 204 BYTES, TRUNCATE IT TO 204 BYTES.
* IF A RECORD IS LESS THAN 204 BYTES, PAD IT OUT TO 204 BYTES.
* ALL OF THE RESULTING RECORDS WILL BE 204 BYTES LONG

**E15,12**

SHOW BASE REG

STM 14,12,(13) SAVE ALL REGS EXCEPT 13
LA 12,0(0,15) SET BASE REG
ST 13,SAVE15+4 SAVE BACKWARD POINTER
LA 14,SAVE15 SET FORWARD POINTER
ST 14,8(13) IN SAVE AREA
LR 13,14 SET OUR SAVE AREA
LR 2,1 SAVE PARM LIST POINTER
L 3,0,(2) LOAD ADDR OF RECORD
LTR 3,3 EOF
BZ EOF YES - DO NOT RETURN
LA 12,0(0,15) GET RDW
CH 4,CON204 IS RDW EQ 204
BE ACCEPT YES-ACCEPT IT
BL PAD LESS THAN 204-PAD
LA 14,SAVE15 LIMIT LENGTH TO 204
B TRUNC MORE THAN 204-TRUNCATE

**E15 PAD**

DS OH PAD OR TRUNCATE
MVI DATA,X'00' ZERO OUT THE BUFFER
MVC DATA+1(199),DATA

**E15 TRUNC**

DS OH PAD OR TRUNCATE
MVC DATA+1(199),DATA
LA 14, BUFFER POINT TO PADDED/TRUNCATED RECORD

**E16 User Exit: Sorting Current Records When NMAX Is Exceeded**

This routine tells DFSORT that, when DFSORT issues the message "NMAX EXCEEDED", it must sort only the records already read in.

**E16 CSECT**

LA 15,0 SET RETURN CODE
BR 14

**E35 User Exit: Altering Record Length**

This routine changes the variable-length output records making them all the same length.

---

**Figure 20. E15 User Exit Example**

**Figure 21. E16 User Exit Example**
Sample Routines Written in Assembler

E35 CSECT
* IF A RECORD IS GREATER THAN 204 BYTES, TRUNCATE IT TO 204 BYTES.
* IF A RECORD IS LESS THAN 204 BYTES, PAD IT OUT TO 204 BYTES.
* ALL OF THE RESULTING RECORDS WILL BE 204 BYTES LONG
USING E35,12
SHOW BASE REG
STM 14,12,(13) SAVE ALL REGS EXCEPT 13
LA 12,0,(15) SET BASE REG
ST 13,SAVE15+4 SAVE BACKWARD POINTER
LA 14,SAVE15 SET FORWARD POINTER
ST 14,13 IN SAVE AREA
LR 13,14 SET OUR SAVE AREA
LR 2,1 SAVE PARM LIST POINTER
L 3,0,(2) LOAD ADDR OF RECORD
LTR 3,3 EOF
BZ EOF YES - DO NOT RETURN
LH 4,0,(3) GET ROW
CH 4,CON204 IS ROW EQ 204
BE ACCEPT YES-ACCEPT IT
BL PAD LESS THAN 204-PAD
LH 4,CON204 LIMIT LENGTH TO 204
B TRUNC MORE THAN 204-TRUNCATE
PAD DS 0H PAD OR TRUNCATE
MVI DATA,X'00' ZERO OUT THE BUFFER
MVC DATA+1(199),DATA
TRUNC DS 0H PAD OR TRUNCATE
BCTR 4,0 DECREASE RDW FOR EXECUTE
EX 4,MVPAD MOVE RECORD INTO PAD/TRUNCATE BUFFER
MVC NEWRDW(2),CON204 SET NEW RDW TO 204
LA 3,BUFFER POINT TO PADDED/TRUNCATED RECORD
ACCEPT DS 0H SET RC=0
SR 15,15 SET RECORD POINTER
B GOBACK
EDF LA 15,8 EDF - SET RC=8
GOBACK L 13,4,(13)
L 14,12,(13)
LM 2,12,28,(13) RESTORE REGS
BR 14 RETURN
MVPAD MVC BUFFER(*-*),0(3) FOR EXECUTE
SAVE15 DS 18F
CON204 DC H'204'
BUFFER DS 0H
NEWROW DS H'0'
DATA DC XL200'00' BUFFER FOR PADDING/TRUNCATING
END

Figure 22. E35 User Exit Example

E61 User Exit: Altering Control Fields
This routine can be used to change the order of binary control fields passed to it (that is, those for which 'E' is specified) from ascending order to descending order.
COBOL User Exit Routines

You can perform the same tasks with E15 and E35 user exit routines written in COBOL that you can perform with E15 and E35 user exit routines written in assembler. However, COBOL routines differ from assembler routines in the way they pass information between themselves and DFSORT.

- COBOL routines must pass information through fields described in the LINKAGE SECTION of the DATA DIVISION. Assembler uses general register 1 and pointers in a parameter list.
- COBOL routines must use RETURN-CODE, a COBOL special register. Assembler uses register 15 for the return code.
- COBOL routines must use return code 20 to alter or replace a record. Assembler uses return code 0.
- COBOL routines can use the user exit area for E15/E35 communication. Assembler uses the user address constant.

**COBOL User Exit Requirements**

The following rules apply to COBOL user exits. Failure to observe these COBOL user exit rules can result in termination or unpredictable results.

- User exits written in COBOL must not use STOP RUN statements. To return to DFSORT, use the GOBACK statement.
- VS COBOL II user exits must be compiled with the RES and RENT compiler options.
- If a user exit contains a DISPLAY statement, the DFSORT messages normally written to SYSOUT must be directed to another data set using the MSGDDN parameter. For DISPLAY statements, COBOL also writes to SYSOUT. The messages to SYSOUT can, therefore, be lost because of interleaving of output.

---

Figure 23. E61 User Exit Example

```cobol
* E61 PARAMETER LIST DSECT
PARML DSECT
DS 3C
PARMNUM DS C CONTROL FIELD NUMBER
PARMPTR DS A ADDRESS OF CONTROL FIELD
DS 2C
PARMLEN DS H CONTROL FIELD LENGTH
*
* E61REV CSECT
* CHANGE THE ORDER OF EACH CONTROL FIELD PASSED TO THIS ROUTINE
* FROM ASCENDING TO DESCENDING BY REVERSING ALL OF THE BITS.
* ASSUMES THAT ONLY BI CONTROL FIELDS ARE PASSED.
USING E61REV,12
STM 14,12(13) SAVE ALL REGS EXCEPT R13
LA 12,0(0,15) SET BASE REG
ST 13,SAVE61+4 SAVE BACKWARD POINTER
LA 14,SAVE61 SET FORWARD POINTER
ST 14,0(13) IN SAVE AREA
LR 13,14 SET OUR SAVE AREA
LR 3,1 SET PARMLIST POINTER
USING PARML,3
L 4,PARMPTR GET POINTER TO CONTROL FIELD IMAGE
LH 5,PARMLEN GET LENGTH OF CONTROL FIELD
BCTR 5,0 SUBTRACT 1 FOR EXECUTE
EX 5,REVCF CHANGE FROM ASCENDING TO DESCENDING
GOBACK L 13,4 GO TO ET61
LM 14,12(13) RESTORE REGS
BR 14 RETURN
REVCF XC 0(*-*,4),REVFF REVERSE CONTROL FIELD BITS
SAVE61 DS 18F
REVFF DC 256X'FF'
LTORG
END
```
COBOL User Exit Routines

An alternative is to direct the COBOL output to another data set by using the OUTDD compiler option.

- COBOL user exits must not contain a SORT or a MERGE verb.
- When coding the MODS control statement to describe a COBOL user exit, use C for the fourth parameter. This instructs DFSORT to build the correct parameter list.
- If invoking DFSORT from a COBOL program, you can use a COBOL E15 if the FASTSRT option is in effect for input and a COBOL E35 if FASTSRT is in effect for output.
- COBOL library routines in Language Environment must be available at run time.

COBOL Requirements for Copy Processing
For copy processing, all sort requirements apply except for the following restrictions:

- When you directly invoke DFSORT, you can use either a separately compiled COBOL E15 user exit or a separately compiled COBOL E35 user exit, but not both.
- When you invoke DFSORT from a COBOL program, the following limitations apply when FASTSRT is in effect for:
  - Input only: You can use a separately compiled E15 user exit, but not a separately compiled E35 user exit.
  - Output only: You can use a separately compiled E35 user exit, but not a separately compiled E15 user exit.
  - Input and output: You can use either a separately compiled E15 or a separately compiled E35, but not both together.

If separately compiled E15 and E35 user exits are found together, DFSORT copy processing terminates. Message ICE161A is issued.

COBOL Storage Requirements
If you are running COBOL user exits compiled with the RES compiler option, make sure that you have enough storage available for the COBOL library subroutines. (This does not apply if the library has been installed resident.)

Besides the minimum DFSORT main storage requirements, you need an additional 1200KB of storage in your REGION to run Language Environment.

Under certain conditions, DFSORT can use all the storage in your REGION below 16MB virtual, thus leaving no room to load the COBOL library subroutines required during processing of your user exit.

Main storage is available above 16MB virtual unless the TMAXLIM or SIZE/MAINSIZE options specify an extremely high value (for example, your system limit for main storage above 16MB virtual). In that case, you can use the ARESALL or ARESINV option to release storage.

During processing, the actual amount of storage required for the COBOL library subroutines depends on the functions performed in the COBOL user exit. You must add a minimum of 20KB to the size of the user exit. If the user exit does I/O, additional storage must be reserved for the I/O buffers. Additional storage for buffers is specified by the m parameter on the MODS statement.

When SIZE/MAINSIZE=MAX is in effect, an alternative way to release storage is to use the RESALL or RESINV option.
COBOL User Exit Routines

Note: You might need to release an additional 70KB of storage when you are:
• Calling both E15 and E35 user exits
• Running with nonresident library subroutines
• Performing a sort with DFSORT residing above 16MB virtual.

This can be done by adding 70KB more to one of the following:
• The m parameter of the MODS statement for the E35 user exit (m = E35 user exit size + 20KB + 70KB)
• The RESALL option when SIZE/MAINSIZE=MAX is in effect.

COBOL User Exit Routines (Input Phase User Exit)

COBOL E15 User Exit: Passing or Changing Records for Sort

The EXITCK option affects the way DFSORT interprets certain return codes from user exit E15. To avoid ambiguity, this section assumes that the IBM default, EXITCK=STRONG, was selected at your site. For complete information about E15 return codes in various situations with EXITCK=STRONG and EXITCK=WEAK, see “E15/E35 Return Codes and EXITCK” on page 534.

DFSORT enters the E15 user exit routine each time a new record is brought into the input phase. DFSORT continues to enter E15 (even when there are no input records) until the user exit tells DFSORT, with a return code of 8, not to return.

See Figure 16 on page 491 for logic flow details.

Some uses for the E15 user exit are:
• Adding records to an input data set
• Passing an entire input data set to DFSORT
• Deleting records from an input data set
• Changing records in an input data set.

Notes:
1. If both E15 and E35 user exits are used, they must be in the same version of COBOL.
2. If you use the E15 user exit to pass all your records to DFSORT, you can omit the SORTIN DD statement, in which case you must include a RECORD statement in the program control statements.
3. If you omit the SORTIN DD statement, all input records are passed to DFSORT through your COBOL E15 user exit. You return to DFSORT with a return code of 12. When DFSORT returns to the E15 user exit after the last record has been passed, you return to DFSORT with a return code of 8 in register 15, which indicates “do not return.”
4. DFSORT continues to reenter your E15 user exit until a return code of 8 is received. However, if STOPAFT is in effect, no additional records are inserted to DFSORT after the STOPAFT count is satisfied (even if you pass back a return code of 12).
5. You cannot use dynamic link-editing with a COBOL E15 user exit.

E15 Interface with COBOL

Each time the E15 user exit is called, DFSORT supplies the following fields:
• Record flags
• New record
• Length of the new record (for variable-length records)
• Length of user exit area
COBOL User Exit Routines (Input Phase User Exit)

- User exit area.

When E15 returns to DFSORT, the E15 user exit provides to DFSORT some or all of the fields mentioned below. The first field is required; the others can be modified as appropriate.
- RETURN-CODE (assigned by the user exit by setting the COBOL special register RETURN-CODE)
- Return record
- Length of the return record (for VLR)
- Length of user exit area
- User Exit area.

For more information on how these fields are used in a COBOL E15 user exit, see “E15 LINKAGE SECTION Fields for Fixed-Length and Variable-Length Records” on page 524.

Figure 24 on page 523 details the interface to COBOL for the E15 user exit.
E15 LINKAGE SECTION Examples: Figure 25 on page 524 is an example of the LINKAGE SECTION code for a fixed-length record (FLR) data set with a logical record length (LRECL) of 100. The example shows the layout of the fields passed to your COBOL routine.

Figure 24. E15 DFSORT Interface with COBOL
Figure 26 is an example of the LINKAGE SECTION code for a variable-length record (VLR) data set with a maximum LRECL of 200. The example shows the layout of the fields passed to your COBOL routine.

**E15 LINKAGE SECTION Fields for Fixed-Length and Variable-Length Records**

The fields in the LINKAGE SECTION are used by DFSORT and your routine as stated below. For clarity, the field names from Figure 26 have been used.

- To give your COBOL routine the status of the passed records, DFSORT uses the record flags field (RECORD-FLAGS) in the following way:
  
  0 (FIRST-REC) The new record is the first passed record.
  
  4 (MIDDLE-REC) The new record is not the first passed record.
  
  8 (END-REC) All records have been passed to your routine or there were no records to pass.

- DFSORT places the next input record in the new record field (NEW-REC). A VLR does not contain an RDW, but DFSORT places the length of this VLR in the new record length field (NEW-REC-LEN). The value in the NEW-REC-LEN field is the length of the record only and does not include the 4 bytes for the RDW.

- When your routine places an insertion/replacement record in the return record field (RETURN-REC), the VLR must not contain an RDW; your routine must place the length of this record in the return record length field.
COBOL User Exit Routines (Input Phase User Exit)

(RETURN-REC-LEN). The value of the RETURN-REC-LEN field is the length of the record only and must not include the 4 bytes for the RDW.

- Each time DFSORT calls your COBOL E15 or COBOL E35 user exit, it passes the user exit a 256-byte user exit area field (EXITAREA). The first time the user exit area field is passed to your COBOL E15 user exit, it contains 256 blanks, and the user exit area length field (EXITAREA-LEN) contains 256.

Any changes you make to the user exit area field or user exit area length fields are passed back both to your COBOL E15 user exit and your COBOL E35 user exit.

Notes:
1. Do not set the user exit area length field to more than 256 bytes.
2. If the data used for input was not created by a COBOL run, you need to know the LRECL defined for your data set. For a VLR, the maximum length of the record defined in your COBOL user exit is 4 bytes less than the LRECL value, because COBOL does not include the RDW as part of the record. (Each VLR begins with an RDW field of 4 bytes. The RDW is not included in the record passed to your COBOL user exit.)
3. You need to code only up to the last field that your routine actually uses (for example, up to RETURN-REC if you do not use the user exit area).
4. DFSORT uses the specified or defaulted value for L2 in the RECORD statement to determine the length of the records your E15 user exit passes back to DFSORT. For fixed-length records, be sure that each record your E15 user exit changes or inserts has a length that is equal to the specified or defaulted L2 value. For variable-length records, be sure that each record your E15 user exit changes or inserts has a length that is less than or equal to the specified or defaulted L2 value. Unwanted truncation or abends may occur if DFSORT uses the wrong length for the records passed to it by your E15 user exit.

For details of the L2 value, see "RECORD Control Statement" on page 437.

E15 Return Codes

Your COBOL E15 routine must pass a return code to DFSORT in the RETURN-CODE field, a COBOL special register. Following are the return codes for the E15 user exit:

<table>
<thead>
<tr>
<th>Return Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>00 (X'00')</td>
<td>No Action</td>
</tr>
<tr>
<td>04 (X'04')</td>
<td>Delete Record</td>
</tr>
<tr>
<td>08 (X'08')</td>
<td>Do Not Return</td>
</tr>
<tr>
<td>12 (X'0C')</td>
<td>Insert Record</td>
</tr>
<tr>
<td>16 (X'10')</td>
<td>Terminate DFSORT</td>
</tr>
<tr>
<td>20 (X'14')</td>
<td>Alter or Replace Record</td>
</tr>
</tbody>
</table>

0: No Action
   If you want DFSORT to retain the record unchanged, return with RETURN-CODE set to 0.

4: Delete Record
   If you want DFSORT to delete the record, return with RETURN-CODE set to 4.

8: Do Not Return
   DFSORT continues to enter your routine until you return with RETURN-CODE set to 8. After that, the user exit is not used again during the DFSORT application. Unless you are inserting records after the end of the data set, you must set RETURN-CODE to 8 when DFSORT indicates the end of the data set, which it does by entering your routine with the record flags field set to 8.
COBOL User Exit Routines (Input Phase User Exit)

If your user exit routine passes a return code of 8 to DFSORT when input records still remain to be processed, the remaining records are processed by DFSORT but are not passed to your user exit.

12: Insert Record
If you want DFSORT to add a record before the new record in the input data set:
- Move the insert record to the return record field
- For VLR, move the length to the return record length field (Do not include the 4-byte RDW in this length.)
- Return with RETURN-CODE set to 12.
DFSORT returns to your routine with the same record as before in the new record field, allowing your routine to insert more records or handle the new record.

You can also insert records after the end of the data set. DFSORT keeps returning to your routine as long as you pass it a RETURN-CODE of 12 and until you return with a RETURN-CODE set to 8.

16: Terminate DFSORT
If you want to terminate DFSORT, return with RETURN-CODE set to 16. DFSORT then returns to its calling program or to the system with a return code of 16.

20: Alter Record
If you want to change the new record:
- Move the new record to the return record field.
- Change the record in the return record field.
- For VLR records, move the length to the return record length field.
- Return with RETURN-CODE set to 20.

Note: If your routine changes record size, you must indicate the new size on the RECORD statement.

20: Replace Record
If you want to replace the new record:
- Move the replacement record to the return record field.
- For VLR records, move the length to the return record length field. (Do not include the 4-byte RDW in this length.)
- Return with RETURN-CODE set to 20.

See “E15/E35 Return Codes and EXITCK” on page 534 for complete details of the meanings of return codes in various situations.

E15 Procedure Division Requirements
When coding the PROCEDURE DIVISION, the following requirements must be met:
- To return control to DFSORT, you must use the GOBACK statement.
- In the USING option of the PROCEDURE DIVISION header, you must specify each 01-level name in the LINKAGE SECTION. You must specify each name in order up to the last one you plan to use even when you do not use all the 01-level names preceding the header.

Examples:
For the FLR example, Figure 25 on page 524, you would code:
COBOL User Exit Routines (Input Phase User Exit)

PROCEDURE DIVISION USING RECORD-FLAGS, NEW-REC,
RETURN-REC, UNUSED1, UNUSED2, UNUSED3,
UNUSED4, UNUSED5, EXITAREA-LEN, EXITAREA.

For the VLR example, Figure 26 on page 524 you would code:
PROCEDURE DIVISION USING RECORD-FLAGS, NEW-REC,
RETURN-REC, UNUSED1, UNUSED2,
NEW-REC-LEN, RETURN-REC-LEN,
UNUSED3, EXITAREA-LEN, EXITAREA.

COBOL User Exit Routines (Output Phase User Exit)

COBOL E35 User Exit: Changing Records

The EXITCK option affects the way DFSORT interprets certain return codes from user exit E35. To avoid ambiguity, this section assumes that the IBM default, EXITCK=STRONG, was selected at your site. For complete information about E35 return codes in various situations with EXITCK=STRONG and EXITCK=WEAK, see "E15/E35 Return Codes and EXITCK" on page 534.

DFSORT enters the E35 user exit routine each time it prepares to place a record in the output area.

See Figure 16 on page 491 for logic flow details.

Some uses for the E35 user exit are:
- Adding records for output data sets
- Omitting records for output data sets
- Changing records for output data sets

When DFSORT indicates the end of the data set (record flags field set to 8), you must set RETURN-CODE to 8 (unless you are inserting records after the end of the data set); otherwise, DFSORT continues to enter E35.

Notes:
1. If both E15 and E35 user exits are used, they must be in the same version of COBOL.
2. If you use the E35 user exit to dispose of all your output records, you can omit the SORTOUT DD statement.
3. If you omit the SORTOUT DD statement and you do not specify any OUTFIL data sets, your E35 user exit routine must dispose of each output record and return to DFSORT with a return code of 4. When DFSORT returns to your routine after you have disposed of the last record, return to DFSORT with a return code of 8 to indicate “do not return.”
4. You cannot use dynamic link-editing with a COBOL E35 user exit.

E35 Interface with COBOL

Each time your E35 user exit is called, DFSORT supplies the following fields:
- Record flags
- Record leaving DFSORT
- Length of record leaving DFSORT (for variable-length records)
- Length of user exit area
- User Exit area.

When your E35 user exit returns to DFSORT, the E35 user exit provides to DFSORT some or all of the fields mentioned below. The first field is required; the others can be modified as appropriate.
COBOL User Exit Routines (Output Phase User Exit)

- RETURN-CODE (assigned by the user exit by setting the COBOL special register RETURN-CODE)
- Return record
- Length of return record (for variable-length records)
- Length of user exit area
- User exit area.

For more information on how these fields are used in a COBOL E35 user exit, see “E35 LINKAGE SECTION Fields for Fixed-Length and Variable-Length Records” on page 529.

Figure 27 details the interface to COBOL for the E35 user exit.

Figure 27. E35 Interface with COBOL

E35 LINKAGE SECTION Examples: Figure 28 is an example of the LINKAGE SECTION code for a fixed-length record (FLR) data set with a logical record length (LRECL) of 100. The example shows the layout of the fields passed to your
COBOL User Exit Routines (Output Phase User Exit)

COBOL routine.

```
LINKAGE SECTION.
  01 RECORD-FLAGS PIC 9(8) BINARY.
  88 FIRST-REC VALUE 00.
  88 MIDDLE-REC VALUE 04.
  88 END-REC VALUE 08.
  01 LEAVING-REC PIC X(100).
  01 RETURN-REC PIC X(100).
  01 OUTPUT-REC PIC X(100).
  01 UNUSED1 PIC 9(8) BINARY.
  01 UNUSED2 PIC 9(8) BINARY.
  01 UNUSED3 PIC 9(8) BINARY.
  01 UNUSED4 PIC 9(8) BINARY.
  01 EXITAREA-LEN PIC 9(4) BINARY.
  01 EXITAREA.
    05 EAREA OCCURS 1 TO 256 TIMES DEPENDING ON EXITAREA-LEN PIC X.
```

Figure 28. LINKAGE SECTION Code Example for E35 (Fixed-Length Records)

```
LINKAGE SECTION.
  01 RECORD-FLAGS PIC 9(8) BINARY.
  88 FIRST-REC VALUE 00.
  88 MIDDLE-REC VALUE 04.
  88 END-REC VALUE 08.
  01 LEAVING-REC.
    05 LREC OCCURS 1 TO 200 TIMES DEPENDING ON LEAVING-REC-LEN PIC X.
  01 RETURN-REC.
    05 RREC OCCURS 1 TO 200 TIMES DEPENDING ON RETURN-REC-LEN PIC X.
  01 OUTPUT-REC.
    05 OREC OCCURS 1 TO 200 TIMES DEPENDING ON OUTPUT-REC-LEN PIC X.
  01 UNUSED1 PIC 9(8) BINARY.
  01 LEAVING-REC-LEN PIC 9(8) BINARY.
  01 RETURN-REC-LEN PIC 9(8) BINARY.
  01 OUTPUT-REC-LEN PIC 9(8) BINARY.
  01 EXITAREA-LEN PIC 9(4) BINARY.
  01 EXITAREA.
    05 EAREA OCCURS 1 TO 256 TIMES DEPENDING ON EXITAREA-LEN PIC X.
```

Figure 29. LINKAGE SECTION Code Example for E35 (Variable-Length Records)

**E35 LINKAGE SECTION** Fields for Fixed-Length and Variable-Length Records

The fields in the LINKAGE SECTION are used by DFSORT and your routine as stated below. For clarity, the field names from Figure 29 have been used.

- **To give your COBOL routine the status of the passed records, DFSORT uses the record flags field (RECORD-FLAGS) in the following way:**
  - **0 (FIRST-REC)** The record leaving DFSORT is the first passed record.
  - **4 (MIDDLE-REC)** The record leaving DFSORT is not the first passed record.
  - **8 (END-REC)** There is no record leaving DFSORT to pass; all records have been passed to your routine or there were no records to pass.

- **DFSORT places the next output record, which usually follows the record in the output area, in the record leaving field (LEAVING-REC). A VLR does not contain an RDW; DFSORT places the length of this VLR in the record-leaving length**
COBOL User Exit Routines (Output Phase User Exit)

field (LEAVING-REC-LEN). The value in the LEAVING-REC-LEN field is the length of the record only and does not include the 4 bytes for the RDW.

- When your routine places an insertion or replacement record in the return record field (RETURN-REC), the VLR must not contain an RDW; your routine must place the length of this record in the return record length field (RETURN-REC-LEN). The value in the RETURN-REC-LEN field is the length of the record only and does not include the 4 bytes for the RDW.

- DFSORT places the record already in the output area in the record in output area field (OUTPUT-REC). A VLR does not contain an RDW. DFSORT places the length, not including the 4 bytes for RDW, of this VLR in the record in output area length field (OUTPUT-REC-LEN).

- DFSORT passes your COBOL E35 routine a 256-byte user exit area field (EXITAREA) that can contain information passed by your COBOL E15 routine. If no information is passed in the EXITAREA field by your COBOL E15 routine the first time the field is passed to your COBOL E35 routine, EXITAREA contains 256 blanks, and the user exit area length field (EXITAREA-LEN) contains 256.

Any changes you make to the user exit area field or user exit area length field are passed back to your COBOL E35 routine each time it is called by DFSORT.

Notes:
1. Do not set the user exit area length field to more than 256 bytes.
2. VLR records have a 4-byte RDW field at the beginning of each record. The maximum record length plus the RDW will be the length defined for the LRECL attribute of your output data set. COBOL programs do not use the RDW and, therefore, the maximum length defined in your COBOL user exit is 4 bytes less than the LRECL value.
3. You need to code only up to the last field your routine actually uses (for example, up to OUTPUT-REC-LEN if you do not use the user exit area).
4. DFSORT uses the specified or defaulted value for L3 in the RECORD statement to determine the length of the records your E35 user exit passes back to DFSORT. For fixed-length records, be sure that each record your E35 user exit changes or inserts has a length that is equal to the specified or defaulted L3 value. For variable-length records, be sure that each record your E35 user exit changes or inserts has a length that is less than or equal to the specified or defaulted L3 value. Unwanted truncation or abends may occur if DFSORT uses the wrong length for the records passed to it by your E35 user exit.

For details of the L3 value, see "RECORD Control Statement" on page 437.

E35 Return Codes
Your COBOL E35 routine must pass a return code to DFSORT in the RETURN-CODE field, a COBOL special register. Following are the return codes for the E35 exit:

<table>
<thead>
<tr>
<th>Return Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>00 (X'00')</td>
<td>No Action</td>
</tr>
<tr>
<td>04 (X'04')</td>
<td>Delete Record</td>
</tr>
<tr>
<td>08 (X'08')</td>
<td>Do Not Return</td>
</tr>
<tr>
<td>12 (X'0C')</td>
<td>Insert Record</td>
</tr>
<tr>
<td>16 (X'10')</td>
<td>Terminate DFSORT</td>
</tr>
<tr>
<td>20 (X'14')</td>
<td>Alter or Replace Record</td>
</tr>
</tbody>
</table>

0: No Action
If you want DFSORT to retain the record leaving DFSORT unchanged, return with RETURN-CODE set to 0.
COBOL User Exit Routines (Output Phase User Exit)

4: Delete Record
If you want DFSORT to delete the record leaving DFSORT, return with RETURN-CODE set to 4.

8: Do Not Return
DFSORT keeps returning to your routine until you pass a RETURN-CODE set to 8. After that, the user exit is not used again during the DFSORT application. Unless you are inserting records after the end of the data set, you must set RETURN-CODE to 8 when DFSORT indicates the end of the data set. This is done by entering your routine with the record flags field set to 8.

If your user exit routine passes a return code of 8 to DFSORT when input records still remain to be processed, the remaining records are processed by DFSORT but are not passed to your user exit.

If you do not have an output data set and would usually return with a return code of 8 before EOF, you can avoid getting the ICE025A message by specifying NOCHECK on the OPTION control statement (if installation option CHECK=NO had not already been specified).

12: Insert Record
If you want DFSORT to add an output record before the record leaving DFSORT:
- Move the insert record to the return record field
- For VLR records, move the length to the return record length field
- Return with RETURN-CODE set to 12.

DFSORT returns to your routine with the inserted record in the record output area field and with the same record as before in the record leaving DFSORT field. In this way, your routine can insert more records or handle the record leaving DFSORT.

You can also insert records after the end of the data set. DFSORT keeps returning to your routine as long as you pass it a RETURN-CODE 12 and until you return with RETURN-CODE set to 8.

DFSORT does not perform sequence checking for disk work data set sorts. For tape work data set sorts, DFSORT does not perform sequence checking on inserted records unless you delete the record leaving DFSORT and then replace it.

16: Terminate DFSORT
If you want to terminate DFSORT, return with RETURN-CODE set to 16. DFSORT then returns to its calling program or to the system with a return code of 16.

20: Alter Record
If you want to change the record leaving DFSORT:
- Move the record leaving DFSORT to the return record field
- Change the record in the return record field
- For VLR records, move the length to the return record length field
- Return with RETURN-CODE set to 20.

Note: If your routine changes record size, you must indicate the new size on the RECORD statement.

20: Replace Record
If you want to replace the record leaving DFSORT:
- Move the replacement record to the return record field
- For VLR records, move the length to the return record length field
- Return with RETURN-CODE set to 20.
COBOL User Exit Routines (Output Phase User Exit)

See “E15/E35 Return Codes and EXITCK” on page 534 for complete details of the meanings of return codes in various situations.

E35 Procedure Division Requirements
When coding the PROCEDURE DIVISION, the following requirements must be met:

- To return control to DFSORT, you must use the GOBACK statement.
- In the USING option of the PROCEDURE DIVISION header, you must specify each 01-level name in the LINKAGE SECTION. You must specify each name in order up to the last one you plan to use even when you do not use all the 01-level names preceding the header.

Examples:
For the FLR example, Figure 28 on page 529, you would code:

```cobol
PROCEDURE DIVISION USING RECORD-FLAGS, LEAVING-REC,
    RETURN-REC, OUTPUT-REC, UNUSED1, UNUSED2,
    UNUSED3, UNUSED4, EXITAREA-LEN, EXITAREA.
```

For the VLR example, Figure 29 on page 529, you would code:

```cobol
PROCEDURE DIVISION USING RECORD-FLAGS, LEAVING-REC,
    RETURN-REC, OUTPUT-REC, UNUSED1,
    LEAVING-REC-LEN, RETURN-REC-LEN,
    OUTPUT-REC-LEN, EXITAREA-LEN, EXITAREA.
```

Sample Routines Written in COBOL

This section provides some sample program user exits written in COBOL.

COBOL E15 User Exit: Altering Records

Figure 30 shows an example of a COBOL E15 routine for a data set with fixed-length records of 100 bytes. It examines the department field in the passed record and takes the following action:

- If the department is D29, it changes it to J99.
- If the department is not D29, it accepts the record unchanged.
Figure 31 shows an example of a COBOL E35 routine for a data set with
variable-length records up to 200 bytes. It examines the department field in each
passed record (records are assumed to be sorted by the department field) and takes
the following action:

- It inserts a record for department K22 in the proper sequence.
- It accepts all passed records unchanged.

```cobol
IDENTIFICATION DIVISION.
PROGRAM-ID. COBOL E35.
ENVIRONMENT DIVISION.
DATA DIVISION.
LINKAGE SECTION.
  01 RECORD-FLAGS PIC 9(8) BINARY.
    88 FIRST-REC VALUE 00.
    88 MIDDLE-REC VALUE 04.
    88 END-REC VALUE 08.
  01 NEW-REC.
    05 NFILL1 PIC X(10).
    05 NEW-DEPT PIC X(3).
    05 NFILL2 PIC X(87).
  01 RETURN-REC.
    05 RFILL1 PIC X(10).
    05 RETURN-DEPT PIC X(3).
    05 RFILL2 PIC X(87).
PROCEDURE DIVISION USING RECORD-FLAGS, NEW-REC, RETURN-REC.
  IF END-REC
    MOVE 8 TO RETURN-CODE
  ELSE
    IF NEW-DEPT EQUAL TO "D29"
      MOVE NEW-REC TO RETURN-REC
      MOVE "J99" TO RETURN-DEPT
      MOVE 20 TO RETURN-CODE
    ELSE
      MOVE 0 TO RETURN-CODE
      END-IF
  END-IF
GOBACK.
```

Figure 30. COBOL E15 Routine Example (FLR)
E15/E35 Return Codes and EXITCK

DFSORT's interpretation of E15 and E35 return codes depends upon whether EXITCK=STRONG or EXITCK=WEAK is in effect. See the discussion of the EXITCK option in "OPTION Control Statement" on page 173 for more information. The following tables show the exact meaning of each E15 and E35 return code with EXITCK=STRONG and EXITCK=WEAK in all possible situations.

Notes:
1. You can determine whether EXITCK=STRONG or EXITCK=WEAK is in effect from message ICE132I.
2. Use of EXITCK=WEAK can make it difficult to detect errors in the logic of your E15 and E35 user exit routines.
E15/E35 Return Codes and EXITCK

3. EXITCK=WEAK is treated like EXITCK=STRONG if tape work data sets are specified for a sort application or if the Blockset technique is not selected for a merge application.

Table 62. E15 Without a SORTIN Data Set

<table>
<thead>
<tr>
<th>E15 Return Code</th>
<th>Meaning with EXITCK=STRONG</th>
<th>Meaning with EXITCK=WEAK</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Invalid</td>
<td>Do not return</td>
</tr>
<tr>
<td>4</td>
<td>Invalid</td>
<td>Do not return</td>
</tr>
<tr>
<td>8</td>
<td>Do not return</td>
<td>Do not return</td>
</tr>
<tr>
<td>12</td>
<td>Insert record</td>
<td>Insert record</td>
</tr>
<tr>
<td>16</td>
<td>Terminate DFSORT</td>
<td>Terminate DFSORT</td>
</tr>
<tr>
<td>20 (COBOL only)</td>
<td>Invalid</td>
<td>Do not return</td>
</tr>
<tr>
<td>All others</td>
<td>Invalid</td>
<td>Invalid</td>
</tr>
</tbody>
</table>

Table 63. E15 With a SORTIN Data Set Before End of Input

<table>
<thead>
<tr>
<th>E15 Return Code</th>
<th>Meaning with EXITCK=STRONG or EXITCK=WEAK</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No action/record altered</td>
</tr>
<tr>
<td>4</td>
<td>Delete record</td>
</tr>
<tr>
<td>8</td>
<td>Do not return</td>
</tr>
<tr>
<td>12</td>
<td>Insert record</td>
</tr>
<tr>
<td>16</td>
<td>Terminate DFSORT</td>
</tr>
<tr>
<td>20 (COBOL only)</td>
<td>Alter/replace record</td>
</tr>
<tr>
<td>All others</td>
<td>Invalid</td>
</tr>
</tbody>
</table>

Table 64. E15 With a SORTIN Data Set After End of Input

<table>
<thead>
<tr>
<th>E15 Return Code</th>
<th>Meaning with EXITCK=STRONG</th>
<th>Meaning with EXITCK=WEAK</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Invalid</td>
<td>Do not return</td>
</tr>
<tr>
<td>4</td>
<td>Invalid</td>
<td>Do not return</td>
</tr>
<tr>
<td>8</td>
<td>Do not return</td>
<td>Do not return</td>
</tr>
<tr>
<td>12</td>
<td>Insert record</td>
<td>Insert record</td>
</tr>
<tr>
<td>16</td>
<td>Terminate DFSORT</td>
<td>Terminate DFSORT</td>
</tr>
<tr>
<td>20 (COBOL only)</td>
<td>Invalid</td>
<td>Do not return</td>
</tr>
<tr>
<td>All others</td>
<td>Invalid</td>
<td>Invalid</td>
</tr>
</tbody>
</table>

Table 65. E35 With a SORTOUT or OUTFIL Data Set Before End of Input

<table>
<thead>
<tr>
<th>E35 Return Code</th>
<th>Meaning with EXITCK=STRONG or EXITCK=WEAK</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No action/record altered</td>
</tr>
<tr>
<td>4</td>
<td>Delete record</td>
</tr>
<tr>
<td>8</td>
<td>Do not return</td>
</tr>
<tr>
<td>12</td>
<td>Insert record</td>
</tr>
<tr>
<td>16</td>
<td>Terminate DFSORT</td>
</tr>
</tbody>
</table>
Table 65. E35 With a SORTOUT or OUTFIL Data Set Before End of Input (continued)

<table>
<thead>
<tr>
<th>E35 Return Code</th>
<th>Meaning with EXITCK=STRONG or EXITCK=WEAK</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 (COBOL only)</td>
<td>Alter/replace record</td>
</tr>
<tr>
<td>All others</td>
<td>Invalid</td>
</tr>
</tbody>
</table>

Table 66. E35 Without a SORTOUT or OUTFIL Data Set Before End of Input

<table>
<thead>
<tr>
<th>E35 Return Code</th>
<th>Meaning with EXITCK=STRONG</th>
<th>Meaning with EXITCK=WEAK</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Invalid</td>
<td>Delete record</td>
</tr>
<tr>
<td>4</td>
<td>Delete record</td>
<td>Delete record</td>
</tr>
<tr>
<td>8</td>
<td>Do not return</td>
<td>Do not return</td>
</tr>
<tr>
<td>12</td>
<td>Invalid</td>
<td>Delete record</td>
</tr>
<tr>
<td>16</td>
<td>Terminate DFSORT</td>
<td>Terminate DFSORT</td>
</tr>
<tr>
<td>20 (COBOL only)</td>
<td>Invalid</td>
<td>Delete record</td>
</tr>
<tr>
<td>All others</td>
<td>Invalid</td>
<td>Invalid</td>
</tr>
</tbody>
</table>

Table 67. E35 With a SORTOUT or OUTFIL Data Set After End of Input

<table>
<thead>
<tr>
<th>E35 Return Code</th>
<th>Meaning with EXITCK=STRONG</th>
<th>Meaning with EXITCK=WEAK</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Invalid</td>
<td>Do not return</td>
</tr>
<tr>
<td>4</td>
<td>Invalid</td>
<td>Do not return</td>
</tr>
<tr>
<td>8</td>
<td>Do not return</td>
<td>Do not return</td>
</tr>
<tr>
<td>12</td>
<td>Insert record</td>
<td>Insert record</td>
</tr>
<tr>
<td>16</td>
<td>Terminate DFSORT</td>
<td>Terminate DFSORT</td>
</tr>
<tr>
<td>20 (COBOL only)</td>
<td>Invalid</td>
<td>Do not return</td>
</tr>
<tr>
<td>All others</td>
<td>Invalid</td>
<td>Invalid</td>
</tr>
</tbody>
</table>

Table 68. E35 Without a SORTOUT or OUTFIL Data Set After End of Input

<table>
<thead>
<tr>
<th>E35 Return Code</th>
<th>Meaning with EXITCK=STRONG</th>
<th>Meaning with EXITCK=WEAK</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Invalid</td>
<td>Do not return</td>
</tr>
<tr>
<td>4</td>
<td>Invalid</td>
<td>Do not return</td>
</tr>
<tr>
<td>8</td>
<td>Do not return</td>
<td>Do not return</td>
</tr>
<tr>
<td>12</td>
<td>Invalid</td>
<td>Do not return</td>
</tr>
<tr>
<td>16</td>
<td>Terminate DFSORT</td>
<td>Terminate DFSORT</td>
</tr>
<tr>
<td>20 (COBOL only)</td>
<td>Invalid</td>
<td>Do not return</td>
</tr>
<tr>
<td>All others</td>
<td>Invalid</td>
<td>Invalid</td>
</tr>
</tbody>
</table>
## Chapter 6. Invoking DFSORT from a Program

**Invoking DFSORT Dynamically**

DFSORT can be invoked dynamically from programs written in COBOL or PL/I. Specific information on dynamic invocation is covered in the COBOL and PL/I programming guides. JCL requirements are the same as those for assembler.

This section explains what you need to know to initiate DFSORT from within your assembler program using a system macro instruction instead of an EXEC job control statement in the input stream. Specific restrictions on invoking DFSORT from PL/I and COBOL are listed in "Restrictions for Dynamic Invocation" on page 553.

**What Are System Macro Instructions?**

System macro instructions are macro instructions provided by IBM for communicating service requests to the control program. You can use these instructions only when programming in assembler language. They are processed by the assembler program using macro definitions supplied by IBM and placed in the macro library when your control program was installed.

You can specify one of three system macro instructions to pass control to the program: LINK, ATTACH, or XCTL.

When you issue one of these instructions, the first load module of DFSORT is brought into main storage. The linkage relationship between your program and DFSORT differs according to which of the instructions you have used. For a complete description of the macro instructions and how to use them, refer to z/OS MVS Programming: Assembler Services Guide, z/OS MVS Programming: Assembler Services Reference ABE-HSP, and z/OS MVS Programming: Assembler Services Reference IAR-XCT.

**Using System Macro Instructions**

To initiate DFSORT processing with a system macro instruction, you must:

- Write the required job control language (JCL) DD statements.
- Write DFSORT control statements as operands of assembler DC instructions.

(Using DFSPARM or SORTCNTL data sets to specify program control statements can be more convenient. See Chapter 3, “Using DFSORT Program Control Statements,” on page 81 for details.)

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**Invoking DFSORT With The Extended Parameter List**

**What Are System Macro Instructions?**

**Using JCL DD Statements**

**Overriding DFSORT Control Statements from Programs**

**Invoking DFSORT With the 24-Bit Parameter List**

**Providing Program Control Statements**

**CONTROL Statement Images Example**

**Format of the 24-Bit Parameter List**

**Invoking DFSORT With The Extended Parameter List**

**Providing Program Control Statements**

**Format of the Extended Parameter List**

**Writing the Macro Instruction**

**Parameter List Examples**

**Restrictions for Dynamic Invocation**

**Copy Restrictions**

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Using System Macro Instructions

- Write a parameter list containing information to be passed to DFSORT and a pointer containing the address of the parameter list. DFSORT accepts two types of parameter lists: a 24-bit parameter list and an extended parameter list. Although you can choose either parameter list, the extended parameter list can perform a superset of the functions in the 24-bit parameter list; therefore, it should be used for new DFSORT applications.

**Note:** DFSORT can also be called using the system's EXEC PARM parameter list, provided that the rules for passing it are followed (for example, the parameter list must reside below 16MB virtual). DFSORT interprets a call using the EXEC PARM parameter list as a direct invocation rather than a program invocation.

- Prepare the macro instruction specifying one of the following as the entry point name: ICEMAN, SORT, IERRCO00, or IGHRC000.

**Note:** The save area passed to DFSORT must begin on a fullword boundary.

In addition, the following rule applies:

- If you are invoking DFSORT repeatedly (for example, from an E15 or E35 user exit), you must always wait for the last invoked sort to end before you can give control back to any of your user exits in an earlier invoked sort.

Using JCL DD Statements

JCL DD statements are usually required when invoking DFSORT from another program. The statements and their necessary parameters are described in detail.

Overriding DFSORT Control Statements from Programs

You can override the control statements generated or passed by a program (for example, a COBOL SORT verb or PLISRTx routine) with DFSORT's DFSPARM data set.

For example, you could use the following to override the SORT statement generated by a COBOL SORT verb in order to use DFSORT's Year 2000 features:

```
//DFSPARM DD *
OPTION Y2PAST=1956    * set fixed CW of 1956-2055
SORT FIELDS=(11,6,Y2T,A,A,31,10,CH,A)  * sort C'ymmd' using CW
/*
```

You can also use DFSPARM to provide different DFSORT control statements for multiple invocations of DFSORT from a program. However, the control statements must be located in temporary or permanent data sets and FREE=CLOSE must be used. Here's an example of using DFSPARM to override the control statements for a COBOL program with three SORT verbs:

```
//DFSPARM DD DSN=DP1,DISP=SHR,FREE=CLOSE
//DFSPARM DD DSN=DP2,DISP=SHR,FREE=CLOSE
//DFSPARM DD DSN=DP3,DISP=SHR,FREE=CLOSE
```
Overriding DFSORT Control Statements from Programs

DP1, DP2, and DP3 can contain any DFSORT control statements you like. The statements in DP1 will be used for the first call to DFSORT, the statements in DP2 for the second and the statements in DP3 for the third.

For complete details on DFSPARM, see “DFSPARM DD Statement” on page 77.

COBOL also offers additional methods for overriding DFSORT parameters and control statements such as SORT special registers and the IGZSRCTCD data set. See your COBOL publications for details.

Invoking DFSORT With the 24-Bit Parameter List

Providing Program Control Statements

When using the 24-bit parameter list, you must supply the starting and ending address of a valid image of each control statement to be used during run-time. You must provide the image as a character string in EBCDIC format using assembler DC instructions. The rules for preparing the program control statements are as follows:

• At least one control statement must be specified—generally SORT or MERGE. If more than 15 control statements are specified, only the first 15 control statements are accepted and all others are ignored. Control statements can also be specified in SORTCNTL or DFSPARM.

• The MODS statement is required when user exits other than E15, E32, and E35 are to be used. It is also required when the E15 or E35 routine addresses are not passed by the parameter list.

• The following control statements can be passed using the 24-bit parameter list: SORT or MERGE, RECORD, ALTSEQ, DEBUG, MODS, SUM, INREC, OUTREC, INCLUDE or OMIT, JOINKEYS, JOIN, REFORMAT and OUTFIL.

• At least one blank must follow the operation definer (SORT, for example). A control statement can start and end with one or more blanks; however, no other blanks are allowed.

• The content and format of the statements are as described in Chapter 3, “Using DFSORT Program Control Statements,” on page 81, except:
  – Labels are not allowed although a leading blank is optional.
  – Because each control statement image must be defined contiguously by one or more assembler DC instructions, explicit and implicit continuation of statements is neither necessary nor allowed.

• Neither comment statements, blank statements, nor remark fields are permitted.

• If you use ATTACH to initiate the program, you cannot use the checkpoint/restart facility and must not specify CKPT in the SORT statement image.

For full override and applicability details, see Appendix B, “Specification/Override of DFSORT Options,” on page 857.

CONTROL Statement Images Example

```
SORTBEG DC C' SORT FIELDS=(10,15,CH,A)'  
SORTEND DC C' '  
INCLBEG DC C' INCLUDE COND=(5,3,CH,NE,C'J82''')'  
INCLEND DC C' '  
```

This form, with a trailing blank separately defined, allows you to refer to the last byte of the statement (SORT statement end address) by the name SORTEND.
Invoking DFSORT with the 24-Bit Parameter List

Note: Assembler requires two single apostrophes to represent one single apostrophe.

Format of the 24-Bit Parameter List

Figure 32 on page 541 shows the format of the 24-bit parameter list and the pointer containing its address which you must pass to DFSORT. Detailed specifications for each of the entries in the parameter list follow.

For full override and applicability details, see Appendix B, “Specification/Override of DFSORT Options,” on page 857.
Invoking DFSORT with the 24-Bit Parameter List

<table>
<thead>
<tr>
<th>Register 1</th>
<th>Offset</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3 and 4</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-2</td>
<td>Unused</td>
<td>Unused</td>
<td>Length of parameter list in bytes</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>X'00'</td>
<td>X'00'</td>
<td>Starting address of SORT or MERGE statement image</td>
<td>1.3</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>X'00'</td>
<td>X'00'</td>
<td>Ending address of SORT or MERGE statement image</td>
<td>1.5</td>
</tr>
<tr>
<td>A</td>
<td>10</td>
<td>X'00'</td>
<td>X'00'</td>
<td>Starting address of RECORD statement image (zeros, if none)</td>
<td>1.3</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>X'00'</td>
<td>X'00'</td>
<td>Ending address of RECORD statement image (zeros, if none)</td>
<td>1.5</td>
</tr>
<tr>
<td>12</td>
<td>18</td>
<td>X'00'</td>
<td></td>
<td>Address of E15 or E32 routine (zeros, if none)</td>
<td>1</td>
</tr>
<tr>
<td>16</td>
<td>22</td>
<td>X'00'</td>
<td></td>
<td>Address of E35 routine (zeros, if none)</td>
<td>1</td>
</tr>
<tr>
<td>1A</td>
<td>26</td>
<td>X'02'</td>
<td>X'00'</td>
<td>Starting address of MODS statement image</td>
<td>2.3</td>
</tr>
<tr>
<td>1E</td>
<td>30</td>
<td>X'00'</td>
<td>X'00'</td>
<td>Ending address of MODS statement image</td>
<td>2.5</td>
</tr>
<tr>
<td>22</td>
<td>34</td>
<td>X'00'</td>
<td></td>
<td>Main storage value</td>
<td>2</td>
</tr>
<tr>
<td>26</td>
<td>38</td>
<td>X'01'</td>
<td></td>
<td>Reserved storage value</td>
<td>2</td>
</tr>
<tr>
<td>2A</td>
<td>42</td>
<td>X'03'</td>
<td></td>
<td>Address of 8-character message ddname</td>
<td>2</td>
</tr>
<tr>
<td>2E</td>
<td>46</td>
<td>X'04'</td>
<td></td>
<td>Number of input files (MERGE with E32)</td>
<td>2.4</td>
</tr>
<tr>
<td>32</td>
<td>50</td>
<td>X'05'</td>
<td>X'00'</td>
<td>Starting address of DEBUG statement image</td>
<td>2.3</td>
</tr>
<tr>
<td>36</td>
<td>54</td>
<td>X'00'</td>
<td></td>
<td>Ending address of DEBUG statement image</td>
<td>2.5</td>
</tr>
<tr>
<td>3A</td>
<td>58</td>
<td>X'06'</td>
<td>X'00'</td>
<td>Starting address of ALTSEQ statement image</td>
<td>2.3</td>
</tr>
<tr>
<td>3E</td>
<td>62</td>
<td>X'00'</td>
<td></td>
<td>Ending address of ALTSEQ statement image</td>
<td>2.5</td>
</tr>
<tr>
<td>42</td>
<td>66</td>
<td>X'F6'</td>
<td>X'00'</td>
<td>Address of 256-byte ALTSEQ translation table</td>
<td>2</td>
</tr>
<tr>
<td>46</td>
<td>70</td>
<td>X'F7'</td>
<td>X'00'</td>
<td>User exit address constant</td>
<td>2</td>
</tr>
<tr>
<td>4A</td>
<td>74</td>
<td>X'FD'</td>
<td></td>
<td>The three bytes after X'FD' are ignored</td>
<td>2</td>
</tr>
<tr>
<td>4E</td>
<td>78</td>
<td>X'FE'</td>
<td></td>
<td>Address of a pointer to 104-byte ESTAE work area (or zeros)</td>
<td>2</td>
</tr>
<tr>
<td>52</td>
<td>82</td>
<td>X'FF'</td>
<td></td>
<td>Message option</td>
<td>2</td>
</tr>
<tr>
<td>56</td>
<td>86</td>
<td></td>
<td></td>
<td>4-character prefix for &quot;SORT&quot; DD statement names</td>
<td>2</td>
</tr>
<tr>
<td>5A</td>
<td>90</td>
<td>X'07'</td>
<td>X'00'</td>
<td>Starting address of SUM statement image</td>
<td>2.3</td>
</tr>
<tr>
<td>5E</td>
<td>94</td>
<td>X'00'</td>
<td></td>
<td>Ending address of SUM statement image</td>
<td>2.5</td>
</tr>
<tr>
<td>62</td>
<td>98</td>
<td>X'08'</td>
<td>X'00'</td>
<td>Starting address of INCLUDE or OMIT statement image</td>
<td>2.3</td>
</tr>
<tr>
<td>66</td>
<td>102</td>
<td>X'00'</td>
<td></td>
<td>Ending address of INCLUDE or OMIT statement image</td>
<td>2.5</td>
</tr>
<tr>
<td>6A</td>
<td>106</td>
<td>X'09'</td>
<td>X'00'</td>
<td>Starting address of OUTREC statement image</td>
<td>2.3</td>
</tr>
<tr>
<td>6E</td>
<td>110</td>
<td>X'00'</td>
<td></td>
<td>Ending address of OUTREC statement image</td>
<td>2.5</td>
</tr>
<tr>
<td>72</td>
<td>114</td>
<td>X'0A'</td>
<td>X'00'</td>
<td>Starting address of INREC statement image</td>
<td>2.3</td>
</tr>
<tr>
<td>76</td>
<td>118</td>
<td>X'00'</td>
<td></td>
<td>Ending address of INREC statement image</td>
<td>2.5</td>
</tr>
<tr>
<td>7A</td>
<td>122</td>
<td>X'0B'</td>
<td>X'00'</td>
<td>Starting address of OUTFIL statement image</td>
<td>2.3</td>
</tr>
<tr>
<td>7E</td>
<td>126</td>
<td>X'00'</td>
<td></td>
<td>Ending address of OUTFIL statement image</td>
<td>2.5</td>
</tr>
<tr>
<td>82</td>
<td>130</td>
<td>X'0E'</td>
<td>X'00'</td>
<td>Starting address of JOINKEYS statement image</td>
<td>2.3</td>
</tr>
<tr>
<td>86</td>
<td>134</td>
<td>X'00'</td>
<td></td>
<td>Ending address of JOINKEYS statement image</td>
<td>2.5</td>
</tr>
<tr>
<td>8A</td>
<td>138</td>
<td>X'0F'</td>
<td>X'00'</td>
<td>Starting address of REFORMAT statement image</td>
<td>2.3</td>
</tr>
<tr>
<td>8E</td>
<td>142</td>
<td>X'00'</td>
<td></td>
<td>Ending address of REFORMAT statement image</td>
<td>2.5</td>
</tr>
<tr>
<td>92</td>
<td>146</td>
<td>X'10'</td>
<td>X'00'</td>
<td>Starting address of JOIN statement image</td>
<td>2.3</td>
</tr>
<tr>
<td>96</td>
<td>150</td>
<td>X'10'</td>
<td>X'00'</td>
<td>Ending address of JOIN statement image</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Figure 32. The 24-Bit Parameter List

Notes to Figure 32
**Invoking DFSORT with the 24-Bit Parameter List**

1. **Required entry.** Must appear in the relative position shown. The offset shown is the actual offset of this entry.

2. **Optional entry.** Can appear anywhere after the required entries. The displayed offset is for identification purposes only—the actual offset of this entry can vary. Optional entries must be consecutive but can appear in any order.

3. **A specific control statement.** Shown for illustrative purposes only. SORT or MERGE, RECORD, ALTSEQ, DEBUG, MODS, SUM, INREC, OUTREC, INCLUDE or OMIT, JOINKEYS, JOIN, REFORMAT and OUTFIL can be passed using any of the following hex entry codes: X'00', X'02', X'05' through X'0B', X'0E' through X'11', X'16', X'18' and X'20' through X'29'.

4. **Required entry if the MERGE statement is present and input is supplied through an E32 user exit.** This entry is not required if the FILES option of the MERGE statement is specified.

5. **Required entry.** Contains the ending address for a control statement and must immediately follow the entry containing the starting address for that same control statement.

The specifications for each of the parameter list entries follow:

<table>
<thead>
<tr>
<th>Byte</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>−2 to −1</td>
<td>Unused.</td>
</tr>
<tr>
<td>0 to +1</td>
<td>The byte count. This 2-byte field contains the length in bytes of the parameter list. This two byte field is not included when counting the number of bytes occupied by the list. The total length of the required entries is 24 (X'0018'). All optional entries are four bytes long except those referring to control statement images which are eight bytes each.</td>
</tr>
<tr>
<td>2-5</td>
<td>The starting address of the SORT or MERGE statement image. Must be in the last three bytes of this fullword. The first byte must contain X'00'.</td>
</tr>
<tr>
<td>6-9</td>
<td>The ending address of the SORT or MERGE statement image. Must be in the last three bytes. The first byte must contain X'00'.</td>
</tr>
<tr>
<td>10-13</td>
<td>The starting address of the RECORD statement image, if any; otherwise, all zeros. Must be in the last three bytes. The first byte must contain X'00'.</td>
</tr>
<tr>
<td>14-17</td>
<td>The ending address of the RECORD statement image, if any; otherwise, all zeros. Must be in the last three bytes. The first byte must contain X'00'.</td>
</tr>
<tr>
<td>18-21</td>
<td>The address of the E15 or E32 routine that your program has placed in main storage, if any; otherwise, all zeros. Must be in the last three bytes. The first byte must contain X'00'.</td>
</tr>
<tr>
<td>22-25</td>
<td>The address of the E35 routine that your program has placed in main storage, if any; otherwise, all zeros. Must be in the last three bytes. The first byte must contain X'00'.</td>
</tr>
<tr>
<td>26-29</td>
<td>The starting address of the MODS statement image. Must be in the last three bytes. The first byte must contain X'00'.</td>
</tr>
<tr>
<td>30-33</td>
<td>The ending address of the MODS statement. Must be in the last three bytes. The first byte must contain X'00'.</td>
</tr>
</tbody>
</table>
Invoking DFSORT with the 24-Bit Parameter List

34-37 Main storage value. The first byte must contain X'00'. The next three bytes contain either the characters MAX or a hexadecimal value. You can use this option to temporarily override the SIZE installation option. For full override and applicability details, see Appendix B, “Specification/Override of DFSORT Options,” on page 857. For an explanation of this value, see the discussion of the MAINSIZE parameter in “OPTION Control Statement” on page 173.

38-41 A reserved main storage value. The first byte must contain X'01'. The next three bytes contain a hexadecimal value that specifies a number of bytes to be reserved, where the minimum is 4K. For an explanation of this value, see the explanation of the RESINV parameter in “OPTION Control Statement” on page 173.

You can use this option to temporarily override the RESINV installation option. For full override and applicability details, see Appendix B, “Specification/Override of DFSORT Options,” on page 857.

42-45 Message ddname. The first byte must contain X'03'. The next three bytes contain the address of an 8-byte DD statement name for the message data set, padded with blanks on the right if necessary. The name can be any valid DD statement name, but must be unique.

You can use this option to temporarily override the MSGDDN installation option. For full override details, see Appendix B, “Specification/Override of DFSORT Options,” on page 857. For details on the use of the message data set, see z/OS DFSORT Messages, Codes and Diagnosis Guide.

46-49 Number of input files to a merge. This entry is needed only if the MERGE statement is present without the FILES option and input to the merge is supplied through the E32 user exit. The first byte must contain X'04'. The next three bytes contain the number of files in hexadecimal. For full override and applicability details, see Appendix B, “Specification/Override of DFSORT Options,” on page 857.

50-53 The starting address of the DEBUG statement image. Must be in the last three bytes. The first byte must contain X'05'.

54-57 The ending address of the DEBUG statement image. Must be in the last three bytes. The first byte must contain X'00'.

58-61 The starting address of the ALTSEQ statement image. Must be in the last three bytes. The first byte must contain X'06'.

62-65 The ending address of the ALTSEQ statement image. Must be in the last three bytes. The first byte must contain X'00'.

66-69 The address of a 256-byte translate table supplied instead of an ALTSEQ statement. The first byte must contain X'F6'. If this parameter is present, the X'06' parameter is ignored. For full override and applicability details, see Appendix B, “Specification/Override of DFSORT Options,” on page 857.

70-73 User exit address constant. These 4 bytes are passed to E15 (at offset 4 in the E15 parameter list), to E32 (at offset 8 in the E32 parameter list) or to E35 (at offset 8 in the E35 parameter list) after DFSORT replaces the X'F7' with X'00'.
Invoking DFSORT with the 24-Bit Parameter List

Note: The user exit address constant must not be used for a Conventional merge or tape work data set sort application.

74-77 X'FD' in the first byte (the VLSHRT option) specifies that DFSORT is to continue processing if it finds a variable-length input record too short to contain all specified control fields, compare fields, or summary fields. For full details of this option, see the discussion of the VLSHRT parameter in “OPTION Control Statement” on page 173. You can use this option to temporarily override the VLSHRT installation option. For full override and applicability details, see Appendix B, “Specification/Override of DFSORT Options,” on page 857.

78-81 If the first byte contains X'FE', you can use the next three bytes to pass an address of a 104-byte field save area where ESTAE information is saved. These bytes must contain zeros if the ESTAE information is not saved.

If a system or user exit abend occurs, the DFSORT ESTAE recovery routine will copy the first 104 bytes of the SDWA into this area before returning to any higher level ESTAE recovery routines.

For more information on the DFSORT ESTAE recovery routine, see Appendix E, “DFSORT Abend Processing,” on page 901.

82-85 The message option. The first byte must contain X'FF'. The following three bytes contain the characters NOF, (I), or (U). You can use this option to temporarily override the MSGPRT installation option.

NOF
Messages and control statements are not printed. Critical messages are written to the master console.

(I)
All messages except diagnostic messages (ICE800I to ICE999I) are printed. Critical messages are also written to the master console. Control statements are printed only if LIST is in effect.

(U)
Only critical messages are printed. They are also written to the master console. Control statements are not printed (NOLIST is forced).

All messages are written to the message data set. For details on use of the message data set, see z/OS DFSORT Messages, Codes and Diagnosis Guide. For full override and applicability details, see Appendix B, “Specification/Override of DFSORT Options,” on page 857.

For compatibility reasons, the forms (NO, (AB, (AP, (AC, (CB, (CC, (CP, (PC, (SC, and (SP are also accepted.

The following list shows the equivalent specifications for these aliases:

Table 69. Aliases for Message Option

<table>
<thead>
<tr>
<th>Option</th>
<th>MSGPRT</th>
<th>MSGCON</th>
</tr>
</thead>
<tbody>
<tr>
<td>(NO)</td>
<td>NONE</td>
<td>NONE</td>
</tr>
<tr>
<td>(AB)</td>
<td>ALL</td>
<td>ALL</td>
</tr>
<tr>
<td>(AP)</td>
<td>ALL</td>
<td>CRITICAL</td>
</tr>
</tbody>
</table>
Table 69. Aliases for Message Option (continued)

<table>
<thead>
<tr>
<th>Option</th>
<th>MSGPRT</th>
<th>MSGCON</th>
</tr>
</thead>
<tbody>
<tr>
<td>(AC)</td>
<td>NONE</td>
<td>ALL</td>
</tr>
<tr>
<td>(CB)</td>
<td>CRITICAL</td>
<td>CRITICAL</td>
</tr>
<tr>
<td>(CC)</td>
<td>NONE</td>
<td>CRITICAL</td>
</tr>
<tr>
<td>(CP)</td>
<td>CRITICAL</td>
<td>CRITICAL</td>
</tr>
<tr>
<td>(PC)</td>
<td>ALL</td>
<td>ALL</td>
</tr>
<tr>
<td>(SC)</td>
<td>ALL</td>
<td>CRITICAL</td>
</tr>
<tr>
<td>(SP)</td>
<td>CRITICAL</td>
<td>ALL</td>
</tr>
</tbody>
</table>

86-89

Four characters, which replace “SORT” in the following ddnames: SORTIN, SORTOUT, SORTINn, SORTINnn, SORTOFd, SORTOFdd, SORTWKd, SORTWKdd, SORTJNF1, SORTJNF2, and SORTCNTL. You must use this option when you dynamically invoke DFSORT more than once in a program step.

The four characters must all be alphanumeric or national ($, #, or @) characters. The first character must be alphabetic, and the reserved names DIAG, BALN, OSCL, POLY, CRCX, PEER, LIST, and SYSX (where c is any alphanumeric character) must not be used. Otherwise, the four characters are ignored.

For example, if you use ABC# as replacement characters, DFSORT uses statements ABC#IN, ABC#CNTL, ABC#WKdd, and ABC#OUT instead of SORTIN, SORTCNTL, SORTWKdd, and SORTOUT.

**Note:** This parameter is equivalent to the SORTDD=cccc run-time option.

90-93

The starting address of the SUM statement image. Must be in the last three bytes. The first byte must contain X'07'.

94-97

The ending address of the SUM statement image. Must be in the last three bytes. The first byte must contain X'00'.

98-101

The starting address of the INCLUDE or OMIT statement image. Must be in the last three bytes. The first byte must contain X'08'.

102-105

The ending address of the INCLUDE or OMIT statement image. Must be in the last three bytes. The first byte must contain X'00'.

106-109

The starting address of the OUTREC statement image. Must be in the last three bytes. The first byte must contain X'09'.

110-112

The ending address of the OUTREC statement image. Must be in the last three bytes. The first byte must contain X'00'.

114-116

The starting address of the INREC statement image. Must be in the last three bytes. The first byte must contain X'0A'.

118-121

The ending address of the INREC statement image. Must be in the last three bytes. The first byte must contain X'00'.

122-125

The starting address of the OUTFIL statement image. Must be in the last three bytes. The first byte must contain X'0B'.

126-129

The ending address of the OUTFIL statement image. Must be in the last three bytes. The first byte must contain X'00'.
**Invoking DFSORT with the 24-Bit Parameter List**

<table>
<thead>
<tr>
<th>Start Address</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>130-133</td>
<td>The starting address of the JOINKEYS statement image. Must be in the last three bytes. The first byte must contain X'0E'.</td>
</tr>
<tr>
<td>134-137</td>
<td>The ending address of the JOINKEYS statement image. Must be in the last three bytes. The first byte must contain X'00'.</td>
</tr>
<tr>
<td>138-141</td>
<td>The starting address of the REFORMAT statement image. Must be in the last three bytes. The first byte must contain X'0F'.</td>
</tr>
<tr>
<td>142-145</td>
<td>The ending address of the REFORMAT statement image. Must be in the last three bytes. The first byte must contain X'00'.</td>
</tr>
<tr>
<td>146-149</td>
<td>The starting address of the JOIN statement image. Must be in the last three bytes. The first byte must contain X'10'.</td>
</tr>
<tr>
<td>150-153</td>
<td>The ending address of the JOIN statement image. Must be in the last three bytes. The first byte must contain X'00'.</td>
</tr>
</tbody>
</table>

---

**Invoking DFSORT With The Extended Parameter List**

**Providing Program Control Statements**

When using the extended parameter list, the control statements are written in a single area to which the parameter list points. The control statement area consists of:

- A 2-byte field containing the length (in binary) of the character string to follow.
- A character string in EBCDIC format using assembler DC instructions and containing valid images of the control statements to be used during run-time.

The rules for preparing the program control statements are:

- The control statements must be separated by one or more blanks. A blank preceding the first statement is optional; however, a trailing blank is required. No labels, comment statements, or remark fields are allowed. Because each control statement image must be defined contiguously by one or more assembler DC instructions, explicit and implicit continuation of statements is not necessary or allowed.
- The MODS statement is required when user exits other than E15, E18, E32, E35, and E39 are to be used or when the E15, E18, E35, or E39 routine addresses are not passed by the parameter list.
- All of the control statements described in Chapter 3, “Using DFSORT Program Control Statements,” on page 81 can be specified. None is required, but SORT, MERGE, or OPTION COPY must be specified in the parameter list, SORTCNTL, or DFSPARM.
- If you use ATTACH to initiate the program, you cannot use the checkpoint/restart facility. Do not specify CKPT on the SORT or OPTION statement.

For full override and applicability details, see Appendix B, “Specification/Override of DFSORT Options,” on page 857.

**Format of the Extended Parameter List**

Figure 33 on page 547 shows the format of the extended parameter list and the pointer, which you must pass to DFSORT, containing its address.

The first parameter must be specified. A 4-byte field containing X'FFFFFFFF' must be used to indicate the end of the parameter list. It can be coded anywhere after the first parameter.
**Invoking DFSORT With The Extended Parameter List**

If a parameter is specified, it must appear in the indicated position and must contain a 31-bit address or a clean (the first 8 bits containing zeros) 24-bit address. If a parameter is not specified, it is treated as if it were specified as zeros. For full override and applicability details, see Appendix B, “Specification/Override of DFSORT Options,” on page 857.

<table>
<thead>
<tr>
<th>Register</th>
<th>(Hex)</th>
<th>(Dec)</th>
<th>Byte</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0-3</td>
<td>Required. The address of the area containing the DFSORT control statements, if any; otherwise, all zeros. The high order bit must be 0 to identify this as an extended parameter list. Refer to the previous section for the format of the control statement area. <strong>Attention:</strong> The area must start with a two-byte length field. If you specify this parameter as zeros, you must supply all the required control statements in DFSPARM or SORTCNTL.</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>0</td>
<td>4-7</td>
<td>Optional. The address of the E15 or E32 user exit routine that your program has placed in main storage (for example, via LOAD), if any; otherwise, all zeros. f (bit 0) has the following meaning: 0 = Enter the user exit with 24-bit addressing in effect (AMODE 24). 1 = Enter the user exit with 31-bit addressing in effect (AMODE 31). <strong>Note:</strong> If the Blockset or Peerage/Vale technique is not selected, the user exit is always entered with 24-bit addressing in effect (AMODE 24).</td>
</tr>
</tbody>
</table>

Figure 33. The Extended Parameter List

Detailed specifications for each of the entries in the parameter list follow:

**Byte** | **Explanation** |
---|---|
0-3 | Required. The address of the area containing the DFSORT control statements, if any; otherwise, all zeros. The high order bit must be 0 to identify this as an extended parameter list. Refer to the previous section for the format of the control statement area. **Attention:** The area must start with a two-byte length field. If you specify this parameter as zeros, you must supply all the required control statements in DFSPARM or SORTCNTL. |
4-7 | Optional. The address of the E15 or E32 user exit routine that your program has placed in main storage (for example, via LOAD), if any; otherwise, all zeros. f (bit 0) has the following meaning: 0 = Enter the user exit with 24-bit addressing in effect (AMODE 24). 1 = Enter the user exit with 31-bit addressing in effect (AMODE 31). **Note:** If the Blockset or Peerage/Vale technique is not selected, the user exit is always entered with 24-bit addressing in effect (AMODE 24).
Optional. The address of the E35 user exit routine that your program has placed in main storage (for example, via LOAD), if any; otherwise, all zeros.

f (bit 0) has the following meaning:

0 = Enter the user exit with 24-bit addressing in effect (AMODE 24).
1 = Enter the user exit with 31-bit addressing in effect (AMODE 31).

**Note:** If the Blockset or Peerage/Vale technique is not selected, the user exit is always entered with 24-bit addressing in effect (AMODE 24).

12-15 Optional. This field will be passed to the E15, E32 or E35 user exit routines.

**Note:** The user exit address constant must not be used for a Conventional merge or tape work data set sort application.

16-19 Optional. The address of a 256-byte ALTSEQ translation table supplied instead of an ALTSEQ statement, if any; otherwise, all zeros. You can use this option to override an ALTSEQ installation option. For full override and applicability details, see [Appendix B, “Specification/Override of DFSORT Options,” on page 857](#).

20-23 Optional. The address of a 4-byte field containing the address of a 112-byte work area where ESTAE information is saved, or all zeros if the ESTAE information is not saved.

If a system or user exit abend occurs, the DFSORT recovery routine will copy the first 112 bytes of the software diagnostic work area (SDWA) into this area before returning to your ESTAE recovery routine.

24-27 Optional. The address of the E18 user exit routine that your program has placed in main storage (for example, via LOAD), if any; otherwise, all zeros.

**Note:** This parameter is ignored for a merge application and for a tape work data set sort application.

f (bit 0) has the following meaning:

0 = Enter the user exit with 24-bit addressing in effect (AMODE 24).
1 = Enter the user exit with 31-bit addressing in effect (AMODE 31).

**Note:** If the Blockset or Peerage/Vale technique is not selected, the user exit is always entered with 24-bit addressing in effect (AMODE 24).

28-31 Optional. The address of the E39 user exit routine that your program has placed in main storage (for example, via LOAD), if any; otherwise, all zeros.

**Note:** This parameter is ignored for a conventional merge application and for a tape work data set sort application.

f (bit 0) has the following meaning:

0 = Enter the user exit with 24-bit addressing in effect (AMODE 24).
1 = Enter the user exit with 31-bit addressing in effect (AMODE 31).

**Note:** If the Blockset or Peerage/Vale technique is not selected, the user exit is always entered with 24-bit addressing in effect (AMODE 24).

32-35 Optional. 4 characters to be used as an identifier for this call to DFSORT. This field can be used to uniquely identify each call to DFSORT from a
program that calls DFSORT more than once. DFSORT prints message ICE200I to display the field identifier exactly as you specify it; the field is not checked for valid characters.

If the field identifier is specified, it must appear in the indicated position. If the identifier field contains zeros (X'00000000'), or X'FFFFFFFF' is used to end the parameter list before or at the field identifier, DFSORT does not print message ICE200I.

Note: The list can be ended after any parameter. The last parameter in the list must be followed by X'FFFFFFFF'.

Writing the Macro Instruction

When writing the LINK, ATTACH, or XCTL macro instruction, you must:

- Specify SORT (the entry point) in the EP parameter of the instruction. (This applies to sort, merge, and copy jobs.)
- Load the address of the pointer to the parameter list into register 1 (or pass it in the MF parameter of the instruction).

Note: If you are using ATTACH, you might also need the ECB parameter.

If you provide an E15 user exit routine address in the parameter list, DFSORT ignores the SORTIN data set; your E15 routine must pass all input records to DFSORT. The same applies to a merge if you specify an E32 routine address. This means that your routine must issue a return code of 12 (insert record) until the input data set is complete, and then a return code of 8 (“do not return”).

DFSORT ignores the SORTOUT data set if you provide an E35 routine address in the parameter list. Unless you use OUTFIL processing, your routine is then responsible for disposing of all output records. It must issue a return code of 4 (delete record) for each record in the output data set. When the program has deleted all the records, your routine issues a return code of 8 (“do not return”).

When DFSORT is done, it passes control to the routine that invoked it.

When a single task attaches two or more program applications, you must modify the standard ddnames so that they are unique. For ways of doing this, and for the rules of override, see Appendix B, “Specification/Override of DFSORT Options,” on page 857.

If you ATTACH more than one DFSORT application from the same program, you must wait for each to complete before attaching the next unless DFSORT and your user exits are installed re-entrant.

When you initiate DFSORT via XCTL, you must give special consideration to the area where the parameter list, address list, optional parameters, and modification routines (if any) are stored. This information must not reside in the module that issues the XCTL because the module is overlaid by DFSORT.

There are two ways to overcome this problem. First, the control information can reside in a task that attaches the module that issues the XCTL. Second, the module issuing the XCTL can first issue a GETMAIN macro instruction and place the control information in the main storage area it obtains. This area is not overlaid when the XCTL is issued. The address of the control information in the area must be passed to DFSORT in general register 1.
Writing The Macro Instruction

Parameter List Examples

24-Bit Parameter List Example 1

*Figure 34* shows the format of the 24-bit parameter list you would use to specify the main storage option for a sort application.

<table>
<thead>
<tr>
<th>(Hex)</th>
<th>(Dec)</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Bytes 3 and 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2</td>
<td>-2</td>
<td>Unused</td>
<td>X '001C'</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>X '00'</td>
<td>Starting address of SORT statement</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>X '00'</td>
<td>Ending address of SORT statement</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>10</td>
<td>X '00'</td>
<td>Starting address of RECORD statement</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>X '00'</td>
<td>Ending address of RECORD statement</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>18</td>
<td>X '00'</td>
<td>Zeros (no E15 routine provided)</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>22</td>
<td>X '00'</td>
<td>Zeros (no E35 routine provided)</td>
<td></td>
</tr>
<tr>
<td>1A</td>
<td>26</td>
<td>X '00'</td>
<td>Main storage value (in hexadecimal)</td>
<td></td>
</tr>
</tbody>
</table>

*Figure 34. Specifying the Main Storage Option (24-Bit Parameter List)*

24-Bit Parameter List Example 2

*Figure 35* shows the format of the 24-bit parameter list that you would use for a merge application when you want to supply input through an E32 routine and give control to the ESTAE routine if the program fails.

<table>
<thead>
<tr>
<th>(Hex)</th>
<th>(Dec)</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Bytes 3 and 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2</td>
<td>-2</td>
<td>Unused</td>
<td>X '001C'</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>X '00'</td>
<td>Starting address of MERGE statement</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>X '00'</td>
<td>Ending address of MERGE statement</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>10</td>
<td>X '00'</td>
<td>Starting address of RECORD statement</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>X '00'</td>
<td>Ending address of RECORD statement</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>18</td>
<td>X '00'</td>
<td>Address of E32 routine</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>22</td>
<td>X '00'</td>
<td>Zeros (no E35 routine provided)</td>
<td></td>
</tr>
<tr>
<td>1A</td>
<td>26</td>
<td>X '04'</td>
<td>Number of input files</td>
<td></td>
</tr>
<tr>
<td>1E</td>
<td>30</td>
<td>X 'FE'</td>
<td>Zeros-no work area address provided</td>
<td></td>
</tr>
</tbody>
</table>

*Figure 35. Specifying E32 and ESTAE Routine (24-Bit Parameter List)*

24-Bit Parameter List Example 3

*Figure 36* on page 551 shows how a 24-bit parameter list might appear in main storage. General register 1 contains a pointer to the address of the parameter list.
which is at location 1000. The address points to the parameter list which begins at location 1006. The first 2-byte field of the parameter list contains, right-justified in hexadecimal, the number of bytes in the list (36 decimal).

Figure 36. The 24-Bit Parameter List in Main Storage

The first two fullwords in the parameter list point to the beginning (location 1036) and end (location 105B) of the SORT control statement. The next two fullwords point to the beginning (location 105C) and end (location 1075) of the RECORD statement.

The fifth and sixth fullwords in the list contain the entry point addresses for the E15 user exit (location 2000) and E35 user exit (location 3000).

The next fullword in the list contains four characters to replace the letters 'SORT' in the ddnames of standard DD statements.

The next two fullwords in the list specify a main storage value for this application and a message option.

24-Bit Parameter List Example 4

The example in Figure 37 on page 552 shows, in assembler language, how to code the parameters and statement images needed for the 24-bit parameter list in Figure 36. It also shows how to pass control to DFSORT.
The example in Figure 38 on page 553 shows, in assembler language, how to use an extended parameter list to code parameters and statement images and how to pass control to DFSORT.

Extended Parameter List Example 1

The example in Figure 38 on page 553 shows, in assembler language, how to use an extended parameter list to code parameters and statement images and how to pass control to DFSORT.
Restrictions for Dynamic Invocation

Merge Restriction

Merge applications cannot be done when DFSORT is invoked from a PL/I program.

Copy Restrictions

Copy applications cannot be done when DFSORT is invoked from a PL/I program.

If you invoke DFSORT from a COBOL program, the following restrictions apply:

- The OPTION COPY statement can be placed in either the COBOL IGZSRTCD data set or the DFSORT SORTCNTL or DFSPARM data set.
- If using the FASTSRT compiler option for any part or all of the COBOL SORT statement, a copy application can be done.
- If using the COBOL MERGE statement, a copy application cannot be done.

See “COBOL Requirements for Copy Processing” on page 520 for user exit requirements.
## Chapter 7. Using ICETOOL

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<td>Example 4</td>
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<td>Example 5</td>
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<td>Example 6</td>
<td>677</td>
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<tr>
<td>Example 7</td>
<td>677</td>
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<tr>
<td>Example 8</td>
<td>677</td>
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<td>Example 10</td>
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<td>Example 2 - Combine complete records from four files</td>
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</tr>
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Overview

This chapter describes ICETOOL, a multi-purpose DFSORT utility. ICETOOL uses the capabilities of DFSORT to perform multiple operations on one or more data sets in a single job step. These operations include the following:

- Creating multiple copies of sorted, merged, edited, or unedited input data sets
- Creating output data sets containing subsets of input data sets based on various criteria for character and numeric field values, the number of times unique values occur, header records, trailer records or relative record numbers
- Sorting records between headers and trailers
- Creating output data sets containing different field arrangements of input data sets
  - Resizing fixed length records by creating a larger record from multiple shorter records, or multiple shorter records from a larger record
  - Creating list data sets showing character and numeric fields in a variety of simple, tailored, and sectioned report formats, allowing control of title, date, time, page numbers, carriage control characters, headings, lines per page, field formats, and total, maximum, minimum, average and count values for the columns of numeric data
  - Printing messages that give statistical information for selected numeric fields such as minimum, maximum, average, total, count of values, and count of unique values
  - Printing messages that identify invalid decimal values
  - Printing messages that give record counts
  - Setting RC=12, RC=8, RC=4, or RC=0 based on record counts
  - Creating an output data set containing an output record with text and the record count
  - Creating a list data set showing the DFSORT installation defaults in use
  - Creating list data sets showing unique values for selected character and numeric fields and the number of times each occurs, in a variety of simple and tailored report formats
  - Creating list and output data sets for records with: duplicate values, non-duplicate values, or values that occur n times, less than n times or more than n times
Overview

- Creating output data sets with information spliced together from two or more input records with duplicate values. The information in the input records can originate from different data sets, helping you to perform various file “join” and “match” operations.
- Using three different modes (stop, continue, and scan) to control error checking and actions after error detection for groups of operators.

You can use ICETOOL for SORT, MERGE and COPY operations.

ICETOOL/DFSORT Relationship

ICETOOL is a batch front-end utility that uses the capabilities of DFSORT to perform the operations you request.

ICETOOL includes 17 operators that perform sort, merge, copy, statistical, report, selection, and splice operations. Most of the operations performed by ICETOOL require only simple JCL and operator statements. Some ICETOOL operations require or allow you to specify complete DFSORT control statements (such as SORT, MERGE, INCLUDE or OMIT, INREC, and OUTFIL) to take full advantage of DFSORT’s capabilities.

ICETOOL automatically calls DFSORT with the particular DFSORT control statements and options required for each operation (such as DYNALLOC for sorting).

ICETOOL also produces messages and return codes describing the results of each operation and any errors detected. Although you generally do not need to look at the DFSORT messages produced as a result of an ICETOOL run, they are available in a separate data set if you need them.

ICETOOL can be called directly or from a program. ICETOOL allows operator statements (and comments) to be supplied in a data set or in a parameter list passed by a calling program. For each operator supplied in the parameter list, ICETOOL puts information in the parameter list pertaining to that operation, thus allowing the calling program to use the information derived by ICETOOL.

ICETOOL JCL Summary

The JCL statements used with ICETOOL are summarized below. See “Job Control Language for ICETOOL” on page 564 for more detailed information. See also “JCL Restrictions” on page 566 and “ICETOOL Notes and Restrictions” on page 724.

//JOBLIB DD Defines your program link library if it is not already known to the system.
//STEPLIB DD Same as //JOBLIB DD
//TOOLMSG DD Defines the ICETOOL message data set for all operations.
//DFSMSG DD Defines the DFSORT message data set for all operations.
//SYM NAMES DD Defines the SYMNAMES data set containing statements to be used for symbol processing.
//SYM NOUT DD Defines the data set in which SYMNAMES statements and the symbol table are to be listed.
//TOOLIN DD Contains ICETOOL control statements.
ICETOOL Operator Summary

ICETOOL has 17 operators that are used to perform a variety of functions. The functions of these operators are summarized below. See "ICETOOL Statements" on page 567 for more detailed information. Additionally, information pertaining to each operator is provided to calling programs that supply statements to ICETOOL using a parameter list. See "Parameter List Interface" on page 718 for details.

**COPY**
Copies a data set to one or more output data sets.

**COUNT**
Prints a message containing the count of records in a data set. COUNT can also be used to create an output data set containing text and the count, or to set RC=12, RC=8, RC=4, or RC=0 based on meeting criteria for the number of records in a data set.

**DATASORT**
Sorts data records between header and trailer records in a data set to an output data set.

**DEFAULTS**
Prints the DFSORT installation defaults in a separate list data set.

**DISPLAY**
Prints the values or characters of specified numeric or character fields in a separate list data set. Simple, tailored, or sectioned reports can be produced. Maximums, minimums, totals, averages and counts can be produced.

**MERGE**
Merges one or more data sets to one or more output data sets.

**MODE**
Three modes are available that can be set or reset for groups of operators:
- STOP mode (the default) stops subsequent operations if an error is detected
- CONTINUE mode continues with subsequent operations if an error is detected
- SCAN mode allows ICETOOL statement checking without actually performing any operations.

**OCCUR**
Prints each unique value for specified numeric or character fields and how many times it occurs in a separate list data set. Simple or tailored reports can be produced. The values printed can be limited to those for which the value count meets specified criteria (for example, only duplicate values or only non-duplicate values).
Overview

<table>
<thead>
<tr>
<th>Operator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESIZE</td>
<td>Creates a larger record from multiple shorter records, or creates multiple shorter records from a larger record, that is, resizes fixed length records.</td>
</tr>
<tr>
<td>RANGE</td>
<td>Prints a message containing the count of values in a specified range for a specified numeric field in a data set.</td>
</tr>
<tr>
<td>SELECT</td>
<td>Selects records from a data set for inclusion in an output data set based on meeting criteria for the number of times specified numeric or character field values occur (for example, only duplicate values or only non-duplicate values). Records that are not selected can be saved in a separate output data set.</td>
</tr>
<tr>
<td>SORT</td>
<td>Sorts a data set to one or more output data sets.</td>
</tr>
<tr>
<td>SPLICE</td>
<td>Splices together specified fields from records that have the same specified numeric or character field values (that is, duplicate values), but different information. Specified fields from two or more records can be combined to create an output record. The fields to be spliced can originate from records in different data sets, so you can use SPLICE to do various “join” and “match” operations.</td>
</tr>
<tr>
<td>STATS</td>
<td>Prints messages containing the minimum, maximum, average, and total for specified numeric fields in a data set.</td>
</tr>
<tr>
<td>SUBSET</td>
<td>Selects records from a data set based on keeping or removing header records (the first n records), relative records, or trailer records (the last n records). Records that are not selected can be saved in a separate output data set.</td>
</tr>
<tr>
<td>UNIQUE</td>
<td>Prints a message containing the count of unique values for a specified numeric or character field.</td>
</tr>
<tr>
<td>VERIFY</td>
<td>Examines specified decimal fields in a data set and prints a message identifying each invalid value found for each field.</td>
</tr>
</tbody>
</table>

**Restriction:** You can perform a JOINKEYS application with the COPY and SORT operators, but not with the other operators.

**Complete ICETOOL Examples**

[“ICETOOL Example” on page 845](#) contains a complete ICETOOL sample job with all required JCL and control statements. The example below shows the JCL and control statements for a simple ICETOOL job.
Using Symbols

You can define and use a symbol for any field or constant in the following ICETOOL operators: COUNT, DATASORT, DISPLAY, OCCUR, RANGE, SELECT, SPLICE, STATS, SUBSET, UNIQUE, and VERIFY. You can also use symbols in the DFSORT control statements you specify for an ICETOOL run. This makes it easy to create and reuse collections of symbols (that is, mappings) representing information associated with various record layouts. You can use system symbols (for example, &JOBNAME.) in your symbol constants. See Chapter 8, “Using Symbols for Fields and Constants,” on page 727 for complete details.

Using SET and PROC Symbols in Control Statements

For jobs that directly invoke ICETOOL (PGM=ICETOOL), you can construct DFSORT symbols that incorporate JCL PROC or SET symbols as well as text and system symbols. You can then use those constructed DFSORT symbols in ICETOOL and DFSORT control statements in the same way you use regular DFSORT symbols. For complete information, see Chapter 8, “Using Symbols for Fields and Constants,” on page 727.

Invoking ICETOOL

ICETOOL can be invoked in the following three ways:

- Directly (that is, not from a program) using the TOOLIN Interface
- From a program using the TOOLIN Interface
- From a program using the Parameter List Interface.
Overview

With the TOOLIN Interface, you supply ICETOOL statements in a data set defined by the TOOLIN DD statement. ICETOOL prints messages in the data set defined by the TOOLMSG DD statement.

With the Parameter List Interface, your program supplies ICETOOL statements in a parameter list. ICETOOL prints messages in the data set defined by the TOOLMSG DD statement and also puts information in the parameter list for use by your program.

Putting ICETOOL to Use

By using various combinations of the 17 ICETOOL operators, you can easily create applications that perform many complex tasks. The two small samples that follow show some things you can do with ICETOOL.

Obtaining Various Statistics

Table 70. Obtaining Various Statistics

<table>
<thead>
<tr>
<th>MODE STOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>VERIFY FROM(DATA1) ON(22,7,PD)</td>
</tr>
<tr>
<td>DISPLAY FROM(DATA1) LIST(SALARIES) -</td>
</tr>
<tr>
<td>TITLE('Employee Salaries') DATE TIME -</td>
</tr>
<tr>
<td>HEADER('Employee Name') HEADER('Salary') -</td>
</tr>
<tr>
<td>ON(1,20,CH) ON(22,7,PD) BLANK -</td>
</tr>
<tr>
<td>AVERAGE('Average Salary')</td>
</tr>
<tr>
<td>STATS FROM(DATA1) ON(22,7,PD)</td>
</tr>
<tr>
<td>RANGE FROM(DATA1) ON(22,7,PD) LOWER(20000)</td>
</tr>
<tr>
<td>RANGE FROM(DATA1) ON(22,7,PD) HIGHER(19999) LOWER(40000)</td>
</tr>
<tr>
<td>RANGE FROM(DATA1) ON(22,7,PD) HIGHER(40000)</td>
</tr>
<tr>
<td>OCCUR FROM(DATA1) LIST(SALARIES) -</td>
</tr>
<tr>
<td>TITLE('Employees Receiving Each Salary') DATE TIME -</td>
</tr>
<tr>
<td>HEADER('Salary') HEADER('Employee Count') -</td>
</tr>
<tr>
<td>ON(22,7,PD) ON(VALCNT) BLANK</td>
</tr>
</tbody>
</table>

Assume that you specify DD statements with the following ddnames for the indicated data sets:

DATA1 A data set containing the name, salary, department, location and so on, of each of your employees. The name field is in positions 1 through 20 in character format and the salary field is in positions 22 through 28 in packed decimal format.

SALARIES A SYSOUT data set.

You can use the ICETOOL operators in Table 70 to do the following:

MODE STOP If an error is found while processing one of the operators, subsequent operators are not processed (that is, each operator is dependent on the success of the previous operator).

VERIFY Prints error messages in the TOOLMSG data set identifying any invalid values in the packed decimal salary field.

DISPLAY Prints a report with each employee's name and salary and the average for all employee salaries in the SALARIES list data set.
Overview

STATS Prints messages in the TOOLMSG data set showing the minimum, maximum, average, and total of the individual salaries.

RANGE The three RANGE operators print messages in the TOOLMSG data set showing the number of salaries below $20,000, from $20,000 to $39,999, and above $40,000.

OCCUR Prints a report with each unique salary and the number of employees who receive it in the SALARIES list data set.

Creating Multiple Versions/Combinations of Data Sets

Table 71. Creating Multiple Versions/Combinations of Data Sets

<table>
<thead>
<tr>
<th>* GROUP 1</th>
<th>* GROUP 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MODE CONTINUE</strong></td>
<td><strong>MODE STOP</strong></td>
</tr>
<tr>
<td>COPY FROM(DATA1) TO(DATA2)</td>
<td>COPY FROM(DATA1) TO(TEMP1) USING(NEW1)</td>
</tr>
<tr>
<td>COPY FROM(MSTR1) TO(MSTR2)</td>
<td>COPY FROM(DATA1) TO(TEMP2) USING(NEW2)</td>
</tr>
<tr>
<td>SELECT FROM(DATA1) TO(SMALLDPT) ON(30,4,CH) LOWER(10)</td>
<td>COPY FROM(DATA1) TO(TEMP3) USING(NEW3)</td>
</tr>
<tr>
<td>UNIQUE FROM(MSTR1) ON(30,4,CH)</td>
<td>SORT FROM(CONCAT) TO(FINALD, FINALP) USING(FINL)</td>
</tr>
</tbody>
</table>

Assume that you specify DD statements with the following ddnames for the indicated data sets:

DATA1 A data set containing the name, salary, department, location, and so on, of each of your employees. The department field is in positions 30 through 33 in character format.

MSTR1 Master data set containing only the name and department of each of your employees. The department field is in positions 30 through 33 in character format.

DATA2, MSTR2, and SMALLDPT Permanent data sets.

NEW1CNTL A data set containing DFSORT control statements to INCLUDE employees in department X100 and change the records to match the format of MSTR1.

NEW2CNTL Same as NEW1CNTL but for department X200.

NEW3CNTL Same as NEW1CNTL but for department X300.

TEMP1, TEMP2, and TEMP3 Temporary data sets.

FINLCNTL A data set containing a DFSORT control statement to sort by department and employee name.

CONCAT A concatenation of the TEMP1, TEMP2, TEMP3, and MSTR1 data sets.

FINALD A permanent data set.

FINALP A SYSOUT data set.
You can use the ICETOOL operators in Table 71 to do the following:

**MODE CONTINUE**
If an error is found while processing any of the group 1 operators, subsequent group 1 operators are still processed; that is, group 1 operators are not dependent on the success of the previous group 1 operators.

**COPY**
The two copy operators create backup copies of DATA1 and MSTR1.

**SELECT**
Creates a permanent output data set containing the name, salary, department, location, and so on, of each employee in departments with less than 10 people.

**UNIQUE**
Prints a message in the TOOLMSG data set showing the number of unique departments.

**MODE STOP**
If an error is found while processing one of the group 2 operators, subsequent group 2 operators are not processed; that is, each group 2 operator is dependent on the success of previous group 2 operators.

**COPY**
The three COPY operators create an output data set for the employees in each department containing only name and department. Note that the ddname requested by the USING(xxxx) operand is xxxxCNTL. For example, USING(NEW1) requests ddname NEW1CNTL.

**SORT**
Sorts the three output data sets created by the COPY operators along with the master name/department data set and creates permanent and SYSOUT data sets containing the resulting sorted records.

You can combine both of these examples into a single ICETOOL job step.
Job Control Language for ICETOOL

An overview of the job control language (JCL) statements for ICETOOL is given below followed by discussions of each ICETOOL DD statement and the use of reserved DD statements and ddnames.

Table 72. JCL Statements for ICETOOL

//EXAMPL JOB ...  
//* ICETOOL CAN BE CALLED DIRECTLY OR FROM A PROGRAM
//* STEP EXEC PGM=ICETOOL (or PGM=program_name)
//* THE FOLLOWING DD STATEMENTS ARE ALWAYS REQUIRED
//TOOLMSG DD SYSOUT=A (or DSN=...)  
//DFSMSG DD SYSOUT=A  
//* THE FOLLOWING DD STATEMENTS ARE USED FOR SYMBOL PROCESSING
//* SYMNAMES DD ... 
//* SYMNOUT DD SYSOUT=A (or DSN=...) 
//* THE TOOLIN DD STATEMENT IS ONLY REQUIRED IF THE TOOLIN INTERFACE
//* IS USED. 
//TOOLIN DD *
  //ICETOOL statements
/*
//* THE FOLLOWING DD STATEMENTS ARE ONLY REQUIRED IF SPECIFIED IN
//* ICETOOL STATEMENTS.
//indd DD ... 
  .
  . 
//outdd DD ... 
  .
  .
//listdd DD SYSOUT=A (or DSN=...) 
  .
  . 
//countdd DD ... 
  .
  . 
//xxxxCNTL DD * 
   DFSORT control statements
/*

TOOLMSG DD Statement

Defines the ICETOOL message data set for all operations.
ICETOOL messages and statements appear in this data set.
ICETOOL uses RECFM=FBA, LRECL=121 and the specified
BLKSIZE for the TOOLMSG data set. If the BLKSIZE you specify is
not a multiple of 121, ICETOOL uses BLKSIZE=121. If you do not
specify the BLKSIZE, ICETOOL selects the block size as directed by
the SDBMSG installation option (see z/OS DFSORT Installation and
Customization).
The TOOLMSG DD statement **must** be present.

DFSMSG DD Statement

Defines the DFSORT message data set for all operations. The
DFSORT messages and control statements from all ICETOOL calls
to DFSORT appear in this data set. Refer to the discussion of
SYSOUT in [“System DD Statements” on page 65](#) for details.
Either a DFSMSG DD statement or an SSMG DD statement must be present. If both are present, ICETOOL uses DFSMSG as the DFSORT message data set. If a DFSMSG DD is not present, but an SSMG DD is present, ICETOOL uses SSMG as the DFSORT message data set.

Note: A SYSOUT data set should be used for the DFSORT message data set (for example, //DFSMSG DD SYOUT=*). If you define the DFSORT message data set as a temporary or permanent data set, you will only see the DFSORT messages from the last call to DFSORT, unless you allocate a new data set using a disposition of MOD.

//SYMNAME DD
Defines the SYMNAMES data set containing statements to be used for symbol processing. See Chapter 8, “Using Symbols for Fields and Constants,” on page 727 for complete details.

//SYMNOUT DD
Defines the data set in which SYMNAMES statements and the symbol table are to be listed. See Chapter 8, “Using Symbols for Fields and Constants,” on page 727 for complete details.

TOOLIN DD statement
Defines the ICETOOL statement data set that must have the following attributes: RECFM=F or RECFM=FB and LRECL=80.

If the TOOLIN Interface is used, the TOOLIN DD statement must be present. If the Parameter List Interface is used, the TOOLIN DD statement is not required and is ignored if present.

inDD DD Statement
Defines an input data set for an operation. Refer to “SORTIN DD Statement” on page 69 (copy or sort) or “SORTINnn DD Statement” on page 71 (merge) for details. ICETOOL imposes the additional restriction that the LRECL of this data must be at least 4.

An indd DD statement must be present for each unique indd name specified in each FROM operand.

outDD DD Statement
Defines an output data set for a COPY, DATASORT, MERGE, RESIZE, SELECT, SORT, SPLICE or SUBSET operation. Refer to “SORTOUT and OUTFIL DD Statements” on page 75 for details.

An outdd DD statement must be present for each unique outdd name specified in each TO operand.

savedDD DD Statement
Defines an output data set for a SELECT or SUBSET operation. Refer to “SORTOUT and OUTFIL DD Statements” on page 75 for details.

A savedd DD statement must be present for each unique savedd name specified in each DISCARD operand.

listDD DD Statement
Defines the list data set for a DEFAULTS, DISPLAY, or OCCUR operation. For each listdd data set, ICETOOL uses RECFM=FBA (or RECFM=FB for DISPLAY or OCCUR with the NOCC operand specified), LRECL=121 (for DEFAULTS) or the LRECL specified in
Job Control Language for ICETOOL

the WIDTH operand or calculated as needed if WIDTH is not specified (DISPLAY and OCCUR), and the specified block size. If the BLKSIZE you specify is not a multiple of the LRECL, ICETOOL uses BLKSIZE=LRECL. If you do not specify BLKSIZE, ICETOOL selects the block size as directed by the LISTSDB or LISTNOSDB option if specified, or otherwise as directed by the SDBMSG installation option (see z/OS DFSORT Installation and Customization).

A listdd DD statement must be present for each unique listdd name specified in each LIST operand.

countdd DD Statement

Defines the output data set for a COUNT operation. For each countdd data set, ICETOOL uses RECFM=FB, the LRECL specified in the WIDTH operand or calculated if WIDTH is not specified, and the specified block size. If the BLKSIZE you specify is not a multiple of the LRECL, ICETOOL uses BLKSIZE=LRECL. If you do not specify BLKSIZE, ICETOOL uses the system-determined optimum block size.

A countdd DD statement must be present for each unique countdd name specified in each WRITE operand.

xxxxCNTL DD Statement

Defines the DFSORT control statement data set for a COPY, COUNT, DATASORT, MERGE, RESIZE, SELECT, SORT, SPLICE or SUBSET operation. Refer to “SORTCNTL DD Statement” on page 77 for more details.

An xxxxCNTL DD statement must be present for each unique xxxx specified in each USING operand.

JCL Restrictions

You should avoid using ddnames reserved for ICETOOL and DFSORT in ICETOOL operands (FROM, TO, LIST, DISCARD, WRITE). In general, you should also avoid supplying DD statements with ddnames reserved for DFSORT when using ICETOOL because doing so can cause unpredictable results. Specifically:

- SORTCNTL should not be used as a ddname in ICETOOL operators nor should it be supplied as a DD statement. A xxxxCNTL DD statement should only be supplied when you specify a USING(xxxx) operand. xxxx must be four characters that are valid in a ddname of the form xxxxCNTL. xxxx must not be SYSx.

- SYSIN, SORTCNTL, SORTIN, SORTOUT, SORTINnn, and xxxxInnn (where xxxx is specified in a USING operand) should not be used as ddnames in ICETOOL operators nor supplied as DD statements.

- TOOLMSG, DFSMSG, SSMG, SYMNAMES, SYMNOUT, TOOLIN, SYSUDUMP, and SYSABEND should not be used as ddnames in ICETOOL operators.

- In general, xxxxWKdd ddnames should not be used as ddnames in ICETOOL operators nor supplied as DD statements. However, if you want to override dynamic allocation of work data sets for ICETOOL operators OCCUR and UNIQUE, you can use SORTWKdd DD statements for that purpose. If you want to override dynamic allocation of work data sets for ICETOOL operators DATASORT, RESIZE, SELECT, SORT, SPLICE, and SUBSET, you can use xxxxWKdd DD statements for that purpose in conjunction with the USING operand.

- DFSParm (or the ddname specified for the PARMDNN installation option) should not be used as a ddname in ICETOOL operators. It should only be used
as a DD statement to override DFSORT options for all operators, if appropriate. Refer to "DFSPARM DD Statement" on page 77 for details.

* xxxxOFdd (where xxxx is specified in a USING operand) is required as the ddname when an OUTFIL statement in the xxxxCNTL data set specifies FILES=dd. To avoid this requirement, use the FNAMES=ddname operand rather than the FILES=dd operand in OUTFIL statements, and include a DD statement for the specified ddname. See "OUTFIL Control Statements" on page 229 for details of the FNAMES operand.

You should not use different DDs for a data set to be used for output and then input in the same step, if that data set can be extended to a second or subsequent volume, because that will result in incorrect output. See "Data Set Notes and Limitations" on page 13 for more information.

**ICETOOL Statements**

Each operation must be described to ICETOOL using an operator statement. Additionally, ICETOOL allows comment statements and blank statements. An explanation of the general rules for coding ICETOOL statements is given below followed by a detailed discussion of each operator.

**General Coding Rules**

The general format for all ICETOOL operator statements is:

```operatorexample operand ...
```

where each operand consists of KEYWORD(parameter, parameter...) or just KEYWORD. Any number of operators can be specified and in any order.

The following rules apply for operator statements:

- The operator and operands must be in uppercase EBCDIC.
- The operator must be specified first.
- One blank is required between the operator and the first operand.
- One blank is required between operands.
- Any number of blanks can be specified before or after the operator or any operand, but blanks cannot be specified anywhere else except within quoted character strings.
- Parentheses must be used where shown. Commas or semicolons must be used where commas are shown.
- Operands can be in any order.
- Columns 1-72 are scanned; columns 73-80 are ignored.
- Continuation can be indicated by a hyphen (-) **after** the operator or after any operand. The next operand must then be specified on the next line. For example:

```sort from(indd) -
   using(abcd) -
   to(output1,output2,output3)
```

Any characters specified after the hyphen are ignored. Each operand **must** be completely specified on one line.

A statement with an asterisk (*) in column 1 is treated as a comment statement. It is printed with the other ICETOOL statements, but otherwise not processed. A statement with blanks in columns 1 through 72 is treated as a blank statement. It is ignored, because ICETOOL prints blank lines where appropriate.
Copies an input data set to one or more output data sets.

DFSORT is called to copy the indd data set to the outdd data sets; the DFSORT control statements in xxxxCNTL are used if USING(xxxx) is specified. You can use DFSORT control statements and options in the xxxxCNTL data set to copy a subset of the input records (INCLUDE or OMIT statement; SKIPREC and STOPAFT options; OUTFIL INCLUDE, OMIT, SAVE, STARTREC, ENDREC, SAMPLE, SPLIT, SPLITBY, and SPLIT1R operands; user exit routines), reformat records for output (INREC, OUTREC and OUTFIL statements, user exit routines), and so on.

If an INCLUDE or OMIT statement or an OUTFIL INCLUDE or OMIT operand is specified in the xxxxCNTL data set, the active locale's collating rules affect INCLUDE and OMIT processing, as explained in the “Cultural Environment Considerations” discussion in “INCLUDE Control Statement” on page 98.

### Operand Descriptions

The operands described below can be specified in any order.

**FROM(indd)**

Specifies the ddname of the input data set to be read by DFSORT for this operation. An indd DD statement must be present and must define an input data set that conforms to the rules for DFSORT’s SORTIN data set.

Refer to “JCL Restrictions” on page 566 for more information regarding the selection of ddnames.

**JKFROM**

Specifies you are using a JOINKEYS application with this COPY operator to copy the joined records. You must provide a USING(xxxx) operand. In xxxxCNTL, you must provide a JOINKEYS statement with F1=ddname1 for the F1 file and a JOINKEYS statement with F2=ddname2 for the F2 file, as well as JOIN and REFORMAT statements as needed.

**TO(outdd,...)**

Specifies the ddnames of the output data sets to be written by DFSORT for this operation. From 1 to 10 outdd names can be specified. An outdd DD statement must be present for each outdd name specified. If a single outdd data set is
COPY Operator

specified, DFSORT is called once to copy the indd data set to the outdd data set, using SORTOUT processing; the outdd data set must conform to the rules for DFSORT’s SORTOUT data set. If multiple outdd data sets are specified and SERIAL is not specified, DFSORT is called once to copy the indd data set to the outdd data sets, using OUTFIL processing; the outdd data sets must conform to the rules for DFSORT’s OUTFIL data sets.

TO and USING can both be specified. If USING is not specified, TO must be specified. If TO is not specified, USING must be specified.

A ddname specified in the FROM operand must not also be specified in the TO operand.

Refer to “JCL Restrictions” on page 566 for more information regarding the selection of ddnames.

USING(xxxx)

Specifies the first 4 characters of the ddname for the control statement data set to be used by DFSORT for this operation. xxxx must be four characters that are valid in a ddname of the form xxxxCNTL. xxxx must not be SYSx.

If USING is specified, an xxxxCNTL DD statement must be present and the control statements in it must conform to the rules for DFSORT’s SORTCNTL data set.

TO and USING can both be specified. If USING is not specified, TO must be specified. If TO is not specified, USING must be specified and the xxxxCNTL data set must contain either one or more OUTFIL statements or a MODS statement for an E35 routine that disposes of all records. Other statements are optional.

Refer to “JCL Restrictions” on page 566 for more information regarding the selection of ddnames.

VSAMTYPE(x)

Specifies the record type for a VSAM input data set. x must be either F for fixed-length record processing or V for variable-length record processing. If VSAMTYPE(x) is specified, ICETOOL will pass a RECORD TYPE=x control statement to DFSORT. (If you specify a RECORD TYPE=x statement in the xxxxCNTL data set, it will override the one passed by ICETOOL.) For complete information on record type processing for VSAM input, see “RECORD Control Statement” on page 437.

LOCALE(name)

Specifies that locale processing is to be used and designates the name of the locale to be made active during DFSORT processing. LOCALE(name) can be used to override the LOCALE installation option. For complete details on LOCALE(name), see the discussion of the LOCALE operand in “OPTION Control Statement” on page 173.

LOCALE(CURRENT)

Specifies that locale processing is to be used, and the current locale active when DFSORT is entered will remain the active locale during DFSORT processing. LOCALE(CURRENT) can be used to override the LOCALE installation option. For complete details on LOCALE(CURRENT), see the discussion of the LOCALE operand in “OPTION Control Statement” on page 173.

LOCALE(NONE)

Specifies that locale processing is not to be used. DFSORT will use the binary
encoding of the code page defined for your data for collating and comparing. LOCALE(NONE) can be used to override the LOCALE installation option. For complete details on LOCALE(NONE), see the discussion of the LOCALE operand in "OPTION Control Statement" on page 173.

**SERIAL**

Specifies that OUTFIL processing is not to be used when multiple outdd data sets are specified. DFSORT is called multiple times and uses SORTOUT processing; the outdd data sets must conform to the rules for DFSORT's SORTOUT data set. SERIAL is not recommended because the use of serial processing (that is, multiple calls to DFSORT) instead of OUTFIL processing can degrade performance and imposes certain restrictions as detailed below. SERIAL is ignored if a single outdd data set is specified.

DFSORT is called to copy the indd data set to the first outdd data set using the DFSORT control statements in the xxxxCNTL data set if USING(xxxx) is specified. If the first copy is successful, DFSORT is called as many times as necessary to copy the first outdd data set to the second and subsequent outdd data sets. Therefore, for maximum efficiency, use a disk data set as the first in a list of outdd data sets on both disk and tape. If more than one outdd data set is specified, DFSORT must be able to read the first outdd data set after it is written in order to copy it to the other outdd data sets. Do not use a SYSOUT or DUMMY data set as the first in a list of outdd data sets because:

- if the first data set is SYSOUT, DFSORT abends when it tries to copy the SYSOUT data set to the second outdd data set.
- if the first data set is DUMMY, DFSORT copies the empty DUMMY data set to the other outdd data sets, with the result that all outdd data sets are then empty.

**COPY Examples**

Although the COPY operators in the examples below could all be contained in a single ICETOOL job step, they are shown and discussed separately for clarity.

**Example 1**

* Method 1
COPY FROM(MASTER) TO(PRINT,TAPE,DISK)

* Method 2
COPY FROM(MASTER) TO(DISK,TAPE,PRINT) SERIAL

This example shows two different methods for creating multiple output data sets.

Method 1 requires one call to DFSORT, one pass over the input data set, and allows the output data sets to be specified in any order. The COPY operator copies all records from the MASTER data set to the PRINT (SYSOUT), TAPE, and DISK data sets, using OUTFIL processing.

Method 2 requires three calls to DFSORT, three passes over the input data set, and imposes the restriction that the SYSOUT data set must not be the first TO data set. The COPY operator copies all records from the MASTER data set to the DISK data set and then copies the resulting DISK data set to the TAPE and PRINT (SYSOUT) data sets. Because the first TO data set is processed three times (written, read, read), placing the DISK data set first is more efficient than placing the TAPE data set first. PRINT must not be the first in the TO list because a SYSOUT data set cannot be read.
Example 2

* Method 1
COPY FROM(IN) TO(DEPT1) USING(DPT1)
COPY FROM(IN) TO(DEPT2) USING(DPT2)
COPY FROM(IN) TO(DEPT3) USING(DPT3)

* Method 2
COPY FROM(IN) USING(ALL3)

This example shows two different methods for creating subsets of an input data set. Assume that:

- The DPT1CNTL data set contains:
  INCLUDE COND=(5,3,CH,EQ,C'D01')
- The DPT2CNTL data set contains:
  INCLUDE COND=(5,3,CH,EQ,C'D02')
- The DPT3CNTL data set contains:
  INCLUDE COND=(5,3,CH,EQ,C'D03')
- The ALL3CNTL data set contains:
  OUTFIL FNAMES=DEPT1,INCLUDE=(5,3,CH,EQ,C'D01')
  OUTFIL FNAMES=DEPT2,INCLUDE=(5,3,CH,EQ,C'D02')
  OUTFIL FNAMES=DEPT3,INCLUDE=(5,3,CH,EQ,C'D03')

Method 1 requires three calls to DFSORT and three passes over the input data set:
- The first COPY operator copies the records from the IN data set that contain D01 in positions 5-7 to the DEPT1 data set.
- The second COPY operator copies the records from the IN data set that contain D02 in positions 5-7 to the DEPT2 data set.
- The third COPY operator copies the records from the IN data set that contain D03 in positions 5-7 to the DEPT3 data set.

Method 2 accomplishes the same result as method 1, but because it uses OUTFIL statements instead of TO operands, requires only one call to DFSORT and one pass over the input data set.

Example 3
COPY FROM(VSAMIN) TO(VSAMOUT) VSAMTYPE(V)

The COPY operator copies all records from the VSAMIN data set to the VSAMOUT data set. The VSAM records are treated as variable-length.

COPY Operator with JOINKEYS Example

Here is an example of using multiple COPY operators for JOINKEYS applications that preprocess different input files in different ways:

```
//CPYJK EXEC PGM=ICETOOL
//TOOLMSG DD SYSOUT=*
//DFSMSG DD SYSOUT=*
//IN1 DD DSN=MY.IN1,DISP=SHR
//IN2 DD DSN=MY.IN2,DISP=SHR
//IN3 DD DSN=MY.IN3,DISP=SHR
//OUT1 DD SYSOUT=*
//OUT2 DD SYSOUT=*
//TOOLIN DD *

* First COPY operator with JOINKEYS application.
COPY JKFROM TO(OUT1) USING(CTL1)
* Second COPY operator with JOINKEYS application.
COPY JKFROM USING(CTL2)
/*
COPY Operator

//CTL1CNTL DD *
* JOINKEYS application control statements for first COPY operator.
JOINKEYS F1=IN1,FIELDS=(5,12,A),TASKID=T1
JOINKEYS F2=IN2,FIELDS=(11,12,A),TASKID=T1
JOIN UNPAIRED
REFORMAT FIELDS=(F1:4,40,F2:15,20),FILL=C'$'
* Main task control statements for first COPY operator
* (operates on joined records).
INCLUDE COND=(8,1,CH,EQ,C'Y')

//CTL2CNTL DD *
* JOINKEYS application control statements for second COPY operator.
JOINKEYS F1=IN1,FIELDS=(5,12,A),TASKID=T1
JOINKEYS F2=IN3,FIELDS=(9,12,A),TASKID=T2,SORTED
REFORMAT FIELDS=(F1:4,40,F2:7,20)
* Main task control statements for second COPY operator
* (operates on joined records).
OUTFIL FNAMES=OUT2,HEADER1=('Analysis Report'),REMOVECC

/*
//T1F1CNTL DD *
* Control statements for subtask1 (F1=IN1) of both COPY operators.
* Subtask1 sorts/joins on 5,12,A automatically
* per JOINKEYS statement for TASKID=T1/F1=IN1.
INCLUDE COND=(21,3,CH,EQ,C'J82')
SUM FIELDS=None

/*
//T1F2CNTL DD *
* Control statements for subtask2 (F2=IN2) of first COPY operator.
* Subtask1 sorts/joins on 11,12,A automatically
* per JOINKEYS statement for TASKID=T1/F2=IN2.
OPTION SKIPREC=1
INCLUDE COND=(25,3,CH,EQ,C'J82')

/*
//T2F2CNTL DD *
* Control statements for subtask2 (F2=IN3) of second COPY operator.
* Subtask1 copies/joins on 9,12,A automatically
* per JOINKEYS statement for TASKID=T2/F2=IN3/SORTED.
INCLUDE COND=(5,3,CH,EQ,C'J82')

/*

COUNT Operator

COUNT--FROM(indd) --USING(ffff) --VSAMTYPE(x)

LOCALE(name) --RC4 --EMPTY --SUB(q)
LOCALE(CURRENT) --RC8 --NOTEMPTY --ADD(r)
LOCALE(NONE) --RC12 --HIGHER(x) --

WRITE(countdd) --TEXT('string') --DIGITS(d) --EDCOUNT(formatting)

WIDTH(n)
COUNT Operator

Prints a message containing the count of records in a data set. Can also be used to subtract a value from the count or add a value to the count, to create an output data set containing text and the count, or to set RC=12, RC=8, RC=4, or RC=0 based on meeting criteria for the number of records in a data set.

DFSORT is called to copy the indd data set to ICETOOL’s E35 user exit. The DFSORT control statements in xxxxCNTL are used if USING(xxxx) is specified. You can use a DFSORT INCLUDE or OMIT statement in the xxxxCNTL data set to count a subset of the input records.

If an INCLUDE or OMIT statement is specified in the xxxxCNTL data set, the active locale’s collating rules affect INCLUDE and OMIT processing as explained in the “Cultural Environment Considerations” discussion in “INCLUDE Control Statement” on page 98.

If EMPTY, NOTEMPTY, HIGHER(x), LOWER(y), EQUAL(v) or NOTEQUAL(w) is not specified, ICETOOL prints a message containing the record count as determined by its E35 user exit.

If EMPTY, NOTEMPTY, HIGHER(x), LOWER(y), EQUAL(v) or NOTEQUAL(w) is specified, ICETOOL checks the record count as determined by its E35 user exit against the specified criteria. If the criteria is met (for example, HIGHER(20) is specified and the record count is 21 or more), ICETOOL sets the following return code for the COUNT operator:

- RC=12 if RC12 is specified, or by default if RC8 and RC4 are not specified
- RC=8 if RC8 is specified
- RC=4 if RC4 is specified

If the criteria is not met (for example, HIGHER(20) is specified and the record count is 20 or less), ICETOOL sets RC=0 for the COUNT operator. ICETOOL uses DFSORT’s STOPAFT option to process the minimum number of records required to determine whether or not the criteria is met.

Note: Be sure to check the messages in TOOLMSG when you initially set up any COUNT operators with criteria to make sure that RC=12 is not issued because of syntax errors.

If SUB(q) is specified, ICETOOL subtracts q from the count, but does not reduce the count below 0. If ADD(r) is specified, ICETOOL adds r to the count. SUB(q) and ADD(r) are especially useful for dealing with data sets that contain header and trailer records.

If WRITE(countdd) is specified, ICETOOL writes a record containing the count in the countdd data set. TEXT('string') can be used to insert a string before the count in the output record. DIGITS(n) or EDCOUNT(formatting) can be used to change the appearance of the count in the output record. WIDTH(n) can be used to change the length of the output record.

You must not supply your own DFSORT MODS statement because it would override the MODS statement passed by ICETOOL for this operator.

Note: The record count is also printed for the DISPLAY, OCCUR, RANGE, SELECT, STATS, UNIQUE, and VERIFY operators.
COUNT Operator

Operand Descriptions

The operands described below can be specified in any order.

FROM(indd)
See the discussion of this operand on the COPY statement in “COPY Operator” on page 568.

USING(xxxx)
Specifies the first 4 characters of the ddname for the control statement data set to be used by DFSORT for this operation. xxxx must be four characters that are valid in a ddname of the form xxxxCNTL. xxxx must not be SYSx.

If USING is specified, an xxxxCNTL DD statement must be present and the control statements in it:
1. Must conform to the rules for DFSORT's SORTCNTL data set.
2. Should generally be used only for an INCLUDE or OMIT statement or comments statements.

Refer to “JCL Restrictions” on page 566 for more information regarding the selection of ddnames.

VSAMTYPE(x)
See the discussion of this operand on the COPY statement in “COPY Operator” on page 568.

LOCALE(name)
See the discussion of this operand on the COPY statement in “COPY Operator” on page 568.

LOCALE(CURRENT)
See the discussion of this operand on the COPY statement in “COPY Operator” on page 568.

LOCALE(NONE)
See the discussion of this operand on the COPY statement in “COPY Operator” on page 568.

RC4
Can be used to set RC=4 for this COUNT operator if the record count meets the specified criteria. RC4 can be specified only if EMPTY, NOTEMPTY, HIGHER(x), LOWER(y), EQUAL(v), or NOTEQUAL(w) is specified. RC4 overrides the default of setting RC=12 for this COUNT operator if the record count meets the specified criteria.

RC8
Can be used to set RC=8 for this COUNT operator if the record count meets the specified criteria. RC8 can be specified only if EMPTY, NOTEMPTY, HIGHER(x), LOWER(y), EQUAL(v), or NOTEQUAL(w) is specified. RC8 overrides the default of setting RC=12 for this COUNT operator if the record count meets the specified criteria.

RC12
Can be used to set RC=12 for this COUNT operator if the record count meets the specified criteria. RC12 can be specified only if EMPTY, NOTEMPTY, HIGHER(x), LOWER(y), EQUAL(v), or NOTEQUAL(w) is specified. RC12 is equivalent to the default used when RC4 or RC8 is not specified.

EMPTY
Sets RC=12 (or RC=8 if RC8 is specified, or RC=4 if RC4 is specified) for this COUNT operator if the input data set or subset is empty, or sets RC=0 for this COUNT operator if the input data set or subset is not empty.
COUNT Operator

EMPTY is equivalent to EQUAL(0).

NOTEMPTY
Sets RC=12 (or RC=8 if RC8 is specified, or RC=4 if RC4 is specified) for this
COUNT operator if the input data set or subset is not empty, or sets RC=0 for
this COUNT operator if the input data set or subset is empty.

EMPTY is equivalent to NOTEQUAL(0).

HIGHER(x)
Sets RC=12 (or RC=8 if RC8 is specified, or RC=4 if RC4 is specified) for this
COUNT operator if the record count is higher than x, or sets RC=0 for this
COUNT operator if the record count is equal to or lower than x.

x must be specified as n or +n where n can be 0 to 562949953421310.

LOWER(y)
Sets RC=12 (or RC=8 if RC8 is specified, or RC=4 if RC4 is specified) for this
COUNT operator if the record count is lower than y, or sets RC=0 for this
COUNT operator if the record count is equal to or higher than y.

y must be specified as n or +n where n can be 0 to 562949953421310.

EQUAL(v)
Sets RC=12 (or RC=8 if RC8 is specified, or RC=4 if RC4 is specified) for this
COUNT operator if the record count is equal to v, or sets RC=0 for this
COUNT operator if the record count is not equal to v.

v must be specified as n or +n where n can be 0 to 562949953421310.

NOTEQUAL(w)
Sets RC=12 (or RC=8 if RC8 is specified, or RC=4 if RC4 is specified) for this
COUNT operator if the record count is not equal to w, or sets RC=0 for this
COUNT operator if the record count is equal to w.

w must be specified as n or +n where n can be 0 to 562949953421310.

SUB(q)
Subtracts q from the record count, but does not reduce the count below 0. The
resulting modified record count is displayed in the count message in
TOOLMSG. If WRITE(countdd) is specified, the modified record count is used
in the count record. If EMPTY, NOTEMPTY, HIGHER(x), LOWER(y),
EQUAL(v) or NOTEQUAL(w) is specified, the modified record count is used
to determine if the criteria is satisfied.

SUB(q) is especially useful for getting the count of just the data records for a
data set that contains header, data and trailer records.

q must be specified as n or +n where n can be 1 to 999.

ADD(r)
Adds r to the record count. The resulting modified record count is displayed in
the count message in TOOLMSG. If WRITE(countdd) is specified, the modified
record count is used in the count record. If EMPTY, NOTEMPTY, HIGHER(x),
LOWER(y), EQUAL(v) or NOTEQUAL(w) is specified, the modified record
count is used to determine if the criteria is satisfied.

ADD(r) is especially useful for getting the count of header, data and trailer
records for a data set that just contains data records to which you want to add
header and trailer records.

r must be specified as n or +n where n can be 1 to 999.
COUNT Operator

WRITE(countdd)
Specifies the dname of the count data set to be produced by ICETOOL for this operation. A countdd DD statement must be present. ICETOOL sets the attributes of the count data set as follows:

- RECFM is set to FB.
- LRECL is set to one of the following:
  - If WIDTH(n) is specified, LRECL is set to n. Use WIDTH(n) if your count record length and LRECL must be set to a particular value (for example, 80), or if you want to ensure that the count record length does not exceed a specific maximum (for example, 20 bytes).
  - If WIDTH(n) is not specified, LRECL is set to the calculated required record length. If your LRECL does not need to be set to a particular value, you can let ICETOOL determine and set the appropriate LRECL value by not specifying WIDTH(n).
- BLKSIZE is set to one of the following:
  - The BLKSIZE from the DD statement, DSCB, or label, if it is a multiple of the LRECL used.
  - The LRECL if the BLKSIZE from the DD statement, DSCB, or label is not a multiple of the LRECL used.
  - The system determined blocksize if the BLKSIZE is not available from the DD statement, DSCB, or label.

TEXT('string')
Specifies a string to be printed starting in the first byte of the count record. The count follows the string. TEXT can only be specified if WRITE(countdd) is specified.

The string (1 to 50 characters) must be enclosed in single apostrophes. To include a single apostrophe (') in the string, specify two single apostrophes ("'). To suppress printing of a string, do not specify TEXT('string') or specify TEXT('') using two single apostrophes.

DIGITS(d)
Specifies d digits for the count in the output record, overriding the default of 15 digits. d can be 1 to 15. The count is written as d decimal digits with leading zeros. DIGITS can only be specified if WRITE(countdd) is specified.

If you know that your count requires less than 15 digits, you can use a lower number of digits (d) instead by specifying DIGITS(d). For example, if DIGITS(10) is specified, 10 digits are used instead of 15.

If you use DIGITS(d) and the count overflows the number of digits used, ICETOOL terminates the operation. You can prevent the overflow by specifying an appropriately higher d value for DIGITS(d). For example, if DIGITS(5) results in overflow, you can use DIGITS(6) instead.

EDCOUNT(formatting)
Specifies formatting items that indicate how the count in the output record is to be formatted, overriding the default of 15 digits with leading zeros. Formatting items can be specified in any order, but each item can only be specified once. EDCOUNT can only be specified if WRITE(countdd) is specified.

mask
See the discussion of mask under ON(p,m,f,formatting) in “DISPLAY Operator” on page 595.
COUNT Operator

E'pattern'
specifies an edit pattern to be applied to the count. The pattern (1 to 24 characters) must be enclosed in single apostrophes. Each 9 in the pattern (up to 15) is replaced by a corresponding digit from the count. Characters other than 9 in the pattern appear as specified. To include a single apostrophe ('') in the pattern, specify two single apostrophes ("'"). F'string' or a mask cannot be specified with E'pattern'.

When E'pattern' is specified for the count:
- If the number of significant digits in the count is less than the number of 9's in the pattern, 0's are filled in on the left. For example, 1234 is shown as 001234 with EDCOUNT(E'999999').
- If the number of significant digits in the count is greater than the number of 9's in the pattern, digits are truncated from the left. For example, 1234567 is shown as *4567* with EDCOUNT(E'*9999*').

L'string
See the discussion of L'string' under ON(p,m,f,formatting) in "DISPLAY Operator" on page 597

F'string'
See the discussion of F'string' under ON(p,m,f,formatting) in "DISPLAY Operator" on page 597

T'string'
See the discussion of T'string' under ON(p,m,f,formatting) in "DISPLAY Operator" on page 597

LZ See the discussion of LZ under ON(p,m,f,formatting) in "DISPLAY Operator" on page 597

Udd
specifies the number of digits to be used for the count. dd specifies the number of digits and must be a two-digit number between 01 and 15. The default number of digits (d) for the count is 15.

If you know that your count requires less than 15 digits, you can use a lower number of digits (dd) instead by specifying Udd. For example, if EDCOUNT(U09) is specified, 9 digits (from U09) is used instead of 15 (default for the count).

If you use Udd and the count overflows the number of digits used, ICETOOL terminates the operation. You can prevent the overflow by specifying an appropriately higher dd value for Udd. For example, if EDCOUNT(U05) results in overflow, you can use EDCOUNT(U06) instead.

If E'pattern' is specified, Udd is ignored, because d is determined from the pattern.

WIDTH(n)
Specifies the record length and LRECL you want ICETOOL to use for the count data set. n can be from 1 to 32760. WIDTH can only be specified if WRITE(countdd) is specified. ICETOOL always calculates the record length required to write the count record and uses it as follows:
- If WIDTH(n) is specified and the calculated record length is less than or equal to n, ICETOOL sets the record length and LRECL to n. ICETOOL pads the count record on the right with blanks to the record length.
- If WIDTH(n) is specified and the calculated record length is greater than n, ICETOOL issues an error message and terminates the operation.
COUNT Operator

- If WIDTH(n) is not specified, ICETOOL sets the record length and LRECL to the calculated record length.

Use WIDTH(n) if your count record length and LRECL must be set to a particular value (for example, 80), or if you want to ensure that the count record length does not exceed a specific maximum (for example, 20 bytes). Otherwise, you can let ICETOOL calculate and set the appropriate record length and LRECL by not specifying WIDTH(n).

COUNT Examples

Example 1
For this example, assume that the CTL1CNTL data set contains a DFSORT INCLUDE statement.
COUNT FROM(IN1)
COUNT FROM(IN2) USING(CTL1)

The first COUNT operator prints a message containing the count of records in the IN1 data set.

The second COUNT operator prints a message containing the count of records included from the IN2 data set.

Example 2
COUNT FROM(INPUT1) EMPTY

Sets RC=12 if INPUT1 is empty (that is, INPUT1 has no records), or sets RC=0 if INPUT1 is not empty (that is, INPUT1 has at least one record).

Example 3
For this example, assume that the CTL2CNTL data set contains a DFSORT INCLUDE statement.
COUNT FROM(INPUT2) HIGHER(50000) RC4 USING(CTL2)

Sets RC=4 if more than 50000 records are included from INPUT2, or sets RC=0 if 50000 or less records are included from INPUT2.

Example 4
COUNT FROM(IN2) WRITE(CT2) TEXT('Count is ') - EDCOUNT(A1,U10) WIDTH(80)

Prints a message containing the count of records in the IN2 data set. Writes an 80-byte record with the specified string and an edited count to the CT2 data set. If IN2 contains 3286721 records, the 80-byte output record in CT2 would look like this:
Count is 3,286,721

Example 5
COUNT FROM(IN3) WRITE(CT3) DIGITS(6) SUB(2)

Subtracts 2 from the count of records in the IN3 data set. Prints a message containing the modified count. Writes a 6-byte record with the modified count to the CT3 data set. If IN3 contains 8125 records, the 6-byte output record in CT3 would look like this:
008123
Copies one or more header records and one or more trailer records to the output data set in their original input record order, while sorting the data records between the header and trailer records, using the DFSORT control statements in xxxxCNTL. By definition, the header records are the first n records in the input data set, the trailer records are the last n records in the input data set, and the data records (also called detail records) are the records between the header and trailer records. Thus, the first n records (header records) and last n records (trailer records) are kept in place and the data records between them are sorted.

You must specify one header operand (HEADER, FIRST, HEADER(u) or FIRST(u)), one trailer operand (TRAILER, LAST, TRAILER(v) or LAST(v)), or one header operand and one trailer operand. If you specify a header operand without a trailer operand, only the header records will be kept in place. If you specify a trailer operand without a header operand, only the trailer records will be kept in place. If you specify a header operand and a trailer operand, both the header records and trailer records will be kept in place.

DFSORT is called to copy the header and trailer records and to sort the data records. DFSORT uses its E15 and E35 exits to process the records as needed. ICETOOL passes the EQUALS option to DFSORT to ensure that duplicates are kept in their original input order.

You must supply a DFSORT SORT statement in the xxxxCNTL data set to indicate the control fields for sorting the data records.

You can use additional DFSORT control statements in xxxxCNTL providing you observe these rules:

- A SORT statement must be present
- MODS and OUTREC statements should not be present.
- A STOPAFT operand should not be present.
- Comment statements can be present.
- Header and trailer records will only be affected by the SKIPREC option and OUTFIL statements. SKIPREC=n will remove the first n indd records, so the first header record will be the n+1 indd record. OUTFIL statements will process the header and trailer records in the normal way.
- Data records will be processed by INCLUDE, OMIT, INREC, SUM, OPTION and OUTFIL statements in the normal way.
DATASORT Operator

- If you use INREC to change the length of the data records, DFSORT will preserve the header and trailer records by setting the TO data set LRECL to the maximum of the input or reformatted record length. For fixed-length records, DFSORT will pad the header and trailer records, or data records, on the right with blanks as appropriate.
- You can further process the outdd records after DATASORT processing using an OUTFIL statement like this:

  OUTFIL FNAMES=outdd,.

or multiple OUTFIL statements like this:

  OUTFIL FNAMES=outdd,.
  OUTFIL FNAMES=outdd1,.

For example, with TO(OUT1) you could further modify the OUT1 records after DATASORT processing, with a statement like this:

  OUTFIL FNAMES=OUT1,REMOVECC,
  TRAILER1=('Record count ',COUNT=(M11,LENGTH=5))

ICETOOL requires extra storage for DATASORT processing, over and above what is normally needed by ICETOOL and DFSORT, in order to save your header and trailer records. The amount of storage needed depends on the number of header and trailer records you specify, and the LRECL of the FROM data set. In most cases, the needed storage can be obtained (above 16MB virtual). However, if ICETOOL cannot get the storage it needs, it issues a message and terminates the DATASORT operation. Increasing the REGION by the amount indicated in the message may allow ICETOOL to run successfully.

The DYNALLOC option is passed to DFSORT to ensure that work space is available for the sort. If your installation defaults for dynamic allocation are inappropriate for a DATASORT operator, you can take one of the following actions:

1. Override the DYNALLOC option using an OPTION control statement such as:

   OPTION DYNALLOC=(,8)

   in the xxxxCNTL data set.

2. Use xxxxWKdd DD statements to override the use of dynamic allocation. Refer to "SORTWKdd DD Statement" on page 72 for details.

Tape work data sets cannot be used with ICETOOL.

Operand Descriptions

The operands described below can be specified in any order.

FROM(indd)

See the discussion of this operand on the COPY statement in "COPY Operator" on page 568.

TO(outdd)

Specifies the ddname of the output data set to be written by DFSORT for this operation.

An outdd DD statement must be present and must define an output data set that conforms to the rules for DFSORT’s SORTOUT data set.

The ddname specified in the TO operand must not be the same as the ddname specified in the FROM operand.

Refer to "JCL Restrictions" on page 566 for more information.
DATASORT Operator

USING(xxxx)
Specifies the first 4 characters of the ddname for the control statement data set to be used by DFSORT for this operation. xxxx must be four characters that are valid in a ddname of the form xxxxCNTL. xxxx must not be SYSx.

An xxxxCNTL DD statement must be present. The xxxxCNTL data set must contain a SORT statement. Other control statements are optional, but if specified must conform to the rules for DFSORT's SORTCNTL data set, and should be used as described for "DATASORT Operator" on page 579.

HEADER or FIRST
Specifies one header record (the first record in the indd data set) is to be kept in place.

HEADER and FIRST are equivalent to HEADER(1) and FIRST(1).

HEADER(u) or FIRST(u)
Specifies u header records (the first u records in the indd data set) are to be kept in place.

u must be specified as n or +n where n can be 1 to 1000000.

TRAILER or LAST
Specifies one trailer record (the last record in the indd data set) is to be kept in place.

TRAILER and LAST are equivalent to TRAILER(1) and LAST(1).

TRAILER(v) or LAST(v)
Specifies v trailer records (the last v records in the indd data set) are to be kept in place.

v must be specified as n or +n where n can be 1 to 1000000.

VSAMTYPE(x)
See the discussion of this operand on the COPY statement in "COPY Operator" on page 569.

DATASORT Examples

Although the DATASORT operators in the examples below could all be contained in a single ICETOOL job step, they are shown and discussed separately for clarity.

Example 1
DATASORT FROM(INPUT) TO(OUTPUT) HEADER TRAILER USING(CTL1)

This example shows how you can sort the data records between a header record (first record) and a trailer record (last record).

The CTL1CNTL data set contains:

```
SORT FIELDS=(16,13,CH,A)
```

The input records look like this:

```
MM9999900510100823DDDDD FFFFF 00420806128
AAR FIRST C 113434144441 XXXXXXXXX
ATX SECOND 7777777770111 XXXXXXXXX
ATX THIRD L 6297132201111 XXXXXXXXX
ATX FOURTH 2830012906356 XXXXXXXXX
MM9999900510100823DDDDD FFFFF 004
```
We want to keep the MM records in place and sort the other records by the CH field in positions 16-28. We use HEADER and TRAILER to indicate the first and last records should not be sorted. We use the SORT statement to SORT ascending on positions 16-28.

The output records would look like this:

<table>
<thead>
<tr>
<th>MM99999005100823DDDDD</th>
<th>FFFFF 004200806128</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAR FIRST C 1143341444441</td>
<td>XXXXXXXXX</td>
</tr>
<tr>
<td>ATX FOURTH 2830612906356</td>
<td>XXXXXXXXX</td>
</tr>
<tr>
<td>ATX THIRD L 6297132201111</td>
<td>XXXXXXXXX</td>
</tr>
<tr>
<td>ATX SECOND 7777777770111</td>
<td>XXXXXXXXX</td>
</tr>
<tr>
<td>MM99999005100823DDDDD</td>
<td>FFFFF 004</td>
</tr>
</tbody>
</table>

Note that we could use FIRST and LAST instead of HEADER and TRAILER.

**Example 2**

DATASORT FROM(IN) TO(OUT) HEADER(2) TRAILER(3) USING(CTL2)

This example illustrates how you can sort the data records between header records (first records) and trailer records (last records), and modify just the data records or the header, data and trailer records.

The CTL2CNTL data set contains:

```
INREC IFTHEN=(WHEN=(24,2,CH,EQ,C'23'),
OVERLAY=(30:C'Old'))
SORT FIELDS=(1,14,CH,A)
OUTFIL FNAME=OUT,
  IFTHEN=(WHEN=(24,2,CH,EQ,C'23'),
    OVERLAY=(35:C'First'))
```

The input records look like this:

<table>
<thead>
<tr>
<th>Header 1</th>
<th>2008/04/23</th>
</tr>
</thead>
<tbody>
<tr>
<td>Header 2</td>
<td>2008/04/23</td>
</tr>
<tr>
<td>Geometry</td>
<td>2008/04/24</td>
</tr>
<tr>
<td>Algebra</td>
<td>2008/04/23</td>
</tr>
<tr>
<td>Trigonometry</td>
<td>2008/04/24</td>
</tr>
<tr>
<td>Calculus</td>
<td>2008/04/25</td>
</tr>
<tr>
<td>Geography</td>
<td>2008/04/25</td>
</tr>
<tr>
<td>History</td>
<td>2008/04/23</td>
</tr>
<tr>
<td>Trailer 1</td>
<td>2008/04/23</td>
</tr>
<tr>
<td>Trailer 2</td>
<td>2008/04/23</td>
</tr>
<tr>
<td>Trailer 3</td>
<td>2008/04/23</td>
</tr>
</tbody>
</table>

We want to keep the two Header records and the three Trailer records in place and sort the other records by the CH field in positions 1-14. We want to put 'Old' in positions 30-32 of each data record (but not the Header or Trailer records) that has '23' in positions 24-25. We want to put 'First' in positions 35-39 of each record (Header, data and Trailer) that has '23' in positions 24-25.

We use HEADER(2) and TRAILER(3) to indicate the first two records and last three records should not be sorted. We use the INREC statement to add 'Old' to data records that have '23' in positions 24-25. INREC applies to the data records, but not to the Header and Trailer records. We use the SORT statement to sort ascending on positions 1-14. We use the OUTFIL statement to add 'First' to Header, data and Trailer records that have '23' in positions 24-25. OUTFIL applies to all of the records.

The output records would look like this:
Note that we could use FIRST(2) and LAST(3) instead of HEADER(2) and TRAILER(3).

DEFAULTS Operator

DFSORT enables you to maintain separate sets of installation defaults for eight different installation environments as follows:
- JCL (ICEAM1) - batch JCL directly invoked installation environment
- INV (ICEAM2) - batch program invoked installation environment
- TSO (ICEAM3) - TSO directly invoked installation environment
- TSOINV (ICEAM4) - TSO program invoked installation environment
- TD1 (ICETD1) - first time-of-day installation environment
- TD2 (ICETD2) - second time-of-day installation environment
- TD3 (ICETD3) - third time-of-day installation environment
- TD4 (ICETD4) - fourth time-of-day installation environment

Each installation default has two or more possible values; DFSORT is shipped with a set of IBM-supplied defaults that can be modified using ICEPRMxx members of PARMLIB or the ICEMAC macro. The DEFAULTS operator provides an easy way to determine the installation default values to be used at run-time. See z/OS DFSORT Installation and Customization for a complete discussion of ICEPRMxx members in PARMLIB, the ICEMAC macro, the eight installation environments, and the installation default values.

DEFAULTS produces a three-part report showing:
1. The merged PARMLIB/ICEMAC installation default values for ICEAM1-4 and ICETD1-4 that will be used at run-time.
2. The specified PARMLIB ICEPRMxx member option values for ICEAM1-4 and ICETD1-4 (for reference).
3. The ICEMAC installation default values for ICEAM1-4 and ICETD1-4 (for reference).
The format of the report produced by DEFAULTS varies depending on the defaults selected, but the first part of the report might look like this conceptually:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>JCL (ICEAM1) VALUE</th>
<th>INV (ICEAM2) VALUE</th>
<th>TSO (ICEAM3) VALUE</th>
<th>TSOINV (ICEAM4) VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>item 1</td>
<td>value</td>
<td>value</td>
<td>value</td>
<td>value</td>
</tr>
<tr>
<td>item 2</td>
<td>value</td>
<td>value</td>
<td>value</td>
<td>value</td>
</tr>
<tr>
<td>item 3</td>
<td>value</td>
<td>value</td>
<td>value</td>
<td>value</td>
</tr>
<tr>
<td>item 4</td>
<td>value</td>
<td>value</td>
<td>value</td>
<td>value</td>
</tr>
</tbody>
</table>

The merged PARMLIB/ICEMAC default value for each item is shown as it is set for each of the eight installation environments. For any value that is different from the IBM-supplied value, the IBM-supplied value is shown below it.

The control character occupies the first byte of each record. The title and headings are always printed; p is the page number. The item name column occupies 10 bytes, each of the item value columns occupies 20 bytes, and 5 blanks appear between columns.

### Operand Descriptions

The operands described below can be specified in any order.

#### LIST(listdd)

Specifies the ddname of the list data set to be produced by ICETOOL for this operation. A listdd DD statement must be present. ICETOOL uses RECFM=FBA, LRECL=121 and the specified BLKSIZE for the list data set. If the BLKSIZE you specify is not a multiple of 121, ICETOOL uses BLKSIZE=121. If you do not specify the BLKSIZE, ICETOOL selects the block size as directed by LISTSDB or LISTNOSDB, if specified, or otherwise as directed by installation option SDBMSG from ICEAM2 or ICEAM4 (see z/OS DFSORT Installation and Customization).

Refer to "JCL Restrictions" on page 566 for more information regarding the selection of ddnames.

#### LISTSDB or LISTNOSDB

Can be used to override the SDBMSG value for this LIST data set. LISTSDB directs ICETOOL to select the system-determined optimum block size for the LIST data set in the same way as for installation option SDBMSG=YES.
LISTNOSDB directs ICETOOL to select the block size for the LIST data set in the same way as for installation option SDBMSG=NO. See the discussion of the LIST(listdd) operand above for more information on how LISTSDB or LISTNOSDB affects the LIST data set block size.

**Attention:** LISTSDB has no effect for SYSOUT data sets (for example, //RPT1 DD SYSOUT=*), because the system-determined optimum block size is not used for spool or dummy data sets.

**DEFAULTS Example**

```plaintext
DEFAULTS LIST(OPTIONS)
```

Prints, in the OPTIONS data set, the DFSORT installation defaults report. The OPTIONS output starts on a new page and might look as follows. The first few items are shown with illustrative values for ICEAM1-4 and ICETD1-4 for each of the three parts of the report.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>JCL (ICEAM1) VALUE</th>
<th>INV (ICEAM2) VALUE</th>
<th>TSO (ICEAM3) VALUE</th>
<th>TSOINV (ICEAM4) VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENABLE</td>
<td>none</td>
<td>TD1</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>ABCODE</td>
<td>MSG</td>
<td>99</td>
<td>MSG</td>
<td>99</td>
</tr>
<tr>
<td>ALTSEQ</td>
<td>SEE BELOW</td>
<td>SEE BELOW</td>
<td>SEE BELOW</td>
<td>SEE BELOW</td>
</tr>
<tr>
<td>ARESALL</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>ARESINV</td>
<td>NOT APPLICABLE</td>
<td>0</td>
<td>NOT APPLICABLE</td>
<td>0</td>
</tr>
<tr>
<td>CFW</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>CHALT</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>CHECK</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>CINV</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### IECOPT Command in Effect: START IECOPT,ICEOPT=(03)

**Z/OS DFSORT V1R10 PARMLIB ICEPRMXX MEMBER OPTIONS**

**JCL (ICEAM1) OPTIONS**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>VALUE</th>
<th>MEMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESALL</td>
<td>40000</td>
<td>ICEPRM03</td>
</tr>
<tr>
<td>CHALT</td>
<td>YES</td>
<td>ICEPRM03</td>
</tr>
</tbody>
</table>

**INV (ICEAM2) OPTIONS**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>VALUE</th>
<th>MEMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESINV</td>
<td>40000</td>
<td>ICEPRM03</td>
</tr>
<tr>
<td>CHALT</td>
<td>YES</td>
<td>ICEPRM03</td>
</tr>
</tbody>
</table>

**TSO (ICEAM3) OPTIONS**

**TSOINV (ICEAM4) OPTIONS**

**TD1 (ICETD1) OPTIONS**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>VALUE</th>
<th>MEMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHALT</td>
<td>YES</td>
<td>ICEPRM03</td>
</tr>
</tbody>
</table>

**TD2 (ICETD2) OPTIONS**

**TD3 (ICETD3) OPTIONS**

**TD4 (ICETD4) OPTIONS**
The title and appropriate heading lines appear at the top of each page. The specified and IBM-supplied ALTSEQ tables are printed separately after the other items.

**DISPLAY Operator**
Prints the values or characters of specified numeric fields (including SMF, TOD, and ETOD date and time) or character fields in a separate list data set. Simple, tailored, and sectioned reports can be produced. From 1 to 50 fields can be specified, but the resulting list data set line length must not exceed the limit specified by the WIDTH operand or 8192 bytes if LONGLINE is specified and WIDTH is not specified, or 2048 bytes if LONGLINE and WIDTH are not specified. The record number can be printed as a special field.
DISPLAY Operator

DFSORT is called to copy the indd data set to ICETOOL’s E35 user exit. ICETOOL uses its E35 user exit to print appropriate titles, headings and data in the list data set.

You must not supply your own DFSORT MODS, INREC, or OUTREC statement, because they would override the DFSORT statements passed by ICETOOL for this operator.

Specifying formatting items or the PLUS or BLANK operand, which can “compress” the columns of output data, can enable you to include more fields in your report, up to a maximum of 50, if your line length is limited by the character width your printer or display supports.

Simple Report

You can produce a simple report by specifying just the required operands. For example, if you specify FROM and LIST operands, and ON operands for 10-byte character and 7-byte zoned decimal fields, the output in the list data set can be represented as follows:

```
(p,m,f) (p,m,f)
characters sdddddddddddddd
```

A control character occupies the first byte of each list data set record. Left-justified standard headings are printed at the top of each page to indicate the contents of each column, followed by a line for each record showing the characters and numbers in the fields of that record.

The fields are printed in columns in the same order in which they are specified in the DISPLAY statement. All fields are left-justified. For numeric fields, leading zeros are printed, a - is used for the minus sign, and a + is used for the plus sign.

By default, the first column of data starts immediately after the control character, and three blanks appear between columns. The NOCC operand can be used to suppress the control character. The INDENT operand can be used to change the number of blanks before the first column of data. The BETWEEN operand can be used to change the number of blanks between columns.

The standard column widths are as follows:

- Character data: the length of the character field, or 20 bytes if the field length is less than 21 bytes
- Numeric data: 16 bytes, or 32 bytes if the numeric field is BI or FI with a length greater than 4, PD with a length greater than 8, ZD, CSF, FS, UFF or SFF with a length greater than 15, or FL.
- Record number: 15 bytes

HEADER operands can be used to change or suppress the headings. Formatting items or the PLUS or BLANK operand can be used to change the appearance of numeric fields in the report. PLUS, BLANK, and HEADER operands can be used to change the width of the columns for numeric and character fields and the justification of headings and fields.
DISPLAY Operator

The NOHEADER operand can be used to create list data sets containing only data records. Data sets created in this way can be processed further by other operators (for example, STATS or UNIQUE) using CH format for character values or FS format for numeric values.

The TOTAL, MAXIMUM, MINIMUM, and AVERAGE operands can be used to print statistics for numeric fields after the columns of data. Formatting items can be used to suppress the statistics for selected numeric fields. The COUNT operand can be used to print the record count after the columns of data.

Tailored Report

You can tailor the output in the list data set using various operands that control title strings, date, time, page number, headings, lines per page, field formats, total, maximum, minimum, and average values for the columns of numeric data, and the record count. The optional operands can be used in many different combinations to produce a wide variety of report formats. For example, if you specify FROM, LIST, BLANK, TITLE, PAGE, DATE, TIME, HEADER and AVERAGE operands, and ON operands for 10-byte character and 7-byte zoned decimal fields, the output in the list data set can be represented as follows:

<table>
<thead>
<tr>
<th>title</th>
<th>- p -</th>
<th>mm/dd/yy</th>
<th>hh:mm:ss</th>
</tr>
</thead>
<tbody>
<tr>
<td>header</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>-------</td>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td>characters</td>
<td>sd</td>
<td></td>
<td></td>
</tr>
<tr>
<td>.</td>
<td>.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>.</td>
<td>.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>average</td>
<td>sd</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

By default, a control character occupies the first byte of each list data set record. The NOCC operand can be used to suppress the control characters. The title lines (up to 3) are printed at the top of each page of the list data set. The first title line contains the elements you specify (title strings, page number, date and time) in the order in which you specify them. The second and third title lines contain the title strings you specify. By default, eight blanks appear between title elements, the title strings are centered with respect to each other, and the title lines appear on every page. The TBETWEEN(n) operand can be used to change the number of blanks between title elements. The TLEFT operand can be used to left-justify the title strings with respect to each other. The TFIRST operand can be used to only print the title lines on the first page. A blank line is printed after each title line.

Your specified headings (underlined) are printed after the title line on each page to indicate the contents of each column, followed by a line for each record showing the characters and numbers in the fields of that record. Your specified headings can be one, two or three lines. Headings for character fields are left-justified and headings for numeric fields are right-justified.

Your specified statistical lines (total, maximum, minimum, average, and count, and their associated strings) are printed for selected numeric fields and the record count, after the columns of data. The associated strings can be printed in the first column or to the left of it.

The fields are printed in columns in the same order in which they are specified in the DISPLAY statement. Character fields are left-justified and numeric fields are right-justified. For numeric fields, leading zeros are suppressed, a − is used for the
DISPLAY Operator

minus sign, and a blank is used for the plus sign (you can specify PLUS rather than BLANK if you want a + to be used for the plus sign).

Formatting items can be used to change the appearance of individual numeric fields in the report with respect to separators, number of digits, decimal point, decimal places, signs, leading zeros, division by 10, 100, 1000, 10000, 100000, 1000000, 1024, 1048576 (1024*1024), or 1073741824 (1024*1024*1024), leading strings, floating strings, and trailing strings. Formatting items can also be used to insert leading or trailing strings for character fields.

The column widths are dynamically adjusted according to the length of the headings and the maximum number of bytes needed for the character or numeric data.

Sectioned Report

You can produce a sectioned report (simple or tailored) by including a BREAK operand to indicate the break field used to divide the report into sections. Each set of sequential input records (which you have previously sorted on the break field and other fields, as appropriate), with the same value for the specified break field, results in a corresponding set of data lines that is treated as a section in the report.

The break field is printed at the beginning of each section. Formatting items can be used to change the appearance of numeric break fields, and to insert a string before or after character or numeric break fields.

Optional break operands can be used to modify the break title for each section (the break value is always printed as part of the break title) and to print statistics for selected numeric fields and the count, in each section. For example, if you add BTITLE, BREAK, BCOUNT, BMAXIMUM, and BMINIMUM to the operands for the tailored report discussed above, each section of the output in the list data set starts on a new page and can be represented as follows:

```
title - p - mm/dd/yy hh:mm:ss
btitle bvalue
header header
---------- --------
characters sd
... ... ...
bcount d
bmaximum sd
bminimum sd
```

The final page showing the overall statistics starts on a new page and can be represented as follows:

```
title - p - mm/dd/yy hh:mm:ss
header header
---------- --------
average sd
```
### Operand Descriptions

The operands described below can be specified in any order.

**FROM**(indd)

Specifies the ddname of the input data set to be read by DFSORT for this operation. An indd DD statement must be present and must define an input data set that conforms to the rules for DFSORT’s SORTIN data set. In addition, the LRECL of the data set must be at least 4.

**ON**(p,m,f)

Specifies the position, length, and format of a numeric or character field to be used for this operation. ‘(p,m,f)’ is used for the standard column heading (see `HEADER('string1'), HEADER('string1','string2'), HEADER('string1','string2','string3'), HEADER(NONE) and NOHEADER for alternative heading options).

By default, three blanks appear between columns. You can change the space between columns with `BETWEEN(n)`.

- **p** specifies the first byte of the field relative to the beginning of the input record. `p` is 1 for the first data byte of a fixed-length record and 5 for the first data byte of a variable-length record as illustrated below (RRRR represents the 4-byte record descriptor word):

<table>
<thead>
<tr>
<th>Fixed-length record</th>
<th>Variable-length record</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>A</td>
</tr>
<tr>
<td>p= 1 2 3 4</td>
<td>p= 1 2 3 4 5 6 7 8</td>
</tr>
</tbody>
</table>

- **m** specifies the length of the field in bytes. A field must not extend beyond position 32752 or beyond the end of a record. The maximum length for a field depends on its format.

- **f** specifies the format of the field as shown below.

<table>
<thead>
<tr>
<th>Format Code</th>
<th>Length</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BI</td>
<td>1 to 8 bytes</td>
<td>Unsigned binary</td>
</tr>
<tr>
<td>FI</td>
<td>1 to 8 bytes</td>
<td>Signed fixed-point</td>
</tr>
<tr>
<td>PD</td>
<td>1 to 16 bytes</td>
<td>Signed packed decimal</td>
</tr>
<tr>
<td>ZD</td>
<td>1 to 31 bytes</td>
<td>Signed zoned decimal</td>
</tr>
<tr>
<td>FL</td>
<td>4 or 8 bytes</td>
<td>Signed hexadecimal floating-point converted to signed integer</td>
</tr>
<tr>
<td>CH</td>
<td>1 to 4000 bytes</td>
<td>Character</td>
</tr>
<tr>
<td>CSF or FS</td>
<td>1 to 32 bytes (31 digit limit)</td>
<td>Signed numeric with optional leading floating sign</td>
</tr>
<tr>
<td>UFF</td>
<td>1 to 44 bytes (31 digit limit)</td>
<td>Unsigned free form numeric</td>
</tr>
<tr>
<td>SFF</td>
<td>1 to 44 bytes (31 digit limit)</td>
<td>Signed free form numeric</td>
</tr>
<tr>
<td>DT1</td>
<td>4 bytes</td>
<td>SMF date interpreted as Z’yyyymmdd’</td>
</tr>
<tr>
<td>DT2</td>
<td>4 bytes</td>
<td>SMF date interpreted as Z’yyyyymm’</td>
</tr>
<tr>
<td>DT3</td>
<td>4 bytes</td>
<td>SMF date interpreted as Z’yyyyyddd’</td>
</tr>
</tbody>
</table>
## DISPLAY Operator

<table>
<thead>
<tr>
<th>Format Code</th>
<th>Length</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC1</td>
<td>8 bytes</td>
<td>TOD date interpreted as Z'yyyyMMdd'</td>
</tr>
<tr>
<td>DC2</td>
<td>8 bytes</td>
<td>TOD date interpreted as Z'yyyymm'</td>
</tr>
<tr>
<td>DC3</td>
<td>8 bytes</td>
<td>TOD date interpreted as Z'yyyydd'</td>
</tr>
<tr>
<td>DE1</td>
<td>8 bytes</td>
<td>ETOD date interpreted as Z'yyyyMMdd'</td>
</tr>
<tr>
<td>DE2</td>
<td>8 bytes</td>
<td>ETOD date interpreted as Z'yyyymm'</td>
</tr>
<tr>
<td>DE3</td>
<td>8 bytes</td>
<td>ETOD date interpreted as Z'yyyydd'</td>
</tr>
<tr>
<td>TM1</td>
<td>4 bytes</td>
<td>SMF time interpreted as Z'hhmmss'</td>
</tr>
<tr>
<td>TM2</td>
<td>4 bytes</td>
<td>SMF time interpreted as Z'hhmm'</td>
</tr>
<tr>
<td>TM3</td>
<td>4 bytes</td>
<td>SMF time interpreted as Z'hh'</td>
</tr>
<tr>
<td>TM4</td>
<td>4 bytes</td>
<td>SMF time interpreted as Z'hhmmssxx'</td>
</tr>
<tr>
<td>TC1</td>
<td>8 bytes</td>
<td>TOD time interpreted as Z'hhmmssxx'</td>
</tr>
<tr>
<td>TC2</td>
<td>8 bytes</td>
<td>TOD time interpreted as Z'hhmm'</td>
</tr>
<tr>
<td>TC3</td>
<td>8 bytes</td>
<td>TOD time interpreted as Z'hh'</td>
</tr>
<tr>
<td>TC4</td>
<td>8 bytes</td>
<td>TOD time interpreted as Z'hhmmssxx'</td>
</tr>
<tr>
<td>TE1</td>
<td>8 bytes</td>
<td>ETOD time interpreted as Z'hhmmssxx'</td>
</tr>
<tr>
<td>TE2</td>
<td>8 bytes</td>
<td>ETOD time interpreted as Z'hhmm'</td>
</tr>
<tr>
<td>TE3</td>
<td>8 bytes</td>
<td>ETOD time interpreted as Z'hh'</td>
</tr>
<tr>
<td>TE4</td>
<td>8 bytes</td>
<td>ETOD time interpreted as Z'hhmmssxx'</td>
</tr>
</tbody>
</table>

**Note:** See [Appendix C, “Data Format Descriptions,” on page 885](#) for detailed format descriptions.

For a CSF, FS, UFF, or SFF format field:
- A maximum of 31 digits is allowed. If a value with more than 31 digits is found, ICETOOL issues an error message and terminates the operation.

For a ZD or PD format field:
- If a decimal value contains an invalid digit (A-F), ICETOOL identifies the bad value in a message and prints asterisks for that value, and for the total, maximum, minimum and average (if specified) for that field, in the list data set. If the number of bad values reaches the LIMIT for invalid decimal values,
ICETOOL terminates the operation. If the LIMIT operand is not specified, a default of 200 is used for the invalid decimal value limit.

- A value is treated as positive if its sign is F, E, C, A, 8, 6, 4, 2, or 0.
- A value is treated as negative if its sign is D, B, 9, 7, 5, 3, or 1.

For an FL format field:
- The normalized or unnormalized FL (hexadecimal floating-point) value is converted to a signed integer in the range -9223372036854775808 to 9223372036854775807. The fractional part of the FL value is lost, and in some cases the signed integer may be one of a number of possible signed integers for the FL value depending on its precision. Converted values less than -9223372036854775808 are set to -9223372036854775808. Converted values greater than 9223372036854775807 are set to 9223372036854775807.
- If you are not running in z/Architecture mode, specifying an FL format field results in an error message and termination.

For a DT1, DT2 or DT3 format field:
- An invalid SMF date can result in a data exception (0C7 ABEND) or an incorrect ZD date.
- SMF date values are always treated as positive.

For a DC1, DC2, DC3, DE1, DE2, or DE3 format field:
- TOD and ETOD date values are always treated as positive.

For a TM1, TM2, TM3 or TM4 format field:
- An invalid SMF time can result in an incorrect ZD time.
- SMF time values are always treated as positive.

For a TC1, TC2, TC3, TC4, TE1, TE2, TE3, or TE4 format field:
- TOD and ETOD time values are always treated as positive.

**ON(p,m,f,formatting)**

Specifies the position, length, and format of a numeric or character field to be used for this operation and how the data for this field is to be formatted for printing. The BLANK operand is automatically in effect.

See ON(p,m,f) for further details.

**formatting**
DISPLAY Operator

specifies formatting items that indicate how the data for this field is to be formatted for printing. Formatting items can be specified in any order, but each item can only be specified once. Any formatting item can be specified for a numeric field, but only L’string’ and T’string’ can be specified for a character field.

The column width is dynamically adjusted to accommodate the maximum bytes to be inserted as a result of all formatting items specified.

mask
specifies an edit mask to be applied to the numeric data for this field.
Thirty-nine pre-defined edit masks are available, encompassing many of the numeric notations throughout the world with respect to separators, decimal point, decimal places, signs, and so forth. ICETOOL edits the data according to the selected mask. If other formatting items are specified but mask is not, the default mask of A0 is applied to the data.

E’pattern’ cannot be specified with a mask.

The attributes of each group of masks is shown below.

Table 73. Attributes of Edit Masks

<table>
<thead>
<tr>
<th>Masks</th>
<th>Separators</th>
<th>Decimal Places</th>
<th>Positive Sign</th>
<th>Negative Sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>No</td>
<td>0</td>
<td>blank</td>
<td>-</td>
</tr>
<tr>
<td>A1-A5</td>
<td>Yes</td>
<td>0</td>
<td>blank</td>
<td>-</td>
</tr>
<tr>
<td>B1-B6</td>
<td>Yes</td>
<td>1</td>
<td>blank</td>
<td>-</td>
</tr>
<tr>
<td>C1-C6</td>
<td>Yes</td>
<td>2</td>
<td>blank</td>
<td>-</td>
</tr>
<tr>
<td>D1-D6</td>
<td>Yes</td>
<td>3</td>
<td>blank</td>
<td>-</td>
</tr>
<tr>
<td>E1-E4</td>
<td>Yes</td>
<td>0</td>
<td>blank</td>
<td>( )</td>
</tr>
<tr>
<td>F1-F5</td>
<td>Yes</td>
<td>2</td>
<td>blank</td>
<td>( )</td>
</tr>
<tr>
<td>G1-G6</td>
<td>Yes</td>
<td>4</td>
<td>blank</td>
<td>-</td>
</tr>
</tbody>
</table>

The table below describes the available masks and shows how the values 12345678 and -1234567 would be printed for each mask. In the pattern:

- d is used to represent a decimal digit (0-9)
- w is used to represent a leading sign that will be blank for a positive value or – for a negative value
- x is used to represent a trailing sign that will be blank for a positive value or – for a negative value
- y is used to represent a leading sign that will be blank for a positive value or ( for a negative value
- z is used to represent a trailing sign that will be blank for a positive value or ) for a negative value

Table 74. Edit Mask Patterns

<table>
<thead>
<tr>
<th>Mask</th>
<th>Pattern</th>
<th>12345678</th>
<th>-1234567</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>wddddddddddddd</td>
<td>12345678</td>
<td>-1234567</td>
</tr>
<tr>
<td>A1</td>
<td>wd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd</td>
<td>12,345,678</td>
<td>-1,234,567</td>
</tr>
<tr>
<td>A2</td>
<td>wd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd</td>
<td>12,345,678</td>
<td>-1,234,567</td>
</tr>
<tr>
<td>A3</td>
<td>wd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd</td>
<td>12,345,678</td>
<td>-1,234,567</td>
</tr>
<tr>
<td>A4</td>
<td>wd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd</td>
<td>12,345,678</td>
<td>-1,234,567</td>
</tr>
</tbody>
</table>
### DISPLAY Operator

**Table 74. Edit Mask Patterns (continued)**

<table>
<thead>
<tr>
<th>Mask</th>
<th>Pattern</th>
<th>12345678</th>
<th>-1234567</th>
</tr>
</thead>
<tbody>
<tr>
<td>A5</td>
<td>d ddd ddd ddd ddd ddd ddd ddd ddd ddd ddd dx</td>
<td>12 345 678</td>
<td>1 234 567-</td>
</tr>
<tr>
<td>B1</td>
<td>wddd ddd ddd ddd ddd ddd ddd ddd ddd ddd ddd d d</td>
<td>1,234,567,8</td>
<td>-13,456,7</td>
</tr>
<tr>
<td>B2</td>
<td>wddd ddd ddd ddd ddd ddd ddd ddd ddd ddd ddd d d</td>
<td>1,234,567,8</td>
<td>-13,456,7</td>
</tr>
<tr>
<td>B3</td>
<td>wddd ddd ddd ddd ddd ddd ddd ddd ddd ddd ddd d d</td>
<td>1 234 567,8</td>
<td>-123 456,7</td>
</tr>
<tr>
<td>B4</td>
<td>wddd ddd ddd ddd ddd ddd ddd ddd ddd ddd ddd d d</td>
<td>123,456,7,8</td>
<td>-1234,566,7</td>
</tr>
<tr>
<td>B5</td>
<td>wddd ddd ddd ddd ddd ddd ddd ddd ddd ddd ddd d d</td>
<td>123,456,7,8</td>
<td>-1234,566,7</td>
</tr>
<tr>
<td>B6</td>
<td>ddd ddd ddd ddd ddd ddd ddd ddd ddd ddd ddd dx</td>
<td>1 234 567,8</td>
<td>12 345,67-</td>
</tr>
<tr>
<td>C1</td>
<td>wdd ddd ddd ddd ddd ddd ddd ddd ddd ddd ddd d d</td>
<td>123,456,78</td>
<td>-123 456,7</td>
</tr>
<tr>
<td>C2</td>
<td>wdd ddd ddd ddd ddd ddd ddd ddd ddd ddd ddd d d</td>
<td>123,456,78</td>
<td>-123 456,7</td>
</tr>
<tr>
<td>C3</td>
<td>wdd ddd ddd ddd ddd ddd ddd ddd ddd ddd ddd d d</td>
<td>123,456,78</td>
<td>-123 456,7</td>
</tr>
<tr>
<td>C4</td>
<td>wdd ddd ddd ddd ddd ddd ddd ddd ddd ddd ddd d d</td>
<td>123,456,78</td>
<td>-123 456,7</td>
</tr>
<tr>
<td>C5</td>
<td>wdd ddd ddd ddd ddd ddd ddd ddd ddd ddd ddd d d</td>
<td>123,456,78</td>
<td>-123 456,7</td>
</tr>
<tr>
<td>C6</td>
<td>d ddd ddd ddd ddd d dd ddd ddd ddd ddd dx</td>
<td>12 345,678</td>
<td>12 345,67-</td>
</tr>
<tr>
<td>D1</td>
<td>wdd ddd ddd ddd ddd ddd ddd ddd ddd ddd ddd d d</td>
<td>12,345,678</td>
<td>-1,234,567</td>
</tr>
<tr>
<td>D2</td>
<td>wdd ddd ddd ddd ddd ddd ddd ddd ddd ddd ddd d d</td>
<td>12,345,678</td>
<td>-1,234,567</td>
</tr>
<tr>
<td>D3</td>
<td>wdd ddd ddd ddd ddd ddd ddd ddd ddd ddd ddd d d</td>
<td>12 345,678</td>
<td>-123 456,7</td>
</tr>
<tr>
<td>D4</td>
<td>wdd ddd ddd ddd ddd ddd ddd ddd ddd ddd ddd d d</td>
<td>12 345,678</td>
<td>-123 456,7</td>
</tr>
<tr>
<td>D5</td>
<td>wdd ddd ddd ddd ddd ddd ddd ddd ddd ddd ddd d d</td>
<td>12 345,678</td>
<td>-123 456,7</td>
</tr>
<tr>
<td>D6</td>
<td>d ddd ddd ddd ddd ddd ddd ddd ddd ddd ddd dx</td>
<td>12 345,678</td>
<td>1 234 567-</td>
</tr>
<tr>
<td>E1</td>
<td>yd ddd ddd ddd ddd ddd ddd ddd ddd ddd ddd d d</td>
<td>12,345,678</td>
<td>(1,234,567)</td>
</tr>
<tr>
<td>E2</td>
<td>yd ddd ddd ddd ddd ddd ddd ddd ddd ddd ddd d d</td>
<td>12,345,678</td>
<td>(1,234,567)</td>
</tr>
<tr>
<td>E3</td>
<td>yd ddd ddd ddd ddd ddd ddd ddd ddd ddd ddd d d</td>
<td>12 345,678</td>
<td>(123 456,7)</td>
</tr>
<tr>
<td>E4</td>
<td>yd ddd ddd ddd ddd ddd ddd ddd ddd ddd ddd d d</td>
<td>12'345,678</td>
<td>(12'345,67)</td>
</tr>
<tr>
<td>F1</td>
<td>yd ddd ddd ddd ddd ddd ddd ddd ddd ddd ddd d d</td>
<td>123,456,78</td>
<td>(123,456,7)</td>
</tr>
<tr>
<td>F2</td>
<td>yd ddd ddd ddd ddd ddd ddd ddd ddd ddd ddd d d</td>
<td>123,456,78</td>
<td>(123,456,7)</td>
</tr>
<tr>
<td>F3</td>
<td>yd ddd ddd ddd ddd ddd ddd ddd ddd ddd ddd d d</td>
<td>123 456,78</td>
<td>(123 456,7)</td>
</tr>
<tr>
<td>F4</td>
<td>yd ddd ddd ddd ddd ddd ddd ddd ddd ddd ddd d d</td>
<td>123'456,78</td>
<td>(123'456,7)</td>
</tr>
<tr>
<td>F5</td>
<td>yd ddd ddd ddd ddd ddd ddd ddd ddd ddd ddd d d</td>
<td>123'456,78</td>
<td>(123'456,7)</td>
</tr>
<tr>
<td>G1</td>
<td>wddd ddd ddd ddd ddd ddd ddd ddd ddd ddd d dd</td>
<td>1,234,5678</td>
<td>-1234567</td>
</tr>
<tr>
<td>G2</td>
<td>wddd ddd ddd ddd ddd ddd ddd ddd ddd ddd d dd</td>
<td>1,234,5678</td>
<td>-1234567</td>
</tr>
<tr>
<td>G3</td>
<td>wddd ddd ddd ddd ddd ddd ddd ddd ddd ddd d dd</td>
<td>1 234,5678</td>
<td>-1234567</td>
</tr>
<tr>
<td>G4</td>
<td>wddd ddd ddd ddd ddd ddd ddd ddd ddd ddd d dd</td>
<td>1'234,5678</td>
<td>-1234567</td>
</tr>
<tr>
<td>G5</td>
<td>wddd ddd ddd ddd ddd ddd ddd ddd ddd ddd d dd</td>
<td>1'234,5678</td>
<td>-1234567</td>
</tr>
<tr>
<td>G6</td>
<td>ddd ddd ddd ddd ddd ddd ddd ddd ddd ddd ddd dx</td>
<td>1 234,5678</td>
<td>1234567-</td>
</tr>
</tbody>
</table>

If LZ is specified, leading zeros are printed. For example, +1 is shown as 0,000.01 with ON(21,6,FS,C1,LZ).

If LZ is not specified, leading zeros are suppressed except when inappropriate. For example, +1 is shown as 1 with ON(21,6,FS,A1) and as 0.01 with ON(21,6,FS,C1).
The leading sign (blank for a positive value or − for a negative value) appears to the left of the first non-suppressed digit of the formatted value. For example, −1 is shown as −1 with ON(21,6,FS,A2), as −000.001 with ON(21,6,FS,A2,LZ) and as −0.01 with ON(21,6,FS,C2).

**E'pattern'**

specifies an edit pattern to be applied to the numeric data for this field. **E’pattern’** is useful for formatting **unsigned** numeric data such as telephone numbers, dates, time-of-day, social security numbers, and so on. For example, 0123456789 is shown as (012)-345-6789 with ON(21,10,ZD,E’999-9999’).

The pattern (1 to 44 characters) must be enclosed in single apostrophes. Each 9 in the pattern (up to 31) is replaced by a corresponding digit from the numeric value. Characters other than 9 in the pattern appear as specified. To include a single apostrophe (’) in the pattern, specify two single apostrophes (’’).

F’string’ or a mask cannot be specified with E’pattern’.

When E’pattern’ is specified for a field:

- Values are shown unsigned. For example, +120622 and −120622 are both shown as 12:06:22 with ON(12,7,FS,E’99:99:99’).
- If the number of significant digits in a value is less than the number of 9’s in the pattern, 0’s are filled in on the left. For example, 1234 is shown as 0012-34 with ON(12,6,FS,E’9999-99’).
- If the number of significant digits in a value is greater than the number of 9’s in the pattern, digits are truncated from the left. For example, 1234567 is shown as *45:67* with ON(9,4,PD,E’*99:99*’).

**L’string’**

specifies a leading string to appear at the beginning of the character or numeric data column for this field. For example, 'DFSORT ' is shown as **```DFSORT '** with ON(1,8,CH,L’```’).

The string (1 to 10 characters) must be enclosed in single apostrophes. To include a single apostrophe (’) in the string, specify two single apostrophes (’’).

**F'string’**

specifies a floating string to appear to the left of the first non-blank character of the formatted numeric data for this field. For example, 0001234 is shown as $12.34 with ON(9,7,ZD,C1,F$’).

The string (1 to 10 characters) must be enclosed in single apostrophes. To include a single apostrophe (’) in the string, specify two single apostrophes (’’).

E’pattern’ cannot be specified with F’string’.

**T’string’**

specifies a trailing string to appear at the end of the character or numeric data column for this field. For example, 'DFSORT ' is shown as ```DFSORT ***' with ON(1,8,CH,L'```',T'***').

The string (1 to 10 characters) must be enclosed in single apostrophes. To include a single apostrophe (’) in the string, specify two single apostrophes (’’).

**LZ**

specifies that leading zeros are to be printed when the specified edit mask is applied to the numeric data for this field, overriding the default of suppressing leading zeros. For example, +123 is shown as 123 with ON(21,6,FS,A0), but as 000123 with ON(21,6,FS,A0,LZ).

LZ is useful for formatting numeric data, such as account numbers, for which leading zeros must be printed.
Leading zeros are always printed for E’pattern’ regardless of whether or not LZ is specified.

**NOST**

specifies that requested statistics (TOTAL, MAXIMUM, MINIMUM, AVERAGE, BTOTAL, BMAXIMUM, BMINIMUM, BVERAGE) are **not** to be printed for this numeric field.

**Ndd or Udd**

specifies the number of digits to be used for the numeric field. Ndd or Udd can be used to change the column width for numeric fields, and to prevent overflow for totals. dd specifies the number of digits and must be a **two-digit** number between 01 and 31.

The default number of digits (d) for a numeric field is the maximum number of digits for that field. For example, d is 5 for ON(1,5,ZD). If you know that your numeric field requires less than d digits, you can use a lower number of digits (dd) instead by specifying Udd, thus reducing the column width if it is determined by d. For example, ON(1,5,ZD,U03) reduces d from 5 to 3. If you want your numeric field to be displayed with more than d digits, you can use a higher number of digits (dd) instead by specifying Ndd or Udd, thus increasing the column width if it is determined by d. For example, ON(1,5,ZD,U10) increases d from 5 to 10.

The default number of digits (d) for a total is 15 if the numeric field is BI or FI with a length up to 4, PD with a length up to 8, or ZD, CSF, FS, UFF or SFF with a length up to 15. The default number of digits (d) for a total is 31 if the numeric field is BI or FI with a length greater than 4, PD with a length greater than 8, or ZD, CSF, FS, UFF or SFF with a length greater than 15.

If you know that your total requires less than d digits, you can use a lower number of digits (dd) instead by specifying Ndd or Udd for the ON field, thus reducing the column width if it is determined by d. For example, ON(1,18,ZD,U18) with TOTAL reduces d from 31 to 18. If you know that your total can overflow d digits, you can use a higher number of digits (dd) instead by specifying Ndd or Udd, thus preventing overflow and increasing the column width if it is determined by d. For example, ON(1,15,ZD,U17) with TOTAL increases d from 15 to 17.

Either Ndd or Udd can be used to set d greater than the maximum for a numeric field, but only Udd can be used to set d less than the maximum for a numeric field.

**For Udd:**

dd is used for d. For example:

If TOTAL and BTOTAL are not used:
- If ON(1,5,ZD) is specified, 5 digits (default for 5,ZD) are used.
- If ON(1,5,ZD,U10) is specified, 10 digits (from U10) are used.
- If ON(1,5,ZD,U03) is specified, 3 digits (from U03) are used.
- If ON(1,16,FS) is specified, 16 digits (default for 16,FS) are used.
- If ON(1,16,FS,U16) is specified, 16 digits (from U16) are used.
- If ON(1,16,FS,U15) is specified, 15 digits (from U15) are used.

If TOTAL or BTOTAL is used:
- If ON(1,5,ZD) is specified, 15 digits (default for TOTAL or BTOTAL and 5,ZD) are used.
- If ON(1,5,ZD,U10) is specified, 10 digits (from U10) are used.
- If ON(1,5,ZD,U03) is specified, 3 digits (from U03) are used.
DISPLAY Operator

- If ON(1,16,FS) is specified, 31 digits (default for TOTAL or BTOTAL and 16,FS) are used.
- If ON(1,16,FS,U16) is specified, 16 digits (from U16) are used.
- If ON(1,16,FS,U15) is specified, 15 digits (from U15) are used.

If you use Udd and a numeric value or total overflows dd digits, ICETOOL prints asterisks for that numeric value or total and terminates the operation. You can prevent the overflow by specifying an appropriately higher dd value for Udd. For example, if ON(1,12,ZD,U09) results in overflow, you can use ON(1,12,ZD,U10) instead.

If E'pattern' is specified, Udd is ignored, because d is determined from the pattern.

For Ndd:

If dd is greater than or equal d, dd is used. If dd is less than d, d is used. For example:

- If TOTAL and BTOTAL are not used:
  - If ON(1,5,ZD) is specified, 5 digits (default for 5,ZD) are used.
  - If ON(1,5,ZD,N10) is specified, 10 digits (from N10) are used.
  - If ON(1,5,ZD,N03) is specified, 5 digits (from 5,ZD) are used

- If TOTAL or BTOTAL is used:
  - If ON(1,5,ZD) is specified, 15 digits (default for TOTAL or BTOTAL and 5,ZD) are used.
  - If ON(1,5,ZD,N10) is specified, 10 digits (from N10) are used.
  - If ON(1,5,ZD,N03) is specified, 5 digits (from 5,ZD) are used.

If you use Ndd and a total overflows dd digits, ICETOOL prints asterisks for the total and terminates the operation. You can prevent the overflow by specifying an appropriately higher dd value for Ndd. For example, if ON(1,17,ZD,N17) with TOTAL results in overflow, you can use ON(1,17,ZD,N18) instead.

If E'pattern' is specified, Ndd is ignored, because d is determined from the pattern.

/x specifies division of the numeric data for this field before formatting. x indicates the division factor to be used as described below. The resulting values are rounded down to the nearest integer. Statistics (TOTAL, MAXIMUM, MINIMUM, AVERAGE, BTOTAL, BMAXIMUM, BMINIMUM, BVERAGE) and column widths reflect the divided numbers.

/D specifies division by 10 before formatting. For example, −1234 is shown as −123 with ON(11,2,FI,/D).

/C specifies division by 100 before formatting. For example, 12345 is shown as 12.3 with ON(11,2,BI,/C,B1).

/K specifies division by 1000 before formatting. For example, −1234567890 is shown as (1 234 567) with ON(1,11,FS,/K,E3).

/DK specifies division by 10000 (10*1000) before formatting. For example, 6213849653 is shown as 6-213-84 with ON(31,10,FS,/DK,E'9-9999-99').

/CK specifies division by 100000 (100*1000) before formatting. For example, 1234567890123456789012345 is shown as 1,234,567,890,123,456,7890 with ON(21,25,ZD,G1,/CK).

/M specifies division by 1000000 (1000*1000) before formatting. For example, −123456789 is shown as −1.23 with ON(31,10,FS,/M,C4).
DISPLAY Operator

/G specifies division by 1000000000 (1000*1000*1000) before formatting.
For example, 1234567898765 is shown as 1'234 with
ON(15,13,ZD,A4,/G).

/KB specifies division by 1024 before formatting. For example, 1234567890
is shown as 1 205 632 with ON(45,10,ZD,/KB,A3).

/MB specifies division by 1048576 (1024*1024) before formatting. For
example, 123456789 is shown as 117 with ON(60,9,FS,/MB).

/GB specifies division by 1073741824 (1024*1024*1024) before formatting.
For example, 1234567898765 is shown as 1,149 with
ON(15,13,ZD,/GB,A1).

ON(p,m,HEX)
Specifies the position and length of a character field to be used for this
operation and printed in hexadecimal format (00-FF for each byte). 'p,m,HEX'
is used for the standard column heading. See HEADER('string1'),
HEADER('string1','string2'), HEADER('string1','string2','string3'),
HEADER(NONE), and NOHEADER for alternative heading options.
See ON(p,m,f) for a discussion of p.

m specifies the length of the field in bytes. A field must not extend beyond
position 32752 or beyond the end of a record. A field can be 1 to 2000 bytes.

ON(VLEN)
Equivalent to specifying ON(1,2,BI); a two-byte binary field starting at position
1. For variable-length records, ON(VLEN) represents the record-length for each
record. ' RECORD LENGTH' is used for the standard column heading. See
HEADER('string1'), HEADER('string1','string2'),
HEADER('string1','string2','string3'), HEADER(NONE), and NOHEADER for
alternative heading options.

ON(VLEN,formatting)
Equivalent to specifying ON(1,2,BI,formatting); a two-byte binary field starting
at position 1, and how the data for this field is to be formatted for printing.
The BLANK operand is automatically in effect.

See ON(VLEN) for further details.

formatting

\[
\begin{array}{c}
\text{mask}
\end{array}
\]
\[
\begin{array}{c}
E'\text{pattern}'
\end{array}
\]
\[
\begin{array}{c}
L'\text{string}'
\end{array}
\]
\[
\begin{array}{c}
F'\text{string}'
\end{array}
\]
\[
\begin{array}{c}
T'\text{string}'
\end{array}
\]
\[
\begin{array}{c}
LZ
\end{array}
\]
\[
\begin{array}{c}
\text{NOST}
\end{array}
\]
\[
\begin{array}{c}
\text{Ndd}
\end{array}
\]
\[
\begin{array}{c}
\text{Udd}
\end{array}
\]
\[
\begin{array}{c}
/\times
\end{array}
\]

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specifies formatting items that indicate how the data for this field is to be formatted for printing. Formatting items can be specified in any order, but each item can only be specified once.

The column width is dynamically adjusted to accommodate the maximum bytes to be inserted as a result of all formatting items specified.

See ON(p,m,f,formatting) for a discussion of formatting.

ON(NUM)

Specifies that the record number is to be printed. The record number starts at 1 and is incremented by 1 for each record printed in the list data set. 'RECORD NUMBER' is used for the standard column heading. See HEADER('string1'), HEADER('string1','string2'), HEADER('string1','string2','string3'), HEADER(NONE), and NOHEADER for alternative heading options.

ON(NUM,formatting)

Specifies that the record number is to be printed, and how the record number is to be formatted for printing. The BLANK operand is automatically in effect.

See ON(NUM) for further details.

formatting

specifies formatting items that indicate how the record number is to be formatted for printing. Formatting items can be specified in any order, but each item can only be specified once.

The column width is dynamically adjusted to accommodate the maximum bytes to be inserted as a result of all formatting items specified.

mask

See ON(p,m,f,formatting) for a discussion of mask.

E'pattern'

specifies an edit pattern to be applied to the record number. The pattern (1 to 24 characters) must be enclosed in single apostrophes. Each 9 in the pattern (up to 15) is replaced by a corresponding digit from the numeric value. Characters other than 9 in the pattern appear as specified. To include a single apostrophe (') in the pattern, specify two single apostrophes ('').

F'string' or a mask cannot be specified with E'pattern'.

When E'pattern' is specified for the record number:

- If the number of significant digits in a record number is less than the number of 9's in the pattern, 0's are filled in on the left. For example, 1234 is shown as 001234 with ON(NUM,E'999999').
• If the number of significant digits in a record number is greater than the number of 9's in the pattern, digits are truncated from the left. For example, 1234567 is shown as *4567* with ON(NUM,E‘*9999*’).

L'string'
See ON(p,m,f,formatting) for a discussion of L'string'.

F'string'
See ON(p,m,f,formatting) for a discussion of F'string'.

T'string'
See ON(p,m,f,formatting) for a discussion of T'string'.

LZ
See ON(p,m,f,formatting) for a discussion of LZ.

Ndd or Udd
Specifies the number of digits to be used for the record number when determining the column width. dd specifies the number of digits and must be a two-digit number between 01 and 15.

The default number of digits (d) for the record number is 15. If you know that your record numbers require less than 15 digits, you can use a lower number of digits (dd) instead by specifying Ndd or Udd thus reducing the column width if it is determined by d. For example, if ON(NUM,N09) or ON(NUM,U09) is specified, 9 digits (from N09 or U09) is used instead of 15 (default for record number).

If you use Ndd or Udd and the number of records overflows the number of digits used, ICETOOL terminates the operation. You can prevent the overflow by specifying an appropriately higher dd value for Ndd or Udd. For example, if ON(NUM,N05) results in overflow, you can use ON(NUM,N06) instead.

If E'pattern' is specified, Ndd or Udd is ignored, because d is determined from the pattern.

LIST(listdd)
Specifies the ddname of the list data set to be produced by ICETOOL for this operation. A listdd DD statement must be present. ICETOOL sets the attributes of the list data set as follows:

• If NOCC is not specified, RECFM is set to FBA. If NOCC is specified, RECFM is set to FB.
• LRECL is set to one of the following:
  – If WIDTH(n) is specified, LRECL is set to n. Use WIDTH(n) if your LRECL must be set to a particular value (for example, if you use DISP=MOD to place several reports in the same data set).
  – If WIDTH(n) is not specified and NOCC is not specified, LRECL is set to 121 or to the calculated required line length if it is greater than 121 characters.
  – If WIDTH(n) is not specified and NOCC is specified, LRECL is set to 120 or to the calculated required line length if it is greater than 120 characters.

If your LRECL does not need to be set to a particular value, you can let ICETOOL determine and set the appropriate LRECL value by not specifying WIDTH(n).

• BLKSIZE is set to one of the following:
  – The BLKSIZE from the DD statement, DSCB, or label, if it is a multiple of the LRECL used.
DISPLAY Operator

- The LRECL if the BLKSIZE from the DD statement, DSCB, or label is not a multiple of the LRECL used.
- The block size as directed by LISTSDB or LISTNOSDB if specified, or otherwise as directed by the SDBMSG installation option from ICEAM2 or ICEAM4 (see z/OS DFSORT Installation and Customization), if the BLKSIZE is not available from the DD statement, DSCB, or label.

Refer to “JCL Restrictions” on page 566 for more information regarding the selection of ddnames.

TITLE('string')

Specifies printing of a title string in a title line. The title string is of the form:

string

Up to three TITLE operands can be specified.

The first TITLE operand, if specified, supplies a string for the first title line. Other title elements (PAGE for page number, DATE, DATE(abcd), DATENS(abcd), YDDD(abcd) or YDDDNS(ab) for the date, and TIME, TIME(abcd) or TIMENS(ab) for the time) can also be specified for the first title line with or without a title string.

The second TITLE operand, if specified, specifies a string for the second title line. The third TITLE operand, if specified, specifies a string for the third title line.

If you specify any title elements (title string, page number, date or time), the first title line is printed at the top of each page of the list data set. It contains the title elements you specify in the order in which you specify them. By default, eight blanks appear between title elements on the first title line. You can change the space between title elements on the first title line with TBETWEEN(n). A blank line is printed after the first title line.

If you specify a second TITLE operand, the second title line containing the specified title string is printed after the first title line. A blank line is printed after the second title line. If you specify a third TITLE operand, the third title line containing the specified title string is printed after the second title line. A blank line is printed after the third title line.

By default, the title strings in the title lines are centered with respect to each other. TLEFT can be used to left-justify the title string in the title lines with respect to each other.

By default, the title lines are printed on every page. TFIRST can be used to only print the title lines on the first page.

The string (1 to 50 characters) must be enclosed in single apostrophes. To include a single apostrophe (') in the string, specify two single apostrophes ("'). Blanks at the start of the string move the text to the right. Blanks at the end of the string increase the spacing between the string and the next title element.

TITLE('string1','string2')

Specifies printing of a two part title string in a title line. The title string is of the form:

string1string2
Note: string1 and string2 can be any combination of inline constants, DFSORT symbol constants, and DFSORT symbol constants for system information (for example, S'&Sysname'). See TITLE('string') for additional information on title lines.

Each string (1 to 50 characters) must be enclosed in single apostrophes. The total combined length of string1 and string2 can be up to 50 characters. To include a single apostrophe (') in a string, specify two single apostrophes ("'). Blanks at the start of a string move the text to the right. Blanks at the end of string1 increase the spacing between string1 and string2. Blanks at the end of string2 increase the spacing between string2 and the next title element.

TITLE('string1','string2','string3')
Specifies printing of a three part title string in a title line. The title string is of the form:

string1string2string3

Note: string1, string2 and string3 can be any combination of inline constants, DFSORT symbol constants, and DFSORT symbol constants for system information (for example, S'&Sysname'). See TITLE('string') for additional information on title lines.

Each string (1 to 50 characters) must be enclosed in single apostrophes. The total combined length of string1, string2 and string3 can be up to 50 characters. To include a single apostrophe (') in a string, specify two single apostrophes ("'). Blanks at the start of a string move the text to the right. Blanks at the end of string1 increase the spacing between string1 and string2. Blanks at the end of string2 increase the spacing between string2 and string3. Blanks at the end of string3 increase the spacing between string3 and the next title element.

TLEFT Specifies that the title strings in each title line are to be left justified with respect to each other (overriding the default of centering the title strings with respect to each other). See TITLE('string') for additional information on title lines.

TFIRST Specifies that the title lines are only to appear on the first page of the report (overriding the default of having the title lines appear on every page of the report). See TITLE('string') for additional information on title lines.

PAGE Specifies printing of the page number in the first title line. The page number is printed in the form - p - where p is in decimal with no leading zeros. The page number is 1 for the first page and is incremented by 1 for each subsequent page. See TITLE('string') for additional information on the first title line.

DATE Specifies printing of the date in the first title line. The date is printed in the form mm/dd/yy where mm is the month, dd is the day, and yy is the year. DATE is equivalent to specifying DATE(MDY/). See TITLE('string') for additional information on the first title line.

DATE(abcd) Specifies printing of the date in the first title line. The date is printed in the form 'adbdc' according to the specified values for abc and d. For example, on March 29, 2002, DATE(4MD-) would produce '2002-03-29'
and DATE(MDY.) would produce '03.29.02'. See TITLE('string') for additional information on the first title line.

abc can be any combination of M, D, and Y or 4 (each specified once) where M represents the month (01-12), D represents the day (01-31), Y represents the last two digits of the year (for example, 02), and 4 represents the four digits of the year (for example, 2002).

d can be any character and is used to separate the month, day, and year.

**DATENS(abc)**

Specifies printing of the date in the first title line. The date is printed in the form 'abc' according to the specified values for abc. For example, on March 29, 2002, DATENS(4MD) would produce '20020329' and DATENS(MDY) would produce '032902'. See TITLE('string') for additional information on the first title line.

abc can be any combination of M, D, and Y or 4 (each specified once) where M represents the month (01-12), D represents the day (01-31), Y represents the last two digits of the year (for example, 02), and 4 represents the four digits of the year (for example, 2002).

**YDDD(abc)**

specifies printing of the date in the first title line. The date is printed in the form 'acb' according to the specified values for ab and c. For example, on April 7, 2004, YDDD(DY-) would produce '098-04' and YDDD(4D/) would produce '2004/098'. See TITLE('string') for additional information on the first title line.

ab can be any combination of D, and Y or 4 (each specified once) where D represents the day of the year (001-366), Y represents the last two digits of the year (for example, 04), and 4 represents the four digits of the year (for example, 2004).

c can be any character and is used to separate the month, day and year.

**YDDDNS(ab)**

specifies printing of the date in the first title line. The date is printed in the form 'ab' according to the specified values for ab. For example, on April 7, 2004, YDDDNS(DY) would produce '09804' and YDDD(4D) would produce '2004098'. See TITLE('string') for additional information on the first title line.

ab can be any combination of D, and Y or 4 (each specified once) where D represents the day of the year (001-366), Y represents the last two digits of the year (for example, 04), and 4 represents the four digits of the year (for example, 2004).

**TIME**

Specifies printing of the time in the first title line. The time is printed in the form hh:mm:ss where hh is hours, mm is minutes and ss is seconds. TIME is equivalent to specifying TIME(24:). See TITLE('string') for additional information on the first title line.

**TIME(abc)**

Specifies printing of the time in the first title line. The time is printed in the form 'hhcmmcss xx' according to the specified value for ab and c. For example, at 08:25:13 pm, TIME=(24:) would produce '20:25:13' and TIME=(12,) would produce '08.25.13 pm'. See TITLE('string') for additional information on the first title line.
**DISPLAY Operator**

ab can be:

- 12 to indicate 12-hour time. hh (hours) is 01-12, mm (minutes) is 00-59, ss (seconds) is 00-59 and xx is am or pm.
- 24 to indicate 24-hour time. hh (hours) is 00-23, mm (minutes) is 00-59, ss (seconds) is 00-59 and xx is not included.

c can be any character and is used to separate the hours, minutes, and seconds.

**TIMENS(ab)**

Specifies printing of the time in the first title line. The time is printed in the form 'hhmmss xx' according to the specified value for ab. For example, at 08:25:13 pm, TIMENS=(24) would produce '202513' and TIMENS=(12) would produce '082513 pm'. See TITLE('string') for additional information on the first title line.

ab can be:

- 12 to indicate 12-hour time. hh (hours) is 01-12, mm (minutes) is 00-59, ss (seconds) is 00-59 and xx is am or pm.
- 24 to indicate 24-hour time. hh (hours) is 00-23, mm (minutes) is 00-59, ss (seconds) is 00-59 and xx is not included.

**BLANK**

Specifies an alternate format for printing character and numeric data as follows:

- Numeric values for which formatting is not specified are printed with blank for plus sign, – for minus sign and no leading zeros (overriding the default of + for plus sign and leading zeros).

  Numeric values are thus displayed as:
  
  - d...d for positive values (blank sign immediately to the left of the digits and no leading zeros)
  - –d...d for negative values (– sign immediately to the left of the digits and no leading zeros)

- Column widths are dynamically adjusted according to the length of the headings and the maximum number of bytes needed for the character or numeric data

- Headings and data for numeric fields are right-justified (overriding the default of left-justified headings and data for numeric fields)

**PLUS**

Specifies an alternate format for printing character and numeric data as follows:

- Numeric values for which formatting is not specified are printed with + for plus sign, – for minus sign and no leading zeros (overriding the default of leading zeros).

  Numeric values are thus displayed as:

  - +d...d for positive values (– sign immediately to the left of the digits and no leading zeros)
  - –d...d for negative values (– sign immediately to the left of the digits and no leading zeros)

- Column widths are dynamically adjusted according to the length of the headings and the maximum number of bytes needed for the character or numeric data

- Headings and data for numeric fields are right-justified (overriding the default of left-justified headings and data for numeric fields)

For ON(NUM), PLUS is treated as BLANK.
NOCC  Specifies that carriage control characters are not to be included in the lines of the list data set (overriding the default of using a carriage control character as the first byte of each line). A blank line is used instead of a page eject control character to separate elements of the report (such as sections).

The RECFM of the list data set is set to FB.

The LRECL of the list data set will not include a byte for the carriage control character. If the line length is less than or equal to 120 bytes, the LRECL will be set to 120. If the line length is greater than 120 bytes, the LRECL will be set to the line length. The maximum line length is 2047 bytes if LONGLINE is not specified, or 8191 bytes if LONGLINE is specified.

If WIDTH(n) is specified, n can be 121 to 8191.

HEADER('string1')
Specifies a heading to be printed for the corresponding ON field. The specified string is used instead of the standard column heading for the corresponding ON field. (ON fields and HEADER operands correspond one-for-one according to the order in which they are specified; that is, the first HEADER operand corresponds to the first ON field, the second HEADER operand corresponds to the second ON field, and so on.)

The string (1 to 50 characters) must be enclosed in single apostrophes. To include a single apostrophe (') in the string, specify two single apostrophes ('). If the string length is greater than the column width for the corresponding ON field, the column width is increased to the string length.

The heading is left-justified for character fields or right-justified for numeric fields and is underlined with hyphens for the entire column width (overriding the default of left-justified, non-underlined headings). Character values are left-justified and numeric values are right-justified (overriding the default of left-justified field values).

A null string ("") or blank string (" ") may be used to set string1 to blanks.

Blanks at the start or end of a heading string may alter the justification of the heading or the width of the column.

If HEADER('string1') is used for any ON field, HEADER('string1'), HEADER('string1','string2'), HEADER('string1','string2','string3'), or HEADER(NONE) must be used for each ON field.

HEADER('string1','string2')
Specifies a heading to be printed for the corresponding ON field. A two-line heading is used with string1 on line1 and string2 on line2. A null string ("") or blank string (" ") may be used to set string1 or string2 to blanks. A comma (,) may also be used to set string1 to blanks. For example, HEADER('string1') results in blanks for this heading in line1 and string1 for this heading in line2.

If HEADER('string1','string2') is used for any ON field, HEADER('string1'), HEADER('string1','string2'), HEADER('string1','string2','string3') or HEADER(NONE) must be used for each ON field.
If a HEADER('string1','string2') operand is specified, a two-line heading is also used for any HEADER('string1') operands you specify, with string1 for that heading on line1 and blanks for that heading on line2. HEADER('string1') can be used to put blanks for that heading on line1 and string1 for that heading on line2.

See HEADER('string1') for more details on the HEADER operand.

**HEADER('string1','string2','string3')**

Specifies a heading to be printed for the corresponding ON field. A three-line heading is used with string1 on line1, string2 on line2 and string3 on line3. A null string (""") or blank string ("") may be used to set string1, string2 or string3 to blanks. A comma (,) may also be used to set string1 or string2 to blanks. For example, HEADER('string1') results in blanks for this heading in line1 and line2 and string1 for this heading in line3.

If HEADER('string1','string2','string3') is used for any ON field, HEADER('string1'), HEADER('string1','string2'), HEADER('string1','string2','string3') or HEADER(NONE) must be used for each ON field.

If a HEADER('string1','string2','string3') operand is specified:
- a three-line heading is also used for any HEADER('string1') operands you specify, with string1 for that heading on line1 and blanks for that heading on line2 and line3. HEADER('','string1') can be used to put blanks for that heading on line1 and line2 and string1 for that heading on line3.
- a three-line heading is also used for any HEADER('string1','string2') operands you specify, with string1 for that heading on line1, string2 for that heading on line2 and blanks for that heading on line3. HEADER('string1','string2') can be used to put blanks for that heading on line1, string1 for that heading on line2 and string2 for that heading on line3.

See HEADER('string1') for more details on the HEADER operand.

**HEADER(NONE)**

Specifies that a heading is not to be printed for the corresponding ON field. The standard column heading for the corresponding ON field is suppressed.

If HEADER(NONE) is used for any ON field, HEADER('string1'), HEADER('string1','string2'), HEADER('string1','string2','string3'), or HEADER(NONE) must be used for each ON field. Specifying HEADER(NONE) for every ON field is equivalent to specifying NOHEADER.

**NOHEADER**

Specifies that headings for ON fields are not to be printed (overriding the default of printing standard headings for ON fields).

If NOHEADER is used, it must be specified only once and HEADER('string1'), HEADER('string1','string2'), HEADER('string1','string2','string3'), and HEADER(NONE) must not be used.

If NOHEADER is specified without any TITLE, DATE, TIME, or PAGE operands, the resulting list data set contains only data records. Data
sets created in this way can be processed further by other operators (for example, STATS or UNIQUE) using CH for character values or FS for numeric values.

**LINES(n)**
Specifies the number of lines per page for the list data set (overriding the default of 58). n must be greater than 9, but less than 1000.

**INDENT(n)**
Specifies the number of blanks to be used to indent the report (overriding the default of 0). n can be from 0 to 50. For example, if INDENT(n) is not specified, the report starts in column 2 (after the control character), whereas if INDENT(10) is specified, the report starts in column 12 (after the control character and 10 blanks).

**BETWEEN(n)**
Specifies the number of blanks to be used between the columns of data (overriding the default of 3). n can be from 0 to 50. For example, if BETWEEN(n) is not specified, three blanks appear between columns, whereas if BETWEEN(7) is specified, seven blanks appear between columns.

**TBETWEEN(n)**
Specifies the number of blanks to be used between title elements (title strings, page number, date and time) in the first title line (overriding the default of 8). n can be from 0 to 50. For example, if TBETWEEN(n) is not specified, eight blanks appear between the title strings and page number in the first title line, whereas if TBETWEEN(4) is specified, four blanks appear between the title strings and page number in the first title line.

**TOTAL('string')**
Specifies an overall TOTAL line is to be printed after the rows of data for the report. The specified string is printed starting at the indent column of the overall TOTAL line, followed by the overall total for each numeric data column. If STATLEFT is specified, the string is printed to the left of the first column of data with the totals on the same line as the string. If STATLEFT is not specified, the string is printed in the first column of data with the totals on the same line as the string, or on the next line, as appropriate. A blank line is printed before the overall TOTAL line.

The string (1 to 50 characters) must be enclosed in single apostrophes. To include a single apostrophe (') in the string, specify two single apostrophes ("'). To suppress printing of a string, specify TOTAL("") using two single apostrophes.

The overall total for each numeric ON field is printed in the format (formatting, PLUS, BLANK, or standard) you specify. The total for a specific numeric field is suppressed if the NOST formatting item is specified for that field. Totals are printed for ON(VLEN) fields, but not for ON(NUM) fields.

The default number of digits (d) for a total is 15 if the ON field is BI or FI with a length up to 4, PD with a length up to 8, or ZD, CSF, FS, UFF or SFF with a length up to 15. The default number of digits (d) for a total is 31 if the ON field is BI or FI with a length greater than 4, PD with a length greater than 8, ZD, CSF, FS, UFF or SFF with a length greater than 15, or FL. By default, column widths are adjusted to allow for a maximum of a sign and d digits for the totals. If the overall total
for an ON field overflows $d$ digits, ICETOOL prints asterisks for the overall total for that field and terminates the operation.

You can use the Ndd or Udd formatting item to decrease or increase the number of digits used for a total. If you use Ndd or Udd and the overall total for an ON field overflows $dd$ digits, ICETOOL prints asterisks for the overall total for that field and terminates the operation.

You can prevent overflow by specifying an appropriate $dd$ value for Ndd or Udd. For example, if ON(1,15,ZD) with TOTAL overflows the default of 15 digits, you can specify ON(1,15,ZD,U16) to prevent overflow. If ON(1,15,ZD,U16) still results in overflow, you can specify ON(1,15,ZD,U17), and so on.

Either Ndd or Udd can be used to set the number of digits greater than the maximum for a numeric field, but only Udd can be used to set the number of digits less than the maximum for a numeric field.

See the discussion of Ndd or Udd under ON(p,m,f,formatting) for more details on using Ndd or Udd with TOTAL.

The TOTAL, MAXIMUM, MINIMUM, AVERAGE, and COUNT lines are printed in the order in which you specify them.

**MAXIMUM('string')**

Specifies an overall MAXIMUM line is to be printed after the rows of data for the report. The specified string is printed starting at the indent column of the overall MAXIMUM line, followed by the overall maximum for each numeric data column. If STATLEFT is specified, the string is printed to the left of the first column of data with the maximums on the same line as the string. If STATLEFT is not specified, the string is printed in the first column of data with the maximums on the same line as the string, or on the next line, as appropriate. A blank line is printed before the overall MAXIMUM line.

The string (1 to 50 characters) must be enclosed in single apostrophes. To include a single apostrophe ('') in the string, specify two single apostrophes ("'). To suppress printing of a string, specify MAXIMUM("") using two single apostrophes.

The overall maximum for each numeric ON field is printed in the format (formatting, PLUS, BLANK, or standard) you specify. The maximum for a specific numeric field is suppressed if the NOST formatting item is specified for that field. Maximums are printed for ON(VLEN) fields, but not for ON(NUM) fields.

The TOTAL, MAXIMUM, MINIMUM, AVERAGE, and COUNT lines are printed in the order in which you specify them.

**MINIMUM('string')**

Specifies an overall MINIMUM line is to be printed after the rows of data for the report. The specified string is printed starting at the indent column of the overall MINIMUM line, followed by the overall minimum for each numeric data column. If STATLEFT is specified, the string is printed to the left of the first column of data with the minimums on the same line as the string. If STATLEFT is not specified, the string is printed in the first column of data with the minimums on the same line as the string, or on the next line, as appropriate. A blank line is printed before the overall MINIMUM line.
DISPLAY Operator

The string (1 to 50 characters) must be enclosed in single apostrophes. To include a single apostrophe (') in the string, specify two single apostrophes ("'"). To suppress printing of a string, specify MINIMUM("") using two single apostrophes.

The overall minimum for each numeric ON field is printed in the format (formatting, PLUS, BLANK, or standard) you specify. The minimum for a specific numeric field is suppressed if the NOST formatting item is specified for that field. Minimums are printed for ON(VLEN) fields, but not for ON(NUM) fields.

The TOTAL, MAXIMUM, MINIMUM, AVERAGE, and COUNT lines are printed in the order in which you specify them.

AVERAGE('string')

Specifies an overall AVERAGE line is to be printed after the rows of data for the report. The specified string is printed starting at the indent column of the overall AVERAGE line, followed by the overall average for each numeric data column. If STATLEFT is specified, the string is printed to the left of the first column of data with the averages on the same line as the string. If STATLEFT is not specified, the string is printed in the first column of data with the averages on the same line as the string, or on the next line, as appropriate. A blank line is printed before the overall AVERAGE line.

The overall average (or mean) is calculated by dividing the overall total by the number of values in the report and rounding down to the nearest integer (examples: 23 / 5 = 4, −23 / 5 = −4).

The string (1 to 50 characters) must be enclosed in single apostrophes. To include a single apostrophe (') in the string, specify two single apostrophes ("'"). To suppress printing of a string, specify AVERAGE("") using two single apostrophes.

The overall average for each numeric ON field is printed in the format (formatting, PLUS, BLANK, or standard) you specify. The average for a specific numeric field is suppressed if the NOST formatting item is specified for that field. Averages are printed for ON(VLEN) fields, but not for ON(NUM) fields.

You can use the Ndd or Udd formatting item to decrease or increase the number of digits used for a total. If the overall total for an ON field overflows d digits, ICETOOL prints asterisks for the overall average for that field and terminates the operation. You can prevent overflow by specifying an appropriate dd value for Ndd or Udd. For example, if ON(1,15,ZD) with AVERAGE overflows the default of 15 digits for the total, you can specify ON(1,15,ZD,U16) to prevent overflow.

See the discussion of Ndd or Udd under ON(p,m,f,formatting) for more details on using Ndd or Udd.

The TOTAL, MAXIMUM, MINIMUM, AVERAGE, and COUNT lines are printed in the order in which you specify them.

COUNT('string')

Specifies an overall COUNT line is to be printed after the rows of data for the report. The specified string is printed starting at the indent column of the overall COUNT line, followed by the overall count of data records. If STATLEFT is specified, the string is printed to the left of the first column of data. If STATLEFT is not specified, the string is
DISPLAY Operator

printed in the first column of data. The count is printed on the same line as the string. A blank line is printed before the overall COUNT line.

The string (1 to 50 characters) must be enclosed in single apostrophes. To include a single apostrophe (’) in the string, specify two single apostrophes (’’). To suppress printing of a string, specify COUNT(””) using two single apostrophes.

The count is printed in the format (PLUS, BLANK, or standard) you specify. EDCOUNT(formatting) can be used to apply formatting items to the count. The default number of digits (d) for the count is 15.

The TOTAL, MAXIMUM, MINIMUM, AVERAGE, and COUNT lines are printed in the order in which you specify them.

EDCOUNT(formatting)
Specifies how the overall count is to be formatted for printing. Formatting items can be specified in any order, but each item can only be specified once. EDCOUNT can only be specified if COUNT('string') is specified.

mask
See ON(p,m,f,formatting) for a discussion of mask.

E'pattern'
specifies an edit pattern to be applied to the count. The pattern (1 to 24 characters) must be enclosed in single apostrophes. Each 9 in the pattern (up to 15) is replaced by a corresponding digit from the count. Characters other than 9 in the pattern appear as specified. To include a single apostrophe (’) in the pattern, specify two single apostrophes (’’). F'string' or a mask cannot be specified with E'pattern'.

When E'pattern' is specified for the count:
• If the number of significant digits in the count is less than the number of 9's in the pattern, 0's are filled in on the left. For example, 1234 is shown as 001234 with EDCOUNT(E'999999').
• If the number of significant digits in the count is greater than the number of 9's in the pattern, digits are truncated from the left. For example, 1234567 is shown as *4567* with EDCOUNT(E'*9999*').

L'string'
See ON(p,m,f,formatting) for a discussion of L'string'.

F'string'
See ON(p,m,f,formatting) for a discussion of F'string'.

T'string'
See ON(p,m,f,formatting) for a discussion of T'string'.

LZ See ON(p,m,f,formatting) for a discussion of LZ.

Udd specifies the number of digits to be used for the count. dd specifies the number of digits and must be a two-digit number between 01 and 15. The default number of digits (d) for the count is 15.

If you know that your count requires less than 15 digits, you can use a lower number of digits (dd) instead by specifying Udd. For
DISPLAY Operator

Example, if EDCOUNT(U09) is specified, 9 digits (from U09) is used instead of 15 (default for the count).

If you use Udd and the count overflows the number of digits used, ICETOOL terminates the operation. You can prevent the overflow by specifying an appropriately higher dd value for Udd. For example, if EDCOUNT(U05) results in overflow, you can use EDCOUNT(U06) instead.

If E‘pattern’ is specified, Udd is ignored, because d is determined from the pattern.

**LIMIT(n)**

Specifies a limit for the number of invalid decimal values (overriding the default of 200). If n invalid decimal values are found, ICETOOL terminates the operation. n can be 1 to 15 decimal digits, but must be greater than 0.

**VSAMTYPE(x)**

See the discussion of this operand on the COPY statement in "COPY Operator" on page 568.

**WIDTH(n)**

Specifies the line length and LRECL you want ICETOOL to use for your list data set. If NOCC is not specified, n can be from 121 to 8192.

If NOCC is specified, n can be from 121 to 8191.

ICETOOL always calculates the line length required to print all titles, headings, data, and statistics and uses it as follows:

- If WIDTH(n) is specified and the calculated line length is less than or equal to n, ICETOOL sets the line length and LRECL to n.
- If WIDTH(n) is specified and the calculated line length is greater than n, ICETOOL issues an error message and terminates the operation.
- If WIDTH(n) is not specified, NOCC is not specified, and the calculated line length is less than or equal to 121, ICETOOL sets the line length and LRECL to 121.
- If WIDTH(n) is not specified, NOCC is specified, and the calculated line length is less than or equal to 120, ICETOOL sets the line length and LRECL to 120.
- If WIDTH(n) is not specified, NOCC is specified, and the calculated line length is between 121 and 2047, or between 121 and 8191 if LONGLINE is specified, ICETOOL sets the line length and LRECL to the calculated line length.
- If WIDTH(n) is not specified, NOCC is specified, and the calculated line length is between 122 and 2048, or between 122 and 8192 if LONGLINE is specified, ICETOOL sets the line length and LRECL to the calculated line length.
- If WIDTH(n) is not specified, NOCC is not specified, and the calculated line length is greater than 2048, or greater than 8192 if LONGLINE is specified, ICETOOL issues an error message and terminates the operation.
- If WIDTH(n) is not specified, NOCC is specified, and the calculated line length is greater than 2047, or greater than 8191 if LONGLINE is specified, ICETOOL issues an error message and terminates the operation.
DISPLAY Operator

Use WIDTH(n) if your LRECL must be set to a particular value (for example, if you use DISP=MOD to place several reports in the same data set) or if you want to ensure that the line length for your report does not exceed a specific maximum (for example, 133 bytes). Otherwise, you can let ICETOOL calculate and set the appropriate line length and LRECL by not specifying WIDTH(n).

LONGLINE
Specifies the calculated line length can be a maximum of 8191 bytes if NOCC is specified, or a maximum of 8192 bytes if NOCC is not specified (overriding the defaults of 2047 bytes if NOCC is specified or 2048 bytes if NOCC is specified). Use LONGLINE if you do not specify WIDTH(n) and your calculated line length is larger than the default.

BREAK(p,m,f)
Specifies a numeric or character break field to be used to divide the report into sections. Each set of sequential input records, with the same value for the specified break field, results in a corresponding set of data lines that is treated as a section in the report. The DISPLAY operator should be preceded by a SORT operator (or another application) that sorts the break field and any other appropriate fields in the desired sequence for the report.

Each section starts on a new page. Each page of a section includes a break title line showing the break value for the section. Numeric break values are printed with blank for plus sign, – for minus sign, and no leading zeros. BTITLE can be used to specify a string to appear in the break title line. The break value and break title string appear in the order in which you specify BREAK and BTITLE. Two blanks appear between break title elements. A blank line is printed after the break title line.

BTOTAL, BMAXIMUM, BMINIMUM, BVERAGE, and BCOUNT can be used to produce break statistics for each numeric ON field and for the break count-for example, the maximum of the values in the section for ON(5,3,ZD) and the maximum of the values in the section for ON(22,2,BI). The break statistics for each section are printed at the end of the section (on one or more pages that include the break title). TOTAL, MAXIMUM, MINIMUM, AVERAGE, and COUNT can be used to produce overall statistics for each numeric ON field and for the overall count-for example, the maximum of the values in the report for ON(5,3,ZD) and the maximum of the values in the report for ON(22,2,BI). The overall statistics for each section are printed at the end of the report (on a separate page that does not include the break title).

See ON(p,m,f) for a discussion of p and m.

f specifies the format of the field as shown for ON(p,m,f).

Note: An FL (hexadecimal floating-point) field can be specified for ON, but not for BREAK.

For a CSF, FS, UFF, or SFF format break field:
- A maximum of 31 digits is allowed. If a value with more than 31 digits is found, ICETOOL issues an error message and terminates the operation.

For a ZD or PD format break field:
If a decimal value with an invalid digit (A-F) is found, ICETOOL issues an error message and terminates the operation.

- A value is treated as positive if its sign is F, E, C, A, 8, 6, 4, 2, or 0.
- A value is treated as negative if its sign is D, B, 9, 7, 5, 3, or 1.

For a DT1, DT2 or DT3 format field:
- An invalid SMF date can result in a data exception (0C7 ABEND) or an incorrect ZD date.
- SMF date values are always treated as positive.

For a DC1, DC2, DC3, DE1, DE2, or DE3 format field:
- TOD and ETOD date values are always treated as positive.

For a TM1, TM2, TM3 or TM4 format field:
- An invalid SMF time can result in an incorrect ZD time.
- SMF time values are always treated as positive.

For a TC1, TC2, TC3, TC4, TE1, TE2, TE3, or TE4 format field:
- TOD and ETOD time values are always treated as positive.

**BREAK(p,m,f,formatting)**

Specifies a numeric or character break field to be used to divide the report into sections, and how the data for this field is to be formatted for printing.

See **BREAK(p,m,f)** for further details.

**formatting**

```
mask
E'pattern'
L'string'
F'string'
T'string'
LZ
Udd
```

specifies formatting items that indicate how the record number is to be formatted for printing. Formatting items can be specified in any order, but each item can only be specified once. Any formatting item can be specified for a numeric break field, but only L'string' and T'string' can be specified for a character break field.

**mask** See ON(p,m,f,formatting) for a discussion of mask.

**E'pattern'**

See ON(p,m,f,formatting) for a discussion of E'pattern'.

**L'string'**

See ON(p,m,f,formatting) for a discussion of L'string'.

**F'string'**

See ON(p,m,f,formatting) for a discussion of F'string'.
DISPLAY Operator

T'string'
See ON(p,m,f,formatting) for a discussion of T'string'.

LZ
See ON(p,m,f,formatting) for a discussion of LZ.

Udd
specifies the number of digits to be used for a numeric break field. Udd can be used to change the column width for numeric break fields. dd specifies the number of digits and must be a two-digit number between 01 and 31.

The default number of digits (d) for a numeric break field is the maximum number of digits for that field. For example, d is 8 for BREAK(1,8,ZD). If you know that your break field requires less than d digits, you can use a lower number of digits (dd) instead by specifying Udd, thus reducing the break field width. For example, BREAK(1,8,ZD,U06) reduces d from 8 to 6. If you want your break field to be displayed with more than d digits, you can use a higher number of digits (dd) instead by specifying Udd, thus increasing the field width. For example, BREAK(1,8,ZD,U11) increases d from 8 to 11.

BTITLE('string')
Specifies a string to appear in the break title line printed for each page of a section. BTITLE can only be specified if BREAK is specified. The break value and break title string appear in the order in which you specify BREAK and BTITLE. Two blanks appear between break title elements. A blank line is printed after the break title line.

The string (1 to 50 characters) must be enclosed in single apostrophes. To include a single apostrophe (') in the string, specify two single apostrophes (''). Blanks at the start of the string move the text to the right. Blanks at the end of the string increase the spacing between the string and the break value if BTITLE is specified before BREAK.

BTOTAL('string')
Specifies a break TOTAL (BTOTAL) line is to be printed after the rows of data for each section. BTOTAL can only be specified if BREAK is specified. The specified string is printed starting at the indent column of the break TOTAL line, followed by the break total for each numeric data column. If STATLEFT is specified, the string is printed to the left of the first column of data with the totals on the same line as the string. If STATLEFT is not specified, the string is printed in the first column of data with the totals on the same line as the string, or on the next line, as appropriate. A blank line is printed before the break TOTAL line.

The string (1 to 50 characters) must be enclosed in single apostrophes. To include a single apostrophe (') in the string, specify two single apostrophes (''). To suppress printing of a string, specify BTOTAL("") using two single apostrophes.

The break total for each numeric ON field is printed in the format (formatting, PLUS, BLANK, or standard) you specify. The total for a specific numeric field is suppressed if the NOST formatting item is specified for that field. Totals are printed for ON(VLEN) fields, but not for ON(NUM) fields.

The default number of digits (d) for a break total is 15 if the ON field is BI or FI with a length up to 4, PD with a length up to 8, or ZD, CSF, FS, UFF or SFF with a length up to 15. The default number of digits...
(d) for a break total is 31 if the ON field is BI or FI with a length greater than 4, PD with a length greater than 8, or ZD, CSF, FS, UFF or SFF with a length greater than 15. By default, column widths are adjusted to allow for a maximum of a sign and d digits for the totals. If the break total for an ON field overflows d digits, ICETOOL prints asterisks for the break total for that field and terminates the operation.

You can use the Ndd or Udd formatting item to decrease or increase the number of digits used for a break total. If you use Ndd or Udd and the break total for an ON field overflows dd digits, ICETOOL prints asterisks for the break total for that field and terminates the operation.

You can prevent overflow by specifying an appropriate dd value for Ndd or Udd. For example, if ON(1,15,ZD) with BTOTAL overflows the default of 15 digits, you can specify ON(1,15,ZD,U16) to prevent overflow. If ON(1,15,ZD,U16) still results in overflow, you can specify ON(1,15,ZD,U17), and so on.

Either Ndd or Udd can be used to set the number of digits greater than the maximum for a numeric field, but only Udd can be used to set the number of digits less than the maximum for a numeric field.

See the discussion of Ndd or Udd under ON(p,m,f,formatting) for more details on using Ndd or Udd with BTOTAL.

The BTOTAL, BMAXIMUM, BMINIMUM, BAVERAGE, and BCOUNT lines are printed in the order in which you specify them.

BMAXIMUM('string')

Specifies a break MAXIMUM line is to be printed after the rows of data for each section. BMAXIMUM can only be specified if BREAK is specified. The specified string is printed starting at the indent column of the break MAXIMUM line, followed by the break maximum for each numeric data column. If STATLEFT is specified, the string is printed to the left of the first column of data with the maximums on the same line as the string. If STATLEFT is not specified, the string is printed in the first column of data with the maximums on the same line as the string, or on the next line, as appropriate. A blank line is printed before the break MAXIMUM line.

The string (1 to 50 characters) must be enclosed in single apostrophes. To include a single apostrophe (') in the string, specify two single apostrophes (''). To suppress printing of a string, specify BMAXIMUM('') using two single apostrophes.

The break maximum for each numeric ON field is printed in the format (formatting, PLUS, BLANK, or standard) you specify. The maximum for a specific numeric field is suppressed if the NOST formatting item is specified for that field. Maximums are printed for ON(VLEN) fields, but not for ON(NUM) fields.

The BTOTAL, BMAXIMUM, BMINIMUM, BAVERAGE, and BCOUNT lines are printed in the order in which you specify them.

BMINIMUM('string')

Specifies a break MINIMUM line is to be printed after the rows of data for each section. BMINIMUM can only be specified if BREAK is specified. The specified string is printed starting at the indent column of the break MINIMUM line, followed by the break minimum for each numeric data column. If STATLEFT is specified, the string is printed to the left of the first column of data with the minimums on the same line as the string. If STATLEFT is not specified, the string is printed in the first column of data with the minimums on the same line as the string, or on the next line, as appropriate. A blank line is printed before the break MINIMUM line.

The string (1 to 50 characters) must be enclosed in single apostrophes. To include a single apostrophe (') in the string, specify two single apostrophes (''). To suppress printing of a string, specify BMINIMUM('') using two single apostrophes.

The break minimum for each numeric ON field is printed in the format (formatting, PLUS, BLANK, or standard) you specify. The minimum for a specific numeric field is suppressed if the NOST formatting item is specified for that field. Minimums are printed for ON(VLEN) fields, but not for ON(NUM) fields.
the left of the first column of data with the minimums on the same line as the string. If STATLEFT is not specified, the string is printed in the first column of data with the minimums on the same line as the string, or on the next line, as appropriate. A blank line is printed before the break MINIMUM line.

The string (1 to 50 characters) must be enclosed in single apostrophes. To include a single apostrophe (') in the string, specify two single apostrophes ("'"). To suppress printing of a string, specify BMINIMUM("") using two single apostrophes.

The break minimum for each numeric ON field is printed in the format (formatting, PLUS, BLANK, or standard) you specify. The minimum for a specific numeric field is suppressed if the NOST formatting item is specified for that field. Minimums are printed for ON(VLEN) fields, but not for ON(NUM) fields.

The BTOTAL, BMAXIMUM, BMINIMUM, BAVERAGE, and BCOUNT lines are printed in the order in which you specify them.

**BAVERAGE('string')**

Specifies a break AVERAGE line is to be printed after the rows of data for each section. BAVERAGE can only be specified if BREAK is specified. The specified string is printed starting at the indent column of the break AVERAGE line, followed by the break average for each numeric data column. If STATLEFT is specified, the string is printed to the left of the first column of data with the averages on the same line as the string. If STATLEFT is not specified, the string is printed in the first column of data with the averages on the same line as the string, or on the next line, as appropriate. A blank line is printed before the break AVERAGE line.

The break average (or mean) is calculated by dividing the break total by the number of values in the section and rounding down to the nearest integer (examples: 23 / 5 = 4, −23 / 5 = −4).

The string (1 to 50 characters) must be enclosed in single apostrophes. To include a single apostrophe (') in the string, specify two single apostrophes ("'"). To suppress printing of a string, specify BAVERAGE("") using two single apostrophes.

The break average for each numeric ON field is printed in the format (formatting, PLUS, BLANK, or standard) you specify. The average for a specific numeric field is suppressed if the NOST formatting item is specified for that field. Averages are printed for ON(VLEN) fields, but not for ON(NUM) fields.

You can use the Ndd or Udd formatting item to decrease or increase the number of digits used for a break total. If the break total for an ON field overflows d digits, ICETOOL prints asterisks for the break average for that field and terminates the operation. You can prevent overflow by specifying an appropriate dd value for Ndd or Udd. For example, if ON(1,15,ZD) with BAVERAGE overflows the default of 15 digits for the total, you can specify ON(1,15,ZD,U16) to prevent overflow.

See the discussion of Ndd or Udd under ON(p,m,f,formatting) for more details on using Ndd or Udd.

The BTOTAL, BMAXIMUM, BMINIMUM, BAVERAGE, and BCOUNT lines are printed in the order in which you specify them.
**BCOUNT('string')**

Specifies a break COUNT line is to be printed after the rows of data for each section. BCOUNT can only be specified if BREAK is specified. The specified string is printed starting at the indent column of the break COUNT line, followed by the break count of data records in the section. If STATLEFT is specified, the string is printed to the left of the first column of data. If STATLEFT is not specified, the string is printed in the first column of data. The count is printed on the same line as the string. A blank line is printed before the break COUNT line.

The string (1 to 50 characters) must be enclosed in single apostrophes. To include a single apostrophe ('') in the string, specify two single apostrophes (''). To suppress printing of a string, specify BCOUNT("") using two single apostrophes.

The count is printed in the format (PLUS, BLANK, or standard) you specify. EDBCOUNT(formatting) can be used to apply formatting items to the count. The default number of digits (d) for the count is 15.

The BTOTAL, BMAXIMUM, BMINIMUM, BAVERAGE, and BCOUNT lines are printed in the order in which you specify them.

**EDBCOUNT(formatting)**

Specifies how the break count is to be formatted for printing. Formatting items can be specified in any order, but each item can only be specified once. EDBCOUNT can only be specified if BCOUNT('string') is specified.

- **mask**  
  See ON(p,m,f,formatting) for a discussion of mask.

- **E'pattern'**  
  See ON(p,m,f,formatting) for a discussion of E'pattern'.

- **L'string'**  
  See ON(p,m,f,formatting) for a discussion of L'string'.

- **F'string'**  
  See ON(p,m,f,formatting) for a discussion of F'string'.

- **T'string'**  
  See ON(p,m,f,formatting) for a discussion of T'string'.

- **LZ**  
  See ON(p,m,f,formatting) for a discussion of LZ.

- **Udd**  
  See EDCOUNT(formatting) for a discussion of Udd.

**STATLEFT**

Specifies that the strings for statistics (TOTAL, MAXIMUM, MINIMUM, AVERAGE, COUNT, BTOTAL, BMAXIMUM, BMINIMUM, BAVERAGE, BCOUNT) are to be placed to the left of the first column of data (overriding the default of placing the strings in the first column). STATLEFT ensures that each statistic appears on the same line as its string while making the statistics lines stand out from the columns of data.

**UZERO**

Specifies that −0 and +0 are to be treated as unsigned zero values, that is, as the same value. With UZERO, −0 and +0 are treated as positive for ON, MINIMUM, MAXIMUM, BREAK, BMINIMUM and BMAXIMUM processing.

UZERO overrides the default of treating −0 and +0 as signed zero values, that is, as different values. Without UZERO, −0 is treated as
DISPLAY Operator

negative and +0 is treated as positive for ON, MINIMUM, MAXIMUM, BREAK, BMINIMUM and BMAXIMUM processing.

LISTSDB OR LISTNOSDB

Can be used to override the SDBMSG value for this LIST data set. LISTSDB directs ICETOOL to select the system-determined optimum block size for the LIST data set in the same way as for installation option SDBMSG=YES. LISTNOSDB directs ICETOOL to select the block size for the LIST data set in the same way as for installation option SDBMSG=NO. See the discussion of the LIST(listdd) operand above for more information on how LISTSDB or LISTNOSDB affects the LIST data set block size.

Attention: LISTSDB has no effect for SYSOUT data sets (for example, //RPT1 DD SYSOUT=*), because the system-determined optimum block size is not used for spool or dummy data sets.

DISPLAY Examples

Although the DISPLAY operators in the examples below could all be contained in a single ICETOOL job step, they are shown and discussed separately for clarity. See "OCCUR Operator" on page 643 for additional examples of tailoring the report format.

Example 1

DISPLAY FROM(SOURCE) LIST(FIELDS) ON(NUM) ON(40,12,CH) -
ON(20,8,PD)

Prints, in the FIELDS data set:

• A heading line containing the standard headings
• Data lines in the standard format containing:
  – The record number in the standard format
  – The characters from positions 40-51 of the SOURCE data set
  – The packed decimal values from positions 20-27 of the SOURCE data set in the standard format

The FIELDS output starts on a new page and looks as follows (the first 2 records are shown with illustrative values):

<table>
<thead>
<tr>
<th>RECORD NUMBER</th>
<th>(40,12,CH)</th>
<th>(20,8,PD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>00000000000001</td>
<td>SAN JOSE</td>
<td>000000000003745</td>
</tr>
<tr>
<td>00000000000002</td>
<td>MORGAN HILL</td>
<td>0000000000016502</td>
</tr>
</tbody>
</table>

The heading line appears at the top of each page.

Example 2

DISPLAY FROM(IN) LIST(LIST1) -
TITLE('National Accounting Report') -
PAGE DATE TIME -
HEADER('Division') HEADER('Revenue') HEADER('Profit/Loss') -
ON(1,25,CH) ON(45,10,ZD) ON(35,10,ZD) -
BLANK -
TOTAL('Company Totals') -
AVERAGE('Company Averages')
DISPLAY Operator

Prints, in the LIST1 data set:
- A title line containing the specified title, the page number, the date and the time
- A heading line containing the specified underlined headings
- Data lines in the BLANK format containing:
  - The characters from positions 1-25 of the IN data set
  - The zoned decimal values from positions 45-54 of the IN data set
  - The zoned decimal values from positions 35-44 of the IN data set
- A TOTAL line containing the specified string and the total for each of the two zoned decimal fields in the BLANK format
- An AVERAGE line containing the specified string and the average for each of the two zoned decimal fields in the BLANK format.

The LIST1 output starts on a new page and looks as follows (the first 2 records are shown with illustrative values):

<table>
<thead>
<tr>
<th>Division</th>
<th>Revenue</th>
<th>Profit/Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research and Development</td>
<td>54323456</td>
<td>-823325</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>159257631</td>
<td>1372610</td>
</tr>
<tr>
<td>Company Totals</td>
<td>612867321</td>
<td>5277836</td>
</tr>
<tr>
<td>Company Averages</td>
<td>76608415</td>
<td>659729</td>
</tr>
</tbody>
</table>

The title line and underlined heading line appear at the top of each page.

Example 3

DISPLAY FROM(DATA) LIST(JUSTDATA) -
  NOHEADER -
  ON(17,5,PD) ON(1,2,FI)

Prints, in the JUSTDATA data set:
- Data lines in the standard format containing:
  - The packed decimal values from positions 17-21 of the DATA data set in the standard format
  - The fixed-point values from positions 1-2 of the DATA data set in the standard format

The JUSTDATA output contains no page ejects or heading lines and looks as follows (the first 2 records are shown with illustrative values):

-00000000000273216 +0000000000000027
+00000000000993112 +0000000000000321
  . .
  . .

Example 4

COPY FROM(INPUT) TO(TEMP) USING(TREG)
DISPLAY FROM(TEMP) LIST(REGULAR) -
  PAGE TITLE('Report on Regular Tools') TBETWEEN(12) -
  HEADER(NONE) ON(1,18,CH) -
This example shows how reports for different subsets of data can be produced. Assume that:

- The TREGCNTL data set contains:
  
  ```
  INCLUDE COND=(44,8,CH,EQ,C'Regular')
  ```

- The TPOWCNTL data set contains:
  
  ```
  INCLUDE COND=(44,8,CH,EQ,C'Power')
  ```

The first COPY operator copies the records from the INPUT data set that contain 'Regular' in positions 44-51 to the TEMP (temporary) data set.

The first DISPLAY operator uses the first subset of records in the TEMP data set to print, in the REGULAR data set:

- A title line containing the page number and specified title, with twelve blanks between these report elements.
- A two-line heading containing the specified underlined strings (with no heading for the first ON field). Note the comma in HEADER(,'Item') to place 'Item' on line2 of the heading.
- Data lines for the first subset of records containing:
  - The characters from positions 1-18
  - The characters from positions 35-39
  - The floating sign values from positions 28-31 formatted with one decimal place and a period as the decimal point.

The second COPY operator copies the records from the INPUT data set that contain 'Power' in positions 44-51 to the TEMP (temporary) data set.

The second DISPLAY operator uses the second subset of records in the TEMP data set to print, in the POWER data set:

- A title line containing the page number and specified title, with twelve blanks between these report elements.
- A two-line heading containing the specified underlined strings (with no heading for the first ON field). Note the comma in HEADER(,'Item') to place 'Item' on line2 of the heading.
- Data lines for the second subset of records containing:
  - The characters from positions 1-18
  - The characters from positions 35-39
  - The floating sign values from positions 28-31 formatted with one decimal place and a period as the decimal point.

The REGULAR output starts on a new page and looks as follows (the first 2 records are shown with illustrative values):
The title line and underlined heading lines appear at the top of each page. The number of lines per page is 66, overriding the default of 58.

The POWER output starts on a new page and looks as follows (the first 2 records are shown with illustrative values):

```
- 1 - Report on Power Tools

<table>
<thead>
<tr>
<th>Item</th>
<th>Percent</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hammers</td>
<td>10325</td>
<td>-7.3</td>
</tr>
<tr>
<td>Wrenches</td>
<td>00273</td>
<td>15.8</td>
</tr>
</tbody>
</table>
```

The title line and underlined heading lines appear at the top of each page. The number of lines per page is 66, overriding the default of 58.

**Example 5**

```
DISPLAY FROM(INV) LIST(RDWLIST1) -
    TITLE('No Frills RDW Report') -
    ON(NUM) -
    ON(VLEN) -
    ON(1,4,HEX) -
    MINIMUM('Smallest') -
    MAXIMUM('Largest')
```

Prints, in the RDWLIST1 data set:

- A title line containing the specified title
- A heading line containing the standard headings
- Data lines in the standard format containing:
  - The record number
  - The record length
  - The record descriptor word (RDW) in hexadecimal
- A MINIMUM line containing the specified string and the minimum record length in the standard format
- A MAXIMUM line containing the specified string and the maximum record length in the standard format.

The RDWLIST1 output starts on a new page and looks as follows (the first 2 records are shown with illustrative values):
## DISPLAY Operator

No Frills RDW Report

<table>
<thead>
<tr>
<th>RECORD NUMBER</th>
<th>RECORD LENGTH</th>
<th>(1,4,HEX)</th>
</tr>
</thead>
<tbody>
<tr>
<td>000000000000001 +000000000000075 004B0000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>000000000000002 +000000000000071 00470000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>.. .. ..</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Smallest +000000000000058

Largest +000000000000078

The title line and heading line appear at the top of each page.

### Example 6

```c
DISPLAY FROM(INV) LIST(RDWMIST2) -
  DATE(DMY.) -
  TFIRST TBETWEEN(3) -
  TITLE('Fancy RDW Report with') -
  TITLE('length in decimal and hex') -
  TITLE('and max and min length') -
  TIME(12:) -
  HEADER('Relative Record') ON(NUM) -
  HEADER('RDW (length)') ON(VLEN) -
  HEADER('RDW (Hex)') ON(1,4,HEX) -
  BLANK -
  MINIMUM('Smallest Record:') -
  MAXIMUM('Largest Record:') -
  COUNT('Number of Records: ') EDCOUNT(U04)
```

Prints, in the RDWLIST2 data set:

- Title lines containing the date, the specified title strings and the time
- A heading line containing the specified underlined headings
- Data lines in the BLANK format containing:
  - The record number
  - The record length
  - The record descriptor word (RDW) in hexadecimal
- A MINIMUM line containing the specified string and the minimum record length in the BLANK format
- A MAXIMUM line containing the specified string and the maximum record length in the BLANK format
- A COUNT line containing the specified string and the edited overall record count.

RDWLIST2 output starts on a new page and looks as follows (the first 2 records are shown with illustrative values):
The title lines only appear at the top of the first page as specified by the TFIRST operand. The underlined heading line appears at the top of each page.

**Example 7**

```plaintext
SORT FROM(PARTS) TO(TEMP) USING(SRT1)  
DISPLAY FROM(TEMP) LIST(USA) -  
   TITLE('Parts Completion Report for USA') DATE -  
   HEADER('Part') HEADER('Completed') HEADER('Value ($)') -  
   ON(15,6,CH) ON(3,4,ZD,A1) ON(38,8,ZD,C1) -  
   TOTAL('Total:')  
DISPLAY FROM(TEMP) LIST(FRANCE) -  
   TITLE('Parts Completion Report for France') DATE(DM4/) -  
   HEADER('Part') HEADER('Completed') HEADER('Value (F)') -  
   ON(15,6,CH) ON(3,4,ZD,A3) ON(38,8,ZD,C3) -  
   TOTAL('Total:')  
DISPLAY FROM(TEMP) LIST(DENMARK) -  
   TITLE('Parts Completion Report for Denmark') DATE(DMY-) -  
   HEADER('Part') HEADER('Completed') HEADER('Value (kr)') -  
   ON(15,6,CH) ON(3,4,ZD,A2) ON(38,8,ZD,C2) -  
   TOTAL('Total:')
```

This example shows how reports for three different countries can be produced. The reports differ only in the way that date and numeric values are displayed.

Assume that the SRT1CNTL data set contains:

```plaintext
SORT FIELDS=(15,6,CH,A)
```

The SORT operator sorts the PARTS data set to the TEMP data set using the SORT statement in SRT1CNTL.

The first DISPLAY operator uses the sorted records in the TEMP data set to print, in the USA data set:
DISPLAY Operator

- A title line containing the specified title and the date in the format commonly used in the United States.
- A heading line containing the specified underlined headings.
- Data lines containing:
  - The characters from positions 15-20.
  - The zoned decimal values from positions 3-6 formatted with the separators commonly used in the United States.
  - The zoned decimal values from positions 38-45 formatted with two decimal places and the separators and decimal point commonly used in the United States.
- A TOTAL line containing the specified string and the total for each of the two zoned decimal fields formatted in the same way as the data values.

The second DISPLAY operator uses the sorted records in the TEMP data set to print, in the FRANCE data set:

- A title line containing the specified title and the date in the format commonly used in France.
- A heading line containing the specified underlined headings.
- Data lines containing:
  - The characters from positions 15-20.
  - The zoned decimal values from positions 3-6 formatted with the separators commonly used in France.
  - The zoned decimal values from positions 38-45 formatted with two decimal places and the separators and decimal point commonly used in France.
- A TOTAL line containing the specified string and the total for each of the two zoned decimal fields formatted in the same way as the data values.

The third DISPLAY operator uses the sorted records in the TEMP data set to print, in the DENMARK data set:

- A title line containing the specified title and the date in the format commonly used in Denmark.
- A heading line containing the specified underlined headings.
- Data lines containing:
  - The characters from positions 15-20.
  - The zoned decimal values from positions 3-6 formatted with the separators commonly used in Denmark.
  - The zoned decimal values from positions 38-45 formatted with two decimal places and the separators and decimal point commonly used in Denmark.
- A TOTAL line containing the specified string and the total for each of the two zoned decimal fields formatted in the same way as the data values.

The USA output starts on a new page and looks as follows (several records are shown with illustrative values):
The title line and underlined heading line appear at the top of each page.

The FRANCE output starts on a new page and looks as follows (several record are shown with illustrative values):

```
Parts Completion Report for France 14/01/2005
Part Completed Value (F)
------ --------------------- ---------------------
000310 562 8317,53
001184 1234 23456,78
029633 35 642,10
192199 3150 121934,65
821356 233 2212,34
Total: 5214 156563,40
```

The title line and underlined heading line appear at the top of each page.

The DENMARK output starts on a new page and looks as follows (several records are shown with illustrative values):

```
Parts Completion Report for Denmark 14-01-05
Part Completed Value (kr)
------ -------------------- ---------------------
000310 562 8317,53
001184 1234 23456,78
029633 35 642,10
192199 3150 121934,65
821356 233 2212,34
Total: 5214 156563,40
```

The title line and underlined heading line appear at the top of each page.

Example 8

```
SORT FROM(DATA) TO(TEMP) USING(SRTX)
DISPLAY FROM(TEMP) LIST(WEST) -
  DATE TITLE('Western Region Profit/Loss Report') PAGE -
  BTITLE('Division:') BREAK(3,10,CH) -
  HEADER('Branch Office') ON(16,13,CH) -
  HEADER('Profit/Loss (K)') ON(41,4,PD,/K,E1) -
  BMINIMUM('Lowest Profit/Loss in this Division:') -
  BMAXIMUM('Highest Profit/Loss in this Division:') -
  BAVVERAGE('Average Profit/Loss for this Division:') -
  MINIMUM('Lowest Profit/Loss for all Divisions:') -
  MAXIMUM('Highest Profit/Loss for all Divisions:') -
  AVERAGE('Average Profit/Loss for all Divisions:') -
```

This example shows how a report with sections can be produced.
DISPLAY Operator

Assume that the SRTXCNTL data set contains:

```
SORT FIELDS=(3,10,A,16,13,A),FORMAT=CH
```

The SORT operator sorts the DATA data set to the TEMP data set using the SORT statement in SRTXCNTL.

The DISPLAY operator uses the sorted records in the TEMP data set to print, in the WEST data set, sections with:

- A title line containing the date, the specified title string, and the page number
- A break title containing the specified break title string, and the break field characters from positions 3-12
- A heading line containing the specified underlined headings
- Data lines containing:
  - The characters from positions 16-28
  - The packed decimal values from positions 41-44 divided by 1000 and formatted with separators and signs as specified.
- Break MINIMUM, MAXIMUM, and AVERAGE lines containing the specified strings and statistics for the packed decimal field values in this section, formatted in the same way as the data values.

The last page of the report contains:

- A title line containing the date, the specified title string, and the page number
- A heading line containing the specified underlined headings
- Overall MINIMUM, MAXIMUM, and AVERAGE lines containing the specified strings and statistics for the packed decimal field values in the report, formatted in the same way as the data values.

The first section of the WEST output starts on a new page and looks as follows (several records are shown with illustrative values):

```
01/14/05 Western Region Profit/Loss Report - 1 -

Division: Chips
Branch Office     Profit/Loss (K)
------------------- ---------------
Gilroy            3,293
Los Angeles (141)  
Morgan Hill       213
Oakland           1,067
San Francisco (31) 
San Jose           92
San Martin         1,535

Lowest Profit/Loss in this Division: (141)
Highest Profit/Loss in this Division: 3,293
Average Profit/Loss for this Division: 861
```

The title line, break title line, and underlined heading line appear at the top of each page of the section.

The second section of the WEST output starts on a new page and looks as follows (several records are shown with illustrative values):
DISPLAY Operator

01/14/05 Western Region Profit/Loss Report - 2 -

Division: Ice Cream

<table>
<thead>
<tr>
<th>Branch Office</th>
<th>Profit/Loss (K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marin</td>
<td>673</td>
</tr>
<tr>
<td>Napa</td>
<td>95</td>
</tr>
<tr>
<td>San Francisco</td>
<td>(321)</td>
</tr>
<tr>
<td>San Jose</td>
<td>2,318</td>
</tr>
<tr>
<td>San Martin</td>
<td>21</td>
</tr>
</tbody>
</table>

Lowest Profit/Loss in this Division: (321)

Highest Profit/Loss in this Division: 2,318

Average Profit/Loss for this Division: 557

The title line, break title line, and underlined heading line appear at the top of each page of the section.

The last page of the WEST output starts on a new page and looks as follows:

01/14/05 Western Region Profit/Loss Report - 3 -

<table>
<thead>
<tr>
<th>Branch Office</th>
<th>Profit/Loss (K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowest Profit/Loss for all Divisions: (321)</td>
<td></td>
</tr>
<tr>
<td>Highest Profit/Loss for all Divisions: 3,293</td>
<td></td>
</tr>
<tr>
<td>Average Profit/Loss for all Divisions: 734</td>
<td></td>
</tr>
</tbody>
</table>

Example 9

MODE CONTINUE

VERIFY FROM(CHECK) ON(2,3,PD) LIMIT(500)
DISPLAY FROM(CHECK) LIST(PDREPORT) BLANK LIMIT(500) -
  HEADER('Relative Record') ON(NUM) -
  HEADER('Numeric') ON(2,3,PD) -
  HEADER('Hexadecimal') ON(2,3,HEX) -
  HEADER('Associated Field') ON(21,20,CH)

This example shows how each record containing an invalid decimal value can be identified either by its relative record number or an associated field in the record.

The MODE operator ensures that the DISPLAY operator is processed if the VERIFY operator identifies an invalid decimal value.

The VERIFY operator checks for invalid digits (A-F) and invalid signs (0-9) in the packed decimal values from positions 2-4 of the CHECK data set. Messages ICE618A and ICE649A are printed in the TOOLMSG data set for each value (if any) that contains an invalid digit or sign. If 500 invalid values are found, the operation is terminated.

The DISPLAY operator checks for invalid digits (A-F) in the packed decimal values from positions 2-4 of the CHECK data set. Messages ICE618A and ICE649A are
printed in the TOOLMSG data set for each value (if any) that contains an invalid digit. If 500 invalid values are found, the operation is terminated. If a check for invalid signs is required, the VERIFY operator must be used, because the DISPLAY operator only checks for invalid digits. The VERIFY operator is not required if signs need not be checked.

The DISPLAY operator also prints, in the PDREPORT data set:
- A heading line containing the specified underlined headings
- Data lines in the BLANK format containing:
  - The relative record number. This number can be matched against the RECORD numbers printed in the ICE618A messages to find the records with invalid signs.
  - The numeric representation of the packed decimal value in positions 2-4. Asterisks are shown for values with invalid digits, making them easy to identify. Asterisks are not shown for values with invalid signs; these must be identified by matching the relative record number against the RECORD number in ICE618A.
  - The hexadecimal representation of the packed decimal value in positions 2-4 (also shown in ICE649A). This makes it easy to find the specific hexadecimal digits or signs that are invalid.
  - The characters in positions 21-40. An associated field such as this can be used to make identification of the records with invalid values easier.

The ICE618A and ICE649A messages in TOOLMSG for the VERIFY operator are:

```
ICE618A 0 INVALID (2,3,PD) VALUE - RECORD: 000000000000003
ICE649A 0 HEX VALUE: 53A54C
ICE618A 0 INVALID (2,3,PD) VALUE - RECORD: 000000000000012
ICE649A 0 HEX VALUE: 621540
ICE618A 0 INVALID (2,3,PD) VALUE - RECORD: 000000000000019
ICE649A 0 HEX VALUE: 400F3C
```

The ICE618A and ICE649A messages in TOOLMSG for the DISPLAY operator are:

```
ICE618A 0 INVALID (2,3,PD) VALUE - RECORD: 000000000000003
ICE649A 0 HEX VALUE: 53A54C
ICE618A 0 INVALID (2,3,PD) VALUE - RECORD: 000000000000012
ICE649A 0 HEX VALUE: 621540
ICE618A 0 INVALID (2,3,PD) VALUE - RECORD: 000000000000019
ICE649A 0 HEX VALUE: 400F3C
```

The PDREPORT output looks as follows:
PDREPORT can be used in conjunction with the ICE618A and ICE649A messages to identify that:

- Record 3 has an invalid digit of A and an associated field of “Giulianelli”
- Record 12 has an invalid sign of 0 and an associated field of “Wu”
- Record 19 has an invalid digit of F and an associated field of “Yaeger”.

Example 10

COPY FROM(IN) USING(OUTF)
DISPLAY FROM(TEMP) LIST(EMPCT) BLANK -
    TITLE('Employees by Function') -
    DATE -
    HEADER('Function') HEADER('Employees') -
    ON(1,25,CH) ON(30,4,ZD)

This example shows how the OUTFIL table lookup feature can be used to substitute meaningful phrases for cryptic values in ICETOOL reports. Assume that:

- The OUTFCNTL data set contains:
  ```
  OUTFIL FNAMES=TEMP,
  OUTREC=(1:9,2,CHANGE=(25,
    C'MN',C'Manufacturing',
    C'RD',C'Research and Development',
    C'FN',C'Finance',
    C'MR',C'Marketing',
    C'IS',C'Information Systems'),
  30:4,4)
  ```

The COPY operator uses the OUTFIL statement in OUTFCNTL to reformat the IN data set records to the TEMP (temporary) data set. Two fields are extracted for use by the DISPLAY operator:

- The 2-character department code in positions 9-10 is changed to a 25-character name in positions 1-25 using the table lookup feature.
- The zoned decimal value in positions 4-7 is moved to positions 30-33.

The DISPLAY operator uses the reformatted fields in the TEMP data set to print, in the EMPCT data set:

- A title line containing the specified title and the date
DISPLAY Operator

- A heading line containing the specified underlined headings
- Data lines in the BLANK format containing:
  - The names from positions 1-25 that were substituted for the department codes
  - The zoned decimal values from positions 30-33.

The EMPCT output starts on a new page and looks as follows:

<table>
<thead>
<tr>
<th>Employees by Function</th>
<th>02/14/05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>Employees</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>486</td>
</tr>
<tr>
<td>Marketing</td>
<td>21</td>
</tr>
<tr>
<td>Research and Development</td>
<td>55</td>
</tr>
<tr>
<td>Information Systems</td>
<td>123</td>
</tr>
<tr>
<td>Finance</td>
<td>33</td>
</tr>
</tbody>
</table>

Example 11

DISPLAY FROM(ACCTS) LIST(PLAIN) -
  TITLE('Accounts Report for First Quarter') -
  DATE(MD4/) BLANK -
  HEADER('Amount') ON(12,6,ZD) -
  HEADER('Id') ON(NUM) -
  HEADER('Acct#') ON(31,3,PD) -
  HEADER('Date') ON(1,4,ZD) -
  TOTAL('Total for Q1') -
  AVERAGE('Average for Q1') -

DISPLAY FROM(ACCTS) LIST(FANCY) -
  TITLE('Accounts Report for First Quarter') -
  DATE(MD4/) BLANK -
  HEADER('Amount') ON(12,6,ZD,C1,N08) -
  HEADER('Id') ON(NUM,N02) -
  HEADER('Acct#') ON(31,3,PD,NOST,LZ) -
  HEADER('Date') ON(1,4,ZD,E'99/99',NOST) -
  INDENT(2) BETWEEN(5) -
  STATLEFT -
  TOTAL('Total for Q1') -
  AVERAGE('Average for Q1') -

This example shows some options you can use to improve the appearance of a DISPLAY report. The first DISPLAY operator produces a "plain" report, and the second DISPLAY operator uses the options shown in bold to produce a "fancy" report.

The PLAIN output starts on a new page and looks as follows:

<table>
<thead>
<tr>
<th>Accounts Report for First Quarter</th>
<th>05/04/2001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount</td>
<td>Id</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>93271</td>
<td>1</td>
</tr>
<tr>
<td>137622</td>
<td>2</td>
</tr>
<tr>
<td>83147</td>
<td>3</td>
</tr>
<tr>
<td>183261</td>
<td>4</td>
</tr>
<tr>
<td>76389</td>
<td>5</td>
</tr>
<tr>
<td>920013</td>
<td>6</td>
</tr>
<tr>
<td>Total for Q1</td>
<td></td>
</tr>
<tr>
<td>Average for Q1</td>
<td></td>
</tr>
</tbody>
</table>
DISPLAY Operator

The FANCY output starts on a new page and looks as follows:

<table>
<thead>
<tr>
<th>Amount</th>
<th>Id</th>
<th>Acct#</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>932.71</td>
<td>1</td>
<td>15932</td>
<td>01/06</td>
</tr>
<tr>
<td>1,376.22</td>
<td>2</td>
<td>00187</td>
<td>01/28</td>
</tr>
<tr>
<td>831.47</td>
<td>3</td>
<td>15932</td>
<td>02/12</td>
</tr>
<tr>
<td>1,832.61</td>
<td>4</td>
<td>02158</td>
<td>02/17</td>
</tr>
<tr>
<td>763.89</td>
<td>5</td>
<td>00187</td>
<td>03/05</td>
</tr>
<tr>
<td>9,200.13</td>
<td>6</td>
<td>15932</td>
<td>03/19</td>
</tr>
</tbody>
</table>

Total for Q1 14,937.03
Average for Q1 2,489.50

Here is an explanation of the extra options used for the "fancy" report:

- First ON field: In the PLAIN report, BLANK causes ICETOOL to print the 6-byte ZD values as unedited digits with leading zeros suppressed. But for this example, we know the digits really represent dollars and cents. So in the FANCY report, we use the C1 formatting item (one of thirty-three available masks) to print the values with a comma (,) as the thousands separator and a period (.) as the decimal point.

In the PLAIN report, TOTAL causes ICETOOL to allow 15 digits for the values because it does not know how many digits are needed. But for this example, we know the total amount will not exceed 8 digits. So in the FANCY report, we use the N08 formatting item to set the number of digits to 8. This decreases the column width for the field.

- Second ON field: In the PLAIN report, NUM causes ICETOOL to allow 15 digits for the record number because it does not know how many digits are needed. But for this example, we know the number of records will not exceed 99. So in the FANCY report, we use the N02 formatting item to set the number of digits to 2. This decreases the column width for the record number.

- Third ON field: In the PLAIN report, TOTAL and AVERAGE cause ICETOOL to print the total and average for this 3-byte PD field. But for this example, we know we do not want statistics for the field because it is an account number. So in the FANCY report, we use the NOST formatting item to suppress the statistics for this field.

In the PLAIN report, the default mask of A0 causes ICETOOL to suppress leading zeros for this 3-byte PD field. But for this example, we know that we want to show leading zeros for the field because it is an account number. So in the FANCY report, we use the LZ formatting item to print leading zeros for this field.

- Fourth ON field: In the PLAIN report, BLANK causes ICETOOL to print the 4-byte ZD values as unedited digits with leading zeros suppressed. But for this example, we know the digits represent a date (month and day). So in the FANCY report, we use the E'99/99' formatting item to print the values with leading zeros and a slash (/) between the month and day.

In the PLAIN report, TOTAL and AVERAGE cause ICETOOL to print the total and average for this 4-byte ZD field. But for this example, we know we do not want the total or average for this field because it is a date. So in the FANCY report, we use the NOST formatting item to suppress the statistics for this field.

Note: In some applications, we might want the minimum and maximum for a date displayed with E'pattern', so we would not specify NOST for the date field.
DISPLAY Operator

- **INDENT:** In the PLAIN report, ICETOOL starts the report in column 2 (after the control character), by default. But for this example, we want to indent the report a bit. So in the FANCY report, we use the **INDENT** operand to indent the report by 2 blanks so it starts in column 4.

- **BETWEEN:** In the PLAIN report, ICETOOL uses 3 blanks between the columns of data, by default. But for this example, we want more space between the columns. So in the FANCY report, we use the **BETWEEN** operand to insert 5 blanks between the columns.

- **STATLEFT:** In the PLAIN report, ICETOOL prints the strings for TOTAL and AVERAGE under the first column of data, by default, and uses two lines for each statistic to avoid having the string overlay the value. But for this example, we would like to have the TOTAL and AVERAGE strings stand out in the report and also have each string on the same line as its value. So in the FANCY report, we use the **STATLEFT** operand to print the TOTAL and AVERAGE strings to the left of the first column of data.

**Example 12**

```plaintext
SORT FROM(RAWSMF) TO(SMF14) USING(SMFI) 
DISPLAY FROM(SMF14) LIST(SMF14RPT) -
  TITLE('SMF Type-14 Records') DATE(4MD/) -
  HEADER('Date') ON(11,4,DT1,E'9999/99/99') -
  HEADER('Time') ON(7,4,TM1,E'99:99:99') -
  HEADER('Sys') ON(15,4,CH) -
  HEADER('Jobname') ON(19,8,CH) -
  HEADER('Datasetname') ON(69,44,CH)
```

This example shows how SMF date and time values can be displayed in a meaningful way in a report on SMF type-14 records.

The SORT operator selects the type-14 records from the RAWSMF data set and sorts them by date and time to the SMF14 data set. It uses the following control statements in SMFICNTL:

```plaintext
  INCLUDE COND=(6,1,BI,EQ,14)
  SORT FIELDS=(11,4,PD,A,7,4,BI,A)
```

The DISPLAY operator uses the selected type-14 records in SMF14 to print, in the SMF14RPT data set:

- A title line containing the specified title and the date
- A heading line containing the specified underlined headings
- Data lines containing:
  - The SMF date values in positions 11-14 displayed as C'yyyy/mm/dd'
  - The SMF time values in positions 7-10 displayed as C'hh:mm:ss'
  - The character values in positions 15-18
  - The character values in positions 19-26
  - The character values in positions 69-112

The SMF14RPT output starts on a new page and looks as follows:
Note: When you use SMF date formats (DTn) or SMF time formats (TMn), the SMF values are treated as numeric. This allows you to use numeric formatting items such as masks and patterns to edit the SMF values. By default, DTn and TMn headings, like other numeric headings, appear right-aligned as shown in the SMF14RPT output example above. If you want to center-align or left-align headings for numeric values, you can add an appropriate number of blanks at the end of HEADER('string1').

For example, if you wanted to left-align the SMF date heading, you could use six blanks at the end of the header string like so:

HEADER('Date ') to get the following heading:

Date
---------

If you wanted to center-align the SMF date heading, you could use three blanks at the end of the header string like so:

HEADER('Date ') to get the following heading:

Date
---------

Example 13

SORT FROM(SMFIN) TO(SMF71) USING(TY71) DISPLAY FROM(SMF71) LIST(SMF71RPT) -
TITLE('Low impact central storage frames') -
BREAK(15,4,CH,L'System: ') -
HEADER('Date') ON(11,4,DT1,E'9999-99-99') -
HEADER('Time') ON(7,4,TM1,E'99:99:99') -
HEADER('Min Frames') ON(925,8,FL,U10) -
HEADER('Max Frames') ON(933,8,FL,U10) -
HEADER('Avg Frames') ON(941,8,FL,U10) -
BLANK PAGE

This example shows how floating point values can be displayed as integers in a report on SMF type-71 records with a section for each system id.

The SORT operator selects SMF type-71 records that are at least 19 bytes long and sorts them by system id, date and time to the SMF71 data set. It uses the following control statements in TY71CNTL:

OMIT COND=(6,1,B1,NE,+71,OR,1,2,B1,LE,+18)
SORT FIELDS=(15,4,CH,A,11,4,PD,A,7,4,B1,A)

The DISPLAY operator uses the selected type-71 records in SMF71 to print, in the SMF71RPT data set:
A title line containing the specified title and the page number.

A break title containing the specified leading string and the SMF71SID system id character values in positions 15-18.

A heading line containing the specified underlined headings.

Data lines containing:
- The SMF71DTE date value. This SMF date value in positions 11-14 is displayed as a C'yyyy-mm-dd' value.
- The SMF71TME time value. This SMF time value in positions 7-10 is displayed as a C'hh:mm:ss' value.
- The SMF71CLM minimum number of low-impact central storage frames value. This floating-point value in positions 925-932 is displayed as a 10 digit integer value. (The U10 formatting item reduces the number of digits for the integer representation of the floating-point value from 20 to 10, decreasing the column width for the field.)
- The SMF71CLX maximum number of low-impact central storage frames value. This floating-point value in positions 933-940 is displayed as a 10 digit integer value.
- The SMF71CLA average number of low-impact central storage frames value. This floating-point value in positions 941-948 is displayed as a 10 digit integer value.

Each system id value starts on a new page and looks as follows (several sections and records are shown with illustrative values):

**Low impact central storage frames - 1 -**

**System: SYSA**

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Min Frames</th>
<th>Max Frames</th>
<th>Avg Frames</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005-08-01</td>
<td>11:45:00</td>
<td>934215</td>
<td>1001596</td>
<td>963434</td>
</tr>
<tr>
<td>2005-08-01</td>
<td>12:00:00</td>
<td>971599</td>
<td>1004939</td>
<td>984437</td>
</tr>
<tr>
<td>2005-08-01</td>
<td>12:15:00</td>
<td>970192</td>
<td>982565</td>
<td>973760</td>
</tr>
</tbody>
</table>

**Low impact central storage frames - 2 -**

**System: SYSB**

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Min Frames</th>
<th>Max Frames</th>
<th>Avg Frames</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005-08-01</td>
<td>11:45:00</td>
<td>947220</td>
<td>985444</td>
<td>966581</td>
</tr>
<tr>
<td>2005-08-01</td>
<td>12:00:00</td>
<td>980120</td>
<td>1018982</td>
<td>986360</td>
</tr>
<tr>
<td>2005-08-01</td>
<td>12:15:00</td>
<td>980387</td>
<td>1051920</td>
<td>1011873</td>
</tr>
</tbody>
</table>
Merges up to 50 input data sets to an output data set. The records in each input data set to be merged must already be in sorted order as specified by the control fields in a supplied DFSORT MERGE statement.

You must specify at least one FROM operand and a USING(xxxx) operand. Each FROM operand can be used to specify one or more ddnames. You can specify up to 10 FROM operands. The maximum number of ddnames in all of the FROM operands must not exceed 50.

DFSORT is called to merge the indd data sets to the outdd data sets using the DFSORT control statements in xxxxCNTL. You must supply a DFSORT MERGE statement in the xxxxCNTL data set to indicate the control fields for the merge. You can use additional DFSORT statements in the xxxxCNTL data set to merge a subset of the input records (INCLUDE or OMIT statement; OUTFIL INCLUDE, OMIT, SAVE, STARTREC, ENDREC, SAMPLE, SPLIT, SPLITBY and SPLIT1R operands), reformat records for output (INREC, OUTREC, and OUTFIL statements; user exit routines), and so on.

If EQUALS is in effect, records that collate identically are output in the order of their ddnames in the FROM operands.

The active locale’s collating rules affect MERGE processing as explained in “MERGE Control Statement” on page 162. If an INCLUDE or OMIT statement or an OUTFIL INCLUDE or OMIT operand is specified in the xxxxCNTL data set, the active locale’s collating rules affect INCLUDE and OMIT processing as explained in the “Cultural Environment Considerations” discussion in “INCLUDE Control Statement” on page 98.

Note: For a merge application, records deleted during an E35 exit routine are not sequence checked. If you use an E35 exit routine without an output data set, sequence checking is not performed at the time the records are passed to the E35 user exit; therefore, you must ensure that input records are in correct sequence.

Operand Descriptions

The operands described below can be specified in any order:
Operand Descriptions

FROM(inddd,...)
Specifies the ddnames of the input data sets to be read by DFSORT for this operation. Up to 10 FROM operands can be used to specify up to 50 input ddnames. An indd DD statement must be present for each indd name specified. Each indd input data set must conform to the rules for DFSORT’s SORTINnn data sets.

USING(xxxx)
Specifies the first 4 characters of the ddname for the control statement data set to be used by DFSORT for this operation. xxxx must be four characters that are valid in a ddname of the form xxxxCNTL. xxxx must not be SYSx.

An xxxxCNTL DD statement must be present, and the control statements in it must conform to the rules for DFSORT’s SORTCNTL data set.

The xxxxCNTL data set must contain a MERGE statement. If TO is not specified, the xxxxCNTL data set must also contain either one or more OUTFIL statements or a MODS statement for an E35 routine that disposes of all records. Other statements are optional.

TO(outdd,...)
Specifies the ddnames of the output data sets to be written by DFSORT for this operation. From 1 to 10 outdd names can be specified. An outdd DD statement must be present for each outdd name specified. If a single outdd data set is specified, DFSORT is called once to merge the indd data sets to the outdd data set using SORTOUT processing; the outdd data set must conform to the rules for DFSORT’s SORTOUT data set. If multiple outdd data sets are specified and SERIAL is not specified, DFSORT is called once to merge the indd data sets to the outdd data sets using OUTFIL processing; the outdd data sets must conform to the rules for DFSORT’s OUTFIL data sets.

A ddname specified in a FROM operand must not also be specified in the TO operand.

VSAMTYPE(x)
See the discussion of this operand on the COPY statement in “COPY Operator” on page 568.

LOCALE(name)
See the discussion of this operand on the COPY statement in “COPY Operator” on page 568.

LOCALE(CURRENT)
See the discussion of this operand on the COPY statement in “COPY Operator” on page 568.

LOCALE(NONE)
See the discussion of this operand on the COPY statement in “COPY Operator” on page 568.

SERIAL
Specifies that OUTFIL processing is not to be used when multiple outdd data sets are specified. DFSORT is called multiple times and uses SORTOUT processing; the outdd data sets must conform to the rules for DFSORT’s SORTOUT data set. SERIAL is not recommended because the use of serial processing (that is, multiple calls to DFSORT) instead of OUTFIL processing can degrade performance and imposes certain restrictions as detailed below. SERIAL is ignored if a single outdd data set is specified.

DFSORT is called to merge the indd data set to the first outdd data set using the DFSORT control statements in the xxxxCNTL data set. If the merge
operation is successful, DFSORT is called as many times as necessary to copy
the first outdd data set to the second and subsequent outdd data sets.
Therefore, for maximum efficiency, use a disk data set as the first in a list of
outdd data sets on both disk and tape. If more than one outdd data set is
specified, DFSORT must be able to read the first outdd data set after it is
written in order to copy it to the other outdd data sets. Do not use a SYSOUT
or DUMMY data set as the first in a list of outdd data sets because:
• If the first data set is SYSOUT, DFSORT abends when it tries to copy the
  SYSOUT data set to the second outdd data set.
• If the first data set is DUMMY, DFSORT copies the empty DUMMY data set
to the other outdd data sets (that is, all of the resulting outdd data sets are
empty).

**MERGE Examples**

Although the MERGE operators in the examples below could all be contained in a
single ICETOOL job step, they are shown and discussed separately for clarity.

**Example 1**

```
//TOOLIN DD *
MERGE FROM(IN01,IN02,IN03,IN04,IN05) TO(OUTPUT) USING(MERG)
//MERGCNTL DD *
   OPTION EQUALS
   MERGE FIELDS=(21,4,CH,A)
/*
This example merges 5 input files to an output file. EQUALS is used to ensure that
records that collate identically are output in the order specified in the FROM
operand. For example, if IN01, IN03 and IN05 all have records with a key or
'AAAA' in positions 21-24, the output will contain the 'AAAA' record from IN01,
the 'AAAA' record from IN03 and the 'AAAA' record from IN05, in that order.

**Example 2**

```
//TOOLIN DD *
MERGE FROM(INPUT1,INPUT2,INPUT3,INPUT4) -
   FROM(INPUT5,INPUT6,INPUT7) VSAMTYPE(F) USING(MRG1)
//MRGCNTL DD *
   MERGE FIELDS=(52,8,UFF,D)
   OUTFIL FNAMES=OUT1,INCLUDE=(15,3,SS,EQ,C'D21,D33')
   OUTFIL FNAMES=OUT2,SAVE
/*
This example merges 7 input files to 2 output files. It uses two OUTFIL statements
to create the two output files; each output file will have a different subset of the
merged records. VSAMTYPE(F) tells DFSORT the record type is F (only needed for
VSAM input files).

**MODE Operator**

![MODE Diagram]

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**MODE Operator**

Specifies one of three modes to control error checking and actions after error detection. A MODE operator effects the “processing” (that is, error checking of ICETOOL statements and calling DFSORT) of the operators that follow it, up to the next MODE operator (if any). MODE operators allow you to do the following for groups of operators or all operators:

1. Stop or continue processing operators after a return code of 8, 12 or 16. A return code of 12 or 16 can be set as the result of a statement or run-time error detected by ICETOOL or DFSORT. A return code of 8 can be set as the result of a COUNT operator with RC8.
2. Check for errors in ICETOOL statements, but do not call DFSORT.

**Operand Descriptions**

The operands described below can be specified in any order.

**STOP**

Stops subsequent operations if a return code of 8, 12 or 16 is set. If an error is detected for an operator, SCAN mode is automatically set in effect; DFSORT is not called for subsequent operators, although checking ICETOOL statements for errors continues.

STOP mode can be used to group dependent operators (that is, if an operation fails, do not process the remaining operators).

STOP MODE is set in effect automatically at the start of the ICETOOL run.

**CONTINUE**

Continues with subsequent operations regardless of whether or not a return code of 8, 12 or 16 is set. If an operator results in an error, processing continues for subsequent operators.

CONTINUE mode can be used to group independent operators (that is, process each operator regardless of the success or failure of the others).

**SCAN**

ICETOOL statements are checked for errors, but DFSORT is not called.

SCAN mode can be used to test ICETOOL statements for errors.

*Note:* SCAN mode is set automatically if an error is detected while in STOP mode.

**MODE Example**

```
MODE SCAN
  RANGE ...  
  UNIQUE ...
MODE STOP
  VERIFY ...  
  DISPLAY ...  
MODE CONTINUE
  COPY ...  
  SORT ...
  STATS ...
```

SCAN mode: RANGE and UNIQUE are checked for statement errors, but DFSORT is not called.

STOP mode: DISPLAY is dependent on VERIFY. If the return code for VERIFY is 12 or 16, SCAN mode is entered; DISPLAY is checked for statement errors, but DFSORT is not called.
CONTINUE mode: COPY, SORT, and STATS are independent of each other. SORT is processed even if the return code for COPY is 12 or 16. STATS is processed even if the return code for COPY or SORT is 12 or 16.

Note that the return codes for one group of operators does not affect the other groups of operators.
OCCUR Operator

OCCUR Operator

Prints each unique value for specified numeric fields (including SMF, TOD, and ETOD date and time) or character fields, and how many times it occurs, in a separate list data set. Simple or tailored reports can be produced. The values printed can be limited to those for which the value count meets specified criteria.
From 1 to 10 fields can be specified, but the resulting list data set line length must not exceed the limit specified by the WIDTH operand or 8192 bytes if LONGLINE is specified and WIDTH is not specified, or 2048 bytes if LONGLINE and WIDTH are not specified. At least one ON(VLEN) or ON(p,m,f) field must be specified; all such ON fields specified are used to determine whether a record contains a unique value. A single list data set record is printed for each unique value. If ON(VALCNT) is specified, the "value count" (that is, the number of times the ON values occur) is printed in the list data set record along with the other ON values.

Specifying formatting items or the PLUS or BLANK operand, which can "compress" the columns of output data, can enable you to include more fields in your report, up to a maximum of 10, if your line length is limited by the character width your printer or display supports.

ALLDUPS, NODUPS, HIGHER(x), LOWER(y) or EQUAL(v) can be specified to limit the ON values printed to those for which the value count meets the specified criteria (for example, ALLDUPS for duplicate values only). The default criteria is HIGHER(0) resulting in the ON values being printed for each unique value.

DFSORT is called to sort the indd data set to ICETOOL's E35 user exit. ICETOOL uses its E35 exit to print appropriate titles, headings and data in the list data set.

You must not supply your own DFSORT MODS, INREC, OUTREC, SUM, or RECORD statement, because they override the DFSORT statements passed by ICETOOL for this operator.

The DYNALLOC option is passed to DFSORT to ensure that work space is available for the sort. If your installation defaults for dynamic allocation are inappropriate for an OCCUR operator, you can take one of the following actions:
1. Override the DYNALLOC option using an OPTION control statement such as:
   \[\text{OPTION DYNALLOC=(,8)}\]
in the DFSPARM data set.
2. Use SORTWKdd DD statements to override the use of dynamic allocation. Refer to "SORTWKdd DD Statement" on page 72 for details.

Attention: Either of these actions affects the work data sets used for a UNIQUE operator, or for a SELECT or SPLICE operator for which USING(xxxx) is not specified.

Tape work data sets cannot be used with ICETOOL.

**Simple Report**

You can produce a simple report by specifying just the required operands. For example, if you specify FROM and LIST operands, and ON operands for 10-byte character and 7-byte zoned decimal fields and the value count, the output in the list data set can be represented as follows:

<table>
<thead>
<tr>
<th>(p,m,f)</th>
<th>(p,m,f)</th>
<th>VALUE COUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>characters</td>
<td>sdddddddddddddd</td>
<td>ddddddddddddddd</td>
</tr>
<tr>
<td>:</td>
<td>:</td>
<td>:</td>
</tr>
</tbody>
</table>

A control character occupies the first byte of each list data set record. Left-justified standard headings are printed at the top of each page to indicate the contents of
OCCUR Operator

each column, followed by a line for each record showing the characters and numbers in the fields of that record, and the count of occurrences (value count) of the specified values.

The fields are printed in columns in the same order in which they are specified in the OCCUR statement. All fields are left-justified. For numeric fields, leading zeros are printed, a − is used for the minus sign, and a + is used for the plus sign. For the value count, leading zeros are printed.

By default, the first column of data starts immediately after the control character, and three blanks appear between columns. The NOCC operand can be used to suppress the control character. The INDENT operand can be used to change the number of blanks before the first column of data. The BETWEEN operand can be used to change the number of blanks between columns.

The standard column widths are as follows:
- Character data: the length of the character field or 20 bytes if the field length is less than 21 bytes
- Numeric data: 16 bytes, or 32 bytes if the numeric field is BI or FI with a length greater than 4, PD with a length greater than 8, or ZD, CSF, FS, UFF or SFF with a length greater than 15.
- Value count: 15 bytes

HEADER operands can be used to change or suppress the headings. PLUS or BLANK operands can be used to change the format of numeric fields. PLUS, BLANK and HEADER operands can be used to change the width of the columns for numeric and character fields and the justification of headings and fields.

The NOHEADER operand can be used to create list data sets containing only data records. Data sets created in this way can be processed further by other operators (for example, STATS or UNIQUE) using CH format for character values or FS format for numeric values (including the value count).

Tailored Report

You can tailor the output in the list data set using various operands that control title strings, date, time, page number, headings, lines per page and field formats. The optional operands can be used in many different combinations to produce a wide variety of report formats. For example, if you specify FROM, LIST, BLANK, TITLE, PAGE, DATE, TIME, and HEADER operands, and ON operands for 10-byte character and 7-byte zoned decimal fields and the value count, the output in the list data set looks as follows:

<table>
<thead>
<tr>
<th>title</th>
<th>- p -</th>
<th>mm/dd/yy</th>
<th>hh:mm:ss</th>
</tr>
</thead>
<tbody>
<tr>
<td>header</td>
<td>header</td>
<td>header</td>
<td></td>
</tr>
<tr>
<td>characters</td>
<td>sd</td>
<td></td>
<td>d</td>
</tr>
<tr>
<td>.</td>
<td>.</td>
<td>.</td>
<td></td>
</tr>
<tr>
<td>.</td>
<td>.</td>
<td>.</td>
<td></td>
</tr>
</tbody>
</table>

By default, a control character occupies the first byte of each list data set record. The NOCC operand can be used to suppress the control characters. The title lines (up to 3) are printed at the top of each page of the list data set. The first title line contains the elements you specify (title strings, page number, date and time) in the order in which you specify them. The second and third title lines contain the title
strings you specify. By default, eight blanks appear between title elements, the title strings are centered with respect to each other, and the title lines appear on every page. The TBETWEEN(n) operand can be used to change the number of blanks between title elements. The TLEFT operand can be used to left-justify the title strings with respect to each other. The TFIRST operand can be used to only print the title lines on the first page. A blank line is printed after each title line.

Your specified headings (underlined) are printed after the title line on each page to indicate the contents of each column, followed by a line for each record showing the characters and numbers in the fields of that record. Your specified headings can be one, two or three lines. Headings for character fields are left-justified and headings for numeric fields are right-justified.

The fields are printed in columns in the same order in which they are specified in the OCCUR statement. Character fields are left-justified and numeric fields are right justified. For numeric fields, leading zeros are suppressed, a - is used for the minus sign, and a blank is used for the plus sign (you can specify PLUS rather than BLANK if you want a + to be used for the plus sign). For the value count, leading zeros are suppressed.

Formatting items can be used to change the appearance of individual numeric fields in the report with respect to separators, number of digits, decimal point, decimal places, signs, leading zeros, leading strings, floating strings, and trailing strings. Formatting items can also be used to insert leading or trailing strings for character fields.

The column widths are dynamically adjusted according to the length of the headings and the maximum number of bytes needed for the character or numeric data.

**Operand Descriptions**

The operands described below can be specified in any order.

**FROM(indd)**

See the discussion of this operand on the DISPLAY statement in "DISPLAY Operator" on page 587.

**ON(p,m,f)**

Specifies the position, length, and format of a numeric or character field to be used for this operation. (p,m,f) is used for the standard column heading (see HEADER('string1'), HEADER('string1','string2'), HEADER('string1','string2','string3'), HEADER(NONE), and NOHEADER for alternative heading options).

By default, three blanks appear between columns. You can change the space between columns with BETWEEN(n).

p specifies the first byte of the field relative to the beginning of the input record. p is 1 for the first data byte of a fixed-length record and 5 for the first data byte of a variable-length record as illustrated below (RRRR represents the 4-byte record descriptor word):

<table>
<thead>
<tr>
<th>Fixed-length record</th>
<th>Variable-length record</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>A</td>
</tr>
<tr>
<td>p = 1</td>
<td>2</td>
</tr>
</tbody>
</table>

m specifies the length of the field in bytes. A field must not extend beyond position 32752 or beyond the end of a record. The maximum length for a field depends on its format.
The `f` specifies the format of the field as follows:

<table>
<thead>
<tr>
<th>Format Code</th>
<th>Length</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BI</td>
<td>1 to 8 bytes</td>
<td>Unsigned binary</td>
</tr>
<tr>
<td>FI</td>
<td>1 to 8 bytes</td>
<td>Signed fixed-point</td>
</tr>
<tr>
<td>PD</td>
<td>1 to 16 bytes</td>
<td>Signed packed decimal</td>
</tr>
<tr>
<td>ZD</td>
<td>1 to 31 bytes</td>
<td>Signed zoned decimal</td>
</tr>
<tr>
<td>CH</td>
<td>1 to 4000 bytes</td>
<td>Character</td>
</tr>
<tr>
<td>CSF or FS</td>
<td>1 to 32 bytes (31 digit limit)</td>
<td>Signed numeric with optional leading floating sign</td>
</tr>
<tr>
<td>UFF</td>
<td>1 to 44 bytes (31 digit limit)</td>
<td>Unsigned free form numeric</td>
</tr>
<tr>
<td>SFF</td>
<td>1 to 44 bytes (31 digit limit)</td>
<td>Signed free form numeric</td>
</tr>
<tr>
<td>DT1</td>
<td>4 bytes</td>
<td>SMF date interpreted as <code>Z'yyyymmdd'</code></td>
</tr>
<tr>
<td>DT2</td>
<td>4 bytes</td>
<td>SMF date interpreted as <code>Z'yyyymm'</code></td>
</tr>
<tr>
<td>DT3</td>
<td>4 bytes</td>
<td>SMF date interpreted as <code>Z'yyyyddd'</code></td>
</tr>
<tr>
<td>DC1</td>
<td>8 bytes</td>
<td>TOD date interpreted as <code>Z'yyyymmdd'</code></td>
</tr>
<tr>
<td>DC2</td>
<td>8 bytes</td>
<td>TOD date interpreted as <code>Z'yyyymm'</code></td>
</tr>
<tr>
<td>DC3</td>
<td>8 bytes</td>
<td>TOD date interpreted as <code>Z'yyyyddd'</code></td>
</tr>
<tr>
<td>DE1</td>
<td>8 bytes</td>
<td>ETOD date interpreted as <code>Z'yyyymmdd'</code></td>
</tr>
<tr>
<td>DE2</td>
<td>8 bytes</td>
<td>ETOD date interpreted as <code>Z'yyyymm'</code></td>
</tr>
<tr>
<td>DE3</td>
<td>8 bytes</td>
<td>ETOD date interpreted as <code>Z'yyyyddd'</code></td>
</tr>
<tr>
<td>TM1</td>
<td>4 bytes</td>
<td>SMF time interpreted as <code>Z'hhmmss'</code></td>
</tr>
<tr>
<td>TM2</td>
<td>4 bytes</td>
<td>SMF time interpreted as <code>Z'hhmm'</code></td>
</tr>
<tr>
<td>TM3</td>
<td>4 bytes</td>
<td>SMF time interpreted as <code>Z'hh'</code></td>
</tr>
<tr>
<td>TM4</td>
<td>4 bytes</td>
<td>SMF time interpreted as <code>Z'hhmmssxx'</code></td>
</tr>
<tr>
<td>TC1</td>
<td>8 bytes</td>
<td>TOD time interpreted as <code>Z'hhmmss'</code></td>
</tr>
<tr>
<td>TC2</td>
<td>8 bytes</td>
<td>TOD time interpreted as <code>Z'hhmm'</code></td>
</tr>
<tr>
<td>TC3</td>
<td>8 bytes</td>
<td>TOD time interpreted as <code>Z'hh'</code></td>
</tr>
<tr>
<td>TC4</td>
<td>8 bytes</td>
<td>TOD time interpreted as <code>Z'hhmmssxx'</code></td>
</tr>
<tr>
<td>TE1</td>
<td>8 bytes</td>
<td>ETOD time interpreted as <code>Z'hhmmss'</code></td>
</tr>
</tbody>
</table>
For a CSF, FS, UFF, or SFF format field:
- A maximum of 31 digits is allowed. If a value with more than 31 digits is found, ICETOOL issues an error message and terminates the operation.

For a ZD or PD format field:
- If a decimal value contains an invalid digit (A-F), ICETOOL identifies the bad value in a message and terminates the operation.
- F, E, C, A, 8, 6, 4, 2, and 0 are treated as equivalent positive signs. Thus the zoned decimal values F2F3C1, F2F3F1 and 020301 are counted as only one unique value.
- D, B, 9, 7, 5, 3, and 1 are treated as equivalent negative signs. Thus the zoned decimal values F2F3B0, F2F3D0, and 020310 are counted as only one unique value.

The fields of records that do not meet the specified criteria are not checked for invalid digits (PD and ZD) or excessive digits (CSF, FS, UFF, and SFF).

For a DT1, DT2 or DT3 format field:
- An invalid SMF date can result in a data exception (0C7 ABEND) or an incorrect ZD date.
- SMF date values are always treated as positive.

For a DC1, DC2, DC3, DE1, DE2, or DE3 format field:
- TOD and ETOD date values are always treated as positive.

For a TM1, TM2, TM3 or TM4 format field:
- An invalid SMF time can result in an incorrect ZD time.
- SMF time values are always treated as positive.

For a TC1, TC2, TC3, TC4, TE1, TE2, TE3, or TE4 format field:
- TOD and ETOD time values are always treated as positive.

**ON(p,m,f,formatting)**

Specifies the position, length and format of a numeric or character field to be used for this operation and how the data for this field is to be formatted for printing. The BLANK operand is automatically in effect.

See ON(p,m,f) for further details.
specifies formatting items that indicate how the data for this field is to be formatted for printing. Formatting items can be specified in any order, but each item can only be specified once. Any formatting item can be specified for a numeric field, but only L'string' and T'string' can be specified for a character field.

The column width is dynamically adjusted to accommodate the maximum bytes to be inserted as a result of all formatting items specified.

**mask**  
See the discussion of **mask** under ON(p,m,f,formatting) in "DISPLAY Operator" on page 587.

**E'pattern'**  
See the discussion of **E'pattern'** under ON(p,m,f,formatting) in "DISPLAY Operator" on page 587.

**L'string'**  
See the discussion of **L'string'** under ON(p,m,f,formatting) in "DISPLAY Operator" on page 587.

**F'string'**  
See the discussion of **F'string'** under ON(p,m,f,formatting) in "DISPLAY Operator" on page 587.

**T'string'**  
See the discussion of **T'string'** under ON(p,m,f,formatting) in "DISPLAY Operator" on page 587.

**LZ**  
See the discussion of **LZ** under ON(p,m,f,formatting) in "DISPLAY Operator" on page 587.

**Ndd or Udd**  
specifies the number of digits to be used for the numeric field. Ndd or Udd can be used to change the column width for numeric fields. dd specifies the number of digits and must be a **two-digit** number between 01 and 31.

The default number of digits (d) for a numeric field is the maximum number of digits for that field. For example, d is 5 for ON(1,5,ZD). If you know that your numeric field requires less than d digits, you can use a lower number of digits (dd) instead by specifying Udd, thus reducing the column width if it is determined by d. For example, ON(1,5,ZD,U03) reduces d from 5 to 3. If you want your numeric field to be displayed with more than d digits, you can use a higher number of digits (dd) instead by specifying Ndd or Udd, thus increasing the column width if it is determined by d. For example, ON(1,5,ZD,U10) increases d from 5 to 10.
Either Ndd or Udd can be used to set \( d \) greater than the maximum for a numeric field, but only Udd can be used to set \( d \) less than the maximum for a numeric field.

For Udd:

dd is used for \( d \). For example:

- If \( \text{ON}(1,5,ZD) \) is specified, 5 digits (default for 5,ZD) are used.
- If \( \text{ON}(1,5,ZD,U10) \) is specified, 10 digits (from U10) are used.
- If \( \text{ON}(1,5,ZD,U03) \) is specified, 3 digits (from U03) are used.
- If \( \text{ON}(1,16,FS) \) is specified, 16 digits (default for 16,FS) are used.
- If \( \text{ON}(1,16,FS,U16) \) is specified, 16 digits (from U16) are used.
- If \( \text{ON}(1,16,FS,U15) \) is specified, 15 digits (from U15) are used.

If you use Udd and a numeric value overflows dd digits, ICETOOL terminates the operation. You can prevent the overflow by specifying an appropriately higher dd value for Udd. For example, if \( \text{ON}(1,12,ZD,U09) \) results in overflow, you can use \( \text{ON}(1,12,ZD,U10) \) instead.

If E'pattern' is specified, Udd is ignored, because the number of digits is determined from the pattern.

For Ndd:

If dd is greater than or equal to \( d \), dd is used. If dd is less than \( d \), \( d \) is used. For example:

- If \( \text{ON}(1,5,ZD) \) is specified, 5 digits (default for 5,ZD) are used.
- If \( \text{ON}(1,5,ZD,N10) \) is specified, 10 digits (from N10) are used.
- If \( \text{ON}(1,5,ZD,N03) \) is specified, 5 digits (from 5,ZD) are used.

If E'pattern' is specified, Ndd is ignored, because \( d \) is determined from the pattern.

**ON\((p,m,\text{HEX})\)**

Specifies the position and length of a character field to be used for this operation and printed in hexadecimal format (00-FF for each byte). \( \text{\texttt{(p,m,HEX)}} \) is used for the standard column heading (see \texttt{HEADER('string1')}, \texttt{HEADER('string1','string2')}, \texttt{HEADER('string1','string2','string3')}, \texttt{HEADER(NONE)}, and \texttt{NOHEADER} for alternative heading options).

See \texttt{ON\((p,m,f)\)} for a discussion of \texttt{p}.

\texttt{m} specifies the length of the field in bytes. A field must not extend beyond position 32752 or beyond the end of a record. A field can be 1 to 2000 bytes.

**ON\((\text{VLEN})\)**

Equivalent to specifying \( \text{ON}(1,2,BI) \); a two-byte binary field starting at position 1. For variable-length records, ON(VLEN) represents the record-length for each record. \texttt{RECORD LENGTH} is used for the standard column heading. See \texttt{HEADER('string1')}, \texttt{HEADER('string1','string2')}, \texttt{HEADER('string1','string2','string3')}, \texttt{HEADER(NONE)}, and \texttt{NOHEADER} for alternative heading options.

**ON\((\text{VLEN},formatting)\)**

Equivalent to specifying \( \text{ON}(1,2,BI,\text{formatting}) \); a two-byte binary field starting at position 1, and how the data for this field is to be formatted for printing. The BLANK operand is automatically in effect.

See \texttt{ON\((\text{VLEN})\)} for further details.
OCCUR Operator

specifies formatting items that indicate how the data for this field is to be formatted for printing. Formatting items can be specified in any order, but each item can only be specified once.

The column width is dynamically adjusted to accommodate the maximum bytes to be inserted as a result of all formatting items specified.

mask See the discussion of mask under ON(p,m,f,formatting) in "DISPLAY Operator" on page 587.

E'pattern' See the discussion of E'pattern' under ON(p,m,f,formatting) in "DISPLAY Operator" on page 587.

L'string' See the discussion of L'string' under ON(p,m,f,formatting) in "DISPLAY Operator" on page 587.

F'string' See the discussion of F'string' under ON(p,m,f,formatting) in "DISPLAY Operator" on page 587.

T'string' See the discussion of T'string' under ON(p,m,f,formatting) in "DISPLAY Operator" on page 587.

LZ See the discussion of LZ under ON(p,m,f,formatting) in "DISPLAY Operator" on page 587.

Ndd or Udd See the discussion of Ndd or Udd under ON(p,m,f,formatting) in "OCCUR Operator" on page 642.

ON(VALCNT)

Specifies that the number of occurrences for each unique value is to be printed. 'VALUE COUNT' is used for the standard column heading (see HEADER('string1'), HEADER('string1','string2'), HEADER('string1','string2','string3'), HEADER(NONE) and NOHEADER for alternative heading options).

ON(VALCNT,formatting)

Specifies that the number of occurrences for each unique value is to be printed, and how the value count is to be formatted for printing. The BLANK operand is automatically in effect.

See ON(VALCNT) for further details.
specifies formatting items that indicate how the value count is to be formatted for printing. Formatting items can be specified in any order, but each item can only be specified once.

The column width is dynamically adjusted to accommodate the maximum bytes to be inserted as a result of all formatting items specified.

**mask**

See the discussion of *mask* under ON(p,m,f,formatting) in "DISPLAY Operator" on page 587.

**E'pattern'**

specifies an edit pattern to be applied to the value count. The pattern (1 to 24 characters) must be enclosed in single apostrophes. Each 9 in the pattern (up to 15) is replaced by a corresponding digit from the numeric value. Characters other than 9 in the pattern appear as specified. To include a single apostrophe (') in the pattern, specify two single apostrophes ('').

F'string' or a mask cannot be specified with E'pattern'.

When E'pattern' is specified for the value count:

- If the number of significant digits in a value count is less than the number of 9's in the pattern, 0's are filled in on the left. For example, 1234 is shown as 001234 with ON(VALCNT,E'999999').
- If the number of significant digits in a value count is greater than the number of 9's in the pattern, digits are truncated from the left. For example, 1234567 is shown as *4567* with ON(VALCNT,E'99999').

**L'string'**

See the discussion of L'string' under ON(p,m,f,formatting) in "DISPLAY Operator" on page 587.

**F'string'**

See the discussion of F'string' under ON(p,m,f,formatting) in "DISPLAY Operator" on page 587.

**T'string'**

See the discussion of T'string' under ON(p,m,f,formatting) in "DISPLAY Operator" on page 587.

**LZ**

See the discussion of LZ under ON(p,m,f,formatting) in "DISPLAY Operator" on page 587.

**Ndd or Udd**

Specifies the number of digits to be used for the value count when

Chapter 7. Using ICETOOL 651
determining the column width. dd specifies the number of digits and must be a two-digit number between 01 and 15.

The default number of digits (d) for the value count is 15. If you know that your value counts require less than 15 digits, you can use a lower number of digits (dd) instead by specifying Ndd or Udd, thus reducing the column width if it is determined by d. For example, if ON(VALCNT,N06) or ON(VALCNT,U06) is specified, 6 digits (from N06 or U06) is used instead of 15 (default for value count).

If you use Ndd or Udd and a value count overflows the number of digits used, ICETOOL terminates the operation. You can prevent the overflow by specifying an appropriately higher dd value for Ndd or Udd. For example, if ON(VALCNT,N05) results in overflow, you can use ON(VALCNT,N06) instead.

If E'pattern' is specified, Ndd or Udd is ignored, because d is determined from the pattern.

LIST(listdd)
See the discussion of this operand on the DISPLAY statement in DISPLAY Operator on page 587.

TITLE('string')
See the discussion of this operand on the DISPLAY statement in DISPLAY Operator on page 587.

TITLE('string1','string2')
See the discussion of this operand on the DISPLAY statement in DISPLAY Operator on page 587.

TITLE('string1','string2','string3')
See the discussion of this operand on the DISPLAY statement in DISPLAY Operator on page 587.

TLEFT
See the discussion of this operand on the DISPLAY statement in DISPLAY Operator on page 587.

TFIRST
See the discussion of this operand on the DISPLAY statement in DISPLAY Operator on page 587.

PAGE
See the discussion of this operand on the DISPLAY statement in DISPLAY Operator on page 587.

DATE
See the discussion of this operand on the DISPLAY statement in DISPLAY Operator on page 587.

DATE(abcd)
See the discussion of this operand on the DISPLAY statement in DISPLAY Operator on page 587.

DATENS(abc)
See the discussion of this operand on the DISPLAY statement in DISPLAY Operator on page 587.

YDDD(abc)
See the discussion of this operand on the DISPLAY statement in DISPLAY Operator on page 587.
YDDDNS(ab)
See the discussion of this operand on the DISPLAY statement in "DISPLAY Operator" on page 587.

TIME
See the discussion of this operand on the DISPLAY statement in "DISPLAY Operator" on page 587.

TIME(abc)
See the discussion of this operand on the DISPLAY statement in "DISPLAY Operator" on page 587.

TIMENS(ab)
See the discussion of this operand on the DISPLAY statement in "DISPLAY Operator" on page 587.

BLANK
See the discussion of this operand on the DISPLAY statement in "DISPLAY Operator" on page 587.

PLUS
See the discussion of this operand on the DISPLAY statement in "DISPLAY Operator" on page 587.
For ON(VALCNT), PLUS is treated as BLANK.

NOCC
See the discussion of this operand on the DISPLAY statement in "DISPLAY Operator" on page 587.

HEADER('string1')
See the discussion of this operand on the DISPLAY statement in "DISPLAY Operator" on page 587.

HEADER('string1','string2')
See the discussion of this operand on the DISPLAY statement in "DISPLAY Operator" on page 587.

HEADER('string1','string2','string3')
See the discussion of this operand on the DISPLAY statement in "DISPLAY Operator" on page 587.

HEADER(NONE)
See the discussion of this operand on the DISPLAY statement in "DISPLAY Operator" on page 587.

NOHEADER
See the discussion of this operand on the DISPLAY statement in "DISPLAY Operator" on page 587.

LINES(n)
See the discussion of this operand on the DISPLAY statement in "DISPLAY Operator" on page 587.

INDENT(n)
See the discussion of this operand on the DISPLAY statement in "DISPLAY Operator" on page 587.

BETWEEN(n)
See the discussion of this operand on the DISPLAY statement in "DISPLAY Operator" on page 587.
**OCCUR Operator**

**TBETWEEN(n)**
- See the discussion of this operand on the DISPLAY statement in [DISPLAY Operator](#) on page 587.

**ALLDUPS**
- Limits the ON values printed to those that occur more than once (that is, those with duplicate field values). The ON values are printed when value count > 1.
- ALLDUPS is equivalent to HIGHER(1).

**NODUPS**
- Limits the ON values printed to those that occur only once (that is, those with no duplicate field values). The ON values are printed when value count = 1.
- NODUPS is equivalent to EQUAL(1) or LOWER(2).

**HIGHER(x)**
- Limits the ON values printed to those that occur more than x times. The ON values are printed when value count > x.
- x must be specified as n or +n where n can be 1 to 15 decimal digits.

**LOWER(y)**
- Limits the ON values printed to those that occur less than y times. The ON values are printed when value count < y.
- y must be specified as n or +n where n can be 1 to 15 decimal digits.

**EQUAL(v)**
- Limits the ON values printed to those that occur v times. The ON values are printed when value count = v.
- v must be specified as n or +n where n can be 1 to 15 decimal digits.

**VSAMTYPE(x)**
- See the discussion of this operand on the COPY statement in [COPY Operator](#) on page 568.

**WIDTH(n)**
- See the discussion of this operand on the DISPLAY statement in [DISPLAY Operator](#) on page 587.

**LONGLINE**
- See the discussion of this operand on the DISPLAY statement in [DISPLAY Operator](#) on page 587.

**UZERO**
- Specifies that −0 and +0 are to be treated as unsigned zero values, that is, as the same value. With UZERO, −0 and +0 are treated as positive for ON processing.
- UZERO overrides the default of treating −0 and +0 as signed zero values, that is, as different values. Without UZERO, −0 is treated as negative and +0 is treated as positive for ON processing.

**LISTSDB or LISTNOSDB**
- See the discussion of these operands on the DISPLAY statement in [DISPLAY Operator](#) on page 587.
OCCUR Examples

Although the OCCUR operators in the examples below could all be contained in a single ICETOOL job step, they are shown and discussed separately for clarity. See “DISPLAY Operator” on page 587 for additional examples of tailoring the report format.

Example 1

OCCUR FROM(SOURCE) LIST(VOLSERS) ON(40,6,CH) ON(VALCNT)

Prints, in the VOLSERS data set:

- A heading line containing the standard headings
- A data line for each unique ON(40,6,CH) value in the standard format containing:
  - The characters from positions 40-45 of the SOURCE data set for the unique value
  - The count of occurrences in the SOURCE data set of the unique value

The VOLSERS output starts on a new page and looks as follows (the first 2 records are shown with illustrative values):

<table>
<thead>
<tr>
<th>(40,6,CH)</th>
<th>VALUE</th>
<th>COUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABC001</td>
<td>000000000000025</td>
<td></td>
</tr>
<tr>
<td>ABC002</td>
<td>000000000000011</td>
<td></td>
</tr>
<tr>
<td>.</td>
<td>.</td>
<td></td>
</tr>
<tr>
<td>.</td>
<td>.</td>
<td></td>
</tr>
</tbody>
</table>

The heading line appears at the top of each page.

Example 2

OCCUR FROM(IN) LIST(LIST1) -
  TITLE(' 3090 Distribution ') -
  PAGE -
  HEADER('Data Centers') ON(VALCNT) -
  HEADER('State') ON(1,16,CH) -
  HEADER('3090s') ON(25,3,PD) -
  BLANK

Prints, in the LIST1 data set:

- A title line containing the specified title and the page number
- A heading line containing the specified underlined headings
- A data line for each unique ON(1,16,CH) and ON(25,3,PD) value in the BLANK format containing:
  - The count of occurrences in the IN data set of the unique value
  - The characters from positions 1-16 of the IN data set for the unique value
  - The packed decimal values from positions 25-27 of the IN data set for the unique value

The LIST1 output starts on a new page and looks as follows (the first 2 records are shown with illustrative values):
The title line and underlined heading line appear at the top of each page.

### Example 3

```
OCCUR FROM(FAILURES) LIST(CHECKIT) BLANK HIGHER(4) -
DATE TITLE('Possible System Intruders on ',System) -
  TITLE(Sysplex, ' in ',Location) PAGE -
TBETWEEN(2) -
HEADER('Userid') ON(23,8,CH) -
HEADER('Logon failures','(More than 4)') ON(VALCNT)
```

Assume that the SYMNAMES data set contains the following symbols:

```
System, S'&SYSNAME'
Sysplex, S'&SYSPLEX'
Location, 'San Jose'
```

Prints, in the CHECKIT data set:

- A first title line containing the date, the string and System name specified in the first TITLE operand, and the page number. Two blanks appear between the title elements in the first title line as specified by the TBETWEEN(2) operand. A blank line follows the first title line.
- A second title line containing the Sysplex name, string and Location specified in the second TITLE operand. A blank line follows the second title line.
- An underlined three-line heading. The three-line heading for the first ON field has blanks on line1 and line2 and 'Userid' on line3. The heading for the second ON field has 'Number of' on line1, 'Logon Failures' on line2 and '(More than 4)' on line3.
- A data line for each unique ON(23,8,CH) value for which there are more than 4 occurrences, in the BLANK format, containing:
  - The characters from positions 23-30 of the FAILURES data set
  - The count of occurrences of the characters from positions 23-30 of the FAILURES data set

The CHECKIT output starts on a new page and looks as follows (the first 2 records are shown with illustrative values):

```
07/22/08 Possible System Intruders on EDS3 - 1 -
       MAS3 in San Jose

  Userid Logon failures
  -------- ---------------
    B7234510 5
    D9853267 11
    ...
```

The title lines and underlined three-line heading lines appear at the top of each page.
Example 4

OCCUR FROM(VARN) LIST(ONCE) -
  TITLE('Record lengths that occur only once') -
  TIME(12:) DATE(DMY.) -
  ON(VLEN) NODUPS BLANK

Prints, in the ONCE data set:
• A title line containing the specified title and the time and date
• A heading line containing the standard heading
• A data line for each record length for which there is only one occurrence, in the
  BLANK format, containing the record length

The ONCE output starts on a new page and looks as follows (the first 2 records
are shown with illustrative values):

<table>
<thead>
<tr>
<th>Record lengths that occur only once</th>
<th>09:52:17 am</th>
<th>21.10.92</th>
</tr>
</thead>
<tbody>
<tr>
<td>RECORD LENGTH</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td></td>
<td>61</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The title line and heading line appear at the top of each page.

Example 5

OCCUR FROM(BRANCH) LIST(CALLRPT) -
  DATENS(4MD) -
  TITLE('Yearly Branch Phone Call Counts') -
  HEADER('Phone Number') ON(7,10,ZD,E'(999)-999-9999') -
  HEADER('Calls') ON(VALCNT,A1,N05) -
  INDENT(5) BETWEEN(10)

Prints, in the CALLRPT data set:
• A title line containing the date (without separators) and the specified title.
• A heading line containing the specified underlined headings.
• A data line for each unique ON(7,10,ZD) value containing:
  – The zoned decimal value from positions 7-16 of the BRANCH data set printed
    as (ddd)-ddd-dddd according to the E'pattern' formatting item.
  – The count of occurrences of this value printed as dd,ddd according to the A1
    and N05 formatting items.

The report is indented by five blanks as specified by the INDENT(5) operand, and
ten blanks appear between the columns as specified by the BETWEEN(10)
operand.

The CALLRPT output starts on a new page and looks as follows:

<p>| 20020316 Yearly Branch Phone Call Counts |
|-----------------------------------------|----------------|</p>
<table>
<thead>
<tr>
<th>Phone Number</th>
<th>Calls</th>
</tr>
</thead>
<tbody>
<tr>
<td>(037)-325-1807</td>
<td>3,125</td>
</tr>
<tr>
<td>(216)-721-5530</td>
<td>2,087</td>
</tr>
<tr>
<td>(218)-062-7214</td>
<td>872</td>
</tr>
</tbody>
</table>
Prints a message containing the count of values in a specified range for a specific numeric field.

DFSORT is called to copy the indd data set to ICETOOL's E35 user exit. ICETOOL prints a message containing the range count as determined by its E35 user exit.

The range can be specified as higher than x, lower than y, higher than x and lower than y, equal to v, or not equal to w, where x, y, v, and w are signed or unsigned decimal values. If the range is specified as higher than x and lower than y, it must be a valid range (for example, higher than 5 and lower than 6 is not a valid range, because there is no integer value that satisfies the criteria).

You must not supply your own DFSORT MODS, INREC, or OUTREC statement, because they would override the DFSORT statements passed by ICETOOL for this operator.

**Operand Descriptions**

The operands described below can be specified in any order.

**FROM(indd)**

See the discussion of this operand on the DISPLAY statement in "DISPLAY Operator" on page 587.

**ON(p,m,f)**

Specifies the position, length, and format of the numeric field to be used for this operation.

- **p** specifies the first byte of the field relative to the beginning of the input record. p is 1 for the first data byte of a fixed-length record and 5 for the first data byte of a variable-length record as illustrated below (RRRR represents the 4-byte record descriptor word):

<table>
<thead>
<tr>
<th>Fixed-length record</th>
<th>Variable-length record</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>A</td>
</tr>
<tr>
<td>p= 1 2 3 4</td>
<td>p= 1 2 3 4 5 6 7 8</td>
</tr>
</tbody>
</table>

- **m** specifies the length of the field in bytes. A field must not extend beyond position 32752 or beyond the end of a record. The maximum length for a field depends on its format.

- **f** specifies the format of the field as follows:
### RANGE Operator

<table>
<thead>
<tr>
<th>Format Code</th>
<th>Length</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BI</td>
<td>1 to 8 bytes</td>
<td>Unsigned binary</td>
</tr>
<tr>
<td>FI</td>
<td>1 to 8 bytes</td>
<td>Signed fixed-point</td>
</tr>
<tr>
<td>PD</td>
<td>1 to 16 bytes</td>
<td>Signed packed decimal</td>
</tr>
<tr>
<td>ZD</td>
<td>1 to 31 bytes</td>
<td>Signed zoned decimal</td>
</tr>
<tr>
<td>CSF or FS</td>
<td>1 to 32 bytes (31 digit limit)</td>
<td>Signed numeric with optional leading floating sign</td>
</tr>
<tr>
<td>UFF</td>
<td>1 to 44 bytes (31 digit limit)</td>
<td>Unsigned free form numeric</td>
</tr>
<tr>
<td>SFF</td>
<td>1 to 44 bytes (31 digit limit)</td>
<td>Signed free form numeric</td>
</tr>
</tbody>
</table>

**Note:** See Appendix C, “Data Format Descriptions,” on page 885 for detailed format descriptions.

For a CSF, FS, UFF, or SFF format field:

- A maximum of 31 digits is allowed. If a value with more than 31 digits is found, ICETOOL issues an error message and terminates the operation.

For a ZD or PD format field:

- If a decimal value contains an invalid digit (A-F), ICETOOL identifies the bad value in a message and terminates the operation.
- A value is treated as positive if its sign is F, E, C, A, 8, 6, 4, 2, or 0.
- A value is treated as negative if its sign is D, B, 9, 7, 5, 3, or 1.

For a ZD, PD, CSF, FS, or SFF format field, a negative zero value is treated as a positive zero value.

**ON(VLEN)**

See the discussion of this operand on the DISPLAY statement in “DISPLAY Operator” on page 587.

**HIGHER(x)**

Values higher than x are counted as contained in the range. If only HIGHER(x) is specified, the range count is incremented when x < value. If LOWER(y) is also specified, the range count is incremented when x < value < y.

x must be specified as n, +n, or −n where n can be 1 to 31 decimal digits.

**LOWER(y)**

Values lower than y are counted as contained in the range. If only LOWER(y) is specified, the range count is incremented when value < y. If HIGHER(x) is also specified, the range count is incremented when x < value < y.

y must be specified as n, +n, or −n where n can be 1 to 31 decimal digits.

**EQUAL(v)**

Values equal to v are counted as contained in the range. The range count is incremented when v = value.

v must be specified as n, +n, or −n where n can be 1 to 31 decimal digits.

**NOTEQUAL(w)**

Values not equal to w are counted as contained in the range. The range count is incremented when w ≠ value.

w must be specified as n, +n, or −n where n can be 1 to 31 decimal digits.

**VSAMTYPE(x)**

See the discussion of this operand on the COPY statement in “COPY Operator” on page 568.
**RANGE Operator**

**RANGE Example**

```
RANGE FROM(DATA1) ON(VLEN) HIGHER(10)
RANGE FROM(DATA2) ON(31,18,ZD) LOWER(+123456789012345678)
RANGE FROM(DATA3) ON(29001,4,FI) -
     HIGHER(-10000) LOWER(27)
RANGE FROM(DATA2) ON(45,3,PD) EQUAL(-999)
RANGE FROM(DATA3) ON(40,1,BI) NOTEQUAL(199)
```

The first RANGE operator prints a message containing the count of binary values from positions 1-2 of the DATA1 data set that are higher than 10.

The second RANGE operator prints a message containing the count of zoned decimal values from positions 31-48 of the DATA2 data set that are lower than 123456789012345678.

The third RANGE operator prints a message containing the count of fixed-point values from positions 29001-29004 of the DATA3 data set that are higher than -10000 but lower than 27.

The fourth RANGE operator prints a message containing the count of packed decimal values from positions 45-47 of the DATA2 data set that are equal to -999.

The fifth RANGE operator prints a message containing the count of binary values from position 40 of the DATA3 data set that are not equal to 199. This RANGE operator could be used to count the number of records that do not have 'G' in position 40, because 199 (X'C7') is the EBCDIC code for 'G'. Alternatively, the COUNT operator could be used with OMIT COND=(40,1,CH,EQ,C'G').

**RESIZE Operator**

```
RESIZE—FROM(indd)—TO(outdd)—TOLEN(n)
    —USING(xxx)
```

Produces fixed length output records, with the specified TOLEN length, from fixed length input records of a different length, as follows:

- If the input length is smaller than the requested TOLEN size, multiple smaller input records are combined into one larger output record of size TOLEN. If the combined input records do not completely fill up an output record, the output record will be padded on the right with blanks. For example, if we have five input records of 20 bytes and TOLEN is 70, two output records of 70 bytes will be created. The first output record will have input records 1-3 (60 bytes) followed by 10 blanks, and the second output record will have input records 4-5 (40 bytes) followed by 30 blanks. Note that the first 10 bytes of input record 4 are not used for the first output record; **bytes or words are not "wrapped" between records**.

To illustrate, if the following RESIZE operator was specified:

```
RESIZE FROM(FB20) TO(FB70) TOLEN(70)
```

and FB20 had these 20 byte input records:
FB70 would have these 70 byte output records:

```
<111111111111111111><222222222222222222><333333333333333333>
<444444444444444444><555555555555555555>
```

- If the input length is larger than the requested TOLEN size, each larger input record is broken up into multiple smaller output records of size TOLEN. If a broken up input record does not completely fill up the multiple output records, the last of the multiple output records will be padded on the right with blanks. For example, if we have two input records of 50 bytes and TOLEN is 20, six output records of 20 bytes each will be created. The first two output records will have bytes 1-20 and 21-40 of the first input record (40 bytes), respectively. The third output record will have bytes 41-50 of the first input record (10 bytes) followed by 10 blanks. Likewise, the fourth output record will have bytes 1-20 of the second input record, the fifth output record will have bytes 21-40 of the second input record, and the sixth output record will have bytes 41-50 of the second input record followed by 10 blanks.

To illustrate, if the following RESIZE operator was specified:

```
RESIZE FROM(F50) TO(F20) TOLEN(20)
```

and F50 had these 50 byte input records:

```
<111111111111111111><222222222222222222><333333333333333333>
<444444444444444444><555555555555555555><66666666>
```

F20 would have these 20 byte output records:

```
<111111111111111111>
<222222222222222222>
<33333333>
<444444444444444444>
<555555555555555555>
<66666666>
```

You must specify the FROM(indd), TO(outdd) and TOLEN(n) operands. The FROM data set must be fixed-length (for example, RECFM=FB). The TO data set must also be fixed-length (unless you use an OUTFIL statement with the FTOV operand to change the fixed-length resized records to variable-length output records). If a VSAM input data set is used, it will be treated as TYPE=F (fixed-length) by default. If you specify a variable-length input data set (or use TYPE=V for a VSAM input data set), the RESIZE operation will be terminated.

The USING(xxxx) operand is optional; do not supply your own MODS or OUTREC statement.

DFSORT is called to copy or sort the indd data set, as appropriate, before the records are resized. ICETOOL uses its E35 exit to create a larger record from multiple smaller records, or to create multiple smaller records from a larger record. ICETOOL passes the EQUALS option to DFSORT to ensure that if records are sorted, duplicate records are kept in their original input order when resized.

If USING(xxxx) is specified, any SORT, INCLUDE, OMIT, INREC, or SUM statement specified in xxxxCNTL is processed before the records are resized. The order of the records, and the input length, will be affected by these control statements. Any OUTFIL statements specified in xxxxCNTL are processed after the records are resized.
The DYNALLOC option is passed to DFSORT to ensure that work space is available for the sort. If your installation defaults for dynamic allocation are inappropriate for a RESIZE operator, you can take one of the following actions:

1. Override the DYNALLOC option using an OPTION control statement such as:
   ```
   OPTION DYNALLOC=(,8)
   in the xxxxCNTL data set.
   ```

2. Use xxxxWKdd DD statements to override the use of dynamic allocation. Refer to “SORTWKdd DD Statement” on page 72 for details.

Tape work data sets cannot be used with ICETOOL.

**Operand Descriptions**

The operands described below can be specified in any order.

- **FROM(indd)**
  
  See the discussion of this operand on the COPY statement in “COPY Operator” on page 568.

- **TO(outdd)**
  
  See the discussion of this operand on the DATASORT statement in “DATASORT Operator” on page 579.

- **TOLEN(n)**
  
  Specifies the record length you want ICETOOL to use for the resized output records. n can be 1 to 32760. n must not be equal to the input record length.

- **USING(xxxx)**
  
  Specifies the first 4 characters of the ddname for the control statement data set to be used by DFSORT for this operation. xxxx must be four characters that are valid in a ddname of the form xxxxCNTL. xxxx must not be SYSx. If USING(xxxx) is specified, an xxxxCNTL DD statement must be present, and the control statements in it must conform to the rules for DFSORT’s SORTCNTL data set.

**RESIZE Examples**

Although the RESIZE operators in the examples below could all be contained in a single ICETOOL job step, they are shown and discussed separately for clarity.

**Example 1**

```
RESIZE FROM(IN1) TO(OUT1) TOLEN(40)
```

This example illustrates how you can create larger records from smaller records.

The IN1 data set has RECFM=FB and LRECL=10 with these 10-byte records:

- Bird
- Bluejay
- 4
- Charlie
- Rodent
- Rat
- 2
- Sara

The OUT1 data set has RECFM=FB and LRECL=40 with these 40 byte records:

- Bird  Bluejay  4  Charlie
- Rodent  Rat  2  Sara
RESIZE Operator

Example 2
RESIZE FROM(OLD) TO(NEW) TOLEN(15) USING(CTL1)

This example illustrates how you can create larger records from a subset of smaller sorted records.

The CTL1CNTL data set contains:

OMIT COND=(2,4,ZD,EQ,0)
SORT FIELDS=(1,1,CH,A)

The OLD data set has RECFM=FB and LRECL=5 with these 5-byte records:

C0005
B0000
A0008
I1234
F0053
D0123
H0001
G0000
E0022

The NEW data set will have RECFM=FB and LRECL=15 with these 15-byte records:

A0008C0005D0123
E0022F0053H0001
I1234

Note that before the records were resized, the two records with 0 in positions 2-5 were omitted, and the remaining records were sorted as directed by the DFSORT control statements in CTL1CNTL. The last output record was padded with blanks on the right to 15 bytes.

Example 3
RESIZE FROM(IN3) TO(OUT3) TOLEN(3) USING(CTL2)

This example illustrates how you can break up large records into multiple smaller records.

The CTL2CNTL data set contains:

OUTFIL FNAMES=OUT3,OMIT=(1,3,CH,EQ,C' '),OVERLAY=(10:X)

The IN3 data set has RECFM=FB and LRECL=18 with these 18-byte records:

000111222333444555
666777888999

Every 3-byte field in each large IN3 record will be broken up into a single 3-byte field and then padded on the right with blanks to 10-bytes. TOLEN(3) indicates that the resized records will have a length of 3 bytes. OVERLAY=(10:X) expands each resized record to 10 bytes in OUT3. OMIT=(1,3,CH,EQ,C' ') removes any resized records that are completely blank (that is, the two blank resized records resulting from the blanks in positions 13-18 of the second input record).

The OUT3 data set will have RECFM=FB and LRECL=10 with these 10-byte records:

000
111
222
**RESIZE Operator**

**SELECT Operator**

SELECT FROM(indd) TO(outdd) DISCARD(savedd) TO(outdd) DISCARD(savedd)

ALLDUPS
- NODUPS
- HIGHER(x)
- LOWER(y)
- EQUAL(v)
- FIRST
- FIRSTDUP
- LASTDUP
- FIRSTDUP(w)
- LASTDUP

Selects records from an input data set based on meeting criteria for the number of times specified numeric or character field values occur. This makes it possible to only keep records with duplicate field values, only keep records with no duplicate field values, only keep records with field values that occur more than, less than, or exactly n times, only keep the first or first n duplicate records with each field value, or only keep the first or last record with each unique or duplicate field value. From 1 to 10 fields can be specified. At least one ON(VLEN) or ON(p,m,f) field must be specified; all such ON fields specified will be used to determine the "value count" (that is, the number of times the ON values occur) to be matched against the criteria.

DISCARD(savedd) can be used to save the records that do not meet the criteria (that is, the discarded records), in the savedd data set. DISCARD(savedd) can be used with or without TO(outdd).

DFSORT is called to sort the indd data set. ICETOOL uses its E35 exit to determine which records to include in the outdd data set or savedd data set. ICETOOL passes the EQUALS option to DFSORT to ensure that duplicates are kept in their original input order.

The DFSORT control statements in xxxxCNTL are used if USING(xxxx) is specified.

Do not supply your own MODS, SUM or OUTREC statement.
You can use comment statements. You can use INCLUDE, OMIT, INREC, OPTION, SORT, or OUTFIL statements providing you observe these rules:

- You can use an INCLUDE or OMIT statement to remove input records before SELECT processing.
- You can use an INREC statement to reformat input records before SELECT processing. You can use INREC’s PARSE, BUILD (FIELDS), OVERLAY, FINDREP, IFTHEN, or IFOUTLEN functions. If your INREC statement changes the starting position of an ON field, you must specify the new starting position for that ON field. For example, if your input records have a CH key at positions 1-5 and you use an INREC statement like this:
  
  ```
  INREC FIELDS=(25:1,50)
  ```

  you must specify ON(25,5,CH) instead of ON(1,5,CH).
- If you specify a SORT statement, you must specify each ON field as a p,m,f,A sort field and these sort fields must be in the same order as the ON fields. After these sort fields, you can specify additional p,m,f,A or p,m,f,D sort fields. The additional sort fields will be used for sorting, but not for selecting. For example, if you use a SELECT statement like this:
  
  ```
  SELECT FROM(IN) TO(OUT) ON(21,5,CH) FIRST(3) USING(CTL1)
  ```

  you can use a SORT statement in CTL1CNTL like this:
  
  ```
  SORT FIELDS=(21,5,CH,A,41,6,CH,D)
  ```

  The records will be sorted by the 21,5,CH,A field and the 41,6,CH,D field, but only selected by the 21,5,CH field. This would allow you to select the three highest 41,6,CH values for each 21,5,CH value.
- If you specify TO(outdd) without DISCARD(savedd), you can further process the outdd records after SELECT processing using an OUTFIL statement like this:
  
  ```
  OUTFIL FNAMES=outdd,...
  ```

  or multiple OUTFIL statements like this:
  
  ```
  OUTFIL FNAMES=outdd,...
  OUTFIL FNAMES=outdd1,...
  ...
  ```

  - If you specify DISCARD(savedd) without TO(outdd), you can further process the savedd records after SELECT processing using one (and only one) OUTFIL statement like this:
    
    ```
    OUTFIL FNAMES=savedd,...
    ```

  - If you specify TO(outdd) and DISCARD(savedd), you can further process the outdd and savedd records after SELECT processing using two (and only two) OUTFIL statements like this:
    
    ```
    OUTFIL FNAMES=outdd,...
    OUTFIL FNAMES=savedd,...
    ```

  Both statements must be specified in the order shown with at least the FNAMES parameter. For example, to further modify only the DISCARD data set, you could use statements like this:
  
  ```
  OUTFIL FNAMES=OUT
  OUTFIL FNAMES=SAVE, INCLUDE=(21,3,ZD,GT,+25)
  ```

ICETOOL requires extra storage for SELECT processing, over and above what is normally needed by ICETOOL and DFSORT, in order to save your records until it can determine whether or not they meet your specified criteria. In most cases, only a small amount of storage is needed and can be obtained (above 16MB virtual).
SELECT Operator

However, for a FROM data set with a large record length and criteria requiring many saved records, a large amount of storage is needed. For example, with a record length of 32756 and HIGHER(99), over 3 MBs of storage is needed. If ICETOOL cannot get the storage it needs, it issues a message and terminates the SELECT operation. Increasing the REGION by the amount indicated in the message may allow ICETOOL to run successfully.

The DYNALLOC option is passed to DFSORT to ensure that work space is available for the sort. If your installation defaults for dynamic allocation are inappropriate for a SELECT operator, you can specify USING(xxxx) and take one of the following actions:

1. Override the DYNALLOC option using an OPTION control statement such as:

   ```
   OPTION DYNALLOC=(,8) in the xxxxCNTL data set.
   ```

2. Use xxxxWKdd DD statements to override the use of dynamic allocation. Refer to "SORTWKdd DD Statement" on page 72 for details.

Tape work data sets cannot be used with ICETOOL.

Operand Descriptions

The operands described below can be specified in any order.

FROM(indd)

See the discussion of this operand on the COPY statement in "COPY Operator" on page 568.

TO(outdd)

Specifies the ddname of the output data set to which DFSORT will write the records it selects for the operation (that is, the records that meet the specified criteria). Thus, the outdd data set will contain the records selected by ALLDUPS, NODUPS, HIGHER(x), LOWER(y), EQUAL(v), FIRST, FIRST(u), LAST, FIRSTDUP, FIRSTDUP(w) or LASTDUP.

An outdd DD statement must be present and must define an output data set that conforms to the rules for DFSORT's SORTOUT data set (if the DISCARD operand is not specified) or OUTFIL data set (if the DISCARD operand is specified).

TO and DISCARD can both be specified. If DISCARD is not specified, TO must be specified. If TO is not specified, DISCARD must be specified.

The ddname specified in the TO operand must not be the same as the ddname specified in the FROM or DISCARD operand.

Refer to "JCL Restrictions" on page 566 for more information.

DISCARD(savedd)

Specifies the ddname of the output data set to which DFSORT will write the records it does not select for this operation (that is, the records that do not meet the specified criteria). Thus, the savedd data set will contain the records discarded by ALLDUPS, NODUPS, HIGHER(x), LOWER(y), EQUAL(v), FIRST, FIRST(u), LAST, FIRSTDUP, FIRSTDUP(w) or LASTDUP.

A savedd DD statement must be present and must define an output data set that conforms to the rules for DFSORT's OUTFIL data set.

TO and DISCARD can both be specified. If DISCARD is not specified, TO must be specified. If TO is not specified, DISCARD must be specified.
The ddname specified in the DISCARD operand must not be the same as the ddname specified in the FROM or TO operand.

Refer to "JCL Restrictions" on page 566 for more information.

**ON(p,m,f)**

Specifies the position, length, and format of a numeric or character field to be used for this operation.

- **p** specifies the first byte of the field relative to the beginning of the input record. p is 1 for the first data byte of a fixed-length record and 5 for the first data byte of a variable-length record as illustrated below (RRRR represents the 4-byte record descriptor word):

```
Fixed-length record | Variable-length record
| D | A | T | A | ... | R | R | R | D | A | T | A | ...
```

```
p = 1 2 3 4 | p = 1 2 3 4 5 6 7 8
```

If INREC is specified, p must refer to the record as reformatted by INREC.

- **m** specifies the length of the field in bytes. A field must not extend beyond position 32752, or beyond the end of a record. If INREC is specified, a field must not extend beyond the end of the record as reformatted by INREC. The maximum length for a field depends on its format.

- **f** specifies the format of the field as shown below.

<table>
<thead>
<tr>
<th>Format Code</th>
<th>Length</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BI</td>
<td>1 to 1500 bytes</td>
<td>Unsigned binary</td>
</tr>
<tr>
<td>FI</td>
<td>1 to 256 bytes</td>
<td>Signed fixed-point</td>
</tr>
<tr>
<td>PD</td>
<td>1 to 16 bytes</td>
<td>Signed packed decimal</td>
</tr>
<tr>
<td>ZD</td>
<td>1 to 31 bytes</td>
<td>Signed zoned decimal</td>
</tr>
<tr>
<td>CH</td>
<td>1 to 4000 bytes</td>
<td>Character</td>
</tr>
<tr>
<td>CSF or FS</td>
<td>1 to 32 bytes</td>
<td>Signed numeric with optional leading floating sign</td>
</tr>
<tr>
<td>UFF</td>
<td>1 to 44 bytes</td>
<td>Unsigned free form numeric</td>
</tr>
<tr>
<td>SFF</td>
<td>1 to 44 bytes</td>
<td>Signed free form numeric</td>
</tr>
</tbody>
</table>

**Note:** See Appendix C, “Data Format Descriptions,” on page 885 for detailed format descriptions.

For a ZD or PD format field:

- F, E, C, A, 8, 6, 4, 2, and 0 are treated as equivalent positive signs. Thus the zoned decimal values F2F3C1, F2F3F1 and 020301 are counted as only one unique value.
- D, B, 9, 7, 5, 3, and 1 are treated as equivalent negative signs. Thus the zoned decimal values F2F3B0, F2F3D0, and 020310 are counted as only one unique value.
- Digits are not checked for validity.

**ON(VLEN)**

See the discussion of this operand on the DISPLAY statement in "DISPLAY Operator" on page 587.

**ALLDUPS**

Limits the records selected to those with ON values that occur more than once (value count > 1). You can use this operand to keep just those records with duplicate field values.
SELECT Operator

ALLDUPS is equivalent to HIGHER(1).

**NODUPS**
Limits the records selected to those with ON values that occur only once (value count = 1). You can use this operand to keep just those records with no duplicate field values.

NODUPS is equivalent to EQUAL(1) or LOWER(2).

**HIGHER(x)**
Limits the records selected to those with ON values that occur more than x times (value count > x). You can use this operand to keep just those records with field values that occur more than x times.

x must be specified as n or +n where n can be 0 to 99.

**LOWER(y)**
Limits the records selected to those with ON values that occur less than y times (value count < y). You can use this operand to keep just those records with field values that occur less than y times.

y must be specified as n or +n where n can be 0 to 99.

**EQUAL(v)**
Limits the records selected to those with ON values that occur v times (value count = v). You can use this operand to keep just those records with field values that occur v times.

v must be specified as n or +n where n can be 0 to 99.

**FIRST**
Limits the records selected to those with ON values that occur only once (value count = 1) and the first record of those with ON values that occur more than once (value count > 1). You can use this operand to keep just the first record for each unique field value.

FIRST is equivalent to FIRST(1).

**FIRST(u)**
Limits the records selected to those with ON values that occur only once (value count = 1) and the first u records of those with ON values that occur more than once (value count > 1). You can use this operand to keep just the first u records for each unique field value.

u must be specified as n or +n where n can be 1 to 999999999999999.

**LAST**
Limits the records selected to those with ON values that occur only once (value count = 1) and the last record of those with ON values that occur more than once (value count > 1). You can use this operand to keep just the last record for each unique field value.

**FIRSTDUP**
Limits the records selected to the first record of those with ON values that occur more than once (value count > 1). You can use this operand to keep just the first record of those records with duplicate field values.

FIRSTDUP is equivalent to FIRSTDUP(1).

**FIRSTDUP(w)**
Limits the records selected to the first w records of those with ON values that occur more than once (value count > 1). You can use this operand to keep just the first w records of those records with duplicate field values.
SELECT Operator

w must be specified as n or +n where n can be 1 to 999999999999999.

LASTDUP
Limits the records selected to the last record of those with ON values that occur more than once (value count > 1). You can use this operand to keep just the last record of those records with duplicate field values.

VSAMTYPE(x)
See the discussion of this operand on the COPY statement in “COPY Operator” on page 568.

UZERO
See the discussion of this operand on the OCCUR statement in “OCCUR Operator” on page 642.

USING(xxxx)
Specifies the first 4 characters of the ddname for the control statement data set to be used by DFSORT for this operation. xxxx must be four characters that are valid in a ddname of the form xxxxCNTL. xxxx must not be SYSx.

If USING is specified, an xxxxCNTL DD statement must be present and the control statements in it:
1. Must conform to the rules for DFSORT’s SORTCNTL data set.
2. Should generally be used only for an INCLUDE or OMIT statement, an INREC statement, a SORT statement, comment statements, or OUTFIL statements as described for “SELECT Operator” on page 664.

SELECT Examples
Although the SELECT operators in the examples below could all be contained in a single ICETOOL job step, they are shown and discussed separately for clarity.

Example 1
SELECT FROM(INPUT) TO(DUPS) ON(11,8,CH) ON(30,44,CH) ALLDUPS

Sorts the INPUT data set to the DUPS data set, selecting only the records from INPUT with characters in positions 11-18 and characters in positions 30-73 that occur more than once (that is, only records with duplicate ON field values).

The DUPS data set might look as follows (several records are shown for illustrative purposes):

USR002 BETTEN 12 DOC.EXAMPLES
DFSRT2 BETTEN 5 DOC.EXAMPLES
DFSRT5 BOENIG 20 MYDATA
DFSRT1 BOENIG 20 MYDATA
SYS003 BOENIG 20 MYDATA
DFSRT2 BOENIG 20 SORTST1.TEST
USR003 BOENIG 20 SORTST1.TEST
.
.
.
.
.
.

Example 2
SELECT FROM(INPUT) TO(ONLYONE) ON(23,3,FS) NODUPS

Sorts the INPUT data set to the ONLYONE data set, selecting only the records from INPUT with floating sign values in positions 23-25 that occur just once (that is, only records with no duplicate ON field values).
SELECT Operator

The ONLYONE data set might look as follows (several records are shown for illustrative purposes):

<table>
<thead>
<tr>
<th>Data Set</th>
<th>User</th>
<th>Value</th>
<th>File Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>DFSRT2</td>
<td>BOENIG</td>
<td>5</td>
<td>DOC.EXAMPLES</td>
</tr>
<tr>
<td>DFSRT1</td>
<td>PACKER</td>
<td>8</td>
<td>ICETOOL.SMF.RUNS</td>
</tr>
<tr>
<td>USR002</td>
<td>BETTEN</td>
<td>12</td>
<td>DOC.EXAMPLES</td>
</tr>
<tr>
<td>SYS003</td>
<td>YAEGER</td>
<td>32</td>
<td>ICETOOL.TEST.CASES</td>
</tr>
<tr>
<td>DFSRT2</td>
<td>CORNELL</td>
<td>108</td>
<td>FS.TEST.CASES</td>
</tr>
</tbody>
</table>

Example 3

```
SELECT FROM(FAILURES) TO(CHECKOUT) ON(28,8,CH) ON(1,5,CH) - HIGHER(3)
```

Sorts the FAILURES data set to the CHECKOUT data set, selecting only the records from FAILURES with characters in positions 28-35 and characters in positions 1-5 that occur more than three times (that is only records with four or more duplicate ON field values).

The CHECKOUT data set might look as follows (several records are shown for illustrative purposes):

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>03/12/04</td>
<td>08:36:59</td>
<td>A3275647</td>
</tr>
<tr>
<td>03/12/04</td>
<td>09:27:32</td>
<td>A3275647</td>
</tr>
<tr>
<td>03/12/04</td>
<td>09:03:18</td>
<td>A3275647</td>
</tr>
<tr>
<td>03/12/04</td>
<td>08:56:13</td>
<td>A3275647</td>
</tr>
<tr>
<td>03/06/04</td>
<td>15:12:01</td>
<td>C3275647</td>
</tr>
<tr>
<td>03/06/04</td>
<td>14:57:00</td>
<td>C3275647</td>
</tr>
<tr>
<td>03/06/04</td>
<td>15:43:19</td>
<td>C3275647</td>
</tr>
<tr>
<td>03/06/04</td>
<td>16:06:39</td>
<td>C3275647</td>
</tr>
<tr>
<td>03/06/04</td>
<td>15:22:08</td>
<td>C3275647</td>
</tr>
</tbody>
</table>

Example 4

```
SELECT FROM(BOOKS) TO(PUBLISHR) ON(29,10,CH) FIRST
```

Sorts the BOOKS data set to the PUBLISHR data set, selecting only the records from BOOKS with characters in positions 29-38 that occur only once and the first record of those with characters in positions 29-38 that occur more than once (that is, one record for each unique ON field value).

The PUBLISHR data set might look as follows (several records are shown for illustrative purposes):

<table>
<thead>
<tr>
<th>Book Title</th>
<th>Author</th>
<th>Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banana Slugs I Have Known</td>
<td>Brent</td>
<td>Animals</td>
</tr>
<tr>
<td>Toads on Parade</td>
<td>Cooper</td>
<td>Animals</td>
</tr>
<tr>
<td>Pets Around the World</td>
<td>Davis</td>
<td>Animals</td>
</tr>
</tbody>
</table>

Example 5

```
SELECT FROM(BOOKS) TO(PUBLISHR) ON(29,10,CH) FIRST - DISCARD(SAVEREST)
```

This example creates the same PUBLISHR data set as Example 4. In addition, it creates a SAVEREST data set that contains all of the records not written to the PUBLISHR data set. The SAVEREST data set might look as follows (several records are shown for illustrative purposes):
Example 6

```
SELECT FROM(MASTPULL) TO(MATCH) ON(5,8,CH) FIRSTDUP
```

This example shows how you can use a list of account numbers in a "pull" data set to only select records with those account numbers from a "master" data set. The MASTPULL DD would have the "master" data set and "pull" data set concatenated together (in that order).

The SELECT operator sorts the concatenated data sets and selects only the first record of those with characters in positions 5-12 that occur more than once (that is, one record for each duplicate ON field value). Because the "master" data set is first in the concatenation, the selected records will come from the "master" data set.

If the "master" data set looked like this:

A52 RB172832 2001/03/15
N92 MX328126 2001/01/27
B12 LB018725 2000/12/28
J73 AB007231 2001/02/13
Q28 SP973004 2000/11/19

and the "pull" data set looked like this:

AB007231
RS859276
QN005001
MX328126

the MATCH data set would look like this:

J73 AB007231 2001/02/13
N92 MX328126 2001/01/27

Note: This example assumes that there are not any duplicate account numbers in either the "master" or "pull" data sets. If that is not true, you can use SELECT with FIRST or LAST, for the appropriate data set, to make it true. For example, if your "master" data set has duplicate account numbers and you want to select the first account number from the "master" data set for each account number in the "pull" data set, you could use the following statements:

```
SELECT FROM(MASTER) TO(TEMP) ON(5,8,CH) FIRST
SELECT FROM(TEMPPULL) TO(MATCH) ON(5,8,CH) FIRSTDUP
```

The TEMPPULL DD would have the temporary data set and "pull" data set concatenated together (in that order).

Example 7

```
SELECT FROM(INPUT) TO(ONLYONE) ON(23,3,FS) NODUPS USING(CTL1)
```

This example shows how you can use USING(xxxx) to supply an OUTFIL statement to modify the TO data set. SELECT chooses the same output records as for "Example 2" on page 669, but an OUTFIL statement is used to further modify those records for output to the ONLYONE data set.
SELECT Operator

The CTL1CNTL data set contains:

```
OUTFIL FNAMES=ONLYONE,
   REMOVECC,
   INCLUDE=(23,3,FS,LT,100),
   OUTREC=(1:1,7,8:C'|',11:11,7,19:C'|',23:23,3,FS,M11,
         27:C'|',30:30,15),
   TRAILER1=(/,'TOTAL= ',TOT=(23,3,FS,M11,LENGTH=6))
```

and the ONLYONE data set might look as follows:

<table>
<thead>
<tr>
<th>DFSRT2</th>
<th>EISSLER</th>
<th>005</th>
<th>DOC.EXAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>DFSRT1</td>
<td>PACKER</td>
<td>008</td>
<td>ICE TOOL.SMF.RUN</td>
</tr>
<tr>
<td>USR002</td>
<td>EISSLER</td>
<td>012</td>
<td>DOC.EXAMPLES</td>
</tr>
<tr>
<td>SYS003</td>
<td>YAEGER</td>
<td>032</td>
<td>ICE TOOL.TEST.CA</td>
</tr>
</tbody>
</table>

TOTAL= 000057

**Example 8**

This example shows how you can use USING(xxxx) to supply an OMIT statement to remove certain input records and an INREC statement to reformat certain input records before SELECT processing begins.

```
SELECT FROM(INB) TO(OUTB) ON(8,10,CH) -
   FIRSTDUP USING(BIRD)
```

Let's say the INB data set looks like this:

```
TYPE1  CROWS
TYPE1  PIGEONS
TYPE1  HAWKS
TYPE1  ROBINS
TYPE1  SPARROWS
TYPE1  CHICKENS
TYPE1  RAVENS
TYPE2  PIGEONS
TYPE2  ROBINS
TYPE2  HAWKS
TYPE2  TERNS
TYPE3  EAGLES
TYPE3  STARLINGS
```

We want to remove the TYPE3 records and then select one record for each type of bird that appears in both a TYPE1 and a TYPE2 record. We could use the following control statements in BIRDCNTL:

* Remove the TYPE3 records.
  OMIT COND=(1,5,CH,EQ,C'TYPE3')
* Reformat the TYPE2 records to place the bird name in
  same place as in the TYPE1 records so we can match them.
  INREC IFTHEN=(WHEN=(1,5,CH,EQ,C'TYPE2'),
                  BUILD=(8:18,10))

The OUTB data set would look like this:

```
TYPE1  HAWKS
TYPE1  PIGEONS
TYPE1  ROBINS
```

**Example 9**

This example shows how you can use USING(xxxx) to supply a SORT statement to alter the records that are selected.

```
SELECT FROM(IN) TO(OUT) ON(1,5,CH) FIRST(3) USING(CTL1)
```

Let's say the IN data set looks like this:
We want to select the three records with each name that have the highest counts. If we just used ON(1,5,CH) without any CTL1CNTL statements, we’d get the first three records for each name without regard to the count. The OUT data set would look like this:

FRANK 00015
FRANK 00012
FRANK 00003
FRANK 00018
FRANK 00005
FRANK 00035
VICKY 00022
VICKY 00007
VICKY 00014
VICKY 00028
VICKY 00002
VICKY 00015

To get the three records with the highest counts for each name, we can use the following SORT statement in CTL1CNTL:

```
SORT FIELDS=(1,5,CH,A,7,5,ZD,D)
```

The records will be sorted in ascending order on the name field, and in descending order on the count field. By sorting descending on the count, we ensure that the three records with the highest counts are the first three records for each name. Thus, when ON(1,5,CH) selects the first three records, they will be those with the highest counts. The OUT data set will look like this:

FRANK 00035
FRANK 00018
FRANK 00015
VICKY 00028
VICKY 00022
VICKY 00015

**SORT Operator**

```
SORT FROM(indd) USING(xxxx) VSAMTYPE(x)
```

Sorts a data set to one or more output data sets.
SORT Operator

DFSORT is called to sort the indd data set to the outdd data sets using the DFSORT control statements in xxxxCNTL. You must supply a DFSORT SORT statement in the xxxxCNTL data set to indicate the control fields for the sort. You can use additional DFSORT statements in the xxxxCNTL data set to sort a subset of the input records (INCLUDE or OMIT statement; SKIPREC and STOPAFT options; OUTFIL INCLUDE, OMIT, SAVE, STARTREC, ENDREC, SAMPLE, SPLIT, SPLITBY, and SPLIT1R operands; user exit routines), reformat records for output (INREC, OUTREC, and OUTFIL statements, user exit routines), and so on.

The active locale’s collating rules affect SORT processing as explained in “SORT Control Statement” on page 442. If an INCLUDE or OMIT statement or an OUTFIL INCLUDE or OMIT operand is specified in the xxxxCNTL data set, the active locale’s collating rules affect INCLUDE and OMIT processing as explained in the “Cultural Environment Considerations” discussion in “INCLUDE Control Statement” on page 98.

The DYNALLOC option is passed to DFSORT to ensure that work space is available for the sort. If your installation defaults for dynamic allocation are inappropriate for a SORT operator, you can take one of the following actions:

1. Override the DYNALLOC option using an OPTION control statement such as:

   ```
   OPTION DYNALLOC=(,8)
   ```

   in the xxxxCNTL data set in conjunction with the USING(xxxx) operand.

2. Use xxxxWKdd DD statements to override the use of dynamic allocation in conjunction with the USING(xxxx) operand. Refer to “SORTWKdd DD Statement” on page 72 for details.

Tape work data sets cannot be used with ICETOOL.

Operand Descriptions

The operands described below can be specified in any order.

FROM(indd)

See the discussion of this operand on the COPY statement in “COPY Operator” on page 568.

JKFROM

Specifies you are using a JOINKEYS application with this SORT operator to sort the joined records. You must provide a USING(xxxx) operand. In xxxxCNTL, you must provide a SORT statement, a JOINKEYS statement with F1=ddname1 for the F1 file, and a JOINKEYS statement with F2=ddname2 for the F2 file, as well as JOIN and REFORMAT statements as needed.

USING(xxxx)

Specifies the first 4 characters of the ddname for the control statement data set to be used by DFSORT for this operation. xxxx must be four characters that are valid in a ddname of the form xxxxCNTL. xxxx must not be SYSx.

An xxxxCNTL DD statement must be present, and the control statements in it must conform to the rules for DFSORT’s SORTCNTL data set.

The xxxxCNTL data set must contain a SORT statement. If TO is not specified, the xxxxCNTL data set must also contain either one or more OUTFIL statements or a MODS statement for an E35 routine that disposes of all records. Other statements are optional.

If you want to override dynamic allocation of work data sets for this operation, you can use xxxxWKdd DD statements for that purpose.
**SORT Operator**

Refer to "JCL Restrictions" on page 566 for more information regarding the selection of ddnames.

TO(outdd,...)

Specifies the ddnames of the output data sets to be written by DFSORT for this operation. From 1 to 10 outdd names can be specified. An outdd DD statement must be present for each outdd name specified. If a single outdd data set is specified, DFSORT is called once to sort the indd data set to the outdd data set using SORTOUT processing; the outdd data set must conform to the rules for DFSORT’s SORTOUT data set. If multiple outdd data sets are specified and SERIAL is not specified, DFSORT is called once to sort the indd data set to the outdd data sets using OUTFIL processing; the outdd data sets must conform to the rules for DFSORT’s OUTFIL data sets.

A ddname specified in the FROM operand must not also be specified in the TO operand.

Refer to "JCL Restrictions" on page 566 for more information regarding the selection of ddnames.

VSAMTYPE(x)

See the discussion of this operand on the COPY statement in "COPY Operator" on page 568.

LOCALE(name)

See the discussion of this operand on the COPY statement in "COPY Operator" on page 568.

LOCALE (CURRENT)

See the discussion of this operand on the COPY statement in "COPY Operator" on page 568.

LOCALE (NONE)

See the discussion of this operand on the COPY statement in "COPY Operator" on page 568.

SERIAL

Specifies that OUTFIL processing is not to be used when multiple outdd data sets are specified. DFSORT is called multiple times and uses SORTOUT processing; the outdd data sets must conform to the rules for DFSORT’s SORTOUT data set. SERIAL is not recommended because the use of serial processing (that is, multiple calls to DFSORT) instead of OUTFIL processing can degrade performance and imposes certain restrictions as detailed below. SERIAL is ignored if a single outdd data set is specified.

DFSORT is called to sort the indd data set to the first outdd data set using the DFSORT control statements in the xxxxCNTL data set. If the sort operation is successful, DFSORT is called as many times as necessary to copy the first outdd data set to the second and subsequent outdd data sets. Therefore, for maximum efficiency, use a disk data set as the first in a list of outdd data sets on both disk and tape. If more than one outdd data set is specified, DFSORT must be able to read the first outdd data set after it is written in order to copy it to the other outdd data sets. Do not use a SYSOUT or DUMMY data set as the first in a list of outdd data sets because:

- If the first data set is SYSOUT, DFSORT abends when it tries to copy the SYSOUT data set to the second outdd data set.
- If the first data set is DUMMY, DFSORT copies the empty DUMMY data set to the other outdd data sets (that is, all of the resulting outdd data sets are empty).
SORT Examples

Although the SORT operators in the examples below could all be contained in a single ICETOOL job step, they are shown and discussed separately for clarity.

Example 1

* Method 1
SORT FROM(MASTER) TO(PRINT,TAPE,DISK) USING(ABCD)

* Method 2
SORT FROM(MASTER) TO(DISK,TAPE,PRINT) USING(ABCD) SERIAL

This example shows two different methods for creating multiple sorted output data sets. Assume that the ABCDCNTL data set contains:

```
SORT FIELDS=(15,20,CH,A,1,5,PD,D)
```

Method 1 requires one call to DFSORT, one pass over the input data set, and allows the output data sets to be specified in any order. The SORT operator sorts all records from the MASTER data set to the PRINT (SYSOUT), TAPE, and DISK data sets, using the SORT statement in the ABCDCNTL data set and OUTFIL processing.

Method 2 requires three calls to DFSORT, three passes over the input data set, and imposes the restriction that the SYSOUT data set must not be the first TO data set. The SORT operator sorts all records from the MASTER data set to the DISK data set, using the SORT statement in the ABCDCNTL data set, and then copies the resulting DISK data set to the TAPE and PRINT (SYSOUT) data sets. Because the first TO data set is processed three times (written, read, read), placing the DISK data set first is more efficient than placing the TAPE data set first. PRINT must not be the first in the TO list because a SYSOUT data set cannot be read.

Example 2

* Method 1
SORT FROM(IN) TO(DEPT1) USING(DPT1)
SORT FROM(IN) TO(DEPT2) USING(DPT2)
SORT FROM(IN) TO(DEPT3) USING(DPT3)

* Method 2
SORT FROM(IN) USING(ALL3)

This example shows two different methods for creating sorted subsets of an input data set. Assume that:

- The DPT1CNTL data set contains:
  
  ```
  SORT FIELDS=(51,2,BI,A,18,5,CH,A,58,4,BI,A)
  INCLUDE COND=(5,3,CH,EQ,C'D01')
  ```

- The DPT2CNTL data set contains:
  
  ```
  SORT FIELDS=(51,2,BI,A,18,5,CH,A,58,4,BI,A)
  INCLUDE COND=(5,3,CH,EQ,C'D02')
  ```

- The DPT3CNTL data set contains:
  
  ```
  SORT FIELDS=(51,2,BI,A,18,5,CH,A,58,4,BI,A)
  INCLUDE COND=(5,3,CH,EQ,C'D03')
  ```

- The ALL3CNTL data set contains:
  
  ```
  SORT FIELDS=(51,2,BI,A,18,5,CH,A,58,4,BI,A)
  OUTFIL FNAMES=DEPT1,INCLUDE=(5,3,CH,EQ,C'D01')
  OUTFIL FNAMES=DEPT2,INCLUDE=(5,3,CH,EQ,C'D02')
  OUTFIL FNAMES=DEPT3,INCLUDE=(5,3,CH,EQ,C'D03')
  ```

Method 1 requires three calls to DFSORT and three passes over the input data set:
SORT Operator

- The first SORT operator sorts the records from the IN data set that contain D01 in positions 5-7 to the DEPT1 data set.
- The second COPY operator sorts the records from the IN data set that contain D02 in positions 5-7 to the DEPT2 data set.
- The third COPY operator sorts the records from the IN data set that contain D03 in positions 5-7 to the DEPT3 data set.

Method 2 accomplishes the same result as method 1 but, because it uses OUTFIL statements instead of TO operands, requires only one call to DFSORT and one pass over the input data set.

Example 3
SORT FROM(IN1) TO(FRANCE) USING(SRT1) LOCALE(FR_FR)
SORT FROM(IN1) TO(CANADA) USING(SRT1) LOCALE(FR_CA)
SORT FROM(IN1) TO(BELGIUM) USING(SRT1) LOCALE(FR_BE)

This example shows how sorted data for three different countries can be produced. Assume that the SRT1CNTL data set contains:

```
SORT FIELDS=(5,20,CH,A,31,15,CH,A,1,4,FI,D,63,10,CH,D)
```

The first SORT operator sorts all records from the IN1 data set to the FRANCE data set, using the SORT statement in the SRT1CNTL data set. The character (CH) control fields are sorted according to the collating rules defined in locale FR_FR (French language for France).

The second SORT operator sorts all records from the IN1 data set to the CANADA data set, using the SORT statement in the SRT1CNTL data set. The character (CH) control fields are sorted according to the collating rules defined in locale FR_CA (French language for Canada).

The third SORT operator sorts all records from the IN1 data set to the BELGIUM data set, using the SORT statement in the SRT1CNTL data set. The character (CH) control fields are sorted according to the collating rules defined in locale FR_BE (French language for Belgium).

SORT Operator with JOINKEYS Example

Here is an example of using one SORT operator for a simple JOINKEYS application.

```
//SRTJK EXEC PGM=ICETOOL
//TOOLMSG DD SYSOUT=*
//DFSMSG DD SYSOUT=*
//JNA DD DSN=MY.INPUTA,DISP=SHR
//JNB DD DSN=MY.INPUTB,DISP=SHR
//OUT DD SYSOUT=*
//TOOLIN DD *
*/

SORT JKFROM TO(OUT) USING(CTL1)
*/

//CTL1CNTL DD *
*/
JOINKEYS F1=JNA,FIELDS=(5,4,A)
JOINKEYS F2=JNB,FIELDS=(11,4,A),SORTED
REFORMAT FIELDS=(F1:1,20,F2:5,15)
*/

Main task control statement for SORT operator
* (operates on joined records).
OPTION EQUALS
SORT FIELDS=(1,3,2D,A)
*/
Splices together specified fields from records with matching numeric or character field values (that is, duplicate values), but different information. This makes it possible to join fields from different types of input records to create an output record with information from two or more records.

Typically, you will want to reformat the records from two or more data sets to a temporary MOD data set, and use that temporary MOD data set as input to the SPLICE operator.

“SPLICE Examples” on page 687 shows some techniques for splicing records from different data sets together in a variety of ways to perform various file “join” and “match” operations.

By default (when WITHALL, WITHANY and WITHEACH are not specified), one spliced record is created for each set of duplicates by splicing the first duplicate with specified fields from the last duplicate.

The first duplicate is treated as a "base record". The last duplicate is treated as an "overlay record". Specified fields from the overlay record are overlaid on to the base record. Thus, the output record consists of fields from the base (first) record intermixed with specified fields from the overlay (last) record.

The records to be spliced can originate from two or more different input data sets.

From 1 to 10 ON fields can be used for the fields to match on. At least one ON(p,m,f) field must be specified; all such ON fields specified will be used to determine the matching records to be spliced together.

From 1 to 50 WITH fields can be used to specify the fields to be overlaid on the base record from the overlay record. At least one WITH(p,m) field must be specified; all such WITH fields specified will be overlaid on to the base record. All other fields in the base record will be kept unchanged.
To illustrate the splicing process, if we had the following two fixed-length input records with the base fields, ON field and WITH fields as shown:

```
BASE1 ON1 BASE2 BASE3 BASE4 GGGGG
ON1 WITHA WITHB
```

the resulting spliced output record would be:

```
BASE1 ON1 BASE2 WITHA BASE3 BASE4 WITHB
```

For variable-length records, by default (without VLENMAX or VLENOVLY), the spliced record has the same length as the base record, and WITH fields from the overlay record that are beyond the end of the base record do not appear in the spliced record. For example, if we had the following two records with the lengths (in the RDW), ON field and WITH fields as shown:

```
25 | ON1 BASE1 BASE2
35 | ON1 WITH1 WITH2
```

the resulting spliced output record would be:

```
25 | ON1 BASE1 WITH1 BASE2
```

The WITH2 field is beyond the end of the base record, so it is not spliced.

However, if you specify VLENMAX, the spliced record is given the larger of the base record length or overlay record length. If we specify VLENOVLY, the spliced record is given the overlay record length. In either case, if the overlay record length is larger, bytes in the extended spliced record that are not overlaid are filled in with blanks.

The resulting spliced output record with either VLENMAX or VLENOVLY would be:

```
35 ON1 BASE1 WITH1 BASE2
```

You can use VLENMAX when you want the spliced record to have the maximum length of the base or overlay record. You can use VLENOVLY when you want the spliced record to have the length of the overlay record, regardless of whether it's longer or shorter than the base record. Without VLENMAX or VLENOVLY, the spliced record has the length of the base record regardless of whether it's longer or shorter than the overlay record.

For fixed-length records, the length of the base, overlay and spliced records are all the same. Thus, VLENOVLY and VLENMAX have no meaning for fixed-length records and are ignored.

**WITHALL** can be used to create multiple spliced records for each set of duplicates. The first duplicate is spliced with the specified fields from the second duplicate. Then the first duplicate is spliced with the specified fields from the third duplicate, and so on.

The first duplicate is treated as a base record. Each subsequent duplicate is treated as an overlay record. The specified fields from each overlay record are overlaid on to the base record. Thus, the output records consist of fields from the base record intermixed with specified nonblank and blank fields from the overlay records.

The records to be spliced can originate from multiple input data sets.
SPLICE Operator

To illustrate the splicing process when WITHALL is specified, if we had the following four fixed-length records with the base fields, ON field and WITH fields as shown:

<table>
<thead>
<tr>
<th>BASE1</th>
<th>ON1</th>
<th>BASE2</th>
<th>BASE3</th>
<th>BASE4</th>
<th>GGGGG</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ON1</td>
<td>WITHA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ON1</td>
<td>WITHB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ON1</td>
<td>WITHC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ON1</td>
<td>WITHE</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The resulting three spliced output records would be:

<table>
<thead>
<tr>
<th>BASE1</th>
<th>ON1</th>
<th>BASE2</th>
<th>WITHA</th>
<th>BASE3</th>
<th>BASE4</th>
<th>WITHB</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASE1</td>
<td>ON1</td>
<td>BASE2</td>
<td>WITHC</td>
<td>BASE3</td>
<td>BASE4</td>
<td></td>
</tr>
<tr>
<td>BASE1</td>
<td>ON1</td>
<td>BASE2</td>
<td>WITHE</td>
<td>BASE3</td>
<td>BASE4</td>
<td>WITHF</td>
</tr>
</tbody>
</table>

Note that without WITHALL, the resulting single spliced output record would be:

| BASE1 | ON1 | BASE2 | WITHE | BASE3 | BASE4 | WITHF |

For variable-length records, by default (without VLENMAX or VLENOVLY), the spliced record has the same length as the base record, and WITH fields from the overlay record that are beyond the end of the base record do not appear in the spliced record. For example, with WITHALL, if we had the following four records with the lengths (in the RDW), ON field and WITH fields as shown:

<table>
<thead>
<tr>
<th></th>
<th>BASE1</th>
<th>ON1</th>
<th>BASE2</th>
<th>ON1</th>
<th>WITHA</th>
<th>BASE3</th>
<th>BASE4</th>
<th>WITHB</th>
<th>WITHC</th>
<th>WITHD</th>
<th>WITHE</th>
<th>WITHF</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>BASE1</td>
<td>ON1</td>
<td>BASE2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>BASE1</td>
<td>ON1</td>
<td>WITHA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>BASE1</td>
<td>ON1</td>
<td>WITHB</td>
<td>WITHC</td>
<td>WITHD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>BASE1</td>
<td>ON1</td>
<td>WITHE</td>
<td>WITHF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The resulting three spliced output records would be:

<table>
<thead>
<tr>
<th></th>
<th>BASE1</th>
<th>ON1</th>
<th>WITHA</th>
<th>BASE2</th>
<th>ON1</th>
<th>BASE3</th>
<th>BASE4</th>
<th>WITHB</th>
<th>WITHC</th>
<th>WITHD</th>
<th>WITHE</th>
<th>WITHF</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>BASE1</td>
<td>ON1</td>
<td>WITHA</td>
<td>BASE2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>BASE1</td>
<td>ON1</td>
<td>WITHB</td>
<td>BASE2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>BASE1</td>
<td>ON1</td>
<td>WITHE</td>
<td>BASE2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The WITHC, WITHD and WITHF fields are beyond the end of the base record, so they are not spliced.

However, if you specify VLENMAX, the spliced record is given the larger of the base record length or overlay record length. If we specify VLENOVLY, the spliced record is given the overlay record length. In either case, if the overlay record length is larger, bytes in the extended spliced record that are not overlaid are filled in with blanks. The resulting three spliced output records with WITHALL and VLENMAX would be:

<table>
<thead>
<tr>
<th></th>
<th>BASE1</th>
<th>ON1</th>
<th>WITHA</th>
<th>BASE2</th>
<th>ON1</th>
<th>BASE3</th>
<th>BASE4</th>
<th>WITHB</th>
<th>WITHC</th>
<th>WITHD</th>
<th>WITHE</th>
<th>WITHF</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>BASE1</td>
<td>ON1</td>
<td>WITHA</td>
<td>BASE2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>BASE1</td>
<td>ON1</td>
<td>WITHB</td>
<td>BASE2</td>
<td>WITHC</td>
<td>BASE3</td>
<td>BASE4</td>
<td>WITHD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>BASE1</td>
<td>ON1</td>
<td>WITHE</td>
<td>BASE2</td>
<td>WITHF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The resulting three spliced output records with WITHALL and VLENOVLY would be:

<table>
<thead>
<tr>
<th></th>
<th>BASE1</th>
<th>ON1</th>
<th>WITHA</th>
<th>BASE2</th>
<th>ON1</th>
<th>BASE3</th>
<th>BASE4</th>
<th>WITHB</th>
<th>WITHC</th>
<th>WITHD</th>
<th>WITHE</th>
<th>WITHF</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>BASE1</td>
<td>ON1</td>
<td>WITHA</td>
<td>BASE2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>BASE1</td>
<td>ON1</td>
<td>WITHB</td>
<td>BASE2</td>
<td>WITHC</td>
<td>BASE3</td>
<td>BASE4</td>
<td>WITHD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>BASE1</td>
<td>ON1</td>
<td>WITHE</td>
<td>BASE2</td>
<td>WITHF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

WITHANY can be used to create one spliced record for each set of duplicates. The first duplicate is spliced with the nonblank values of each subsequent duplicate for specified fields.

The first duplicate is treated as a base record. Each subsequent duplicate is treated as an overlay record. Each specified field with a nonblank value in each overlay record is overlaid on to the base record. Thus, the output record consists of fields
from the base record intermixed with specified nonblank fields from each overlay record. The value from the last overlay record with each nonblank value will appear in the output record. Note that a specified "field" from an overlay record can actually consist of multiple fields from the record that have previously been reformatted into one contiguous field.

The records to be spliced can originate from multiple input data sets.

To illustrate the splicing process when WITHANY is specified, if we had the following four fixed-length records with the base fields, ON field and WITH fields as shown:

```
BASE1 ON1 BASE2
ON1 WITHC
ON1 WITHA
ON1 WITHB
```

The resulting spliced output record would be:

```
BASE1 ON1 BASE2 WITHB WITHC WITHA
```

For variable-length records, by default (without VLENMAX), the spliced record has the same length as the base record. For example, with WITHANY, if we had the following four records with the lengths (in the RDW), ON field and WITH fields as shown:

```
30 | BASE1 ON1 BASE2
50 | ON1 WITHB
25 | ON1 WITHA
40 | ON1 WITHC
```

the resulting spliced output records would be:

```
30 | BASE1 ON1 WITHA BASE2
```

The WITHB and WITHC fields are beyond the end of the base record, so they are not spliced. However, if you specify VLENMAX, the spliced record is given the largest of the base record length or overlay record lengths. If the largest overlay record length is larger than the base record length, bytes in the extended spliced record that are not overlaid are filled in with blanks. The resulting spliced output record with WITHANY and VLENMAX would be:

```
50 | BASE1 ON1 WITHA BASE2 WITHC WITHB
```

VLENOVLY cannot be specified with WITHANY.

**WITHEACH** can be used to create one spliced record for each set of duplicates. The first duplicate is spliced with one specified field from each subsequent duplicate.

The first duplicate is treated as a base record. Each subsequent duplicate is treated as an overlay record. The specified blank or nonblank field from each overlay record is overlaid on to the base record. Thus, the output record consists of fields from the base record intermixed with a specified nonblank or blank field from each overlay record. Note that the specified "field" from an overlay record can actually consist of multiple fields from the record that have previously been reformatted into one contiguous field.

The records to be spliced can originate from multiple input data sets.
To illustrate the splicing process when WITHEACH is specified, if we had the following four records with the base fields, ON field and WITH fields as shown:

<table>
<thead>
<tr>
<th>BASE1</th>
<th>ON1</th>
<th>BASE2</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON1</td>
<td>WITHA</td>
<td></td>
</tr>
<tr>
<td>ON1</td>
<td>WITHB</td>
<td></td>
</tr>
<tr>
<td>ON1</td>
<td>WITHC</td>
<td></td>
</tr>
</tbody>
</table>

The resulting spliced output record would be:

| BASE1 | ON1 | BASE2 | WITHA | WITHB | WITHC |

For variable-length records, by default (without VLENMAX), the spliced record has the same length as the base record. For example, with WITHEACH, if we had the following four records with the lengths (in the RDW), ON field and WITH fields as shown:

| 30 | BASE1 | ON1 | BASE2 |
| 25 | ON1   | WITHA |
| 50 | ON1   | WITHB |
| 40 | ON1   | WITHC |

the resulting spliced output records would be:

| 30 | BASE1 | ON1 | WITHA | BASE2 |

The WITHB and WITHC fields are beyond the end of the base record, so they are not spliced.

However, if you specify VLENMAX, the spliced record is given the largest of the base record length or overlay record lengths. If the largest overlay record length is larger than the base record length, bytes in the extended spliced record that are not overlaid are filled in with blanks. The resulting spliced output record with WITHEACH and VLENMAX would be:

| 50 | BASE1 | ON1 | WITHA | BASE2 | WITHC | WITHB |

VLENOVLY cannot be specified with WITHEACH.

**KEEPNODUPS** can be used to keep the non-duplicate records as well as the spliced records. The non-duplicate records will be unchanged.

To illustrate the splicing process when KEEPNODUPS is specified, if we had the following six records with the base fields, ON fields and WITH fields as shown:

<table>
<thead>
<tr>
<th>UNIQA</th>
<th>ONA</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASEA</td>
<td>ONB</td>
</tr>
<tr>
<td>DUPAA</td>
<td>ONB</td>
</tr>
<tr>
<td>UNIQB</td>
<td>ONC</td>
</tr>
<tr>
<td>BASEB</td>
<td>OND</td>
</tr>
<tr>
<td>DUPBB</td>
<td>OND</td>
</tr>
</tbody>
</table>

The two unique records (ONA and OND) would be kept along with the two spliced records (ONB and OND). The resulting four unspliced and spliced output records would be:

<table>
<thead>
<tr>
<th>UNIQA</th>
<th>ONA</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASEA</td>
<td>ONB</td>
</tr>
<tr>
<td>UNIQB</td>
<td>ONC</td>
</tr>
<tr>
<td>BASEB</td>
<td>OND</td>
</tr>
</tbody>
</table>

Note that without KEEPNODUPS, the two unique records (ONA and ONC) would not be kept. The resulting two spliced output records would be:
**SPLICE Operator**

BASEA ONB WITHA
BASEB OND WITHB

**KEEPBASE** can be used to keep the base records (first duplicate) as well as the spliced records. The base records will be unchanged.

To illustrate the splicing process when **KEEPBASE** is specified, if we had the following six records with the base fields, ON fields and WITH fields as shown:

UNIQA ONA
BASEA ONB
DUPAA ONB WITHA
UNIQB ONC
BASEB OND
DUPBB OND WITHB

The two base records with duplicates (first ONB record and first OND record) would be kept along with the two spliced records (ONB and OND). The resulting four unspliced and spliced output records would be:

BASEA ONB
BASEA ONB WITHA
BASEB OND
BASEB OND WITHB

Note that without **KEEPBASE**, the two base records with duplicates (first ONB record and first OND record) would not be kept. The resulting two spliced output records would be:

BASEA ONB WITHA
BASEB OND WITHB

If we used **KEEPNODUPS** and **KEEPBASE** with the original six records, the resulting six unspliced and spliced output records would be:

UNIQA ONA
BASEA ONB
BASEA ONB WITHA
UNIQB ONC
BASEB OND
BASEB OND WITHB

DFSORT is called to sort the indd data set. ICETOOL uses its E35 exit to determine which records to splice and include in the outdd data set. ICETOOL passes the **EQUALS** option to DFSORT to ensure that duplicates are kept in their original input order.

The DFSORT control statements in xxxxCNTL are used if USING( xxxx ) is specified.

Do not supply your own MODS, SUM, OUTREC, or SORT statement.

You can use comment statements. You can use INCLUDE, OMIT, INREC, OPTION, and OUTFIL statements providing you observe these rules:

- You can use an INCLUDE or OMIT statement to remove input records **before** SPLICE processing.
- You can use an INREC statement to reformat input records **before** SPLICE processing; the base and overlay records are reformatted according to the INREC statement. You can use INREC’s PARSE, BUILD (FIELDS), OVERLAY, FINDREP, IFTHEN, or IFOUTLEN functions. If your INREC statement changes the starting position of an ON field or WITH field, you must specify the new starting...
SPLICE Operator

position for that ON field or WITH field. For example, if your input records have a CH key at positions 1-5 and a WITH field at 6-8 and you use an INREC statement like this:

\[ \text{INREC FIELDS}=(31:1,50) \]

you must specify ON(31,5,CH) instead of ON(1,5,CH) and WITH(36,3) instead of WITH(6,3).

- You can further process the outdd records associated with TO(outdd) after SPLICE processing using an OUTFIL statement like this:

\[ \text{OUTFIL FNMES=outdd,} \ldots \]

or multiple OUTFIL statements like this:

\[ \text{OUTFIL FNMES=outdd,} \ldots \]
\[ \text{OUTFIL FNMES=outdd1,} \ldots \]

\[ \ldots \]

For example, with TO(OUT1) you could further modify the OUT1 records after they have been spliced, with a statement like this:

\[ \text{OUTFIL FNMES=OUT1,FTOV,VLTRIM=X'40' \]

The DYNALLOC option is passed to DFSORT to ensure that work space is available for the sort. If your installation defaults for dynamic allocation are inappropriate for a SPLICE operator, you can specify USING(xxxx) and take one of the following actions:

1. Override the DYNALLOC option using an OPTION control statement such as:

\[ \text{OPTION DYNALLOC=(,8) \]

in the xxxxCNTL data set.

2. Use xxxxWKdd DD statements to override the use of dynamic allocation. Refer to "SORTWKdd DD Statement" on page 72 for details.

Tape work data sets cannot be used with ICETOOL.

Operand Descriptions

FROM(indd)
See the discussion of this operand on the COPY statement in "COPY Operator" on page 568.

TO(outdd)
Specifies the ddname of the output data set to which DFSORT will write the records it produces for the operation (that is, the spliced records, the non-duplicate records if KEEPNODUPS is specified, and the base records if KEEPBASE is specified).

An outdd DD statement must be present and must define an output data set that conforms to the rules for DFSORT's SORTOUT data set.

The ddname specified in the TO operand must not be the same as the ddname specified in the FROM operand.

Refer to "JCL Restrictions" on page 566 for more information.

ON(p,m,f)
See the discussion of this operand on the SELECT statement in "SELECT Operator" on page 664.
WITH(p,m)

Specifies the position and length of a field to be overlaid from the overlay record on to the base record.

p specifies the first byte of the field relative to the beginning of the overlay record. p is 1 for the first data byte of a fixed-length record and 5 for the first data byte of a variable-length record as illustrated below (RRRR represents the 4-byte record descriptor word):

<table>
<thead>
<tr>
<th>D</th>
<th>A</th>
<th>T</th>
<th>A</th>
<th>...</th>
<th>R</th>
<th>R</th>
<th>R</th>
<th>D</th>
<th>A</th>
<th>T</th>
<th>A</th>
<th>...</th>
</tr>
</thead>
<tbody>
<tr>
<td>p=</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>p=</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
</tbody>
</table>

If INREC is specified, p must refer to the record as reformatted by INREC.

m specifies the length of the field in bytes. A field must not extend beyond position 32752.

A WITH field will not be used to overlay the RDW of a variable-length base record or to overlay bytes from beyond the end of an overlay record on to a base record. When necessary, WITH fields will be adjusted to prevent these situations. For example, if WITH(1,6) is specified for a variable-length record, it will be treated as WITH(5,2) and if WITH(75,10) is specified for an 80-byte overlay record, it will be treated as WITH(75,6).

A WITH field will not be used to overlay bytes beyond the end of a base record. When necessary, WITH fields will be adjusted to prevent this situation. For example, if WITH(75,10) is specified for an 80-byte base record, it will be treated as WITH(75,6). However, if you specify VLENMAX or VLENOVLY, a WITH field can be used to overlay bytes beyond the end of a base record provided that WITH field is present in the overlay record. For example, if VLENMAX and WITH(75,10) is specified for an 80-byte base record and a 90-byte overlay record, the spliced record will have a length of 90 bytes and the WITH(75,10) field will be present at positions 75-84 followed by 6 blanks in positions 85-90.

WITHALL

Specifies that the first duplicate is spliced with specified fields from the second duplicate, and then from each subsequent duplicate in turn. All of the WITH fields (nonblank and blank) from each overlay record are overlaid on to the base record.

With WITHALL, a spliced output record is created from each base record and overlay record, resulting in n–1 spliced records for each set of n duplicates.

WITHALL overrides the default of splicing the first duplicate with all of the specified fields from the last duplicate.

WITHANY

Specifies that the first duplicate is spliced with specified nonblank fields from each subsequent duplicate. Each nonblank WITH field from each overlay record is overlaid on to the base record.

With WITHANY, a single spliced output record is created using the base record and each nonblank field from each overlay record. If more than one overlay record has a nonblank value for a WITH field, the nonblank value from the last overlay record for that WITH field will appear in the output record. Note that the specified “field” from an overlay record can actually consist of multiple fields from the record that have previously been reformatted into one contiguous field.
SPLICE Operator

WITHANY overrides the default of splicing the first duplicate with all of the specified fields from the last duplicate.

VLENOVLY cannot be specified with WITHANY.

WITHEACH

Specifies that the first duplicate is spliced with one specified field from each subsequent duplicate. One WITH field (nonblank or blank) from each overlay record is overlaid on to the base record. The first WITH field specifies the bytes to be overlaid from the second duplicate record on to the first duplicate record. The second WITH field specifies the bytes to be overlaid from the third duplicate record on to the first duplicate record, and so on. For any set of duplicates, extra overlay records without matching WITH fields, or extra WITH fields without matching overlay records are ignored.

With WITHEACH, a single spliced output record is created using the base record and one field from each overlay record. Note that the specified "field" from an overlay record can actually consist of multiple fields from the record that have previously been reformatted into one contiguous field.

WITHEACH overrides the default of splicing the first duplicate with all of the specified fields from the last duplicate.

VLENOVLY cannot be specified with WITHEACH.

KEEPNODUPS

Specifies that non-duplicate records are to be kept as well as spliced records. The non-duplicate records will be unchanged.

KEEPBASE

Specifies that base records (first duplicate) are to be kept as well as spliced records. The base records will be unchanged.

VLENMAX

Specifies that for variable-length records, the length of the spliced record is set to the maximum length of the base record and overlay record. VLENMAX overrides the default of setting the length of the spliced record to the length of the base record.

If VLENMAX is specified with or without WITHALL, the spliced record is given the larger of the base record length or overlay record length. If the overlay record length is larger than the base record length, bytes in the extended spliced record that are not overlaid are filled in with blanks.

If VLENMAX is specified with WITHANY or WITHEACH, the spliced record is given the largest of the base record length or overlay record lengths. If the largest overlay record length is larger than the base record length, bytes in the extended spliced record that are not overlaid are filled in with blanks.

For fixed-length records, VLENMAX is ignored since the base, overlay and spliced records all have the same length.

VLENOVLY

Specifies that for variable-length records, the length of the spliced record is set to the length of the overlay record. VLENOVLY overrides the default of setting the length of the spliced record to the length of the base record.

If VLENOVLY is specified with or without WITHALL, the spliced record is given the overlay record length. If the overlay record length is larger than the base record length, the spliced record is padded with blanks from the end of
SPLICE Operator

the base record to the new length. If the overlay record length is smaller than
the base record length, bytes in the extended spliced record that are not
overlaid are filled in with blanks.

VLENOVLY cannot be specified with WITHANY or WITHEACH.
For fixed-length records, VLENOVLY is ignored since the base, overlay and
spliced records all have the same length.

USING(xxxx)
Specifies the first 4 characters of the ddname for the control statement data set
to be used by DFSORT for this operation. xxxx must be four characters that are
valid in a ddname of the form xxxxCNTL. xxxx must not be SYSx.

If USING is specified, an xxxxCNTL DD statement must be present and the
control statements in it:
1. Must conform to the rules for DFSORT’s SORTCNTL data set.
2. Should generally be used only for an INCLUDE or OMIT statement, an
   INREC statement, comment statements, or appropriate OUTFIL statements
   as described for “SPLICE Operator” on page 678.

VSAMTYPE(x)
See the discussion of this operand on the COPY statement in "COPY Operator"
on page 568.

UZERO
See the discussion of this operand on the OCCUR statement in "OCCUR
Operator" on page 642.

SPLICE Examples
SPLICE normally requires reformatting the records of two or more data sets so
they can be joined, so complete JCL examples are shown in this section to illustrate
the suggested techniques. These techniques and others can be employed with
SPLICE to perform a variety of tasks.

Because SPLICE overlays the WITH fields from the overlay record to the base
record using matching ON fields, it’s usually necessary to do some initial setup
before using SPLICE, to ensure that:
• the ON fields are in the same positions in the base and overlay records
• the WITH fields in the overlay records are in the positions they will occupy in
  the base records
• the base records and overlay records are the same length. This is always
  required for fixed-length records, and is required for variable-length records
  unless VLENMAX or VLENOVLY is specified.

For optimum efficiency, it is also a good idea to remove any records that are not
needed for the SPLICE operation as part of the initial setup before the SPLICE
operation, by using appropriate INCLUDE or OMIT statements.

Example 1 - Create one spliced record for each match in two
files
This example shows how you can splice data together for each pair of records with
the same ON field in two different input data sets.

```bash
//S1 EXEC PGM=ICETOOL
//TOOLMSG DD SYSOUT=* 
//DFSMSG DD SYSOUT=* 
//IN1 DD * 
Y12 89503 MKT
```
SPLICE Operator

Y12 57301 MKT
Z35 02316 DEV
Y12 91073 MKT
Z35 18693 DEV

/*
IN2 DD *
89503 27M $9,185,354 SAN JOSE CA
72135 08M $317,632 BOSTON MA
18693 10M $8,732,105 BUFFALO NY
57301 50M $30,000 NEWARK NJ
*/

/*
TEMP1 DD DSN=&TEMP1,DISP=(MOD,PASS),SPACE=(TRK,(5,5)),UNIT=SYSDA
//COMBINE DD SYSPUT=*
//TOOLIN DD *
* Reformat the File1 records for splicing
COPY FROM(IN1) TO(TEMP1) USING(CTL1)
* Reformat the File2 records for splicing
COPY FROM(IN2) TO(TEMP1) USING(CTL2)
* Splice the needed data from File1 and File2 together
SPLICE FROM(TEMP1) TO(COMBINE) ON(5,5,ZD) WITH(15,17)
*/

/*
CTL1CNTL DD *
OUTREC FIELDS=(1,14, file1 data
31:X) add blanks for spliced file2 data
*/

/*
CTL2CNTL DD *
OUTREC FIELDS=(5:1,5, put file2 key in same place as file1 key
15:7,15, file2 data
30:33,2) file2 data
*/

The base records originate from the IN1 data set and are copied and reformatted to
the TEMP1 data set. The reformatted TEMP1 records are 31 bytes long and look
like this:
Y12 89503 MKT
Y12 57301 MKT
Z35 02316 DEV
Y12 91073 MKT
Z35 18693 DEV

The overlay records originate from the IN2 data set and are copied and
reformatted to the end (MOD) of the TEMP1 data set. The reformatted TEMP1
records are 31 bytes long and look like this:
89503 27M $9,185,354 CA
72135 08M $317,632 MA
18693 10M $8,732,105 NY
57301 50M $30,000 NJ

Note that MOD is used for the TEMP1 data set, so the reformatted records from
IN1 and IN2 will be output to the TEMP1 data set in that order, ensuring that they
are spliced in that order.

The base and overlay records from the TEMP1 data set are sorted and spliced to
the COMBINE data set.

The records look like this after they are sorted on the 5,5,ZD field, but before they
are spliced. As a visual aid, the WITH fields in the overlay records are shown in
bold.
Z35 02316 DEV
Z35 18693 DEV
18693 10M $8,732,105 NY
Y12 57301 MKT
The spliced COMBINE records are 31 bytes long and look like this:

Z35 18693 DEV 10M $8,732,105 NY
Y12 57301 MKT 50M $30,000 NJ
Y12 89503 MKT 27M $9,185,354 CA

Note that the base records for 18693, 57301 and 89503 have been spliced together with their respective overlay records.

Here is what the various ICETOOL operators do in this job:

- The first COPY operator creates reformatted IN1 records in TEMP1. The second COPY operator creates reformatted IN2 records in TEMP1. The reformatted IN1 records have blanks where the reformatted IN2 WITH fields will go. The reformatted IN2 records have the ON field from IN2 in the same place as in the reformatted IN1 records, and have the IN2 data where we want it to go in the reformatted IN1 records. We made the reformatted IN1 and reformatted IN2 records the same size so we can put them all in the TEMP1 data set and use TEMP1 as input to the SPLICE operator.

- The SPLICE operator sorts the records from TEMP1 using the ON field. TEMP1 has the reformatted IN1 records before the reformatted IN2 records. The spliced records are created from the base records and the overlay records in TEMP1. Whenever two records are found with the same ON field, the WITH field from the second record (reformatted IN2 overlay record) is overlaid on to the first record (reformatted IN1 base record). The resulting spliced records are written to the COMBINE data set.

Example 2 - Combine complete records from four files

This example shows how you can use the WITHEACH operand to splice complete records from four different data sets together.

```plaintext
//S2 EXEC PGM=ICETOOL
//TOOLMSG DD SYSOUT=* 
//DFSMSG DD SYSOUT=* 
//FILE1 DD DSN=... input file1 - 300-byte records 
//FILE2 DD DSN=... input file2 - 400-byte records 
//FILE3 DD DSN=... input file3 - 150-byte records 
//FILE4 DD DSN=... input file4 - 20-byte records 
//** BE SURE TO USE MOD FOR T1 
//T1 DD DSN=&&TX,UNIT=SYSDA,SPACE=(CYL,(5,5)), DISP=(MOD,PASS) 
//ALLRDCS DD DSN=... output file - 870-byte records 
//TOOLIN DD * 
* Reformat the File1 records for splicing on added sequence number 
COPY FROM(FILE1) TO(T1) USING(CTL1) 
* Reformat the File2 records for splicing on added sequence number 
COPY FROM(FILE2) TO(T1) USING(CTL2) 
* Reformat the File3 records for splicing on added sequence number 
COPY FROM(FILE3) TO(T1) USING(CTL3) 
* Reformat the File4 records for splicing on added sequence number 
COPY FROM(FILE4) TO(T1) USING(CTL4) 
* Splice record-by-record on added sequence number 
SPLICE FROM(T1) TO(ALLRDCS) ON(871,8,PD) WITHEACH - WITH(301,400) WITH(701,150) WITH(851,20) - USING(CTL5) 
*/ 
//CTLCNTL DD * 
* Reformat records to:
```
Because the data sets do not have a common key, we add sequence numbers to the records from each data set and use the sequence numbers as the ON field for SPLICE. Using this technique, we can splice together the 300-byte records from FILE1, the 400-byte records from FILE2, the 150-byte records from FILE3 and the 20-byte records from FILE4, to produce 870-byte records in ALLRCDS.

Conceptually, the 870-byte records in ALLRCDS would look like this:

File1 Record1 ... File2Record1 ... File3Record1 ... File4Record1 ...
File1 Record2 ... File2Record2 ... File3Record2 ... File4Record2 ...
...

The base records originate from the FILE1 data set and the overlay records originate from the FILE2, FILE3 and FILE4 data sets.

Here is what the various ICETOOL operators do in this job:

The first COPY operator creates reformatted records in the T1 data set with the FILE1 records in positions 1-300, blanks in all other positions up to 870, and a sequence number in positions 871-878. The sequence number will be 1 for the first FILE1 record, 2 for the second FILE1 record, and so on.

The second COPY operator creates reformatted records in the T1 data set with the FILE2 records in positions 301-700, blanks in all other positions up to 870, and a sequence number in positions 871-878. The sequence number will be 1 for the first FILE2 record, 2 for the second FILE2 record, and so on.

The third COPY operator creates reformatted records in the T1 data set with the FILE3 records in positions 701-850, blanks in all other positions up to 870, and a sequence number in positions 871-878. The sequence number will be 1 for the first FILE3 record, 2 for the second FILE3 record, and so on.

The fourth COPY operator creates reformatted records in the T1 data set with the FILE4 records in positions 851-870, blanks in all other positions up to 850, and a
sequence number in positions 871-878. The sequence number will be 1 for the first
FILE4 record, 2 for the second FILE4 record, and so on.

Note that MOD is used for the T1 data set, so the reformatted records from FILE1,
FILE2, FILE3 and FILE4 will be output in that order in T1, ensuring that they are
sorted and spliced in that order.

The SPLICE operator sorts the records from T1 using the sequence number as the
ON field. With WITHEACH, the reformatted FILE1 records are treated as the base
records, and the reformatted FILE2, FILE3 and FILE4 records are treated as the
overlay records; each WITH field is associated with an overlay record in turn. So
the first WITH field specifies the bytes to be used from the second duplicate
(FILE2 record), the second WITH field specifies the bytes to be used from the third
duplicate (FILE3 record) and the third WITH field specifies the bytes to be used
from the fourth duplicate (FILE4 record).

SPLICE matches each base and overlay record by their sequence numbers, and
creates a new combined 878-byte record. The OUTFIL statement in CTL5CNTL is
used to remove the sequence number so that the 870-byte spliced record is written
to the ALLRCDS data set.

Example 3 - Create files with matching and non-matching
records
This example shows how you can match records in input data sets 1 and 2 to
produce three output data sets with:
• ON fields that appear in both input data set 1 and input data set 2
• ON fields that appear only in input data set 1
• ON fields that appear only in input data set 2

```plaintext
//S3 EXEC PGM=ICETOOL
//TOOLMSG DD SYSOUT=* 
//DFSMSG DD SYSOUT=* 
//IN1 DD * 
Vicky
Frank
Carrie
Holly
Paul
/*
//IN2 DD * 
Karen
Holly
Carrie
Vicky
Mary
/*
//OUT12 DD SYSOUT=* 
//OUT1 DD SYSOUT=* 
//OUT2 DD SYSOUT=* 
//T1 DD DSN=&T1,DISP=(MOD,PASS),UNIT=SYSDA,SPACE=(TRK,(5,5)) 
//TOOLIN DD * 
* Add '11' identifier for FILE1 records.
COPY FROM(IN1) TO(T1) USING(CTL1)
* Add '22' identifier for FILE2 records.
COPY FROM(IN2) TO(T1) USING(CTL2)
* SPLICE to match up records and write them to their
* appropriate output files.
SPLICE FROM(T1) TO(OUT12) ON(1,10,CH) WITH(13,1) -
USING(CTL3) KEEPNODUPS
/*
//CTLICNTL DD * 
```
SPLICE Operator

* Mark FILE1 records with '11'
  OUTREC FIELDS=(1,10,12:C'11')
/*
//CTL2CNTL DD *
* Mark FILE2 records with '22'
  OUTREC FIELDS=(1,10,12:C'22')
/*
//CTL3CNTL DD *
* Write matching records to OUT12 file. Remove id.
  OUTFIL FNAMES=OUT12,INCLUDE=(12,2,CH,EQ,C'12'),OUTREC=(1,10)
* Write FILE1 only records to OUT1 file. Remove id.
  OUTFIL FNAMES=OUT1,INCLUDE=(12,2,CH,EQ,C'11'),OUTREC=(1,10)
* Write FILE2 only records to OUT2 file. Remove id.
  OUTFIL FNAMES=OUT2,INCLUDE=(12,2,CH,EQ,C'22'),OUTREC=(1,10)
/*

We copy the IN1 records to the T1 data set and add an identifier of '11' to show they come from FILE1.

We copy the IN2 records to the end (MOD) of the T1 data set and add an identifier of '22' to show they come from FILE2.

We sort the records of T1 on positions 1-3 and splice the second id byte for matching records. We use KEEPNODUPS to keep non-duplicate records.

The records look like this after they are sorted, but before they are spliced:

Carrie 11
Carrie 22
Frank 11
Holly 11
Holly 22
Karen 22
Mary 22
Paul 11
Vicky 11
Vicky 22

The records look like this after they are spliced, but before we do the OUTFIL processing specified by CTL3CNTL with USING(CTL3) for SPLICE:

Carrie 12
Frank 11
Holly 12
Karen 22
Mary 22
Paul 11
Vicky 12

An id of 12 indicates an ON field that appears in IN1 and IN2. An id of 11 indicates an ON field that appears only in IN1. An id of 22 indicates an ON field that appears only in IN2.

The OUTFIL statements in CTL3CNTL write the records to their appropriate output data sets (without the ids) as follows:

OUT12 contains:
Carrie
Holly
Vicky

OUT1 contains:
Example 4 - Create a matrix of values

This example shows how you can use the WITHANY operand to create a matrix of values. We combine multiple rows for different types of data with a common key into a single row of data for that key, even if some rows are missing.

```
//S4 EXEC PGM=ICETOOL
//TOOLMSG DD SYSOUT=*  
//DFSMSG6 DD SYSOUT=*  
//IN DD *  
001 3  150
001 2  120
001 1  100
002 2  140
002 3  250
003 1  050
003 3  920
004 3  005
/*/  
//OUT DD SYSOUT=*  
//TOOLIN DD *  
* Splice nonblank type 1 values (in 5-7), type 2 values (9-11)  
* and type 3 values (13-15) for each key.  
SPLICE FROM(IN) TO(OUT) ON(1,3,CH) WITHANY KEEPNODUPS -  
  WITH(5,3) WITH(9,3) WITH(13,3) USING(CTL1)
/*/  
//CTLICNLT DD *  
* Before SPLICE:  
* Reformat type 1 records to:  
* 1  5  
* key val  
  INREC IFTHEN=(WHEN=(5,1,CH,EQ,C'1'),  
               BUILD=(1,3,5:8,3)),  
* Reformat type 2 records to:  
* 1  9  
* key val  
  IFTHEN=(WHEN=(5,1,CH,EQ,C'2'),  
            BUILD=(1,3,9:8,3)),  
* Reformat type 3 records to:  
* 1  13  
* key val  
  IFTHEN=(WHEN=(5,1,CH,EQ,C'3'),  
            BUILD=(1,3,13:8,3))
/*/  
```

The input records look like this:

```
001 3  150
001 2  120
001 1  100
002 2  140
002 3  250
003 1  050
003 3  920
004 3  005
```
We have a key (for example, '001') in positions 1-3, a record type (1, 2 or 3) in position 5 and a numeric value in positions 8-10. We want to set up a single row for each key with the values for the three record types and blanks for missing record types.

Before we SPLICE the records, we use the INREC IFTHEN clauses to put the values from the type 1 records in positions 5-7, the values from the type 2 records in positions 9-11 and the values from the type 3 records in positions 13-15. The reformatted INREC records look like this:

```
001  150
001  120
001  100
002  140
002  250
003  050
003  920
004   05
```

We use SPLICE with WITHANY and appropriate WITH fields to create one combined record for each key with the values for the record types. We use KEEPNODUPS to keep records for keys with only one value (for example, '004').

The OUT records are 15 bytes long and look like this:

```
001  100  120  150
002   140  250
003  050  920
004   005
```

Note that if we used WITHEACH instead of WITHANY, the output would not be what we wanted since record types are missing for some keys (for example, type 1 is missing for key 002), and record types are out of order for some keys (for example, we have type 3, type 2 and type 1 in that order for key 001). With WITHEACH, the OUT records would look like this:

```
001   150
002   140
003
004   005
```

**Example 5 - Create multiple spliced records for each match in two types of records**

This example shows how you can use the WITHALL operand to tell ICETOOL to splice data together for a single record of one type (A records) and multiple records of another type (H records), in the same input data set, that all have the same ON field (duplicate records). It also shows how to ensure that duplicates of the second type without a match of the first type are not written to the output data set. IFTHEN clauses are used in an INREC statement to reformat the two types of records appropriately before they are sorted and spliced.
SPLICE Operator

/*
//OUT DD SYSOUT=* 
//TOOLIN DD *
* Splice needed base and overlay data together.
* Do NOT splice identifier.
SPLICE FROM(MAST) TO(OUT) WITH(1,7) WITH(13,4) ON(20,3,CH) -
           WITH(23,3) WITH(26,3) WITHALL USING(CTL1)
*/

//CTLICNTL DD *
* Before SPLICE:
* Set up fields in base (A) records. Add 'B' id in position 33.
** INREC IFTHEN=(WHEN=(1,1,CH,EQ,C'A' ),
**        BUILD=(8:14,5:17:31,3,20:11,3,29:34,4,33:C'B')),
* Set up fields in overlay (H) records. Add 'V' id in position 33.
** IFTHEN=(WHEN=(1,1,CH,EQ,C'H' ),
* After SPLICE:
* Remove duplicate overlay records without matching base record.
* Remove base or overlay indicator.
** OUTFIL FNAMES=OUT,OMIT=(33,1,CH,EQ,C'V'),OUTREC=(1,32)
*/

The base records are the records in MAST with an 'A' in column 1. They are reformatted by the INREC statement as 33 byte records that look like this:

```
C0000 F00KRS G0008
C1111 F11FLY G1118
```

We put a 'B' in position 33 to identify these records as base records.

The overlay records are the records in MAST with an 'H' in column 1. They are reformatted by the INREC statement as 33 bytes records that look like this:

```
1000002 K002 KRSH02L02 V
1000003 K003 FLYH03L03 V
1000004 K004 VQXH04L04 V
1000005 K005 FLYH05L05 V
1000006 K006 KHNH06L06 V
1000007 K007 KRSH07L07 V
1000008 K008 FLYH08L08 V
1000009 K009 KHNH09L09 V
```

We put a 'V' in position 33 to identify these records as overlay records.

The base and overlay records set up by the INREC statement are sorted and spliced.

The records look like this after they are sorted on the 20,3,CH field, but before they are spliced. As a visual aid, the WITH fields in the overlay records are shown in bold.

```
C1111 F11FLY G1118
1000003 K003 FLYH03L03 V
1000005 K005 FLYH05L05 V
1000008 K008 FLYH08L08 V
1000006 K006 KHNH06L06 V
1000009 K009 KHNH09L09 V
C0000 F00KRS G0008
1000002 K002 KRSH02L02 V
1000007 K007 KRSH07L07 V
1000004 K004 VQXH04L04 V
```

The spliced output records are 33 bytes long and look like this:
Note that the base record (type A) for FLY has been spliced together with each of
the three overlay records (type H) for FLY. Likewise, the base record (type A) for
KRS has been spliced together with each of the two overlay records (type H) for
KRS.

But also note that the overlay records (type H) for KHN have been spliced
together. Because KHN does not appear as a base record (type A) we don't want
the KHN records to appear in the OUT data set. So we will use the 'V' we put in
position 33 for the overlay records to identify and delete spliced overlay records
without a matching base record. We only have to do this if we have duplicate
overlay records without a matching base record. Single overlay records without a
matching base record will be deleted automatically (unless you specify
KEEPNODUPS).

After we eliminate the spliced overlay records and the position 33 indicator, the
OUT records are 32 bytes long and look like this:

I000003C1111K003F11FLYH03L03G111
I000005C1111K005F11FLYH05L05G111
I000008C1111K008F11FLYH08L08G111
I000002C0000K002F00KRSH02L02G000
I000007C0000K007F00KRSH07L07G000

Note that if we had not specified WITHALL, only the first and last records for
each set of duplicates would have been spliced, producing the following output:

I000008C1111K008F11FLYH08L08G111
I000007C0000K007F00KRSH07L07G000

**Example 6 - Pull records from a master file in sorted order**

This example shows how you can use the WITHALL operand to tell ICETOOL to
use ON fields in a "PULL" data set to select one or more records from a "MASTER"
data set. In other words, you can use a PULL list to select records from a MASTER
list. In this case, the PULL data set has VB records and the MASTER data set has
FB records. The ON field is a City Name that can be 1-20 bytes long, and the
selected MASTER records are to be sorted by the City Name. (**Example 7 - Pull
records from a master file in their original order** on page 698 shows how to keep
the MASTER records in their original order.)

```
//S6 EXEC PGM=ICETOOL
//TOOLMSG DD SYSOUT=* 
//DFSMSG DD SYSOUT=* 
//PULL DD DSN=VAR.PULL.FILE,DISP=SHR 
//MASTER DD DSN=FIXED.MASTER.FILE,DISP=SHR 
//TEMP1 DD DSN=&&T1,DISP=(MOD,PASS),SPACE=(TRK,(5,5)),UNIT=SYSDA 
//OUT DD DSN=FIXED.OUTPUT.FILE,DISP=(NEW,CATLG,DELETE), 
// SPACE=(TRK,(5,5)),UNIT=SYSDA 
//TOOLIN DD * 
* Convert PULL records from VB to FB and add 'P' identifier. 
COPY FROM(PULL) USING(CTL1) 
* Add 'M' identifier to MASTER records. 
COPY FROM(MASTER) TO(TEMP1) USING(CTL2) 
* Splice PULL and MASTER records (do NOT splice identifier): 
  * Spliced MASTER records with matching PULL records have 'P' id. 
  * Spliced MASTER records without matching PULL records have 'M' id. 
```
SPLICE Operator

* Eliminate records with 'M' id.
  SPLICE FROM(TEMP1) TO(OUT) ON(1,20,CH) WITHALL WITH(1,40) -
  USING(CTL3)
  /*
  //CTL1CNTL DD *
  * Convert PULL records from VB to FB and add 'P' identifier.
  OUTFIL FNAMES=TEMP1,VTOF,OUTREC=(5,20,41:C'P')
  */
  //CTL2CNTL DD *
  * Add 'M' identifier to MASTER records.
  OUTREC FIELDS=(1,40,41:C'M')
  */
  //CTL3CNTL DD *
  * Eliminate MASTER records without matching PULL records.
  OUTFIL FNAMES=OUT,OMIT=(41,1,CH,EQ,C'M'),OUTREC=(1,40)
  */

The base records originate from the PULL data set (VAR.PULL.FILE). The PULL data set has variable-length (VB) records with the RDW in positions 1-4 and the variable-length City Name starting in position 5 for 1-20 bytes. Conceptually, the PULL records look like this:

<table>
<thead>
<tr>
<th>Length</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>SAN JOSE</td>
</tr>
<tr>
<td>12</td>
<td>NEW YORK</td>
</tr>
<tr>
<td>11</td>
<td>DENVER</td>
</tr>
<tr>
<td>15</td>
<td>LOS ANGELES</td>
</tr>
</tbody>
</table>

The overlay records originate from the MASTER data set (FIXED.MASTER.FILE). The MASTER data set has 40-byte fixed-length (FB) records with the City Name in positions 1-20.

The PULL records are copied and reformatted to the TEMP1 data set as 41-byte fixed-length (FB) records with the City Name in positions 1-20 (padded on the right with blanks as necessary), and a 'P' in position 41 to identify them as PULL records. The VTOF and OUTREC parameters of DFSORT's OUTFIL statement are used to convert the VB records to FB records with blank padding. The reformatted PULL records in TEMP1 look like this:

SAN JOSE   P
NEW YORK   P
DENVER     P
LOS ANGELES P

The MASTER records are copied and reformatted to the end (MOD) of the TEMP1 data set as 41-byte fixed-length (FB) records with an 'M' added in position 41 to identify them as MASTER records. The reformatted MASTER records in TEMP1 look like this:

SAN JOSE     8630  SUSAN  M
PHOENIX      7993  PAUL   M
LOS ANGELES  9203  MICHAEL M
SAN JOSE     0052  VICKY  M
NEW YORK     5218  CARRIE M
SAN JOSE     3896  FRANK  M
TUCSON       1956  LISA   M
NEW YORK     6385  MICHAEL M
PHOENIX      5831  HOLLY  M

The base and overlay records from the TEMP1 data set are sorted and spliced.

The records look like this after they are sorted on the 1,20,CH field, but before they are spliced. As a visual aid, the WITH fields in the overlay records are shown in bold.
DENVER P
LOS ANGELES P
LOS ANGELES 9203 MICHAEL M
NEW YORK P
NEW YORK 5218 CARRIE P
NEW YORK 6385 MICHAEL M
PHOENIX 7993 PAUL M
PHOENIX 5831 HOLLY M
SAN JOSE P
SAN JOSE 8630 SUSAN M
SAN JOSE 0052 VICKY P
SAN JOSE 3896 FRANK M
TUCSON 1056 LISA M

The spliced records look like this:

LOS ANGELES 9203 MICHAEL P
NEW YORK 5218 CARRIE P
NEW YORK 6385 MICHAEL P
SAN JOSE 8630 SUSAN P
SAN JOSE 0052 VICKY P
SAN JOSE 3896 FRANK P

Finally, we use the OUTFIL statement for SPLICE to remove each spliced record with an 'M' in position 41, because that represents a base record without a matching overlay record. The OUTFIL statement also removes the 'P' indicator in position 41 from each record, because it is not needed in the OUT data set.

Thus, for each MASTER record that matches a PULL record, we've overlaid the PULL record with the MASTER record. This effectively selects all of the MASTER records on the PULL list. The resulting OUT data set (FIXED.OUTPUT.FILE) has the following 40-byte fixed-length records:

LOS ANGELES 9203 MICHAEL
NEW YORK 5218 CARRIE
NEW YORK 6385 MICHAEL
SAN JOSE 8630 SUSAN
SAN JOSE 0052 VICKY
SAN JOSE 3896 FRANK

Example 7 - Pull records from a master file in their original order

This example is similar to "Example 6 - Pull records from a master file in sorted order" on page 696, except that we want to keep the resulting MASTER records in their original order instead of sorting them by the City Name field. We use DFSORT's SEQNUM parameter to add a sequence number to each MASTER record before the records are spliced, and we splice that sequence number along with the data. After SPLICE sorts by the City Name, we SORT again by the sequence number to get the resulting MASTER records back in their original order.

```
//S7 EXEC PGM=ICETOOL
//TOOLMSG DD SYSOUT=*  
//DFSMSG DD SYSOUT=* 
//PULL DD DSN=VAR.PULL.FILE,DISP=SHR 
//MASTER DD DSN=FIXED.MASTER.FILE,DISP=SHR 
//TEMP1 DD DSN=&TEMP1,DISP=(MOD,PASS),SPACE=(TRK,(5,5)),UNIT=SYSDA 
//TEMP2 DD DSN=&TEMP2,DISP=(,PASS),SPACE=(TRK,(5,5)),UNIT=SYSDA 
//OUT DD DSN=FIXED.OUTPUT.FILE,DISP=(NEW,CATLG,DELETE), 
//     SPACE=(TRK,(5,5)),UNIT=SYSDA 
//TOOLIN DD *  
  * Convert PULL records from VB to FB and add 'P' identifier. 
COPY FROM(PULL) USING(CTL1)  
  * Add sequence number and 'M' identifier to MASTER records. 
COPY FROM(MASTER) TO(TEMP1) USING(CTL2)  
  * Splice PULL and MASTER records (splice sequence number, but
SPLICE Operator

* do NOT splice identifier:
* Spliced MASTER records with matching PULL records have 'P' id.
* Spliced MASTER records without matching PULL records have 'M' id.
* Eliminate records with 'M' id.
SPLICE FROM(TEMP1) TO(TEMP2) ON(1,20,CH) WITHALL WITH(1,48) - USING(CTL3)
* Sort resulting spliced records on original sequence number to get them back in their original order.
* Remove id and sequence number.
SORT FROM(TEMP2) TO(OUT) USING(CTL4)

/*
//CTL1CNTL DD *
* Convert PULL records from VB to FB and add 'P' identifier
OUTFIL FNAMES=TEMP1,VTOF,OUTREC=(5,20,49:C'P')
/*

/*
//CTL2CNTL DD *
* Add sequence number and 'M' identifier to MASTER records.
OUTREC FIELDS=(1,40,41:SEQNUM,8,B1,49:C'M')
/*

/*
//CTL3CNTL DD *
* Eliminate MASTER records without matching PULL records.
OUTFIL FNAMES=TEMP2,OMIT=(49,1,CH,EQ,C'M')
/*

/*
//CTL4CNTL DD *
* Sort on sequence number and remove id and sequence number.
SORT FIELDS=(41,8,B1,A)
OUTREC FIELDS=(1,40)
/*

The resulting OUT data set (FIXED.OUTPUT.FILE) has the following 40-byte fixed-length records:

SAN JOSE     8630     SUSAN
LOS ANGELES  9203   MICHAEL
SAN JOSE     0052     VICKY
NEW YORK    5218     CARRIE
SAN JOSE     3896     FRANK
NEW YORK    6385     MICHAEL

Example 8 - Create a report showing if needed parts are on-hand

This example shows how you can use the KEEPNODUPS operand to tell ICETOOL to compare the ON fields in a list of needed parts to the ON fields in a list of on-hand parts, and produce a report showing if each needed part is on-hand or not.

//S8 EXEC PGM=ICETOOL
//TOOLMSG DD SYSOUT=* 
//DFSMSG DD SYSOUT=* 
//ONHAND DD *
P62 Blue
P62 Red
G73 Blue
A27 Green
L90 Red
P63 Blue
/*
//NEEDED DD *
2003/05/07   A27 Green
2002/12/29   P62 Blue
2003/03/17   A27 Blue
2003/06/14   M92 Yellow
2002/12/18   L90 Red
/*
//COMBINED DD DSN=&T1,UNIT=SYSDA,SPACE=(TRK,(5,5)), 
// DISP=(MOD,PASS) 
//RPT DD SYSOUT=* 

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SPLICE Operator

//TOOLIN DD *
* Reformat the ONHAND records for splicing.
* Add 'Yes' for found in ONHAND data set.
* Add 'O' to indicate ONHAND record.
COPY FROM(ONHAND) TO(COMBINED) USING(CTL1)
* Reformat the NEEDED records for splicing.
* Add 'No' for missing from ONHAND data set.
* Add 'N' to indicate NEEDED record.
COPY FROM(NEEDED) TO(COMBINED) USING(CTL2)
* Splice ONHAND and NEEDED records (splice identifier):
* NEEDED records found in ONHAND list will have 'Yes'
* and 'N'.
* NEEDED records not found in ONHAND list will have 'No'
* and 'N'.
* ONHAND records that are not needed will have 'Yes'
* and 'O'.
* Eliminate records with 'O'.
SPLICE FROM(COMBINED) TO(RPT) -
ON(1,12,CH) WITH(24,10) WITH(40,1) -
KEEPNODUPS -
USING(CTL3)
/*
//CTL1CNTL DD *
* Reformat ONHAND records with part in 1-12, 'Yes' in 15-17
* and 'O' in 40.
OUTREC FIELDS=(1:1,12,15:C'Yes',40:C'O')
/*
//CTL2CNTL DD *
* Reformat NEEDED records with part in 1-12, 'No ' in 15-17,
* date in 24-33 and 'N' in 40.
OUTREC FIELDS=(1:15,12,15:C'No',24:2,10,40:C'N')
/*
//CTL3CNTL DD *
* Eliminate ONHAND parts that do not appear in NEEDED list.
* Create the report showing if needed parts are on-hand.
OUTFIL FNAMES=RPT,OMIT=(40,1,CH,EQ,C'O'),OUTREC=(1,33),
HEADER2=(1:'Part',15:'On-Hand',24:'Needed by',/
1:'------------',15:'-------',24:'----------')
/*

The base records originate from the ONHAND data set and are copied and reformatted to the COMBINED data set. We put an 'O' in position 40 to identify these records as ONHAND records. The overlay records originate from the NEEDED data set and are copied and reformatted to the COMBINED data set. We put an 'N' in position 40 to identify these records as NEEDED records. Because MOD is used for the COMBINED data set, it contains the reformatted ONHAND records followed by the reformatted NEEDED records. The COMBINED records are 40 bytes long and look like this:

<table>
<thead>
<tr>
<th>Part</th>
<th>On-Hand</th>
<th>Needed by</th>
</tr>
</thead>
<tbody>
<tr>
<td>P62</td>
<td>Yes</td>
<td>0</td>
</tr>
<tr>
<td>P62</td>
<td>Yes</td>
<td>0</td>
</tr>
<tr>
<td>G73</td>
<td>Yes</td>
<td>0</td>
</tr>
<tr>
<td>A27</td>
<td>Yes</td>
<td>0</td>
</tr>
<tr>
<td>L90</td>
<td>Yes</td>
<td>0</td>
</tr>
<tr>
<td>P63</td>
<td>Yes</td>
<td>0</td>
</tr>
<tr>
<td>A27</td>
<td>No</td>
<td>2003/05/07</td>
</tr>
<tr>
<td>P62</td>
<td>No</td>
<td>2002/12/29</td>
</tr>
<tr>
<td>A27</td>
<td>No</td>
<td>2003/03/17</td>
</tr>
<tr>
<td>M92</td>
<td>No</td>
<td>2003/06/14</td>
</tr>
<tr>
<td>L90</td>
<td>No</td>
<td>2002/12/18</td>
</tr>
</tbody>
</table>

The base and overlay records from the COMBINED data set are sorted and spliced.
The records look like this after they are sorted on the 1,12,CH field, but before they are spliced. As a visual aid, the WITH fields in the overlay records are shown in bold.

<table>
<thead>
<tr>
<th>Part</th>
<th>Color</th>
<th>Condition</th>
<th>Date</th>
<th>OnHand</th>
</tr>
</thead>
<tbody>
<tr>
<td>A27</td>
<td>Blue</td>
<td>No</td>
<td>2003/03/17</td>
<td>N</td>
</tr>
<tr>
<td>A27</td>
<td>Green</td>
<td>Yes</td>
<td>2003/05/07</td>
<td>N</td>
</tr>
<tr>
<td>A27</td>
<td>Green</td>
<td>No</td>
<td>2003/05/07</td>
<td>N</td>
</tr>
<tr>
<td>G73</td>
<td>Blue</td>
<td>Yes</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>L90</td>
<td>Red</td>
<td>Yes</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>L90</td>
<td>Red</td>
<td>No</td>
<td>2002/12/18</td>
<td>N</td>
</tr>
<tr>
<td>M92</td>
<td>Yellow</td>
<td>Yes</td>
<td>2003/06/14</td>
<td>N</td>
</tr>
<tr>
<td>P62</td>
<td>Blue</td>
<td>Yes</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>P62</td>
<td>Blue</td>
<td>No</td>
<td>2002/12/29</td>
<td>N</td>
</tr>
<tr>
<td>P62</td>
<td>Red</td>
<td>Yes</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>P63</td>
<td>Blue</td>
<td>Yes</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

The spliced output records are 40 bytes long and look like this:

<table>
<thead>
<tr>
<th>Part</th>
<th>Color</th>
<th>Condition</th>
<th>Date</th>
<th>OnHand</th>
</tr>
</thead>
<tbody>
<tr>
<td>A27</td>
<td>Blue</td>
<td>No</td>
<td>2003/03/17</td>
<td>N</td>
</tr>
<tr>
<td>A27</td>
<td>Green</td>
<td>Yes</td>
<td>2003/05/07</td>
<td>N</td>
</tr>
<tr>
<td>G73</td>
<td>Blue</td>
<td>Yes</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>L90</td>
<td>Red</td>
<td>Yes</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>L90</td>
<td>Red</td>
<td>No</td>
<td>2002/12/18</td>
<td>N</td>
</tr>
<tr>
<td>M92</td>
<td>Yellow</td>
<td>Yes</td>
<td>2003/06/14</td>
<td>N</td>
</tr>
<tr>
<td>P62</td>
<td>Blue</td>
<td>Yes</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>P62</td>
<td>Red</td>
<td>Yes</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>P63</td>
<td>Blue</td>
<td>Yes</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

We have three types of records above as follows:

1. Records with 'Yes' and 'N' are NEEDED records with an ONHAND match that have been spliced together. We want these for our report.
2. Records with 'No' and 'N' are NEEDED records without an ONHAND match that have been kept because we used KEEPNODUPS. We want these for our report.
3. Records with 'Yes' and 'O' are ONHAND records without a NEEDED match that have been kept because we used KEEPNODUPS. We do not want these for our report.

We use the OUTFIL statement for SPLICE to further process the spliced records. It omits the 'O' records, removes the 'N' byte, and sets up the headers for the report. The resulting RPT data set looks like this:

<table>
<thead>
<tr>
<th>Part</th>
<th>On-Hand</th>
<th>Needed by</th>
</tr>
</thead>
<tbody>
<tr>
<td>A27</td>
<td>No</td>
<td>2003/03/17</td>
</tr>
<tr>
<td>A27</td>
<td>Yes</td>
<td>2003/05/07</td>
</tr>
<tr>
<td>L90</td>
<td>Yes</td>
<td>2002/12/18</td>
</tr>
<tr>
<td>M92</td>
<td>No</td>
<td>2003/06/14</td>
</tr>
<tr>
<td>P62</td>
<td>Yes</td>
<td>2002/12/29</td>
</tr>
</tbody>
</table>

**Example 9 - Create a report showing if needed parts are on-hand - advanced**

This example is a more complex variation of “Example 8 - Create a report showing if needed parts are on-hand” on page 699. It shows how you can use the WITHALL, KEEPBASE, and KEEPNODUPS operands to tell ICETOOL to compare the ON fields in a list of needed parts to the ON fields in a list of on-hand parts, and produce a report showing if each needed part is on-hand or not. However, it also has duplicate parts in the NEEDED data set, and produces a report with more information from the ONHAND and NEEDED records.

```plaintext
//S9 EXEC PGM=ICETOOL
//TOOLMSG DD SYSOUT=* 
//DFSMSSG DD SYSOUT=* 
//ONHAND DD *
```
The base records originate from the ONHAND data set. They are copied and reformatted to the COMBINED data set. The reformatted records look like this:

P62 Blue Yes Dallas D
G73 Blue Yes San Jose D
A27 Green Yes Vancouver D

The overlay records originate from the NEEDED data set and are copied and reformatted to the COMBINED data set. The reformatted records look like this:
A27 Green No Rachel n/a Phoenix K
P62 Blue No Monica n/a Phoenix K
A27 Blue No Phoebe n/a Toronto K
M92 Yellow No Chandler n/a Los Angeles K
M92 Yellow No Joey n/a Paris K
A27 Green No Ross n/a Paris K

The base and overlay records from the COMBINED data set are sorted and spliced.

However, we need to make sure that all parts which appear in more than one NEEDED record, but do not appear in the ONHAND list, will appear in the report. For example, we have two M92 Yellow parts in the NEEDED data set that do not appear in the ONHAND data set. These two records are reformatted and appear in the COMBINED data set as follows:

M92 Yellow No Chandler n/a Los Angeles K
M92 Yellow No Joey n/a Paris K

ICETOOL would normally treat the first record as the base record and the second record as the overlay record. As a result, these two records would be spliced together into one record instead of two. To prevent this, and ensure that we keep both M92 Yellow parts, we must specify KEEPBASE. As a result, two records are kept: the unchanged first M92 Yellow record, and the spliced first and second M92 Yellow records (which in this case looks identical to the unspliced second record).

The records look like this after they are sorted on the 1,12,CH field, but before they are spliced. As a visual aid, the WITH fields in the overlay records are shown in bold:

A27 Blue No Phoebe n/a Toronto K
A27 Green Yes Vancouver D
A27 Green No Rachel n/a Phoenix K
A27 Green No Ross n/a Paris K
G73 Blue Yes San Jose D
M92 Yellow No Chandler n/a Los Angeles K
M92 Yellow No Joey n/a Paris K
P62 Blue Yes Dallas D
P62 Blue No Monica n/a Phoenix K

The spliced records look like this:

A27 Blue No Phoebe n/a Toronto K
A27 Green Yes Vancouver D
A27 Green Yes Rachel Vancouver Phoenix K
A27 Green Yes Ross Vancouver Paris K
G73 Blue Yes San Jose D
M92 Yellow No Chandler n/a Los Angeles K
M92 Yellow No Joey n/a Paris K
P62 Blue Yes Dallas D
P62 Blue Yes Monica Dallas Phoenix K

Records with 'D' are not needed, so we use the OUTFIL statement for SPLICE to omit them. The TEMP1 records look like this:

A27 Blue No Phoebe n/a Toronto K
A27 Green Yes Rachel Vancouver Phoenix K
A27 Green Yes Ross Vancouver Paris K
M92 Yellow No Chandler n/a Los Angeles K
M92 Yellow No Joey n/a Paris K
P62 Blue Yes Monica Dallas Phoenix K

Although we could have used the OUTFIL statement for SPLICE to print the report, we've chosen instead to use a separate DISPLAY operator. DISPLAY
requires an extra pass over the spliced records in TEMP1, but is easier to use than 
OUTFIL for reports. The resulting RPT data set looks like this:

<table>
<thead>
<tr>
<th>Part</th>
<th>On-Hand</th>
<th>Requested by</th>
<th>Ship from</th>
<th>Ship to</th>
</tr>
</thead>
<tbody>
<tr>
<td>A27</td>
<td>Blue</td>
<td>No</td>
<td>Phoebe</td>
<td>n/a</td>
</tr>
<tr>
<td>A27</td>
<td>Green</td>
<td>Yes</td>
<td>Rachel</td>
<td>Vancouver</td>
</tr>
<tr>
<td>A27</td>
<td>Green</td>
<td>Yes</td>
<td>Ross</td>
<td>Vancouver</td>
</tr>
<tr>
<td>M92</td>
<td>Yellow</td>
<td>No</td>
<td>Chandler</td>
<td>n/a</td>
</tr>
<tr>
<td>M92</td>
<td>Yellow</td>
<td>No</td>
<td>Joey</td>
<td>n/a</td>
</tr>
<tr>
<td>P62</td>
<td>Blue</td>
<td>Yes</td>
<td>Monica</td>
<td>Dallas</td>
</tr>
</tbody>
</table>

**Example 10 - Create spliced variable-length records from two files**

This example shows how you can splice data together for each pair of records with 
the same ON field in two different VB input data sets, even when records are of 
different lengths.

```plaintext
//S10 EXEC PGM=ICETOOL
//TOOLMSG DD SYSOUT=*  
//DFSMSG DD SYSOUT=*  
//CON DD DSN=VAR.INPUT1,DISP=SHR  
// DD DSN=VAR.INPUT2,DISP=SHR  
//OUT DD DSN=VAR.OUTPUT,DISP=(NEW,CATLG,DELETE),  
// SPACE=(CYL,(5,5)),UNIT=SYSDA  
//TOOLIN DD *  
* Splice the needed data from the two VB files together  
SPLICE FROM(CON) TO(OUT) ON(5,5,CH) WITHALL -  
     WITH(12,5) WITH(22,20) VLENMAX  
/*  
VAR.INPUT1 has RECFM=VB and LRECL=25. It contains the base records which 
look like this:

<table>
<thead>
<tr>
<th>Length</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>DIV01</td>
</tr>
<tr>
<td>15</td>
<td>DIV02</td>
</tr>
<tr>
<td>25</td>
<td>DIV03</td>
</tr>
<tr>
<td>25</td>
<td>DIV05</td>
</tr>
</tbody>
</table>

VAR.INPUT2 has RECFM=VB and LRECL=50. It contains the overlay records 
which look like this:

<table>
<thead>
<tr>
<th>Length</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>42</td>
<td>DIV01 83201  FERN BROTHERS INTL</td>
</tr>
<tr>
<td>33</td>
<td>DIV01 73268  ROSS INC.</td>
</tr>
<tr>
<td>39</td>
<td>DIV02 00589  ACME PAINT SHOP</td>
</tr>
<tr>
<td>19</td>
<td>DIV05 57003</td>
</tr>
<tr>
<td>47</td>
<td>DIV05 01381  FLOWERS BY RENEE</td>
</tr>
<tr>
<td>43</td>
<td>DIV06 37982  EVERYTHING FOR PETS</td>
</tr>
</tbody>
</table>

Because some of the overlay records are longer than their corresponding base 
records, we use VLENMAX to ensure that none of the data from the overlay 
records is lost. VLENMAX ensures that the larger length between the base record 
and overlay record is used for the spliced record, and that blanks are added to the 
end of the spliced record when needed.

The base and overlay records from the concatenated data sets are sorted and 
spliced. VAR.OUTPUT has RECFM=VB and LRECL=50. It contains the spliced 
records, which look like this:

<table>
<thead>
<tr>
<th>Length</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>42</td>
<td>DIV01 83201  L2  FERN BROTHERS INTL</td>
</tr>
<tr>
<td>33</td>
<td>DIV01 73268  L2  ROSS INC.</td>
</tr>
</tbody>
</table>
Notice that VLENMAX prevented any data from being lost. Without VLENMAX, data would have been lost; the spliced records would have looked like this:

<table>
<thead>
<tr>
<th>Length</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>DIV01 83201 L2 FERN</td>
</tr>
<tr>
<td>25</td>
<td>DIV01 73268 L2 ROSS</td>
</tr>
<tr>
<td>15</td>
<td>DIV02 0058</td>
</tr>
<tr>
<td>25</td>
<td>DIV05 57003 L8</td>
</tr>
<tr>
<td>25</td>
<td>DIV05 01381 L8 FLOW</td>
</tr>
</tbody>
</table>

Notice that VLENMAX prevented any data from being lost. Without VLENMAX, data would have been lost; the spliced records would have looked like this:

<table>
<thead>
<tr>
<th>Length</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>DIV01 83201 L2 FERN</td>
</tr>
<tr>
<td>25</td>
<td>DIV01 73268 L2 ROSS</td>
</tr>
<tr>
<td>15</td>
<td>DIV02 0058</td>
</tr>
<tr>
<td>25</td>
<td>DIV05 57003 L8</td>
</tr>
<tr>
<td>25</td>
<td>DIV05 01381 L8 FLOW</td>
</tr>
</tbody>
</table>

Prints messages containing the minimum, maximum, average, and total for specified numeric fields. From 1 to 10 fields can be specified.

DFSORT is called to copy the indd data set to ICETOOL’s E35 user exit. ICETOOL prints messages containing the minimum, maximum, average, and total for each field as determined by its E35 exit.

The average (or mean) is calculated by dividing the total by the record count and rounding down to the nearest integer (examples: 23 / 5 = 4, -23 / 5 = -4).

You must not supply your own DFSORT MODS, INREC, or OUTREC statement, because they would override the DFSORT statements passed by ICETOOL for this operator.

**Operand Descriptions**

The operands described below can be specified in any order.

**FROM(indd)**

See the discussion of this operand on the DISPLAY statement in “DISPLAY Operator” on page 587.

**ON(p,m,f)**

Specifies the position, length, and format of a numeric field to be used for this operation.

p specifies the first byte of the field relative to the beginning of the input record. p is 1 for the first data byte of a fixed-length record and 5 for the first data byte of a variable-length record as illustrated below (RRRR represents the 4-byte record descriptor word):

<table>
<thead>
<tr>
<th>Fixed-length record</th>
<th>Variable-length record</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>A</td>
</tr>
<tr>
<td>p=</td>
<td>1</td>
</tr>
</tbody>
</table>

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m specifies the length of the field in bytes. A field must not extend beyond position 32752 or beyond the end of a record. The maximum length for a field depends on its format.

f specifies the format of the field as follows:

<table>
<thead>
<tr>
<th>Format Code</th>
<th>Length</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BI</td>
<td>1 to 8 bytes</td>
<td>Unsigned binary</td>
</tr>
<tr>
<td>FI</td>
<td>1 to 8 bytes</td>
<td>Signed fixed-point</td>
</tr>
<tr>
<td>PD</td>
<td>1 to 16 bytes</td>
<td>Signed packed decimal</td>
</tr>
<tr>
<td>ZD</td>
<td>1 to 31 bytes</td>
<td>Signed zoned decimal</td>
</tr>
<tr>
<td>CSF or FS</td>
<td>1 to 32 bytes (31 digit limit)</td>
<td>Signed numeric with optional leading floating sign</td>
</tr>
<tr>
<td>UFF</td>
<td>1 to 44 bytes (31 digit limit)</td>
<td>Unsigned free form numeric</td>
</tr>
<tr>
<td>SFF</td>
<td>1 to 44 bytes (31 digit limit)</td>
<td>Signed free form numeric</td>
</tr>
</tbody>
</table>

Note: See Appendix C, “Data Format Descriptions,” on page 885 for detailed format descriptions.

If the total for a field overflows 31 digits, ICETOOL continues processing, but prints asterisks for the average and total for that field.

For a CSF, FS, UFF, or SFF format field:
- A maximum of 31 digits is allowed. If a value with more than 31 digits is found, ICETOOL issues an error message and terminates the operation.

For a ZD or PD format field:
- If a decimal value contains an invalid digit (A-F), ICETOOL identifies the bad value in a message and prints asterisks for the minimum, maximum, average and total for that field.
- A value is treated as positive if its sign is F, E, C, A, 8, 6, 4, 2, or 0.
- A value is treated as negative if its sign is D, B, 9, 7, 5, 3, or 1.

For a ZD, PD, CSF, FS, or SFF format field, a negative zero value is treated as a positive zero value.

ON(VLEN)
See the discussion of this operand on the DISPLAY statement in “DISPLAY Operator” on page 587.

VSAMTYPE(x)
See the discussion of this operand on the COPY statement in “COPY Operator” on page 568.

LMSG
Specifies that the minimum, maximum, average and total for all numeric fields are to be printed using messages that display 31 digits (overriding the default of printing messages that display 15 digits when possible). LMSG ensures that only message ICE648I is used to display the statistics. Without LMSG, a combination of messages ICE608I, ICE609I and ICE648I can be used to display the statistics.

**STATS Example**

```
STATS FROM(DATA1) ON(VLEN) ON(15,4,ZD)
```
**STATS Operator**

Prints messages containing the minimum, maximum, average and total of the binary values in positions 1-2 of the DATA1 data set. For variable-length records, this gives statistics about the length of the records. Prints messages containing the minimum, maximum, average and total of the zoned decimal values in positions 15-18 of the DATA1 data set.

---

**SUBSET Operator**

```
SUBSET FROM(indd) TO(outdd) DISCARD(savedd) TO(outdd) DISCARD(savedd)
```

Keeps or removes input or output records based on meeting criteria for the first n records, specific relative record numbers, and the last n records. DFSORT writes the records that are kept or not removed to the outdd data set.

DFSORT is called to copy or sort the indd data set, as appropriate. ICETOOL uses its E15 or E35 exit to determine which records to include in the outdd or savedd data set. ICETOOL passes the EQUALS option to DFSORT to ensure that duplicates are kept in their original input order if records are sorted.

If the criteria includes the last n records, ICETOOL may call DFSORT twice. For the first pass, ICETOOL counts the indd records without opening the output data sets. For the second pass, ICETOOL opens the output data sets and does SUBSET processing against the indd data set using the count obtained in the first pass.

DISCARD(savedd) can be used to write the records that are removed or not kept in the savedd data set. DISCARD(savedd) can be used with or without TO(outdd).

If you do not specify a header operand (HEADER, FIRST, HEADER(u), FIRST(u)), a relative record number operand (RRN(q), RRN(q,r), RRN(q,*)), or a trailer operand (TRAILER, LAST, TRAILER(v), LAST(v)), all of the records will be kept or removed. You can specify a header operand, relative record number operands, and a trailer operand in any combination. Records will be kept or removed according to the criteria you specify.

You can only specify one header operand. You can specify from 1 to 300 relative record number operands in any combination. You can only specify one trailer operand.

The DFSORT control statements in xxxxCNTL are used if USING(xxxx) is specified. However, you must observe these rules for control statements in the xxxxCNTL data set:
SUBSET Operator

- MODS and OUTREC statements should not be present.
- SKIPREC and STOPAFT operands, and INCLUDE and OMIT statements, should not be present.
- A SORT statement can be present unless INPUT and DISCARD(savedd) are specified.
- INREC and SUM statements can be present.
- If INPUT is specified, the records selected will not be affected by INREC, SORT or SUM. If OUTPUT is specified, the records selected will be affected by INREC, SORT and SUM.
- Comment statements can be present.
- If you specify TO(outdd) without DISCARD(savedd), you can further process the outdd records after SUBSET processing using an OUTFIL statement like this:
  
  `OUTFIL FNAME=outdd,...`
  
  or multiple OUTFIL statements like this:
  `OUTFIL FNAME=outdd,...
  OUTFIL FNAME=outdd1,...`

- If you specify DISCARD(savedd) without TO(outdd), you can further process the savedd records after SUBSET processing using one (and only one) OUTFIL statement like this:

  `OUTFIL FNAME=savedd,...`

- If you specify TO(outdd) and DISCARD(savedd), you can further process the outdd and savedd records after SUBSET processing using two (and only two) OUTFIL statements like this:

  `OUTFIL FNAME=outdd,...`

  or multiple OUTFIL statements like this:
  `OUTFIL FNAME=outdd,...
  OUTFIL FNAME=savedd,...`

  Both statements must be specified in the order shown with at least the FNAME parameter. For example, to further modify only the DISCARD data set, you could use statements like this:

  `OUTFIL FNAME=OUT
  OUTFIL FNAME=SAVE,OMIT=(21,3,ZD,GT,+25)`

If you specify a SORT statement in xxxxCNTL, the DYNALLOC option is passed to DFSORT to ensure that work space is available for the sort. If your installation defaults for dynamic allocation are inappropriate for a SUBSET operator, you can take one of the following actions:

1. Override the DYNALLOC option using an OPTION control statement such as:

   `OPTION DYNALLOC=(,8)`

   in the xxxxCNTL data set.

2. Use xxxWKdd DD statements to override the use of dynamic allocation. Refer to “SORTWKdd DD Statement” on page 72 for details.

Tape work data sets cannot be used with ICETOOL.

Operands Descriptions

The operands described below can be specified in any order.
FROM(indd)
See the discussion of this operand on the COPY statement in "COPY Operator" on page 568.

TO(outdd)
Specifies the ddname of the output data set to which DFSORT will write the records it selects for the operation (that is, the records that are kept or not removed according to the specified criteria).

An outdd DD statement must be present and must define an output data set that conforms to the rules for DFSORT's SORTOUT data set.

TO and DISCARD can both be specified. If DISCARD is not specified, TO must be specified. If TO is not specified, DISCARD must be specified.

The ddname specified in the TO operand must not be the same as the ddname specified in the FROM or DISCARD operand.

Refer to "JCL Restrictions" on page 566 for more information.

DISCARD(savedd)
Specifies the ddname of the output data set to which DFSORT will write the records it does not select for the operation.

A savedd DD statement must be present and must define an output data set that conforms to the rules for DFSORT's OUTFIL data set.

TO and DISCARD can both be specified. If DISCARD is not specified, TO must be specified. If TO is not specified, DISCARD must be specified.

The ddname specified in the DISCARD operand must not be the same as the ddname specified in the FROM or TO operand.

Refer to "JCL Restrictions" on page 566 for more information.

KEEP
Specifies that the records that meet the criteria are to be kept.

REMOVE
Specifies that the records that meet the criteria are to be removed.

INPUT
Specifies that the criteria are to be applied using the first n input records, relative input record numbers, and the last n input records. Use INPUT if you want to apply the criteria directly to the records from the indd data set.

The criteria will be applied to keep or remove records before they are reformatted by INREC, sorted by SORT and summed by SUM. The kept records will subsequently be reformatted, sorted and summed. OUTFIL will be applied to the resulting records.

As an example, if the input data set contains these records:

```
AAAA R01
AAAA R02
BBBB R03
CCCC R04
CCCC R05
CCCC R06
DDDD R07
DDDD R08
EEEE R09
EEEE R10
EEEE R11
```
and the following SUBSET operator and DFSORT control statements were specified:

```plaintext
... 
//TOOLIN DD *
SUBSET FROM(IN) TO(OUT) KEEP INPUT RRN(3,10) USING(CTL1)
//CTL1CNTL DD *
  SORT FIELDS=(1,5,CH,D)
  SUM FIELDS=NONE
/*

First, input records 3-10 would be kept, so the intermediate result would be:
BBBB R03
CCCC R04
CCCC R05
CCCC R06
DDDD R07
DDDD R08
EEEE R09
EEEE R10

Then the SORT statement would be applied, so the intermediate result would be:
EEEE R09
EEEE R10
DDDD R07
DDDD R08
CCCC R04
CCCC R05
CCCC R06
BBBB R03

Finally, the SUM statement would be applied, so the final output in the OUT data set would be:
EEEE R09
DDDD R07
CCCC R04
BBBB R03

OUTPUT
Specifies that the criteria are to be applied using the first n output records, relative output record numbers, and the last n output records. Use OUTPUT if you want to apply the criteria to the indd records after they are processed by INREC, SORT and SUM as specified.

The criteria will be applied to keep or remove records after they are reformatted by INREC, sorted by SORT and summed by SUM. OUTFIL will be applied to the resulting records.

As an example, if the input data set contains these records:
AAAA R01
AAAA R02
BBBB R03
CCCC R04
CCCC R05
CCCC R06
DDDD R07
DDDD R08
EEEE R09
EEEE R10
EEEE R11

and the following SUBSET operator and DFSORT control statements were specified:
First, the SORT statement would be applied, so the intermediate result would be:

```
EEEE R09
EEEE R10
EEEE R11
DDDD R07
DDDD R08
CCCC R04
CCCC R05
CCCC R06
BBBB R03
AAAA R01
AAAA R02
```

Then the SUM statement would be applied, so the intermediate result would be:

```
EEEE R09
DDDD R07
CCCC R04
BBBB R03
AAAA R01
```

Finally, output records 2-3 would be kept, so the final output in the OUT data set would be:

```
DDDD R07
CCCC R04
```

**HEADER or FIRST**

Specifies one header record (the first record) is to be kept or removed.

HEADER and FIRST are equivalent to HEADER(1) and FIRST(1).

**HEADER(u) or FIRST(u)**

Specifies u header records (the first u records) are to be kept or removed. For example, HEADER(3) or FIRST(3) keeps or removes the first three records.

u must be specified as n or +n where n can be 1 to 999999999999999.

**TRAILER or LAST**

Specifies one trailer record (the last record) is to be kept or removed.

TRAILER and LAST are equivalent to TRAILER(1) and LAST(1).

**TRAILER(v) or LAST(v)**

Specifies v trailer records (the last v records) are to be kept or removed. For example, TRAILER(4) or LAST(4) keeps or removes the last 4 records.

v must be specified as n or +n where n can be 1 to 999999999999999.

**RRN(q)**

Specifies relative record number q is to be kept or removed. For example, RRN(8) keeps or removes the eighth record.

q must be specified as n or +n where n can be 1 to 999999999999999.

**RRN(q,r) or RRN(r,q)**

Specifies relative record numbers q through r are to be kept or removed. q can
be less than, equal to, or greater than r. For example, RRN(5,10) and RRN(10,5)
both keep or remove the fifth through tenth records.

q and r must be specified as n or +n where n can be 1 to 9999999999.

RRN(q,*
Specifies relative record numbers q through the last record are to be kept or
removed. For example, RRN(7,*) keeps or removes the seventh through last
records.

q must be specified as n or +n where n can be 1 to 9999999999.

Note: RRN(*,q) is not valid

USING(xxxx)
Specifies the first 4 characters of the ddname for the control statement data set
to be used by DFSORT for this operation. xxxx must be four characters that are
valid in a ddname of the form xxxxCNTL. xxxx must not be SYSx.

If USING is specified, an xxxxCNTL DD statement must be present. Control
statements in xxxxCNTL can be used as described for "SUBSET Operator" on
page xxx, and must conform to the rules for DFSORT's SORTCNTL data set.

VSAMTYPE(x)
See the discussion of this operand on the COPY statement in "COPY Operator"
on page 568.

SUBSET Examples
Although the SUBSET operators in the examples below could all be contained in a
single ICETOOL job step, they are shown and discussed separately for clarity.

Example 1
SUBSET FROM(IN1) TO(OUT1) REMOVE INPUT HEADER TRAILER

This example shows how you can remove the header record (first record) and
trailer record (last record).

The variable-length input records look like this:

<table>
<thead>
<tr>
<th>Len</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>33</td>
<td>01A RODENTS FFFFF</td>
</tr>
<tr>
<td>23</td>
<td>01A VOLE BINKY</td>
</tr>
<tr>
<td>26</td>
<td>02B HAMSTER GARFIELD</td>
</tr>
<tr>
<td>22</td>
<td>03A RAT JUNE</td>
</tr>
<tr>
<td>24</td>
<td>04B MOUSE MICKEY</td>
</tr>
<tr>
<td>21</td>
<td>01A COUNT 004</td>
</tr>
</tbody>
</table>

We just want to keep the data records. We use REMOVE, INPUT, HEADER and
TRAILER to indicate we want to remove the header and trailer input records.

The output records would look like this:

<table>
<thead>
<tr>
<th>Len</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>01A VOLE BINKY</td>
</tr>
<tr>
<td>26</td>
<td>02B HAMSTER GARFIELD</td>
</tr>
<tr>
<td>22</td>
<td>03A RAT JUNE</td>
</tr>
<tr>
<td>24</td>
<td>04B MOUSE MICKEY</td>
</tr>
</tbody>
</table>

Note that we could use FIRST and LAST instead of HEADER and TRAILER.

Example 2
SUBSET FROM(IN2) TO(OUT2) DISCARD(OUT3) -
KEEP INPUT RRN(3,4) LAST(3)
This example shows how you can create one output file with relative records and the last n records, and another output file with the remaining records.

The input records look like this:
Algebra
Astronomy
Biology
Calculus
French
Geography
Geometry
Greek
History
Latin
Psychology
Russian

In the first output file (OUT2), we want the third and fourth input records and the last three input records. In the second output file (OUT3), we want the records that are not in the first output file. We use TO(OUT2) and DISCARD(OUT3) for the two output files. We use KEEP, INPUT, RRN(3,4) and LAST(3) to indicate we want to keep relative input records 3 and 4 and the last 3 input records.

The OUT2 records would look like this:
Biology
Calculus
Latin
Psychology
Russian

The OUT3 records would look like this:
Algebra
Astronomy
French
Geography
Geometry
Greek
History

Note that we could use TRAILER(3) instead of LAST(3).

Example 3
SUBSET FROM(IN3) TO(OUT4) KEEP OUTPUT -
   LAST(5) USING(CTL1)

This example illustrates how you can keep the last 5 sorted records.

The CTL1CNTL data set contains:
SORT FIELDS=(1,15,CH,A)

The input records look like this:
Psychology
Biology
Russian
French
History
Geography
Calculus
Geometry
SUBSET Operator

We want to sort the records by the CH field in positions 1-15 and keep the last 5 sorted records. We use KEEP, OUTPUT and LAST(5) to keep the last 5 output records. We use the SORT statement to sort the records before they are output. After the SORT statement is executed, the intermediate records look like this:

Algebra  
Greek  
Astronomy  
Latin  

After the SUBSET operator is executed, the final output records look like this:

Greek  
History  
Latin  
Psychology  
Russian  

Note that we could use TRAILER(5) instead of LAST(5).

UNIQUE Operator

Prints a message containing the count of unique values for a specified numeric or character field.

DFSORT is called to sort the indd data set to ICETOOL's E35 user exit. ICETOOL prints a message containing the unique count as determined by its E35 user exit.

The DYNALLOC option is passed to DFSORT to ensure that work space is available for the sort. If your installation defaults for dynamic allocation are inappropriate for a UNIQUE operator, you can take one of the following actions:

1. Override the DYNALLOC option using an OPTION control statement such as:

   

   OPTION DYNALLOC=(8)

   in the DFSPARM data set.

2. Use SORTWKdd DD statements to override the use of dynamic allocation. Refer to “SORTWKdd DD Statement” on page 72 for details.
Attention: Either of these actions affects the work data sets used for an OCCUR operator, or for a SELECT or SPLICE operator for which USING(xxxx) is not specified.

Tape work data sets cannot be used with ICETOOL. You must not supply your own DFSORT MODS, INREC, OUTREC, SUM or RECORD statement, because they override the DFSORT statements passed by ICETOOL for this operator.

**Operand Descriptions**

The operands described below can be specified in any order.

**FROM(indd)**

See the discussion of this operand on the DISPLAY statement in [DISPLAY Operator](#) on page 587.

**ON(p,m,f)**

Specifies the position, length, and format of a numeric or character field to be used with this operation.

p specifies the first byte of the field relative to the beginning of the input record. p is 1 for the first data byte of a fixed-length record and 5 for the first data byte of a variable-length record as illustrated below (RRRR represents the 4-byte record descriptor word):

<table>
<thead>
<tr>
<th>Fixed-length record</th>
<th>Variable-length record</th>
</tr>
</thead>
</table>
| D | A | T | A | ... | R | R | R | R | D | A | T | A |...

p = 1234 | p = 12345678

m specifies the length of the field in bytes. A field must not extend beyond position 32752 or beyond the end of a record. The maximum length for a field depends on its format.

f specifies the format of the field as shown below:

<table>
<thead>
<tr>
<th>Format Code</th>
<th>Length</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BI</td>
<td>1 to 256 bytes</td>
<td>Unsigned binary</td>
</tr>
<tr>
<td>FI</td>
<td>1 to 256 bytes</td>
<td>Signed fixed-point</td>
</tr>
<tr>
<td>PD</td>
<td>1 to 32 bytes</td>
<td>Signed packed decimal</td>
</tr>
<tr>
<td>ZD</td>
<td>1 to 32 bytes</td>
<td>Signed zoned decimal</td>
</tr>
<tr>
<td>CH</td>
<td>1 to 4000 bytes</td>
<td>Character</td>
</tr>
<tr>
<td>CSF or FS</td>
<td>1 to 32 bytes</td>
<td>Signed numeric with optional leading floating sign</td>
</tr>
<tr>
<td>UFF</td>
<td>1 to 44 bytes</td>
<td>Unsigned free form numeric</td>
</tr>
<tr>
<td>SFF</td>
<td>1 to 44 bytes</td>
<td>Signed free form numeric</td>
</tr>
</tbody>
</table>

Note: See [Appendix C, “Data Format Descriptions,” on page 885](#) for detailed format descriptions.

For a ZD or PD format field:

- F, E, C, A, 8, 6, 4, 2, and 0 are treated as equivalent positive signs. Thus the zoned decimal values F2F3C1, F2F3F1, and 020301 are counted as only one unique value.
- D, B, 9, 7, 5, 3, and 1 are treated as equivalent negative signs. Thus the zoned decimal values F2F3B0, F2F3D0, and 020310 are counted as only one unique value.
UNIQUE Operator

- Digits are not checked for validity.

**ON(VLEN)**
See the discussion of this operand on the DISPLAY statement in [DISPLAY Operator](#) on page 587.

**VSAMTYPE(x)**
See the discussion of this operand on the COPY statement in [COPY Operator](#) on page 568.

**UZERO**
See the discussion of this operand on the OCCUR statement on [OCCUR Operator](#) on page 642.

**UNIQUE Example**

```
UNIQUE FROM(DATAIN) ON(20,40,CH)
UNIQUE FROM(DATAIN) ON(5,3,ZD)
```

The first UNIQUE operator prints a message containing the count of unique character data in positions 20-59 of the DATAIN data set.

The second UNIQUE operator prints a message containing the count of unique zoned decimal values in positions 5-7 of the DATAIN data set.

---

**VERIFY Operator**

Examines particular decimal fields in a data set and prints a message identifying each invalid value found for each field. From 1 to 10 fields can be specified.

DFSORT is called to copy the indd data set to ICETOOL's E35 user exit. ICETOOL uses its E35 user exit to examine the digits and sign of each value for validity, and for each invalid value found, prints an error message containing the record number and field value (in hexadecimal).

You must not supply your own DFSORT MODS, INREC, or OUTREC statement, because they would override the DFSORT statements passed by ICETOOL for this operator.

**Notes:**

1. Values with invalid decimal digits are also identified for the DISPLAY, OCCUR, RANGE, and STATS operators.


2. The DISPLAY operator can be used to print a report identifying the relative record number, hexadecimal value, and associated fields for each invalid (and valid) decimal value, as shown in Example 9 under “DISPLAY Operator” on page 587.

Operands Descriptions

The operands described below can be specified in any order.

**FROM (indd)**

See the discussion of this operand on the DISPLAY statement in “DISPLAY Operator” on page 587.

**ON (p, m, f)**

Specifies the position, length, and format of a decimal field to be used for this operation.

- **p** specifies the first byte of the field relative to the beginning of the input record. p is 1 for the first data byte of a fixed-length record and 5 for the first data byte of a variable-length record as illustrated below (RRRR represents the 4-byte record descriptor word):

<table>
<thead>
<tr>
<th>Fixed-length record</th>
<th>Variable-length record</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>A</td>
</tr>
<tr>
<td>p = 1 2 3 4</td>
<td>p = 1 2 3 4 5 6 7 8</td>
</tr>
</tbody>
</table>

- **m** specifies the length of the field in bytes. A field must not extend beyond position 32752 or beyond the end of a record. The maximum length for a field depends on its format.

- **f** specifies the format of the field as shown below:

<table>
<thead>
<tr>
<th>Format Code</th>
<th>Length</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PD</td>
<td>1 to 16 bytes</td>
<td>Signed packed decimal</td>
</tr>
<tr>
<td>ZD</td>
<td>1 to 31 bytes</td>
<td>Signed zoned decimal</td>
</tr>
</tbody>
</table>

*Note: See Appendix C, “Data Format Descriptions,” on page 885 for detailed format descriptions.*

A value is considered invalid under one of the following circumstances:

- it contains A-F as a digit (examples: a PD field of 00AF or a ZD field of F2FB)

- it contains 0-9 as a sign and the NOSIGN operand is not specified (examples: a PD field of 3218 or a ZD field of F235).

If the number of bad values reaches the LIMIT for invalid decimal values, ICETOOL terminates the operation. If the LIMIT operand is not specified, a default of 200 is used for the invalid decimal value limit.

**NOSIGN**

Specifies that the sign of the decimal values is not to be validity checked (overriding the default of checking for 0-9 as invalid signs).

**LIMIT (n)**

See the discussion of this operand on the DISPLAY statement in “DISPLAY Operator” on page 587.

**VSAMTYPE (x)**

See the discussion of this operand on the COPY statement in “COPY Operator” on page 568.
VERIFY Operator

VERIFY Example

VERIFY FROM(NEW) ON(22,16,PD) ON(7,9,ZD)
VERIFY FROM(NEW) ON(22,16,PD) ON(7,9,ZD) NOSIGN LIMIT(10)

The first VERIFY operator checks for invalid digits (A-F) and invalid signs (0-9) in the packed decimal values from positions 22-37 and the zoned decimal values from positions 7-15 of the NEW data set. A message is printed identifying each value (if any) that contains an invalid digit or sign. If 200 invalid values are found, the operation is terminated.

The second VERIFY operator checks for invalid digits (A-F) in the packed decimal values from positions 22-37 and the zoned decimal values from positions 7-15 of the NEW data set. A message is printed identifying each value (if any) that contains an invalid digit. If 10 invalid values are found, the operation is terminated.

Note: The DISPLAY operator can be used to print a report identifying the relative record number, hexadecimal value, and associated fields for each invalid (and valid) decimal value, as shown in Example 9 under "DISPLAY Operator" on page 587.

Calling ICETOOL from a Program

ICETOOL can be called from an assembler program using the LINK, ATTACH, or XCTL system macros. Standard linkage conventions must be used. When ICETOOL finishes processing, it returns to the calling program with register 15 set to the highest operation return code encountered. See "ICETOOL Return Codes" on page 725 for an explanation of the ICETOOL return codes.

When you call ICETOOL from a program, you have a choice of two different interfaces: the TOOLIN Interface and the Parameter List Interface.

TOOLIN Interface

With the TOOLIN Interface, you supply ICETOOL statements in the TOOLIN data set. ICETOOL prints messages in the TOOLMSG data set, but does not return information directly to your program.

To use the TOOLIN interface, set a value of 0 in register 1, or place the address of a 4-byte field containing X'80000000' in register 1, before calling ICETOOL as shown below:

```
... SLR R1,R1 TOOLIN INTERFACE - METHOD 1
  LINK EP=ICETOOL CALL ICETOOL
...

... LQ R1,NOPLIST TOOLIN INTERFACE - METHOD 2
  LINK EP=ICETOOL CALL ICETOOL
...

NOPLIST DC X'80',AL3(0) TOOLIN INTERFACE INDICATOR
...```

Parameter List Interface

The Parameter List Interface allows you to use the information derived by ICETOOL in your program. With this interface, you supply ICETOOL statements in a parameter list. ICETOOL prints messages in the TOOLMSG data set, and puts an operation status indicator and "operation-specific values" in the parameter list for use by your calling program.
Calling ICETOOL from a Program

Figure 40 shows the format of the parameter list used with the Parameter List Interface. Table 75 on page 720 shows the operation-specific values returned to the calling program.

The flags field must be specified. A 4-byte field containing X' FFFFFFFF' must be used to indicate the end of the parameter list. It can be coded after any pair of statement/return addresses.

All addresses in the parameter list must be 31-bit addresses or clean 24-bit addresses (the first 8 bits contain zeros).

Explanation of Fields

**Flags**

**Bit 0 = 0:**
Use the Parameter List Interface. Process ICETOOL statements from this parameter list and return information to this parameter list. Ignore TOOLIN.

**Bit 0 = 1:**
Use the TOOLIN Interface. Process ICETOOL statements from TOOLIN. Ignore this parameter list.

**Bits 1-31:**
Reserved. Must be set to zero to ensure future extendability.

**Statement Area Address and Statement Area**

Each statement area address gives the location of a statement area that describes an ICETOOL operation to be performed. If the statement area address is 0, ICETOOL ignores this statement area/return area pair. Otherwise, the statement area address must point to a statement area in the following format:

- A 2-byte length field containing the length of the statement area for this operation. If this field is 0, ICETOOL ignores this statement area/return area pair.
- One or more 80-character ICETOOL statement images in the format described in "ICETOOL Statements" on page 567. Each statement area must have one operator statement. Comment and blank statements before the operator statement are processed. Comment, blank, and additional operator statements after the end of the first operator statement are ignored.
Calling ICETOOL from a Program

Return Area Address and Return Area
Each return area address gives the location of a return area in which ICETOOL is to return operation-specific information for the operation described in the corresponding statement area. If the return area address is 0, ICETOOL does not return any information for this operation. Otherwise, the return area address must point to a return area in the following general format:

- A 2-byte length field containing the length of the return area for this operation. If this field is 0, ICETOOL does not return any information for this operation.
- A 1-byte operation status indicator which is set by ICETOOL as follows:
  - 0 = This operation was run and completed with return code 0 or 4. Operation-specific values (see below) were returned.
  - 4 = This operation was not run (for example, scan mode was in effect) or did not complete with return code 0 or 4. Operation-specific values (see below) were not returned.
- Operation-specific values. Each count value returned by ICETOOL is an 8-byte packed decimal value with a C for a positive sign or a D for a negative sign. For a STATS operator, each minimum, maximum, average and total value returned by ICETOOL is a 16-byte packed decimal value with a C for a positive sign or a D for a negative sign. If ICETOOL set the operation status to 4, it did not return any values for this operation.

Note: Programs in LPALIB that call ICETOOL must provide return areas that ICETOOL can store into.

The required return area length and the operation-specific values returned for each operator are shown in Table 75. If the return area length is less than the length required, ICETOOL issues a message and terminates the operation.

Table 75. Return Area Lengths/Operation-Specific Values

<table>
<thead>
<tr>
<th>Operator</th>
<th>Return Area Length (Bytes)</th>
<th>Operation-Specific Values Returned</th>
</tr>
</thead>
<tbody>
<tr>
<td>COPY</td>
<td>1</td>
<td>None</td>
</tr>
<tr>
<td>COUNT</td>
<td>9</td>
<td>Count of records processed, or 0 if any criteria specified. If SUB(q) or ADD(r) is specified, the modified count is returned.</td>
</tr>
<tr>
<td>DATASORT</td>
<td>1</td>
<td>None</td>
</tr>
<tr>
<td>DEFAULTS</td>
<td>1</td>
<td>None</td>
</tr>
<tr>
<td>DISPLAY</td>
<td>9</td>
<td>Count of records processed</td>
</tr>
<tr>
<td>MERGE</td>
<td>1</td>
<td>None</td>
</tr>
<tr>
<td>MODE</td>
<td>1</td>
<td>None</td>
</tr>
<tr>
<td>OCCUR</td>
<td>17</td>
<td>Count of records processed, count of values in range</td>
</tr>
<tr>
<td>RANGE</td>
<td>17</td>
<td>Count of records processed, count of records resulting from criteria</td>
</tr>
<tr>
<td>RESIZE</td>
<td>1</td>
<td>None</td>
</tr>
<tr>
<td>SELECT</td>
<td>17</td>
<td>Count of records processed, count of records resulting from criteria</td>
</tr>
</tbody>
</table>
### Calling ICETOOL from a Program

**Table 75. Return Area Lengths/Operation-Specific Values (continued)**

<table>
<thead>
<tr>
<th>Operator</th>
<th>Return Area Length (Bytes)</th>
<th>Operation-Specific Values Returned</th>
</tr>
</thead>
<tbody>
<tr>
<td>SORT</td>
<td>1</td>
<td>None</td>
</tr>
<tr>
<td>SPLICE</td>
<td>17</td>
<td>Count of records processed, count of records resulting from criteria</td>
</tr>
<tr>
<td>STATS</td>
<td>$64^n + 9$</td>
<td>Count of records processed, minimum for ON field 1, maximum for ON field 1, average for ON field 1, total for ON field 1, ... minimum for ON field n, maximum for ON field n, average for ON field n, total for ON field n</td>
</tr>
<tr>
<td>SUBSET</td>
<td>1</td>
<td>None</td>
</tr>
<tr>
<td>UNIQUE</td>
<td>17</td>
<td>Count of records processed, count of unique values</td>
</tr>
<tr>
<td>VERIFY</td>
<td>9</td>
<td>Count of records processed</td>
</tr>
</tbody>
</table>

**Parameter List Interface Example**
The example in Figure 41 on page 722 shows a portion of an assembler language program that uses the Parameter List Interface. Figure 42 on page 724 shows the JCL you might use to run the program in Figure 41 on page 722.
DEPTVIEW CSEC

* SET UP PARAMETER LIST AND CALL ICETOOL
LA RL,PARLST LOAD ADDRESS OF PARAMETER LIST
LINK EP=ICETOOL CALL ICETOOL
LTR R15,R15 IF ANY OPERATIONS WERE NOT SUCCESSFUL,
BNZ CKSTAT1 DETERMINE WHICH ONE FAILED

* ALL OPERATIONS WERE SUCCESSFUL
CP RT2AVG1,EMAVGCK IF AVERAGE IS ACCEPTABLE,
BNH CKQUAL NO MESSAGE IS NEEDED

* ISSUE A MESSAGE SHOWING AVERAGE, MINIMUM, MAXIMUM, AND
* TOTAL NUMBER OF EMPLOYEES PER DEPARTMENT.

* CHECK EXPENSES PER DEPARTMENT AGAINST ACCEPTABLE LEVEL
CKQUAL CP RT2AVG2,TLAVGCK IF AVERAGE IS ACCEPTABLE,
BNH PCTCALC NO MESSAGE IS NEEDED

* ISSUE A MESSAGE SHOWING AVERAGE, MINIMUM, MAXIMUM, AND
* TOTAL EXPENSES PER DEPARTMENT.

* CALCULATE THE PERCENTAGE OF DEPARTMENTS OVER/UNDER EMPLOYEE LIMIT
PCTCALC MVC WORK+2(4),RT3RNG+4 COPY NUMBER OF DEPARTMENTS
SP WORK+2(4),RT3RCD+4(4) SUBTRACT 'NUMBER WITHIN LIMITS' TO
* GET 'NUMBER OVER/UNDER LIMIT'
CP WORK+2(4),P0 IF NONE OVER/UNDER LIMIT,
BE PCTPRT PERCENTAGE IS ZERO
MP WORK+2(4),P100 MULTIPLY NUMBER OVER/UNDER BY 100
DP WORK(6),RT3RCD+4(4) DIVIDE BY NUMBER OF DEPARTMENTS

* ISSUE A MESSAGE SHOWING THE PERCENTAGE OF DEPARTMENTS THAT ARE
* OVER/UNDER EMPLOYEE LIMIT
PCTPRT UNPK PCTVAL,WORK(2) CONVERT AVERAGE TO PRINTABLE EBCDIC
01 PCTVAL+2,'02' ENSURE LAST DIGIT IS PRINTABLE

* ONE OR MORE OPERATIONS FAILED
CKSTAT1 CLI RT1STAT,0 IF OPERATION 1 WORKED,
BNE CKSTAT2 CHECK OPERATION 2

* ISSUE MESSAGE: OPERATION 1 FAILED - CHECK TOOLMSG

* PARAMETER LIST
PARLST DC A(0) USE PARAMETER LIST INTERFACE
DC A(ST1A) STATEMENT AREA 1 ADDRESS
DC A(RT1A) RETURN AREA 1 ADDRESS
DC A(ST2A) STATEMENT AREA 2 ADDRESS
DC A(RT2A) RETURN AREA 2 ADDRESS
DC A(ST3A) STATEMENT AREA 3 ADDRESS
DC A(RT3A) RETURN AREA 3 ADDRESS
DC F'.*-1' END OF PARAMETER LIST= OPERATOR STATEMENT AREAS

Figure 41. ICETOOL Parameter List Interface Example (Part 1 of 2)
* COPY OPERATION
ST1A DC AL2(ST1E-ST1) LENGTH OF STATEMENT AREA 1
ST1 DC CL80'** CREATE TWO COPIES OF THE DENVER SITE**
DC CL80'** DEPARTMENT RECORDS**
DC CL80'** COPY FROM(IN) TO(OUT1,OUT2) USING(CTL1)**
ST1E EQU *

* STATS OPERATION
ST2A DC AL2(ST2E-ST2) LENGTH OF STATEMENT AREA 2
ST2 DC CL80'** GET STATISTICS FOR NUMBER OF EMPLOYEES**
DC CL80'** AND TRAVEL EXPENSES PER DEPARTMENT**
DC CL80'** STATS FROM(OUT1) ON(15,2,PD) ON(28,8,ZD)**
ST2E EQU *

* RANGE OPERATION
ST3A DC AL2(ST3E-ST3) LENGTH OF STATEMENT AREA 3
ST3 DC CL80'** DETERMINE THE NUMBER OF DEPARTMENTS THAT ARE**
DC CL80'** WITHIN THE LIMIT FOR NUMBER OF EMPLOYEES**
DC CL80'** RANGE FROM(OUT1) ON(15,2,PD) -**
DC CL80'** HIGHER(10) LOWER(21)**
ST3E EQU *

* RETURN AREAS
COPY OPERATION
RT1A DC AL2(RT1E-RT1STAT) LENGTH OF RETURN AREA 1
RT1STAT DS C OPERATION STATUS
RT1E EQU *

* STATS OPERATION
RT2A DC AL2(RT2E-RT2STAT) LENGTH OF RETURN AREA 2
RT2STAT DS C OPERATION STATUS
RT2Rnds DS PL8 COUNT OF RECORDS PROCESSED
RT2MIN1 DS PL16 FIELD 1 - MINIMUM VALUE
RT2MAX1 DS PL16 FIELD 1 - MAXIMUM VALUE
RT2AVG1 DS PL16 FIELD 1 - AVERAGE VALUE
RT2TOT1 DS PL16 FIELD 1 - TOTAL VALUE
RT2MIN2 DS PL16 FIELD 2 - MINIMUM VALUE
RT2MAX2 DS PL16 FIELD 2 - MAXIMUM VALUE
RT2AVG2 DS PL16 FIELD 2 - AVERAGE VALUE
RT2TOT2 DS PL16 FIELD 2 - TOTAL VALUE
RT2E EQU *

* RANGE OPERATION
RT3A DC AL2(RT3E-RT3STAT) LENGTH OF RETURN AREA 3
RT3STAT DS C OPERATION STATUS
RT3Rnds DS PL8 COUNT OF RECORDS PROCESSED
RT3RNG DS PL8 COUNT OF VALUES IN RANGE
RT3E EQU *

* VARIABLES/CONSTANTS
WORK DS PL6 WORKING VARIABLE
P100 DC P'100' CONSTANT 100
P0 DC P'0' CONSTANT 0
EMAVGC DC P'17' ACCEPTABLE AVERAGE EMPLOYEE COUNT
TLAVGC DC P'5000' ACCEPTABLE AVERAGE TRAVEL EXPENSES
PCTVAL DS PL3 PERCENTAGE OF DEPARTMENTS THAT ARE
  OVER/UNDER EMPLOYEE LIMIT
...
ICETOOL Notes and Restrictions

Small REGION values can cause storage problems when ICETOOL calls DFSORT. Large REGION values give DFSORT the flexibility to use the storage it needs for best performance. We recommend that you use a REGION value of at least 1024K for ICETOOL.

Each ICETOOL operation results in a set of ICETOOL messages in the TOOLMSG data set, and a corresponding set of DFSORT messages in the DFSMSG data set. For a particular call to DFSORT, you can relate the sets of messages in the TOOLMSG and DFSMSG data sets by using the unique identifier for that call. Just match the identifier printed in ICETOOL message ICE606I or ICE627I to the same identifier printed in DFSORT message ICE200I. This is particularly important if an ICETOOL operation fails due to an error detected by DFSORT (return code 16).

Because ICETOOL calls DFSORT, the installation defaults used for DFSORT are those in effect for the appropriate program-invoked environment, that is, the ICEAM2 or ICEAM4 defaults, or the ICETDx defaults activated for ICEAM2 or ICEAM4. The DFSORT installation defaults apply only to DFSORT, not to ICETOOL. For example, installation option MSGCON=ALL causes DFSORT, but not ICETOOL, to write messages to the master console. The one exception is the SDBMSG installation option; the value in effect from ICEAM2 or ICEAM4 is used for ICETOOL's TOOLMSG data set.

When ICETOOL calls DFSORT, it passes control statements and options appropriate to the specific operations being performed. You should not override the DFSORT control statements or options passed by ICETOOL unless you understand the ramifications of doing so.

For example, ICETOOL passes the NOABEND option to DFSORT to ensure that ICETOOL will regain control if DFSORT issues an error message. If you specify:

```
//DFSPARM DD *
  DEBUG ABEND
```

you cause DFSORT to abend when it issues an error message, thus preventing ICETOOL from performing subsequent operators.

Tape work data sets cannot be used with ICETOOL.

An ON field must not include bytes beyond the fixed part of variable length input records. The entire field specified must be present in every input record, otherwise, DFSORT issues message ICE015A, ICE218A, or ICE027A and terminates.
Notes on Using JOINKEYS with COPY and SORT

- You can use a JOINKEYS application with a COPY or SORT operator of ICETOOL, but not with any of the other ICETOOL operators. Use the JKFROM operand instead of the FROM operand to indicate you are using a JOINKEYS application.

- See Chapter 4, “Using a JOINKEYS Application for Joining Two Files,” on page 457 for complete details on JOINKEYS applications.

- If you want to sort the joined records, use a SORT operator with USING(xxxx) in TOOLIN and a SORT control statement along with the appropriate JOINKEYS, JOIN and REFORMAT statements in xxxxCNTL (main task).

- If you want to copy the joined records, use a COPY operator with USING(yyyy) in TOOLIN and the appropriate JOINKEYS, JOIN and REFORMAT statements in yyyyCNTL (main task).

- For multiple JOINKEYS applications within a single ICETOOL step:
  - You can reference different JOINKEYS F1 and F2 input files for the different SORT and/or COPY operators by using F1=ddname and F2=ddname on the various JOINKEYS statements as appropriate.
  - You can reference different subtaskn message and control files for the different SORT and/or COPY operators by using TASKID=id on the various JOINKEYS statements as appropriate.

ICETOOL Return Codes

ICETOOL sets a return code for each operation it performs in STOP or CONTINUE mode and passes back the highest return code it encounters to the operating system or the invoking program.

For successful completion of all operations, ICETOOL passes back a return code of 0 or 4 to the operating system or the invoking program.

For unsuccessful completion due to an unsupported operating system, ICETOOL passes back a return code of 24 to the operating system or invoking program.

For unsuccessful completion of one or more operations, ICETOOL passes back a return code of 8, 12, 16, or 20 to the operating system or the invoking program.

The meanings of the return codes that ICETOOL passes back (in register 15) are:

0  Successful completion. All operations completed successfully.

4  Successful completion. All operations completed successfully. Either:
    • RC4 was specified for an ICETOOL COUNT operator and the record count met the specified criteria, or
    • DFSORT passed back a return code of 4 for one or more operations. See “DFSORT Messages and Return Codes” on page 23 for details.

8  Unsuccessful completion. RC8 was specified for an ICETOOL COUNT operator and the record count met the specified criteria.

12 Unsuccessful completion. ICETOOL detected one or more errors that prevented it from completing successfully. Messages for these errors were printed in the TOOLMSG data set.

16 Unsuccessful completion. DFSORT detected one or more errors that
ICETOOL Return Codes

prevented ICETOOL from completing successfully. Messages for these errors were printed in the DFSMSG data set.

20 **Message data set error.** The TOOLMSG DD statement was not present or the TOOLMSG data set was not opened.

24 **Unsupported operating system.** This operating system is not supported by this release of DFSORT.
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Field and Constant Symbols Overview

This chapter describes DFSORT's simple and flexible method for using symbols in DFSORT and ICETOOL statements. You can define and use a symbol for any field, constant, or output column that is recognized in a DFSORT control statement or ICETOOL operator. This makes it easy to create and reuse collections of symbols (that is, mappings) representing information associated with various record layouts.

In addition, you can obtain and use collections of DFSORT symbols created specifically for records produced by other products (for example, RACF®, DFSMSrmm and DCOLLECT) or by your site. Visit the DFSORT home page at the following URL to obtain information about downloading DFSORT symbol mappings for records produced by other products, and examples that use these symbols:

http://www.ibm.com/storage/dfsor

Symbols can increase your productivity by automatically providing the positions, lengths and formats of the fields, the values of the constants, and the positions of the output columns associated with the particular records you are processing with DFSORT or ICETOOL.

You can even use system symbols (for example, &JOBNAME.) and SET and PROC symbols, in your symbol constants.

To use symbols for DFSORT or ICETOOL, you just:
1. Create or obtain the DFSORT symbol data sets you need. Symbol data sets contain symbols that map the fields in your records, and constants used for comparisons, titles, headings and so on. The symbols are specified in DFSORT's
simple but flexible SYMNAMES statement format. Symbols can be easily added or modified using an editor, such as ISPF EDIT.

2. Include a SYMNAMES DD statement in your job. SYMNAMES specifies one or more symbol data sets (sequential, partitioned member, DD *) to be used for your DFSORT or ICETOOL application. SYMNAMES can be used to concatenate as many symbol data sets as you like.

3. Use the symbols from SYMNAMES where appropriate in DFSORT control statements or ICETOOL operators. You can mix symbols (for example, Last_Name) with regular fields (for example, p,m,f) and constants (for example, C'string').

DFSORT or ICETOOL will read SYMNAMES and use the symbols it contains to "transform" your statements by performing symbol substitution. DFSORT or ICETOOL will then use the transformed statements as if you had specified them directly.

If your record layout changes, just make a corresponding change to your DFSORT symbol data set. DFSORT will use the new mapping to "transform" your symbols correctly, even if positions change, so you won’t have to change your statements. Be sure that your symbol definitions match your record layout before you attempt to use them.

**DFSORT Example**

The example below shows the JCL and control statements for a simple DFSORT job that uses symbols.

Let’s say you created a symbols data set named MY.SYMBOLS that contains the following SYMNAMES statements:

* Fields
  First_Name,6,20,CH
  Last_Name,*,=,=
  Account_Number,53,3,PD
  SKIP,2
  Balance,*,6,ZD
  Type,*,8,CH

* Constants
  Loan,'LOAN'
  Check,'CHECKING'
  Level1,50000
  Level2,-100

Here’s the JCL and control statements for the example:

```plaintext
//EXAMP JOB A402,PROGRAMMER
//RUNIT EXEC PGM=ICEMAN
//SYMNAMES DD DSN=MY.SYMBOLS,DISP=SHR
//SYMNOUT DD SYSOUT=* 
//SYSOUT DD SYSOUT=* 
//SORTIN DD ...
//SORTOUT DD ...
//SYSIN DD *
  INCLUDE COND=((Type,EQ,Loan,AND,Balance,GT,Level1),OR, 
               (Type,EQ,Check,AND,Balance,LE,Level2))
  SORT FIELDS=(Last_Name,A,First_Name,A, 
               Type,A,Account_Number,D)
  /*
```
This example is only meant to give you a quick overview of how symbols can be used. The rest of this chapter will explain all of the details, but here are a few important things to take note of:

- The SYMNAMES DD indicates you want DFSORT or ICETOOL to do symbol processing. The SYMNAMES data set contains the symbols for fields and constants.
- DFSORT or ICETOOL will print your original symbols and the symbol table constructed from them in the SYMNOUT data set, if you specify it. You might want to use SYMNOUT while debugging a set of symbols and then remove it, or you might want to keep SYMNOUT permanently so you can always see your original symbols and the symbol table.
- The simple, yet flexible, format for SYMNAMES statements is:
  
  symbol, value remark

  where value can represent a field (p,m,f or p,m, f or p), a parsed field (%nn), or a constant (C'string', c'string', 'string', S'string', x'string', B'string', b'string', n, +n or −n). Leading blanks are allowed before symbol so indentation can be used. For example, the following SYMNAMES statements could be specified:

  Div1_Department,8,1,BI Division 1 Department
  Research,B'0001....' Research Departments
  Marketing,B'0010....' Marketing Departments
  Development,B'0100....' Development Departments

- Symbols are case-sensitive: Frank, FRANK and frank are three different symbols.
- An asterisk (*) can be used to assign the next position to p. For example:

  Symbola,6,20,CH
  Symbolb,*,5,BI
  Symbolc,*,12,ZD

  is the same as specifying:

  Symbola,6,20,CH
  Symbolb,26,5,BI
  Symbolc,31,12,ZD

  By using * for p, you can map consecutive fields in your records without having to compute their actual positions.
- SKIP, n can be used to advance the next position by n bytes so it can be used for *.

  For example:

  Symbola,6,20,CH
  SKIP,2
  Symbolb,*,5,BI

  is the same as specifying:

  Symbola,6,20,CH
  Symbolb,28,5,BI

  SKIP, n gives you an easy way to skip unused bytes. Other mapping aids allow you to reset the next position (POSITION,q or POSITION,symbol), or align the next position on a halfword (ALIGN,H), fullword (ALIGN,F) or doubleword (ALIGN,D).
- An equal sign (=) can be used for p, m or f to assign the previous position, length or format to p, m, or f, respectively. For example:

  Symbola,6,20,CH
  Symbola1,=,8,=
  Symbola2,*,12,=
  Symbolb,*,=,ZD
Using Symbols for Fields and Constants

is the same as specifying:

Symbola,6,20,CH
Symbola1,6,8,CH
Symbola2,14,12,CH
Symbolb,26,12,2D

By using = and *, you can easily map fields onto other fields.
• Symbols for fields and constants can be specified in any order. However, the use of * and = imposes order dependencies on symbols for fields.
• Comment statements and blank statements are allowed in SYMNAMES.

SYMNAMES DD Statement

A SYMNAMES DD statement indicates you want DFSORT or ICETOOL to do symbol processing. It specifies the SYMNAMES data set (SYMNAMES for short), which can consist of one DFSORT symbol data set or many concatenated symbol data sets.

A symbol data set can be a sequential data set, a partitioned member or a DD * data set; all three types can be concatenated together for the SYMNAMES DD. Each symbol data set must contain SYMNAMES statements describing the symbols for fields and constants to be used for the DFSORT or ICETOOL application. Each symbol data set must have the following attributes: RECFM=F or RECFM=FB and LRECL=80.

For best performance, use a large block size, such as the system determined optimum block size, for all DFSORT symbol data sets.

If a SYMNAMES DD statement is not present, or SYMNAMES is empty, symbol processing is not performed.

SYMNOUT DD Statement

A SYMNOUT DD statement specifies a data set in which you want DFSORT or ICETOOL to print your original SYMNAMES statements and the symbol table constructed from them. DFSORT or ICETOOL uses RECFM=FBA, LRECL=121 and the specified BLKSIZE for the SYMNOUT data set (SYMNOUT for short).

If the BLKSIZE you specify is not a multiple of 121, or you do not specify the BLKSIZE:
• the system determined optimum block size is used, if supported
• otherwise, BLKSIZE=121 is used.

For best performance, use a large block size, such as the system determined optimum block size, for the SYMNOUT data set.

SYMNAMES Statements

Each symbol in SYMNAMES must be described using a SYMNAMES statement. A SYMNAMES statement can be a symbol statement, keyword statement, comment statement or blank statement.
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Comment and Blank Statements

A statement with an asterisk (*) in column 1 is treated as a comment statement. It is printed in SYMNOTOUT (if specified), but otherwise not processed. A statement with blanks in columns 1 through 80 is treated as a blank statement. It is printed in SYMNOTOUT (if specified), but otherwise not processed.

Symbol Statements

The general format for a symbol statement is:

```
symbol, value remark
```

The general coding rules are as follows:
- Columns 1 through 80 are scanned.
- The symbol can start in column 1 or in any column after 1.
- A remark is optional, but if specified, must be separated from the value by at least one blank. A remark is printed in SYMNOTOUT (if specified), but otherwise not processed.
- A semicolon (;) can be used instead of a comma (,) between the symbol and the value.
- Continuation is not allowed. Each symbol and value must be completely specified on one line.

The specific syntax for symbol statements is:

```
<symbol>, <constant> <field> parsed <field>
```

Symbol: A symbol can be 1 to 50 EBCDIC characters consisting of uppercase letters (A-Z), lowercase letters (a-z), numbers (0-9), the number sign (#), the dollar sign ($), the commercial at sign (@), the underscore (_) and the hyphen (-). The first character of a symbol must not be a number or a hyphen. Symbols are treated as case-sensitive: Frank, FRANK and frank are three different symbols.

The following DFSORT/ICETOOL reserved words (uppercase only as shown) are not allowed as symbols: A, AC, ADD, ADDDAYS, ADDMONS, ADDYEARS, ALL, AND, AQ, ASL, AST, BI, CH, CLO, COPY, COUNT, COUNT15, CSF, CSL, CST, CTO, D, DATE, DATEDIFF, DATE1, DATE1..., DATE2, DATE2..., DATE3, DATE3..., DATE4, DATE5, DC1, DC2, DC3, DC4, DE1, DE2, DE3, DE4, DIV, DT1, DT2, DT3, D1, D2, E, F, FL, FS, H, HEX, LASTDAYM, LASTDAYQ, LASTDAYW, LASTDAYY, LS, MAX, MIN, MOD, MUL, Mn, Mnn, NEXTDday, NONE, NUM, OL, OR, OT, PAGE, PAGEHEAD, PD, PDC, PDF, PD0, PREVDday, SEQNUM, SFF, SS, SUB, SUBCOUNT, SUBCOUNT15, SUBDAYS, SUBMONS, SUBYEARS, TC1, TC2, TC3, TC4, TE1, TE2, TE3, TE4, TIME, TIME1, TIME1P, TIME2, TIME2P, TIME3, TIME3P, TM1, TM2, TM3, TM4, TS, UFF, VALCNT, VLEN, X, Y2x, Y2xx, Y4x, Z, ZD, ZDC, and ZDF, where n is 0-9, day is SUN, MON, TUE, WED, THU, FRI or SAT, and x is any character. Lower case and mixed case forms of these words, such as None and page, can be used as symbols.
POSITION, SKIP and ALIGN (uppercase only) are treated as keywords as discussed in "Keyword Statements" on page 741 and thus are not recognized as symbols. However, lowercase and mixed case forms of these words, such as Position and skip, can be used as symbols.

Some examples of valid symbols are: Account_Number, CON12, PHONE#, count, SORT-KEY, and _Invalid.

Some examples of invalid symbols are: 123_Account (starts with a number), COUNT (reserved word), DATE1-20 (reserved word), and -Invalid (starts with a hyphen).

**Constant:** A constant can be a character string, system symbol string, hexadecimal string, bit string, decimal number, or two-digit year date string.

A symbol for a constant value must be used only where such a constant is allowed and has the desired result. Otherwise, substitution of the symbol for the constant will result in an error message or unintended processing. For example, if the following SYMNAMES statement is specified:

SYM,B'10110001'

SYMB can be used in this INCLUDE statement:

INCLUDE COND=(12,1,BI,EQ,SYMB)

because a bit string can be compared to a binary field. However, SYMB will result in an error message if used in this INCLUDE statement:

INCLUDE COND=(12,1,CH,EQ,SYMB)

because a bit string cannot be compared to a character field.

Make sure the constants that will be substituted for your symbols are appropriate. If in doubt, check the rules for constants given in the description of the relevant operand.

A symbol can represent one of the following types of constants:

- A character string in the format 'xx...x', C'xx...x' or c'xx...x'. The value x may be any EBCDIC character. You can specify up to 64 characters for the string. c'xx...x' will be treated like C'xx...x'.

**Note:** If you want to use system symbols (for example, &JOBNAME.) in your character strings, use a system symbol string (S'string' or s'string') as described below instead of a character string.

If you want to include a single apostrophe in the character string, you must specify it as two single apostrophes (each pair of apostrophes counts as two characters towards the 64 character limit for the string). Thus:

Required: O'Neill Specify: C'O''Neill'

Double-byte data may be used in a character string (each pair of shift-in/shift-out characters and each double-byte character counts as two characters towards the 64 character limit for the string). See "INCLUDE Control Statement" on page 98 for details on double-byte data.

Some examples of valid character strings are: '+0.193', c'Title', CO'Neil', C'J62,J82,M72' and ''. 

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Some examples of invalid character strings are: C'AB'' (apostrophes not paired), c'title (ending apostrophe missing) and C'O'NEIL' (one apostrophe after O instead of two).

You can use C'xx...x' and 'xx...x' interchangeably. 'xx...x' will be substituted for symbols where appropriate even if C'xx...x' is specified in SYMNAMES. Likewise, C'xx...x' will be substituted for symbols where appropriate even if 'xx...x' is specified in SYMNAMES. For example, if these SYMNAMES statements are specified:

```
My_Title,c'My Report'
My_Heading,c'January'
DEPT1,'J82'
DEPT2,c'M72'
```

the ICETOOL operator:

```
DISPLAY TITLE(My_Title) HEADER(My_Heading) ...
```

will be transformed to:

```
DISPLAY TITLE('My Report') HEADER('January') ...
```

and the INCLUDE statement:

```
INCLUDE COND=(5,3,EQ,DEPT1,OR,5,3,EQ,DEPT2),FORMAT=CH
```

will be transformed to:

```
INCLUDE COND=(5,3,EQ,C'J82',OR,5,3,EQ,C'M72'),FORMAT=CH
```

Although the rules for character strings used as symbols generally follow the rules for INCLUDE/OMIT character strings, keep in mind that the same rules do not apply for character strings in all DFSORT and ICETOOL operands, so use symbols representing character strings appropriately. For example, ICETOOL only allows up to 50 characters for a TITLE string, so TITLE(MYCON) would result in an error message if MYCON is a 64-character string, even though MYCON could be used without error in an INCLUDE statement. As another example, double-byte characters would be recognized in a character string substituted for a symbol in an INCLUDE statement, but would not be recognized in a character string substituted in an OUTREC statement.

• A system symbol string in the format S'original_string' or s'original_string'

The original_string can contain any combination of EBCDIC characters and system symbols (&SYMBOL or &SYMBOL.) you want to use to form a character string. DFSORT will replace each system symbol in the system symbol string with its substitution text to create a character string in the format C'result_string'.

For example, you could specify the following symbol statement in SYMNAMES:

```
Rpt_hdr,S' Job &JOBNAME. was run on Sysplex &SYSPLEX. on &LWDAY'
```

If you used this symbol statement in a job named TEST2 that you ran on sysplex MAS3 on a Thursday, DFSORT would transform it into the following symbol statement:

```
Rpt_hdr,C' Job TEST2 was run on Sysplex MAS3 on THU'
```

&JOBNAME. was replaced with 'TEST2', &SYSPLEX. was replaced with 'MAS3' and &LWDAY was replaced with 'THU'.

If you used this same symbol statement in a job named BIGTEST that you ran on sysplex MAS2 on a Monday, DFSORT would transform it into the following symbol statement:

```
Rpt_hdr,C' Job BIGTEST was run on Sysplex MAS2 on MON'
```
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This time &JOBNAME. was replaced with 'BIGTEST', &SYSPLEX. was replaced with 'MAS2' and &LWDAY was replaced with 'MON'.

You could use the Rpt_hdr symbol in an OUTFIL statement like this:

```plaintext
OUTFIL HEADER2=(Rpt_hdr,5X,'Page ',PAGE=(EDIT=(TTT)),/)
```

and get the heading you needed based on the setting of the system symbol values where and when the job was run.

The types of system symbols you can use in a system symbol string are:

- Dynamic system symbols like &YYMMDD, &LYYMMDD, &HHMMSS, &LHHMMSS, &DAY, &LDAY, &HR, &LHR, &JDAY, &LJDAY, &JOBNAME, &MIN, &LMIN, &MON, &LMON, &SEC, &LSEC, &WDAY, &LWDAY, &YR2, &LYR2, &YR4, and &LYR4.
- System-defined static system symbols like &SYSCLONE, &SYSNAME, &SYSPLEX, &SYSR1, and &SYSALVL.
- Installation-defined static system symbols specified by your installation in an IEASYMxx member of SYS1.PARMLIB.

Note: System symbols must be specified using all uppercase characters. Lowercase characters are not recognized as system symbols. For example, &JOBNAME is recognized as a system symbol, but &jobname and &Jobname are not.

You can use all three types of system symbols separately or in combination within a system symbol string. You can also use all of the system symbol string building facilities such as substring notation, concatenation, embedded blanks, and so on, in a system symbol string. Thus, system symbol strings can be very simple like this one:

```plaintext
Sysname,s'&SYSNAME'
```

Or more complex like this one:

```plaintext
Dsn1,s'ACCT.&SYSNAME(3:2)..D&LJDAY'
```

For more information on system symbols, see z/OS MVS Initialization and Tuning Reference, SA22-7592.

Note: JCL symbols and IPCS symbols are not system symbols and will not be recognized or replaced in a system symbol string.

`s'original_string' will be treated like S'original_string'.

If you want to include a single apostrophe in the system symbol string, you must specify it as two single apostrophes.

DFSORT uses the ASASYMBM service to transform S'original_string' into C'result_string'. If your system symbol string has errors involving symbol names, substring notation, and so on, ASASYMBM transforms the symbol system string to a character string according to its rules for substitution. For example, if you specify these symbol statements:

```plaintext
Ok,S'&YR4(1:2).&SYSNAME.'
Bad,S'&YR4(1.2).&SYSNAME.'
```

where the valid substring notation 1:2 and the known system symbol &SYSNAME. (for example, 'ED53') are used for Ok, but the invalid substring notation 1.2 and the unknown system symbol &SYSNAM. are used for Bad, the resulting symbol statements are:

```plaintext
Ok,C'20EDS3'
Bad,C'2006(1.2).&SYSNAM.'
```
Using Symbols for Fields and Constants

See [z/OS MVS Programming: Assembler Services Reference ABE-HSP, SA22-7606](#) for complete details on the ASASYMBM service.

After a symbol statement containing a system symbol string (S"original_string") is transformed into a symbol statement containing the resulting character string (C"result_string"), it will be error checked and processed like any other symbol statement containing a character string. See the description of character string above for details.

If a SYMNOUT data set is specified, it will show the symbol statement containing the original system symbol string as well as the transformed symbol statement containing the resulting character string. This can be helpful for debugging "errors" or unexpected results in your system symbol strings.

- **A hexadecimal string in the format X'yy...yy' or x'yy...yy'.**
  - The value yy represents any pair of hexadecimal digits. Each hexadecimal digit must be 0-9, A-F or a-f. You can specify up to 32 pairs of hexadecimal digits. x'yy...yy' will be treated like X'yy...yy'. a-f will be treated like A-F.
  - Some examples of valid hexadecimal strings are: X'F2C3', x'2fa71e', and X'07'.
  - Some examples of invalid hexadecimal strings are: X'F2G301' (G is not a valid hexadecimal digit), x'bf3' (unpaired hexadecimal digits) and X'' (no hexadecimal digits).

- **A bit string in the format B'bbbbbbbb...bbbbbbbb' or b'bbbbbbbb...bbbbbbbb'.**
  - The value bbbbbbbbb represents 8 bits that constitute a byte. Each bit must be 1, 0 or . (period). You can specify up to 8 groups of 8 bits. b'bbbbbbbb...bbbbbbbb' will be treated like B'bbbbbbbb...bbbbbbbb'.
  - Some examples of valid bit strings are: B'01100100', b'11..00..000..111' and B'11......'.
  - Some examples of invalid bit strings are: B'0101' (not a multiple of eight bits), b'00..11....' (not a multiple of eight bits), b'00000002' (2 is not a valid bit) and B'' (no bits).

- **A decimal number in the format n, +n or −n.** You can specify from 1 to 31 significant digits.
  - Some examples of valid decimal numbers are: +270, 270, 000036, +0 and −200000.
  - Some examples of invalid decimal numbers are: ++15 (too many plus signs), 280− (sign in wrong place) and 2.8 (period is not allowed).

- **A two-digit year date string in the format Y'string' or y'string'.**
  - The string can be:
    - yy, yyy, yyyy, yyyy or yyyy yyyy where y is a hexadecimal year digit (0-9) and x is a hexadecimal non-year digit (0-9).
    - Uppercase, lowercase or mixed case forms of LOW, BLANKS, or HIGH.
    - A two-digit year date string in the format Y'datex', Y'datex'+n or Y'datex'−n.
      - datex can be uppercase, lowercase or mixed case forms of DATE1, DATE2 or DATE3.
      - n is a decimal number representing the number of days for DATE1 and DATE3, or the number of months for DATE2.
  - Some examples of valid two-digit year date strings are: Y'99', y'00123', y'date2', Y'DATE1'+20, y'Date3'-1, and Y'Blanks'.
  - Some examples of invalid two-digit year date strings are: Y'9', y'AB123', Y'DATE2-3', and Y'blank'.

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Field: A field can be specified as p,m,f (position, length and format), p,m (position and length) or p (position only).

A symbol for a field value must be used only where such a field is allowed and has the desired result. Otherwise, substitution of the field for the symbol will result in an error message or unintended processing. For example, if the following SYMNAMES statement is specified:

Field1,15,2,CH

Field1 can be used in a SORT statement such as:

SORT FIELDS=(Field1,A)

because a character field is allowed in a SORT statement. However, Field1 will result in an error message if used in a SUM statement such as:

SUM FIELDS=(Field1)

because a character field is not allowed in a SUM statement.

As another example, Field1: can be used in an INREC statement such as:

OUTFIL OVERLAY=(Field1:C'AB')

to set the output column to 15, because column notation is allowed in the BUILD, OVERLAY or PUSH operand of an INREC or OUTREC statement and in the BUILD, OVERLAY, PUSH, TRLUPD, HEADERx, or TRAILERx operand of an OUTFIL statement. However, Field1: will result in an error message if used in any other operand, such as WHEN.

Make sure the fields that will be substituted for your symbols are appropriate. If in doubt, check the rules for p, m, f, and c: given in the description of the relevant operand.

You can specify p,m,f for your field symbols and then use them where p,m is required because DFSORT or ICETOOL will substitute just p,m when appropriate. You can specify p,m,f or p,m for your field symbols and then use them where c: is required because DFSORT will substitute just p: when appropriate. For example, if you specify the following in SYMNAMES:

First_Field,12,2,BI
Second_Field,18,6,CH
Third_Field,28,5,PD
Fourth_Field,36,3
Fifth_Field,52,4,PD
Max,200000
Outcol2,16

These DFSORT control statements:

OMIT COND=(Fifth_Field,GT,Max)
SORT FIELDS=(First_Field,A,Fourth_Field,A),FORMAT=CH
SUM FIELDS=(Second_Field,ZD)
OUTFIL OUTREC=(First_Field:First_Field,
Outcol2:Third_Field,M11,
Fourth_Field)

will be transformed to:

OMIT COND=(52,4,PD,GT,200000)
SORT FIELDS=(12,2,A,36,3,A),FORMAT=CH
SUM FIELDS=(18,6,ZD)
OUTFIL BUILD=(12:12,16:28,5,PD,M11,36,3)
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Note that DFSORT did the following substitutions:

- OMIT statement: p,m,f for Fifth_Field as required by COND without FORMAT.
- SORT statement: p,m for First_Field and Fourth_Field as required by FIELDS with FORMAT.
- SUM statement: p,m for Second_Field as required for symbol,f (that is, Second_Field,ZD).
- OUTFIL statement: p: for First_Field: and Outcol2: as required by the OUTREC operand for an output column. p,m for First_Field and Fourth_Field as required by the OUTREC operand for an unedited field. p,m,f for Third_Field as required by the OUTREC operand for an edited field (that is, Third_Field,M11).

The general rules for using p, m and f in symbol statements are as follows:

- p can be a number, an asterisk (*) or an equal sign (=). A number from 1 to 32752 is allowed in p,m or p,m,f. Because p (position only) cannot be distinguished from the constant n, 1 to 15 significant digits are allowed for p (position only).

An asterisk (*) can be used to assign the next position to p. Each time a symbol for p,m,f or p,m is read, the next position is set to p+m. Additionally, the next position can be modified by keyword statements (see “Keyword Statements” on page 741). When * is specified for p, the next position is assigned to p. If the next position has not been set when * is used for p (for example, * is used in the first symbol), p is set to 1.

The symbol table printed in the SYMNOUT data set (if specified) will show you the actual positions assigned when you specify * for p.

As an example of how * can be used, if you specify the following SYMNAMES statements:

```plaintext
Sym1,*5,ZD
Con1,27
Sym2,*2,BI
Field1,8,13,CH
Field2,*5,PD
Field3,*2,FI
```

SYMNOUT will show the following symbol table:

```plaintext
Sym1,1,5,ZD
Con1,27
Sym2,6,2,BI
Field1,8,13,CH
Field2,21,5,PD
Field3,26,2,FI
```

By using * for p, you can map consecutive fields in your records without having to compute their actual positions. You can also map fields added between other fields without having to change the p values for the original or inserted fields. * is also useful for creating mappings of contiguous fields using concatenated symbol data sets. As a simple example, if you specify:

```plaintext
//SYMNAMES DD DSN=MY.SYMPSD(RDW),DISP=SHR
  // DD DSN=MY.SYMPSD(SECTION1),DISP=SHR
  // DD DSN=MY.SYMPSD(SECTION2),DISP=SHR
```

and the RDW member contains:

```plaintext
RDW,1,4,BI
```

the SECTION1 member contains:
Using Symbols for Fields and Constants

Flag_Byte,*1,BI
   Error1,X'80'
   Error2,X'40'
Count_of_Parts,*5,ZD

and the SECTION2 member contains:

New_Parts,*5,ZD
Old_Parts,*5,ZD
Variable_Fields,*

SYMNOUT will show the following symbol table:

RDW,1,4,BI
Flag_Byte,5,1,BI
Error1,X'80'
Error2,X'40'
Count_of_Parts,6,5,ZD
New_Parts,11,5,ZD
Old_Parts,16,5,ZD
Variable_Fields,21

You might use these symbols in the following statements:

OPTION COPY
OUTFIL FNAMES=ERR1,INCLUDE=(Flag_Byte,EQ,Error1),
   OUTREC=(RDW,Count_of_Parts,Variable_Fields)
OUTFIL FNAMES=ERR2,INCLUDE=(Flag_Byte,EQ,Error2),
   OUTREC=(RDW,New_Parts,Old_Parts,Variable_Fields)

An equal sign (=) can be used to assign the previous position to p. Each time a symbol for p,m,f or p,m is read, the previous position is set to p. Additionally, the previous position can be modified by a POSITION keyword statement (see below).

When = is specified for p, the previous position is assigned to p. If the previous position has not been set when = is used for p, an error message is issued.

The symbol table printed in the SYMNOUT data set (if specified) will show you the actual positions assigned when you specify = for p.

As an example of how = can be used for p, if you specify the following SYMNAMES statements:

Sym1,5,4,CH
   Sym2,*,2,CH
   Sym3,*,2,CH

SYMNOUT will show the following symbol table:

Sym1,5,4,CH
Sym2,5,2,CH
Sym3,7,2,CH

By using = and * for p, you can easily map fields onto other fields.

Whenever you use = for p, you must ensure that the previous position is the one you want. In particular, if you insert a new field symbol with the wrong position before a symbol that uses = for p, you will need to change = to the actual position you want.

- m can be an equal sign (=) or a number from 1 to 32752. An equal sign (=) can be used to assign the previous length to m. Each time a symbol for p,m,f or p,m is read, the previous length is set to m. When = is specified for m, the previous length is assigned to m. If the previous length has not been set when = is used for m, an error message is issued.

The symbol table printed in the SYMNOUT data set (if specified) will show you the actual lengths assigned when you specify = for m.
Using Symbols for Fields and Constants

As an example of how = can be used for m, if you specify the following SYMNAMES statements:

Flags1,5,1,BI
  Error1,'X'08'
Flags2,15,=,BI
  Error2,'X'04'
Flags3,22,=,BI
  Error3,'X'23'

SYMNOUT will show the following symbol table:

Flags1,5,1,BI
  Error1,'X'08'
Flags2,15,1,BI
  Error2,'X'04'
Flags3,22,1,BI
  Error3,'X'23'

Whenever you use = for m, you must ensure that the previous length is the one you want. In particular, if you insert a new field symbol with the wrong length before a symbol that uses = for m, you will need to change = to the actual length you want.

- f can be an equal sign (=) or one of the following formats: AC, AQ, ASL, AST, BI, CH, CLO, CSF, CSL, CST, CTO, DC1, DC2, DC3, DE1, DE2, DE3, DT1, DT2, DT3, D1, D2, FI, FL, FS, LS, OL, OT, PD, PD0, SFF, SS, TC1, TC2, TC3, TC4, TE1, TE2, TE3, TE4, TM1, TM2, TM3, TM4, TS, UFF, Y2B, Y2C, Y2D, Y2DP, Y2P, Y2PP, Y2S, Y2T, Y2TP, Y2U, Y2UP, Y2V, Y2VP, Y2W, Y2WP, Y2X, Y2YP, Y2Z, Y4T, Y4U, Y4V, Y4W, Y4X, Y4Y or ZD.

An equal sign (=) can be used to assign the previous format to f. Each time a symbol for p,m,f is read, the previous format is set to f. When = is specified for f, the previous format is assigned to f. If the previous format has not been set when = is used for f, an error message is issued.

The symbol table printed in the SYMNOUT data set (if specified) will show you the actual formats assigned when you specify = for f.

As an example of how = can be used for f, if you specify the following SYMNAMES statements:

Field1,5,8,CH
Field1a,=,3
Field2,*,12,=
Field3,*,20,=

SYMNOUT will show the following symbol table:

Field1,5,8,CH
Field1a,5,3
Field2,8,12,CH
Field3,20,20,CH

Whenever you use = for f, you must ensure that the previous format is the one you want. In particular, if you insert a new field symbol with the wrong format before a symbol that uses = for f, you will need to change = to the actual format you want.

Parsed field: A parsed field can be specified as %nn with nn as 00-99 or as %n with n as 0-9. %0n will be substituted for %n. A symbol for a parsed field must be used only where such a field is allowed and has the desired result. Otherwise,
substitution of %nn for the symbol will result in an error message. For example, if
the following SYMNAMES statement is specified:

Revenue,%03

Revenue can be used in an OUTREC statement such as:

OUTREC PARSE=(Revenue=(STARTAT=C'+',FIXLEN=9)),
OVERLAY=(31:Revenue,UFF,EDIT=(III,IIT,TTT))

because a parsed field is allowed in the PARSE operand and the OVERLAY
operand. However, Revenue will result in an error message if used in a SORT
statement such as:

SORT FIELDS=(Revenue,UFF,A)

because a parsed field is not allowed in a SORT statement.

Make sure the parsed fields that will be substituted for your symbols are
appropriate. If in doubt, check the rules for %nn given in the the description of the
relevant operand.

As an example of how parsed fields can be used, if you specify the following
SYMNAMES statements:

branch,1,7
tab,X'05'
comma,','
first_name,%00
last_name,%01
date,%02
company,%03
city,%04
state,%05

SYMNOT will show the following symbol table:

branch,1,7
tab,X'05'
comma,C','
first_name,%00
last_name,%01
date,%02
company,%03
city,%04
state,%05

This DFSORT control statement:

INREC PARSE=(first_name=(ABSPOS=9,FIXLEN=12,ENDBEFR=comma),
last_name=(FIXLEN=15,ENDBEFR=comma),
=ENDBEFR=tab),
date=(FIXLEN=10,ENDBEFR=tab),
company=(FIXLEN=31,ENDBEFR=tab),
city=(FIXLEN=14,ENDBEFR=tab),
state=(FIXLEN=12)),
BUILD=(branch,9;first_name,22;last_name,
38:date,JFY=(SHIFT=RIGHT),
49:company,83:city,98:state)

will be transformed to:

INREC PARSE=(%00=(ABSPOS=9,FIXLEN=12,ENDBEFR=C','),%01=(FIXLEN=15,ENDBEF
R=C','),%02=(ENDBEFR=X'05'),%03=(FIXLEN=31,ENDBEFR=X'05'),%04=(FIXLEN=14,ENDBEFR=X
'05'),%05=(FIXLEN=12)),BUILD=(1,7;9;00,22;01,38;02,JFY
Y=(SHIFT=RIGHT),49;03,83;04,98;05)
Using Symbols for Fields and Constants

Keyword Statements

The general format for a keyword statement is:

keyword,value remark

The general coding rules are as follows:

- Columns 1 through 80 are scanned.
- The keyword can start in column 1 or in any column after 1.
- The keyword must be specified in all **uppercase** letters. Otherwise, it will be treated as a symbol.
- A remark is optional, but if specified, must be separated from the value by at least one blank. A remark is printed in SYMNOUT (if specified), but otherwise not processed.
- A semicolon (;) can be used instead of a comma (,) between the keyword and the value.
- Continuation is not allowed. Each keyword and value must be completely specified on one line.

The specific syntax for keyword statements is:

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Syntax</th>
</tr>
</thead>
<tbody>
<tr>
<td>POSITION,q</td>
<td></td>
</tr>
<tr>
<td>POSITION,symbol</td>
<td></td>
</tr>
<tr>
<td>SKIP,n</td>
<td></td>
</tr>
<tr>
<td>ALIGN,H</td>
<td></td>
</tr>
<tr>
<td>ALIGN,F</td>
<td></td>
</tr>
<tr>
<td>ALIGN,D</td>
<td></td>
</tr>
</tbody>
</table>

Keyword statements can help you map the fields in your records by letting you set a starting position, skip unused bytes and align fields on specific boundaries.

- **POSITION,q** can be used to set the next position and the previous position to q. As discussed under p above, the next position is used when an asterisk (*) is specified for p in a symbol statement, and the previous position is used when an equal sign (=) is specified for p in a symbol statement. q can be a number from 1 to 32752. When you use POSITION,q you can use either * or = interchangably for p of the next symbol.

As an example of how POSITION,q can be used, if you specify the following SYMNAMES statements:

```plaintext
POSITION,27
Account_Balance,*,5,PD
Account_Id,*,8,CH
POSITION,84
New_Balance,=,20
```

SYMNOUT will show the following symbol table:

```plaintext
Account_Balance,27,5,PD
Account_Id,32,8,CH
New_Balance,84,20
```

- **POSITION,symbol** can be used to set the next position and the previous position to the position established for the indicated symbol. As discussed under p above, the next position is used when an asterisk (*) is specified for p in a symbol statement, and the previous position is used when an equal sign (=) is specified
Using Symbols for Fields and Constants

for p in a symbol statement. When you use POSITION,symbol you can use either * or = interchangeably for p of the next symbol.

symbol can be any previously defined field symbol. Thus, POSITION,symbol can be used like the Assembler ORG instruction to map different fields onto the same area.

As an example of how POSITION,symbol can be used, if you specify the following SYMNAMES statements:

```plaintext
Workarea,21,100 Use workarea for volsers
   volser1,=,6,CH
   volser2,*,6,CH
POSITION,Workarea Reuse workarea for status and dsname
   status,=,1,BI
   dsname,*,44,CH
```

SYMNOUT will show the following symbol table:

```plaintext
Workarea,21,100
   volser1,21,6,CH
   volser2,27,6,CH
   status,21,1,BI
   dsname,22,44,CH
```

- **SKIP,n** can be used to add n bytes to the next position. As discussed under p above, the next position is used when an asterisk (*) is specified for p in a symbol statement. n can be a number from 1 to 32752.

As an example of how SKIP,n can be used, if you specify the following SYMNAMES statements:

```plaintext
Field#1,15,6,FS
   SKIP,4 Unused bytes
Field#2,*,5,=
   SKIP,2 Unused bytes
Field#3,*,8,CH
```

SYMNOUT will show the following symbol table:

```plaintext
Field#1,15,6,FS
Field#2,25,5,FS
Field#3,32,8,CH
```

- **ALIGN,H** can be used to align the next position on a halfword boundary, that is, 1, 3, 5 and so on. As discussed under p above, the next position is used when an asterisk (*) is specified for p in a symbol statement. ALIGN,h will be treated like ALIGN,F.

As an example of how ALIGN,H can be used, if you specify the following SYMNAMES statements:

```plaintext
A1,7,3,CH
ALIGN,H
A2,*,2,BI
```

SYMNOUT will show the following symbol table:

```plaintext
A1,7,3,CH
A2,11,2,BI
```

- **ALIGN,F** can be used to align the next position on a fullword boundary, that is, 1, 5, 9 and so on. As discussed under p above, the next position is used when an asterisk (*) is specified for p in a symbol statement. ALIGN,f will be treated like ALIGN,F.

As an example of how ALIGN,F can be used, if you specify the following SYMNAMES statements:
ALIGN,D can be used to align the next position on a doubleword boundary, that is, 1, 9, 17 and so on. As discussed under P above, the next position is used when an asterisk (*) is specified for P in a symbol statement. ALIGN,D will be treated like ALIGN,D.

As an example of how ALIGN,D can be used, if you specify the following SYMNAMES statements:

```
C1,7,3,CH
ALIGN,D
C2,*,8,BI
```

SYMNOUT will show the following symbol table:
```
C1,7,3,CH
C2,17,8,BI
```

Using SYMNOUT to Check Your SYMNAMES Statements

To avoid surprises, it's a good idea to check for errors and incorrect positions, lengths and formats in any SYMNAMES statements you create before you use them in DFSORT or ICETOOL statements.

The following simple job will cause DFSORT to issue messages in SYSOUT for any errors it detects in your SYMNAMES statements, allowing you to correct these errors before proceeding. Once your SYMNAMES statements are free of errors, the job will cause DFSORT to show the Symbol Table in SYMNOUT, allowing you to correct any incorrect positions, lengths or formats for your symbols (for example, those caused by incorrect use of *, =, SKIP, and so on).

```
//CHECK JOB A402,PROGRAMMER
//DOIT EXEC PGM=ICEMAN
//SYMNAMES DD ... SYMNAMES statements to be checked
//SYMNOUT DD SYSOUT=* ...
//SORTIN DD *
//SORTOUT DD SYSOUT=* ...
//SYSIN DD *
//OPTION COPY ...
```

Once you've "debugged" your SYMNAMES statements, you can use them in DFSORT and ICETOOL statements.

Using Symbols in DFSORT Statements

You can use symbols in the following DFSORT control statements: INCLUDE, INREC, JOINKEYS, MERGE, OMIT, OUTFIL, OUTREC, REFORMAT, SORT and SUM. In general, you can use symbols in these DFSORT statements where you can use constants ('string', C'string', X'string', B'string', n, +n or −n), fields (p,m,f or p,m or p), parsed fields (%nn), and output columns (c). See the discussion of each control statement in Chapter 3, “Using DFSORT Program Control Statements,” on page 81 for a description of its syntax.

You can use symbols in these control statements in any source (that is, DFSPARM, SYSIN, SORTCNTL, and parameter lists).
Using Symbols for Fields and Constants

When DFSORT transforms these control statements, it removes labels and remarks, and continues statements by placing an asterisk in column 72 and beginning the next line in column 16. DFSORT will list the original control statements as specified (with labels, remarks, comment statements and blank statements) by source, as well as the transformed statements.

Details and examples of the use of symbols for each applicable DFSORT control statement is given below. The examples are meant to illustrate variations in how symbols can be used and how they will be transformed. Therefore, the examples do not necessarily correspond to how symbols would be used in real applications.

The examples use these SYMNAMES statements:

```
C_Field1,6,5,CH
Filler,'*'
Any_Format,12,3
Z_Field1,22,8,ZD
P_Field1,30,4,PD
C_Field2,4,2,ch
SubString16,3,SS
Start_col,11
Dept_col,55
LIMIT, +12500
Sysplex,'SYSPLEX.'
Depts,'J82,L92,M92'
Code_1,'0864Z'
QCON,'Carrie''s Constant'
Stopper,X'FFFFFF'
Flags,35,1,BI
  Error,B'11010000'
  Empty,B'......01'
  Full,X'FF'
Lookup,52,1,BI
Entry1,X'05'
Value1,'Read'
Entry2,X'20'
Value2,'Update'
RDW,1,4
  Record Descriptor Word
Variable_Fields,451
  Variable fields at end of variable-length record
* Constants for report
  Div_Title,'Division: '
  BO_Title,'Branch Office' 
  BO_Hyphens,'-------------'
  BO_Equals,'============='
  PL_Title,' Profit/(Loss)'
  PL_Hyphens,'--------------------'
  PL_Equals,'===================='
  Total,'Total'
  Lowest,'Lowest'
* Fields for report
  Division,3,10,CH
  Branch Office,16,13,CH
  Profit_or_Loss,31,10,ZD
  Class_value,%00
  Students_value,%01
  Class_constant,'CLASS=('
  Students_constant,'STUDENTS=(' 
  End_constant,')'
```

**SORT and MERGE**

**FIELDS operand:** You can use symbols where you can use fields (p,m,f and p,m). A symbol for p,m,f results in substitution of p,m if FORMAT=f or symbol,f is specified.
Using Symbols for Fields and Constants

Example 1
SORT FIELDS=(C_Field1,A,Z_Field1,D,
       C_Field2,ZD,A),EQUALS

will be transformed to:
SORT FIELDS=(6,5,CH,A,22,8,ZD,D,4,2,ZD,A),EQUALS

Example 2
MERGE FIELDS=(Any_Format,A,C_Field1,A),FORMAT=CH

will be transformed to:
MERGE FIELDS=(12,3,A,6,5,A),FORMAT=CH

SUM

FIELDS operand: You can use symbols where you can use fields (p,m,f and p,m).
A symbol for p,m,f results in substitution of p,m if FORMAT=f or symbol,f is
specified.

Example 1
SUM FIELDS=(Z_Field1,C_Field1,ZD)

will be transformed to:
SUM FIELDS=(22,8,ZD,6,5,ZD)

Example 2
SUM FORMAT=ZD,FIELDS=(C_Field1,Any_Format)

will be transformed to:
SUM FORMAT=ZD,FIELDS=(6,5,12,3)

INCLUDE and OMIT

COND operand: You can use symbols where you can use fields (p1,m1,f1 and
p1,m1 and p2,m2,f2 and p2,m2) and constants (n, +n, −n, C'xx...x', X'yy...y',
Y'yy...x' and B'bbbbbbbb...bbbbbbbb'). A symbol for p,m,f results in substitution of
p,m if FORMAT=f or symbol,f is specified. A symbol for 'string' always results in
substitution of C'string'.

Example 1
INCLUDE COND=((Z_Field1,GT,LIMIT,AND,Any_Format,CH,EQ,C_Field2),OR,
       (SubString,NE,Depts),OR,
       (Flags,ALL,Error,AND,Flags,NE,Empty))

will be transformed to:
INCLUDE COND=((22,8,ZD,GT,+12500,AND,12,3,CH,EQ,4,2,CH),OR,(16,3,SS,NE*
       ,C'J82,L92,M72'),OR,(35,1,BI,ALL,B'11010000',AND,35,1,BI*
       ,NE,B'......01'))

Example 2
OMIT FORMAT=BI,COND=(C_Field1,EQ,Code_1,OR,
       Any_Format,EQ,Stopper,OR,
       Flags,EQ,Full)

will be transformed to:
Using Symbols for Fields and Constants

Example 3

```
INCLUDE COND=(25,8,CH,EQ,Sysplex)
```

If the value for the system symbol &SYSPLEX. is 'MAS3', the INCLUDE statement will be transformed to:

```
INCLUDE COND=(25,8,CH,EQ,'MAS3')
```

Note: You can use a symbol for Y'DATEx', Y'DATEx'+n or Y'DATEx'-n (where x is 1, 2 or 3) in the COND operand, but you cannot use symbol+n or symbol-n to substitute Y'DATEEn'+n or Y'DATEEn'-n in the COND operand. For example, if you have the symbols:

```
YD1,Y'DATE1'
YD1P5,Y'DATE1'+5
```

The INCLUDE statement:

```
INCLUDE COND=(1,6,Y2T,EQ,YD1)
```

will be transformed to:

```
INCLUDE COND=(1,6,Y2T,EQ,Y'DATE1')
```

The INCLUDE statement:

```
INCLUDE COND=(1,6,Y2T,EQ,YD1P5)
```

will be transformed to:

```
INCLUDE COND=(1,6,Y2T,EQ,Y'DATE1'+5)
```

The INCLUDE statement:

```
INCLUDE COND=(1,6,Y2T,EQ,YD1+5)
```

will not be transformed because YD1+5 is not valid.

INREC and OUTREC

```
PARSE operand: You can use symbols where you can use parsed fields (%nn) and constants (C'xx...x' and X'yy...yy').
```

```
FIELDS, BUILD, OVERLAY, FINDREP, IFTHEN BUILD, IFTHEN OVERLAY, IFTHEN FINDREP and IFTHEN PUSH operands: You can use symbols where you can use output columns (c), fields (p,m,f and p,m and p), parsed fields (%nn), non-repeated constants (C'xx...x' and X'yy...yy', but not nC'xx...x' or nX'yy...yy'), and decimal constants (+n and −n, but not n). You cannot use symbols for edit patterns ('pattern').
```

In the JFY and SQZ suboperands, you can use symbols where you can use constants (C'xx...x' and X'yy...yy').

In the CHANGE and NOMATCH suboperands, you can use symbols where you can use fields (q,n), parsed fields (%nn), and constants (C'xx...x', X'yy...yy' and B'bbbbbbbb').

In the RESTART suboperand for SEQNUM, you can use a symbol where you can use a field (p,m) or parsed field (%nn).
Using Symbols for Fields and Constants

A symbol for p or p,m or p,m,f or p,m,Y2x or p,m,Y2xP or p,m,Y4x results in substitution of p: for symbol: (output column).

A symbol for p,m,f results in substitution of p,m,f if (symbol),fo or symbol,TO=fo or symbol,ZDF or symbol,ZDC or symbol,PDC or symbol,ZDF or symbol,PDF is specified, but results in substitution of p,m if symbol,fo is specified (when fo is not ZDF, ZDC, PDC, or PDF) because fo cannot be distinguished from f (except for ZDF, ZDC, PDC, or PDF). For example, if SYM1 is defined as 5,4,ZD, (SYM1),PD is transformed to (5,4,ZD),PD and SYM1,TO=PD is transformed to 5,4,ZD,TO=PD, whereas SYM1,PD is transformed to 5,4,PD. Thus, you should always use (symbol),fo or symbol,TO=fo rather than symbol,fo

A symbol for p,m,f results in substitution of p,m unless symbol,edit or symbol,to or (symbol) is specified or the symbol is part of an arithmetic expression. For example, if SYM1 is defined as 5,4,ZD, SYM1,X is transformed to 5,4,X, whereas SYM1,M12 is transformed to 5,4,ZD,M12 and SYM1,ADD,+1 is transformed to 5,4,ZD,ADD,+1.

A symbol for p,m,Y2x results in substitution of p,m,Y2x unless symbol,f or symbol,HEX is specified. A symbol for p,m,Y2xP results in substitution of p,m,Y2xP unless symbol,f or symbol,HEX is specified.

A symbol for p,m,Y4x results in substitution of p,m,Y4x unless symbol,f or symbol,HEX is specified.

A symbol for p,m,Y4x results in substitution of p,m,Y4x unless symbol,f or symbol,HEX is specified.

A symbol for 'string' always results in substitution of C'string'.

Example 1

```
INREC FIELDS=(Start_col:C_Field2,2X,C_Field1,F,Stopper,5C'*',
             Z_Field1,Dept_col:Depts,X,P_Field1,TO=FS,X,Z_Field1,M10,
             Z_Field1,MUL,(P_Field1,SUB,LIMIT),EDIT=(SIIIIIT.TT),SIGNS= (+,-))
```

will be transformed to:

```
INREC FIELDS=(11:4,2,2X,6,5,F,X'FFFFFF',5C'*',22,8,55:C'J82,L92,M72',X*
             ,30,4,PD,TO=FS,X,22,8,ZD,M10,22,8,ZD,MUL,(30,4,PD,SUB,+1*
             2500),EDIT=(SIIIIIT.TT),SIGNS= (+,-))
```

Example 2
Using Symbols for Fields and Constants

```
OUTREC FIELDS=(RDW, ** Record Descriptor Word **
               Z_Field1,2Z,
               3'C'Symbol cannot be used for a repeated constant',
               Code_1,Flags,
               Variable_Fields) ** Variable part of input record
```

will be transformed to:

```
OUTREC FIELDS=(1,4,2Z,8,2Z,3'C'Symbol cannot be used for a repeated con*
               stant',C'86A42',35,1,451)
```

Example 3

```
INREC PARSE=(Class_value=(STARTAFT=Class_constant,
               ENDBEFR=End_constant, FIXLEN=8),
               Students_value=(STARTAFT=Students_constant,
               ENDBEFR=End_constant, FIXLEN=5)),
               BUILD=(Class_value,3X,Students_value,UFF,M11,LENGTH=5)
```

will be transformed to:

```
INREC PARSE=(%00=(STARTAFT=C'CLASS=(',ENDBEFR=C')',FIXLEN=8),%01=(STAR*
               TAFT=C'STUDENTS=(',ENDBEFR=C')',FIXLEN=5)),BUILD=(%00,3X*
               ,%01,UFF,M11,LENGTH=5)
```

**IFTHEN WHEN=(logexp), IFTHEN BEGIN=(logexp) and IFTHEN END=(logexp)**

operands: You can use symbols where you can use fields (p1,m1,f1 and p1,m1 and
p2,m2,f2 and p2,m2) and constants (n, +n, −n, C'xx...x', X'yy...yy', Y'yyx...x' and
B'bbbbbbbb...bbbbbbbb'). A symbol for p,m,f results in substitution of p,m if
symbol,f is specified. A symbol for 'string' always results in substitution of
C'string'.

Example 1

```
INREC IFTHEN=(WHEN=(Lookup,EQ,Entry1),OVERLAY=(75:Value1)),
               IFTHEN=(WHEN=(Lookup,EQ,Entry2),OVERLAY=(75:Value2))
```

will be transformed to:

```
INREC IFTHEN=(WHEN=(52,1,BI,EQ,X'05'),OVERLAY=(75:C'Read')),IFTHEN=(WH*
               EN=(52,1,BI,EQ,X'20'),OVERLAY=(75:C'Update'))
```

**Note:** You can use a symbol for Y'DATEEx', Y'DATEEx'+n or Y'DATEEx'-n (where x is
1, 2 or 3) in the WHEN, BEGIN or END operand, but you cannot use
symbol+n or symbol-n to substitute Y'DATEEn'+n or Y'DATEEn'-n in the
WHEN, BEGIN or END operand. See the discussion of 'INCLUDE and
OMIT' for further details.

**OUTFIL**

```
INCLUDE, OMIT, IFTRAIL TRLID=(logexp), IFTHEN WHEN=(logexp), IFTHEN
BEGIN=(logexp) and IFTHEN END=(logexp) operands: You can use symbols
where you can use fields (p1,m1,f1 and p1,m1 and p2,m2,f2 and p2,m2) and
constants (n, +n, −n, C'xx...x', X'yy...yy', Y'yyx...x' and B'bbbbbbbb...bbbbbbbb'). A
symbol for p,m,f results in substitution of p,m if symbol,f is specified. A symbol for
'string' always results in substitution of C'string'.

**Note:** You can use a symbol for Y'DATEEx', Y'DATEEx'+n or Y'DATEEx'-n (where x is
1, 2 or 3) in the INCLUDE, OMIT, TRLID, WHEN, BEGIN or END operand,
but you cannot use symbol+n or symbol-n to substitute Y'DATEEn'+n or
Y'DATEEn'-n in the INCLUDE, OMIT, TRLID, WHEN, BEGIN or END
operand. See the discussion of 'INCLUDE and OMIT' for further details.
Using Symbols for Fields and Constants

**PARSE operand:** You can use symbols where you can use parsed fields (%nn) and constants (C’xx...x’ and X’yy...yy’).

**OUTREC, BUILD, OVERLAY, FINDREP, IFTRAIL TRLUPD, ITHEN BUILD, ITHEN OVERLAY, ITHEN FINDREP and ITHEN PUSH operands:** You can use symbols where you can use output columns (c), fields (p,m,f and p,m and p), parsed fields (%nn), non-repeated constants (C’xx...x’ and X’yy...yy’), and decimal constants (+n and −n, but not n). You cannot use symbols for edit patterns (‘pattern’).

In the JFY and SQZ suboperands, you can use symbols where you can use constants (C’xx...x’ and X’yy...yy’).

In the CHANGE and NOMATCH suboperands, you can use symbols where you can use fields (q,n), parsed fields (%nn), and constants (C’xx...x’, X’yy...yy’ and B’bbbbbbbb’).

In the RESTART suboperand for SEQNUM, you can use a symbol where you can use a field (p,m) or a parsed field (%nn).

In the ITHEN KEYBEGIN operand, you can use a symbol where you can use a field (p,m).

A symbol for p or p,m or p,m,f or p,m,Y2x or p,m,Y2xP results in substitution of p: for symbol: (output column).

A symbol for p,m,f results in substitution of p,m,f if (symbol),fo or symbol,TO=fo or symbol,ZDF or symbol,ZDC or symbol,PDC or symbol,PDF is specified, but results in substitution of p,m if symbol,fo is specified (when fo is not ZDF or ZDC or ZDF or ZDC, PDC, or PDF) because fo cannot be distinguished from f (except for ZDF, ZDC, PDC, and PDF). For example, if SYM1 is defined as 5,4,ZD, (SYM1),PD is transformed to (5,4,ZD),PD and SYM1,TO=PD is transformed to 5,4,ZD,TO=PD, whereas SYM1,PD is transformed to 5,4,PD. Thus, you should always use (symbol),fo or symbol,TO=fo rather than symbol,fo.

A symbol for p,m,f results in substitution of p,m unless symbol,edit or symbol,to or (symbol) is specified or the symbol is part of an arithmetic expression. For example, if SYM1 is defined as 5,4,ZD, SYM1,X is transformed to 5,4,X, whereas SYM1,M12 is transformed to 5,4,ZD,M12 and SYM1,ADD,+1 is transformed to 5,4,ZD,ADD,+1.

A symbol for p,m,Y2x results in substitution of p,m,Y2x if symbol,TO=fo or symbol,todate or symbol, dateop or symbol,ZDF or symbol,ZDC or symbol,PDC or symbol,PDF is specified, but results in substitution of p,m if symbol,fo is specified (when fo is not ZDF or ZDC, ZDF, ZDC, PDC, or PDF) because fo cannot be distinguished from f (except for ZDF, ZDC, PDC, and PDF). For example, if SYM1 is defined as 5,4,Y2T, SYM1,TO=PD is transformed to 5,4,Y2T,TO=PD, whereas SYM1,PD is transformed to 5,4,PD. Thus, you should always use symbol,TO=fo rather than symbol,fo when dealing with symbols for p,m,Y2x fields.

A symbol for p,m,Y2x results in substitution of p,m,Y2x unless symbol,f or symbol,HEX is specified. A symbol for p,m,Y2xP results in substitution of p,m,Y2xP unless symbol,f or symbol,HEX is specified.

A symbol for p,m,Y4x results in substitution of p,m,Y4x if symbol,TO=fo or symbol,todate or symbol, dateop or symbol,ZDF or symbol,ZDC or symbol,PDC or
Using Symbols for Fields and Constants

symbol,PDF is specified, but results in substitution of p,m if symbol,fo is specified (when fo is not ZDF, ZDC, PDC, or PDF) because fo cannot be distinguished from f (except for ZDF, ZDC, PDC, or PDF). For example, if SYM1 is defined as 5,8,Y4T, SYM1,TO=PD is transformed to 5,8,Y4T,TO=PD, whereas SYM1,PD is transformed to 5,4,PD. Thus, you should always use symbol,TO=fo rather than symbol,fo when dealing with symbols for p,m,Y4x fields.

A symbol for p,m,Y4x results in substitution of p,m,Y4x unless symbol,f or symbol,HEX is specified.

A symbol for 'string' always results in substitution of C'string'.

**VLFILL operand:** You can use symbols where you can use constants (C'x' and X'yy'). A symbol for 'string' always results in substitution of C'string'.

**VLTRIM operand:** You can use symbols where you can use constants (C'x' and X'yy'). A symbol for 'string' always results in substitution of C'string'.

**HEADER1 and HEADER2 operands:** You can use symbols where you can use output columns (c), fields (p,m) and non-repeated constants ('xx...x', C'xx...x', and X'yy...yy', but not n'xx...x', n'Cxx...x', or n'Xyy...yy'). A symbol for p or p,m or p,m,f results in substitution of p: for symbol: (output column). A symbol for p,m,f always results in substitution of p,m. A symbol for 'string' always results in substitution of C'string'.

**TRAILER1 and TRAILER2 operands:** Outside of the suboperands TOTAL, TOT, MIN, MAX, AVG, SUBTOTAL, SUBTOT, SUB, SUBMIN, SUBMAX and SUBAVG: You can use symbols where you can use output columns (c), fields (p,m) and non-repeated constants ('xx...x', C'xx...x' and X'yy...yy', but not n'xx...x', n'Cxx...x' or n'Xyy...yy'). A symbol for p or p,m or p,m,f results in substitution of p: for symbol: (output column). A symbol for p,m,f always results in substitution of p,m. A symbol for 'string' always results in substitution of C'string'.

Inside of the suboperands TOTAL, TOT, MIN, MAX, AVG, SUBTOTAL, SUBTOT, SUB, SUBMIN, SUBMAX and SUBAVG: You can use symbols where you can use fields (p,m,f). A symbol for p,m,f results in substitution of p,m,f if symbol,TO=fo or symbol,ZDF or symbol,ZDC or symbol,PDC or symbol,PDF is specified, but results in substitution of p,m if symbol,fo is specified (when fo is not ZDF, ZDC, PDC, or PDF) because fo cannot be distinguished from f (except for ZDF, ZDC, PDC, or PDF). For example, if SYM1 is defined as 5,4,ZD, MIN=(SYM1,TO=PD) is transformed to MIN=(5,4,ZD,TO=PD) whereas MIN=(SYM1,PD) is transformed to MIN=(5,4,PD). Thus, you should always use symbol,TO=fo rather than symbol,fo.

**SECTIONS operand:** The "HEADER1 and HEADER2 operands" discussion above also applies to the HEADER3 suboperand of SECTIONS. The "TRAILER1 and TRAILER2 operands" discussion above also applies to the TRAILER3 suboperand of SECTIONS.

Outside of the HEADER3 and TRAILER3 suboperands, you can use symbols where you can use fields (p,m). A symbol for p,m,f always results in substitution of p,m.

**Example 1**

```
OUTFIL FNAMES=OUT1,
INCLUDE=(Z_Field1,GT,LIMIT,AND,Any_Format,CH,EQ,C_Field2),
OUTREC=(Any_Format:P_Field1,M0,2X,Any_Format,B1,LENGTH=3,2X,
```
Using Symbols for Fields and Constants

QCON, 2X,
  C_Field2, HEX, 2X, Z_Field1, EDIT=('I III IIT.T'), 2X,

* Lookup Table
  Lookup, CHANGE=(6, Entry1, Value1, Entry2, Value2),
  NOMATCH=(Lookup))

will be transformed to:

OUTFIL FNAMES=OUT1, INCLUDE=(22, 8, ZD, GT, +12500, AND, 12, 3, CH, EQ, 4, 2, CH), 0*
  UTREC=(12:30, 4, PD, M0, 2X, 12, 3, 81, LENGTH=3, 2X, C'Carrie's *
  Constant', 2X, 4, 2, HEX, 2X, 22, 8, ZD, EDIT=('I III IIT.T'), 2X,*
  52, 1, CHANGE=(6, X'05', C'Read', X'20', C'Update'), NOMATCH=(5+* 2, 1))

Example 2

OUTFIL FNAMES=REPORT,  
  OUTREC=(6: Branch_Office, 24: Profit_or_Loss, M5, LENGTH=20, 75: X),
  SECTIONS=(Division, SKIP=P,  
    HEADER3=(2: Div_Title, Division, 5X, 'Page:', &:PAGE, 2/,  
      6: BO_Title, 24: PL_Title, /,  
      6: BO_Hyphens, 24: PL_Hyphens),
  TRAILER3=(6: BO_Equals, 24: PL_Equals, /,  
    6: Total, 24: TOTAL=(Profit_or_Loss, M5, LENGTH=20), /,  
    6: Lowest, 24: MIN=(Profit_or_Loss, M5, LENGTH=20)))

will be transformed to:

OUTFIL FNAMES=REPORT, OUTREC=(6: 16, 13, 24: 31, 10, ZD, M5, LENGTH=20, 75: X), SE*
  CTIONS=(3, 10, SKIP=P, HEADER3=(2: 'Division: ', 3, 10, 5X, 'P*  
    age:', &:PAGE, 2/, 6: 'Branch Office', 24: 'Profit/(Lo*  
    ss)', '/', 6: C'----------', 24: C'------------------'), TR*  
    AILER3=(6: C'=', 24: C'='), TRAILER3=(6: C'Total', 24: TOTAL=(31, 10, ZD, M5, LENGTH=20), /,  
    6: C'Lowest* ', 24: MIN=(31, 10, ZD, M5, LENGTH=20)))

Example 3

OUTFIL IFTHEN=(WHEN=INIT,  
  PARSE=(Class_value=(STARTAFT=Class_constant,  
    ENDBEFR=End_constant, FIXLEN=8),  
    Students_value=(STARTAFT=Students_constant,  
    ENDBEFR=End_constant, FIXLEN=5)),  
  BUILD=(1: Class_value)),
  IFTHEN=(WHEN=(1, 8, SS, EQ, C'Biology, Algebra, Geometry'),  
    BUILD=(C'There are ', Students_value, UFF, M10, X,  
    Class_value, C'Students')),  
  IFTHEN=(WHEN=NONE,  
    BUILD=(C'*Not relevant*'))

will be transformed to:

OUTFIL IFTHEN=(WHEN=INIT, PARSE=(%00=(STARTAFT=C'CLASS=',EndBEFR=C'),  
  FIXLEN=8), %01=(STARTAFT=C'STUDENTS=',EndBEFR=C'), FIXLE*  
  N=5), BUILD=(1: %00), IFTHEN=(WHEN=(1, 8, SS, EQ, C'Biology,  
    Algebra, Geometry'), BUILD=(C'There are ', %01, UFF, M10, X, %  
    00, C'Students')), IFTHEN=(WHEN=NONE,BUILD=(C'*Not releva*  
    nt*'))

JOINKEYS

FIELDS operand: You can use symbols where you can use fields (p,m). A symbol  
for p,m,f results in substitution of p,m.

INCLUDE and OMIT operands: You can use symbols where you can use fields  
(p1,m1,f1 and p1,m1 and p2,m2,f2 and p2,m2) and constants (n, +n, -n, C'x...x',

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X'yy...yy', Y'yyx...x' and B'bbbbbbbb...bbbbbbbb'). A symbol for p,m,f results in substitution of p,m if symbol,f is specified. A symbol for 'string' always results in substitution of C'string'.

**Note:** You can use a symbol for Y'DATEx', Y'DATEx'+n or Y'DATEx'-n (where x is 1, 2 or 3) in the INCLUDE or OMIT operand, but you cannot use symbol+n or symbol-n to substitute Y'DATEn'+n or Y'DATEn'-n in the INCLUDE or OMIT operand. See the discussion of "INCLUDE and OMIT" for further details.

**Example 1**

JOINKEYS FILE=F1,FIELDS=(Division,A),
INCLUDE=(Substring,EQ,Depts)

will be transformed to:

JOINKEYS FILE=F1,FIELDS=(3,10,A),INCLUDE=(16,3,SS,EQ,C'J82,L92,M72')

**REFORMAT**

**FIELDS operand:** You can use symbols where you can use fields (p,m and p). A symbol for p,m,f results in substitution of p,m.

**FILL operand:** You can use symbols where you can use constants (C'x' and X'yy'). A symbol for 'string' always results in substitution of C'string'.

**Example 1**

REFORMAT FIELDS=(F1:RDW,Profit_or_Loss,F2:Any_Format,
F1:Variable_Fields),FILL=filler

will be transformed to:

REFORMAT FIELDS=(F1:1,4,31,10,F2:12,3,F1:451),FILL=C'*'

Using Symbols in ICETOOL Operators

You can use symbols in the following ICETOOL operators: COUNT, DATASORT, DISPLAY, OCCUR, RANGE, SELECT, SPLICE, STATS, SUBSET, UNIQUE, and VERIFY. In general, you can use symbols in these ICETOOL operators where you can use constants ('string', n, +n or −n) and fields (p,m,f or p,m). See the discussion of each operator in [Chapter 7, “Using ICETOOL,” on page 555](#) for a description of its syntax.

ICETOOL reads the SYMNAMES data set once and uses it for all operators and DFSORT control statements for the run. You can use symbols in operators from the TOOLIN data set or your parameter list. You can also use symbols in DFSORT control statements in xxxxCNTL data sets or in the DFSPARM data set (see ["Using Symbols in DFSORT Statements” on page 743](#) for details).

ICETOOL will list the original operator statements as well as the transformed operator statements.

Details of the use of symbols for each applicable ICETOOL operator is given below followed by a complete ICETOOL example. The example is meant to illustrate variations in how symbols can be used and how they will be transformed. Therefore, the example does not necessarily correspond to how symbols would be used in real applications.
COUNT

**HIGHER, LOWER, EQUAL and NOTEQUAL operands:** You can use symbols where you can use constants (x, y, v, and w).

**SUB and ADD operands:** You can use symbols where you can use constants (q and r).

**TEXT operand:** You can use symbols where you can use constants (’string’). A symbol for C’string’ always results in substitution of ’string’.

DATASORT

**HEADER, FIRST, TRAILER and LAST operands:** You can use symbols where you can use constants (u and v).

DISPLAY

**ON operand:** You can use symbols where you can use fields (p,m,f and p,m). A symbol for p,m,f results in substitution of p,m if symbol,f or symbol,HEX is specified.

**BREAK operand:** You can use symbols where you can use fields (p,m,f and p,m). A symbol for p,m,f results in substitution of p,m if symbol,f is specified.

**TITLE, HEADER, TOTAL, MAXIMUM, MINIMUM, AVERAGE, COUNT, BTITLE, BTOTAL, BMAXIMUM, BMINIMUM, BVERAGE and BCOUNT operands:** You can use symbols where you can use constants (’string’). A symbol for C’string’ always results in substitution of ’string’.

OCCUR

**ON operand:** You can use symbols where you can use fields (p,m,f and p,m). A symbol for p,m,f results in substitution of p,m if symbol,f or symbol,HEX is specified.

**TITLE and HEADER operands:** You can use symbols where you can use constants (’string’). A symbol for C’string’ always results in substitution of ’string’.

**HIGHER, LOWER and EQUAL operands:** You can use symbols where you can use constants (x, y, and v).

RANGE

**ON operand:** You can use symbols where you can use fields (p,m,f and p,m). A symbol for p,m,f results in substitution of p,m if symbol,f is specified.

**HIGHER, LOWER, EQUAL and NOTEQUAL operands:** You can use symbols where you can use constants (x, y, v, and w).

SELECT

**ON operand:** You can use symbols where you can use fields (p,m,f and p,m). A symbol for p,m,f results in substitution of p,m if symbol,f is specified.

**FIRST, FIRSTDUP, HIGHER, LOWER and EQUAL operands:** You can use symbols where you can use constants (u, v, w, x, and y).
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SPLICE

ON operand: You can use symbols where you can use fields (p,m,f and p,m). A symbol for p,m,f results in substitution of p,m if symbol,f is specified.

WITH operand: You can use symbols where you can use fields (p,m). A symbol for p,m,f results in substitution of p,m.

STATS, UNIQUE and VERIFY

ON operand: You can use symbols where you can use fields (p,m,f and p,m). A symbol for p,m,f results in substitution of p,m if symbol,f is specified.

SUBSET

HEADER, FIRST, RRN, TRAILER and LAST operands: You can use symbols where you can use constants (q, r, u and w).

ICETOOL Example

```plaintext
//TOOLSYM JOB A402,PROGRAMMER
//DOIT EXEC PGM=ICETOOL
//TOOLMSG DD SYSOUT=*  
//DFSMMSG DD SYSOUT=*  
//SYMNOUT DD SYSOUT=*  
//SYMNAMES DD *  
  Rdw,1,4,BI  
  Account_Code,12,1,CH  
  Dept_Code,*,,=  
  Customer_Name,*,,20,CH  
  SKIP,2  
  Customer_Balance,*,,10,ZD  
  Customer_Flags,*,,1,BI  
* Department Codes
  Research,'R'
  Marketing,'M'
* Balance Cutoffs
  Cancel,+10000 100.00
  Gift,+100000 10,000.00
  Stop_Check,-500 -5.00
* Headings and Titles
  Title,S'Customer Report for &LWDay.'
  Head1,'Customer Name'
  Head2,'Customer Balance'
  Head3,'Customer Flags'
/*
//IN DD DSN=MY.CUSTOMER.INPUT,DISP=SHR  
//OUT DD DSN=&&O,UNIT=SYSDA,SPACE=(CYL,(5,5),RLSE),  
  DISP=(,PASS)  
//LIST1 DD SYSOUT=*  
//TOOLIN DD *  
  RANGE FROM(IN) ON(Customer_Balance) LOWER(Stop_Check)  
  SORT FROM(IN) TO(OUT) USING(CTL1)  
  DISPLAY FROM(OUT) LIST(LIST1) BLANK WIDTH(133) -  
    TITLE(Title) DATE(4MD/) PAGE -  
    HEADER(Head1) ON(Customer_Name) -  
    HEADER(Head2) ON(Customer_Balance,C1) -  
    HEADER(Head3) ON(Customer_Flags,HEX)  
/*
//CTL1CNTL DD *  
  SORT FIELDS=(Customer_Balance,D,Customer_Name,A)  
  INCLUDE COND=((Dept_Code,EQ,Research,OR,Dept_Code,EQ,Marketing),  
  AND,Customer_Balance,GT,Gift)  
/*
```
If the value for the system symbol &LWDAY. is 'FRI', SYMNOUT will show the following:

-------- ORIGINAL STATEMENTS FROM SYMNAMES --------
Rdw,1,4,BI
Account_Code,12,1,CH
Dept_Code,*,=,=
Customer_Name,*,20,CH
SKIP,2
Customer_Balance,*,10,ZD
Customer_Flags,*,1,BI
* Department Codes
  Research,'R'
  Marketing,'M'
* Balance Cutoffs
  Cancel,+10000 100.00
  Gift,+1000000 10,000.00
  Stop_Check,-500 -5.00
* Headings and Titles
  Title,S'Customer Report for &LWDAY.'
  Head1,'Customer Name'
  Head2,'Customer Balance'
  Head3,'Customer Flags'

------------------ SYMBOL TABLE -----------------
Rdw,1,4,BI
Account_Code,12,1,CH
Dept_Code,13,1,CH
Customer_Name,14,20,CH
Customer_Balance,36,10,ZD
Customer_Flags,46,1,BI
Research,C'R'
Marketing,C'M'
Cancel,+10000
Gift,+1000000
Stop_Check,-500
Title,C'Customer Report for &LWDAY.'
Head1,C'Customer Name'
Head2,C'Customer Balance'
Head3,C'Customer Flags'

The ICETOOL operators will be transformed to:
RANGE FROM(IN) ON(36,10,ZD) LOWER(-500)
SORT FROM(IN) TO(OUT) USING(CTL1)
DISPLAY FROM(OUT) LIST(LIST1) BLANK WIDTH(133)
  TITLE('Customer Report for FRI')
  HEADER('Customer Name') ON(14,20,CH)
  HEADER('Customer Balance') ON(36,10,ZD,C1)
  HEADER('Customer Flags') ON(46,1,HEX)

The DFSORT control statements in CTL1CNTL will be transformed to:
SORT FIELDS=(36,10,ZD,D,14,20,CH,A)
   INCLUDE COND=((13,1,CH,EQ,'R',OR,13,1,CH,EQ,'M'),AND,36,10,ZD,GT,+10*00000)

### Using SET and PROC Symbols in DFSORT and ICETOOL Statements

For jobs that directly invoke DFSORT (PGM=SORT or PGM=ICEMAN) or ICETOOL (PGM=ICETOOL), you can construct DFSORT symbols that incorporate JCL PROC or SET symbols as well as text and system symbols. You can then use those constructed DFSORT symbols in DFSORT and ICETOOL control statements in the same way you use regular DFSORT symbols.
Using Symbols for Fields and Constants

As a simple example, if you wanted to use JCL SET symbols named XDSN and YDSN in a DFSORT statement, you could code the following:

```
// SET XDSN='X.DATA', YDSN='Y.DATA'
//S1 EXEC PGM=SORT,PARM='MSGDDN=MYOUT,JP1"&XDSN",JP2"&YDSN",LIST'
//MYOUT DD SYSOUT=*  
//SYSIN DD *
OPTION COPY
OMIT COND=(1,44,CH,EQ,JP1,OR,1,44,CH,EQ,JP2)
/*
For each JPn"string" parameter found in EXEC PARM, a DFSORT symbol in the following form is constructed, and treated as if it was specified in the SYMNAMES data set (even if a SYMNAMES data set is not actually present):
JPn,S'string'
Up to ten symbols, JP0-JP9, can be set up this way.
For the example above, the following DFSORT symbols are constructed and treated as if they were specified in SYMNAMES:
JP1,S'X.DATA'
JP2,S'Y.DATA'
These symbols are placed in the Symbol Table as:
JP1,C'X.DATA'
JP2,C'Y.DATA'
When JP1 and JP2 are used in the OMIT statement, the statement is transformed to:
OMIT COND=(1,44,CH,EQ,C'X.DATA',OR,1,44,CH,EQ,C'Y.DATA')
Here is another example using ICETOOL:
// SET VLRS1='339001'
// SET VLRS2='339002'
//S2 EXEC PGM=ICETOOL,
// PARM='JP0"Report for disks &VLRS1 and &VLRS2 on &WDAY"'
... 
//TOOLIN DD *
DISPLAY TITLE(JP0) -
 FROM(IN) LIST(RPT) ON(5,4,CH)
The following DFSORT symbol is constructed:
JP0,S'Report for disks 339001 and 339002 on &WDAY'
If the job is run on Friday, 'FRI' is substituted for the &WDAY system symbol and the following is placed in the Symbol Table:
JP0,C'Report for disks 339001 and 339002 on FRI'
When JP0 is used in the DISPLAY statement, the statement is transformed to:
DISPLAY TITLE('Report for disks 339001 and 339002 on FRI')-
 FROM(IN) LIST(OUT) ON(1,5,CH)
Using JPn Parameters in EXEC PARM for DFSORT
   //stepname EXEC PGM=SORT,PARM='option<,option>...'
option can be JPn"string" or one of the other valid DFSORT options (for example, VLSCMP or DSA=8). JPn"string" options are used to construct DFSORT symbols. Other DFSORT options are passed to DFSORT as EXEC PARM options in the normal way.

PGM=ICEMAN or one of the other aliases can be used instead of PGM=SORT.

Normal system JCL rules for the EXEC PARM operand apply. In addition:
- JPn"string" parameters can only be used when DFSORT is invoked directly (for example, with PGM=SORT), not when DFSORT is invoked from a program (for example, with LINK EP=SORT).
- If the length of the EXEC PARM options is greater than the JCL limit of 100 bytes, JPn"string" options will not be processed.

Using JPn Parameters in EXEC PARM for ICETOOL

```plaintext
//stepname EXEC PGM=ICETOOL,PARM='option<,option>...'
```

option can be JPn"string". JPn"string" options are used to construct DFSORT symbols. Other options are ignored by ICETOOL.

Normal system JCL rules for the EXEC PARM operand apply. In addition:
- JPn"string" parameters can only be used when ICETOOL is invoked directly (for example, with PGM=ICETOOL), not when ICETOOL is invoked from a program (for example, with LINK EP=ICETOOL).
- If the length of the EXEC PARM options is greater than the JCL limit of 100 bytes, JPn"string" options will not be processed.

Description of JPn"string"

Only JP0 through JP9 can be used for a symbol name where 'JP' must be uppercase EBCDIC (X'D1D7') and n must be '0'-9 (X'F0'-X'F9').

A quote must appear before and after the string. A quote must not appear within the string (it would be interpreted as the ending quote). PARM='...,JPn"string' (a missing ending quote) will be interpreted as PARM='...,JPn"string"'.

If the keyword does not appear as JPn"string", it will not be used as a JPn symbol. For example, JP1"ABC" would be used as a JP1 symbol, but JP1="ABC", JP1("ABC"), JP1=("ABC") or jp1"ABC" would not.

Any or all of the following can appear in the string:
- any EBCDIC character (except quote). If you want to include a single apostrophe in the character string, you must specify it as two single apostrophes
- a JCL SET or PROC symbol (&SYMBOL). Normal system rules for SET and PROC symbols apply.
- a system symbol (for example, &JOBNAME, &SYSPLEX, etc). Normal system rules for system symbols apply.

The symbol will be constructed as:

```
JPn,S'string'
```

and must conform to the rules for a system symbol string as documented earlier in this Chapter.
Using Symbols for Fields and Constants

If you specify:

```
//SYMNOUT DD SYSOUT=*
```

the JPn symbols will be listed along with any other DFSORT symbols you specify in SYMNAMES.

If you specify a SYMNAMES data set, the JPn symbols will be processed before the first SYMNAMES symbol.

Note: Here is an example of one suggested way of specifying multiple options in EXEC PARM:

```
// SET X1='ANY-STRING'
// SET X2='ANOTHER-STRING'
//S1 EXEC PGM=SORT,
//   "PARM=('RESALL=12K',
//        'VLLONG',
//        'JP1"&X1"',
//        'JP2"&X2"')"
```

Example 1

**MYPROC Procedure**

```
//MYPROC PROC DAY=
//STEP01 EXEC PGM=SORT,PARM='JP1"&DAY"'
//SYMNOUT DD SYSOUT=*
//SORTIN DD DSN=MYCNTL.PDS(SEL),DISP=SHR
//SORTOUT DD SYSOUT=*
//SYSIN DD DSN=MYCNTL.PDS(OVLY),DISP=SHR
// PEND
```

**Execution of MYPROC**

```
//S1 EXEC MYPROC,DAY=2
```

**Record in SEL member**

```
SELECT * FROM MYTABLE WHERE TM_RECEIPT >= (CURRENT DATE - ? DAYS)
```

**Records in OVLY member**

```
OPTION COPY
INREC OVERLAY=(59:JP1)
```

This example illustrates how you can use a JCL PROC symbol in a DFSORT control statement.

The JCL PROC symbol is DAY which will be set to a 1 character numeric value (2 in this example), and used to overlay the number of days in the SELECT statement (in the SEL member).

```
PARM='JP1"&DAY"'
```

is used to create a DFSORT symbol named JP1 containing a string with the DAY value.

The SYMNOUT listing will show the following:

```
------- SYMNAMES STATEMENTS FROM EXEC PARM -------
JP1,'S'2'
------- SYMBOL TABLE -------
JP1,'C'2'
```
The DFSORT INREC statement in the OVLY member uses JP1. It will be transformed to:

\[
\text{INREC OVERLAY=(59:C'2')}\]

and used to change the SELECT statement to the following in SORTOUT:

\[
\text{SELECT * FROM MYTABLE WHERE TM_RECEIPT >= (CURRENT DATE - 2 DAYS)}\]

Example 2

\[
\begin{align*}
// & \text{SET JOBNM='FRANK2'} \\
// & \text{S1 EXEC PGM=ICETOOL,} \\
// & \text{PARM=('JP1}&\text{JOBNM''',} \\
// & \quad 'JP2}&\text{JOBNM STEP'',} \\
// & \quad 'JP3}&\text{JOBNM EXCPS'')} \\
// & \text{TOOLMSG DD SYSOUT=''} \\
// & \text{DFSMSG DD SYSOUT=''} \\
// & \text{SYMNAMES DD *} \\
// & \quad JOBN,5,8,CH \\
// & \quad STEPN,*,8,CH \\
// & \quad EXCPS,*,5,ZD \\
// & \text{SYMNOUT DD SYSOUT=''} \\
// & \text{IN DD *} \\
// & \quad FRANK2 S1 00008 \\
// & \quad FRANK2 S2 00123 \\
// & \quad FRANK2 S3 00023 \\
// & \quad FRANK3 S1 00016 \\
// & \quad FRANK3 S2 00152 \\
// & \text{/1 DD DSN=&&T1,UNIT=SYSDA,SPACE=(CYL,(5,5)),DISP=(,PASS) } \\
// & \text{RPT DD SYSOUT=''} \\
// & \text{TOOLIN DD *} \\
// & \text{COPY FROM(IN) TO(T1) USING(CTL1) } \\
// & \text{DISPLAY FROM(T1) LIST(RPT) BLANK - } \\
// & \quad HEADER(JP2) ON(STEPN) - \\
// & \quad HEADER(JP3) ON(EXCPS) \\
// & \text{/1} \\
// & \text{CTL1CNTL DD *} \\
// & \quad INCLUDE COND=(JOBN,EQ,JP1) \\
// & \text{/1} \\
\end{align*}
\]

This example illustrates how you can use a JCL SET symbol in ICETOOL and DFSORT control statements.

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Using Symbols for Fields and Constants

EXCPS,*,5,ZD

-------------------- SYMBOL TABLE ---------------------
JP1,C'FRANK2'
JP2,C'FRANK2 STEP'
JP3,C'FRANK2 EXCPS'
JOBN,5,8,CH
STEPN,13,8,CH
EXCPS,21,5,ZD

The DFSORT INCLUDE statement in CTL1CNTL uses the JOBN and JP1 symbols. It will be transformed to:

```
INCLUDE COND=(5,8,CH,EQ,C'FRANK2')
```

The ICETOOL DISPLAY statement uses the JP2, JP3, STEPN and EXCPS symbols. It will be transformed to:

```
DISPLAY FROM(T1) LIST(RPT) BLANK-
HEADER('FRANK2 STEP') ON(13,8,CH)-
HEADER('FRANK2 EXCPS') ON(21,5,ZD)
```

RPT will contain the following report:

```
FRANK2 STEP FRANK2 EXCPS
--------- ---------
S1 8
S2 123
S3 23
```

Notes for Symbols

- EFS programs cannot be used with symbol processing.
- DFSORT or ICETOOL scans each SYMNAMES statement for errors, and prints an error message for the first error detected. A marker ($) is printed directly below the SYMNAMES statement near the error, if appropriate. Scanning stops at the first error, and then continues with the next SYMNAMES statement. However, once an error is detected, positions generated by using an asterisk (*) for p or POSITION,symbol in subsequent statements will not be checked for errors. DFSORT and ICETOOL terminate after all SYMNAMES statements are scanned if an error is detected in any statement.
- If DFSORT or ICETOOL detects an error in a control statement or operator statement during the substitution phase (that is, while attempting to substitute values for symbols), it may either:
  - print the original statement in error followed by a $ marker (if appropriate) and an error message, continue the substitution phase with the next statement and terminate when the substitution phase is complete, or
  - stop performing substitution for the statement in error, continue with the next statement and let processing after the substitution phase handle the error. It is possible in this case for a symbol, rather than a substituted value, to appear in a transformed statement.
- If the substitution phase is successful, DFSORT and ICETOOL will substitute values for symbols wherever symbols are allowed. Substituted values which are invalid for a particular statement or operand will be detected after the substitution phase. This makes it easier to determine the cause of the error. For example, if SYMNAMES contains:

```
Sym1,5,4,ZD
Con1,'1234'
Con2,1234
```
Using Symbols for Fields and Constants

the statement:

```plaintext
INCLUDE COND=(Sym1,EQ,Con1)
```

will be transformed to the following during the substitution phase:

```plaintext
INCLUDE COND=(5,4,ZD,EQ,C'1234')
```

An ICE114A message with a $ marker under C'1234' will then be issued for the statement because a ZD field cannot be compared to a character constant. In this example, the error could be fixed by using Con2 (a decimal constant) in the statement instead of Con1 or by redefining Con1 as a decimal constant.

• If you use a temporary or permanent message data set, it is best to specify a disposition of MOD to ensure you see all messages and control statements in the message data set. In particular, if you use symbols processing and do not use MOD, you will not see the original control statements unless Blockset is selected.

• If you rearrange your records in any way (for example, using E15, E35, INREC, OUTREC or OUTFIL) and want to use symbols for the rearranged records, be sure to use symbols that map to the new positions of your fields. For example, if you use a SYMNAMES data set with the following statements:

```plaintext
Field1,1,5,ZD
Field2,*,6,ZD
Field3,*,3,ZD
Field4,*,4,ZD
```

for this INREC statement:

```plaintext
INREC FIELDS=(Field2,Field4)
```

the resulting records will only contain Field2 and Field4. If you want to use symbols for the rearranged records (for example, in a SORT statement), you will need to use a SYMNAMES data set with symbols that map to the rearranged records, such as:

```plaintext
New_Field2,1,6,ZD
New_Field4,*,4,ZD
```

If you use unique symbols for the rearranged fields, as in the example above, you can concatenate the old and new symbol data sets together and use the old and new symbols where appropriate, as in this example:

```plaintext
INREC FIELDS=(Field2,Field4)
SORT FIELDS=(New_Field2,A,New_Field4,A)
```
Using Symbols for Fields and Constants
Chapter 9. Using Extended Function Support

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 Using EFS

Like the user exits described in Chapter 5, “Using Your Own User Exit Routines,” the DFSORT Extended Function Support (EFS) interface is a means by which you can pass run-time control to an EFS program you write yourself. An EFS program is essential if you want to process double-byte character sets (such as Japanese characters) with DFSORT.

To process Japanese data types with DFSORT, you can use the IBM Double Byte Character Set Ordering Support Program (DBCS Ordering), Licensed Program 5665-360, Release 2.0, or you can use locale processing with the appropriate locale.

Using an EFS program and EFS program exit routines, you can:

- Sort or merge user-defined data types (such as double-byte character sets) with user-defined collating sequences
- Include or omit records based on the user-defined data types
- Provide user-written messages to DFSORT for printing to the message data set
- Examine, alter, or ignore control statements or EXEC PARM options prior to processing by DFSORT.

The EFS program can also perform routine tasks, such as opening and initializing data sets, terminating DFSORT, and closing data sets.
Using EFS

You can write your EFS program in any language that uses standard register and linkage conventions, and can:

- Pass a parameter list and a record (if you provide the EFS01 and EFS02 exit routines in the EFS program) in register 1
- Pass a return code in general register 15.

Notes:

1. DFSORT does not support EFS programs for Conventional merge or tape work data set applications.
2. VLSHRT is not allowed if EFS processing is in effect and an EFS01 or EFS02 exit routine is provided by the EFS program.
3. If you use locale processing for SORT, MERGE, INCLUDE, or OMIT fields, you must not use an EFS program. DFSORT’s locale processing may eliminate the need for an EFS program. See “OPTION Control Statement” on page 173 for information related to locale processing.
4. If you use symbol processing, you must not use an EFS program.

The DFSORT target library, SICEUSER, contains a mapping macro called ICEDEFS, which provides a separate Assembler DSECT for the EFS parameter list.

Addressing and Residence Mode of the EFS Program

You can design the EFS program to reside and run above or below 16MB virtual. Residency and addressing mode can be any valid combination of 24-bit, 31-bit, or ANY. If your EFS program is designed to reside and run below 16MB virtual, the EFS program must determine the proper return mode.

How EFS Works

The EFS interface consists of a variable-length parameter list used to communicate between DFSORT and your EFS program. DFSORT activates the EFS program you write at specific points during run-time, and communicates information back and forth across the interface as your EFS program runs.

You can activate your EFS program with the installation or run-time option EFS=name (name is the name of your EFS program):

See Appendix B, “Specification/Override of DFSORT Options,” on page 857 for override information. Figure 43 on page 765 illustrates the role of the EFS interface in linking DFSORT’s processing capabilities to the EFS program you write.
DFSORT Program Phases

A DFSORT program phase is a large DFSORT component designed to perform a specific task such as writing the output file. An EFS program is called at various points during run-time of DFSORT program phases in performing the variety of tasks capable with an EFS program. When the termination phase is completed, DFSORT returns control to the operating system or invoking program.

EFS processing can be invoked during the initialization, input, and termination phases of DFSORT. DFSORT always calls the EFS program during the initialization phase.

During the input phase, DFSORT reads input records, and performs any INCLUDE or OMIT statement logic on the records. If the EFS program generates exit routines (EFS01 and EFS02), DFSORT calls them during the input phase.

During the termination phase, DFSORT closes data sets, releases storage, and returns control to the calling program or system. DFSORT always calls the EFS program from the termination phase.

DFSORT Calls to Your EFS Program

DFSORT makes five functional calls (Major Calls 1 through 5) at various phases to transfer information across the EFS interface, between DFSORT and your EFS program. DFSORT can make multiple calls at Major Calls 2 and 3. Refer to Figure 44 on page 766 and Figure 45 on page 767 as you read this section for illustrations of the relationships between program phases and calls during run-time.
How EFS Works

Figure 44. EFS Program Calls for a Sort. The figure also shows the calls to the EFS program EFS01 and EFS02 exit routines.
Initialization Phase

DFSORT runs Major Calls 1 through 3 during the initialization phase.

**Major Call 1:** The EFS program can perform initialization processing such as opening data sets and obtaining storage.

Information is passed in both directions between DFSORT and the EFS program across the EFS interface.

At Major Call 1, DFSORT supplies your EFS program with fields in the EFS interface containing:
- An action code indicating that Major Call 1 is in effect
- Informational flags that describe current processing.

*Figure 45. EFS Program Calls for a Merge or Copy.* The figure also shows the calls to the EFS program EFS01 and EFS02 exit routines.
How EFS Works

When the EFS program returns control to DFSORT, it can supply fields in the EFS interface containing:

- A control statement request list, with a list of DFSORT and non-DFSORT control statement operation definers, or EXEC PARM options

**Note:** OUTFIL statements cannot be requested by an EFS program.

- An EFS Program Context area (a private communication area for the EFS program)
- A list containing messages for printing to the message data set
- A return code (in general register 15).

**Major Call 2:** At this call, your EFS program can examine, alter, or ignore control statements before DFSORT processes them, and provide user-written messages to the message data set. DFSORT calls your EFS program once for each control statement or EXEC PARM you request.

At Major Call 2, DFSORT supplies your EFS program with fields in the EFS interface containing:

- An action code indicating that Major Call 2 is in effect
- The original control statement or EXEC PARM option requested by the EFS program
- The length of the original control statement or EXEC PARM option
- Informational flags that describe current processing
- An EFS Program Context area (a private communication area for the EFS program).

When the EFS program returns control to DFSORT, it can supply fields in the EFS interface containing:

- A modified version of the control statement or EXEC PARM option sent by DFSORT to the EFS program. If you plan to sort or merge user-defined data types, or include or omit user-defined data types, your EFS program must return new formats for the SORT/MERGE or INCLUDE/OMIT control statements. These new formats (D1 and D2) signal DFSORT to call the EFS01 and EFS02 exit routines you included with your EFS program.

**Note:** OUTFIL statements cannot be passed to an EFS program or returned from an EFS program to be parsed.

- The length of the altered control statement or EXEC PARM option.
- Informational flags signaling DFSORT whether to parse or ignore the control statement or EXEC PARM option.
- A list of messages for DFSORT to print to the message data set.
- A return code (in general register 15).

**Major Call 3:** At Major Call 3, your EFS program can provide DFSORT with user-written messages to print to the message data set. DFSORT can call the EFS program once for the Blockset technique and once for the Peerage/Vale techniques. DFSORT obtains more information at this call from the EFS program to process the EFS01 and EFS02 exit routines.

At Major Call 3, DFSORT supplies your EFS program with fields in the EFS interface containing:

- An action code indicating that Major Call 3 is in effect
How EFS Works

- An extract buffer offsets list needed by the EFS01 exit routine
- A record lengths list of input and output records
- Informational flags that describe current processing
- An EFS Program Context area (a private communication area for the EFS program).

When the EFS program returns control to DFSORT, it can supply fields in the EFS interface containing:
- An EFS01 exit routine address
- An EFS02 exit routine address
- A list of messages for printing to the message data set
- A return code in general register 15.

**Input Phase**

DFSORT runs the two exit routines, EFS01 and EFS02, during the input phase. The EFS01 routine supports sorting or merging user-defined data types with user-defined collating sequences and is called once for each record. The EFS02 routine provides logic to include or omit records on user-defined data types and is called one or more times for each record, according to the logic.

Information is passed in both directions between DFSORT and the exit routines across the EFS01 and EFS02 parameter lists.

DFSORT supplies the EFS01 routine with fields in the parameter list containing:
- An Extract Buffer Area to which the EFS01 routine must move all EFS control fields. See “EFS01 User Exit Routine” on page 786 for more information.
- The input data record.
- An EFS Program Context Area (a private communication area for the EFS program).

When the EFS01 routine returns control to DFSORT, it must return a return code in general register 15.

DFSORT supplies the EFS02 routine with fields in the parameter list containing:
- A Correlator Identifier, which identifies a relational condition containing EFS fields. See “EFS02 User Exit Routine” on page 787 for more information.
- The input data record.

When the EFS02 routine returns control to DFSORT, it must return a return code in general register 15.

**Termination Phase**

DFSORT runs Major Calls 4 and 5 during the termination phase. Only one call is made at each of these Major Calls.

**Note:** If a system abend occurs while DFSORT’s ESTAE recovery routine is in effect, and Major Calls 4 and 5 have not already been run, the ESTAE routine runs them. If an EFS abend occurs during Major Call 1, the ESTAE routine does not run Major Calls 4 and 5. See Appendix E, “DFSORT Abend Processing,” on page 901 for more information about ESTAE.

**Major Call 4:** The EFS program provides any final user-written messages for printing to the message data set.
How EFS Works

At Major Call 4, DFSORT supplies your EFS program with fields in the EFS interface containing:
- An action code indicating that Major Call 4 is in effect.
- An EFS Program Context Area (a private communication area for the EFS program).

When the EFS program returns control to DFSORT, it can supply fields in the EFS interface containing:
- A message list containing messages for printing to the message data set.
- A return code (in general register 15).

**Major Call 5**: The EFS program performs any termination processing, such as closing data sets and releasing storage.

At Major Call 5, DFSORT supplies your EFS program with fields in the EFS interface containing:
- An action code indicating that Major Call 5 is in effect.
- An EFS Program Context Area (a private communication area for the EFS program).

When the EFS program returns control to DFSORT, it must supply a return code in general register 15.

What You Can Do with EFS

You can design your EFS program to perform seven basic tasks at the initialization, input, and termination phases of DFSORT. Some of the tasks require using the EFS program-generated user exit routines EFS01 and EFS02.

*Table 76. Functions of an Extended Function Support (EFS) Program*

<table>
<thead>
<tr>
<th>EFS Program Functions</th>
<th>Initialization Phase</th>
<th>Input Phase</th>
<th>Termination Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening and initializing</td>
<td>EFS Program</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Examining, altering, or ignoring DFSORT and non-DFSORT control statements prior to processing by DFSORT</td>
<td>EFS Program</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sorting or merging user-defined data types with user-defined collating sequences</td>
<td></td>
<td>EFS01</td>
<td></td>
</tr>
<tr>
<td>Providing the logic to include or omit records based on user-defined data types</td>
<td></td>
<td>EFS02</td>
<td></td>
</tr>
<tr>
<td>Supplying messages to DFSORT for printing to the message data set</td>
<td>EFS Program</td>
<td></td>
<td>EFS Program</td>
</tr>
</tbody>
</table>
What You Can Do with EFS

### Table 76. Functions of an Extended Function Support (EFS) Program (continued)

<table>
<thead>
<tr>
<th>EFS Program Functions</th>
<th>Initialization Phase</th>
<th>Input Phase</th>
<th>Termination Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminating DFSORT</td>
<td>EFS Program</td>
<td>EFS01, EFS02</td>
<td>EFS Program</td>
</tr>
<tr>
<td>Closing data sets and housekeeping</td>
<td></td>
<td></td>
<td>EFS Program</td>
</tr>
</tbody>
</table>

### Opening and Initializing Data Sets

Your EFS program can open data sets, obtain necessary storage, and perform other forms of initialization needed during a run.

### Examining, Altering, or Ignoring Control Statements

At Major Call 1, your EFS program can send a control statement request list to indicate the control statements and EXEC PARM options you want DFSORT to send to your EFS program at Major Call 2. OUTFIL statements cannot be requested by an EFS program.

At Major Call 2, your EFS program can examine, alter, or ignore control statements and EXEC PARM options that DFSORT reads from the EXEC statement, SYSIN, SORCNCNTL, DFSPARM, or a parameter list passed from an invoking program. OUTFIL statements cannot be passed to an EFS program or returned from an EFS program to be parsed.

Refer to [Figure 46 on page 772](#) for an illustration of the control statement processing sequence used when an EFS program is activated.

The same override rules apply to control statements and parameters returned from an EFS program as apply to the original control statements and parameters.

For example, a STOPAFT parameter added to the SORT statement by an EFS program is overridden by a STOPAFT parameter in an OPTION statement in the same way as if the SORT statement originally contained the STOPAFT parameter.

What You Can Do with EFS

Figure 46. Control Statement Processing Sequence
Processing User-Defined Data Types with EFS Program User Exit Routines

You can write your EFS program to provide two user exit routines to perform various tasks during run-time.

Your EFS program user exit routines can:

- Process user-defined data types. Your EFS program can provide an EFS01 routine to alter any control field of an input record.
- Include or omit records based on user-defined data types. Your EFS program can provide an exit routine to examine any input field of an input record to determine whether or not to include that record for processing.

Supplying Messages for Printing to the Message Data Set

You can use an EFS program to tailor messages for several purposes:

- To describe new types of operations
- To describe extended field parameters
- To customize the message data set to your site
- To display statistical information about control statements or EXEC PARM options.

You can control whether to print the control statements returned by an EFS program to the message data set with:

- The LISTX installation option (see "Installation Defaults" on page 17)
- The LISTX or NOLISTX operators in the PARM field of the JCL EXEC statement (see "Specifying EXEC/DFSPARM PARM Options" on page 29)
- The LIST or NOLIST operators of the OPTION program control statement.

Terminating DFSORT

Your EFS program can terminate DFSORT at any of the five Major Calls and also from either of the two EFS program exit routines during the input phase.

Closing Data Sets and Housekeeping

At Major Call 5, your EFS program can close data sets, free storage and perform any other necessary housekeeping.

Structure of the EFS Interface Parameter List

The EFS interface consists of a variable-length parameter list and is used to communicate between DFSORT and your EFS program. DFSORT initializes the parameter list to zeros during the initialization phase, except that the list end indicator is set to X'FFFFFFFF'.

The parameter list resides below 16MB virtual, and remains accessible while the EFS program is active, although DFSORT might change its storage location during run-time to optimize use of storage. The actual address in register 1 (used to pass the interface parameter list address) can therefore change while DFSORT is running.

Figure 47 on page 774 illustrates the structure of the EFS interface parameter list. The illustrated portions of the list are explained in order in the following pages. EXEC PARMs are not described in the figure, but are included in processing.
Structure of the EFS Interface Parameter List

Figure 47. EFS Interface Parameter List (Part 1 of 2)
**Structure of the EFS Interface Parameter List**

<table>
<thead>
<tr>
<th>Field Description</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address of Extract buffer offsets (zeros if no EFS fields exist)</td>
<td>4</td>
</tr>
<tr>
<td>Address of Record lengths list</td>
<td>4</td>
</tr>
<tr>
<td>RESERVED</td>
<td>4</td>
</tr>
<tr>
<td>RESERVED</td>
<td>4</td>
</tr>
<tr>
<td>RESERVED</td>
<td>4</td>
</tr>
<tr>
<td>RESERVED</td>
<td>4</td>
</tr>
<tr>
<td>Information flags</td>
<td>4</td>
</tr>
<tr>
<td>Address of message list (zeros if none)</td>
<td>4</td>
</tr>
<tr>
<td>RESERVED</td>
<td>4</td>
</tr>
<tr>
<td>RESERVED</td>
<td>4</td>
</tr>
<tr>
<td>RESERVED</td>
<td>4</td>
</tr>
<tr>
<td>RESERVED</td>
<td>4</td>
</tr>
<tr>
<td>Address of EFS01 extract routine (zeros if none)</td>
<td>4</td>
</tr>
<tr>
<td>Address of EFS02 INCLUDE/OMIT routine (zeros if none)</td>
<td>4</td>
</tr>
<tr>
<td>List end indicator (X'FFFFFFFF')</td>
<td>4</td>
</tr>
</tbody>
</table>

** - Length determined by corresponding length field

** - Length determined by length fields in the list

---

**Action Codes**

DFSORT sets one of five action codes before a call to the EFS program:

- **0** Indicates Major Call 1 to the EFS program. DFSORT sends this action code once.
- **4** Indicates Major Call 2 to the EFS program. DFSORT might send this action code several times at Major Call 2 depending on how many control statements are requested and found. For example, if the SORT, MERGE, and INCLUDE control statements are all supplied in SYSIN and are requested, the EFS program is called twice: once for the SORT control statement (because SORT and MERGE are mutually exclusive, and assuming the SORT statement is specified first, only the SORT statement is taken) and once for the INCLUDE control statement.
Structure of the EFS Interface Parameter List

8 Indicates Major Call 3 to the EFS program. DFSORT can send this action code once for the Blockset technique and once for the Peerage/Vale technique.

12 Indicates Major Call 4 to the EFS program. DFSORT sends this action code once.

16 Indicates Major Call 5 to the EFS program. DFSORT sends this action code once.

Control Statement Request List

The control statement request list describes the control statements and the PARM options to be sent to the EFS program by DFSORT. The control statement request list consists of control statement operation definers and PARM option names. The maximum length allowed for an operation definer or PARM option name is eight bytes. If the operation definer or PARM option name is longer, DFSORT will use only the first eight bytes. Length field values must not include their own length.

OUTFIL statements cannot be requested by an EFS program.

Non-DFSORT operation definers and PARM options must be in EBCDIC format, and the first character must be non-numeric. The format of the control statement request list is:

<table>
<thead>
<tr>
<th>Chain pointer to next operation definer or EXEC PARM option name, or zero for end of list</th>
<th>Length of operation definer or EXEC PARM option name</th>
<th>Operation definer or EXEC PARM option name (variable-length)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 bytes</td>
<td>2 bytes</td>
<td>* bytes</td>
</tr>
</tbody>
</table>

The asterisk (*) indicates that the length is determined by the corresponding length field (maximum of 8 bytes).

Control Statement String Sent to the EFS program

DFSORT scans for the requested control statement from SYSIN, SORTCNTL, DFSPARM, or the invoker's parameter list to create a contiguous control statement string; DFSORT will handle any necessary continuation requirements for control statements from SYSIN, SORTCNTL, or DFSPARM. DFSORT scans for the requested PARM option to create a contiguous PARM option string.

DFSORT places a copy of the requested control statement or PARM option string in a contiguous storage area for the EFS program. No labels are supplied with the control statement; the address of the string always points to the first byte of the appropriate operation definer or PARM option.

DFSORT will send the requested control statement(s) or PARM option(s) to the EFS program as found by DFSORT; DFSORT will provide limited syntax checking of control statements or PARM option(s) before sending them to the EFS program.

In addition to following the rules in "General Coding Rules" on page 85, you must observe the following rules for non-DFSORT control statements:

- DFSORT will recognize a control statement with no operand(s) provided the operation definer (1) is supplied in SYSIN, SORTCNTL, or DFSPARM and (2) is the only operation definer contained on a line.
Operation definers supplied through SYSIN, SORTCNTL, DFSPARM, or the extended parameter list and requested by the EFS program will not be recognized if they are longer than eight bytes.

In addition to observing the rules in [z/OS MVS JCL User’s Guide](https://www.ibm.com) and [z/OS MVS JCL Reference](https://www.ibm.com), you must observe the following rule for non-DFSORT PARM options:

- PARM options requested by the EFS program will not be recognized if they are longer than eight bytes.

DFSORT will send the requested DFSORT or non-DFSORT control statements or PARM options that remain after DFSORT override rules have been applied.

If duplicate DFSORT or non-DFSORT control statements or PARM options are supplied through the same source (such as SYSIN), then DFSORT will send the first occurrence of the control statement. The second occurrence of the DFSORT or non-DFSORT control statement or PARM option will be ignored by DFSORT.

If duplicate DFSORT or non-DFSORT control statements are supplied through different sources (such as extended parameter list, SORTCNTL, and DFSPARM), then DFSORT will send the control statement remaining after different source override rules have been applied, except for the DFSORT OPTION and DEBUG control statements (see "Special Handling of OPTION and DEBUG Control Statements").

If mutually exclusive DFSORT control statements (such as SORT/MERGE) are supplied through the same source (such as SYSIN), then DFSORT will send the first occurrence of the control statement. The second occurrence of the DFSORT control statement will be ignored by DFSORT.

If mutually exclusive DFSORT control statements (such as SORT/MERGE) are supplied through different sources (such as extended parameter list, SORTCNTL, and DFSPARM), then DFSORT will send the control statement remaining after different source override rules have been applied. The DFSORT control statement not sent will be ignored by DFSORT.

Thus the EFS program will not be sent duplicate DFSORT or non-DFSORT control statements (except for the DFSORT OPTION and DEBUG control statements as explained in "Special Handling of OPTION and DEBUG Control Statements"), or duplicate PARM options.

If the EFS program supplies non-DFSORT operands on the DFSORT OPTION control statement and the OPTION control statement is supplied in the extended parameter list, the EFS program must specify the non-DFSORT operands after all DFSORT operands.

DFSORT will free any storage it acquired for the control statement or PARM string.

**Note:** Blanks and quotes are very important to DFSORT in determining the control statement to send to an EFS program. Do not supply unpaired quotes in the INCLUDE/OMIT control statements, because DFSORT treats data within quotes as a constant, and treats blanks outside of quotes as the major delimiter.

**Special Handling of OPTION and DEBUG Control Statements**

The override features of both the DFSORT OPTION and DEBUG control statements, when supplied through different sources, require special handling when EFS processing is in effect and either or both control statements are requested by the EFS program.
For example, DFSORT handles override for the OPTION and DEBUG control statements as follows:

- The OPTION control statement supplied in SORTCNTL will selectively override corresponding options on the OPTION control statement supplied in the extended parameter list.
- The DEBUG control statement supplied in SORTCNTL will selectively override corresponding options on the DEBUG control statement supplied in the 24-bit parameter list or the extended parameter list.

Because of these override features, DFSORT cannot simply send the OPTION control statement supplied in SORTCNTL and not send the OPTION control statement supplied in the extended parameter list. For the EFS program to process all possible operands on the OPTION control statements, DFSORT must send the OPTION control statements supplied in both SORTCNTL and the extended parameter list. DFSORT will send both the OPTION and DEBUG control statements supplied through different sources. If duplicate OPTION or DEBUG control statements are supplied in the same source and the OPTION or DEBUG control statements are also supplied in different sources, DFSORT will send the first occurrence of both the OPTION and DEBUG control statements supplied through different sources.

**Control Statement String Returned by the EFS Program**

Your EFS program can alter the control statement or PARM option string and replace it in the original contiguous storage area. If the area is too small, your program must allocate a new contiguous area. If the string is returned in a new storage area, your EFS program will be responsible for freeing the acquired storage.

Your EFS program must set an Informational flag to indicate whether the control statement or PARM option in the string should be parsed or ignored by DFSORT (see "Information Flags" on page 783 for further details).

OUTFIL statements cannot be returned from an EFS program to be parsed.

**Rules for Parsing**

The content and format of the altered control statement to be parsed must correspond to valid DFSORT values as described in Chapter 3, "Using DFSORT Program Control Statements," on page 81, except when using the FIELDS operand with SORT or MERGE, or the COND operand with INCLUDE or OMIT (see "EFS Formats for SORT, MERGE, INCLUDE, and OMIT Control Statements" on page 779).

You must observe the following rules for control statements to be returned to DFSORT for parsing:

- The operation definer and corresponding operands must be in uppercase EBCDIC format.
- At least one blank must follow the operation definer (SORT, MERGE, RECORD, and so on). A control statement can start with one or more blanks and can end with one or more blanks. No other blanks are allowed unless the blanks are part of a constant.
- Labels are not allowed; a leading blank, or blanks, before the control statement name is optional.
- No continuation character is allowed.
- Comment statements, blank statements, and remarks are not allowed.
Structure of the EFS Interface Parameter List

The content and format of the altered EXEC PARM option to be parsed must correspond to valid DFSORT values as described in “Specifying EXEC/DFSPARM PARM Options” on page 29.

The following operands will be ignored by DFSORT if returned by an EFS program on the OPTION control statement:

- EFS
- LIST
- NOLIST
- LISTX
- NOLISTX
- LOCALE
- MSGDDN
- MSGDD
- MSGPRT
- SMF
- SORTDD
- SORTIN
- SORTOUT
- USEWKDD

The following EXEC PARM options will be ignored by DFSORT if returned by an EFS program:

- EFS
- LIST
- NOLIST
- LISTX
- NOLISTX
- LOCALE
- MSGDDN
- MSGDD
- MSGPRT
- EFS Formats for SORT, MERGE, INCLUDE, and OMIT Control Statements

In addition to using the SORT, MERGE, INCLUDE, and OMIT control statements as explained in “Program Control Statements”, you can also use two additional formats on the FIELDS and COND parameters. The formats are termed D1 and D2 and apply as follows:

- D1 with the FIELDS parameter of the SORT or MERGE statement
- D2 with the COND parameter of the INCLUDE or OMIT statement.

Use D1 and D2 to reflect data types that require special processing by EFS program exit routines EFS01 and EFS02, respectively. You cannot specify D2 format with the INCLUDE or OMIT parameters of the OUTFIL statement.

D1 Format on FIELDS Operand

The syntax for the SORT and MERGE statements using the D1 format on the FIELDS operand is as follows.
Structure of the EFS Interface Parameter List

Where Represents

mp  field position within the input record
mm  field length
mf  the D1 format that designates this field as an EFS control field
ms  must be either ascending (A) or descending (D); modification by an E61 exit (E) is not allowed.

Table 77 gives an example of using the D1 format for a SORT control statement returned to DFSORT by the EFS program.

You must adhere to the following requirements for the D1 format:

- The mp, mm, and ms values returned must be valid SORT or MERGE control statement values, except:
  - The combined value of mp and mm may exceed the record length.
  - CHALT will have no effect on EFS fields and will not limit the length to 256.
  - Value E for ms will not be allowed; EFS fields may not be altered by an E61 exit.
  - FORMAT=D1 will not be allowed.

Table 77. D1 Format Returned by an EFS Program

<table>
<thead>
<tr>
<th>Original SORT control statement sent to EFSPGM</th>
<th>Altered SORT control statement returned by EFSPGM</th>
</tr>
</thead>
<tbody>
<tr>
<td>SORT FIELDS=(15,4,FF,A,20,4,CH,A,40,7,FF,D)</td>
<td>SORT FIELDS=(15,4,D1,A,20,4,CH,A,40,7,D1,D)</td>
</tr>
<tr>
<td>where: FF is a user-defined format that is modified to D1 by the EFS program before returning to DFSORT</td>
<td></td>
</tr>
</tbody>
</table>

D2 Format on COND Operand

Following is the syntax for the INCLUDE or OMIT statements using the D2 format on the COND operand.
Structure of the EFS Interface Parameter List

Where Represents

mc  the correlator identifier, a numeric value used to identify each relational condition

mm  field length

mf  the D2 format designating an EFS field within the relational condition

operator  a valid DFSORT comparison or bit logic operator

constant  a valid DFSORT decimal, character, hexadecimal or bit constant.

mask  a valid DFSORT hexadecimal or bit string

Table 78 gives an example of using a correlator identifier and the D2 format for an INCLUDE control statement returned to DFSORT by the EFS program.

Note: The values for the correlator identifiers assigned to each relational condition by the EFS program can be in any chosen order. The example in Table 78 shows a sequential ordering for the correlator identifiers.

You must adhere to the following requirements for the D2 format:
• The mc, mm, or constant values returned must be valid INCLUDE or OMIT control statement values, except:
  – The combined value of mc and mm might exceed the record length.
  – Any valid DFSORT constant or mask is allowed.
  – If COND=(mc1,mm1,mf1,operator,mc2,mm2,mf2) is used, both mf1 and mf2 must be D2.
  – CHALT has no effect on EFS fields.
  – FORMAT=D2 is not allowed.

Table 78. Correlator Identifier and D2 Format Returned by an EFS Program

<table>
<thead>
<tr>
<th>Original INCLUDE control statement sent to EFSPGM</th>
<th>Altered INCLUDE control statement returned by EFSPGM</th>
</tr>
</thead>
<tbody>
<tr>
<td>INCLUDE COND=(15,4,FF,EQ,20,4,FF,AND,40,7,FF,NE,50,7,FF,OR,30,2,FF,NE,35,2,FF)</td>
<td>INCLUDE COND=(1,4,D2,EQ,1,4,D2,AND,2,7,D2,NE,2,7,D2,OR,3,2,D2,NE,3,2,D2)</td>
</tr>
</tbody>
</table>

Where:
• FF is a user-defined format and modified to D2 by the EFS program before returning to DFSORT.
• The first relational condition specified, (1,4,D2,EQ,1,4,D2), uses correlator identifier value 1 to identify this relational condition.
• The second relational condition specified, (2,7,D2,NE,2,7,D2), uses correlator identifier value 2 to identify this relational condition.
• The third relational condition specified, (3,2,D2,NE,3,2,D2), uses correlator identifier value 3 to identify this relational condition.
Length of Original Control Statement
The control statement includes the first byte of the control statement through the last operand of the control statement or, if only an operation definer is supplied, the length of the operation definer. DFSORT does not send labels supplied with the control statement.

Length of the Altered Control Statement
The length includes the first byte of the control statement through the last operand of the control statement. If leading blanks are provided, the length includes the first leading blank.

EFS Program Context Area
The EFS program context area is a private communication area that can be set up and used by the EFS program as appropriate. DFSORT sends the context area address to the EFS program at each Major Call and at each call to EFS01 and EFS02.

The EFS program is responsible for obtaining (at Major Call 1) and releasing (at Major Call 5) the necessary storage for the EFS program context area.

Extract Buffer Offsets List
A linked list of offsets into the extract buffer will be passed to your EFS program. The offsets show the starting positions into the buffer area of any EFS control fields specified on the SORT or MERGE FIELDS operand. The offsets are sent only for EFS control fields and are sent in the same order as specified on the FIELDS operand. If no EFS control fields exist, the address to the offsets is zero.

DFSORT frees any storage it acquired for the extract buffer offsets list. The format of the extract buffer offsets list is:

<table>
<thead>
<tr>
<th>Chain pointer to the next offset or zero for end of list</th>
<th>Offset n</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 bytes</td>
<td>4 bytes</td>
</tr>
</tbody>
</table>

Record Lengths List
The record lengths list is a linked list containing the input and output record lengths. You must be aware of the possible change in record size during run-time (for example, with an E15 user exit).

The input and output record lengths are sent to the EFS program for informational use only. DFSORT ignores any changes to the values made to the record lengths list returned by the EFS program.

DFSORT frees any storage it acquired for the record lengths list. The format of the record lengths list is:
**Information Flags**

The information flags are defined in the figure that follows:

![Figure 48: Information Flags](image)

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Indicate the source of the control statement being processed. Information flags 0 and 1 are set by DFSORT before a call to the EFS program at Major Call 2 (multiple calls are possible at Major Call 2).</td>
</tr>
<tr>
<td>1</td>
<td>Indicate how DFSORT was invoked. Information flag 2 is set by DFSORT before Major Call 1 to the EFS program.</td>
</tr>
<tr>
<td>2</td>
<td>Indicates whether diagnostic messages are to be printed. Information flag 3 is set by DFSORT before Major Call 1 to the EFS program.</td>
</tr>
</tbody>
</table>
Structure of the EFS Interface Parameter List

Bits 4 and 5
Indicate the DFSORT function being run. Information flags 4 and 5 are set by DFSORT before each call at Major Call 2 and Major Call 3 to the EFS program (multiple calls are possible at Major Call 2 and Major Call 3).

Bit 6
Indicates the source of PARM options and control statements from DFSPARM. Information flag 6 is set by DFSORT before each call at Major Call 2 to the EFS program (multiple calls are possible at Major Call 2).

Bit 7
Indicates whether fixed-length records or variable-length records are to be processed. Information flag 7 is set by DFSORT before each call at Major Call 3 to the EFS program (multiple calls are possible at Major Call 3).

Bit 8
Set by the EFS program to inform DFSORT whether to parse or ignore the control statement returned by the EFS program. Printing of the control statement is managed by the LISTX/NOLISTX parameters (see "OPTION Control Statement" on page 175 for further details). Information flag 8 is set by the EFS program before returning to DFSORT from each call at Major Call 2 (multiple calls are possible at Major Call 2).

Message List
Your EFS program can return informational or critical messages. A return code of 0 in general register 15 indicates an informational message while a return code of 16 indicates a critical message. If the EFS program has no messages to send after a Major Call, it must zero the message list address in the EFS interface parameter list.

At Major Call 2, if the EFS program finds a syntax error in a control statement, it can return an offset relative to the start of the string to indicate the location of the error. DFSORT first prints the control statement in error and then prints another line containing a dollar symbol ($) at the location indicated by the offset.

Because DFSORT associates the relative offset with a critical message, the EFS program must return with a return code of 16 in general register 15. If a relative offset is returned for an EXEC PARM, the relative offset will be ignored. The EFS program must free any storage it acquired for its messages.

The length field values must not include their own length.

The message list format follows:

<table>
<thead>
<tr>
<th>Pointer to next message or zero for list end</th>
<th>Relative offset (to syntax error) or zero</th>
<th>Length of the message text</th>
<th>Message text (variable length)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 bytes</td>
<td>2 bytes</td>
<td>2 bytes</td>
<td>* bytes</td>
</tr>
</tbody>
</table>
An asterisk (*) indicates that the length is determined by the corresponding length field.

DFSORT imposes no restrictions on the format of the messages returned by an EFS program. If you wish, you can use the DFSORT message format so that messages in the message data set are consistent in appearance. For a description of the message format used by DFSORT, see *z/OS DFSORT Messages, Codes and Diagnosis* Guide.

**EFS Program Exit Routines**

If you specify EFS control fields (D1 format) or EFS fields (D2 format), DFSORT calls the EFS01 or EFS02 exit routines, respectively, to process those fields. The routines are generated by your EFS program, which can return the following information about them at Major Call 3:

- The address of an extract routine, EFS01, which is used to extract the control fields of an input record to a buffer area before a sort or merge takes place; EFS01 is not applicable to a copy application.
- The address of an INCLUDE or OMIT routine, EFS02, which is used to process comparison logic for including or omitting records.

During the termination phase, the EFS program must free any storage used by these routines.

**EFS01 and EFS02 Function Description**

Each DFSORT control statement describes to DFSORT the type of operation to be performed on input data. Through the EFS interface, DFSORT enables an EFS program to provide user exit routines to perform functions beyond the capabilities of DFSORT control statements.

The EFS program can provide user exit routine EFS01 to supplement the function of the DFSORT SORT/MERGE control statements and can provide user exit routine EFS02 to perform the function of the DFSORT INCLUDE/OMIT control statements.

When preparing your EFS program exit routines, remember:

- The routines must follow standard linkage conventions.
- The general registers used by DFSORT for linkage and communication of parameters follow operating system conventions (see Figure 49 on page 786).
- The routines must use the described interfaces (see "EFS01 Parameter List" on page 787 and "EFS02 Parameter List" on page 788).
EFS Program Exit Routines

<table>
<thead>
<tr>
<th>Register</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DFSORT places the address of a parameter list in this register.</td>
</tr>
<tr>
<td>13</td>
<td>DFSORT places the address of a standard save area in this register. The area can be used to save contents of registers used by the EFS program exit routine. The first word of the area contains the characters SM1 in its three low-order bytes.</td>
</tr>
<tr>
<td>14</td>
<td>Contains the address of DFSORT return point.</td>
</tr>
<tr>
<td>15</td>
<td>Contains the address of the EFS program exit routine. This register can be used as the base register for EFS program exit routine. This register is also used by the EFS program exit routine to pass return codes to DFSORT.</td>
</tr>
</tbody>
</table>

Figure 49. DFSORT Register Convention

EFS01 User Exit Routine

Processing of user-defined data types with the EFS01 exit routine requires using the function that alters control statements. EFS program requirements at Major Calls 1 and 2 are:

- At Major Call 1, the EFS program must provide the control statement request list with the SORT or MERGE operation definer. See “Control Statement Request List” on page 776 or further details.
- At Major Call 2, the EFS program must return a new format, D1, on the SORT or MERGE control statement that informs DFSORT to call the EFS01 routine, (the control fields defined with the D1 format are also known as EFS control fields). See “EFS Formats for SORT, MERGE, INCLUDE, and OMIT Control Statements” on page 779 for further details. The EFS program must also return the final position, length, and sequence order. DFSORT uses the final position and length to create a list of offsets.

At Major Call 3, DFSORT sends the EFS program a list of offsets into a buffer. These offsets indicate where in the buffer the EFS program must have the EFS01 routine move the data indicated by the EFS control fields. See “Extract Buffer Offsets List” on page 782 for further details. At Major Call 3, the EFS program must return the address of the EFS01 routine to DFSORT.

During the input phase, DFSORT calls the EFS01 routine for each input record. The EFS01 exit routine must move all data indicated by the EFS control fields, specified in the SORT or MERGE FIELDS operand, from the input record to the extract buffer area as specified by the offsets in the extract buffer offsets list. For each EFS control field, the total number of bytes moved by EFS01 into the buffer area is equal to the total number of bytes specified in the mm parameter of the altered SORT or MERGE operand. Records are ordered according to the altered ms parameter.

The EFS01 routine is called to extract all EFS control fields to the extract buffer area each time a new record is brought into the input phase.
DFSORT will do sort or merge processing using the data in the extract buffer, and will treat the data as binary data.

**EFS01 Parameter List**

DFSORT sends three words to the EFS01 user exit routine each time it is entered:
- The address of the extract buffer area
- The address of the input record
- The address of the EFS program context area.

DFSORT places the address of a parameter list in register 1. The list begins on a fullword boundary and is three fullwords long. The format of the parameter list is:

<table>
<thead>
<tr>
<th>Bytes 1 through 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address of the extract buffer area</td>
</tr>
<tr>
<td>Address of the input record</td>
</tr>
<tr>
<td>Address of the EFS program context area</td>
</tr>
</tbody>
</table>

The EFS01 routine must return one of the following return codes in general register 15:

0  The extraction of the EFS control field was successful.
16 The extraction of the EFS control field was unsuccessful; terminate DFSORT.

**EFS02 User Exit Routine**

Including or omitting records based on user-defined data types with the EFS02 user exit routine requires using the function of altering control statements. EFS program requirements at Major Calls 1 and 2 are:
- At Major Call 1, the EFS program must provide the control statement request list with the INCLUDE or OMIT operation definer. See "Control Statement Request List" on page 776 for further details.
- At Major Call 2, the EFS program must return a new format, D2, on the INCLUDE or OMIT control statement that informs DFSORT to call the EFS02 routine (the fields defined with the D2 format are also known as EFS compare fields). See "EFS Formats for SORT, MERGE, INCLUDE, and OMIT Control Statements" on page 779 for further details. The EFS program must also return the final length and, in place of the position value, must send an identifier (known as a correlator identifier) that identifies a specific relational condition. For each relational condition containing EFS fields, there must be a unique correlator identifier to identify the particular relational condition. See "EFS Formats for SORT, MERGE, INCLUDE, and OMIT Control Statements" on page 779 for further details.

At Major Call 3, the EFS program must return the address of the EFS02 routine to DFSORT.

The EFS02 routine is called to perform the INCLUDE or OMIT comparison logic for each relational condition containing an EFS field. During the input phase, DFSORT will call the EFS02 exit routine one or more times for each input record according to the evaluation defined by the AND, OR, or parentheses. The EFS02 exit routine must use the correlator identifier to determine the current relational condition being performed. EFS02 must perform the comparison logic for the current relational condition as identified by the correlator identifier.
page 788 repeats Table 78 on page 781 to illustrate an example of the calling sequences to an EFS02 by DFSORT.

Original INCLUDE control statement sent to EFSPGM

INCLUDE COND=(15,4,FF,20,4,FF,AND,40,7,FF,NE,50,7,FF,OR, 30,2,FF,NE,35,2,FF)

Altered INCLUDE control statement returned by EFSPGM

INCLUDE COND=(1,4,02,EQ,1,4,02,AND,2,7,02,NE,2,7,02,OR, 3,2,02,NE,3,2,02)

Where: the calling sequence to EFS02 may be summarized with the following tables:

<table>
<thead>
<tr>
<th>Relational condition with</th>
<th>EFS02 returns a return code of 0=True or 4=False</th>
<th>DFSORT action when the next logical operator is:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlator Identifier 1</td>
<td>True</td>
<td>Call EFS02 with Correlator Id 2</td>
</tr>
<tr>
<td></td>
<td>False</td>
<td>Call EFS02 with Correlator Id 3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Relational condition with</th>
<th>EFS02 returns a return code of 0=True or 4=False</th>
<th>DFSORT action when the next logical operator is:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlator Identifier 2</td>
<td>True</td>
<td>Include the record</td>
</tr>
<tr>
<td></td>
<td>False</td>
<td>Call EFS02 with Correlator Id 3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Relational condition with</th>
<th>EFS02 returns a return code of 0=True or 4=False</th>
<th>DFSORT action when the next logical operator is:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlator Identifier 3</td>
<td>True</td>
<td>Include the record</td>
</tr>
<tr>
<td></td>
<td>False</td>
<td>Omit the record</td>
</tr>
</tbody>
</table>

Figure 50. Calling Sequence to EFS02 by DFSORT

**EFS02 Parameter List**

DFSORT sends three words to the EFS02 exit routine each time it is entered:

- The address of the correlator identifier
- The address of the input record
- The address of the EFS program context area.

DFSORT places the address of a parameter list in register 1. The list begins on a fullword boundary and is three fullwords long. The format of the parameter list is:

<table>
<thead>
<tr>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>00</td>
<td>00</td>
<td>Correlator identifier</td>
</tr>
</tbody>
</table>

Address of the input record
The EFS02 exit routine must return one of the following return codes in general register 15:

0  True
   The record passed the INCLUDE or OMIT test for the relational condition of an EFS field. If applicable, processing continues with the next relational condition. Otherwise, DFSORT accepts the record if INCLUDE is specified or omits the record if OMIT is specified.

4  False
   The record did not pass the INCLUDE or OMIT test for the relational condition of an EFS field. If applicable, processing continues with the next relational condition. Otherwise, DFSORT omits the record if INCLUDE is specified or includes the record if OMIT is specified.

16 Terminate
   An error occurred in processing the INCLUDE or OMIT logic; terminate DFSORT.

Addressing and Residence Mode of EFS Program User Exit Routines

DFSORT supplies the following features to allow residence above or below 16MB virtual and use of either 24-bit or 31-bit addressing:

f (bit 0 of EFS program exit routine address)

0  Enter the EFS program exit routine with 24-bit addressing in effect.
1  Enter the EFS program exit routine with 31-bit addressing in effect.

The EFS program user exit routine can return to DFSORT with either 24-bit or 31-bit addressing in effect. The return address that DFSORT placed in register 14 must be used.

Except for the EFS program context area address (which DFSORT sends to the EFS program user exit routine unchanged), DFSORT handles the EFS program exit routine parameter list addresses (that is, the pointer to the EFS program exit routine parameter list and the addresses in the parameter list) as follows:

- If the EFS program exit routine is entered with 24-bit addressing in effect, DFSORT can pass clean (zeros in the first 8 bits) 24-bit addresses or 31-bit addresses to the EFS program exit routine. The EFS program exit routine must return clean 24-bit addresses if the EFS program exit routine returns to DFSORT with 31-bit addressing in effect.
- If the EFS program exit routine is entered with 31-bit addressing in effect, DFSORT can pass clean 24-bit addresses or 31-bit addresses to the EFS program exit routine. The EFS program exit routine must return 31-bit addresses or clean 24-bit addresses.
EFS Program Return Codes

EFS Program Return Codes You Must Supply

Your EFS program must pass one of two return codes to DFSORT:

0  Continue Processing
   If you want DFSORT to continue processing for this Major Call, return with a return code of zero in general register 15.

16  Terminate DFSORT
    If you want DFSORT to terminate processing for this Major Call, return with a return code of 16 in general register 15.

    If the EFS program returns a return code of 16 from a Major Call prior to Major Call 4 or one of its generated user exit routines returns a return code of 16, DFSORT will skip interim Major Calls, where applicable, to the EFS program or user exit routine, and will call the EFS program at Major Call 4 and at Major Call 5.

    Multiple calls are possible at Major Call 2 and Major Call 3. If the EFS program returns with a return code of 16 from one of the multiple calls at Major Call 2, subsequent calls at Major Call 2, if applicable, will be completed. If the EFS program returns with a return code of 16 from one of the multiple calls at Major Call 3, subsequent calls at Major Call 3, if applicable, will not be completed.

    If the EFS program returns a return code of 16 at Major Call 4, DFSORT will still call the EFS program at Major Call 5.

Record Processing Order

The order of record processing when using EFS is similar to processing without it. Figure 51 on page 791 illustrates the record processing sequence for a sort or merge and Figure 52 on page 792 illustrates the record processing sequence for a copy when EFS processing is in effect.

The figures illustrate the same points as described in Figure 2 on page 9 with the following exceptions:

- When record processing is done for an INCLUDE or OMIT control statement, an EFS02 user exit routine is called to perform the comparison logic for the relational conditions with EFS fields.
- When record processing is done for a SORT or MERGE control statement, an EFS01 user exit routine is called to perform the extraction process for EFS control fields.
Figure 51. EFS Record Processing Sequence for a Sort or Merge
How to Request a SNAP Dump

You can request a SNAP dump for diagnostic purposes before or after any Major Call except Major Call 1. Use either the EFSDPBFR parameter or the EFSDPAFT parameter on the DEBUG statement.

See "DEBUG Control Statement" on page 92 for the correct syntax.
EFS Program Example

The following example shows how an EFS program can be used to change control statements at run-time.

The following information is assumed for this example DFSORT run:

- The EFS program “EFSPGM” resides in the same library as the DFSORT modules.

- The JCL statements for the application are:

```plaintext
//EXAMPLE1 JOB A12345,'J. SMITH'
//S1 EXEC PGM=SORT,PARM='EFS=EFSPGM'
//SYSOUT DD SYSOUT=A
//SORTIN DD DNAME=SMITH.INPUT,DISP=SHR,
//   UNIT=3380,SPACE=(TRK,(15,2)),VOL=SER=XYZ003,
//   DCB=(LRECL=80,BLKSIZE=80,RECFM=F)
//SORTOUT DD DNAME=SMITH.OUTPUT,DISP=(NEW,KEEP),
//   UNIT=3380,SPACE=(TRK,(15,2)),VOL=SER=XYZ003
//SYSIN DD *
SORT FIELDS=(5,20,CH,A,13,5,BI,D)
OPTION STOPAFT=30,DYNALLOC=3390
/*
```

**DFSORT Initialization Phase:**

**Major Call 1**

Prior to Major Call 1, DFSORT sets the following fields in the EFS interface parameter list:

- Action code=0
  
  Major Call 1 is in effect.

- Informational bit flag 2=0
  
  The DFSORT run is JCL-invoked.

- Informational bit flag 3=0
  
  SORTDIAG is not in effect.

DFSORT calls EFS program EFSPGM at Major Call 1, and EFSPGM sets the following fields in the EFS interface parameter list:

- Control statement request list
  
  Contains the OPTION operation definer, which indicates to DFSORT that the OPTION control statement is requested by EFSPGM.

- EFSPGM program context area
  
  EFSPGM will be using the context area.

- Message list=0
  
  EFSPGM has no messages for DFSORT to print to the message data set. General register 15 is set to zero.

**Major Call 2**

Prior to Major Call 2, DFSORT sets the following fields in the EFS interface parameter list:

- Action code=4
  
  Major Call 2 is in effect.

- Informational bit flag 4=0 and informational bit flag 5=0
  
  No application is in effect.
EFS Program Example

EFS Program Example

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EFS Program Example

- Informational bit flag 7=0
  Fixed-length records are being processed.
- Record lengths list values=80
  The LRECL of the input and output data sets is 80. Because the SORTOUT
  LRECL was not specified, DFSORT defaulted to the SORTIN LRECL for the
  SORTOUT LRECL.
- Extract buffer offsets list=0
  No EFS control fields were specified on the SORT control statement.

DFSORT calls EFS program EFSPGM at Major Call 3, and EFSPGM sets the
following fields in the EFS interface parameter list:
- EFS01 address=0
  Because the SORT control statement has no EFS control fields, the EFS01 user
  exit routine is not used.
  Because no INCLUDE control statement was supplied (with EFS fields), the
  EFS02 user exit routine is not used.
- Message list=0
  EFSPGM has no messages for DFSORT to print to the message data set. General
  register 15 is set to zero.

DFSORT Termination Phase

**Major Call 4**
Prior to Major Call 4, DFSORT sets the following fields in the EFS interface
parameter list:
- Action code=12
  Major Call 4 is in effect.

DFSORT calls EFS program EFSPGM at Major Call 4, and EFSPGM sets the
following fields in the EFS interface parameter list:
- Message list=0
  EFSPGM has no messages for DFSORT to print to the message data set.

And general register 15 is set to zero.

**Major Call 5**
Prior to Major Call 5, DFSORT sets the following fields in the EFS interface
parameter list:
- Action Code=16
  Major Call 5 is in effect.

DFSORT calls EFS program EFSPGM at Major Call 5, and EFSPGM does not set
any fields in the EFS interface parameter list but sets general register 15 to zero.
Chapter 10. Improving Efficiency

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Improving Performance

DFSORT is designed to optimize performance automatically. It sets optimization variables (such as buffer sizes) and selects the most efficient of several sorting and merging techniques.

You can improve DFSORT performance in several ways:
  • Design your applications to maximize performance:
    – Directly invoke DFSORT processing
    – Plan ahead when designing new applications
    – Specify efficient sort/merge techniques
    – Specify input/output data set characteristics accurately
    – Use extended format data sets
    – Use DFSMSrmm-managed tapes, or ICETPEX
    – Specify devices that improve elapsed time
    – Use options that enhance performance
    – Use DFSORT's fast, efficient productivity features
    – Avoid options that degrade performance.
  • Use main storage efficiently
  • Allocate temporary work space efficiently
  • Use Hipersorting
  • Sort with data space
Improving Performance

- Use memory object sorting
- Use ICEGENER instead of IEBGENER
- Use DFSORT’s Performance Booster for The SAS System
- Use DFSORT’s BLDINDEX support.

The DFSORT z/OS DFSORT Tuning Guide provides additional information related to many of the topics covered in this chapter.

Design Your Applications to Maximize Performance

Even though DFSORT automatically optimizes performance when your application is run, you can still improve efficiency by using specifications and options that permit DFSORT to make the best possible use of available resources.

Directly Invoke DFSORT Processing

You can enhance performance by invoking DFSORT with JCL instead of invoking it from a COBOL or a PL/I program. Generally, COBOL or PL/I is used for convenience. However, the trade-off can be degraded performance. You can improve efficiency by taking advantage of the way DFSORT installation defaults and run-time options can be fine-tuned for optimum performance, especially to make use of control statements that “work together,” such as INCLUDE/OMIT, INREC/OUTREC, SUM, and OUTFIL. You can eliminate records from input files, reformat records to eliminate unwanted fields, combine records arithmetically, and create reports, without requiring routines from other programs.

Plan Ahead When Designing New Applications

You should consider several factors when designing new applications. Some of these factors are discussed below.

Whenever possible:
- Use either EBCDIC character or binary control fields
- Place binary control fields so they start and end on byte boundaries
- Avoid using the alternative collating sequence character translation
- If you know that a fixed-point control field always contains positive values, specify it as a binary field.
- If you know that a packed decimal or zoned decimal control field always contains positive values with the same sign (for example, X'C'), specify it as a binary field.
- Use packed decimal format rather than zoned decimal
- If several contiguous character or binary control fields in the correct order of significance are to be sorted or merged in the same order (ascending or descending), specify them as one control field
- Avoid overlapping control fields.
- Avoid using locale processing if your SORT, MERGE, INCLUDE, or OMIT character fields can be processed using the binary encoding of the data.

Efficient Blocking

You can improve the performance of DFSORT significantly by blocking your input and output records efficiently. Whenever possible, use system-determined optimum block sizes for your data sets.
Design Your Applications to Maximize Performance

For more information about letting DFSORT select system-determined optimum block sizes for your output data sets, see the discussion of the SDB option in “OPTION Control Statement” on page 173.

Specify Efficient Sort/Merge Techniques

Depending on various conditions, DFSORT selects different techniques for sorting and merging. Message ICE143I informs you which technique has been selected.

For copy applications, Blockset is the only technique used. If your program cannot use Blockset, DFSORT issues error message ICE160A and stops processing.

Sorting Techniques

One condition that affects which sorting technique DFSORT selects is the type of device used for intermediate storage. If you use a tape device, the Conventional technique is used, which is less efficient. For more information on using tape devices for intermediate storage, see “Tape Work Storage Devices” on page 809.

The Blockset and Peerage/Vale techniques can be used only with disk work data sets. These techniques are discussed below.

Blockset Sorting Techniques: DFSORT’s most efficient techniques, FLR-Blockset (for fixed-length records) and VLR-Blockset (for variable-length records), will be used for most sorting applications.

Notes:

• The Blockset technique might require more intermediate work space than Peerage/Vale. For more information, see “Allocate Temporary Work Space Efficiently” on page 808.
• If Blockset is not selected, you can use a SORTDIAG DD statement to force message ICE800I, which gives a code indicating why Blockset cannot be used.

Peerage/Vale Sorting Techniques: When the conditions for use of the Blockset sorting technique are not met, DFSORT uses Peerage/Vale.

Merging Techniques

For merging applications, DFSORT uses the Blockset and Conventional techniques.

Blockset Merging Techniques: DFSORT’s most efficient techniques, FLR-Blockset (for fixed-length records) and VLR-Blockset (for variable-length records), will be used for most merging applications.

Note: If Blockset is not selected, you can use a SORTDIAG DD statement to force message ICE800I, which gives a code indicating why Blockset cannot be used.

Conventional Merging Technique: When the conditions for use of the Blockset merging technique are not met, DFSORT uses the Conventional merge technique, which is less efficient.

Specify Input/Output Data Set Characteristics Accurately

DFSORT uses the information given it (about the operation it is to perform) to optimize for highest efficiency. When you supply incorrect information or do not supply information such as data set size and record format, the program makes assumptions that, if incorrect, can lead to inefficiency or program termination.
Input File Size
When DFSORT has accurate information about the input file size, it can make the most efficient use of both main storage and intermediate work storage. See “File Size and Dynamic Allocation” on page 851 for information about when and how to specify the input file size.

Variable-Length Records
When the input data set consists of variable-length records and dynamic allocation of intermediate data sets is used, specify the average record length as accurately as possible using AVGRLEN=n in the OPTION statement.

Disk Devices
System performance is improved if storage is specified in cylinders rather than tracks or blocks. Storage on sort work data sets will be readjusted to cylinders if possible. The number of tracks per cylinder for disk devices is shown in Table 80.

<table>
<thead>
<tr>
<th>Device</th>
<th>Tracks per Cylinder</th>
</tr>
</thead>
<tbody>
<tr>
<td>3380</td>
<td>15</td>
</tr>
<tr>
<td>3390</td>
<td>15</td>
</tr>
<tr>
<td>9345</td>
<td>15</td>
</tr>
</tbody>
</table>

If WRKSEC is in effect and the work data set is not allocated to virtual I/O, DFSORT allocates secondary extents as required, even if not requested in the JCL.

Allocating twice the space used by the input data sets is usually adequate for the work data sets. Certain conditions can cause additional space requirements. These include:
- Long control words (more than 150 bytes)
- Using different device types or work data sets
- Using an alternative collating sequence
- Low ratio of available storage to input file size.

Care should be taken to ensure that the LRECL parameter of the DCB corresponds to the actual maximum record length contained in your data set.

Use Extended Format Data Sets
Extended format data sets have features that can:
- Significantly reduce the elapsed time DFSORT spends reading and writing data
- Assist in managing the space requirements of very large data sets.

The Sequential Data Striping feature can reduce the time required to read and write your DFSORT input and output data sets. We recommend using sequential data striping for your very large DFSORT input and output data sets as a way to improve elapsed time.

Features such as compression, extended addressability (for VSAM), increased extent and volume support, and space constraint relief options assist in managing the space requirements of very large data sets.
Design Your Applications to Maximize Performance

If you decide to use compression, realize that there is a CPU cost which could outweigh the I/O performance benefits. Although compression can be used to improve disk storage capacity, the impact to CPU usage and elapsed time should be evaluated in your environment.

Consult with your storage administrator to learn how these features can be exploited in your environment.

Use DFSMSrmm-Managed Tapes, or ICETPEX

The use of tapes managed by DFSMSrmm, or a tape management system that uses ICETPEX, allows DFSORT to obtain accurate information about input file size and data set characteristics. This can result in improved performance and more efficient use of both main storage and intermediate work storage.

Specify Devices that Improve Elapsed Time

To get the best elapsed time improvement when using disk with DFSORT, you should use high speed devices, such as IBM's Enterprise Storage Server (ESS) and TotalStorage RS8000 Series subsystems for SORTIN, SORTOUT, SORTWKdd, SORTOUT, and OUTFIL data sets. Throughput can be further improved by leveraging high speed channels, such as IBM's FICON connectivity solutions.

Use Options that Enhance Performance

To obtain optimum performance, you can fine-tune your installation and run-time options. Several options that can enhance performance are described below.

CFW

Blockset sorting performance may be improved by using the Cache Fast Write (CFW) capability of IBM's storage controllers. Because IBM's latest storage subsystems have large cache sizes and high speed disk arrays, the use of CFW may not produce a significant performance gain.

The CFW parameter specifies whether DFSORT can use CFW when processing SORTWKdd data sets. The default is CFW=YES.

If you use the Hyperswap function in an environment that has a high availability configuration, you should specify CFW=NO to prevent DFSORT from abending when a Hyperswap is initiated.

DSA

Performance can be improved for Blockset sort applications by using Dynamic Storage Adjustment (DSA).

The DSA parameter sets the maximum amount of storage available to DFSORT for dynamic storage adjustment of a Blockset sort application when SIZE/MAINSIZE=MAX is in effect. If you specify a DSA value greater than the TMAXLIM value, you allow DFSORT to use more storage than the TMAXLIM value if doing so should improve performance. DFSORT only tries to obtain as much storage as needed to improve performance up to the DSA value.

DSPSIZE

Performance can be improved for sort applications that use the Blockset technique by using dataspace sorting.

The DSPSIZE parameter sets the maximum size of a data space to be used during a run. Specifying DSPSIZE=MAX allows DFSORT to optimize the maximum size of
Design Your Applications to Maximize Performance

A data space to be used during a run, subject to other system and concurrent Hipersorting, memory object sorting and dataspace sorting activity throughout the run. Total dataspace sorting activity on a system can be further limited by the EXPMAX, EXPOLD, and EXPRES installation options. See the description of DSPSIZE in "OPTION Control Statement" on page 173 for more information.

FASTSRT

By specifying the COBOL FASTSRT compiler option, you can significantly reduce DFSORT processor time, EXCPs, and elapsed time. With FASTSRT, DFSORT input/output operations are more efficient because DFSORT rather than COBOL does the input/output (see Figure 53 on page 802). For more details, see the COBOL publications.

The FASTSRT option does not take effect for input and output if input and output procedures are used in the SORT statement. Many of the functions usually performed in an input or output procedure are the same as those done by DFSORT INREC, OUTFIL, OUTREC, INCLUDE or OMIT, STOPAFT, SKIPREC, and SUM functions. You might be able to eliminate your input and output procedures by coding the appropriate DFSORT program control statements and placing them in either the DFSPARM (DFSORT), SORTCNTL (DFSORT), or IGZSRTCD (COBOL) data set, thereby allowing your SORT statement to qualify for FASTSRT.

Figure 53. Faster Sorting with COBOL

SDB

To improve Blockset elapsed time, and disk and tape utilization, specify installation option SDB=LARGE as your site's installation (SDB=INPUT is the IBM-supplied default). SDB=LARGE allows DFSORT to select the system-determined optimum block size for your disk and tape output data sets, when appropriate.
Design Your Applications to Maximize Performance

HIPRMAX
Blockset sorting performance can be improved by using Hiperspace along with disk for temporary storage.

The HIPRMAX parameter sets the maximum amount of Hiperspace to be used during a run. Specifying HIPRMAX=OPTIMAL allows DFSORT to optimize the maximum amount of Hiperspace to be used during a run, subject to other system and concurrent Hipersorting, memory object sorting and dataspace sorting activity throughout the run. Total Hipersorting activity on a system can be further limited by the EXPMAX, EXPOLD, and EXPRES installation options. See the description of HIPRMAX in “OPTION Control Statement” on page 173 for more information.

MOSIZE
Blockset sorting performance can be improved by using memory object sorting.

The MOSIZE parameter sets the maximum amount of memory object storage to be used during a run. Specifying MOSIZE=MAX allows DFSORT to optimize the maximum size of a memory object to be used during a run, subject to other system and concurrent Hipersorting, memory object sorting and dataspace sorting activity throughout the run. Total memory object sorting activity on a system can be further limited by the EXPMAX, EXPOLD, and EXPRES installation options. See the description of MOSIZE in “OPTION Control Statement” on page 173 for more information.

Use DFSORT's Fast, Efficient Productivity Features

DFSORT offers a rich set of fast, efficient productivity features. These features can eliminate the up-front costs of writing and debugging your own code to perform various tasks, and will perform those tasks more efficiently. The functional capabilities of each of the features listed below is described in detail elsewhere in this document. This section highlights the performance aspects of these features.

INCLUDE or OMIT, STOPAFT, and SKIPREC
You can use the INCLUDE or OMIT statement and the STOPAFT and SKIPREC options to reduce the number of records to be processed, which can reduce processor and data transfer time.
• The INCLUDE and OMIT statements allow you to select records by comparing fields with constants or other fields.
• The STOPAFT option allows you to specify the maximum number of records to be accepted for sorting or copying.
• The SKIPREC option allows you to skip records at the beginning of the input file and sort or copy only the remaining records.

OUTFIL
If you need to create multiple output data sets from the same input data set, you can use OUTFIL to read the input data set only once, thus improving performance. OUTFIL can be used for sort, merge, and copy applications to provide sophisticated filtering, editing, conversion, lookup and replace, and report features.

If you are creating only a single output data set and do not need the features of OUTFIL, use SORTOUT rather than OUTFIL for best performance.

LOCALE
You can use the LOCALE option to sort, merge, and compare character data based on collating rules in an active locale; this enables you to obtain results with
DFSORT that were previously possible only through pre-processing or post-processing of your data. By eliminating such costly processing, you can save time and processing resources.

**SUM**
You can improve performance by using SUM to add the contents of fields. The SUM statement adds the contents of specified SUM fields in records with identical control fields. The result is placed in one record while the other record is deleted, thus reducing the number of records to be output by DFSORT.

You can use installation option ZDPRINT=YES or run-time option ZDPRINT to specify that positive zoned decimal fields that result from summing are to be printable. That is, you can tell DFSORT to change the last digit of the zone from hex C to hex F.

**Eliminating Duplicate Records:** You can eliminate records with duplicate keys by specifying

```
SUM FIELDS=NONE
```

when using the SUM control statement.

For a diagram of the processing sequence for record handling statements, user exits, and options, see [Figure 2 on page 9](#).

**ICETOOL**
ICETOOL is a multi-purpose utility that allows you to use DFSORT's highly efficient I/O and processing to perform multiple operations on one or more data sets in a single job step. ICETOOL's 17 operators allow you to perform sort, copy, statistical, and report operations quickly and efficiently.

**Avoid Options that Degrade Performance**
Certain options can adversely affect performance, and should be used only when necessary. For example, the CKPT option, which activates checkpoint/restart, prevents use of the efficient Blockset techniques.

**CKPT**
The CKPT option might preclude the use of the more efficient Blockset technique.

**Note:** If installation option IGNCKPT=YES has been selected, DFSORT ignores the checkpoint/restart request and selects the Blockset technique.

**EQUALS**
The EQUALS option increases the time needed for comparison of records and for data transfer.

**EQUCOUNT**
The EQUCOUNT option takes additional time to count the number of records with equal keys.

**LOCALE**
The LOCALE option may increase the time required to run an application.

**NOCINV**
The NOCINV option precludes the use of control interval access for more efficient VSAM processing.
Design Your Applications to Maximize Performance

**NOBLKSET**
The NOBLKSET option precludes the use of the more efficient Blockset technique.

**VERIFY**
The VERIFY option degrades performance, because it involves extra processing.

**Tape Work Data Sets**
Use of tape work data for intermediate storage precludes the use of the much more efficient disk techniques.

**User Exit Routines**
When user exit routines are included in an application, the time required to run the application is usually increased.

The run time required by most user exit routines is generally small, but the routines at user exits E15, E32, and E35 are entered for each record of the data sets. For large input data sets, the total run time of these routines can be relatively large.

**Dynamic Link-Editing**
Dynamic link-editing of user exit routines degrades performance.

**EFS Programs**
When EFS programs are included in an application, the time required to run the application might increase.

**Use Main Storage Efficiently**
In general, the more main storage you make available to DFSORT, the better the performance for large applications. To prevent excessive paging, ensure that sufficient real storage is available to back up the amount of main storage used. This is especially important with main storage sizes greater than 32MB. The default amount of main storage that will be made available to DFSORT is defined when it is installed.

Although it is possible to run a "very minimal" sort application in 88KB of storage, the actual minimum amount of storage required is generally 128KB to 440KB depending on the application. However, 4MB or more of storage is recommended for better performance. Improved performance will be most noticeable with large input files. With MAINSIZE=MAX, the DSA value can be used to automatically increase the amount of storage DFSORT uses for a sort application when doing so should improve performance.

**Note:** When Blockset is selected, DFSORT can place selected buffers above 16MB virtual. This frees more storage for DFSORT without having to increase the REGION size. A REGION size of at least 440KB must be available to allow DFSORT to use storage effectively.

**Tuning Main Storage**
Either the REGION value or the MAINSIZE/SIZE value can determine how much storage is available to DFSORT. See [z/OS DFSORT Installation and Customization](#) for details.

Generally, the most efficient way to allocate (virtual) main storage is to use MAINSIZE/SIZE=MAX explicitly or by default. However, problems can arise if the
values for the TMAXLIM or MAXLIM installation options have been set excessively high (or low). Guidelines for setting these values are given in DFSORT Installation and Customization.

**Note:** Do not use SIZE/MAINSIZE=MAX with password-protected data sets if passwords are to be entered through a routine at a user exit, because DFSORT cannot then open the data sets during the initialization phase to make the necessary calculations.

If you specify MAINSIZE/SIZE=n and give n a value less than that specified for the MINLIM installation option, MINLIM is used.

When SIZE/MAINSIZE=MAX is in effect, DFSORT will use its Dynamic Storage Adjustment (DSA) feature, when appropriate, to improve performance.

If the MINLIM value is greater than that specified for REGION on the EXEC statement, DFSORT attempts to use the value specified for MINLIM; if it fails to get the amount specified by MINLIM, DFSORT still tries to run, provided at least 88KB (below 16MB virtual) are available to DFSORT.

Storage used for OUTFIL processing will be adjusted automatically, depending upon several factors, including:

- Total available storage
- Non-OUTFIL processing storage requirements
- Number of OUTFIL data sets and their attributes (for example, block size).

OUTFIL processing is subject to the ODMAXBF limit and your system storage limits (for example, IEFUSI) but not to DFSORT storage limits, that is, SIZE/MAINSIZE, MAXLIM, and TMAXLIM. DFSORT attempts to use storage above 16MB virtual for OUTFIL processing whenever possible.

**Notes:**

1. In some cases, this release of DFSORT may use more storage than prior releases for comparable applications. This might affect the operation of some applications. For example, some applications that run as in-storage sorts (with no SORTWKdd data sets) in previous releases might not run in-storage when using this release. The amount of storage allocated is normally controlled by TMAXLIM. A REGION size of at least 440KB must be available if DFSORT is to achieve acceptable performance. The allocation of storage can be adversely affected if you have a smaller region value or if DFSORT needs to allocate buffers below 16MB virtual.

2. For extremely large sorts (for example, 2GB or more of data), make sure that Hipersorting, memory object sorting and dataspace sorting are enabled, and that 32MB or more of main storage is available to DFSORT.

The relationship between TMAXLIM, MAXLIM, MINLIM, and REGION might be described as a series of checks and balances.

Your system programmer has set the default storage values according to your site’s major sorting requirements. If you have an overnight or batch time window that must be met, increasing storage (using REGION or SIZE/MAINSIZE=n) can give you some relief from the time constraint. If you are concerned with processor time, decreasing storage (using REGION or SIZE/MAINSIZE=n) can reduce the processor time associated with sorting small files.
Use Main Storage Efficiently

In general, when you vary the amount of storage available to DFSORT, several things occur:

1. If you increase the amount of storage:
   - EXCPs are reduced.
   - For larger files, processor time generally decreases; that is, overhead in managing the extra storage is offset by DFSORT having to make fewer passes over the data.
   - For a very heavily loaded system, elapsed time might increase because DFSORT can be swapped out more often.
   - For very small sorts, processor time might remain stable or increase because of the overhead in managing the extra storage. For larger files, processor time will usually decrease because the overhead in managing the extra storage would be less than the benefit gained by DFSORT making fewer passes over the data.

2. If you decrease the amount of storage:
   - EXCPs increase.
   - Elapsed time increases for most sorts.
   - Processor time decreases for very small files, but increases for larger files.

Changing the main storage allocation can affect system efficiency. By reducing the amount of main storage allocated, you impair performance of DFSORT to allow other programs to have the storage they need to operate simultaneously; by increasing the allocation, you can run large DFSORT applications efficiently at the risk of decreasing the efficiency of other applications sharing the multiprogramming environment.

Releasing Main Storage

Under some circumstances, DFSORT uses all the available storage in your REGION. This normally will not occur for storage above 16MB virtual (if it does, use the ARESINV or ARESALL options or lower your SIZE/MAINSIZE value). This section explains how to release storage within your REGION.

When SIZE/MAINSIZE=n is in effect and n is greater than the REGION parameter or the default REGION value, or when SIZE/MAINSIZE=MAX and TMAXLIM is greater than your REGION, specify the storage you need released in the following way:

- For applications with user exits:
  - For directly invoked DFSORT, you can choose one of the following:
    - Use the m parameter of the MODS control statement.
    - If SIZE=MAX is in effect, you can use the RESALL option.
    - Change your REGION so that REGION is greater than SIZE/MAINSIZE (the difference is available).
    - If the OVERRGN installation option is smaller than your system IEFUSI value, this difference is available. (OVERRGN is an installation option that can be modified only by your system programmer.)
  - For program invoked DFSORT, you can choose one of the following:
    - If the user exit address is not passed in the parameter list (that is, it is specified with a MODS statement), use the m parameter on the MODS statement.
    - If the user exit address is passed in the parameter list, and SIZE/MAINSIZE=MAX is in effect, use the RESINV option.
Use Main Storage Efficiently

- If the user exit address is passed in the parameter list, and SIZE/MAINSIZE=n is in effect, change your REGION so that the REGION is greater than SIZE/MAINSIZE (the difference is available).
- If many of your DFSORT applications pass the user exit address in the parameter list and SIZE/MAINSIZE=n is in effect, then consider having the OVERRGN value changed by your system programmer to less than your IEFUSI value.

• For applications without user exits:
  – For directly invoked DFSORT, you can choose one of the following:
    - If SIZE/MAINSIZE=MAX is in effect, use the RESALL option.
    - If SIZE/MAINSIZE=n is in effect, change your REGION so that REGION is greater than SIZE/MAINSIZE (the difference is available).
    - Have the OVERRGN value changed by your system programmer to less than your IEFUSI value.
  – For program invoked DFSORT, you can choose one of the following:
    - If SIZE/MAINSIZE=MAX is in effect, use the RESINV option.
    - If SIZE/MAINSIZE=n is in effect, change your REGION so that REGION is greater than SIZE/MAINSIZE (the difference is available).
    - Have the OVERRGN value changed by your system programmer to less than your IEFUSI value.

When SIZE/MAINSIZE is less than REGION, make sure the difference between SIZE/MAINSIZE and your REGION specification value or default provides sufficient storage for system or user exit routine use.

Allocate Temporary Work Space Efficiently

Performance is enhanced when multiple channels are available. Performance is also improved if the device is connected so that two channel paths exist between each device and the processor that is running the program.

Disk Work Storage Devices

Program performance is improved if you use devices, storage areas, and channels efficiently. If you specify a particular device type with the UNIT parameter on the DD statements that define intermediate storage data sets (for example, UNIT=3390), DFSORT assigns areas, and some optimization occurs automatically. You can get the best performance using disk intermediate storage devices when you:

• Use two or more work data sets.
• Select the storage device with the fastest data transfer rate.
• Assign one work data set per volume if Parallel Access Volumes (PAV) are not used. This will help minimize I/O queue time on the SORTWKdd data sets.
• Use devices that are of the same type.
• Use two channel paths to devices.
• Make all work data sets the same size, or as nearly the same size as possible.
• Make sure the SORTWKdd data sets do not share devices or channels with the SORTIN, SORTOUT, or OUTFIL data sets.
• Specify contiguous space for work data sets, and make sure there is enough primary space so that the automatic secondary allocation is not needed.
• Provide adequate virtual storage when work data sets are allocated on non-synchronous devices, as explained in "Non-Synchronous Storage Subsystems" on page 848.
Allocate Temporary Work Space Efficiently

Elapsed time is decreased when DFSORT can both read input while writing to SORTWKd and write output while reading from SORTWKd. If, for example, you have two channels, the best allocation of them is to have SORTIN, SORTOUT, and OUTFIL data sets on one and the SORTWKd data sets on the other.

Storage requirements for different disk techniques can be estimated by using the guidelines found in Appendix A, “Using Work Space,” on page 847.

Virtual I/O for Work Data Sets
Although VIO data sets can provide performance improvements in many applications, these work data sets are generally not as effective as disk work data sets for DFSORT.

DFSORT temporary work data sets allocated to virtual devices (VIO) can provide reduced elapsed time at the cost of increased CPU time for DFSORT applications. In general, this is not a good trade-off and VIO should not be used for DFSORT work data sets.

If work data sets are allocated to VIO, the VIO installation option tells DFSORT how to handle allocation to VIOs:
- VIO=YES causes DFSORT to accept the use of VIOs for work data sets.
- VIO=NO causes DFSORT to reallocate work data sets from virtual devices to real devices. Note that in order for re-allocation to be successful, a real device with the same device type as the virtual device must be available.

Re-allocation of VIO data sets (VIO=NO) is recommended over no re-allocation (VIO=YES). However, it is better to avoid using VIO work data sets in the first place, since re-allocation wastes time and resources.

Tape Work Storage Devices
The use of tape work storage devices prevents the use of the more efficient Blockset technique. Best performance, using tape intermediate storage, is usually obtained when you use six or more tape drives of the fastest type. As a general rule, you should use as many tapes as you have available for intermediate storage. A larger number of tapes increases the number of strings that can be merged in one pass, and, therefore, decreases the number of passes required in the intermediate merge phase. This then reduces elapsed time and, often, the number of I/O operations.

Increasing the number of work units, however, also reduces the block size used for intermediate storage; this can become a critical factor if you have relatively little main storage available for buffers. For example, if DFSORT has only 88KB in which to operate, you probably achieve no improvement (and might find deterioration) if you use more than four tape work units. Therefore, apply the general rule of using as many tapes as possible only when DFSORT has more than 100KB available.

For information on how to determine storage requirements when using different tape techniques, see Appendix A, “Using Work Space,” on page 847.

Notes:
1. The frequency with which the tape direction changes during DFSORT work file operations has more of an impact on the effective data rate of the IBM 3480/3490/3590 Magnetic Tape Subsystems than on IBM 3420 Magnetic Tape.
Allocate Temporary Work Space Efficiently

Units. Because of this characteristic, performance comparisons between these tape units for intermediate storage cannot be reliably predicted and can vary widely.

2. Devices using the Improved Data Recording Capability (IDRC) feature are not recommended as intermediate storage devices, as they do not perform well with the read backward command.

Use Hipersorting

Hipersorting uses Hiperspace to improve the performance of sort applications that use DFSORT’s Blockset Technique. A Hiperspace is a high-performance data space that resides in central storage and is backed by auxiliary storage when necessary. With Hipersorting, Hiperspace is used in place of and along with disk for temporary storage of records during a Blockset sort. Hipersorting reduces I/O processing, which in turn reduces elapsed time, EXCPs, and channel usage. Hipersorting is recommended when the input or output is a compressed sequential or VSAM data set.

You can control the maximum amount of Hiperspace for a Hipersorting application with the HIPRMAX parameter. HIPRMAX can direct DFSORT to dynamically determine the maximum amount of Hiperspace, subject to the available storage at the start of the run. You can also use HIPRMAX to suppress Hipersorting when optimizing CPU time is your major concern because Hipersorting can slightly degrade CPU time.

The actual amount of Hiperspace a Hipersorting application uses depends upon several factors. See the HIPRMAX description in “OPTION Control Statement” on page 173 for more details. Most important, throughout the run, DFSORT determines the amount of available storage as well as the amount of storage needed by other concurrent Hipersorting, memory object sorting, and dataspaces sorting applications. Based on this information, DFSORT switches dynamically from using Hiperspace to using disk work data sets when either a storage shortage is predicted or the total Hipersorting, memory object sorting and dataspaces sorting activity on the system reaches the limits set by the EXPMAX, EXPOLD, and EXPRES installation options. See z/OS DFSORT Installation and Customization for a complete description of these installation options.

Sort with Data Space

Dataspaces sorting uses data space to improve the performance of sort applications that use DFSORT’s Blockset Technique.

Dataspaces sorting allows DFSORT to sort large pieces of data at a time. This helps to reduce CPU time and elapsed time.

You can control the maximum size of a data space for a dataspaces sorting application with the DSPSIZE parameter. DSPSIZE can direct DFSORT to dynamically determine the maximum size of a data space, subject to the available central storage at the start of the run. DSPSIZE=0 means that DFSORT will not use dataspaces sorting.

The actual size of a data space that a dataspaces sorting application uses depends upon several factors. See the DSPSIZE description in “OPTION Control Statement” on page 173 for more details.

The following functions and types of data sets are not supported for dataspaces sorting:
Sort with Data Space

- Spool, dummy, or pipe data set, or z/OS UNIX file, as input.
- User exits
- INREC, OUTFIL, OUTREC, and SUM
- EQUCOUNT

Dataspace sorting is seldom used for very small data sets of a few MB or so because it is more efficient to sort small amounts of data entirely in main storage.

The following are actions you can take that might increase the use of dataspace sorting:
- Specify sufficient main storage. The default is 6MB, the recommended minimum for dataspace sorting. If you increase the amount of main storage specified, more dataspace sorting is possible, especially when sorting large amounts of data (multiple hundred MBs). Specifying more than 12MB or so will have no significant impact on DFSORT’s decision to use dataspace sorting; it will, however, improve the performance of large non-dataspace sorting applications.
- Specify generous extent sizes for work data sets, especially for secondary extents. Dataspace sorting is frequently used in conjunction with disk work space but never with Hiperspace or with tape work data sets.
- Specify DSPSIZE=MAX.
- Verify that IEFUSI does not place any restrictions on the size of the data spaces a single address space can create.
- Ensure that DFSORT has accurate information about the input file size. DFSORT can automatically estimate the file size for disk input data sets and tape data sets managed by DFSMSrmm or a tape management system that uses ICETPEX. See [“File Size and Dynamic Allocation” on page 85](#) for information on situations where DFSORT cannot determine the file size accurately, and what to do about it.

Use Memory Object Sorting

Memory object sorting uses a memory object in 64-bit virtual storage to improve the performance of sort applications that use DFSORT’s Blockset Technique. A memory object is a data area in virtual storage that is allocated above the bar and backed by central storage. With memory object sorting, a memory object is used in place of and along with disk for temporary storage of records during a sort. Memory object sorting reduces I/O processing, which in turn reduces elapsed time, EXCPs, and channel usage. Memory object sorting is recommended for large input data sets when a sufficient amount of central storage is available.

You can control the maximum size of a memory object for a memory object sorting application with the MOSIZE parameter. MOSIZE can direct DFSORT to dynamically determine the maximum size of a memory object, subject to the available central storage at the start of the run. MOSIZE=0 means that DFSORT will not use memory object sorting.

The actual size of a memory object that a memory object sorting application uses depends upon several factors. See the MOSIZE description in [“OPTION Control Statement” on page 17](#) for more details.

The following are actions you can take that might increase the use of memory object sorting:
- Verify that a sufficient size for memory objects is defined by the MEMLIMIT parameter on the JOB or EXEC JCL statement.
Sort with Data Space

- Specify MOSIZE=MAX.
- Specify generous extent sizes for work data sets, especially for secondary extents.
- Verify that IEFUSI does not place any restrictions on the size of the memory objects a single address space can create.
- Ensure that DFSORT has accurate information about the input file size. DFSORT can automatically estimate the file size for disk input data sets and tape data sets managed by DFSMSrmm or a tape management system that uses ICETPEX. See "File Size and Dynamic Allocation" on page 851 for information on situations where DFSORT cannot determine the file size accurately, and what to do about it.

Use ICEGENER Instead of IEBGENER

You can achieve more efficient processing for applications set up to use the IEBGENER system utility by using DFSORT's ICEGENER facility. Qualifying IEBGENER jobs are processed by the equivalent (though not identical), but more efficient, DFSORT copy function. If, for any reason, the DFSORT copy function cannot be used (for example, if IEBGENER control statements are specified), control is automatically transferred to the IEBGENER system utility.

ICEGENER, like IEBGENER, will use an SDB=value parameter you supply using PARM='SDB=value', when appropriate. The valid SDB=value parameters are SDB=LARGE, SDB=YES, SDB=SMALL, SDB=INPUT and SDB=NO, as explained in "OPTION Control Statement" on page 173. If you supply an invalid SDB=value parameter, ICEGENER will transfer control to IEBGENER, which will terminate due to the invalid parameter. If you do not supply an SDB=value parameter, ICEGENER will use your site's DFSORT installation default for SDB, when appropriate (the IBM-supplied default is SDB=INPUT). If ICEGENER transfers control to IEBGENER, IEBGENER will use the SDB=value parameter you supply, if any, or its normal default for SDB.

ICEGENER will also recognize DFSORT parameters other than SDB=value you supply using PARM='parameter' that are valid on DFSORT's OPTION statement as explained in "OPTION Control Statement" on page 173. However, IEBGENER does not recognize any parameters other than the valid SDB=value forms, so if DFSORT must transfer control to IEBGENER, IEBGENER will not recognize DFSORT's parameters and will terminate. Likewise, if you supply a DFSORT parameter using PARM='parameter' that is not valid on DFSORT's OPTION statement, DFSORT will transfer control to IEBGENER and IEBGENER will terminate due to the invalid parameter.

For example, if you specify:

```
//S1 EXEC PGM=ICEGENER,PARM='SIZE=2000,MAINSIZE=2000K'
```

ICEGENER will accept SIZE=2000 and MAINSIZE=2000K as valid DFSORT OPTION parameters that specify an exact file size of 2000 records and a limit of 2000K bytes of storage, respectively. If DFSORT copy can be used, these parameters will be used. But if DFSORT must transfer control to IEBGENER, IEBGENER will terminate because it treats SIZE=2000 and MAINSIZE=2000K as invalid parameters.

As another example, if you specify:

```
//S2 EXEC PGM=ICEGENER,PARM='SIZE=2000K'
```
Use ICEGENER Instead of IEBGENER

ICEGENER will treat SIZE=2000K as an invalid DFSORT OPTION parameter and will transfer control to IEBGENER, which will terminate because it treats SIZE=2000K as an invalid parameter.

Thus, you can pass PARM parameters to ICEGENER that are valid as DFSORT OPTION parameters, but you must be aware that if ICEGENER transfers control to IEBGENER, those parameters will cause IEBGENER to terminate. PARM parameters that are not valid as DFSORT OPTION parameters (even if they are valid as DFSORT PARM parameters) will cause ICEGENER to transfer control to IEBGENER, which will terminate.

ICEGENER can transfer control to IEBGENER due to DFSPARM or SORTCNTL statement errors or other errors detected by DFSORT. Therefore, we recommend that ICEGENER not be used for any application for which IEBGENER cannot be used, to avoid unwanted IEBGENER processing. For example, if ICEGENER is used with an INCLUDE statement in DFSPARM, IEBGENER could be used and complete successfully, but the INCLUDE statement would be ignored. Instead, DFSORT copy should be used directly so that IEBGENER cannot be called.

However, if you know that ICEGENER will use DFSORT copy, you can use a DFSPARM data set with ICEGENER to pass control statements and parameters to DFSORT. For example, if you specify:

```
//DFSPARM DD *
OPTION SPANINC=RCO
/*
```

and ICEGENER uses DFSORT copy, any incomplete spanned records DFSORT detects in a variable spanned input data set are eliminated.

If your site has installed ICEGENER to be invoked by the name IEBGENER, you need not make any changes to your applications to use ICEGENER. If your site has not chosen automatic use of ICEGENER, you can use ICEGENER by substituting the name ICEGENER for IEBGENER on the EXEC statement (when DFSORT is directly invoked) or LINK macro (when DFSORT is program-invoked) in any applications you choose. Program-invoked applications must be recompiled.

Following is an example of how an IEBGENER application can be changed to use ICEGENER by substituting the name ICEGENER for the name IEBGENER in the EXEC statement.

```
//GENER JOB...
// EXEC PGM=ICEGENER
//SYSPRINT DD SYSOUT=*  
//SYSIN DD DUMMY
```

The IEBGENER DD statements SYSUT1 (input), SYSUT2 (output), and SYSPRINT (messages) are used by DFSORT for SORTIN, SORTOUT, and SYSOUT, respectively. These DD statement names will be translated by using an extended parameter list to invoke the copy function. If DFSORT cannot be used (for example, because IEBGENER control statements are specified), control will be transferred to IEBGENER.

Notes:
1. The SYSUT2 data set should not be the same as the SYSUT1 data set because this can cause lost or incorrect data or unpredictable results.
Use ICEGENER Instead of IEBGENER

2. Whether ICEGENER is invoked from a program or not, DFSORT will be invoked from ICEGENER using an extended parameter list. Therefore, the installation defaults for the ICEAM2 or ICEAM4 environment, or for an ICETDx environment if activated for ICEAM2 or ICEAM4, apply and SORTCNTL or DFSPARM can be used to provide additional control statements for the copy application; for example, OPTION. However, ICEGENER can transfer control to IEBGENER due to DFSPARM or SORTCNTL statement errors or other errors detected by DFSORT. Therefore, DFSORT copy should be used directly rather than ICEGENER if DFSORT processing statements such as INCLUDE, OUTREC, SUM and so on are required.

3. For most error conditions that prevent the use of DFSORT copy, control will be transferred to the IEBGENER system utility. DFSORT messages will not be printed unless a SORTDIAG DD statement is supplied. Use of the SORTDIAG DD statement will allow you to determine why DFSORT copy could not be used.

4. If DFSORT copy is used, its operation and messages will be equivalent to a directly called DFSORT copy application. If an unrecoverable error is encountered (for example, an I/O error), DFSORT’s return code of 16 will be changed by ICEGENER to a return code of 12 to emulate the return code from a failing IEBGENER application.

5. DFSORT copy can perform some functions not provided by IEBGENER, such as certain padding and truncation operations. ICEGENER processing is not identical to IEBGENER processing in all cases, since DFSORT copy uses methods to enhance performance (EXCP, for example) that are not used by IEBGENER.

6. In some cases, IEBGENER terminates when the SYSUT2 LRECL is different from the SYSUT1 LRECL. ICEGENER takes one of three actions depending on the GNPAD (LRECL padding) or GNTRUNC (LRECL truncation) installation option, as appropriate.
   - If you want ICEGENER to transfer control to IEBGENER when the SYSUT2 LRECL is larger than the SYSUT1 LRECL, use installation option GNPAD=IEB.
   - If you want ICEGENER to handle LRECL padding, use GNPAD=RC0 (the supplied default) or GNPAD=RC4.
   - If you want ICEGENER to transfer control to IEBGENER when the SYSUT2 LRECL is smaller than the SYSUT1 LRECL, use installation option GNTRUNC=IEB. If you want ICEGENER to handle LRECL truncation, use GNTRUNC=RC0 (the supplied default) or GNTRUNC=RC4.

7. For a call to ICEGENER, or to IEBGENER as an alias for ICEGENER, register 1 must point to a valid parameter list consisting of three addresses as follows:
   - Address1: The address of the Option List.
   - Address2: The address of the Alternate DDname List.
   - Address3: The address of the Page Number List.
   Methods of calling ICEGENER that generate a valid parameter list will allow ICEGENER to use DFSORT’s copy feature, whereas methods of calling ICEGENER that generate an invalid parameter list will cause ICEGENER to transfer control to IEBGENER. For example:
     
     `call *(icegener)`
     
     on the TSO command line generates a valid parameter list, whereas:
     `icegener`
     
     on the TSO command line generates an invalid parameter list.
ICEGENER Return Codes

ICEGENER can use either IEBGENER or the DFSORT copy function. However, for unsuccessful completion due to an unsupported operating system, ICEGENER passes back a return code of 24 to the operating system or the invoking program, without using either IEBGENER or DFSORT copy.

If ICEGENER transfers control to IEBGENER, IEBGENER passes back its return code to the operating system or the invoking program.

If ICEGENER uses the DFSORT copy function:
- For successful completion, ICEGENER passes back a return code of 0 or 4 to the operating system or the invoking program.
- For unsuccessful completion with NOABEND in effect, ICEGENER passes back a return code of 12 (changed from 16) to the operating system or the invoking program.
- For unsuccessful completion with ABEND in effect, DFSORT issues a user abend with the appropriate code as specified by the ABCODE installation option (either the error message number or a number between 1 and 99).

The meanings of the return codes that ICEGENER passes back (in register 15) are:

0  Successful completion. ICEGENER completed successfully.
4  Successful completion. ICEGENER completed successfully, and:
   • Installation option GNPAD=RC4 was specified and the SYSUT2 LRECL was larger than the SYSUT1 LRECL (LRECL padding) or
   • Installation option GNTRUNC=RC4 was specified and the SYSUT2 LRECL was smaller than the SYSUT1 LRECL (LRECL truncation), or
   • SPANINC=RC4 was in effect and one or more incomplete spanned records was detected, or
   • NULLOUT=RC4 was in effect and there were no records for the SYSUT2 data set, or
   • NULLOFL=RC4 was in effect and there were no data records for an OUTFIL data set.
12 Unsuccessful completion. DFSORT detected an error that prevented ICEGENER from completing successfully.
24 Unsupported operating system. This operating system is not supported by this release of DFSORT.

Use DFSORT's Performance Booster for The SAS System

DFSORT provides significant CPU time improvements for SAS applications. To take advantage of this feature, contact SAS Institute Inc. for details of the support they provide to enable this enhancement.

Use DFSORT's BLDINDEX Support

DFSORT provides support that enables IDCAMS BLDINDEX to automatically use DFSORT to improve the performance of most BLDINDEX jobs that require BLDINDEX external sorting.
## Chapter 11. Examples of DFSORT Job Streams

The table below summarizes the examples provided in this chapter.

<table>
<thead>
<tr>
<th>Application</th>
<th>No.</th>
<th>Input</th>
<th>Output</th>
<th>Functions/Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sort</td>
<td>1</td>
<td>Disk</td>
<td>Tape</td>
<td>ALTSEQ</td>
</tr>
<tr>
<td>Sort</td>
<td>2</td>
<td>Disk</td>
<td>Disk</td>
<td>OMIT, SUM, OUTREC, DYNALLOC, ZDPRINT</td>
</tr>
<tr>
<td>Sort</td>
<td>3</td>
<td>Tape</td>
<td>Tape</td>
<td>ASCII Tapes</td>
</tr>
<tr>
<td>Sort</td>
<td>4</td>
<td>Tape</td>
<td>Disk</td>
<td>E15, E35, FILSZ, AVGRLEN, DYNALLOC</td>
</tr>
<tr>
<td>Sort</td>
<td>5</td>
<td>Disk</td>
<td>Disk</td>
<td>Program-invoked, SORTCNTL, CHALT, DYNALLOC, FILSZ</td>
</tr>
<tr>
<td>Sort</td>
<td>6</td>
<td>Disk</td>
<td>Disk</td>
<td>VSAM Input/Output, DFSPARM, Option Override</td>
</tr>
<tr>
<td>Sort</td>
<td>7</td>
<td>Disk</td>
<td>Disk</td>
<td>COBOL E15, EXEC PARM, MSGDDN</td>
</tr>
<tr>
<td>Sort</td>
<td>8</td>
<td>Disk</td>
<td>Disk</td>
<td>Dynamic Link-editing of Exits</td>
</tr>
<tr>
<td>Sort</td>
<td>9</td>
<td>E15</td>
<td>Disk</td>
<td>Extended Parameter List Interface</td>
</tr>
<tr>
<td>Sort</td>
<td>10</td>
<td>Disk</td>
<td>Disk and</td>
<td>OUTFIL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SYSPUT</td>
<td></td>
</tr>
<tr>
<td>Sort</td>
<td>11</td>
<td>Pipe</td>
<td>Pipes</td>
<td>Pipes, OUTFIL SPLIT, FILSZ, DYNALLOC</td>
</tr>
<tr>
<td>Sort</td>
<td>12</td>
<td>Disk</td>
<td>Disk</td>
<td>INCLUDE, LOCALE</td>
</tr>
<tr>
<td>Sort</td>
<td>13</td>
<td>z/OS UNIX</td>
<td>z/OS UNIX</td>
<td></td>
</tr>
<tr>
<td>Merge</td>
<td>1</td>
<td>Disk</td>
<td>Disk</td>
<td>EQUALS</td>
</tr>
<tr>
<td>Merge</td>
<td>2</td>
<td>Disk</td>
<td>Disk</td>
<td>LOCALE, OUTFIL</td>
</tr>
<tr>
<td>Copy</td>
<td>1</td>
<td>Tape</td>
<td>Disk</td>
<td>EXEC PARMs, SKIPREC, MSGPRT, ABEND</td>
</tr>
<tr>
<td>Copy</td>
<td>2</td>
<td>Disk</td>
<td>Disk</td>
<td>INCLUDE, VLSHRT</td>
</tr>
<tr>
<td>Copy</td>
<td>3</td>
<td>Disk</td>
<td>Disk</td>
<td>OUTFREC, PARSE, BUILD</td>
</tr>
</tbody>
</table>

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Summary of Examples

<table>
<thead>
<tr>
<th>Application</th>
<th>No.</th>
<th>Input</th>
<th>Output</th>
<th>Functions/Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICEGENER</td>
<td>1</td>
<td>Disk</td>
<td>Disk</td>
<td></td>
</tr>
<tr>
<td>ICETOOL</td>
<td>1</td>
<td>Disk</td>
<td>Disk</td>
<td>OCCUR, COPY, SORT, MODE, VERIFY, STATS, DISPLAY</td>
</tr>
</tbody>
</table>

Storage Administrator Examples

DFSORT provides a set of sample jobs that demonstrate techniques of interest to Storage Administrators and others who analyze data collected from DFSMSHsm, DFSMSrmm, DCOLLECT and SMF. These sample jobs can be found in the ICESTGEX member of the SICESAMP library (contact your System Programmer for details). You can also download these sample jobs from the DFSORT FTP site.

These sample jobs show some of the many ways DFSORT features such as ICETOOL and OUTFIL can be used to analyze data and generate reports:

- **DCOLEX1**  
  DCOLLECT Example 1: VSAM report

- **DCOLEX2**  
  DCOLLECT Example 2: Conversion reports

- **DCOLEX3**  
  DCOLLECT Example 3: Capacity planning analysis and reports

- **DFHSMEX1**  
  DFHSM Example 1: Deciphering Activity Logs

- **DFHSMEX2**  
  DFHSM Example 2: Recover a DFHSM CDS with a broken index

- **RMMEX1**  
  DFSMSrmm Example 1: SMF audit report

- **RMMEX2**  
  DFSMSrmm Example 2: Create ADDVOLUME commands

REXX Examples

Both DFSORT and ICETOOL can be called from REXX. The key is to specify ALLOCATE statements for the data sets you need and then use an ADDRESS statement like this:

```
ADDRESS LINKMVS name
```

which says to fetch the named program using the standard system search list.

Here is an example of a REXX CLIST to call DFSORT:

```
/* Simple REXX CLIST to call DFSORT */
"FREE FI(SYSOUT SORTIN SORTOUT SYSIN)"
"ALLOC FI(SYSOUT) DA(*)"
"ALLOC FI(SORTIN) DA('Y897797.INS1') REUSE"
"ALLOC FI(SORTOUT) DA('Y897797.OUTS1') REUSE"
"ALLOC FI(SYSIN) DA('Y897797.SORT.STMTS') SHR REUSE"
ADDRESS LINKMVS ICEMAN
```

Here are the DFSORT control statements that might appear in the Y897797.SORT.STMTS data set:

```
SORT FIELDS=(5,4,CH,A)
INCLUDE COND=(21,3,SS,EQ,'L92,J82,M72')
```

Here is an example of a REXX CLIST to call ICETOOL:

```
/* Simple REXX CLIST to call ICETOOL */
"FREE FI(TOOLMSG DFSMSG VLR LENDIST TOOLIN)"
"ALLOC FI(TOOLMSG) DA(*)"
"ALLOC FI(DFSMSG) DUMMY"
"ALLOC FI(VLR) DA('Y897797.VARIN') REUSE"
"ALLOC FI(LENDIST) DA(*)"
"ALLOC FI(TOOLIN) DA('Y897797.TOOLIN.STMTS') SHR REUSE"
ADDRESS LINKMVS ICETOOL
```
Summary of Examples

Here are the ICETOOL statements that might appear in the Y897797.TOOLIN.STMTS data set:

```plaintext
OCCURS FROM(VLR) LIST(LENDIST) -
  TITLE('LENGTH DISTRIBUTION REPORT') BLANK -
  HEADER('LENGTH') HEADER('NUMBER OF RECORDS') -
  ON(VLEN) ON(VALCNT)
```

**CLIST Examples**

Both DFSORT and ICETOOL can be called from a CLIST. They key is to specify ALLOCATE statements for the data sets you need and then use a CALL statement like this:

```plaintext
CALL *(name)
```

Here is an example of a CLIST to call DFSORT:

```plaintext
FREE FI(SYSOUT SORTIN SORTOUT SYSIN)
ALLOC FI(SYSOUT) DA(*)
ALLOC FI(SORTIN) DA('Y897797.INS1') REUSE
ALLOC FI(SORTOUT) DA('Y897797.OUTS1') REUSE
ALLOC FI(SYSIN) DA('Y897797.SORT.STMTS') SHR REUSE
CALL *(ICEMAN)
```

Here are the DFSORT control statements that might appear in the Y897797.SORT.STMTS data set:

```plaintext
SORT FIELDS=(5,4,CH,A)
INCLUDE COND=(21,3,SS,EQ,C'L92,J82,M72')
```

Here is an example of a CLIST to call ICETOOL:

```plaintext
FREE FI(TOOLMSG DFSMSG VLR LENDIST TOOLIN)
ALLOC FI(TOOLMSG) DA(*)
ALLOC FI(DFSMSG) DUMMY
ALLOC FI(VLR) DA('Y897797.VARIN') REUSE
ALLOC FI(LENDIST) DA(*)
ALLOC FI(TOOLIN) DA('Y897797.TOOLIN.STMTS') SHR REUSE
CALL *(ICETOOL)
```

Here are the ICETOOL statements that might appear in the Y897797.TOOLIN.STMTS data set:

```plaintext
OCCURS FROM(VLR) LIST(LENDIST) -
  TITLE('LENGTH DISTRIBUTION REPORT') BLANK -
  HEADER('LENGTH') HEADER('NUMBER OF RECORDS') -
  ON(VLEN) ON(VALCNT)
```

**Sort Examples**

This section includes 14 sort examples.

**Example 1. Sort with ALTSEQ**

<table>
<thead>
<tr>
<th>INPUT</th>
<th>Blocked variable-length records on disk</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTPUT</td>
<td>Blocked variable-length records on 3490</td>
</tr>
<tr>
<td>WORK DATA SETS</td>
<td>Two 3390 data sets</td>
</tr>
<tr>
<td>USER EXITS</td>
<td>None</td>
</tr>
<tr>
<td>FUNCTIONS/OPTIONS</td>
<td>ALTSEQ</td>
</tr>
<tr>
<td>//EXAMP JOB A400,PROGRAMMER</td>
<td>01</td>
</tr>
<tr>
<td>//S1 EXEC PGM=SORT</td>
<td>02</td>
</tr>
<tr>
<td>//SYSOUT DD SYSOUT=A</td>
<td>03</td>
</tr>
<tr>
<td>//SORTIN DD DSN=A123456.IN5,DISP=SHR</td>
<td>04</td>
</tr>
<tr>
<td>//SORTOUT DD DSN=OUT1,UNIT=3490,DISP=(,KEEP),VOL=SER=VOL001</td>
<td>05</td>
</tr>
</tbody>
</table>
Sort Examples

```
//SORTWK01 DD UNIT=3390,SPACE=(CYL,(10,10))
//SORTWK02 DD UNIT=3390,SPACE=(CYL,(10,10))
//SYSIN DD *
* COLLATE $, # and @ AFTER Z
SORT FIELDS=(7,5,AQ,A)
ALTSEQ CODE=(5BEA,7BEB,7CEC)
```

<table>
<thead>
<tr>
<th>Line</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>JOB statement. Introduces this job to the operating system.</td>
</tr>
<tr>
<td>02</td>
<td>EXEC statement. Calls DFSORT directly by its alias SORT.</td>
</tr>
<tr>
<td>03</td>
<td>SYSOUT DD statement. Directs DFSORT messages and control statements to system output class A.</td>
</tr>
<tr>
<td>04</td>
<td>SORTIN DD statement. The input data set is named A123456.IN5 and is cataloged. DFSORT determines from the data set label that the RECFM is VB, the maximum LRECL is 120, and the BLKSIZE is 2200.</td>
</tr>
<tr>
<td>05</td>
<td>SORTOUT DD statement. The output data set is named OUT1 and is to be allocated on 3490 volume VOL001 and kept. DFSORT sets the RECFM and LRECL from SORTIN and selects an appropriate BLKSIZE for this standard labeled tape.</td>
</tr>
<tr>
<td>06</td>
<td>SORTWK01 DD statement. The first work data set is allocated on 3390.</td>
</tr>
<tr>
<td>07</td>
<td>SORTWK02 DD statement. The second work data set is allocated on 3390.</td>
</tr>
<tr>
<td>08</td>
<td>SYSIN DD statement. DFSORT control statements follow.</td>
</tr>
<tr>
<td>09</td>
<td>Comment statement. Printed but otherwise ignored.</td>
</tr>
<tr>
<td>10</td>
<td>SORT statement. FIELDS specifies an ascending 5-byte character control field starting at position 7 (the third data byte, because the RDW occupies the first 4 bytes). The control field is to be collated according to the modified sequence described in the ALTSEQ statement.</td>
</tr>
<tr>
<td>11</td>
<td>ALTSEQ statement. CODE specifies that the three characters $, # and @ are to collate in that order after Z.</td>
</tr>
</tbody>
</table>

Example 2. Sort with OMIT, SUM, OUTREC, DYNALLOC and ZDPRINT

```
//EXAMPLE JOB A400,PROGRAMMER
//STEP1 EXEC PGM=SORT
//SYSOUT DD SYSOUT=H
//SORTIN DD DSN=INP1,DISP=SHR,UNIT=3380,VOL=SER=SCR001
// DD DSN=INP2,DISP=SHR,UNIT=3390,VOL=SER=SYS351
// SPACE=(CYL,(5,1)),DCB=(LRECL=22)
//SYSIN DD *
OMIT COND=(5,1,CH,EQ,C'M')
SORT FIELDS=(20,8,CH,A,10,3,FI,D)
SUM FIELDS=(16,4,2D)
OPTION DYNALLOC,ZDPRINT
OUTREC FIELDS=(10,3,20,8,16,4,2Z,5,1,C' SUM')
```

<table>
<thead>
<tr>
<th>Line</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>02</td>
<td>JOB statement. Introduces this job to the operating system.</td>
</tr>
</tbody>
</table>
Sort Examples

02 EXEC statement. Calls DFSORT directly by its alias SORT.
03 SYSOUT DD statement. Directs DFSORT messages and control statements to system output class H.
04-05 SORTIN DD statement. Consists of a concatenation of two data sets. The first input data set is named INP1 and resides on 3380 volume SCR001. The second input data set is named INP2 and resides on 3390 volume SYS351. DFSORT determines from the data set labels that the record format is FB, the LRECL is 80 and the largest BLKSIZE is 27920.
06-07 SORTOUT DD statement. The output data set is temporary and is to be allocated on a 3390. Because the OUTREC statement results in a reformatted output record length of 22 bytes, LRECL=22 must be specified. DFSORT sets the RECFM from SORTIN and selects an appropriate BLKSIZE.
08 SYSIN DD statement. DFSORT control statements follow.
09 OMIT statement. COND specifies that input records with a character M in position 5 are to be omitted from the output data set.
10 SORT statement. FIELDS specifies an ascending 8-byte character control field starting at position 20 and a descending 3-byte fixed-point control field starting at position 10.
11 SUM statement. FIELDS specifies a 4-byte zoned-decimal summary field starting at position 16. Whenever two records with the same control fields (specified in the SORT statement) are found, their summary fields (specified in the SUM statement) are to be added and placed in one of the records, and the other record is to be deleted.
12 OPTION statement. DYNALLOC specifies that work data sets are to be dynamically allocated using the installation defaults for the type of device and number of devices. ZDPRINT specifies that positive ZD SUM fields are to be printable.
13 OUTREC statement. FIELDS specifies how the records are to be reformatted for output. The reformatted records are 22 bytes long and look as follows:

<table>
<thead>
<tr>
<th>Position</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3</td>
<td>Input positions 10 through 12</td>
</tr>
<tr>
<td>4-11</td>
<td>Input positions 20 through 27</td>
</tr>
<tr>
<td>12-15</td>
<td>Input positions 16 through 19</td>
</tr>
<tr>
<td>16-17</td>
<td>Zeros</td>
</tr>
<tr>
<td>18</td>
<td>Input position 5</td>
</tr>
<tr>
<td>19-22</td>
<td>The character string 'SUM'</td>
</tr>
</tbody>
</table>

Example 3. Sort with ASCII Tapes

INPUT Variable-length ASCII records on 3590
OUTPUT Variable-length ASCII records on 3590
WORK DATA SETS One SYSDA data set
USER EXITS None
FUNCTIONS/OPTIONS None

//EXAMP JOB A400,PROGRAMMER 01
//RUNIT EXEC SORTD 02
//SORTIN DD DSN=SRTFIL,DISP=(OLD,DELETE),UNIT=3590, 03
Example 4. Sort with E15, E35, FILSZ, AVGRLEN and DYNALLOC

**INPUT**
Variable-length records on 3490

**OUTPUT**
Blocked variable-length records on SYSDA

**WORK DATA SETS**
Dynamically allocated

**USER EXITS**
E15 and E35

**FUNCTIONS/OPTIONS**
FILSZ, AVGRLEN, DYNALLOC

---

//EXAMP JOB A400,PROGRAMMER
//STEP1 EXEC PGM=ICEMAN
//SYSOUT DD SYSOUT=A
//SORTIN DD DSN=INPUT,UNIT=3490,DISP=OLD
//SORTOUT DD DSN=OUTFIL,UNIT=3590,DISP=(,KEEP)
// DCB=(RECFM=D,LRECL=400,BLKSIZE=404,OPTCD=Q,BUFOFF=L), 04
// VOL=SER=311500,LABEL=(1,AL) 05
//SORTOUT DD DSN=OUTFIL,UNIT=3590,DISP=(,KEEP), 06
// DCB=(RECFM=EBCDIC,LRECL=400,BLKSIZE=404,OPTCD=Q,BUFOFF=L),VOL=SER=311501 07
//SORTWK01 DD UNIT=SYSDA,SPACE=(CYL,(4)) 08
//SYSIN DD * 09
SORT FIELDS=(10,8,AC,D) 10
RECORD TYPE=D,LENGTH=(,,,20,80) 11

---

Line  Explanation
01  JOB statement. Introduces this job to the operating system.
02  EXEC statement. Uses the SORTD cataloged procedure to call DFSORT directly.
03-05 SORTIN DD statement. The input data set is named SRTFIL and resides on 3590 volume 311500. It is to be deleted after this job step. It has a RECFM of D (variable-length ASCII records), a maximum LRECL of 400, a BLKSIZE of 404 and an ASCII label. For this job, the buffer offset is the block length indicator. The records are to be translated from ASCII to EBCDIC.
06-07 SORTOUT DD statement. The output data set is named OUTFIL and is to be allocated on 3590 volume 311501 and kept. It is to be written with an ASCII label. DFSORT sets the RECFM and LRECL from SORTIN and sets the BLKSIZE to 404 as indicated in the DD statement. For this job, the buffer offset is the block length indicator. The records are to be translated from EBCDIC to ASCII.
08  SORTWK01 DD statement. The work data set is allocated on SYSDA.
09  SYSIN DD statement. DFSORT control statements follow.
10  SORT statement. FIELDS specifies a descending 8-byte ASCII control field starting at position 10.
11  RECORD statement. TYPE specifies ASCII variable-length records.
LENETH specifies that the minimum record length is 20 and the average record length is 80.

---

Example 4. Sort with E15, E35, FILSZ, AVGRLEN and DYNALLOC

**INPUT**
Variable-length records on 3490

**OUTPUT**
Blocked variable-length records on SYSDA

**WORK DATA SETS**
Dynamically allocated

**USER EXITS**
E15 and E35

**FUNCTIONS/OPTIONS**
FILSZ, AVGRLEN, DYNALLOC

---

//EXAMP JOB A400,PROGRAMMER 01
//STEP1 EXEC PGM=ICEMAN 02
//SYSOUT DD SYSOUT=A 03
//SORTIN DD DSN=INPUT,UNIT=3490,DISP=OLD 04
// UNIT=3490,DISP=OLD 05
//SORTOUT DD DSN=OUTFIL,UNIT=3590,DISP=(,KEEP),SPACE=(CYL,(10,12)), 06
// MODLIB DD DSN=EXIT1.RTNS,DISP=SHR 07
// DD DSN=EXIT2.RTNS,DISP=SHR 08
//SYSIN DD * 09
SORT FIELDS=(23,4,PD,A,10,6,FS,A) 10
OPTION DYNALLOC=(3390,3),AVGRLEN=75,FILSZ=E50000 11
MODS E15=(MODREC,1024,MODLIB),E35=(ADDREC,1200,MODLIB) 12

---

Line  Explanation
01  JOB statement. Introduces this job to the operating system.
02  EXEC statement. Uses the SORTD cataloged procedure to call DFSORT directly.
03-05 SORTIN DD statement. The input data set is named SRTFIL and resides on 3590 volume 311500. It is to be deleted after this job step. It has a RECFM of D (variable-length ASCII records), a maximum LRECL of 400, a BLKSIZE of 404 and an ASCII label. For this job, the buffer offset is the block length indicator. The records are to be translated from ASCII to EBCDIC.
06-07 SORTOUT DD statement. The output data set is named OUTFIL and is to be allocated on 3590 volume 311501 and kept. It is to be written with an ASCII label. DFSORT sets the RECFM and LRECL from SORTIN and sets the BLKSIZE to 404 as indicated in the DD statement. For this job, the buffer offset is the block length indicator. The records are to be translated from EBCDIC to ASCII.
08  SORTWK01 DD statement. The work data set is allocated on SYSDA.
09  SYSIN DD statement. DFSORT control statements follow.
10  SORT statement. FIELDS specifies a descending 8-byte ASCII control field starting at position 10.
11  RECORD statement. TYPE specifies ASCII variable-length records.
LENETH specifies that the minimum record length is 20 and the average record length is 80.
Sort Examples

Example 5. Called sort with SORTCNTL, CHALT, DYNALLOC and FILSZ

<table>
<thead>
<tr>
<th>INPUT</th>
<th>Blocked fixed-length records on disk</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTPUT</td>
<td>Blocked fixed-length records on disk</td>
</tr>
<tr>
<td>WORK DATA SETS</td>
<td>Dynamically allocated</td>
</tr>
<tr>
<td>USER EXITS</td>
<td>None</td>
</tr>
<tr>
<td>FUNCTIONS/OPTIONS</td>
<td>CHALT, DYNALLOC, FILSZ</td>
</tr>
</tbody>
</table>

```
//EXAMP JOB A400,PROGRAMMER 01
//RUNSORT EXEC PGM=MYPGM 02
//STEPLIB DD DSN=M999999.LOAD,DISP=SHR 03
//SYSOUT DD SYSOUT=A 04
//SYSPRINT DD SYSOUT=A 05
//SORTIN DD DSN=M999999.INPUT(MASTER),DISP=OLD 06
//SORTOUT DD DSN=M999999.OUTPUT.FILE,DISP=OLD 07
//SORTCNTL DD * 08
OPTION CHALT,DYNALLOC=(3),FILSZ=U25000 09
```
### Sort Examples

<table>
<thead>
<tr>
<th>Line</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>JOB statement. Introduces this job to the operating system.</td>
</tr>
<tr>
<td>02</td>
<td>EXEC statement. Calls a program named MYPGM that in turn calls DFSORT.</td>
</tr>
<tr>
<td>03</td>
<td>STEPLIB DD statement. Specifies the load library that contains MYPGM.</td>
</tr>
<tr>
<td>04</td>
<td>SYSOUT DD statement. Directs DFSORT messages and control statements to system output class A.</td>
</tr>
<tr>
<td>05</td>
<td>SYSPRINT DD statement. Directs MYPGM output to system output class A.</td>
</tr>
<tr>
<td>06</td>
<td>SORTIN DD statement. The input data set is member MASTER in the cataloged partitioned data set M999999.INPUT. DFSORT determines the RECFM, LRECL and BLKSIZE from the data set label.</td>
</tr>
<tr>
<td>07</td>
<td>SORTOUT DD statement. The output data set is named M999999.OUTPUT.FILE and is cataloged. DFSORT determines the RECFM, LRECL and BLKSIZE from the data set label.</td>
</tr>
<tr>
<td>08</td>
<td>SORTCNTL DD statement. DFSORT control statements follow. Statements in SORTCNTL override or supplement statements passed by MYPGM in the DFSORT parameter list it uses.</td>
</tr>
<tr>
<td>09</td>
<td>OPTION statement. CHALT specifies that character format control fields (specified in the SORT statement passed by MYPGM) are to be sorted using the ALTSEQ installation option. DYNALLOC=(,3) specifies that three work data sets are to be dynamically allocated using the installation default for the type of device. FILSZ=U25000 specifies a file size of 25000 records is to be used by DFSORT to determine the amount of work space needed. Because the input data set is a member of a PDS, specifying FILSZ helps DFSORT optimize work data set space.</td>
</tr>
</tbody>
</table>
Example 6. Sort with VSAM Input/Output, DFSPARM and Option Override

<table>
<thead>
<tr>
<th>INPUT</th>
<th>VSAM TYPE=V records</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTPUT</td>
<td>VSAM TYPE=V records</td>
</tr>
<tr>
<td>WORK DATA SETS</td>
<td>Dynamically allocated</td>
</tr>
<tr>
<td>USER EXITS</td>
<td>None</td>
</tr>
<tr>
<td>FUNCTIONS/OPTIONS</td>
<td>Override of Various Options</td>
</tr>
</tbody>
</table>

```plaintext
//EXAMP JOB A400,PROGRAMMER 01
//S1 EXEC PGM=SORT 02
//SYSOUT DD SYSOUT=A 03
//SORTIN DD DSN=TEST.SORTIN.FILE,DISP=SHR 04
//SORTOUT DD DSN=TEST.SORTOUT.FILE,DISP=SHR 05
//DFSPARM DD * 06
  RECORD TYPE=V 07
  SORT FIELDS=(30,4,BI,A) 08
  OPTION HIPRMAX=10,DYNALLOC=3390,MAINSIZE=3M, 09
      MSGPRT=CRTICAL,NOLIST 10
```

For purposes of illustration, assume that none of the standard installation defaults for batch direct invocation of DFSORT have been changed by the site.

**Line** | **Explanation**
--- | ---
01 | JOB statement. Introduces this job to the operating system.
02 | EXEC statement. Calls DFSORT directly by its alias SORT.
03 | SYSOUT DD statement. Directs DFSORT messages and control statements to system output class A.
04 | SORTIN DD statement. The input data set is TEST.SORTIN.FILE. DFSORT determines that it is a VSAM data set and obtains its attributes from the catalog.
05 | SORTOUT DD statement. The output data set is TEST.SORTOUT.FILE. DFSORT determines that it is a VSAM data set and obtains its attributes from the catalog.
06 | DFSPARM DD statement. DFSORT control statements follow. DFSPARM can be used for both direct-invocation and program-invocation of DFSORT and overrides options and statements from all other sources. Certain operands, such as MSGPRT and LIST/NOLIST, are used if supplied in DFSPARM, the EXEC PARM or the invocation parameter list, but not used if supplied in SYSIN or SORTCNTL.
07 | RECORD statement. TYPE=V specifies that DFSORT is to treat the VSAM records as variable-length. In this case, the RECORD statement could be omitted, because DFSORT would automatically set a record type of V due to the use of VSAM data sets for SORTIN and SORTOUT.
08 | SORT statement. FIELDS specifies an ascending 4-byte binary control field starting at position 30. This position corresponds to a specification of KEYS(25) for the VSAM CLUSTER (4 bytes at offset 25, which is equivalent to position 26 with 4 bytes added for the RDW that DFSORT supplies at input and removes at output for VSAM TYPE=V records).
09-10 | OPTION statement. HIPRMAX=10 specifies that up to 10 MBs of Hiperspace can be used for Hipersorting, overriding the standard installation default of HIPRMAX=OPTIMAL. DYNALLOC=3390 specifies that work data sets are to be allocated on 3390s, overriding the standard installation default of SYSDA. The standard installation default of four work data sets is not overridden. MAINSIZE=3M specifies that up to 3
Example 7. Sort with COBOL E15, EXEC PARM and MSGDDN

INPUT Fixed-length records on disk
OUTPUT Fixed-length records on SYSDA
WORK DATA SETS None
USER EXITS COBOL E15
FUNCTIONS/OPTIONS MSGDDN

Line  Explanation
01   JOB statement. Introduces this job to the operating system.
02   EXEC statement. Calls DFSORT directly by its alias name SORT. MSGDDN=DFSOUT specifies an alternate message data set for DFSORT messages and control statements to prevent the COBOL messages in SYSOUT from being interleaved with the DFSORT messages and control statements.
03   STEPLIB statement. Specifies the Language Environment library.
04   SYSOUT statement. Directs COBOL messages to system output class A.
05   DFSOUT statement. Directs DFSORT messages and control statements to system output class A (this is the alternate message data set specified by MSGDDN in the PARM field of the EXEC statement).
06   EXICT statement. Specifies the load library that contains the exit routine.
07   SORTIN DD statement. The input data set is named SORT1.IN and is cataloged. DFSORT determines from the data set label that the RECFM is F, the LRECL is 100 and the BLKSIZE is 100.
08-09 SORTOUT DD statement. The output data set is temporary and is to be allocated on SYSDA. Because the E15 exit changes the length of the records from 100 bytes to 120 bytes, LRECL=120 must be specified. DFSORT sets the RECFM from SORTIN and sets the BLKSIZE to the LRECL (unblocked records).
10   SYSin DD statement. DFSORT control statements follow.
11   SORT statement. FIELDS specifies an ascending 4-byte control field starting at position 5 and an ascending 2-byte control field starting at position 22. FORMAT specifies that the control fields are binary.
12   MODS statement. E15 specifies a user exit routine named COBOLE15
Sort Examples

written in COBOL. Approximately 37000 bytes are required for the exit, the system services (for example, GETMAIN and OPEN) it performs, and the COBOL library subroutines. COBOLE15 resides in the library defined by the EXITC DD statement.

13 RECORD statement. LENGTH specifies that the COBOL E15 routine changes the length of the records to 120 bytes.
Example 8. Sort with Dynamic Link-Editing of Exits

INPUT  Blocked fixed-length records on disk
OUTPUT Blocked fixed-length records on 3380
WORK DATA SETS One SYSDA data set
USER EXITS E11, E15, E17, E18, E19, E31, E35, E38, E39
FUNCTIONS/OPTIONS None

```
//EXAMP JOB A400,PROGRAMMER
//STEPA EXEC SORT
//SORTIN DD DSN=SMITH.INPUT,DISP=SHR
//SORTOUT DD DSN=SMITH.OUTPUT,DISP=(NEW,CATLG), UNIT=3380,SPACE=(TRK,(10,2)),VOL=SER=XYZ003
//SORTWK01 DD UNIT=SYSDA,SPACE=(CYL,(1,1))
//EXIT DD DSN=SMITH.EXIT.OBJ,DISP=SHR
//EXIT2 DD DSN=SMITH.EXIT2.OBJ,DISP=SHR
//SORTMODS DD UNIT=SYSDA,SPACE=(TRK,(10,,3))
//SYSIN DD *
SORT FIELDS=(1,8,CH,A,20,4,BI,D)
MODS E11=(EXIT11,1024,EXIT,S), E15=(E15,1024,SYSIN,T), E17=(EXIT17,1024,EXIT2,T), E18=(EXIT18,1024,EXIT,T), E19=(E19,1024,SYSIN,T), E31=(PH3EXIT,1024,EXIT,T), E35=(PH3EXIT,1024,EXIT,T), E38=(PH3EXIT,1024,EXIT,T), E39=(E39,1024,SYSIN,T)
END
```

Line  Explanation
01  JOB statement. Introduces this job to the operating system.
02  EXEC statement. Uses the SORT cataloged procedure to call DFSORT directly and supply the DD statements (not shown) required by the linkage editor.
03  SORTIN DD statement. The input data set is named SMITH.INPUT and is cataloged. DFSORT determines the RECFM, LRECL and BLKSIZE from the data set label.
04-05 SORTOUT DD statement. The output data set is named SMITH.OUTPUT and is to be allocated on 3380 volume XYZ003 and cataloged. DFSORT sets the RECFM and LRECL from SORTIN and selects an appropriate BLKSIZE.
06  SORTWK01 DD statement. The work data set is allocated on SYSDA.
07  EXIT DD statement. Specifies the partitioned data set containing the object decks for the E11, E18, E31, E35 and E38 exit routines.
08  EXIT2 DD statement. Specifies the partitioned data set containing the object deck for the E17 exit routine.
09  SORTMODS DD statement. The partitioned data set to hold exit routine object decks from SYSIN for input to the linkage editor is to be allocated on SYSDA.
10  SYSIN DD statement. DFSORT control statements, and object decks to be used by the linkage editor, follow.
11  SORT statement. FIELDS specifies an ascending 8-byte character control field starting at position 1 and a descending 4-byte binary control field starting at position 20.
12-20 MODS statement. Specifies the exit routines to be used, the approximate number of bytes required for each exit and that:

- The EXIT11 routine in the EXIT library is to be link-edited separately from other input phase exit routines and associated with user exit E11.
- The E15 and E19 routines in SYSIN, the EXIT17 routine in EXIT2, and the EXIT18 routine in EXIT are to be link-edited together and associated with user exits E15, E19, E17, and E18, respectively.
- The E31, E35, and E38 routines in the PH3EXIT object deck and the E39 routine in SYSIN are to be link-edited together and associated with user exits E31, E35, E38, and E39, respectively.

21 END statement. Marks the end of the DFSORT control statements and the beginning of the exit routine object decks.


Example 9. Sort with the Extended Parameter List Interface

**INPUT**  
Fixed-length records from E15

**OUTPUT**  
Blocked fixed-length records on SYSDA

**WORK DATA SETS**  
Dynamically allocated

**USER EXITS**  
E15

**FUNCTIONS/OPTIONS**  
OMIT, FILSZ, RESINV, DYNALLOC

```
//EXAMP JOB A400,PROGRAMMER 01
//STEP1 EXEC PGM=MYSORT 02
//SYSOUT DD SYSOUT=C 03
//MSGOUT DD SYSOUT=C 04
//STEPLIB DD DSN=A123456.LOAD,DISP=SHR 05
//SORTOUT DD DSN=&&OUTPUT,DISP=(,PASS),UNIT=SYSDA, 06
// SPACE=(CYL,(8,4)) 07
//SORTCNTL DD * 08
*/ Update file size estimate 09
OPTION FILSZ=E30000 10
-----------------------------------------------------------------------
-----------------------------------------------------------------------
MYSORT CSECT 11
   LA R1,PL1 SET ADDRESS OF PARAMETER LIST 12
* TO BE PASSED TO DFSORT 13
   ST R2,PL4 SET ADDRESS OF GETMAINED AREA 14
* TO BE PASSED TO E15 15
   LINK EP=SORT INVOKE DFSORT 16
   .
   .
   LA R1,PL1 SET ADDRESS OF PARAMETER LIST 17
PL1    DC A(CTLST) ADDRESS OF CONTROL STATEMENTS 18
PL2    DC A(E15) ADDRESS OF E15 ROUTINE 19
PL3    DC A(0) NO E35 ROUTINE 20
PL4    DS A USER EXIT ADDRESS CONSTANT 21
PL5    DC F'-1' INDICATE END OF LIST 22
CTLST  DS 0H CONTROL STATEMENTS AREA 23
   DC AL2(CTL2-CTL1) LENGTH OF CHARACTER STRING 24
   DC CTL1 SORT FIELDS=(5,8,CSF,A) 25
   DC CTL1 RECORD TYPE=F,LENGTH=80 ' 26
   DC CTL1 OPTION FILSZ=E25000,DYNALLOC, 27
   DC CTL1 RESINV=8000 ' 28
   DC CTL1 OMIT FORMAT=CSF,COND=(5,8,EQ,13,8) ' 29
   CTL2 EQU * 30
OUT     DCB DDNAME=MSGOUT,... 31
```
The JCL for running program MYSORT, and highlights of the code used by MYSORT to invoke DFSORT with the extended parameter list, are shown below. For purposes of illustration, assume that none of the standard installation defaults for batch program invocation of DFSORT have been changed by the site.

**Line** | **Explanation**
--- | ---
01 | JOB statement. Introduces this job to the operating system.
02 | EXEC statement. Calls a program named MYSORT that in turn calls DFSORT.
03 | SYSOUT DD statement. Directs DFSORT messages and control statements to SYSOUT class C.
04 | MSGOUT DD statement. Directs MYSORT messages to SYSOUT class C.
05 | STEPLIB DD statement. Specifies the load library that contains MYSORT.
06-07 | SORTOUT DD statement. The output data set is temporary and is to be allocated on SYSDA. Because SORTIN is not used, DFSORT sets the RECFM and LRECL from the RECORD statement and sets the BLKSIZE to the LRECL (unblocked records).
08 | SORTCNTL DD statement. DFSORT control statements follow. Statements in SORTCNTL override or supplement statements passed by MYSORT in the extended parameter list it uses.
09 | Comment statement. Printed but otherwise ignored.
10 | OPTION statement. FILSZ=E30000 specifies an estimate of 30000 records, overriding FILSZ=E25000 in the OPTION statement of the extended parameter list. Because the E15 routine supplies all of the input records, DFSORT will not be able to determine the file size accurately; therefore, specifying FILSZ can make a significant difference in work space optimization when an E15 routine supplies all of the input records. It's important to change the FILSZ value whenever the number of input records increases significantly.
11 | This is the start of program MYSORT. Assume that it GETMAINs a work area, saves its address in register 2, and initializes it with information to be used by the E15 routine.
12-13 | MYSORT places the address of the extended parameter list to be passed to DFSORT in register 1.
14-15 | MYSORT places the address of the GETMAINed work area in the user exit address constant field in the extended parameter list.
DFSORT will pass this address to the E15 routine (in the second word of the E15 parameter list) when it is entered.

MYSORT calls DFSORT by its alias SORT.

The extended parameter list specifies: the address of the control statements area, the address of the E15 routine, that no E35 routine is present, and the address of the GETMAINed work area. F-1’ indicates the end of the extended parameter list. Subsequent parameter list fields, such as the address of an ALTSEQ table, are not used in this application.

Because the address of the E15 routine is passed in the parameter list, SORTIN cannot be used; if a SORTIN DD statement were present, it would be ignored.

This is the start of the control statements area. The total length of the control statements is specified.

SORT statement. FIELDS specifies an ascending 8-byte floating-sign control field starting at position 5.

RECORD statement. TYPE=F and LENGTH=80 specify that the E15 inserts fixed-length records of 80 bytes. In this case, TYPE=F could be omitted, because DFSORT would automatically set a record type of F. However, LENGTH must be specified when an E15 supplies all of the input records.

OPTION statement. FILSZ=E25000 specifies an estimate of 25000 records, which is overridden by FILSZ=E30000 in SORTCNTL’s OPTION statement. DYNALLOC specifies that work data sets are to be dynamically allocated using the installation defaults for the type of device and number of devices. RESINV=8000 specifies that approximately 8000 bytes are required for the system services (for example, GETMAIN and OPEN) that MYSORT’s E15 exit routine performs.

OMIT statement. FORMAT specifies that the compare fields are floating-sign. COND specifies that input records with equal 8-byte floating-sign compare fields starting in position 5 (also the control field) and position 13 are to be omitted from the output data set.

This is the end of the control statements area.

This is the DCB for MYSORT’s MSGOUT output.

This is MYSORT’s E15 routine. The E15 routine loads the address of the GETMAINed work area from the second word of the E15 parameter list. The E15 routine must supply each input record by placing its address in register 1 and placing a 12 (insert) in register 15. When all the records have been passed, the E15 routine must place an 8 ("do not return") in register 15.
### Example 10. Sort with OUTFIL

**INPUT**
Fixed-length record data set

**OUTPUT**
Multiple fixed-length record data sets

**WORK DATA SETS**
Dynamically allocated (by default)

**USER EXITS**
None

**FUNCTIONS/OPTIONS**
OUTFIL

```
//EXAMP JOB A400,PROGRAMMER 01
//OUTFIL EXEC PGM=SORT 02
//SYSOUT DD SYSOUT=A 03
//SORTIN DD DSN=GRP.RECORDS,DISP=SHR 04
//ALLGPS DD DSN=GRP.ALLGRPS,DISP=OLD 05
//ALLBU DD DSN=GRP.BU,DISP=(NEW,CATLG,DELETE), 06
// UNIT=3390,SPACE=(TRK,(10,10)) 07
//G1STATS DD SYSOUT=A 08
//G2STATS DD SYSOUT=A 09
//SYSIN DD * 10
SORT FIELDS=(6,5,CH,A) 11
OUTFIL FNAMES=(ALLGPS,ALLBU) 12
```

```
OUTFIL FNAMES=G1STATS, 13
   INCLUDE=(1,3.CH,EQ,C'G01'), 14
   HEADER2=(1:'GROUP 1 STATUS REPORT FOR ',&DATE,
      ' - PAGE ',&PAGE,2/, 15
      6:'ITEM ',16:'STATUS ',31:'PARTS',/,
      6:'-----',16:'------------',31:'-----'), 16
   OUTREC=(6:6,5, 17
      16:14,1,CHANGE=(12, 18
      C'1',C'SHIP', 19
      C'2',C'HOLD', 20
      C'3',C'TRANSFER'), 21
      NOMATCH=(C'*CHECK CODE*'), 22
      31:39,1,BI,M10,LENGTH=5, 23
      120:X) 24
```

```
OUTFIL FNAMES=G2STATS, 25
   INCLUDE=(1,3.CH,EQ,C'G02'), 26
   HEADER2=(1:'GROUP 2 STATUS REPORT FOR ',&DATE,
      ' - PAGE ',&PAGE,2/, 27
      6:'ITEM ',16:'STATUS ',31:'PARTS',/,
      6:'-----',16:'------------',31:'-----'), 28
   OUTREC=(6:6,5, 29
      16:14,1,CHANGE=(12, 30
      C'1',C'SHIP', 31
      C'2',C'HOLD', 32
      C'3',C'TRANSFER'), 33
      NOMATCH=(C'*CHECK CODE*'), 34
      31:39,1,B1,M10,LENGTH=5, 35
      120:X) 36
```

---

**Line**  **Explanation**
---

01 JOB statement. Introduces this job to the operating system.

02 EXEC statement. Calls DFSORT directly by its alias name SORT.

03 SYSOUT DD statement. Directs DFSORT messages and control statements to sysout class A.

04 SORTIN DD statement. The input data set is named GRP.RECORDS and is cataloged. DFSORT determines from the data set label that the RECFM is FB, the LRECL is 80 and the BLKSIZE is 23440.
Sort Examples

05  ALLGPS DD statement. The first OUTFIL output data set is named
    GRP.ALLGRPS and is catalogued. DFSORT determines the RECFM, LRECL
    and BLKSIZE from the data set label.

06-07 ALLBU DD statement. The second OUTFIL output data set is named
    GRP.BU and is to be allocated on a 3390 and catalogued. DFSORT sets the
    RECFM and LRECL from SORTIN and selects an appropriate BLKSIZE.

08  G1STATS DD statement. The third OUTFIL output data set is directed to
    sysout class A. Because this is an OUTFIL report data set, DFSORT sets the
    RECFM to FBA (FB from SORTIN and A for ANSI control characters) and
    the LRECL to 121 (1 byte for the ANSI control character and 120 bytes for
    the data). DFSORT sets an appropriate BLKSIZE.

09  G2STATS DD statement. The fourth OUTFIL output data set is directed to
    sysout class A. Because this is an OUTFIL report data set, DFSORT sets the
    RECFM to FBA (FB from SORTIN and A for ANSI control characters) and
    the LRECL to 121 (1 byte for the ANSI control character and 120 bytes for
    the data). DFSORT sets an appropriate BLKSIZE.

10  SYSIN DD statement. DFSORT control statements follow.

11  SORT statement. FIELDS specifies an ascending 5-byte character control
    field starting at position 6.

12  OUTFIL statement. The sorted input records are written to the ALLGPS
    and ALLBU data sets.

13-26 OUTFIL statement. The subset of sorted input records containing 'G01' in
    positions 1 through 3 are used to produce a report, which is written to the
    G1STATS data set.

27-40 OUTFIL statement. The subset of sorted input records containing 'G02' in
    positions 1 through 3 are used to produce a report, which is written to the
    G2STATS data set.
Example 11. Sort with Pipes and OUTFIL SPLIT

INPUT  Pipes
OUTPUT  Pipes
WORK DATA SETS  Dynamically allocated
USER EXITS  None
FUNCTIONS/OPTIONS  FILSZ, OUTFIL, DYNALLOC

//EXAMP JOB A400,PROGRAMMER 01
//RUNSORT EXEC PGM=ICEMAN 02
//SYSOUT DD SYSOUT=H 03
//SORTIN DD DSN=INPUT.PIPE,SUBSYS=PIPE, 04
//DCB=(LRECL=60,RECFM=FB,BLKSIZE=32760) 05
//OUT1 DD DSN=OUTPUT.PIPE1,SUBSYS=PIPE, 06
//DCB=(LRECL=60,RECFM=FB,BLKSIZE=32760) 07
//OUT2 DD DSN=OUTPUT.PIPE2,SUBSYS=PIPE, 08
//DCB=(LRECL=60,RECFM=FB,BLKSIZE=32760) 09
//SYSIN DD * 10
OPTION DYNALLOC,FiLsz=U1000000 11
SORT FIELDS=(1,20,CH,A,25,4,BI,A) 12
OUTFIL FNAMES=(OUT1,OUT2),SPLIT 13

Line  Explanation
01  Job statement. Introduces this job to the operating system.
02  EXEC statement. Calls DFSORT directly.
03  SYSOUT DD statement. Directs DFSORT messages and control statements to system output class H.
04-05 SORTIN DD statement. The SUBSYS=PIPE parameter directs the allocation to the 'PIPE' subsystem for the pipe named INPUT.PIPE. The DCB statement describes the data set characteristics to subsystem PIPE.
06-07 OUT1 DD statement. The SUBSYS=PIPE parameter directs the allocation to the 'PIPE' subsystem for the pipe named OUTPUT.PIPE1. The DCB statement describes the data set characteristics to subsystem PIPE.
08-09 OUT2 DD statement. The SUBSYS=PIPE parameter directs the allocation to the 'PIPE' subsystem for the pipe named OUTPUT.PIPE2. The DCB statement describes the data set characteristics to subsystem PIPE.
10  SYSIN DD statement. DFSORT control statements follow.
11  OPTION statement. DYNALLOC specifies that work data sets are to be dynamically allocated using the installation defaults for type of device and number of devices. FILSZ=U1000000 specifies an estimate of one million input records.
12  SORT statement. FIELDS specifies an ascending 20-byte character control field starting at position 1 and an ascending 4 byte binary control field starting at position 25.
13  OUTFIL statement. The records from the SORTIN pipe are sorted and written alternatively to the OUT1 and OUT2 pipes (that is, the sorted records are split evenly between the two output pipes).

Example 12. Sort with INCLUDE and LOCALE

INPUT  Fixed-length record data set
OUTPUT  Fixed-length record data set
WORK DATA SETS  Dynamically allocated (by default)
USER EXITS  None
FUNCTIONS/OPTIONS  INCLUDE, LOCALE
Example 13: Sort with z/OS UNIX Files

INPUT
Concatenated z/OS UNIX Files

OUTPUT
z/OS UNIX File

WORK DATA SETS
Dynamically allocated (by default)

USER EXITS
None

FUNCTIONS/OPTIONS
None
Sort Examples

<table>
<thead>
<tr>
<th>Line</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>JOB statement. Introduces this job to the operating system.</td>
</tr>
<tr>
<td>02</td>
<td>EXEC statement. Calls DFSORT directly by its alias name SORT.</td>
</tr>
<tr>
<td>03</td>
<td>SYSOUT DD statement. Directs DFSORT messages and control statements to system output class A.</td>
</tr>
<tr>
<td>04-05</td>
<td>SORTIN DD statement. The first input file is a z/OS UNIX file named /user/hfs.inp1.txt. Only read access is allowed. The file is defined as a text file. It has fixed-length records with a record size of 80 and a block size of 240.</td>
</tr>
<tr>
<td>06-07</td>
<td>The second input file is a z/OS UNIX file named /user/hfs.inp2.txt. Only read access is allowed. The file is defined as a text file. It has fixed-length records with a record size of 80 and a block size of 80.</td>
</tr>
<tr>
<td>08-09</td>
<td>SORTOUT DD statement. The output file is a z/OS UNIX file named /user/hfs.ut.txt. Only write access is allowed. The file is defined as a text file. It has fixed-length records with a record size of 80 and a block size of 80.</td>
</tr>
<tr>
<td>10</td>
<td>SYSIN DD statement. DFSORT control statements follow.</td>
</tr>
<tr>
<td>11</td>
<td>SORT statement. FIELDS specifies an ascending 8-byte character control field starting at position 10.</td>
</tr>
</tbody>
</table>

**Example 14. Sort with IFTHEN**

**INPUT** Three fixed-length record data sets  
**OUTPUT** Fixed-length record data set  
**WORK DATA SETS** Dynamically allocated (by default)  
**USER EXITS** None  
**FUNCTIONS/OPTIONS** IFTHEN

```
//EXAMP JOB A400,PROGRAMMER
//S1 EXEC PGM=SORT
//SYSOUT DD SYSOUT=A
//SORTIN DD DSN=INPUT.FILE1,DISP=SHR
// DD DSN=INPUT.FILE2,DISP=SHR
// DD DSN=INPUT.FILE3,DISP=SHR
//SORTOUT DD DSN=OUTPUT.FILE,DISP=(NEW,CATLG,DELETE),
// SPACE=(CYL,(5,5)),UNIT=SYSDA
//SYSIN DD *
INREC IFTHEN=(WHEN=(1,3,CH,EQ,C'HDR'),
  OVERLAY=(6:YDDD=(D4/),81:C'0',82:SEQNUM,2,ZD)),
  IFTHEN=(WHEN=(1,3,CH,EQ,C'TRL'),
  OVERLAY=(11:YDDD=(D4/),81:C'9',82:SEQNUM,2,ZD)),
  IFTHEN=(WHEN=NONE,
  OVERLAY=(81:C'1'))
SORT FIELDS=(81,1,CH,A,8,5,CH,A)
OUTFIL REMOVECC,
OMIT=(81,1,SS,EQ,C'0',9',AND,82,2,ZD,GT,+1),
OUTREC=(1,80)
```

This example shows how you can use three input files, each with a header record (‘HDR’), detail records (‘DTL’) and a trailer record (‘TRL’), and create an output file with one header record with the current date, the sorted detail records, and one trailer record with the current date.

01 JOB statement. Introduces this job to the operating system.
EXEC statement. Calls DFSORT directly by its alias name SORT.

SYSOUT DD statement. Directs DFSORT messages and control statements to sysout class A.

SORTIN DD statement. Consists of a concatenation of three input data sets: INPUT.FILE1, INPUT.FILE2 and INPUT.FILE3. DFSORT determines from the data set labels that each data set has RECFM=FB and LRECL=80. The BLKSIZEs vary. Each input data set has a header record, detail records, and a trailer record.

SORTOUT DD statement. Creates a new output data set: OUTPUT.FILE. DFSORT sets RECFM=FB, LRECL=80 and selects an appropriate BLKSIZE. The output data set will have one header record, the sorted detail records, and one trailer record.

SYSIN DD statement. DFSORT control statements follow.

INREC statement. The first IFTHEN WHEN=(logexp) clause identifies and operates on header records ('HDR' in positions 1-3); OVERLAY puts today's date in the form 'ddd/yyyy' in positions 6-13, adds a '0' in position 81, adds a ZD sequence number in positions 82-83 and does not affect the rest of the record.

The second IFTHEN WHEN=(logexp) clause identifies and operates on trailer records ('TRL' in positions 1-3); OVERLAY puts today's date in the form 'ddd/yyyy' in positions 11-18, adds a '9' in position 81, adds a ZD sequence number in positions 82-83 and does not affect the rest of the record.

The IFTHEN WHEN=NONE clause identifies and operates on detail records (not 'HDR' or 'TRL' in positions 1-3); OVERLAY adds a '1' in position 81 and does not affect the rest of the record.

DFSORT extends the reformatted input records from 80 bytes to 83 bytes to accommodate the identifier byte added in position 81 and the sequence number added in positions 82-83.

The '0', '1' or '9' identifier byte added in position 81 allows us to sort the header records ('0') first, followed by the detail records ('1'), and then the trailer records ('9'). The sequence number added in positions 82-83 will allow us to keep only the first header record and the first trailer record.

The sequence number will be 1 for the first header record, 2 for the second header record and 3 for the third header record. Likewise, the sequence number will be 1 for the first trailer record, 2 for the second trailer record and 3 for the third trailer record. Since the sequence number is not specified for the detail records, it will be blank.

SORT statement. FIELDS specifies an ascending 1-byte character control field at position 81 (the identifier byte added by INREC), and an ascending 5-byte character control field starting at position 8 (the key for the detail records).

OUTFIL statement. REMOVECC removes the ANSI carriage control characters and ensures that the RECFM is FB rather than FBA. OMIT specifies that reformatted output records with '0' or '9' in position 81 (header or trailer records) and a sequence number in positions 82-83 greater than 1 (second and subsequent header or trailer records), are omitted. OUTREC keeps only positions 1-80 for the OUTFIL output records, thus removing the identifier byte and sequence number we added.
in positions 81-83 with the INREC statement (we do not want these temporary fields in the OUTFIL output records).

Merge Examples

This section contains 2 merge examples.

Example 1. Merge with EQUALS

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<th>Explanation</th>
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</tr>
<tr>
<td>02</td>
<td>EXEC statement. Calls DFSORT directly by its alias SORT.</td>
</tr>
<tr>
<td>03</td>
<td>SYSOUT DD statement. Directs DFSORT messages and control statements to sysout class A.</td>
</tr>
<tr>
<td>04</td>
<td>SORTIN01 DD statement. The first input data set is named M1234.INPUT1 and is cataloged. DFSORT determines the RECFM, LRECL and BLKSIZE from the data set label.</td>
</tr>
<tr>
<td>05</td>
<td>SORTIN02 DD statement. The second input data set is named M1234.INPUT2 and is cataloged. DFSORT determines the RECFM, LRECL and BLKSIZE from the data set label.</td>
</tr>
<tr>
<td>06</td>
<td>SORTIN03 DD statement. The third input data set is named M1234.INPUT3 and is cataloged. DFSORT determines the RECFM, LRECL and BLKSIZE from the data set label.</td>
</tr>
<tr>
<td>07-08</td>
<td>SORTOUT DD statement. The output data set is named M1234.MERGOUT and is to be allocated on 3390 and kept. DFSORT sets the RECFM and LRECL from the SORTINnn data sets and selects an appropriate BLKSIZE.</td>
</tr>
<tr>
<td>09</td>
<td>SYSIN DD statement. DFSORT control statements follow.</td>
</tr>
<tr>
<td>10</td>
<td>MERGE statement. FIELDS specifies an ascending 8-byte character control field starting at position 1 and an ascending 4-byte packed-decimal field starting at position 20. The records in each input data set must already be in the order specified.</td>
</tr>
<tr>
<td>25</td>
<td>OPTION statement. EQUALS specifies that the order of output records with equal control fields is to be based on the file number of the input data sets and the original order of the records within each input data set.</td>
</tr>
</tbody>
</table>
Example 2. Merge with LOCALE and OUTFIL

**INPUT**
- Fixed-length record data set

**OUTPUT**
- Multiple fixed-length record data sets

**WORK DATA SETS**
- Not applicable

**USER EXITS**
- None

**FUNCTIONS/OPTIONS**
- LOCALE, OUTFIL

```plaintext
//EXAMP JOB A400,PROGRAMMER 01
//STEP1 EXEC PGM=SORT 02
//STEPLIB DD DSN=SYS1.SCEERUN,DISP=SHR 03
//SYSOUT DD SYSOUT=A 04
//SORTIN01 DD DSN=INPUT01.GERMAN.GERMANY,DISP=SHR 05
//SORTIN02 DD DSN=INPUT02.GERMAN.GERMANY,DISP=SHR 06
//SORTIN03 DD DSN=INPUT03.GERMAN.GERMANY,DISP=SHR 07
//GP1 DD DSN=OUTPUT.GERMAN.GP1,DISP=OLD 08
//GP2 DD DSN=OUTPUT.GERMAN.GP2,DISP=OLD 09
//GP3 DD DSN=OUTPUT.GERMAN.SAVE,DISP=OLD 10
//DFSPARM DD * 11
LOCALE=De.DE.IBM-1047 12
MERGE FIELDS=(25,5,CH,A,40,4,PD,D) 13
OUTFIL FNAMES=GP1, 14
   INCLUDE=(23,1,CH,LE,C'Ö') 15
OUTFIL FNAMES=GP2, 16
   INCLUDE=(23,1,CH,GT,C'Ö',AND,23,1,CH,LT,C'Ü') 17
OUTFIL FNAMES=GP3,SAVE 19
```

**Line**  **Explanation**

01  JOB statement. Introduces this job to the operating system.
02  EXEC statement. Calls DFSORT directly by its alias name SORT.
03  STEPLIB DD statement. Specifies the Language Environment run-time library containing the dynamically loadable locales.
04  SYSOUT statement. Directs DFSORT messages and control statements to sysout class A.
05  SORTIN01 DD statement. The first input data set is named INPUT01.GERMAN.GERMANY and is cataloged. DFSORT determines the RECFM, LRECL and BLKSIZE from the data set label.
06  SORTIN02 DD statement. The second input data set is named INPUT02.GERMAN.GERMANY and is cataloged. DFSORT determines the RECFM, LRECL and BLKSIZE from the data set label.
07  SORTIN03 DD statement. The third input data set is named INPUT03.GERMAN.GERMANY and is cataloged. DFSORT determines the RECFM, LRECL and BLKSIZE from the data set label.
08  GP1 DD statement. The first OUTFIL output data set is named OUTPUT.GERMAN.GP1 and is cataloged. DFSORT determines the RECFM, LRECL and BLKSIZE from the data set label.
09  GP2 DD statement. The second OUTFIL output data set is named OUTPUT.GERMAN.GP2 and is cataloged. DFSORT determines the RECFM, LRECL and BLKSIZE from the data set label.
10  GP3 DD statement. The third OUTFIL output data set is named OUTPUT.GERMAN.GP3 and is cataloged. DFSORT determines the RECFM, LRECL and BLKSIZE from the data set label.
11  DFSPARM DD statement. DFSORT control statements follow.
12  LOCALE parameter. Overrides the installation default for LOCALE. The
locale for the German language and the cultural conventions of Germany based on the IBM-1047 encoded character set will be active.

13 MERGE statement. FIELDS specifies an ascending 5-byte character control field starting at position 25, and a descending 4-byte packed decimal control field starting at position 40. The character (CH) control field will be merged according to the collating rules defined in locale De_DE.IBM-1047. The records in each input data set must already be in the order specified.

14-15 OUTFIL statement. The subset of records with character values less than or equal to 'Ö' in position 23 are written to the GP1 output data set. The character (CH) compare field and character constant will be compared according to the collating rules defined in locale De_DE.IBM-1047.

16-18 OUTFIL statement. The subset of records with character values greater than 'Ö' but less than 'Ü' in position 23 are written to the GP2 output data set. The character (CH) compare fields and character constants will be compared according to the collating rules defined in locale De_DE.IBM-1047.

19 OUTFIL statement. Any records not written to the GP1 or GP2 output data sets are written to the GP3 output data set.

Copy Examples

This section contains 2 copy examples.
Example 1. Copy with EXEC PARMs, SKIPREC, MSGPRT and ABEND

**INPUT**
Blocked fixed-length records on multivolume 3490

**OUTPUT**
Blocked fixed-length records on disk

**WORK DATA SETS**
Not applicable

**USER EXITS**
None

**FUNCTIONS/OPTIONS**
SKIPREC, MSGPRT, ABEND

```
//EXAMP JOB A400,PROGRAMMER 01
//STEP1 EXEC PGM=SORT, 02
  // PARM='SKIPREC=500,MSGPRT=CRITICAL,ABEND' 03
  //SYSOUT DD SYSOUT=A 04
  //SORTIN DD DSN=FLY.RECORDS,VOL=SER=(000333,000343), 05
  // UNIT=(3490,2),DISP=OLD,LABEL=(,NL), 06
  // DCB=(RECFM=FB,LRECL=12000,BLKSIZE=24000) 07
  //SORTOUT DD DSN=FLY.RECORDS.COPY,DISP=OLD 08
  //SYSIN DD * 09
  SORT FIELDS=COPY 10
```

**Line**
**Explanation**

01  JOB statement. Introduces this job to the operating system.

02-03  EXEC statement. Calls DFSORT directly by its alias SORT. SKIPREC=500 specifies that the first 500 input records are not to be included in the output data set. MSGPRT=CRITICAL specifies that error messages, but not informational messages, are to be printed. ABEND specifies that DFSORT is to terminate with a user ABEND if it issues an error message.

04  SYSOUT DD statement. Directs DFSORT messages and control statements to sysout class A.

05-07  SORTIN DD statement. The input data set is named FLY.RECORDS and resides on 3490 volumes 000333 and 000343. The UNIT parameter requests two tape drives, one for each volume of the data set. Because the tape is unlabeled, DCB parameters must be supplied to indicate that the RECFM is FB, the LRECL is 12000 and the BLKSIZE is 24000.

08  SORTOUT DD statement. The output data set is named FLY.RECORDS.COPY and is cataloged. DFSORT determines the RECFM, LRECL and BLKSIZE from the data set label.

09  SYSIN DD statement. DFSORT control statements follow.

10  SORT statement. FIELDS=COPY specifies a copy application.
Copy Examples

Example 2. Copy with INCLUDE and VLSHRT

INPUT
Blocked spanned records on disk

OUTPUT
Blocked spanned records on SYSDA

WORK DATA SETS
Not applicable

USER EXITS
None

FUNCTIONS/OPTIONS
INCLUDE, VLSHRT

//EXAMP JOB A400,PROGRAMMER 01
//COPY EXEC PGM=SORT 02
//SYSOUT DD SYSOUT=A 03
//SORTIN DD DSN=SMF.DATA,DISP=SHR 04
//SORTOUT DD DSN=SMF.VIOL,DISP=(,KEEP),SPACE=(CYL,(2,5)), 05
// UNIT=SYSDA 06
//SYSIN DD * 07
INCLUDE COND=(6,1,FI,EQ,80,AND,19,1,BI,EQ,B'1.......') 08
OPTION COPY,VLSHRT 09

Line Explanation
01 JOB statement. Introduces this job to the operating system.
02 EXEC statement. Calls DFSORT directly by its alias SORT.
03 SYSOUT DD statement. Directs DFSORT messages and control statements to sysout class A.
04 SORTIN DD statement. The input data set is named SMF.DATA and is cataloged. DFSORT determines from the data set label that the RECFM is VBS, the LRECL is 32760 and the BLKSIZE is 23476.
05-06 SORTOUT DD statement. The output data set is named SMF.VIOL and is to be allocated on SYSDA and kept. DFSORT sets the RECFM and LRECL from SORTIN and selects an appropriate BLKSIZE.
07 SYSIN DD statement. DFSORT control statements follow.
08 INCLUDE statement. COND specifies that only input records with decimal 80 in the 1-byte fixed-point field at position 6 and bit 0 on in the 1-byte binary field at position 19 are to be included in the output data set.
09 OPTION statement. COPY specifies a copy application. VLSHRT specifies that records that are too short to contain all of the INCLUDE compare fields are not to be included in the output data set.

Example 3. Copy with OUTREC, PARSE and BUILD

INPUT
Blocked fixed-length records on disk

OUTPUT
 Blocked fixed-length records on disk

WORK DATA SETS
Not applicable

USER EXITS
None

FUNCTIONS/OPTIONS
OUTREC, PARSE, BUILD

//EXAMP JOB A400,PROGRAMMER 01
//S1 EXEC PGM=ICEMAN 02
//SYSOUT DD SYSOUT=A 03
//SORTIN DD DSN=FLY.VAR.FIELDS.IN,DISP=SHR 04
//SORTOUT DD DSN=FLY.FIX.FIELDS.OUT,DISP=OLD 05
//SYSIN DD * 06
OPTION COPY 07
OUTREC PARSE=(%00=(ABSPOS=21,STARTAFT=BLANKS, 08
ENDBEFR=C'.'), 09
%=(ENDBEFR=C'.'), 10
%01=(ENDBEFR=C'.'), 11
%02=(FIXLEN=10), 12
BUILD=(1,15, 13
Job Statement: Introduces this job to the operating system.

EXEC Statement: Calls DFSORT directly.

SYSOUT DD Statement: Directs DFSORT messages and control statements to sysout class A.

SORTIN DD Statement: The input data set is named FLY.VAR.FIELDS.IN and is cataloged. DFSORT determines from the data set label that the RECFM is FB, the LRECL is 60 and the BLKSIZE is 27960.

SORTOUT DD Statement: The output data set is named FLY.FIX.FIELDS.OUT and is cataloged. DFSORT determines from the data set label that the RECFM is FB, the LRECL is 60 and the BLKSIZE is 27960.

SYSIN DD Statement: DFSORT control statements follow.

OPTION Statement: COPY specifies a copy application.

OUTREC Statement: PARSE and BUILD reformat the input records containing one fixed position/length field and four variable position/length fields to output records containing four fixed position/length fields.
ICEGENER Example

This section contains an ICEGENER example.

INPUT
Same as for IEBGENER job

OUTPUT
Same as for IEBGENER job

WORK DATA SETS
Not applicable

USER EXITS
None

FUNCTIONS/OPTIONS
None

//EXAMP JOB A400,PROGRAMMER 01
//GENR EXEC PGM=ICEGENER 02
//SYSPRINT DD SYSOUT=A 03
//SYSUT1 DD DSN=CTL.MASTER,DISP=SHR 04
//SYSUT2 DD DSN=CTL.BACKUP,DISP=OLD 05
//SYSIN DD DUMMY 06

This example shows how to use the ICEGENER facility for an IEBGENER job if your site has not installed ICEGENER as an automatic replacement for IEBGENER. The ICEGENER facility selects the more efficient DFSORT copy function for this IEBGENER job.

Line  Explanation
01    JOB statement. Introduces this job to the operating system.
02    EXEC statement. Calls the ICEGENER facility. PGM=IEBGENER has been replaced by PGM=ICEGENER.
03-06 No other changes to the IEBGENER job are required.
ICETOOL Example

This section contains an example of ICETOOL with various operators.

**INPUT**
Multiple data sets

**OUTPUT**
Multiple data sets

**WORK DATA SETS**
Dynamically allocated (automatic)

**USER EXITS**
ICETOOL's E35 (automatic)

**FUNCTIONS/OPTIONS**
OCCUR, COPY, SORT, MODE, VERIFY, STATS, DISPLAY

```plaintext
//EXAMP JOB A400,PROGRAMMER 01
//TOOLRUN EXEC PGM=ICETOOL,REGION=1024K 02
//TOOLMSG DD SYSOUT=A 03
//DFSMSG DD SYSOUT=A 04
//TOOLIN DD * 05
* Print report showing departments with less than 5 employees 06
OCCUR FROM(IN1) LIST(LT5) LOWER(5) BLANK - 07
   TITLE('Small Departments') PAGE - 08
   HEADER('Department') HEADER('Employees') - 09
   ON(45,3,CH) ON(VALCNT) 10
* Sort by last name and first name 11
SORT FROM(IN1) TO(DEPTSD,DEPTSP) USING(ABCD) 12
* Do following operators even if a previous operator failed, 13
  but stop processing if a subsequent operator fails. 14
  MODE STOP 15
  * Verify decimal fields 16
  VERIFY FROM(IN2) ON(22,6,PD) ON(30,3,ZD) 17
  * Print statistics for record length and numeric fields 18
  STATS FROM(IN2) ON(VLEN) ON(22,6,PD) ON(30,3,ZD) 19
* Sort and produce total for each unique key 20
SORT FROM(IN2) TO(OUT4) USING(CTL1) 21
* Print report containing: 22
  TITLE('Unique key totals report') DATE TIME - 23
  MINIMUM('Lowest') MAXIMUM('Highest') PLUS 24
//LT5 DD SYSOUT=A 25
//IN1 DD DSN=FLY.INPUT1,DISP=SHR 26
//ABCDCTL DD * 27
* Sort by last name, first name 28
SORT FIELDS=(12,15,CH,A,1,10,CH,A) 29
//DEPTSD DD DSN=FLY.OUTPUT1,DISP=SHR 30
//DEPTSP DD SYSOUT=A 31
//IN2 DD DSN=FLY.INPUT2,DISP=SHR 32
//OUT4 DD DSN=FLY.OUTPUT2,DISP=OLD 33
//CTL1CTL DD * 34
* Sort and produce totals in one record for each unique key 35
SORT FIELDS=(5,10,CH,A) 36
SUM FIELDS=(22,6,PD,30,3,ZD) 37
//LIST1 DD SYSOUT=A 38
```

This example shows how ICETOOL can be used to perform multiple operations in a single step.

**Line**  **Explanation**

01  JOB statement. Introduces this job to the operating system.
02  EXEC statement. Calls ICETOOL specifying the recommended REGION of 1024K.
03  TOOLMSG DD statement. Directs ICETOOL messages and statements to system output class A.
ICETOOL Example

04 DFSMSG DD statement. Directs DFSORT messages and control statements to SYSOUT class A.

05 TOOLIN DD statement. ICETOOL statements follow. The MODE for the ICETOOL run is initially set to STOP. If an error is detected for an operator, SCAN mode will be entered.

06 Comment statement. Printed but otherwise ignored.

07-10 OCCUR operator. Prints, in the LT5 data set, a report detailing each value for the specified field in the IN1 data set and the number of times that value occurs.

11 Comment statement.

12 SORT operator. Records from the IN1 data set are sorted to the DEPTS and DEPTSP data sets using the DFSORT control statements in the ABCDCNTL data set. As a result, FLY.OUTPUT1 and DEPTSP (SYSOUT) contain the sorted records from FLY.INPUT1.

13-14 Comment statements.

15 MODE operator. The MODE is reset to STOP (needed in case SCAN mode was entered due to an error for a previous operator). If an error is detected for a subsequent operator, SCAN mode will be entered. This divides the previous operators and subsequent operators into two unrelated groups.

16 Comment statement.

17 VERIFY operator. Identifies invalid values, if any, in the specified decimal fields of the IN2 data set. Used to stop subsequent operations if any invalid value is found in FLY.INPUT2.

18 Comment statement.

19 STATS operator. Prints the minimum, maximum, average, and total for the specified fields of the IN2 data set.

ON(VLEN) operates on the record length of the records in FLY.INPUT2. Thus, the values printed for ON(VLEN) represent the shortest record, the longest record, the average record length, and the total number of bytes for FLY.INPUT2.

20 Comment statement.

21 SORT operator. Records from the IN2 data set are sorted and summarized to the OUT4 data set using the DFSORT control statements in the CTL1CNTL data set. As a result, FLY.OUTPUT2 contains one record from FLY.INPUT2 for each unique sort field with totals for the sum fields.

22-24 Comment statements.

25-28 DISPLAY operator. Prints, in the LIST1 data set, a report detailing each sort and sum value for the OUT4 data set resulting from the previous operation, and the lowest and highest value for each sum field.

29-42 DD statements. Defines the data sets and DFSORT control statements used for the ICETOOL operations described above.
# Appendix A. Using Work Space

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## Introduction

When a sort application cannot be performed entirely in virtual storage, DFSORT must use work space. The amount of work space required depends on:

- The amount of data being sorted
- The amount of virtual storage available to DFSORT
- The amount of Hiperspace available to DFSORT
- The type of devices you use
- The DFSORT functions and features you use (for example, VLSHRT, locale processing, EFS, and ALTSEQ can increase the amount of work space required).

There are three ways to supply work space for a DFSORT application:

- Hiperspace
- Dynamic allocation of work data sets
- JCL allocation of work data sets.

For best performance, an optimal amount of Hiperspace, in combination with dynamically allocated disk work data sets, is strongly recommended. See “Use Hipersorting” on page 810 for more information on using the HPRMAX option. The DYNALLOC installation option, or the DYNALLOC run-time option, can be used to dynamically allocate work data sets.

## Central Storage

DFSORT leverages central storage as intermediate work space through the use of either memory objects or Hiperspaces. Using the installation defaults of HPRMAX=OPTIMAL, MOSIZE=MAX and MOWRK=YES ensures that DFSORT will use memory object or Hiperspace whenever possible. Sites can tune their definition of HPRMAX=OPTIMAL and MOSIZE=MAX through use of the EXPMAX, EXPOLD, and EXPRES installation options. See z/OS DFSORT Installation and Customization for more information.

DFSORT’s use of memory object or Hiperspace storage depends upon the availability of central storage, the needs of other concurrent memory object sorting, Hipersorting, and dataspace sorting applications throughout the time the application runs, and the settings of the EXPMAX, EXPOLD, and EXPRES installation options. Consequently, it is possible for the same application to use varying amounts of memory object or Hiperspace storage from run to run. If enough memory object or Hiperspace storage is available, DFSORT uses it exclusively for intermediate storage. If the amount of available storage is insufficient, DFSORT uses a combination of work data sets with Hiperspace or memory object storage, or even work data sets alone.
Using Work Space

DFSORT only uses memory object or Hiperspace storage when there is sufficient central storage available to back all the DFSORT work data. DFSORT’s use of memory object and Hiperspace storage is very dynamic: multiple concurrent sort applications always know each other’s storage needs and never try to back their memory objects or Hiperspaces with the same portion of storage. In addition, DFSORT checks the available storage throughout the run, and switches from using memory objects or Hiperspaces to using disk work data sets when either a storage shortage is predicted or the total Hipersorting, memory object sorting, and dataspace sorting activity on the system reaches the limits set by the EXPMAX, EXPOLD, and EXPRES installation options. Memory object and Hipersorting requires that work data sets be available, as well as central storage. DFSORT forces the use of dynamic allocation for memory object sorting or Hipersorting if work data sets are not requested explicitly. For further details, see the MOSIZE, MOWRK and HIPRMAX options of the OPTION Control Statement on page 173.

Work Data Set Devices

The type of device selected for work data sets can have a significant effect on performance. Consider the following when selecting devices for work data sets.

Disk and Tape Devices

For optimal performance, use disk devices to which little other activity is directed, for work data sets. Specify high-speed devices such as IBM's TotalStorage DS8000 storage subsystems, and avoid specifying tape or virtual (VIO).

Using tape devices for work data sets rather than disk causes significant performance degradation for the following reasons:

- Tape work data sets prevent DFSORT from using its more efficient sorting techniques, Blockset and Peerage/Vale. Disk work data sets allow DFSORT to use these techniques.
- Tape work data sets must be accessed sequentially. Disk data sets can be accessed randomly.
- Disk control units can provide additional features, such as cache fast write, that are not available with tape devices.

Number of Devices

Although one work data set is sufficient, using two or more work data sets on separate devices usually reduces the elapsed time of the application significantly. In general, using more than three work data sets does not reduce elapsed time any further, and is only necessary if the work data sets are small or the file size is large.

For optimum allocation of resources such as virtual storage, avoid specifying a large number of work data sets unnecessarily.

No more than 255 work data sets can be specified. If you specify more than 32 work data sets, and the Blockset technique is not selected, a maximum of 32 work data sets is used.

Non-Synchronous Storage Subsystems

Allocation of work data sets on devices attached to non-synchronous storage subsystems can affect the performance of certain DFSORT applications. Whether or not a particular application is affected depends on many factors, the most critical of which is the ratio of input file size to available storage.
Using Work Space

In general, to maximize performance, DFSORT needs the following:

- **Accurate knowledge of the size of the file being sorted**
  
  In most cases, DFSORT is able to calculate the file size accurately. However, for applications that sort many input tapes that are not managed by DFSMSrmm or a tape management system that uses ICETPEX (especially compacted input tapes) or that use E15 exits that add or delete records, we recommend that you specify the file size using the FILSZ or SIZE parameter.

- **Adequate storage relative to the size of the file being sorted**

  Table 81 shows the minimum recommended storage to provide DFSORT based on various input file sizes.

<table>
<thead>
<tr>
<th>Input file size</th>
<th>Minimum storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 200MB</td>
<td>4MB</td>
</tr>
<tr>
<td>200MB to 500MB</td>
<td>8MB</td>
</tr>
<tr>
<td>500MB to 1GB</td>
<td>16MB</td>
</tr>
<tr>
<td>More than 1GB</td>
<td>16-32MB</td>
</tr>
</tbody>
</table>

**Table 81. Minimum Storage Required for Various File Sizes**

**Allocation of Work Data Sets**

Dynamic allocation has the following advantages over JCL allocation:

- **Installation options can be used to automatically activate dynamic allocation for all sort applications.**
  
  To use JCL allocation, appropriate DD statements must be specified for each individual application.

- **As the characteristics (file size, virtual storage, and so on) of an application change over time, DFSORT can automatically optimize the amount of dynamically allocated work space for the application. This eliminates unneeded allocation of disk space.**
  
  JCL allocation is fixed; DFSORT cannot adjust it. Disk space might be wasted.

- **Dynamically allocated work data sets are automatically allocated as large format so they can use more than 65535 tracks on a single volume.**
  
  When disk work space requirements are larger than expected, DFSORT can automatically recover by increasing allocation sizes or using additional work data sets.

- **As the amount of Hiperspace available to the application varies from run to run, DFSORT can automatically adjust the amount of space it dynamically allocates to complement the amount of Hiperspace. This eliminates unneeded allocation of disk space.**
  
  JCL allocation is fixed; DFSORT cannot adjust it, even if all sorting can be done in Hiperspace. Disk space might be wasted.

Dynamic allocation has one drawback: for certain applications, as described in "File Size and Dynamic Allocation" on page 851, you might need to give DFSORT a reasonable estimate of the input file size. Later, if the input file size for the application increases significantly, you must update the file size estimate accordingly.

However, JCL allocation has a similar drawback, except that it applies to all applications. Unless you overallocate the work data sets initially and waste space,
you have to update the JCL allocation when the input file size increases significantly for any application to avoid out-of-space abends.

If you can allocate enough work data set space with JCL to guarantee your applications will never exceed the space allocated, you do not need dynamic allocation. However, since efficient use of disk space is usually desirable, dynamic allocation is recommended over JCL allocation.

For both dynamic allocation and JCL allocation:
- The amount of work space actually used will often be less than the amount allocated. DFSORT tries to minimize dynamic over-allocation while making certain that the application will not fail due to lack of space. With JCL allocation, you could minimize the amount of allocated space manually, but this might require changes to JCL allocation as the characteristics of the application change over time.
- Limiting the virtual storage available to DFSORT can increase the amount of work space required. With a reasonable amount of storage, 4MB for example, DFSORT can sort using a reasonable amount of work space. If storage is limited, more work space might be required. If storage is drastically limited (for example, to 200KB), significantly more work space might be required.

Dynamic Allocation of Work Data Sets
Installation options are available to request automatic dynamic allocation of work data sets and to supply defaults for the device type and number of devices.

For certain applications, it is very important to specify a reasonable estimate of the input file size when using dynamic allocation.

Automatic Dynamic Allocation
Your system programmer has set the DYNAUTO installation option to control whether dynamic allocation is used automatically, or only when requested by the DYNALLOC run-time option.

DYNAUTO also controls whether dynamic allocation or JCL allocation takes precedence when JCL work data sets are specified.

If your system programmer selected DYNAUTO=IGNWKDD, dynamic allocation takes precedence over JCL allocation (JCL work data sets are actually deallocated). If you want the opposite precedence for selected applications, use the run-time option USEWKDD.

If your system programmer selected DYNAUTO=YES, JCL allocation takes precedence over dynamic allocation. If you want the opposite precedence, you must remove the JCL allocation statements.

If your system programmer selected DYNAUTO=NO, dynamic allocation of work data sets is not used unless you specify the DYNALLOC run-time option. JCL allocation takes precedence over dynamic allocation.

Device Defaults
When the device type, or the number of devices for dynamic allocation, is not explicitly specified, DFSORT obtains the missing information from the DYNALOC installation option information supplied by your system programmer.
Allocation of Work Data Sets

**Note:** In rare cases where DFSORT is unable to dynamically allocate the required space using the value supplied by d, allocation may be attempted with a more generic unit name (such as 3390) in an effort to allocate the required space on volumes from a different storage group. Refer to “System Managed Storage” in [z/OS DFSORT Tuning Guide](http://www.example.com) for recommendations on controlling data set allocation.

**File Size and Dynamic Allocation**

DFSORT bases the amount of work space it dynamically allocates on the number of bytes to be sorted—the input file size. Generally, DFSORT can automatically make an accurate determination of the file size by determining the number of input records. However, DFSORT cannot always determine the input file size accurately in the following cases:

- An E15 user exit routine supplies all input records (an input data set is not present). DFSORT cannot automatically determine the number of records to be inserted.
- An input data set is present, along with an E15 user exit routine. DFSORT can automatically determine the number of records in the input data set, but cannot automatically determine the number of records to be inserted or deleted.
- A spool (DD *) or pipe data set is used as input.
- The input consists of small data sets on tape that are not managed by DFSMSrmm or a tape management system that uses ICETPEX. When the tape data sets are not managed, DFSORT cannot know how much of the tapes are used, so it determines the file size assuming full volumes at the maximum regular density for the drives.
- The Improved Data Recording Capability (IDRC) feature is used for the input device and the tape data sets are not managed by DFSMSrmm or a tape management system that uses ICETPEX.
- Input data sets are members of partitioned data sets. DFSORT cannot determine the size of a member in a partitioned data set. Therefore, when input data sets are partitioned, DFSORT uses the size of the entire data set as the input file size. This is usually an over-estimation, which leads to over-allocation of work space.

In the above circumstances, if the number of records is not supplied by the FILSZ or SIZE option, you will receive message ICE118I. If dynamic allocation of work data sets is used, DFSORT allocates the primary space according to the DYNSPC value in effect. This can result in underallocation or overallocation, possibly leading to wasted space or an out-of-space condition, respectively. DFSORT will also allocate additional work data sets with zero space that can be used to recover from an out of space condition. The percentage of additional work data sets will be the greater of 50% or the DYNAPCT value in effect. To avoid unknown file size situations, you should specify FILSZ=En with a reasonably accurate estimate of the number of records to be sorted. If you cannot specify FILSZ=En, you should use DYNSPC=n to adjust the primary space for dynamically allocated work data sets and DYNAPCT=x to increase the number of additional work data sets, as appropriate.

**Note:** FILSZ=E0 is ignored.

For variable-length records, DFSORT uses one-half of the maximum record length (LRECL) in conjunction with the number of records to determine the input file size, unless you specify AVGRLEN=n. If your actual average record length is significantly different from one-half of the maximum record length, specifying AVGRLEN=n can prevent DFSORT from overallocating or underallocating dynamic work space.
Dynamic Over-Allocation of Work Space

DFSORT can dynamically over-allocate the work space even when you specify the number of records under the following circumstances:

- When you delete a significant number of records using:
  - An INCLUDE or OMIT statement, or the SKIPREC option. Use of these statements and options does not force DFSORT to use a SIZE=En or FILSZ=En specification. DFSORT ignores the En value unless it cannot compute the input file size.
  - One or more partitioned data set members as input. DFSORT uses the size of the entire partitioned data set rather than the size of the member in its calculations. DFSORT ignores any SIZE=En or FILSZ=En value unless it cannot determine the input file size itself.

You can avoid over-allocation in these cases by specifying SIZE=Un or FILSZ=Un.

- When the average record length of variable-length records is substantially shorter than one-half of the maximum record length. If DFSORT uses your exact or estimated number of records, it uses one-half of the maximum record length to determine the file size. You can avoid over-allocation in this case by specifying AVGRLEN=n.

Dynamic over-allocation of work space can occur when you do not specify the number of records (for example, with small input data sets on tape), or even when you do (for example, when a significant number of records is deleted). In these cases, you might prefer to use JCL allocation of work data sets to control the amount of space allocated. However, there are drawbacks to doing so, as previously explained. If DYNAUTO=IGNWKDD is used, remember to specify run-time option USEWKDD when you want to use JCL allocation of work data sets.

JCL Allocation of Work Data Sets

The amount of required work space is dependent on many factors such as virtual storage and type of devices used, but is especially sensitive to the file size of the input data set.

Because of the number of variables involved, an exact formula cannot be given for calculating the needed work space. However, the following guidelines usually hold true:

- For fixed length record (FLR) sort applications, 1.5 to 2 times the input file size is usually adequate.
- For variable-length record (VLR) sort applications, 1.5 to 2.5 times the input file size is usually adequate.

These guidelines assume that a reasonable amount of storage (at least 1M) is available to DFSORT. Limiting the available amount of storage can increase the amount of needed work space.

DFSORT can often run with less than the amount of work space indicated by the above guidelines.

To get the best performance using JCL allocation of work data sets:
Allocation of Work Data Sets

- Use devices without much activity on them.
- Use high-speed disk devices such as IBM's TotalStorage DS8000 subsystems for work data sets, and avoid using tape or virtual (VIO) for work data sets.
- Allocate space in cylinders.
- Specify contiguous space for each work data set, and make sure there is enough primary space so that secondary space is not needed.
- Allocate two or more work data sets.
- Use multiple channel paths to the devices.
- Use different volumes and separate channel paths for the work data sets and the input/output data sets.

The following table shows the work data set space needed with 4M of storage for applications with various characteristics when Hipersorting, dataspace sorting, and memory object sorting are not used (HIPRMAX=0, DSPSIZE=0 and MOSIZE=0).

**Table 82. Work Space Requirements for Various Input Characteristics**

<table>
<thead>
<tr>
<th>Filesize (MB)</th>
<th>FLR/VLR</th>
<th>Max LRECL</th>
<th>BLKSIZE</th>
<th>Input Data Set</th>
<th>Work Data Set</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>FLR</td>
<td>80</td>
<td></td>
<td>27920</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>FLR</td>
<td>160</td>
<td></td>
<td>27840</td>
<td>6</td>
</tr>
<tr>
<td>20</td>
<td>FLR</td>
<td>80</td>
<td></td>
<td>27920</td>
<td>26</td>
</tr>
<tr>
<td>20</td>
<td>FLR</td>
<td>160</td>
<td></td>
<td>27840</td>
<td>26</td>
</tr>
<tr>
<td>20</td>
<td>FLR</td>
<td>1000</td>
<td></td>
<td>27000</td>
<td>26</td>
</tr>
<tr>
<td>40</td>
<td>FLR</td>
<td>80</td>
<td></td>
<td>27920</td>
<td>51</td>
</tr>
<tr>
<td>40</td>
<td>FLR</td>
<td>160</td>
<td></td>
<td>27840</td>
<td>51</td>
</tr>
<tr>
<td>40</td>
<td>FLR</td>
<td>1000</td>
<td></td>
<td>27000</td>
<td>52</td>
</tr>
<tr>
<td>150</td>
<td>FLR</td>
<td>160</td>
<td></td>
<td>27840</td>
<td>189</td>
</tr>
<tr>
<td>4</td>
<td>VLR</td>
<td>300</td>
<td></td>
<td>27998</td>
<td>6</td>
</tr>
<tr>
<td>40</td>
<td>VLR</td>
<td>300</td>
<td></td>
<td>27998</td>
<td>51</td>
</tr>
<tr>
<td>40</td>
<td>VLR</td>
<td>6000</td>
<td></td>
<td>27998</td>
<td>55</td>
</tr>
<tr>
<td>150</td>
<td>VLR</td>
<td>300</td>
<td></td>
<td>27998</td>
<td>188</td>
</tr>
<tr>
<td>150</td>
<td>VLR</td>
<td>6000</td>
<td></td>
<td>27998</td>
<td>203</td>
</tr>
</tbody>
</table>

**Disk Capacity Considerations**

You can specify a mixture of disk devices for a given sort application. Any IBM disk device supported by your operating system can be used for work data sets.

For best performance, use high-speed devices such as IBM's TotalStorage DS8000 storage subsystems for work data sets.

System performance is improved if work data sets are specified in cylinders, rather than tracks or blocks. Storage on temporary work data sets will be readjusted to cylinders if possible. The number of tracks per cylinder for disk devices is shown in Table 83.
### Disk Capacity Considerations

Table 83. Number of Tracks per Cylinder for Disk Devices

<table>
<thead>
<tr>
<th>Device</th>
<th>Tracks per Cylinder</th>
<th>Maximum Bytes used per Track</th>
</tr>
</thead>
<tbody>
<tr>
<td>3380</td>
<td>15</td>
<td>47476</td>
</tr>
<tr>
<td>3390</td>
<td>15</td>
<td>56664</td>
</tr>
<tr>
<td>9345</td>
<td>15</td>
<td>46456</td>
</tr>
</tbody>
</table>

If WRKSEC is in effect and the work data set is not allocated to VIO, DFSORT allocates secondary extents as required, even if not requested in the JCL.

### Exceeding Disk Work Space Capacity

If during sorting, the allocation of secondary space on one of the work data sets fails, the system issues a B37 informational message. DFSORT can recover by allocating space on one of the other work data sets, if one is available.

DFSORT normally allocates secondary extents for work data sets, even if not requested in the JCL. This reduces the probability of exceeding work space capacity.

If the disk work space is not sufficient to perform the sort, DFSORT issues a message and terminates.

### Tape Capacity Considerations

Any IBM tape device supported by your operating system can be used for work space. However, using tape devices for work data sets rather than disk causes significant performance degradation and should, therefore, be avoided.

Three different tape work data set techniques are available to DFSORT: Balanced, Polyphase, and Oscillating. For information on how to calculate their requirements, see Table 84.

**Note:** The value you obtain for “min” is literally a minimum value; if, for example, your input uses a more efficient blocking factor than DFSORT or is spanned, you need more work space. Space requirements are also summarized in Table 84. DFSORT selects the most appropriate tape technique using these criteria.

Table 84. Work Space Requirements of the Various Tape Techniques

<table>
<thead>
<tr>
<th>Tape Technique</th>
<th>Maximum Input</th>
<th>Work Space Areas Required</th>
<th>Max. No. of Work Areas</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balanced tape (BALN)</td>
<td>15 volumes</td>
<td>Min=2(V+1)* tape units</td>
<td>32 volumes</td>
<td>Used if more than three work storage tapes are provided and file size is not given.</td>
</tr>
<tr>
<td>Polyphase tape (POLY)</td>
<td>1 volume</td>
<td>Min=3 tape units</td>
<td>17 volumes</td>
<td>Used if three work storage tapes are provided.</td>
</tr>
<tr>
<td>Oscillating tape (OSCL)</td>
<td>15 volumes</td>
<td>Min=V+2* or 4 tape units, whichever is greater</td>
<td>17 volumes</td>
<td>File size must be given. The tape drive containing SORTIN cannot be used as a work unit.</td>
</tr>
</tbody>
</table>

**Note:**

V = Number of input volumes. Number of input volumes of blocking equals work space blocking.
Exceeding Tape Work Space Capacity

At the beginning of a sort using tape work data sets, DFSORT estimates the maximum sort capacity (Nmax) and issues message ICE038I. See the explanation of this message for details.

The value for Nmax printed in message ICE038I is an average value rounded down to the nearest thousand. This value assumes random input. If you have a reversed sequenced file and tape work space, sort capacity may be exceeded at a lower value because of the higher number of partly empty, end-of-string blocks.

For magnetic tape, a tape length of 2400 feet is assumed in calculating Nmax. For tapes of other lengths, the figure is not correct. When tapes with mixed density are used, the smallest density is used in the calculation.

If you specify an actual data set size, and that size is larger than the maximum capacity estimated by the program (Nmax), the program terminates before beginning to sort. If you specify an estimated data set size, or none at all, and the number of records reaches the maximum (Nmax), the program gives control to your routine at user exit E16, if you have written and included one. This routine can direct the program to take one of the following actions:

- Continue sorting the entire input data set with available work space. If the estimate of the input data set size was high, enough work space may remain to complete the application.
- Continue sorting with only part of the input data set; the remainder could be sorted later and the two results merged to complete the application.
- Terminate the program without any further processing.

If you do not include an E16 routine, DFSORT continues to process records for as long as possible. If the work space is sufficient to contain all the records in the input data set, DFSORT completes normally; when work space is not sufficient, DFSORT issues a message and terminates.

The program generates a separate message for each of the three possible error conditions. They are:

1. **ICE041A—N GT NMAX**: Generated before sorting begins when the exact file size is greater than Nmax.
2. **ICE046A—SORT CAPACITY EXCEEDED**: Generated when the sort has used all available work space.
3. **ICE048I—NMAX EXCEEDED**: Generated when the sort has exceeded Nmax and has transferred control to a user-written E16 routine for further action.

The test for message ICE041A is made with the maximum possible calculated value, that is, DFSORT is sure it will fail. In case of doubt, the message is not issued.
Appendix B. Specification/Override of DFSORT Options

"Installation Defaults" on page 17 discusses DFSORT's installation options and environments, and shows you how to use ICETOOL's DEFAULTS operator to list the installation defaults selected at your site.

Listed below are the places in DFSORT where you can specify various options that will override the IBM-supplied defaults. The sources for the options are listed in override order; that is, any option specified in a higher place in the list overrides one specified in a lower place.

**Directly Invoked DFSORT**
- DFSPARM data set
  - PARM options
  - DEBUG and OPTION control statements
  - Other control statements.
- EXEC statement PARM options
- SYSIN data set
  - DEBUG and OPTION control statements
  - Other control statements.
- Installation options set with PARMLIB ICEPRMxx members (JCL, TSO or TDx).
- Installation options set with ICEMAC (JCL, TSO or TDx).

**Program Invoked DFSORT**
- DFSPARM data set
  - PARM options
  - DEBUG and OPTION control statements
  - Other control statements.
- SORTCNTL data set
  - DEBUG and OPTION control statements
  - Other control statements.
- Parameter list
  - DEBUG and OPTION control statements
  - Other control statements.
- Installation options set with PARMLIB ICEPRMxx members (INV, TSOINV or TDx).
- Installation options set with ICEMAC (INV, TSO or TDx).

**Notes:**
1. DFSORT's EXEC PARMs can be specified in the EXEC statement when DFSORT is directly invoked. For example:
   ```
   //S1 EXEC PGM=ICEMAN,PARM='EQUALS,ABEND'
   ```
   DFSORT's EXEC PARMs are ignored if DFSORT is invoked from a program.
2. DFSPARM PARMs can be specified in the DFSPARM data set when DFSORT is directly invoked or invoked from a program. For example:
   ```
   //DFSPARM DD *
   EQUAL,ABEND
   ```
3. DFSORT's control statements can be specified in the DFSPARM or SYSIN data set when DFSORT is directly invoked. At least one blank must precede the operation field (SORT, MERGE, INCLUDE, and so on). For example:
Specification/Override Of Options

//SYSIN DD *
  SORT FIELDS=(5,4,CH,A)
  OPTION EQUALS
  DEBUG ABEND

4. DFSORT’s control statements can be specified in the DFSPARM or SORTCNTL data set, or in the parameter list, when DFSORT is invoked from a program. At least one blank must precede the operation field (SORT, MERGE, INCLUDE, and so on). For example:

//SORTCNTL DD *
  SORT FIELDS=(5,4,CH,A)
  OPTION EQUALS
  DEBUG ABEND

5. For the DEBUG and OPTION statements, override is at the option level. For example, with:

//DFSPARM DD *
  OPTION EQUALS
//SYSIN DD *
  OPTION NOEQUALS, SKIPREC=50

EQUALS from DFSPARM overrides NOEQUALS from SYSIN, but SKIPREC=50 from SYSIN is not affected by the OPTION statement in DFSPARM, so both EQUALS and SKIPREC=50 will be used.

For control statements other than DEBUG and OPTION, override is at the statement level. For example, with:

//DFSPARM DD *
  MODS E15=(CHECK, 4096, EXIT)
//SYSIN DD *
  MODS E35=(MOVE, 2048, EXITX)

the MODS statement in DFSPARM completely overrides the MODS statement in SYSIN, so the E15 exit will be used, but the E35 exit will not.

6. An EFS program or an installation initialization exit (ICEIEXIT) routine can also be used to override options. ICEIEXIT changes override any corresponding changes made by an EFS program.

7. For OUTFIL statements, override is at the ddname level. See "OUTFIL Statements Notes" on page 375 for details.

Main Features of Sources of DFSORT Options

There are five sources for run-time options that allow you to override your site’s installation defaults. To help you decide which source is most efficient for you for a given situation, compare their main features using the following lists:

**DFSPARM Data Set**

- Use with direct or program invocation.
- Overrides all other sources.
- Accepts all DFSORT program control statements, and all EXEC PARM options, including those OPTION statement parameters ignored by SYSIN and SORTCNTL.
- Permits comment statements, blank statements, and remarks.

**EXEC Statement PARM Options**

- Use with direct invocation only.
Specification/Override Of Options

- Accepts all EXEC PARM options, including those equivalent to the OPTION statement parameters ignored by SYSIN and SORTCNTL.

SORTCNTL Data Set
- Use with program invocation only.
- Accepts all DFSORT program control statements.
- Ignores these OPTION statement parameters: EFS, LIST, NOLIST, LISTX, NOLISTX, LOCALE, MSGPRT, MSGDDN, SMF, SORTDD, SORTIN, SORTOUT, and USEWKDD.
- Permits comment statements, blank statements, and remarks.
- Using multiple parameter lists to rename the SORTCNTL data set permits different control statements to be used for a program that invokes DFSORT more than once.

SYSIN Data Set
- Use with direct invocation only.
- Accepts all DFSORT program control statements.
- Ignores these OPTION statement parameters: EFS, LIST, NOLIST, LISTX, NOLISTX, LOCALE, MSGPRT, MSGDDN, SMF, SORTDD, SORTIN, SORTOUT, and USEWKDD.
- Permits comment statements, blank statements, and remarks.
- Can contain user exit routines in object deck format for link-editing.

Parameter Lists
- Use with program invocation only.
- Extended parameter list accepts all DFSORT program control statements, including those OPTION statement parameters ignored by SYSIN and SORTCNTL.
- 24-bit parameter list accepts a subset of DFSORT program control statements.
- Using multiple parameter lists to rename the SORTCNTL data set permits different control statements to be used for a program that invokes DFSORT more than once.
- Can be used to pass the addresses of any user exits that your program has placed in main storage.

Note: The extended parameter list can perform a superset of the functions in the 24-bit parameter list.

Override Tables
The following tables show the possible sources of specification and order of override for individual options.
- The order of override between sources of specification is from left to right. A specification overrides all specifications to its right.
- The order of override within a source is from top to bottom. A specification overrides all specifications below it.
- For DFSPARM, 'keyword' (for example, BSAM) indicates a PARM option, whereas 'operation keyword' (for example, DEBUG BSAM) indicates a control statement option.
- The Function columns indicate which functions (S=sort, M=merge, or C=copy) can use the option.
Although alias names are available for many of the options, they are not shown here.

### Directly Invoked DFSORT

Table 85 on page 861 shows where each sort, merge, or copy option may be specified when DFSORT is directly invoked (that is, not invoked by programs).

**DFSPARM:** PARM options selectively override corresponding options in any other source. DEBUG and OPTION control statement options selectively override corresponding options in EXEC PARM and SYSIN. Control statements other than DEBUG and OPTION completely override corresponding control statements in SYSIN.

**EXEC PARM** options selectively override options in SYSIN.

SORT and MERGE are considered to be corresponding control statements.

INCLUDE and OMIT are considered to be corresponding control statements.
<table>
<thead>
<tr>
<th>Specified with DFSPARM</th>
<th>Specified with EXEC PARM</th>
<th>Specified with SYSIN PARM</th>
<th>Installation (JCL, TSO or TDx)</th>
<th>Description of Option</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>ABCODE</td>
<td>ABEND code</td>
<td>S,M,C</td>
</tr>
<tr>
<td>DEBUG ABSTP</td>
<td>NO</td>
<td>DEBUG ABSTP</td>
<td>NO</td>
<td>Abnormal stop</td>
<td>S,M,C</td>
</tr>
<tr>
<td>ALTSEQ CODE</td>
<td>NO</td>
<td>ALTSEQ CODE</td>
<td>ALTSEQ</td>
<td>Alternate sequence</td>
<td>S,M</td>
</tr>
<tr>
<td>ARESALL</td>
<td>ARESALL</td>
<td>OPTION ARESALL</td>
<td>ARESALL</td>
<td>System storage above 16MB virtual</td>
<td>S,M,C</td>
</tr>
<tr>
<td>DEBUG NOASSIST</td>
<td>NO</td>
<td>DEBUG NOASSIST</td>
<td>NO</td>
<td>Bypass Sorting Instructions</td>
<td>S</td>
</tr>
<tr>
<td>AVGRLEN</td>
<td>AVGRLEN</td>
<td>OPTION AVGRLEN</td>
<td>NO</td>
<td>Average record length</td>
<td>S</td>
</tr>
<tr>
<td>BSAM</td>
<td>BSAM</td>
<td>DEBUG BSAM</td>
<td>NO</td>
<td>Force BSAM</td>
<td>S,M,C</td>
</tr>
<tr>
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<td>NOCFW</td>
<td>NO</td>
<td>DEBUG CFW</td>
<td>NOCFW</td>
<td>CFW</td>
</tr>
<tr>
<td>OPTION CHALT</td>
<td>NOCHALT</td>
<td>NO</td>
<td>OPTION CHALT</td>
<td>NOCHALT</td>
<td>CHALT</td>
</tr>
<tr>
<td>OPTION CHECK</td>
<td>NOCHECK</td>
<td>NO</td>
<td>OPTION CHECK</td>
<td>NOCHECK</td>
<td>CHECK</td>
</tr>
<tr>
<td>CINV</td>
<td>NOCINV</td>
<td>CINV</td>
<td>NOCINV</td>
<td>OPTION CINV</td>
<td>NOCINV</td>
</tr>
<tr>
<td>COBEXIT</td>
<td>COBEXIT</td>
<td>OPTION COBEXIT</td>
<td>COBEXIT</td>
<td>COBOL library</td>
<td>S,M,C</td>
</tr>
<tr>
<td>INCLUDE</td>
<td>OMIT COND</td>
<td>FORMAT</td>
<td>NO</td>
<td>INCLUDE</td>
<td>OMIT COND</td>
</tr>
<tr>
<td>OPTION COPY SORT</td>
<td>MERGE</td>
<td>FIELDS</td>
<td>NO</td>
<td>OPTION COPY SORT</td>
<td>MERGE</td>
</tr>
<tr>
<td>DEBUG CTRx</td>
<td>NO</td>
<td>DEBUG CTRx</td>
<td>NO</td>
<td>ABEND record count</td>
<td>S,M</td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>Time-of-day for activation</td>
<td>Simulate SORTDIAG DD Statement</td>
<td>S,M,C</td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>DIAGSIM</td>
<td>Simulate SORTDIAG DD Statement</td>
<td>S,M,C</td>
</tr>
<tr>
<td>DSA</td>
<td>DSA</td>
<td>OPTION DSA</td>
<td>DSA</td>
<td>Dynamic storage adjustment limit</td>
<td>S</td>
</tr>
<tr>
<td>Specified with DFSPARM</td>
<td>Specified with EXEC PARM</td>
<td>Specified with SYSIN</td>
<td>Installation (JCL, TSO or TDs)</td>
<td>Description of Option</td>
<td>Function</td>
</tr>
<tr>
<td>------------------------</td>
<td>--------------------------</td>
<td>---------------------</td>
<td>-----------------------------</td>
<td>-----------------------</td>
<td>----------</td>
</tr>
<tr>
<td>DSPSIZE</td>
<td>OPTION DSPSIZE</td>
<td>DSPSIZE</td>
<td>DSPSIZE</td>
<td>Dataspace sorting</td>
<td>S</td>
</tr>
<tr>
<td>DYNALLOC</td>
<td>OPTION DYNALLOC</td>
<td>DYNALLOC</td>
<td>DYNALOC</td>
<td>Dynamic SORTWKs</td>
<td>S</td>
</tr>
<tr>
<td>DYNALLOC</td>
<td>OPTION DYNALLOC USEWKDDSORT DYNALLOC</td>
<td>DYNALLOC</td>
<td>DYNALLOC</td>
<td>Automatic dynamic allocation</td>
<td>S</td>
</tr>
<tr>
<td>DYNAPCT</td>
<td>OPTION DYNAPCT</td>
<td>DYNAPCT</td>
<td>DYNAPCT</td>
<td>Additional work data sets</td>
<td>S</td>
</tr>
<tr>
<td>DYNAPCT</td>
<td>OPTION DYNAPCT</td>
<td>DYNAPCT</td>
<td>DYNAPCT</td>
<td>DYNAPCT</td>
<td>S</td>
</tr>
<tr>
<td>DYNSPC</td>
<td>OPTION DYNSPC</td>
<td>DYNSPC</td>
<td>DYNSPC</td>
<td>Dynamic allocation default space</td>
<td>S</td>
</tr>
<tr>
<td>EFS</td>
<td>OPTION EFS</td>
<td>EFS</td>
<td>EFS</td>
<td>EFS program specified</td>
<td>S,M,C</td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>ENABLE</td>
<td>Enable Time-of-Day modules</td>
<td>S,M,C</td>
</tr>
<tr>
<td>EQUALS</td>
<td>NOEQUALS</td>
<td>OPTION EQUALS</td>
<td>NOEQUALS</td>
<td>EQUALS</td>
<td>Equal record order</td>
</tr>
<tr>
<td>DEBUG</td>
<td>NO</td>
<td>DEBUG EQUCOUNT</td>
<td>NO</td>
<td>Equal key count message</td>
<td>S</td>
</tr>
<tr>
<td>ABEND</td>
<td>NOABEND</td>
<td>ABEND</td>
<td>NOABEND</td>
<td>ABEND</td>
<td>Error action</td>
</tr>
<tr>
<td>DEBUG</td>
<td>NO</td>
<td>DEBUG EQUCOUNT</td>
<td>NO</td>
<td>ESTAE routine</td>
<td>S,M,C</td>
</tr>
<tr>
<td>OPTION EXITCK</td>
<td>NO</td>
<td>OPTION EXITCK</td>
<td>EXITCK</td>
<td>E15/E35 return code checking</td>
<td>S,M,C</td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>EXPMAX</td>
<td>Available expanded storage limit for all DFSORT Hiperspaces</td>
<td>S</td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>EXPOLD</td>
<td>Old expanded storage limit for all DFSORT Hiperspaces</td>
<td>S</td>
</tr>
</tbody>
</table>
Table 85. Directly Invoked DFSORT Option Specification/Override (continued). Options are arranged alphabetically on the Installation column. If “NO” is specified in the Installation column, move to the next column to the left and so on.

The order of override is from left to right and from top to bottom within a row.

<table>
<thead>
<tr>
<th>Specified with DFSPARM</th>
<th>Specified with EXEC PARM</th>
<th>Specified with SYSIN</th>
<th>Installation (JCL, TSO or TDs)</th>
<th>Description of Option</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>EXPRES</td>
<td>Available expanded storage reserved for non-Hipersorting use</td>
<td>S</td>
</tr>
<tr>
<td>INREC parameters</td>
<td>NO</td>
<td>INREC parameters</td>
<td>NO</td>
<td>INREC reformatting</td>
<td>S,M,C</td>
</tr>
<tr>
<td>JOINKEYS parameters</td>
<td>NO</td>
<td>JOINKEYS parameters</td>
<td>NO</td>
<td>JOINKEYS processing</td>
<td>S,C</td>
</tr>
<tr>
<td>JOIN parameters</td>
<td>NO</td>
<td>JOIN parameters</td>
<td>NO</td>
<td>JOIN options</td>
<td>S,C</td>
</tr>
<tr>
<td>OUTREC parameters</td>
<td>NO</td>
<td>OUTREC parameters</td>
<td>NO</td>
<td>OUTREC reformatting</td>
<td>S,M,C</td>
</tr>
<tr>
<td>REFORMAT parameters</td>
<td>NO</td>
<td>REFORMAT parameters</td>
<td>NO</td>
<td>REFORMAT fields</td>
<td>S,C</td>
</tr>
<tr>
<td>SORT</td>
<td>MERGE</td>
<td>FIELDS</td>
<td>FORMAT NO</td>
<td>SORT</td>
<td>MERGE</td>
</tr>
<tr>
<td>SUM</td>
<td>FIELDS</td>
<td>FORMAT NO</td>
<td>SUM</td>
<td>FIELDS</td>
<td>FORMAT</td>
</tr>
<tr>
<td>MERGE FILES</td>
<td>NO</td>
<td>MERGE FILES</td>
<td>NO</td>
<td>Merge input files</td>
<td>M</td>
</tr>
<tr>
<td>FILSZ OPTION FILSZ</td>
<td>SIZE SORT</td>
<td>MERGE</td>
<td>FILSZ</td>
<td>SIZE</td>
<td>FILSZ OPTION FILSZ</td>
</tr>
<tr>
<td>HPRMAX OPTION HPRMAX</td>
<td>HIPRMAX</td>
<td>OPTION HPRMAX</td>
<td>HIPRMAX</td>
<td>Hipersorting</td>
<td>S</td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>IDRCPT</td>
<td>IDRC compaction</td>
<td>S</td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>IEXIT</td>
<td>ICEEXIT</td>
<td>S,M,C</td>
</tr>
<tr>
<td>OPTION CKPT(^4) SORT CKPT(^4) NO</td>
<td>OPTION CKPT(^4) SORT CKPT(^4) NO</td>
<td>IGNCKPT</td>
<td>Checkpoints</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>IOMAXBF</td>
<td>Maximum SORTIN/ SORTOUT data set buffer space</td>
<td>S,M,C</td>
</tr>
</tbody>
</table>
## Specification/Override Of Options

<table>
<thead>
<tr>
<th>Description of Option</th>
<th>Installation (JCL, TSO or TDO)</th>
<th>Specification/Override Of Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>RECORD LENGTH NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>OPTION LIST NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>OPTION LOCALIZE</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>OPTION MEREIN</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>OPTION MOSIZE</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>OPTION MOWORK</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>OPTION MSGDDN</td>
<td>No</td>
<td>NO</td>
</tr>
<tr>
<td>OPTION MSGPRT</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>OPTION NOBLKSET</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>OPTION NOMSGDD</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>OPTION NULLOUT</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>OPTION NMLSET</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>OPTION NULLOUT</td>
<td>NO</td>
<td>NO</td>
</tr>
</tbody>
</table>

Options are arranged alphabetically on the Installation column. If "NO" is specified in the Installation column, move to the next column to the left and so on. The order of override is from left to right and from top to bottom within a row.
Table 85. Directly Invoked DFSORT Option Specification/Override (continued). Options are arranged alphabetically on the Installation column. If "NO" is specified in the Installation column, move to the next column to the left and so on.

The order of override is from left to right and from top to bottom within a row.

<table>
<thead>
<tr>
<th>Specified with DFSPARM</th>
<th>Specified with EXEC PARM</th>
<th>Specified with SYSIN</th>
<th>Installation (JCL, TSO or TDx)</th>
<th>Description of Option</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>ODMAXBF</td>
<td>ODMAXBF</td>
<td>OPTION ODMAXBF</td>
<td>ODMAXBF</td>
<td>Maximum OUTFIL data set buffer space</td>
<td>S,M,C</td>
</tr>
<tr>
<td>OUTFIL</td>
<td>OUTFIL</td>
<td>NO</td>
<td>OUTFIL processing</td>
<td>S,M,C</td>
<td></td>
</tr>
<tr>
<td>OUTREL</td>
<td>NOOUTREL</td>
<td>OUTREL</td>
<td>NOOUTREL</td>
<td>OPTION NOOUTREL</td>
<td>Release output data set space</td>
</tr>
<tr>
<td>OPTION NOOUTSEC</td>
<td>NO</td>
<td>OPTION NOOUTSEC</td>
<td>OUTSEC</td>
<td>Output data set secondary allocation</td>
<td>S,M,C</td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>OVERRGN</td>
<td>Storage over REGION</td>
<td>S,M,C</td>
</tr>
<tr>
<td>OVFLO</td>
<td>OVFLO</td>
<td>OPTION OVFLO</td>
<td>OVFLO</td>
<td>Summary fields overflow action</td>
<td>S,M</td>
</tr>
<tr>
<td>PAD</td>
<td>PAD</td>
<td>OPTION PAD</td>
<td>PAD</td>
<td>DFSORT LRECL padding action</td>
<td>S,M,C</td>
</tr>
<tr>
<td>SDB</td>
<td>SDB</td>
<td>OPTION SDB</td>
<td>SDB</td>
<td>System-determined output data set block size</td>
<td>S,M,C</td>
</tr>
<tr>
<td>SKIPREC</td>
<td>SKIPREC</td>
<td>OPTION SKIPREC</td>
<td>NO</td>
<td>Skip records</td>
<td>S,C</td>
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<tr>
<td>SIZE</td>
<td>SIZE</td>
<td>OPTION MAINSIZE</td>
<td>SIZE</td>
<td>Storage</td>
<td>S,M,C</td>
</tr>
</tbody>
</table>

Specification/Override Of Options

Appendix B. Specification/Override of DFSORT Options
Table 85. Directly Invoked DFSORT Option Specification/Override (continued). Options are arranged alphabetically on the Installation column. If "NO" is specified in the Installation column, move to the next column to the left and so on.

The order of override is from left to right and from top to bottom within a row.

<table>
<thead>
<tr>
<th>Specified with DFSPARM</th>
<th>Specified with EXEC PARM</th>
<th>Specified with SYSIN</th>
<th>Installation (JCL, TSO or TDs)</th>
<th>Description of Option</th>
<th>Function</th>
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</thead>
<tbody>
<tr>
<td>OPTION SMF</td>
<td>NO</td>
<td>NO</td>
<td>SMF</td>
<td>SMF records</td>
<td>S,M,C</td>
</tr>
<tr>
<td>SOLRF</td>
<td>NOSOLRF</td>
<td>SOLRF</td>
<td>NOSOLRF</td>
<td>OPTION SOLRF</td>
<td>NOSOLRF</td>
</tr>
<tr>
<td>OPTION SORTDD</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>ddname prefix</td>
<td>S,M,C</td>
</tr>
<tr>
<td>OPTION SORTIN</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>Alternate SORTIN ddname</td>
<td>S,C</td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>SORTLIB</td>
<td>Conventional modules library</td>
<td>S,M</td>
</tr>
<tr>
<td>OPTION SORTOUT</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>Alternate SORTOUT ddname</td>
<td>S,M,C</td>
</tr>
<tr>
<td>SPANINC</td>
<td>SPANINC</td>
<td>OPTION SPANINC</td>
<td>SPANINC</td>
<td>Incomplete spanned records action</td>
<td>S,M,C</td>
</tr>
<tr>
<td>OPTION STOPAFT</td>
<td>STOPAFT</td>
<td>OPTION STOPAFT</td>
<td>SORT STOPAFT</td>
<td>Input limit</td>
<td>S,C</td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>SVC</td>
<td>DFSORT SVC Information</td>
<td>S,M,C</td>
</tr>
<tr>
<td>SZERO</td>
<td>NOSZERO</td>
<td>SZERO</td>
<td>NOSZERO</td>
<td>OPTION SZERO</td>
<td>NOSZERO</td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>TEXIT</td>
<td>ICEEXIT</td>
<td>S,M,C</td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>TMAXLIM</td>
<td>Maximum storage above and below 16 MB virtual</td>
<td>S,M,C</td>
</tr>
<tr>
<td>TRUNC</td>
<td>TRUNC</td>
<td>OPTION TRUNC</td>
<td>TRUNC</td>
<td>DFSORT LRECL truncation action</td>
<td>S,M,C</td>
</tr>
<tr>
<td>RECORD TYPE</td>
<td>NO</td>
<td>RECORD TYPE</td>
<td>NO</td>
<td>Record format</td>
<td>S,M,C</td>
</tr>
<tr>
<td>VERIFY</td>
<td>NOVERIFY</td>
<td>VERIFY</td>
<td>NOVERIFY</td>
<td>OPTION VERIFY</td>
<td>NOVERIFY</td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>VIO</td>
<td>SORTWK virtual I/O</td>
<td>S</td>
</tr>
<tr>
<td>VLLONG</td>
<td>NOVLLONG</td>
<td>VLLONG</td>
<td>NOVLLONG</td>
<td>OPTION VLLONG</td>
<td>NOVLLONG</td>
</tr>
</tbody>
</table>
Table 85. Directly Invoked DFSORT Option Specification/Override (continued). Options are arranged alphabetically on the Installation column. If “NO” is specified in the Installation column, move to the next column to the left and so on.

The order of override is from left to right and from top to bottom within a row.

<table>
<thead>
<tr>
<th>Specified with DFSPARM</th>
<th>Specified with EXEC PARM</th>
<th>Specified with SYSIN</th>
<th>Installation (JCL, TSO or TDx)</th>
<th>Description of Option</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>VLSCMP</td>
<td>NOVLSCMP</td>
<td>OPTION VLSCMP</td>
<td>NOVLSCMP</td>
<td>VLSCMP</td>
<td>Pad short compare fields</td>
</tr>
<tr>
<td>VLSHRT</td>
<td>NOVLSHRT</td>
<td>OPTION VLSHRT</td>
<td>NOVLSHRT</td>
<td>VLSHRT</td>
<td>Action for short control or compare fields</td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>VSAMBS</td>
<td>VSAM buffer space</td>
</tr>
<tr>
<td>VSAMEMT</td>
<td>NVSAMEMT</td>
<td>OPTION VSAMEMT</td>
<td>NVSAMEMT</td>
<td>VSAMEMT</td>
<td>Empty VSAM input</td>
</tr>
<tr>
<td>VSAMIO</td>
<td>NOVSAMIO</td>
<td>OPTION VSAMIO</td>
<td>NOVSAMIO</td>
<td>VSAMIO</td>
<td>Same VSAM input and output</td>
</tr>
<tr>
<td>WRKREL</td>
<td>NOWRKREL</td>
<td>OPTION WRKREL</td>
<td>NOWRKREL</td>
<td>WRKREL</td>
<td>Release SORTWK space</td>
</tr>
<tr>
<td>WRKSEC</td>
<td>NOWRKSEC</td>
<td>OPTION WRKSEC</td>
<td>NOWRKSEC</td>
<td>WRKSEC</td>
<td>SORTWK secondary allocation</td>
</tr>
<tr>
<td>Y2PAST</td>
<td>OPCY2PAST</td>
<td>OPTION Y2PAST</td>
<td>OPCY2PAST</td>
<td>Y2PAST</td>
<td>Set century window</td>
</tr>
<tr>
<td>ZDPRINT</td>
<td>NZDPRINT</td>
<td>OPTION ZDPRINT</td>
<td>NZDPRINT</td>
<td>ZDPRINT</td>
<td>ZD SUM results</td>
</tr>
</tbody>
</table>
Specification/Override Of Options

Notes to Directly Invoked DFSORT Table

1. Does not request dynamic allocation; only supplies defaults.
2. Not used in SYSIN.
3. All functions do not apply to all exits. See Table 57 on page 493 and Table 58 on page 493 for applicable exits.
4. Not used if Blockset is selected and IGNCKPT=YES was specified.
5. Not used if MSGPRT=NONE is in effect; in this case control statements are not printed.
6. Not used unless MAINSIZE=MAX is in effect.
7. Overrides SORTDD for the SORT input ddname.
8. Overrides SORTDD for the SORT output ddname.
9. Override is at the ddname level.

Program Invoked DFSORT with the Extended Parameter List

Table 86 on page 869 shows where each sort, merge, or copy option may be specified when DFSORT is program invoked and an extended parameter list is passed to it.

DFSPARM: PARM options selectively override corresponding options in any other source. DEBUG and OPTION control statement options selectively override corresponding options in SORTCNTL and the Parameter List. Control statements other than DEBUG and OPTION completely override corresponding control statements in SORTCNTL and the Parameter List.

SORTCNTL: DEBUG and OPTION control statement options selectively override corresponding options in the Parameter List. Control statements other than DEBUG and OPTION completely override corresponding control statements in the Parameter List.

SORT and MERGE are considered to be corresponding control statements.

INCLUDE and OMIT are considered to be corresponding control statements.
Table 86. Extended Parameter List DFSORT Option Specification/Override. Options are arranged alphabetically on the Installation column. If "NO" is specified in the Installation column, move to the next column to the left and so on.

The order of override is from left to right and from top to bottom within a row.

<table>
<thead>
<tr>
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<th>Specified with Extended Parameter List</th>
<th>Installation (INV, TSOINV or TDs)</th>
<th>Description of Option</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>ABCODE</td>
<td>ABEND code</td>
<td>S,M,C</td>
</tr>
<tr>
<td>DEBUG ABSTP</td>
<td>DEBUG ABSTP</td>
<td>DEBUG ABSTP</td>
<td>NO</td>
<td>Abnormal stop</td>
<td>S,M,C</td>
</tr>
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<td>ALTSEQ CODE</td>
<td>ALTSEQ CODE</td>
<td>Offset 16 entry</td>
<td>ALTSEQ</td>
<td>Alternate sequence</td>
<td>S,M</td>
</tr>
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<td>ARESALL</td>
<td>OPTION ARESALL</td>
<td>ARESALL</td>
<td>System storage above 16MB virtual</td>
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</tr>
<tr>
<td>OPTION ARESINV</td>
<td>OPTION ARESINV</td>
<td>ARESINV</td>
<td>Storage above 16MB virtual for invoking program</td>
<td>S,M,C</td>
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<tr>
<td>DEBUG NOASSIST</td>
<td>DEBUG NOASSIST</td>
<td>DEBUG NOASSIST</td>
<td>NO</td>
<td>Bypass Sorting Instructions</td>
<td>S</td>
</tr>
<tr>
<td>AVGRLN</td>
<td>OPTION AVGRLN</td>
<td>OPTION AVGRLN</td>
<td>NO</td>
<td>Average record length</td>
<td>S</td>
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<tr>
<td>BSAM</td>
<td>DEBUG BSAM</td>
<td>DEBUG BSAM</td>
<td>NO</td>
<td>Force BSAM</td>
<td>S,M,C</td>
</tr>
<tr>
<td>DEBUG CFW</td>
<td>NOCFW</td>
<td>DEBUG CFW</td>
<td>NOCFW</td>
<td>CFW</td>
<td>Cache fast write</td>
</tr>
<tr>
<td>OPTION CHALT</td>
<td>NOCHALT</td>
<td>OPTION CHALT</td>
<td>NOCHALT</td>
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<td>OPTION CHECK</td>
<td>NOCHECK</td>
<td>CHECK</td>
<td>Record count check</td>
</tr>
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<td>OPTION CINV</td>
<td>NOCINV</td>
<td>OPTION CINV</td>
<td>NOCINV</td>
<td>CINV</td>
<td>Control interval access</td>
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<td>COBEXIT</td>
<td>OPTION COBEXIT</td>
<td>OPTION COBEXIT</td>
<td>COBEXIT</td>
<td>COBOL library</td>
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<td>FORMAT</td>
<td>INCLUDE</td>
<td>OMIT COND</td>
<td>FORMAT</td>
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<td>SORT</td>
<td>MERGE</td>
<td>FIELDS</td>
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<td>DEBUG CTRx</td>
<td>DEBUG CTRx</td>
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<td>ABEND record count</td>
<td>S,M</td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>day</td>
<td>Time-of-day for activation</td>
<td>S,M,C</td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>DIAGSIM</td>
<td>Simulate SORTDIAG DD statement</td>
<td>S,M,C</td>
</tr>
<tr>
<td>DSA</td>
<td>OPTION DSA</td>
<td>OPTION DSA</td>
<td>DSA</td>
<td>Dynamic storage adjustment limit</td>
<td>S</td>
</tr>
</tbody>
</table>
Table 86. Extended Parameter List DFSORT Option Specification/Override (continued)

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<th>Description of Option</th>
<th>Function</th>
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<tr>
<td>DSPSIZE</td>
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<td>OPTION DSPSIZE</td>
<td>DSPSIZE</td>
<td>Dataspace sorting</td>
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<td>DYNALLOC</td>
<td></td>
<td>OPTION DYNALLOC DYNALLOC</td>
<td>DYNALOC</td>
<td>Dynamic SORTWKs</td>
<td>S</td>
</tr>
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<td>DYNALLOC</td>
<td></td>
<td>OPTION DYNALLOC SORT DYNALLOC</td>
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<td>Dynamic SORTWKs</td>
<td>S</td>
</tr>
<tr>
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<td>OPTION DYNALLOC USEWKDD SORT DYNALLOC</td>
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<td>Dynamic SORTWKs</td>
<td>S</td>
</tr>
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<td>DYNAPCT</td>
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<td>OPTION DYNAPCT</td>
<td>DYNAPCT</td>
<td>Additional work data</td>
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<td>DYNSPC</td>
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<td>Dynamic allocation</td>
<td>S</td>
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<td>EFS</td>
<td>EFS program specified</td>
<td>S,M,C</td>
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<td>ENABLE</td>
<td>Enable Time-of-Day</td>
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<td>NOEQUALS</td>
<td>OPTION EQUALS</td>
<td>NOEQUALS</td>
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<td>MERGEEQUALS</td>
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<td>Equal key count</td>
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<td>ABEND/NOABEND</td>
<td>DEBUG/NODEBUG</td>
<td>DEBUG DEBUG</td>
<td>NOBEND</td>
<td>Error action</td>
<td>S,M,C</td>
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<td>DEBUG/NODEBUG</td>
<td>DEBUG DEBUG</td>
<td>NOBEND</td>
<td>ESTAE routine</td>
<td>S,M,C</td>
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<td>OPTION EXITCK</td>
<td>OPTION EXITCK</td>
<td>OPTION EXITCK</td>
<td>EXITCK</td>
<td>E15/E35 return code</td>
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<td>EXPMAX</td>
<td>Available expanded</td>
<td>S</td>
</tr>
<tr>
<td>EXPOLD</td>
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<td>NO</td>
<td>EXPOLD</td>
<td>Old expanded storage</td>
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</table>
Table 86. Extended Parameter List DFSORT Option Specification/Override (continued). Options are arranged alphabetically on the Installation column. If "NO" is specified in the Installation column, move to the next column to the left and so on.

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<th>Function</th>
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<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>EXPRES</td>
<td>Available expanded storage reserved for non-Hipersorting use</td>
<td>S</td>
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<tr>
<td>E15=COB MODS E15# HLEVEL=YES</td>
<td>MODS E15# HLEVEL=YES</td>
<td>Offset 4 entry# MODS E15# HLEVEL=YES</td>
<td>NO</td>
<td>Exit E15</td>
<td>S,C</td>
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<td>MODS E18#</td>
<td>MODS E18#</td>
<td>Offset 24 entry# MODS E18#</td>
<td>NO</td>
<td>Exit E18</td>
<td>S</td>
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<tr>
<td>NO</td>
<td>NO</td>
<td>Offset 4 entry</td>
<td>NO</td>
<td>Exit E32</td>
<td>M</td>
</tr>
<tr>
<td>E35=COB MODS E35# HLEVEL=YES</td>
<td>MODS E35# HLEVEL=YES</td>
<td>Offset 8 entry# MODS E35# HLEVEL=YES</td>
<td>NO</td>
<td>Exit E35</td>
<td>S,M,C</td>
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<tr>
<td>MODS E39#</td>
<td>MODS E39#</td>
<td>Offset 28 entry# MODS E39#</td>
<td>NO</td>
<td>Exit E39</td>
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<td>MODS Exx</td>
<td>MODS Exx</td>
<td>NO</td>
<td>User Exit Exx (xx=11,16,17,19, 31,37,38, and 61)</td>
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<td>INREC parameters</td>
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<td>INREC reformating</td>
<td>S,M,C</td>
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<tr>
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<td>JOINKEYS parameters</td>
<td>JOINKEYS parameters</td>
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<td>JOINKEYS processing</td>
<td>S,C</td>
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<td>JOIN options</td>
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<tr>
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<td>OUTREC parameters</td>
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<td>OUTREC reformating</td>
<td>S,M,C</td>
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<td>REFORMAT parameters</td>
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<td>MERGE FIELDS</td>
<td>FORMAT</td>
<td>SORT</td>
<td>MERGE FIELDS</td>
<td>FORMAT</td>
</tr>
<tr>
<td>SUM FIELDS</td>
<td>FORMAT</td>
<td>SUM FIELDS</td>
<td>FORMAT</td>
<td>SUM FIELDS</td>
<td>FORMAT</td>
</tr>
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<td>MERGE FILES</td>
<td>MERGE FILES</td>
<td>MERGE FILES</td>
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<td>Merge input files</td>
<td>M</td>
</tr>
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<td>FILSZ# OPTION FILSZ#SIZE</td>
<td>OPTION FILSZ#SIZE#</td>
<td>OPTION FILSZ#SIZE#</td>
<td>FSZEST</td>
<td>File size</td>
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<td>NO</td>
<td>GENER</td>
<td>IEBGENER name</td>
<td>C</td>
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<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>GNTRUNC</td>
<td>ICEGENER LRECL padding action</td>
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</tr>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>C</td>
<td>ICEGENER LRECL truncation action</td>
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</table>
Table 86. Extended Parameter List DFSORT Option Specification/Override (continued). Options are arranged alphabetically on the Installation column. If "NO" is specified in the Installation column, move to the next column to the left and so on.

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<th>Function</th>
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<tr>
<td>HIPRMAX</td>
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<td>OPTION HIPRMAX</td>
<td>HIPRMAX</td>
<td>Hipersorting</td>
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<td>NO</td>
<td>IDRCPT</td>
<td>IDRC compaction</td>
<td>S</td>
</tr>
<tr>
<td>NO</td>
<td></td>
<td>NO</td>
<td>IEXIT</td>
<td>ICEEXIT</td>
<td>S,M,C</td>
</tr>
<tr>
<td>OPTION CKPT© SORT</td>
<td>MERGE CKPT©</td>
<td>OPTION CKPT© SORT</td>
<td>MERGE CKPT©</td>
<td>IGNCKPT</td>
<td>Checkpoints</td>
</tr>
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<td>NO</td>
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<td>Maximum SORTIN/SORTOUT data set buffer space</td>
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<td>RECORD LENGTH</td>
<td>RECORD LENGTH</td>
<td>RECORD LENGTH</td>
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<td>Record lengths</td>
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<td>LIST</td>
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<td>OPTION LIST</td>
<td>NOLIST</td>
<td>LIST</td>
<td>Print DFSORT control statements7</td>
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<td>LISTX</td>
<td>NOLISTX</td>
<td>OPTION LISTX</td>
<td>NOLISTX</td>
<td>LISTX</td>
<td>Print control statements returned by an EFS program7</td>
</tr>
<tr>
<td>LOCALE</td>
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<td>OPTION LOCALE</td>
<td>LOCALE</td>
<td>Locale processing</td>
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<tr>
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<td>OPTION MOSIZE</td>
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<td>OPTION MOWRK</td>
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<td>MOWRK</td>
<td>Memory objects as work storage</td>
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<td>OPTION MSGDDN</td>
<td>MSGDDN</td>
<td>Alternate message ddname</td>
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</tr>
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<td>NO</td>
<td>MSGCON</td>
<td>Write messages on master console</td>
<td>S,M,C</td>
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<tr>
<td>MSGPRT</td>
<td>OPTION MSGPRT</td>
<td>OPTION MSGPRT</td>
<td>MSGPRT</td>
<td>Print messages</td>
<td>S,M,C</td>
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<td>OPTION NOBLKSET</td>
<td>OPTION NOBLKSET</td>
<td>NO</td>
<td>Bypass Blockset</td>
<td>S,M</td>
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</tbody>
</table>
Table 86. Extended Parameter List DFSORT Option Specification/Override (continued). Options are arranged alphabetically on the Installation column. If "NO" is specified in the Installation column, move to the next column to the left and so on.

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<tbody>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NOMSGDD</td>
<td>Action when message data set missing</td>
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<tr>
<td>NULLOUT</td>
<td>OPTION NULLOUT</td>
<td>OPTION NULLOUT</td>
<td>NULLOUT</td>
<td>Action when no records for SORTOUT</td>
<td>S,M,C</td>
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<tr>
<td>ODMAXBF</td>
<td>OPTION ODMAXBF</td>
<td>OPTION ODMAXBF</td>
<td>ODMAXBF</td>
<td>Maximum OUTFIL data set buffer space</td>
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<td>OUTFIL processing</td>
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<td>OPTION NOOUTSEC</td>
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<td>Storage over REGION</td>
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<td>Summary fields overflow action</td>
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<td>OPTION RESALL</td>
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<td>System reserved storage</td>
<td>S,M,C</td>
</tr>
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<td>RESET</td>
<td>NORESET</td>
<td>OPTION RESET</td>
<td>NORESET</td>
<td>RESET</td>
<td>NEW or MOD VSAM output</td>
</tr>
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<td>OPTION RESINV</td>
<td>OPTION RESINV</td>
<td>OPTION RESINV</td>
<td>RESINV</td>
<td>Program reserved storage</td>
<td>S,M,C</td>
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<td>SDB</td>
<td>OPTION SDB</td>
<td>OPTION SDB</td>
<td>SDB</td>
<td>System-determined output data set block size</td>
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<td>NO</td>
<td>NO</td>
<td>SDBMSG</td>
<td>System-determined block size for message and list data sets</td>
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</tr>
<tr>
<td>SIZE</td>
<td>OPTION MAINSIZE</td>
<td>OPTION MAINSIZE</td>
<td>SIZE</td>
<td>Storage</td>
<td>S,M,C</td>
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<td>MERGE SKIPREC</td>
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<td>OPTION SMF</td>
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<td>SMF records</td>
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<tr>
<td>SOLRF</td>
<td>NOSOLRF</td>
<td>OPTION SOLRF</td>
<td>NOSOLRF</td>
<td>OPTION SOLRF</td>
<td>NOSOLRF</td>
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<tr>
<td>OPTION SORTDD</td>
<td>NO</td>
<td>OPTION SORTDD</td>
<td>NO</td>
<td>ddbname prefix</td>
<td>S,M,C</td>
</tr>
<tr>
<td>OPTION SORTIN</td>
<td>NO</td>
<td>OPTION SORTIN</td>
<td>NO</td>
<td>Alternate SORTIN ddbname</td>
<td>S,C</td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>SORTLIB</td>
<td>Conventional modules library</td>
<td>S,M</td>
</tr>
<tr>
<td>OPTION SORTOUT</td>
<td>NO</td>
<td>OPTION SORTOUT</td>
<td>NO</td>
<td>Alternate SORTOUT ddbname</td>
<td>S,M,C</td>
</tr>
<tr>
<td>SPANINC</td>
<td>OPTION SPANINC</td>
<td>OPTION SPANINC</td>
<td>SPANINC</td>
<td>Incomplete spanned records action</td>
<td>S,M,C</td>
</tr>
<tr>
<td>STOPAFT</td>
<td>OPTION STOPAFT SORT</td>
<td>MERGE STOPAFT</td>
<td>OPTION STOPAFT SORT</td>
<td>MERGE STOPAFT</td>
<td>NO</td>
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<td>OPTION TRUNC</td>
<td>OPTION TRUNC</td>
<td>OPTION TRUNC</td>
<td>TRUNC</td>
<td>DFSORT LRECL truncation action</td>
<td>S,M,C</td>
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<td>RECORD TYPE</td>
<td>RECORD TYPE</td>
<td>RECORD TYPE</td>
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<td>Record format</td>
<td>S,M,C</td>
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<td>NOVERIFY</td>
<td>OPTION VERIFY</td>
<td>NOVERIFY</td>
<td>OPTION VERIFY</td>
<td>NOVERIFY</td>
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<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>VIO</td>
<td>SORTWK virtual I/O</td>
<td>S</td>
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Table 86. Extended Parameter List DFSORT Option Specification/Override (continued). Options are arranged alphabetically on the Installation column. If “NO” is specified in the Installation column, move to the next column to the left and so on.

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<thead>
<tr>
<th>Specified with DFSPARM</th>
<th>Specified with SORTCNTL</th>
<th>Specified with Extended Parameter List</th>
<th>Installation (INV, TSO/INV or TDs)</th>
<th>Description of Option</th>
<th>Function</th>
</tr>
</thead>
</table>
| VLLONG|NOVLLONG<br>OPTION VLLONG|NOVLLONG<br>OPTION VLLONG|NOVLLONG<br>OPTION VLLONG|NOVLLONG<br>OPTION VLLONG<br>OPTION VLLONG| VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONG<br>VLLONE
Notes to Extended Parameter List Table

1. Does not request dynamic allocation; only supplies defaults.
2. Does not override corresponding option in an OPTION statement specified via the extended parameter list.
3. Not used in SORTCNTL.
4. DFSORT terminates if the exit is specified via the parameter list entry and the exit is specified in a MODS statement.
5. All functions do not apply to all exits. See Table 57 on page 493 and Table 58 on page 493 for applicable exits.
6. Not used if Blockset is selected and IGNCKPT=YES was specified.
7. Not used if MSGPRT=NONE is in effect; in this case control statements are not printed.
8. Not used unless MAINSIZE=MAX is in effect.
9. Overrides SORTDD for the sort input ddname.
10. Overrides SORTDD for the sort output ddname.
11. Override is at the ddname level.

Program Invoked DFSORT with the 24-Bit Parameter List

Table 87 on page 877 shows where each sort, merge, or copy option may be specified when DFSORT is program invoked and a 24-bit parameter list is passed to it.

**DFSPARM:** PARM options selectively override corresponding options in any other source. DEBUG and OPTION control statement options selectively override corresponding options in SORTCNTL and the Parameter List. Control statements other than DEBUG and OPTION completely override corresponding control statements in SORTCNTL and the Parameter List.

**SORTCNTL:** DEBUG control statement options selectively override corresponding options in the Parameter List. Control statements other than DEBUG completely override corresponding control statements in the Parameter List.

SORT and MERGE are considered to be corresponding control statements.

INCLUDE and OMIT are considered to be corresponding control statements.
Table 87. 24-Bit List DFSORT Option Specification/Override. Options are arranged alphabetically on the Installation column. If "NO" is specified in the Installation column, move to the next column to the left and so on.

The order of override is from left to right and from top to bottom within a row.

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<th>Specified with SORTCNTL</th>
<th>Specified with 24-Bit List</th>
<th>Installation (INV, TSOINV or TDx)</th>
<th>Description of Option</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>ABCODE</td>
<td>ABEND code</td>
<td>S,M,C</td>
</tr>
<tr>
<td>DEBUG ABSTP</td>
<td>DEBUG ABSTP</td>
<td>DEBUG ABSTP</td>
<td>NO</td>
<td>Abnormal stop</td>
<td>S,M,C</td>
</tr>
<tr>
<td>ALTSEQ CODE</td>
<td>ALTSEQ CODE</td>
<td>ALTSEQ CODE</td>
<td>XF6' entry</td>
<td>Alternate sequence</td>
<td>S</td>
</tr>
<tr>
<td>OPTION ARESALL</td>
<td>OPTION ARESALL</td>
<td>NO</td>
<td>ARESALL</td>
<td>System storage above 16MB virtual</td>
<td>S,M,C</td>
</tr>
<tr>
<td>OPTION ARESINV</td>
<td>OPTION ARESINV</td>
<td>NO</td>
<td>ARESINV</td>
<td>Storage above 16MB virtual for invoking program</td>
<td>S,M,C</td>
</tr>
<tr>
<td>DEBUG NOASSIST</td>
<td>DEBUG NOASSIST</td>
<td>DEBUG NOASSIST</td>
<td>NO</td>
<td>Bypass Sorting Instructions</td>
<td>S</td>
</tr>
<tr>
<td>OPTION AVGLEN</td>
<td>OPTION AVGLEN</td>
<td>NO</td>
<td>AVGLEN</td>
<td>Average record length</td>
<td>S</td>
</tr>
<tr>
<td>BSAM</td>
<td>DEBUG BSAM</td>
<td>DEBUG BSAM</td>
<td>NO</td>
<td>Force BSAM</td>
<td>S,M,C</td>
</tr>
<tr>
<td>DEBUG CFW\NOCFW</td>
<td>DEBUG CFW\NOCFW</td>
<td>DEBUG CFW\NOCFW</td>
<td>CFW</td>
<td>Cache fast write</td>
<td>S</td>
</tr>
<tr>
<td>OPTION CHALT\NOCHALT</td>
<td>OPTION CHALT\NOCHALT</td>
<td>NO</td>
<td>CHALT</td>
<td>CH field sequence</td>
<td>S,M,C</td>
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<tr>
<td>OPTION CHECK\NOCHECK</td>
<td>OPTION CHECK\NOCHECK</td>
<td>NO</td>
<td>CHECK</td>
<td>Record count check</td>
<td>S,M,C</td>
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<tr>
<td>OPTION CINV\NOCINV</td>
<td>OPTION CINV\NOCINV</td>
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<td>CINV</td>
<td>Control interval access</td>
<td>S,M,C</td>
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<td>OPTION COBEXIT</td>
<td>OPTION COBEXIT</td>
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<td>COBEXIT</td>
<td>COBOL library</td>
<td>S,M,C</td>
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<tr>
<td>OPTION COPY</td>
<td>INCLUDE\OMIT COND\FORMAT</td>
<td>INCLUDE\OMIT COND\FORMAT</td>
<td>NO</td>
<td>Include\Omit fields</td>
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<tr>
<td>OPTION SORT\MERGE FIELDS</td>
<td>OPTION SORT\MERGE FIELDS</td>
<td>SORT\MERGE FIELDS</td>
<td>NO</td>
<td>Copy records</td>
<td>C</td>
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<tr>
<td>DEBUG CTRx</td>
<td>DEBUG CTRx</td>
<td>DEBUG CTRx</td>
<td>NO</td>
<td>ABEND record count</td>
<td>S,M,C</td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>day</td>
<td>Time-of-day for activation</td>
<td>S,M,C</td>
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<tr>
<td>DSA</td>
<td>OPTION DSA</td>
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<td>DSA</td>
<td>Dynamic storage adjustment limit</td>
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</tbody>
</table>
Table 87. 24-Bit List DFSORT Option Specification/Override (continued). Options are arranged alphabetically on the Installation column. If “NO” is specified in the Installation column, move to the next column to the left and so on.

The order of override is from left to right and from top to bottom within a row.

<table>
<thead>
<tr>
<th>Specified with DFSPARM</th>
<th>Specified with SORTCNTL</th>
<th>Specified with 24-Bit List</th>
<th>Installation (INV, TSOINV or TDx)</th>
<th>Description of Option</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSPSIZE</td>
<td>OPTION DSPSIZE</td>
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<td>DSPSIZE</td>
<td>Dataspcc sorting</td>
<td>S</td>
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<td>DYNALLOC</td>
<td>OPTION DYNALLOC</td>
<td>SORT DYNALLOC</td>
<td>DYNALOCD</td>
<td>Dynamic SORTWKs</td>
<td>S</td>
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<td>OPTION DYNALLOC</td>
<td>USEWKDDSORT</td>
<td>SORT DYNALLOC</td>
<td></td>
<td>S</td>
</tr>
<tr>
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<td>OPTION DYNALLOC</td>
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<td>DYNALLOC</td>
<td>Automatic DYNALLOC</td>
<td>S</td>
</tr>
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<td>DYNAPCT</td>
<td>OPTION DYNAPCT</td>
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<td>DYNAPCT</td>
<td>Additional work data sets</td>
<td>S</td>
</tr>
<tr>
<td>DYNAPCT</td>
<td>OPTION DYNAPCT</td>
<td></td>
<td>DYNAPCT</td>
<td></td>
<td>S</td>
</tr>
<tr>
<td>DYNSPC</td>
<td>OPTION DYNSPC</td>
<td>NO</td>
<td>DYNSPC</td>
<td>Dynamic allocation default space</td>
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<td>EFS</td>
<td>OPTION EFS</td>
<td>NO</td>
<td>EFS</td>
<td>EFS program specified</td>
<td>S,M,C</td>
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<tr>
<td>NO</td>
<td></td>
<td>NO</td>
<td>ENABLE</td>
<td>Enable Time-of-Day modules</td>
<td>S,M,C</td>
</tr>
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<td>EQUALS</td>
<td>NOEQUALS</td>
<td>OPTION EQUALS</td>
<td>NOEQUALS</td>
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<td>MERGE</td>
</tr>
<tr>
<td>DEBUG EQUCOUNT</td>
<td>DEBUG EQUCOUNT</td>
<td>DEBUG EQUCOUNT</td>
<td>NO</td>
<td>Equal key count message</td>
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<tr>
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<td>NOABEND</td>
<td>DEBUG ABEND</td>
<td>NOABEND</td>
<td>DEBUG ABEND</td>
<td>NOABEND</td>
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<td>DEBUG ESTAE</td>
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<td>DEBUG ESTAE</td>
<td>NOESTAE</td>
<td>DEBUG ESTAE</td>
<td>NOESTAE</td>
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<td>OPTION EXITCK</td>
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<td>EXITCK</td>
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<td>NO</td>
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<td>EXPMAK</td>
<td>Available expanded storage limit for all DFSORT Hiperspaces</td>
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<tr>
<td>NO</td>
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<td>EXPOLD</td>
<td>Old expanded storage limit for all DFSORT Hiperspaces</td>
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</table>
Table 87. 24-Bit List DFSORT Option Specification/Override (continued). Options are arranged alphabetically on the Installation column. If “NO” is specified in the Installation column, move to the next column to the left and so on.

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<th>Installation (INV, TSOINV or TDx)</th>
<th>Description of Option</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>EXPRES</td>
<td>Available expanded storage reserved for non-Hipersorting use</td>
<td>S</td>
</tr>
<tr>
<td>E15=COB</td>
<td>MODS E15^1</td>
<td>Offset 18 entry^3</td>
<td>NO</td>
<td>User exit E15</td>
<td>S,C</td>
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<tr>
<td>MODS E15^1</td>
<td>HILEVEL=YES</td>
<td>MODS E15^1</td>
<td>NO</td>
<td>User exit E15</td>
<td>S,C</td>
</tr>
<tr>
<td>NO</td>
<td>Offset 18 entry</td>
<td>NO</td>
<td>User exit E32</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>E35=COB</td>
<td>MODS E35^1</td>
<td>Offset 22 entry^3</td>
<td>NO</td>
<td>User exit E35</td>
<td>S,M,C</td>
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<tr>
<td>MODS E35^1</td>
<td>HILEVEL=YES</td>
<td>MODS E35^1</td>
<td>NO</td>
<td>User exit E35</td>
<td>S,M,C</td>
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<td>INREC parameters</td>
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<td>INREC reformatting</td>
<td>S,M,C</td>
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<td>JOINKEYS parameters</td>
<td>JOINKEYS parameters</td>
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<td>JOINKEYS processing</td>
<td>S,C</td>
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<td>JOIN parameters</td>
<td>JOIN parameters</td>
<td>JOIN parameters</td>
<td>NO</td>
<td>JOIN options</td>
<td>S,C</td>
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<tr>
<td>OUTREC parameters</td>
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<td>OUTREC parameters</td>
<td>NO</td>
<td>OUTREC reformatting</td>
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<tr>
<td>REFORMAT parameters</td>
<td>REFORMAT parameters</td>
<td>REFORMAT parameters</td>
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<td>REFORMAT fields</td>
<td>S,C</td>
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<td>SORT</td>
<td>MERGE FIELDS</td>
<td>FORMAT</td>
<td>SORT</td>
<td>MERGE FIELDS</td>
<td>FORMAT</td>
</tr>
<tr>
<td>SUM FIELDS</td>
<td>FORMAT</td>
<td>SUM FIELDS</td>
<td>FORMAT</td>
<td>NO</td>
<td>Sum fields</td>
</tr>
<tr>
<td>MERGE FILES</td>
<td>MERGE FILES</td>
<td>X04^ entry</td>
<td>NO</td>
<td>Merge input files</td>
<td>M</td>
</tr>
<tr>
<td>FILSZ</td>
<td>OPTION FILSZ</td>
<td>SIZE</td>
<td>OPTION FILSZ</td>
<td>SIZE</td>
<td>FSZEST</td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>GENER</td>
<td>IEBGENER name</td>
<td>C</td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>GNPAD</td>
<td>ICEGENER LRECL padding action</td>
<td>C</td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>GNTRUNC</td>
<td>ICEGENER LRECL truncation action</td>
<td>C</td>
</tr>
</tbody>
</table>
Table 87. 24-Bit List DFSORT Option Specification/Override (continued). Options are arranged alphabetically on the Installation column. If “NO” is specified in the Installation column, move to the next column to the left and so on.

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<tbody>
<tr>
<td>HIPRMAX</td>
<td>OPTION HIPRMAX</td>
<td>NO</td>
<td>HIPRMAX</td>
<td>Hipersorting</td>
<td>S</td>
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<td>NO</td>
<td>NO</td>
<td>IDRCPT</td>
<td>IDRC compaction</td>
<td>S</td>
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<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>ICEEXIT</td>
<td>ICEEXIT</td>
<td>S,M,C</td>
</tr>
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<td>OPTION CKPT</td>
<td>SORT MERGE CKPT</td>
<td>IGNCKPT</td>
<td>Checkpoints</td>
<td>S</td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>IOMAXBF</td>
<td>Maximum SORTIN/SORTOUT data set buffer space</td>
<td>S,M,C</td>
</tr>
<tr>
<td>RECORD LENGTH</td>
<td>RECORD LENGTH</td>
<td>RECORD LENGTH</td>
<td>NO</td>
<td>Record lengths</td>
<td>S,M,C</td>
</tr>
<tr>
<td>LIST</td>
<td>NOLIST</td>
<td>OPTION LIST</td>
<td>NOLIST</td>
<td>NO</td>
<td>Print DFSORT control statements</td>
</tr>
<tr>
<td>LISTX</td>
<td>NOLISTX</td>
<td>OPTION LISTX</td>
<td>NOLISTX</td>
<td>NO</td>
<td>Print control statements returned by an EFS program</td>
</tr>
<tr>
<td>LOCALE</td>
<td>OPTION LOCALE</td>
<td>NO</td>
<td>LOCALE</td>
<td>Locale processing</td>
<td>S,M,C</td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>MAXLIM</td>
<td>Maximum storage below 16MB virtual</td>
<td>S,M,C</td>
</tr>
<tr>
<td>OPTION MERGEIN</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>Alternate MERGE ddnames</td>
<td>M</td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>MINLIM</td>
<td>Minimum storage</td>
<td>S,M,C</td>
</tr>
<tr>
<td>MOSIZE</td>
<td>OPTION MOSIZE</td>
<td>NO</td>
<td>MOSIZE</td>
<td>Memory object sorting</td>
<td>S</td>
</tr>
<tr>
<td>MOWRK</td>
<td>NOMOWRK</td>
<td>OPTION MOWRK</td>
<td>NOMOWRK</td>
<td>NO</td>
<td>Memory objects as work storage</td>
</tr>
<tr>
<td>MSGDDN</td>
<td>OPTION MSGDDN</td>
<td>NO</td>
<td>MSGDDN</td>
<td>Alternate message ddname</td>
<td>S,M,C</td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>MSGCON</td>
<td>Write messages on master console</td>
<td>S,M,C</td>
</tr>
<tr>
<td>MSGPRT</td>
<td>OPTION MSGPRT</td>
<td>NO</td>
<td>MSGPRT</td>
<td>Print messages</td>
<td>S,M,C</td>
</tr>
</tbody>
</table>
Table 87. 24-Bit List DFSORT Option Specification/Override (continued). Options are arranged alphabetically on the Installation column. If “NO” is specified in the Installation column, move to the next column to the left and so on.

The order of override is from left to right and from top to bottom within a row.

<table>
<thead>
<tr>
<th>Specified with DFSPARM</th>
<th>Specified with SORTCNTL</th>
<th>Specified with 24-Bit List</th>
<th>Installation (INV, TSOINV or TDXs)</th>
<th>Description of Option</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPTION NOBLKSET</td>
<td>OPTION NOBLKSET</td>
<td>NO</td>
<td>NO</td>
<td>Bypass Blockset</td>
<td>S,M</td>
</tr>
<tr>
<td>NO</td>
<td></td>
<td>NO</td>
<td>NO</td>
<td>NOMSGDD</td>
<td>S,M,C</td>
</tr>
<tr>
<td>NULLOUT</td>
<td>OPTION NULLOUT</td>
<td>NO</td>
<td>NULLOUT</td>
<td>Action when message data set missing</td>
<td>S,M,C</td>
</tr>
<tr>
<td>ODMAXBF</td>
<td>OPTION ODMAXBF</td>
<td>NO</td>
<td>ODMAXBF</td>
<td>Maximum OUTFIL data set buffer space</td>
<td>S,M,C</td>
</tr>
<tr>
<td>OUTFIL</td>
<td>OUTFILE</td>
<td>NO</td>
<td>OUTFILE</td>
<td>OUTFIL processing</td>
<td>S,M,C</td>
</tr>
<tr>
<td>OUTREL</td>
<td>NOOUTREL</td>
<td>OPTION NOOUTREL</td>
<td>NO</td>
<td>OUTREL</td>
<td>Release output data set space</td>
</tr>
<tr>
<td>OPTION NOOUTSEC</td>
<td>OPTION NOOUTSEC</td>
<td>NO</td>
<td>OUTSEC</td>
<td>Output data set secondary allocation</td>
<td>S,M,C</td>
</tr>
<tr>
<td>NO</td>
<td></td>
<td>NO</td>
<td>OVERRGN</td>
<td>Storage over REGION</td>
<td>S,M,C</td>
</tr>
<tr>
<td>OVFLO</td>
<td>OPTION OVFLO</td>
<td>NO</td>
<td>OVFLO</td>
<td>Summary fields overflow action</td>
<td>S,M</td>
</tr>
<tr>
<td>PAD</td>
<td>OPTION PAD</td>
<td>NO</td>
<td>PAD</td>
<td>DFSORT LRECL padding action</td>
<td>S,M,C</td>
</tr>
<tr>
<td>NO</td>
<td></td>
<td>NO</td>
<td>PARMDDN</td>
<td>Alternate ddname for DFSPARM</td>
<td>S,M,C</td>
</tr>
<tr>
<td>RESALL</td>
<td>OPTION RESALL</td>
<td>NO</td>
<td>RESALL</td>
<td>System reserved storage</td>
<td>S,M,C</td>
</tr>
<tr>
<td>RESET</td>
<td>NORESET</td>
<td>OPTION RESET</td>
<td>NO</td>
<td>RESET</td>
<td>NEW or MOD VSAM output</td>
</tr>
<tr>
<td>OPTION RESINV</td>
<td>OPTION RESINV</td>
<td>X01’ entry</td>
<td>RESINV</td>
<td>Program reserved storage</td>
<td>S,M,C</td>
</tr>
<tr>
<td>SDB</td>
<td>OPTION SDB</td>
<td>NO</td>
<td>SDB</td>
<td>System-determined output data set block size</td>
<td>S,M,C</td>
</tr>
</tbody>
</table>
Table 87. 24-Bit List DFSORT Option Specification/Override (continued). Options are arranged alphabetically on the Installation column. If “NO” is specified in the Installation column, move to the next column to the left and so on.

The order of override is from left to right and from top to bottom within a row.

<table>
<thead>
<tr>
<th>Specified with DFSPARM</th>
<th>Specified with SORTCNTL</th>
<th>Specified with 24-Bit List</th>
<th>Installation (INV, TSOINV or TDx)</th>
<th>Description of Option</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>SDBMSG</td>
<td>S,M,C</td>
</tr>
<tr>
<td>SIZE</td>
<td>OPTION MAINSIZE</td>
<td>X'00' entry</td>
<td>SIZE</td>
<td>System-determined block size for message and list data sets</td>
<td>S,M,C</td>
</tr>
<tr>
<td>SKIPREC</td>
<td>OPTION SKIPREC</td>
<td>SORT</td>
<td>MERGE SKIPREC</td>
<td>NO</td>
<td>Skip records</td>
</tr>
<tr>
<td>OPTION SMF</td>
<td>NO</td>
<td>NO</td>
<td>SMF</td>
<td>SMF records</td>
<td>S,M,C</td>
</tr>
<tr>
<td>SOLRF</td>
<td>NOSOLRF</td>
<td>OPTION SOLRF</td>
<td>NOSOLRF</td>
<td>NO</td>
<td>SOLRF</td>
</tr>
<tr>
<td>OPTION SORTIN9</td>
<td>NO</td>
<td>NO</td>
<td>SORTLIB</td>
<td>Conventional modules library</td>
<td>S,M</td>
</tr>
<tr>
<td>OPTION SORTOUT9</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>Alternate SORTOUT dname</td>
<td>S,C</td>
</tr>
<tr>
<td>SPANINC</td>
<td>OPTION SPANINC</td>
<td>NO</td>
<td>SPANINC</td>
<td>Incomplete spanned records action</td>
<td>S,M,C</td>
</tr>
<tr>
<td>STOPAFT</td>
<td>OPTION STOPAFT</td>
<td>SORT</td>
<td>MERGE STOPAFT</td>
<td>NO</td>
<td>Input limit</td>
</tr>
<tr>
<td>OPTION SVC</td>
<td>NO</td>
<td>NO</td>
<td>SVC</td>
<td>DFSORT SVC information</td>
<td>S,M,C</td>
</tr>
<tr>
<td>OPTION SZERO</td>
<td>NOSZERO</td>
<td>NO</td>
<td>SZERO</td>
<td>Signed or unsigned zero</td>
<td>S,M,C</td>
</tr>
<tr>
<td>OPTION TEXIT</td>
<td>NO</td>
<td>NO</td>
<td>TEXIT</td>
<td>ICEEXIT</td>
<td>S,M,C</td>
</tr>
<tr>
<td>OPTION TMAXLIM</td>
<td>NO</td>
<td>NO</td>
<td>TMAXLIM</td>
<td>Maximum storage above and below 16MB virtual</td>
<td>S,M,C</td>
</tr>
<tr>
<td>OPTION TRUNC</td>
<td>NO</td>
<td>NO</td>
<td>TRUNC</td>
<td>DFSORT LRECL truncation action</td>
<td>S,M,C</td>
</tr>
</tbody>
</table>
Table 87. 24-Bit List DFSORT Option Specification/Override (continued). Options are arranged alphabetically on the Installation column. If "NO" is specified in the Installation column, move to the next column to the left and so on.

The order of override is from left to right and from top to bottom within a row.

<table>
<thead>
<tr>
<th>Specified with DFSPARM</th>
<th>Specified with SORTCNTL</th>
<th>Specified with 24-Bit List</th>
<th>Installation (INV, TSOINV or TDX)</th>
<th>Description of Option</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>RECORD TYPE</td>
<td>RECORD TYPE</td>
<td>RECORD TYPE</td>
<td>NO</td>
<td>Record format</td>
<td>S,M,C</td>
</tr>
<tr>
<td>RECOVER</td>
<td>RECOVER</td>
<td>RECOVER</td>
<td>NO</td>
<td>RECOVER</td>
<td>S,M</td>
</tr>
<tr>
<td>OPTION VERIFY</td>
<td>NOVERIFY</td>
<td>OPTION VERIFY</td>
<td>NOVERIFY</td>
<td>NO</td>
<td>VERIFY</td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>VIO</td>
<td>SORTWK virtual I/O</td>
<td>S</td>
</tr>
<tr>
<td>VLLONG</td>
<td>NOVLLONG</td>
<td>OPTION VLLONG</td>
<td>NOVLLONG</td>
<td>NO</td>
<td>VLLONG</td>
</tr>
<tr>
<td>VLSHRT</td>
<td>NOVLSHRT</td>
<td>OPTION VLSHRT</td>
<td>NOVLSHRT</td>
<td>NO</td>
<td>VLSHRT</td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>VSAMISP</td>
<td>VSAM buffer space</td>
<td>S</td>
</tr>
<tr>
<td>VSAMMT</td>
<td>NVSAMMT</td>
<td>OPTION VSAMMT</td>
<td>NVSAMMT</td>
<td>NO</td>
<td>VSAMMT</td>
</tr>
<tr>
<td>VSAM1</td>
<td>NOVSAM1</td>
<td>OPTION VSAM1</td>
<td>NOVSAM1</td>
<td>NO</td>
<td>VSAM1</td>
</tr>
<tr>
<td>WRKREL</td>
<td>NOWRKREL</td>
<td>OPTION WRKREL</td>
<td>NOWRKREL</td>
<td>NO</td>
<td>WRKREL</td>
</tr>
<tr>
<td>Y2PAST</td>
<td>Y2PAST</td>
<td>Y2PAST</td>
<td>SORT</td>
<td>MERGE Y2PAST</td>
<td>Y2PAST</td>
</tr>
<tr>
<td>ZDPRINT</td>
<td>NZDPRINT</td>
<td>OPTION ZDPRINT</td>
<td>NZDPRINT</td>
<td>NO</td>
<td>ZDPRINT</td>
</tr>
</tbody>
</table>
Notes to 24-Bit List Table

1. Does not request dynamic allocation; only supplies defaults.
2. Not used in SORTCNTL.
3. DFSORT terminates if the exit is specified via the parameter list entry and the user exit is specified in a MODS statement.
4. All functions do not apply to all user exits. See Table 57 on page 493 and Table 58 on page 493 for applicable user exits.
5. Not used if Blockset is selected and IGNCKPT=YES was specified.
6. Not used if MSGPRT=None or MSGPRT=CRITICAL is in effect; in this case control statements are not printed.
7. Not used unless MAINSIZE=MAX is in effect.
8. Overrides SORTDD for the sort input ddname.
9. Overrides SORTDD for the sort output ddname.
10. Override is at the ddname level.
Appendix C. Data Format Descriptions

DFSORT Data Formats

<table>
<thead>
<tr>
<th>Format</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH</td>
<td>(character EBCDIC, unsigned). Each character is represented by its 8-bit EBCDIC code.</td>
</tr>
<tr>
<td></td>
<td>Example: AB7 becomes</td>
</tr>
<tr>
<td></td>
<td>C1   C2     F7</td>
</tr>
<tr>
<td></td>
<td>11000001 11000010 11110111</td>
</tr>
</tbody>
</table>

Notes:
1. If CHALT is in effect, a format CH field collates according to the ALTSEQ (alternate collating sequence) table in effect. AQ format can be used for the same purpose.
2. If locale processing is in effect, a format CH field collates according to the collating rules of the active locale.

<table>
<thead>
<tr>
<th>ZD</th>
<th>(zoned decimal, signed). Each digit of the decimal number is converted into its 8-bit EBCDIC representation. The sign indicator replaces the first four bits of the low order byte of the number.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Example: −247 becomes</td>
</tr>
<tr>
<td></td>
<td>2   4   −7</td>
</tr>
<tr>
<td></td>
<td>F2   F4   D7</td>
</tr>
<tr>
<td></td>
<td>11110010 11110100 11010111</td>
</tr>
<tr>
<td></td>
<td>The number +247 becomes</td>
</tr>
<tr>
<td></td>
<td>F2   F4   C7</td>
</tr>
<tr>
<td></td>
<td>11110010 11110100 11000111</td>
</tr>
</tbody>
</table>

Notes:
1. The following are treated as positive sign indicators: E, C, A, 8, 6, 4, 2, 0.
2. The following are treated as negative sign indicators: D, B, 9, 7, 5, 3, 1.
3. For SUM processing, 0 through 9 for the sign or A through F for a digit results in a data exception (0C7 ABEND). For example, a ZD value such as X'0123BF' results in an 0C7 because B is treated as an invalid digit. ICETOOL’s DISPLAY or VERIFY operator can be used to identify ZD values with invalid digits. ICETOOL’s VERIFY operator can be used to identify ZD values with invalid signs.
4. The first four bits of the last digit is the sign indicator. The first four bits of each other digit is ignored. Thus the EBCDIC strings '0025' and ' 25' are both treated as 25 because a leading blank (X'40') is equivalent to a 0 digit (X'00').

<table>
<thead>
<tr>
<th>PD</th>
<th>(packed decimal, signed). Each digit of the decimal number is converted into its 4-bit binary equivalent. The sign indicator is put into the rightmost four bits of the number.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Example: −247 becomes</td>
</tr>
<tr>
<td></td>
<td>2   4   −7</td>
</tr>
<tr>
<td></td>
<td>2   4   7D</td>
</tr>
<tr>
<td></td>
<td>00100100 01111101</td>
</tr>
<tr>
<td></td>
<td>The number +247 becomes 247C in hexadecimal.</td>
</tr>
</tbody>
</table>

Notes:
1. The following are treated as positive sign indicators: E, C, A, 8, 6, 4, 2, 0.
2. The following are treated as negative sign indicators: D, B, 9, 7, 5, 3, 1.
3. For SUM processing, 0 through 9 for the sign or A through F for a digit results in a data exception (0C7 ABEND). For example, a PD value such as X'0123BF' results in an 0C7 because B is treated as an invalid digit. ICETOOL’s DISPLAY or VERIFY operator can be used to identify PD values with invalid digits. ICETOOL’s VERIFY operator can be used to identify PD values with invalid signs.
Data Format Examples

<table>
<thead>
<tr>
<th>Format</th>
<th>Description</th>
</tr>
</thead>
</table>
| PD0    | (packed decimal, with sign and first digit ignored) The PD0 format can be represented as follows:  
  \[ xddd...ds \]  
  x is hexadecimal 0-F and is ignored.  
  d is hexadecimal 0-9 and represents a decimal digit.  
  s is hexadecimal 0-F and is ignored.  
  PD0 can be used for parts of PD fields. For example, in the PD field \( P^mmdyyyy \) (hexadecimal 0mmddyyC), PD0 can be used separately for \( 0mmd \) (mm), \( mddy \) (dd) and \( dyyC \) (yy). |
| FI     | (fixed-point, signed). The complete number is represented by its binary equivalent with the sign indicator placed in the most significant bit position. 0 for + or 1 for −. Negative numbers are in 2’s complement form.  
  Example: +247 becomes in halfword form  
  \[ 00F7 \text{ Hexadecimal} \]  
  \[ 00000001110111 \text{ Binary} \]  
  -247 becomes in halfword form  
  \[ \text{FF09 Hexadecimal} \]  
  \[ 1111111000000001 \text{ Binary} \] |
| BI     | (binary unsigned). Any bit pattern. |
| FL     | (hexadecimal floating-point, signed). The specified number is in the two-part format of characteristic and fraction with the sign indicator in bit position 0.  
  Example: +247 becomes  
  \[ 42F70000... \text{ Hexadecimal} \]  
  0 100010 111101110000000...... Binary  
  + chara. Fraction  
  -247 is identical, except that the sign bit is changed to 1.  
  \[ C2F70000... \text{ Hexadecimal} \]  
  1 100010 111101110000000...... Binary  
  - chara. Fraction |
| AQ     | (character EBCDIC, with alternate collating sequence, unsigned). This is similar to format CH, but the characters collate according to the ALTSEQ (alternate collating sequence) table in effect. |
| AC     | (character EBCDIC, with ASCII collating sequence, unsigned). This is similar to format CH, but the characters collate according to the ASCII collating sequence. |
| D1     | (EFS type).  
  User-defined data type (requires an EFS program) |
| D2     | (EFS type).  
  User-defined data type (requires an EFS program) |
Data Format Examples

<table>
<thead>
<tr>
<th>Format</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSF or FS</td>
<td>(signed numeric with optional leading floating sign).</td>
</tr>
</tbody>
</table>

The floating sign format can be represented as follows:

<s>d . . .d

s is an optional sign immediately to the left of the digits d . . .d. If s is a −, the number is treated as negative, otherwise it is treated as positive. Thus, − must be used for a minus sign, but any other character (for example, + or blank) can be used for a plus sign. The first non-decimal digit (that is, not 0-9) going from right to left is treated as the sign and anything to the left of the sign is ignored.

Examples:

<table>
<thead>
<tr>
<th>Value</th>
<th>Treated as</th>
</tr>
</thead>
<tbody>
<tr>
<td>+34</td>
<td>+34</td>
</tr>
<tr>
<td>+0034</td>
<td>+34</td>
</tr>
<tr>
<td>-003</td>
<td>-3</td>
</tr>
<tr>
<td>-1234</td>
<td>-1234</td>
</tr>
<tr>
<td>1234</td>
<td>+1234</td>
</tr>
<tr>
<td>+01234</td>
<td>+1234</td>
</tr>
<tr>
<td>0</td>
<td>+0</td>
</tr>
</tbody>
</table>

The types of data handled by the CSF or FS format encompass those produced by several different FORTRAN, PL/I and COBOL formats, such as those shown below (using a width of 4 for purposes of illustration):

* FORTRAN: I4 ; G4.0 ; SP4 ; SP4.3 ; S4.3
* PL/I: P(4) ; P'S999' ; P'SSS9' ; P'----9'
* COBOL: PIC ++9 ; PIC +999 ; PIC ++++ ; PIC ----9 ; PIC ---- ; PIC ZZZZ

UFF (unsigned free form numeric).

This format extracts decimal digits (0-9) from right to left anywhere in the field to form a positive number. Any combination of characters is valid, but characters other than 0-9 are ignored.

Examples:

<table>
<thead>
<tr>
<th>Value</th>
<th>Treated as</th>
</tr>
</thead>
<tbody>
<tr>
<td>$58,272,300.10</td>
<td>+5827230010</td>
</tr>
<tr>
<td>$58,272,300.1</td>
<td>+582723001</td>
</tr>
<tr>
<td>$58,272,300</td>
<td>+58272300</td>
</tr>
<tr>
<td>12-31-2004</td>
<td>+12312004</td>
</tr>
<tr>
<td>(402)-125-3721XXX</td>
<td>+4021253721</td>
</tr>
<tr>
<td>G1*** 52 $ 21 R</td>
<td>+15221</td>
</tr>
<tr>
<td>000128637.240</td>
<td>+128637240</td>
</tr>
<tr>
<td>+400.52</td>
<td>+40052</td>
</tr>
<tr>
<td>+400.1</td>
<td>+4001</td>
</tr>
<tr>
<td>173/821/9072/@3</td>
<td>+17382190723</td>
</tr>
</tbody>
</table>

SFF (signed free form numeric).

This format extracts decimal digits (0-9) from right to left anywhere in the field to form a positive or negative number. If - or ) is found anywhere in the field, the number is treated as negative; otherwise it is treated as positive. Any combination of characters is valid, but characters other than 0-9, - and ) are ignored.

Examples:

<table>
<thead>
<tr>
<th>Value</th>
<th>Treated as</th>
</tr>
</thead>
<tbody>
<tr>
<td>358,272,300.10</td>
<td>+35827230010</td>
</tr>
<tr>
<td>358,272,300.1</td>
<td>+3582723001</td>
</tr>
<tr>
<td>-358,272,300</td>
<td>-358272300</td>
</tr>
<tr>
<td>(82, 316.90)</td>
<td>-8231690</td>
</tr>
<tr>
<td>12-31-2004</td>
<td>-12312004</td>
</tr>
<tr>
<td>G1*** 52 $ 21 R</td>
<td>+15221</td>
</tr>
<tr>
<td>G1### ) 52 $ 21 R</td>
<td>-15221</td>
</tr>
<tr>
<td>000128637,240</td>
<td>+128637240</td>
</tr>
<tr>
<td>400.52</td>
<td>-40052</td>
</tr>
<tr>
<td>($400.5)</td>
<td>-4005</td>
</tr>
<tr>
<td>173/821/9072/@3</td>
<td>+17382190723</td>
</tr>
<tr>
<td>X,Y,Z</td>
<td>+0</td>
</tr>
</tbody>
</table>
### Data Format Examples

<table>
<thead>
<tr>
<th>Format</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSL or LS</td>
<td>(signed number, leading separate sign). This format refers to decimal data as punched into cards, and then assembled into EBCDIC code.</td>
</tr>
<tr>
<td></td>
<td>Example: +247 punched in a card becomes</td>
</tr>
<tr>
<td></td>
<td>+ 2 4 7 Punched numeric data</td>
</tr>
<tr>
<td></td>
<td>4E F2 F4 F7 Hexadecimal</td>
</tr>
<tr>
<td></td>
<td>01001110 1110010 11110100 11110111 Binary EBCDIC code</td>
</tr>
<tr>
<td></td>
<td>+247 becomes</td>
</tr>
<tr>
<td></td>
<td>+ 2 4 7 Punched numeric data</td>
</tr>
<tr>
<td></td>
<td>60 F2 F4 F7 Hexadecimal</td>
</tr>
<tr>
<td></td>
<td>01100000 1110010 11110100 11110111 Binary EBCDIC code</td>
</tr>
<tr>
<td></td>
<td>Note: A value with ‘−’ as the leading sign character is treated as a negative value. A value with any leading sign character other than ‘−’ (for example, ‘+’ (plus) or blank) is treated as a positive value.</td>
</tr>
</tbody>
</table>

| CST or TS  | (signed numeric, trailing separate sign). This has the same representation as the CSL format, except that the sign indicator is punched after the number. |
|            | Example: 247+ punched on the card becomes |
|            | F2 F4 F7 4E Hexadecimal |
|            | Note: A value with ‘−’ as the trailing sign character is treated as a negative value. A value with any trailing sign character other than ‘−’ (for example, ‘+’ (plus) or blank) is treated as a positive value. |

| CLO or OL  | (signed numeric, leading overpunch sign). This format again refers to decimal data punched into cards and then assembled into EBCDIC code. The sign indicator is, however, overpunched with the first decimal digit of the number. |
|            | Example: +247 with + overpunched on 2 becomes |
|            | +2 4 7 Punched numeric data |
|            | C2 F4 F7 Hexadecimal |
|            | 11000010 11110100 11110111 Binary EBCDIC code |
|            | Similarly −247 becomes |
|            | D2 F4 F7 |

| CTO or OT  | (signed numeric, trailing overpunch sign). This format has the same representation as for the CLO format, except that the sign indicator is overpunched on the last decimal digit of the number. |
|            | Example: +247 with + overpunched on 7 becomes |
|            | F2 F4 C7 hexadecimal |

| ASL        | (signed numeric, ASCII, leading separate sign). Similar to the CSL format but with decimal data assembled into ASCII code. |
|            | Example: +247 punched into card becomes |
|            | + 2 4 7 Punched numeric data |
|            | 2B 32 34 37 Hexadecimal |
|            | 0101011 00110010 00111000 00111011 Binary ASCII code |
|            | Similarly −247 becomes |
|            | 2D 32 34 37 hexadecimal |
|            | Note: A value with ‘−’ as the leading sign character is treated as a negative value. A value with any leading sign character other than ‘−’ (for example, ‘+’ (plus) or blank) is treated as a positive value. |

| AST        | (signed numeric, ASCII, trailing separate sign). This gives the same bit representation as the ASL format, except that the sign is punched after the number. |
|            | Example: 247+ becomes |
|            | 32 34 37 2B hexadecimal |
|            | Note: A value with ‘−’ as the trailing sign character is treated as a negative value. A value with any trailing sign character other than ‘−’ (for example, ‘+’ (plus) or blank) is treated as a positive value. |

In the date formats below, unless specified otherwise, yy represents the two-digit year (00-99), ddd represents the day of the year (001-366), ccyy represents the four-digit year, mm represents the month (01-12), dd represents the day (01-31), x represents a decimal digit (0-9), s is hexadecimal 0-F and is ignored, and c represents the century indicator (c=0 is transformed to 19, c=1 is transformed to 20 and c>1 is transformed to 21).
### Format Description

**Y2T, Y2W, Y4T, Y4W** (character or zoned decimal date format with special indicators).

The date field can be represented as follows:

- 3,Y2T: C'yyx' or Z'yyx'
- 4,Y2T: C'yyxx' or Z'yyxx'
- 5,Y2T: C'yxdd' or Z'yxdd'
- 6,Y2T: C'yymdd' or Z'yymmd'  
- 7,Y4T: C'cyyddd' or C'cyyddd'
- 8,Y4T: C'cyyymmd' or C'cyyymmd'

- 3,Y2W: C'xyy' or Z'xyy'
- 4,Y2W: C'xxyy' or Z'xxyy'
- 5,Y2W: C'dddyy' or Z'dddyy'
- 6,Y2W: C'nmmdyy' or Z'nmmdyy'
- 7,Y4W: C'dddccyy' or Z'dddccyy'
- 8,Y4W: C'nmmdccyy' or Z'nmmdccyy'

The special indicators are X'00...00' (BI zeros), X'40...40' (blanks), C'0...0' (CH zeros), Z'0...0' (ZD zeros), C'9...9' (CH nines), Z'9...9' (ZD nines) and X'FF...FF' (BI ones).

**Y2U, Y2V, Y2X, Y2Y, Y4U, Y4V, Y4X, Y4Y** (packed decimal date format with special indicators).

The date field can be represented as follows:

- 2,Y2U: P'yyx' (X'yyxs')
- 3,Y2V: P'yyxx' (X'0yyxxs')
- 3,Y2U: P'yxdd' (X'yxddds')
- 4,Y2V: P'yymmd' (X'yymmdds')
- 4,Y4U: P'cyyddd' (X'cyyddds')
- 5,Y4V: P'ccyymmd' (X'0ccyymmds')

- 2,Y2X: P'xyy' (X'xyys')
- 3,Y2Y: P'xxyy' (X'0xxyys')
- 3,Y2X: P'dddyy' (X'dddyys')
- 4,Y2Y: P'ddmdyy' (X'ddmdyyys')
- 4,Y4X: P'dddccyy' (X'ddccyyys')
- 5,Y4Y: P'mmdccyy' (X'mmdccyys')

The special indicators are P'0...0' (PD zeros) and P'9...9' (PD nines).

**Y2C or Y2Z** (two-digit, two-byte character or zoned-decimal year data). The two-digit year data can be represented as follows:

```
xyxy
```

y is hexadecimal 0-9 and represents a year digit. x is hexadecimal 0-F and is ignored.

Thus, 96 might be represented as hexadecimal F9F6 (character 96) or as hexadecimal F9C6 or 0906 (zoned decimal 96).

**Y2P** (two-digit, two-byte packed-decimal year data). The two-digit year data can be represented as follows:

```
xyyx
```

y is hexadecimal 0-9 and represents a year digit. x is hexadecimal 0-F and is ignored.

Thus, 96 might be represented as hexadecimal 096F or 896C (packed decimal 96).

**Y2D** (two-digit, one-byte decimal year data). The two-digit year data can be represented as follows:

```
yy
```

y is hexadecimal 0-9 and represents a year digit.

Thus, 96 would be represented as hexadecimal 96 (decimal 96).
Data Format Examples

<table>
<thead>
<tr>
<th>Format</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y2S</td>
<td>(two-digit, two-byte character or zoned-decimal year data with special indicators). The two-digit year data can be represented as follows: $xyxy$ where y is hexadecimal 0-9 and represents a year digit. x is hexadecimal 0-F and is ignored. For example, 96 might be represented as hexadecimal F9F6 (character 96) or as hexadecimal F9C6 or 0906 (zoned decimal 96). The special indicators can be represented as follows: $qxzx$ where qx is hexadecimal 00, 40 or FF and zx is hexadecimal 00-FF (although typically 00, 40 and FF). Thus, special indicators might be hexadecimal 0000, 0005, 4040, FFFF, FF85 and so on.</td>
</tr>
<tr>
<td>Y2B</td>
<td>(two-digit, one-byte binary year data). The binary year data can be represented as follows: $hh$ where hh is the hexadecimal equivalent of a decimal yy value as follows:</td>
</tr>
<tr>
<td></td>
<td>Binary Values</td>
</tr>
<tr>
<td></td>
<td>X'00'-'X'63'</td>
</tr>
<tr>
<td></td>
<td>X'64'-'X'C7'</td>
</tr>
<tr>
<td></td>
<td>X'C8'-'X'FF</td>
</tr>
<tr>
<td></td>
<td>Thus, 96 might be represented as hexadecimal 60 (decimal 96) or C4 (decimal 196).</td>
</tr>
<tr>
<td>DT1</td>
<td>(SMF date interpreted as Z'yyyymmdd'). A 4-byte SMF date value in the form P'cyyddd' (X'0cyydddF') is converted to a Z'yyyymmdd' value.</td>
</tr>
<tr>
<td>DT2</td>
<td>(SMF date interpreted as Z'yyymmm'). A 4-byte SMF date value in the form P'cyyddd' (X'0cyydddF') is converted to a Z'yyymmm' value.</td>
</tr>
<tr>
<td>DT3</td>
<td>(SMF date interpreted as Z'yyyyddd'). A 4-byte SMF date value in the form P'cyyddd' (X'0cyydddF') is converted to a Z'yyyyddd' value.</td>
</tr>
<tr>
<td>DC1</td>
<td>(TOD date interpreted as Z'yyyymmdd'). The 8 bytes of an input clock value, in the basic time-of-day (TOD) format, is converted to a Z'yyyymmdd' value. The STCKCONV macro is used to do the conversion.</td>
</tr>
<tr>
<td>DC2</td>
<td>(TOD date interpreted as Z'yyymmm'). The 8 bytes of an input clock value, in the basic time-of-day (TOD) format, is converted to a Z'yyymmm' value. The STCKCONV macro is used to do the conversion.</td>
</tr>
<tr>
<td>DC3</td>
<td>(TOD date interpreted as Z'yyyyddd'). The 8 bytes of an input clock value, in the basic time-of-day (TOD) format, is converted to a Z'yyyyddd' value. The STCKCONV macro is used to do the conversion.</td>
</tr>
<tr>
<td>DE1</td>
<td>(ETOD date interpreted as Z'yyyymmdd'). The first 8 bytes of an input clock value, in the extended time-of-day (ETOD) format, is converted to a Z'yyyymmdd' value. The STCKCONV macro is used to do the conversion.</td>
</tr>
<tr>
<td>DE2</td>
<td>(ETOD date interpreted as Z'yyymmm'). The first 8 bytes of an input clock value, in the extended time-of-day (ETOD) format, is converted to a Z'yyymmm' value. The STCKCONV macro is used to do the conversion.</td>
</tr>
<tr>
<td>DE3</td>
<td>(ETOD date interpreted as Z'yyyyddd'). The first 8 bytes of an input clock value, in the extended time-of-day (ETOD) format is converted to a Z'yyyyddd' value. The STCKCONV macro is used to do the conversion.</td>
</tr>
</tbody>
</table>

In the time formats below, unless specified otherwise, hh represents the hour (00-23), mm represents the minutes (00-59), ss represents the seconds (00-59), and xx represents hundredths of a second (00-99).

<table>
<thead>
<tr>
<th>Format</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TM1</td>
<td>(SMF time interpreted as Z'hhmmss'). A 4-byte binary SMF time value in hundredths of a second is converted to a Z'hhmmss' value.</td>
</tr>
<tr>
<td>TM2</td>
<td>(SMF time interpreted as Z'hhmm'). A 4-byte binary SMF time value in hundredths of a second is converted to a Z'hhmm' value.</td>
</tr>
<tr>
<td>TM3</td>
<td>(SMF time interpreted as Z'hh'). A 4-byte binary SMF time value in hundredths of a second is converted to a Z'hh' value.</td>
</tr>
</tbody>
</table>
### Data Format Examples

<table>
<thead>
<tr>
<th>Format</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TM4</td>
<td>(SMF time interpreted as Z’hhmmssxx’). A 4-byte binary SMF time value in hundredths of a second is converted to a Z’hhmmssxx’ value.</td>
</tr>
<tr>
<td>TC1</td>
<td>(TOD time interpreted as Z’hhmmss’). The 8 bytes of an input clock value, in the basic time-of-day (TOD) format, is converted to a Z’hhmmss’ value. The STCKCONV macro is used to do the conversion.</td>
</tr>
<tr>
<td>TC2</td>
<td>(TOD time interpreted as Z’hhmm’). The 8 bytes of an input clock value, in the basic time-of-day (TOD) format, is converted to a Z’hhmm’ value. The STCKCONV macro is used to do the conversion.</td>
</tr>
<tr>
<td>TC3</td>
<td>(TOD time interpreted as Z’hh’). The 8 bytes of an input clock value, in the basic time-of-day (TOD) format, is converted to a Z’hh’ value. The STCKCONV macro is used to do the conversion.</td>
</tr>
<tr>
<td>TC4</td>
<td>(TOD time interpreted as Z’hhmmssxx’). The 8 bytes of an input clock value, in the basic time-of-day (TOD) format, is converted to a Z’hhmmssxx’ value. The STCKCONV macro is used to do the conversion.</td>
</tr>
<tr>
<td>TE1</td>
<td>(ETOD time interpreted as Z’hhmmss’). The first 8 bytes of an input clock value, in the extended time-of-day (ETOD) format, is converted to a Z’hhmmss’ value. The STCKCONV macro is used to do the conversion.</td>
</tr>
<tr>
<td>TE2</td>
<td>(ETOD time interpreted as Z’hhmm’). The first 8 bytes of an input clock value, in the extended time-of-day (ETOD) format, is converted to a Z’hhmm’ value. The STCKCONV macro is used to do the conversion.</td>
</tr>
<tr>
<td>TE3</td>
<td>(ETOD time interpreted as Z’hh’). The first 8 bytes of an input clock value, in the extended time-of-day (ETOD) format, is converted to a Z’hh’ value. The STCKCONV macro is used to do the conversion.</td>
</tr>
<tr>
<td>TE4</td>
<td>(ETOD time interpreted as Z’hhmmssxx’). The first 8 bytes of an input clock value, in the extended time-of-day (ETOD) format, is converted to a Z’hhmmssxx’ value. The STCKCONV macro is used to do the conversion.</td>
</tr>
</tbody>
</table>

The overpunch sign bit is always 'C' for positive and 'D' for negative.

### Where DFSORT Formats Can be Used

The following tables show the statements, operands, and operators allowed with each of the various data formats.

#### Table 88. Allowed with Frequently Used Data Types

<table>
<thead>
<tr>
<th>Statement, Operand, or Operator</th>
<th>CH</th>
<th>BI or FI</th>
<th>PD or ZD</th>
<th>FS or CSF</th>
<th>UFF or SFF</th>
<th>DTn, DCn, DEn, TMn, TCn, or TEn</th>
</tr>
</thead>
<tbody>
<tr>
<td>DFSORT statements</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INCLUDE</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>MERGE</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>OMIT</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>SORT</td>
<td>X</td>
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<td>X</td>
<td>X</td>
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</tr>
<tr>
<td>SUM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>INREC statement operands</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IFTHEN WHEN=(logexp)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>IFTHEN BEGIN=(logexp)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>IFTHEN END=(logexp)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>FIELDS</td>
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<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>BUILD</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>OVERLAY</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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</tr>
<tr>
<td>IFTHEN BUILD</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>IFTHEN OVERLAY</td>
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<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>OUTREC statement operands</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IFTHEN WHEN=(logexp)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
### Data Format Examples

#### Table 88. Allowed with Frequently Used Data Types (continued)

<table>
<thead>
<tr>
<th>Statement, Operand, or Operator</th>
<th>CH</th>
<th>BI or FI</th>
<th>PD or ZD</th>
<th>FS or CSF</th>
<th>UFF or SFF</th>
<th>DTn, DCn, DEn, TMn, TCn, or TEn</th>
</tr>
</thead>
<tbody>
<tr>
<td>IFTHEN BEGIN=(logexp)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IFTHEN END=(logexp)</td>
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<tr>
<td>FIELDS</td>
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<tr>
<td>BUILD</td>
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<td>OVERLAY</td>
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<tr>
<td>IFTHEN BUILD</td>
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<td>X</td>
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</tr>
<tr>
<td>IFTHEN OVERLAY</td>
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<td>X</td>
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</tr>
<tr>
<td>OUTFIL statement operands</td>
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<td>INCLUDE</td>
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<td>OMIT</td>
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<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IFTHEN WHEN=(logexp)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IFTHEN BEGIN=(logexp)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IFTHEN END=(logexp)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OUTREC</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>BUILD</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>OVERLAY</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>IFTHEN BUILD</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>IFTHEN OVERLAY</td>
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<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>TRAILERx</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td></td>
</tr>
<tr>
<td>IFTRAIL TRLID=(logexp)</td>
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<td>X</td>
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#### Table 89. Allowed with Other Data Types

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<th>TS or CST</th>
<th>OL or CLO</th>
<th>OT or CTO</th>
<th>ASL</th>
<th>AST</th>
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<th>D2</th>
<th>PD0</th>
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### DFSORT Formats for COBOL Data Types

Both DFSORT and COBOL support a large number of data types. COBOL describes these data types in one way, and DFSORT describes them in another way. If you SORT or MERGE with COBOL, the compiler automatically generates a SORT or MERGE control statement for you with the correct DFSORT descriptions for the COBOL fields you specify. But to take full advantage of DFSORT, you will often want to describe your fields in your own DFSORT control statements (for example, SORT, MERGE, INCLUDE, OMIT, INREC, OUTREC, OUTFIL, SUM) either outside of COBOL or in a DFSPARM data set used with COBOL. The table below will show you what DFSORT length and format to use for the various commonly used COBOL data types.

For example, say you want to separate out records in a very large file into two data sets based on the values in a PIC S9(4) COMP field starting in position 21. In the first data set, you want records with values in the field that are greater than or equal to +5000. In the second data set, you want records with values in the field...

---

**Table 89. Allowed with Other Data Types (continued)**

<table>
<thead>
<tr>
<th>Statement or Operand</th>
<th>AQ</th>
<th>AC</th>
<th>FL</th>
<th>LS or CSL</th>
<th>TS or CST</th>
<th>OL or CLO</th>
<th>OT or CTO</th>
<th>ASL</th>
<th>AST</th>
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</table>
that are less than -1000. You could use the table below to determine that a PIC S9(4) COMP field is equivalent to a DFSORT field with a length of 2 and a format of FI, allowing you to code your DFSORT statements as follows:

```
OPTION COPY
OUTFIL FNAMES=OUT1,INCLUDE=(21,2,FI,GE,+5000)
OUTFIL FNAMES=OUT2,INCLUDE=(21,2,FI,LT,-1000)
```

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<th>COBOL data type</th>
<th>DFSORT Length</th>
<th>DFSORT Format</th>
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</thead>
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<td>n</td>
<td>CH</td>
</tr>
<tr>
<td>GROUP DATA ITEMS with n bytes</td>
<td>n</td>
<td>CH</td>
</tr>
<tr>
<td>PIC 9(n) DISPLAY</td>
<td>n</td>
<td>ZD</td>
</tr>
<tr>
<td>PIC S9(n) DISPLAY &lt;TRAILING&gt;</td>
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<td>ZD</td>
</tr>
<tr>
<td>PIC S9(n) DISPLAY LEADING</td>
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<td>CLO</td>
</tr>
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<td>PIC S9(n) DISPLAY SEPARATE &lt;TRAILING&gt;</td>
<td>n+1</td>
<td>CST</td>
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<tr>
<td>PIC S9(n) DISPLAY LEADING SEPARATE</td>
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<td>CSL or FS</td>
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<td>BINARY</td>
<td>COMP-4</td>
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<tr>
<td></td>
<td></td>
<td>n=5 to 9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>n &gt;= 10</td>
</tr>
<tr>
<td>PIC S9(n) COMP</td>
<td>BINARY</td>
<td>COMP-4</td>
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<td></td>
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</tr>
<tr>
<td>PIC 9(n) COMP-3</td>
<td>PACKED-DECIMAL</td>
<td>(n/2)+1</td>
</tr>
<tr>
<td>PIC S9(n) COMP-3</td>
<td>PACKED-DECIMAL</td>
<td>(n/2)+1</td>
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<tr>
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<td>FL</td>
</tr>
</tbody>
</table>

Notes:
1. PIC 9(x)V9(y) can be treated like PIC 9(n) where n=x+y. (COBOL does NOT store the decimal point internally.)
2. PIC S9(x)V9(y) can be treated like PIC S9(n) where n=x+y. (COBOL does NOT store the decimal point internally.)
Table 91 shows the collating sequence for EBCDIC character and unsigned decimal data. The collating sequence ranges from low (00000000) to high (11111111). The bit configurations which do not correspond to symbols (that is, 0 through 73, 81 through 89, and so forth) are not shown. Some of these correspond to control commands for the printer and other devices.

ALTSEQ, CHALT, and LOCALE can be used to select alternate collating sequences for character data.

Packed decimal, zoned decimal, fixed-point, and normalized floating-point data are collated algebraically, that is, each quantity is interpreted as having a sign.

### Table 91. EBCDIC Collating Sequence

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<th>Bit Configuration</th>
<th>Symbol</th>
<th>Meaning</th>
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<td>Space</td>
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<td>74</td>
<td>01001010</td>
<td>0</td>
<td>Cent sign</td>
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### Table 91. EBCDIC Collating Sequence (continued)

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### ASCII

Table 92 shows the collating sequence for ASCII, character, and unsigned decimal data. The collating sequence ranges from low (00000000) to high (01111111). Bit configurations that do not correspond to symbols are not shown.

Packed decimal, zoned decimal, fixed-point normalized floating-point data, and the signed numeric data formats are collated algebraically; that is, each quantity is interpreted as having a sign.

### Table 92. ASCII Collating Sequence

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Appendix E. DFSORT Abend Processing

This appendix explains how DFSORT processes an abend. It is intended to help you get the dump you need to diagnose the error causing the abend.

All abend dumps produced by DFSORT are system abend dumps that can be processed by standard dump analysis programs. A dump will be generated if you have included a SYSUDUMP, SYSABEND, or SYSMDUMP DD statement in your application. The actual output of the system dump depends on the system parameters specified in the IEADMP00, IEAABD00 or IEADMR00 members of SYS1.PARMLIB by your installation.

At the beginning of each run, DFSORT establishes an ESTAE recovery routine to trap system or user abends for Blockset and Peer/Vale applications. You can delete the routine by specifying installation option ESTAE=NO, or by specifying NOESTAE on the DEBUG control statement. We recommend that you always run with ESTAE in effect so that in the event of an abend the following benefits are available:

• In general, you get dumps closer to the time of the abend.
• You get additional information useful in diagnosing the problem causing the abend.
• If you have activated SMF, an ICEEXIT exit, or an EFS program, DFSORT attempts to continue processing. That is, an SMF record is created, the termination exit is called, or Major Calls 4 and 5 are made to the EFS program before the application terminates processing. Of course, if one of these functions caused the abend, that function will not complete successfully.

At the end of its recovery routine, DFSORT always returns control to the system to allow termination to continue. The system will then invoke the next higher level ESTAE recovery routine.

Checkpoint/Restart

Checkpoint/Restart is a facility of the operating system that allows information about an application to be recorded so that same application can be restarted after abnormal termination or after some portion of the application has been completed. Restart can take place immediately or be deferred until the application is resubmitted.

DFSORT takes checkpoints when requested during a sort that uses the Peerage or Vale techniques.

To have DFSORT record checkpoints you must code a SORTCKPT DD statement and ensure the Peerage or Vale technique is selected. See “SORTCKPT DD Statement” on page 76 and “OPTION Control Statement” on page 173 for more information on the SORTCKPT and CKPT options, respectively.

In general, no checkpoints are taken if the following conditions exist:

• No work data set is specified.
• The application is a copy or merge.
• Blockset is selected.
Abend Processing

Notes:
1. No ANSI Standard Label tape files can be open during Checkpoint/Restart processing.
2. Do not specify CHKPT=EOV on any DFSORT DD statement.

For more information on the Checkpoint/Restart facility, see z/OS DFSMSdfp Checkpoint/Restart.

DFSORT Abend Categories

There are two categories of abends for DFSORT: unexpected abends and user abends issued by DFSORT.

• Unexpected abends
  These are system abends or user abends not issued by DFSORT. The abend code in these cases is the system abend code or the user abend code. See z/OS DFSORT Messages, Codes and Diagnosis Guide for information about detecting common user errors and reporting DFSORT program failures.

• User abends issued by DFSORT
  DFSORT will issue user abends under the following circumstances:
  – The ABEND or ABSTP option is in effect and DFSORT encounters an error that prevents completion of the run.
  – DFSORT detects an error in its internal logic.
  See z/OS DFSORT Messages, Codes and Diagnosis Guide for complete information about user abends issued by DFSORT.

Abend Recovery Processing for Unexpected Abends

DFSORT normally has an ESTAE recovery routine established to trap system or user exit routine abends for Blockset and Peer/Vale applications. If an abend occurs, the system will pass control to this routine. The DFSORT ESTAE recovery routine functions are shown below:

• Abend dump
  The recovery routine will first have the system issue an abend dump to capture the environment at the time the error occurred.

• Termination functions
  DFSORT tries to accomplish the following tasks when they are specified, whether the program terminates normally or abnormally.
  – Calls 4 and 5 to an EFS program
  – Create the SMF record
  – Call the ICETEXIT routine
  The DFSORT recovery routine runs any of the functions specified above if they have not already been run at the time of the abend.

• Abend information message
  For unexpected system or user exit routine abends, the DFSORT recovery routine issues message ICE185A giving information about when the abend occurred. The description of this message is in z/OS DFSORT Messages, Codes and Diagnosis Guide.

• Snap dumps
  The DFSORT recovery routine provides a snap dump of the system diagnostic work area (SDWA). The snap dumps are written to a dynamically allocated data set whether or not a SYSUDUMP (or SYSABEND or SYSMDUMP) DD statement is included in the application.
Abend Processing

- Copy system diagnostic work area
  If an invoking program passes the address of an SDWA area in the 24-bit or extended parameter list, DFSORT will copy the first 104 or 112 bytes of the system diagnostic work area into the user SDWA area. See Chapter 6, “Invoking DFSORT from a Program,” on page 537 for more information.

- Continuation of an application after successful SORTOUT output
  If an unexpected abend occurs after the sort, merge, or copy application writes the SORTOUT data set successfully, DFSORT issues message ICE186A and completes its normal cleanup and termination functions. The SORTOUT data set written by DFSORT is closed. The run is successful except for the function causing the abend. Message ICE186A says that the SORTOUT data set is usable even though the run has abended. You can then decide to use the SORTOUT data set or rerun the application.

- DFSORT returns control to the system at the end of its abend recovery processing so that recovery routines can be invoked.
  The DFSORT abend recovery routine functions described above may not be performed after an abend if NOESTAE is in effect. The DFSORT ESTAE recovery routine is always established at the beginning of a run. It is deleted early in DFSORT processing if NOESTAE is in effect.

Processing of Error Abends with A-Type Messages

When DFSORT encounters a critical error, it issues an A-type message and terminates. You can specify that DFSORT is to terminate the application with an abend through the ABEND or ABSTP options.

If abend termination is in effect and DFSORT encounters a critical error, DFSORT first causes an abend dump to capture the environment at the time of the error. Then, it issues the A-type message. It also runs the termination functions described earlier before terminating with an abend. The abend code will be the error message number, or a number between 1-99, as determined during installation with the ABCODE installation option.

With NOESTAE and ABEND in effect, the abend dump is produced after the A-type message is printed and other termination functions are run. As a result, the dump produced might not reflect the conditions at the time of the error. It may not include the module that encountered the error.

With NOESTAE and ABSTP in effect, the correct module will be dumped but the A-type message will not be issued.

CTRx Abend processing

The CTRx option can be used to diagnose a problem by requesting that DFSORT abend during record input or output processing. See the DEBUG control statement in Chapter 3, “Using DFSORT Program Control Statements,” on page 81. DFSORT will cause an 0C1 abend when the CTRx count is satisfied. The DFSORT ESTAE recovery routine will process the abend in the same way as it does for an unexpected abend described earlier.

The DFSORT ESTAE recovery routine will return control to the system, which will pass control to any ESTAE recovery routines established by invoking programs.
As described earlier, the DFSORT ESTAE recovery routine will save the first 104 or 112 bytes of the system diagnostic work area in the invoking program's SDWA area if the address of the area is passed to DFSORT.

Since PL/I normally has an ESPIE in effect to intercept program checks (0Cx abend codes), the DFSORT ESTAE recovery routine is not entered after these errors unless you have specified NOSPIE. DFSORT abend recovery processing will occur for all other types of abends.

Invocations from COBOL programs or use of COBOL exits can result in more than one abend dump.
Appendix F. Accessibility

Accessibility features help a user who has a physical disability, such as restricted mobility or limited vision, to use software products successfully. The major accessibility features in z/OS enable users to:

- Use assistive technologies such as screen readers and screen magnifier software
- Operate specific or equivalent features using only the keyboard
- Customize display attributes such as color, contrast, and font size

Using assistive technologies

Assistive technology products, such as screen readers, function with the user interfaces found in z/OS. Consult the assistive technology documentation for specific information when using such products to access z/OS interfaces.

Keyboard navigation of the user interface

Users can access z/OS user interfaces using TSO/E or ISPF. Refer to z/OS TSO/E Primer, z/OS TSO/E User’s Guide, and z/OS ISPF User’s Guide Vol I for information about accessing TSO/E and ISPF interfaces. These guides describe how to use TSO/E and ISPF, including the use of keyboard shortcuts or function keys (PF keys). Each guide includes the default settings for the PF keys and explains how to modify their functions.

z/OS information

z/OS information is accessible using screen readers with the BookServer/Library Server versions of z/OS books in the Internet library at:

http://www.ibm.com/systems/z/os/zos/bkserv/
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Programming Interface information

End of Programming Interface information

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