3100
3200
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COMPUTER SYSTEMS

MSOS SORT/MERGE

REFERENCE MANUAL

CONTROL DATA
CORPORATION

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INTRODUCTION 1

This manual describes two Sort/Merge programs: Mass Storage Sort (MSS) and Tape Sort/Merge (TSM). The function of the Sort/Merge program is the manipulation and rearrangement of records according to user specifications into a prescribed order or collating sequence.

Both Mass Storage Sort and Tape Sort/Merge execute under the CONTROL DATA® 3100, 3200, 3300, or 3500 Computer Systems.

The Sort/Merge program is composed of the following phases:

Sort monitor phase
Edit phase
Internal sort phase
Intermediate merge phase
Final merge phase

The program is modular, providing the user with the following operations:

Sort-Only - The sort-only routine rearranges records of one input file into an order specified by the user.

Merge-Only - The merge-only routine combines from 2 through 15 input files into one output file.

Sort and Merge - The sort and merge operation sorts the input file and merges the output with one or more presorted files.

In this manual Mass Storage Sort and Tape Sort/Merge is referred to as MSS and TSM respectively.

1.1 MASS STORAGE SORT

The Mass Storage Sort program is on the library of the Mass Storage Operating System (MSOS). The user calls MSS into core by the MSOS control card MSSORT.

1.1.1 INPUT

The input to the MSS program consists of:

MSS control cards that describe input and output files and specify sequences and orders of these files.

Input files on either magnetic tape or mass storage.

1.1.2 INTERMEDIATE STORAGE

The intermediate storage area for Mass Storage Sort must be on mass storage intermediate merge files. The intermediate merge files constitute one of the prime differences between the Mass Storage Sort program and the Tape Sort/Merge program.

1.1.3 OUTPUT

The output for MSS is on magnetic tape or mass storage.

1.1.4 HARDWARE REQUIREMENTS

Mass Storage Sort requires the minimum MSOS configuration. Refer to MSOS Reference Manual, Pub. No. 60173000.

1.2 TAPE SORT/MERGE

The Tape Sort/Merge program is on the library of either the Mass Storage Operating System (MSOS) or the Real Time Scope Operating System (RTS). The Sort/Merge program, as well as any user modification routines, is loaded by the MSOS/RTS relocatable binary loader and uses the MSOS/RTS Central Input/Output and Central Interrupt Control package for all required input and output.

1.2.1 INPUT

Input for the Tape Sort/Merge program consists of:

Sort control cards that describe input and output file parameters and specify record order and sequencing for the files.

Magnetic tape files.

1.2.2 INTERMEDIATE STORAGE

The intermediate storage areas for Tape Sort/Merge consist of user specified magnetic scratch tapes.

1.2.3 OUTPUT

Output for Tape Sort/Merge is entirely on magnetic tape.

1.2.4 HARDWARE REQUIREMENTS

Tape Sort/Merge requires the following equipment configuration:

3100, 3200, 3300, or 3500 Computer System

Console typewriter

MSOS/RTS Operating System files or units

standard input

standard output

library (magnetic tape for RTS; mass storage for MSOS)

Magnetic tape units

3-15 for polyphase merge

4-16 (in even increments) for balanced merge

RECORDS AND RECORD FILES 2

Records and record files play a primary role in the operations of the Sort/Merge program in that they provide the basic source of input and output for sorting and/or merging routines. A thorough understanding of records and files in terms of their structures and formats is essential to the user in order to provide him with a correct understanding and application of the Sort/Merge program.

Those readers who feel they have an adequate understanding of records and record files may move ahead to the next chapter.

2.1 LOGICAL RECORDS

A logical record is a collection of related facts or fields of information. Each logical record processed by Sort/Merge must contain a minimum of 17 characters.

2.2 PHYSICAL RECORDS

A physical record is a group of one or more logical records.

2.2.1 MASS STORAGE

Mass Storage physical records are addressable units (tracks or sectors) on which a file structure is superimposed.

2.2.2 MAGNETIC TAPE

A physical record on magnetic tape contains a fixed number of logical records between two inter-record gaps.

2.3 RECORD STRINGS

Record strings consist of groups of logical records sequenced into a specified order during a sort and/or merge phase operation.

The record strings serve as a source of output for the internal sort phase and as both input and output for both the intermediate and final merge phases.

2.4 RECORD FILES

A record file consists of a complete set of logical records treated as a unit of information. Logical records within a file can be in either binary or BCD (binary coded decimal) mode depending on the mode of the file on which they are written.

A file may be either fixed length or variable length according to the structure of the records within it.

2.4.1 FIXED LENGTH FILE

A file is fixed length if all the logical records within the file contain the same number of characters.

Example:

FILE

Record 1 - CONTROL DATA CORP.	KN03	604-29-8731	49	31,000
Record 2 - CONTROL DATA CORP.	TS95	531-02-2210	25	10,000
Record 3 - CONTROL DATA CORP.	TS12	205-73-4510	31	15,000

2.4.2 VARIABLE LENGTH FILE

A variable length file consists of logical records, each of which can contain a varying number of characters.

Example:

FILE

CONTROL DATA CORP.	SQ30	762-10-1390	38	23,000	A-1	2-S
10Q1 CONTROL DATA CORP.	GN68	493-28-3071	43	15,000		
CONTROL DATA CORP.	PK36	598-41-3947	28	11,000	A-1	

The user specifies variable length files by selecting one of the four types of variable length record indicators.

Character Count

A record character count of one to four characters located at the beginning of each file indicates to Sort/Merge the total number of characters (including itself) in a variable length file. Additional record character count fields located within each record of the file indicate the number of characters, including itself, in each record.

The character count field must occupy the same relative position within each logical record of the file.

The size, mode, and relative position of the record character count are specified on a file control card (see sections 7.3.2 and 7.4.2) and must be consistent for all records of any given sort run.

When allocating intermediate merge files make certain the one to four characters of the record character count field are included into the total character count calculation when specifying the block size for each file (see section 5.1).

Example:

Character count fields for both the file and records are indicated by shaded areas.

FILE

0139	51	CONTROL DATA CORP.	SQ30	762-10-1390	38	23,000	
A-1	2-5	10Q1	41	CONTROL DATA CORP.	GN68	493-28	
3071	33	15,000	44	CONTROL DATA CO	PD36	598-41	
3947	28	11,000	A-1				

Record Mark

A special record mark 72_8 terminates each logical record.

As a record mark of a logical record is processed, a one-word character count field is inserted by the Sort/Merge program. Sort/Merge uses this field (in binary) for internal processing (sort and/or merge). The user retains this field on the output file by specifying the character count field on the output file control card, (sections 7.3.2 and 7.4.2), making certain to include the four characters of the record character count in specifying the size of each logical record.

If the user specifies other than the character count for the output file, the Sort/Merge program eliminates the count field.

Example:

FILE

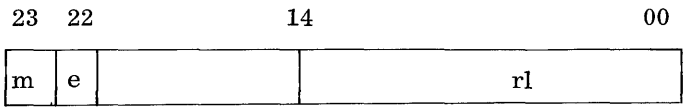
CONTROL DATA CORP.	SQ30	762-10-1390	38	23,000	A-1	2-5	
10Q1	72_8	CONTROL DATA CORP.	GN68	493-28-3071	43	15,000	
72_8	CONTROL DATA CORP.	PK36	598-41-3947	28	11,000	A-1	72_8

Universal Header (MSS Only)

A one word universal header is located as the first word of a logical record. Each universal header specifies the character length, and record type (end-of-file record or data record) of the record in which it appears, excluding itself.

The universal header is specified by the user on the file control card (sections 7.3.2 and 7.4.2). A universal header is written in BCD or binary corresponding to the mode of the file.

The universal header has the following format:



m 1 Binary mode

0 BCD

e 1 End-of-file record

0 Data record

rl character length of record, excluding the four characters of the record header

Interrecord Gap (MSS Only)

Each unblocked variable length record on a magnetic tape file is terminated by an interrecord gap.

As each interrecord gap is processed, the Sort/Merge program adds a binary character count field of four characters to the beginning of each record for internal processing.

Example:

FILE

CONTROL DATA CORP.			SQ30	763-10-1390	38	23,000
A-1	2-5	10Q1	•••••	CONTROL DATA CORP.		GN68
493-28-3071	43	15,000	•••••	CONTROL DATA CORP.		
PK36	598-41-3947	28	11,000	A-1	•••••	

2.5 FILE LABELS

2.5.1 MASS STORAGE FILE LABELS

MSOS requires labels for all mass storage files. File labels for mass storage are constructed by the system to conform to the label format specified in appendix A.

2.5.2 MAGNETIC TAPE LABELS

Header and trailer labels are optional on magnetic tape files. If labeled files are specified by the user, the labels may be specified as standard or non-standard header labels with or without corresponding standard or non-standard trailer labels. The formats for standard header and trailer labels are in appendix B.

Standard Labels

Header. An 80 character standard header label is written by tape Sort/Merge on each work tape during the intermediate merge phase of the program. Tape Sort/Merge reads or writes header labels in the same density as the data file.

Sort/Merge checks standard header labels for input files by comparing them with information specified by the user on the input file control card (section 7.4.2). If the information does not agree, sort types a message on the CTO (console typewriter). The operator then accepts or rechecks the label or deletes the job.

Sort/Merge constructs standard header labels for output files from the information contained in the output file control card (section 7.4.2). When the user does not provide an output file control card, Sort/Merge constructs the header label using the standard header specification from the input file control cards.

Trailer. A standard trailer label consists of 80 characters preceded and followed by an end-of-file mark. Tape Sort/Merge reads or writes a trailer label in the same mode and density as the data file.

Sort/Merge checks a standard trailer label by comparing the record block count against the number of physical blocks actually read. If the count does not agree, it types a message on the CTO. The operator may then continue or terminate the job.

When the user specifies trailer labels on the file control card (section 7.4.2), Sort/Merge writes a standard trailer label on each output tape.

Nonstandard Labels

Header. A 17 to 120 character nonstandard header label is read or written in the same mode and density as the data file. The user specifies a nonstandard header label on the file control card (section 7.4.2).

A nonstandard header label specified for an input file consists of the first physical record read from the file. Nonstandard header labels for input files are not checked by Sort/Merge but are verified by the user at program exits 1 and 2 (chapter 3).

The user requests nonstandard header labels on output files on the file control card (section 7.4.2). The contents of the nonstandard label are specified by the user on the nonstandard output label control card (section 7.4.3). If neither card is present Sort/Merge provides a diagnostic.

If the user specifies a C in column 29 of the output file control card, the nonstandard header label for the input file is copies as the header for the output file. A nonstandard trailer label is not written in this case.

Trailer. A 17 to 120 character nonstandard trailer label is read or written in the same mode and density as the data file.

Nonstandard trailer labels for input files are optionally checked by the user, not Sort/Merge, at program exits 1 and 2.

Nonstandard trailer labels for output files are optionally constructed by the user at program exit 3 (section 3.2).

2.6 RECORD BLOCK

A record block is a fixed-length physical record that can contain one or more logical records per physical record, or a logical record equal to a physical record, according to user specifications on the file control card.

2.6.1 MASS STORAGE RECORD BLOCKS

The user specifies record block size in columns 9 through 12 on the file control card (section 7.3.2) when describing a mass storage data file for allocation.

The block size is always fixed length for a given file and can be no more than 4095 characters long.

To get optimum utilization of available mass storage when specifying record blocks, select a number of records whose total character count approximates as closely as possible a multiple of the 256 character sector increments used in allocating mass storage record blocks.

The first word of each mass storage record block must contain, in binary, the number of the next logically sequential block in the file. The second word must contain, in binary, the number of data characters in the block, including the character of the two word record block header.

Data files are structured two ways on mass storage blocks, sequentially or in a chained formation.

Sequential Files

In sequential files, records are arranged to be read successively:

record 1, block 1

record 2, block 1...

record 1, block 2

record 2, block 2...

record x, block n

Chained Files

In chained files, each record has a field containing the address (block number followed by the character position in the block) of the next record in sequence. This address must be the first field in the record. The first record in the file must be a dummy record containing only the address of the first record. The address field in the last record must be all 7's.

2.6.2 MAGNETIC TAPE RECORD BLOCKS

Physical tape records are substituted for data blocks to contain this specified number of logical records.

Record blocks on magnetic tape contain either fixed or variable length records.

The blocks must be sequential but do not require the two-word block number and character length described for mass storage.

2.7 SORT KEYS

A sort key is a field of information within a record, such as a name, social security number, or address which has the same position relative to the first character position of each record within a file.

Example:

Logical record format	NAME	AGE	DEPT	SALARY	DATE EMPLOYED
	Sort Key 1	Sort Key 2	Sort Key 3	Sort Key 4	Sort Key 5

Both Mass Storage Sort and Tape Sort/Merge use sort keys in processing requests for sort and/or merge operations. Sort/Merge compares the contents of sort keys between pairs of records character by character according to a sequence (ascending or descending) specified by the user. When Sort/Merge finds inequality between sort key characters, it sequences the two records according to the specified collating sequence.

Variable length and fixed length records located on two or more files can be sorted together using the comparison of sort keys within each record if the sort keys specified for the sort routine have the same designated information and location in relation to the beginning of each record.

Example

Fixed length records

0	20	23	27	32	40
NAME	AGE	DEPT	SALARY	DATE EMPLOYED	
NAME	AGE	DEPT	SALARY	DATE EMPLOYED	

Variable length records

0	20	23	27	32	40
NAME	AGE	DEPT	SALARY	DATE EMPLOYED	SECURITY LEVEL
EDUCATION	JOB ACTIVITIES				

Both types of records can be sorted on the basis of name, age, department, salary, or date employed because each of these sort keys contains the same general type of information and is located in the same character position for all three records.

The user identifies the sort key fields through parameters on the Primary (MSS) or MASTER (TSM) control cards.

A summary of these parameters is as follows:

Each sort key field has an associated collating sequence and order which is either ascending or descending.

A sort key must be a multiple of 6-bit bytes. There are four 6-bit bytes per word.

The maximum number of sort keys are arranged in a hierarchical order with each sort key listed having processing priority over the sort keys to its right.

The total number of characters for all sort keys must not exceed the logical record size.

Sort keys within a record need not have the same collating sequence or order. For example:

Sort Key	Key Contents	Collating Sequence	Order	Priority Rank
1	Name	BCD	ascending	1
2	Age	BCD	descending	2
3	Department	Binary	ascending	3
4	Salary	Binary	ascending	4
5	Employment Date	BCD	descending	5

If two records being compared contain identical sort key information for the first sort key (e. g., if the last name and initials in the preceeding example were the same) the comparison of the records moves to the next level of sort keys (sort key 2). If an inequality between the keys exists, the records are sequenced in the order specified by the user for that key field (descending order in the case of the example). If no inequality was found during the comparison of the second level sort key, Sort/Merge continues the comparison of the remaining sort keys of both records according to their listed orders until an inequality exists, or until all keys within both records have been processed.

MODIFICATION ROUTINES 3

Modification routines are not requirements of either Mass Storage Sort or Tape Sort/Merge programs but are extremely useful in sorting and/or merging mixed typed records (fixed length with variable length, record character count with universal records, etc.). These routines provide the user with the means of modifying, inserting, or deleting segments of records or inconsistent structures between records to provide compatible sort key structures (in terms of relative character positions, mode and size) required for any sort and/or merge operation (section 2.7).

The user has the option of providing modification routines through three program exits during a Mass Storage Sort or Tape Sort/Merge run.

Each modification routine is user written.

All modification routines must be previously assembled in relocatable binary on the standard input unit or some other specified unit indicated by EXIT control cards (section 7.3.5 and 7.4.5).

Input/output operations requested by the user must be handled by MSOS or RTS.

The user can specify one or a combination of the following modification routines for each program exit:

Verification of file labels

Modification of file and/or record labels

Deletion of logical records and/or record labels

Insertion of logical records and/or record labels

Generation of operator messages

The three program exits occur during the Sort/Merge program as follows:

Exit 1 The logical record or the file label has been read and is ready to be passed to the internal sort phase.

Exit 2 The logical record or the label of a presorted merge input file has been read and is ready to be merged.

Exit 3 The logical record or the label is ready to be moved to the final output buffer.

The user requests entry to a modification routine by supplying one modification control card for each program exit. When a request occurs, the edit phase places the number of the exit in the program loader list for loading during the appropriate phase. Modification routines must not use the data area.

The user must save the contents of any register used in an exit routine and restore them if they are used during exeuction of a modification routine.

All modification routines within each program exit must be written as a closed subroutine with an eight-word transfer vector. The first word of the transfer vector is the entry point in the card. There can be only one named entry point in each routine. The coding sequence for the modification routine is as follows:

```
(entry 1)   name    UJP   **
                    UJP   address of user logical record checking routine
(entry 2)   +2      UJP   **
                    UJP   address of user header label checking routine
(entry 3)   +4      UJP   **
                    UJP   address of user trailer label checking routine
(entry 4)   +6      UJP   **
                    UJP   address of user routine for end of input
            name          entry point name of the modification routine
                          for a specific exit.
```

If the user specifies operator control, the Sort/Merge return jump (RTJ) places the normal return address in the requested entry (name, name + 2, name + 4, name + 6) to the modification routine.

If the user does not want control for a particular option, he must select a normal return for that option. Sort enters the user modification routine for each of the four options. The normal return is to the UPJ ** (unconditional jump) at the respective entry point. The user may elect alternate returns by incrementing the normal return address by either one or two.

Example:

To check only the header label of an input file, the transfer vector of the routine would be as follows:

```
Entry names     UJP **
                UJP *-1
                UJP **
                UJP check header
                UJP **
                UJP *-1
                UJP **
                UJP *-1
```

3.1 EXIT 1

Exit 1 can be taken after each logical input record is read, but before it is transferred from the input buffer to the record storage area. The user has the option of accepting control after each header label, trailer label, or logical record has been read.

3.1.1 ENTRY 1 LOGICAL RECORD

Logical records can be accepted (unmodified or modified) by a normal return, inserted by adding one to the normal return address, or deleted by adding two to the normal return address. When the routine is entered, the A register contains the character address of the record just read; the Q register contains the record length.

If a record is to be accepted, modified (except for a length increase), or deleted, the A and Q registers should have the same contents at exit as when the routine was entered.

When a record is to be lengthened, the user must assemble it in a work area and must modify the A and Q registers to reflect the new record address and length.

Similarly, an inserted record must be read into a user area and the A and Q registers modified to reflect its address and length.

Sort/Merge enters an inserted record into the sort routine and then returns to the user exit with the A and Q registers set to the address and length of the record just read from the input file. The same record is referenced each time this exit is taken until it is either accepted or deleted.

3.1.2 ENTRY 2 HEADER LABEL (TAPE)

A standard or nonstandard header label may be accepted by a normal return, rechecked by adding one to the normal return address, or rejected by adding two to the normal return address. If the recheck option is taken, the operator is instructed to mount a new tape. The reject option terminates the job.

3.1.3 ENTRY 3 TRAILER LABEL (TAPE)

A standard or nonstandard trailer label may be accepted by a normal return or rejected (terminating the job) by adding one to the normal return address.

3.1.4 ENTRY 4 END OF INPUT

The end-of-input exit occurs at the completion of reading all sort input and before completion of the internal sort. Sorting continues when the normal return is taken. Logical records may be inserted by adding one to the normal return address, or the job may be terminated by adding two to the normal return address. Logical records are inserted in the same way as in entry 1. Sort/Merge takes this exit after each record insertion until a continue or termination return is executed.

3.2 EXIT 2

Sort/Merge can take exit 2 after reading each logical record from a presorted merge input file (for either a sort/merge or merge only run), but before entering the record into the merge routine. Sort/Merge also takes this exit after reading each tape header or trailer label and at the end of input for each file.

3.2.1 ENTRY 1 LOGICAL RECORD

Logical records are accepted (unmodified or modified) by a normal return, inserted by adding one to the normal return. When the routine is entered, bit 23-18 of the A register contain the file identification character from column 2 of the file control card, bits 16-00 of A contain the character address of the record just read, and the Q register contains the length of the record.

Records are accepted, modified, inserted, or deleted as in entry 1, exit 1 (section 3.1). If the user elects to assemble logical records within his modification routine, he must provide a separate work area for each merge input file. Sort/Merge saves the address returned in the A register and does not move the record until it has been merged and transferred to the output buffer. This transfer takes place after the modification routine for exit 3, if any, has been executed.

3.2.2 ENTRY 2 HEADER LABEL (TAPE)

The description of entry 2, exit 1 (section 3.1) applies to this entry also.

3.2.3 ENTRY 3 TRAILER LABEL (TAPE)

The description of entry 3, exit 1 (section 3.1) applies to this entry.

3.2.4 ENTRY 4 END OF INPUT

The end-of-input exit occurs at the completion of all merge input data from each merge input file. Merging can be continued by a normal return, or the job can be terminated by adding two to the normal return address. The user can insert

logical records by adding one to the normal return address and following the procedure described for entry 1, exit 1 (section 3.1). This exit is taken after each record insertion until a continue or termination return is executed.

3.3 EXIT 3

Sort/Merge can take exit 3 after merging each record but before moving the record to the final output area. The user has the option of accepting control at the following times:

Before each logical record

At the end of the job

Before each header or trailer label (tape output file only)

Before end-of-reel, or end-of file is written (tape output file only)

3.3.1 ENTRY 1 LOGICAL RECORDS

Logical records are accepted (modified or unmodified) by a normal return, inserted by adding one to the normal return address, or deleted by adding two to the normal return address.

Record modifications at this exit are limited; neither the sort key nor the record length may be changed.

When a Sort/Merge take this exit, bits 16 through 00 of the A register contain the character address of the current record and bits 16 through 00 of the Q register contain the character address of the immediately preceding record. Index register 3 contains zero when the sort keys of these two records are equal. This routine provides the user with a means of obtaining a summary of sorted output containing identical records and of reducing these records to a single record by summarizing into the previous record and deleting the current record for equal keys.

A logical record, which must agree with the description in the output file card, is inserted by placing its character address in A, the number of characters in index register 1, and the character address of the previous record in the Q register before taking the insert return. Sort/Merge accepts the inserted record for transfer to the final output area and then returns to this exit. The A and Q registers are set to the address of the current and previous records before the insert return was taken. Sort/Merge refers to these two records each time this exit is taken until the current record is either accepted or deleted.

3.3.2 ENTRY 2 HEADER LABEL (TAPE OUTPUT)

At entry 2 the user changes or replaces a standard or nonstandard header label after it has been generated but before it is written. The first word address of the label is in the A register and the label character length is in the Q register. Upon normal return, Sort/Merge writes the label whose first word address and length are in the A and Q registers. The user may terminate the job by adding one or two to the normal return address.

3.3.3 ENTRY 3 TRAILER LABEL (TAPE OUTPUT)

Upon entry to the user modification routine, the A register is positive for the end of an intermediate output reel or negative for the final output reel. The user may change the contents of the trailer label before taking either return. If the normal return is elected, Sort/Merge requests a new output reel when required and continues the sort or merge to completion. A sort or merge can be terminated at the end of any final output reel by adding one to the normal return address. The first word address of the trailer label must be in the A register and the character length must be in the Q register before either return is taken.

3.3.4 ENTRY 4 END OF JOB

The job is complete. When the user returns from this exit, Sort/Merge returns control to MSOS.

Refer to Appendix C for the table summarizing the structure and use of Sort/Merge program exits.

RESTART DUMP 4

Sort/Merge provides the user with a restart dump feature which is effective in processing jobs where a large amount of time is wasted if an irrecoverable error occurred. That is, by using a restart dump the user eliminates repetition of successfully completed passes of the program reducing the number of costly delays and wasted man hours. When the user specifies a restart dump Sort/Merge writes a restart dump consisting of the contents of core and all registers at the end of the internal sort phase and after each intermediate merge pass. If hardware errors occur during the job run or if the operator terminates the job either through error or due to a scheduled stop, the restart of the job can be scheduled for an immediate restart at the time of termination or at a later point in time using the contents of the restart dump as input.

4.1 MASS STORAGE SORT/MERGE MSOS

A restart dump option is specified by the user on the primary control card (section 7.3.1). MSS repositions each dump pointer back to its original location in core. Thus, only one core dump appears on the restart file at any time.

The size of the restart file is determined by the amount of core required by MSS. If the user requests an external restart, that is a restart of MSS at a later point in time, he must allocate his own restart file. In allocating the restart file the user must provide the required MSIO control cards (section 7.2) and a file control card (columns 3, 4, 20, and 21, section 7.3.2). One block containing seven tracks of mass storage is sufficient for all dumps.

If an MSS run terminates before completion of the internal sort phase (MERGE PASS/or FINAL MERGE has not appeared on the CTO) the operator reruns the job from the beginning.

If the program terminates abnormally either through system or operator error after the internal sort phase is completed, the operator restarts the program from the point at which the last restart dump was taken.

To restart, the operator performs the following steps:

1. Removes any control cards which allocate files
2. Sets SELECT JUMP 6
3. Resubmits the job as if starting from the beginning

If a parity error or length error occurs on a read during a merge pass and operator action is specified on the primary control card (section 7.3.1) MSS types the following message on the CTO:

A MSRT 215 B UNIT no. {READ PARITY / BUFFER LENGTH} R, A, S

The operator responds by typing one of the following:

R retry the read

S restart the job

A abort the job

MSS resumes processing or terminates the job according to the option selected.

4.2 TAPE SORT/MERGE MSOS/RTS

The user specifies a restart dump on the master control card (column 7, section 7.4.1).

TSM writes the restart dump on the scratch tape containing the least amount of information.

The restart dump consists of the contents of all control registers and storage, with the exceptions of the MSOS/RTS resident monitor and any priority programs.

CTO types the following message after a restart dump is written:

I TSRT 230 B RESTART INDENT lurc

lu - Logical unit number of tape containing the restart dump

rc - Restart code

For additional recovery protection, SELECT JUMP 5 is set to allow for a programmed stop at the completion of each intermediate merge pass before the current restart dump is written. At this time, the operator can remove the last set of intermediate merge input tapes and save them for a restart from the beginning of that merge pass. Additional work tapes are required to replace them on line.

The CTO prints the following message at the end of the recovery protection routine:

A TSRT 317 B UNITS no.,no.,no.,MAY
BE SAVED FOR RESTART

The operator performs the following steps to restart the program if the program was terminated prematurely or, if intermediate tapes removed from the tape units for additional recovery protection are to serve as input for the restart:

1. Mount each intermediate merge input tape on the logical tape unit

from which it was removed. The equipment configuration on the computer must be the same as when the restart dump was written. Scratch tapes must be mounted on the proper merge output units.

2. Reload on INP the MSOS/RTS control cards (SEQUENCE - MSOS only, JOB, EQUIP, and SORT) required to restore the resident TSM program to pre-restart status and load the TSM program.

3. Set SELECT JUMP 6 to ON. Upon reading the SORT control card, SCOPE loads the TSM monitor and gives control to TSM. The SORT monitor interrogates SELECT JUMP 6 and enters the restart program.

4. The restart program writes the following message on the CTO requesting the operator to enter the restart identification.

   A TSRT 315 B ENTER RESTART, lurc

   lu - Logical unit number of tape containing dump

   rc - Restart code

To do an internal restart during a current merge pass of a Sort/Merge run, the operator:

1. Sets SELECT JUMP 6 to ON.

2. Enters the restart identification when the system requests it.

The restart programs on the basis of the restart identification submitted by the operator, performs the following operations:

Relocates the restart dump

Repositions all work tapes

Checks labels

Continues the Sort/Merge program

LOGICAL UNIT ALLOCATION 5

5.1 MASS STORAGE SORT

Input and output files are located on magnetic tape or any of the following mass storage devices:

CONTROL DATA® 813 Disk File

CONTROL DATA® 814 Disk File

CONTROL DATA® 853 Disk Storage Drive

CONTROL DATA® 854 Disk Storage Drive

In combining both mass storage and magnetic tape the user can specify mass storage input with magnetic tape output or vice versa.

Tape units assigned as input and/or output files for MSS require an MSOS EQUIP control card (section 7.1.3).

When allocating mass storage for input and/or output files the user must specify the files on the MSOS file control cards (section 7.3.2), and on the appropriated MSIO control cards (section 7.2).

MSS operations require two intermediate merge files functioning as intermediate storage areas for record strings processed during the internal sort and intermediate merge phases of MSS. These files are allocated either by MSS or the user. The greatest speed in sort/merge operations is realized if the user allocates each intermediate file on a different on-line device which provides simultaneous read/write as well as reduction in sort time.

The user calculates the specifications for the intermediate merge files by first determining the character size per sector. The 813, 814, 853, and 854 mass storage devices contain 256 characters per sector. The write instruction for the mass storage device always starts within the beginning of a sector. Unused character locations are filled with zeros and the next instruction begins at a new sector within mass storage. If the record block overlfows the sector, the following sector is used.

When allocating intermediate merge files, block sizes must be specified in multiples of whole sectors (256 character). The optimum size of a block must not exceed 1280 characters per block. This number is selected because it is a multiple of the 256 characters per sector and is not so large that it forces the program to allocate huge output buffers.

Example:

Given twenty character records in the input file, blocked five records of 108 characters per block, the user allocates the intermediate file blocks as follows:

1. 1280 optimum block size
   −8 header
   1272 possible character locations

2. 20 char)1272 63 possible records/block to allocate

3. 63
   x20 characters/record
   1260 characters/block
   +8 characters/header
   1268 size of intermediate block

In this example, 12 characters every 5 sectors or 99% of mass storage is used, providing optimum use of available disk storage.

For applications that require a more precise estimate of the optimum size for intermediate merge files, see Appendix D.

5.2 TAPE SORT/MERGE

Tape Sort/Merge requires logical tape units specified by the user on both the MSOS EQUIP control card (section 7.1.3) and the MASTER control card (section 7.4.1). The specifications depend on whether the user has specified a balanced merge or a polyphase merge routine (section 7.4.1) for the Sort/Merge program.

5.2.1 BALANCED MERGE

The total number of tape units (4-16) for a balanced merge are specified in even increments. The tape units included in the left half of the tape list are used for input during the internal sort phase. The units listed in the right half of the list are used as output during the first pass of the Intermediate Merge Phase. If the number of tape units specified equals T, a maximum of T/2 units can also be specified as the following units:

Input and alternate input

Output and alternate output

Modification units

These tapes must be included in the right half of the list. If not, the list will be interchanged. If more than T/2 have been specified, the edit phase attempts to rearrange the extra units to fit within the available number of tape units giving the operator the option to accept the changes or terminate the job.

5.2.2 POLYPHASE MERGE

The user can allocate 3-15 tape units for the polyphase merge routine. For a number of tape units larger than 8, the polyphase merge routine tends to lose its effectiveness in speed of processing. The last tape unit in the list of tape units specified in columns 11-42 of the master control card is assigned as the output tape unit for the first intermediate merge pass (section 7.4.1). Only one unit of the following can be specified in the tape units list:

Input

Alternate input

Modification unit

PROGRAM PHASES 6

This section discusses the general responsibilities and operations for each phase of the Sort/Merge program. The explanation is general enough and the similarities great enough so that it applies to both the Mass Storage Sort and Tape Sort/Merge programs.

6.1 SORT MONITOR

The Sort Monitor performs the following functions:

Provides the communication link between the Sort/Merge program (Mass Storage Sort or Tape Sort/Merge) and the control system (MSOS or RTS).

Is responsible for the loading of the individual program phases.

Supervises interface control between sort/merge phases during the program run.

6.2 EDIT PHASE

The edit phase has the following responsibilities during the Sort/Merge program:

Reads the program control cards form the standard input unit and examines the control card parameters.

Prints control cards and control card diagnostics on the standard output unit if it encounters parameter errors or inconsistencies.

Calculates the internal parameters (sort capacity, size of record storage area in core) used by the internal sort and intermediate merge phases.

Determines what portions of the Sort/Merge program are required and constructs a program load so that the sort monitor loads only the modules and modification routines needed for the requested job.

Types the mounting instructions for the sort input file.

Reassigns logical units when necessary.

6.3 INTERNAL SORT PHASE

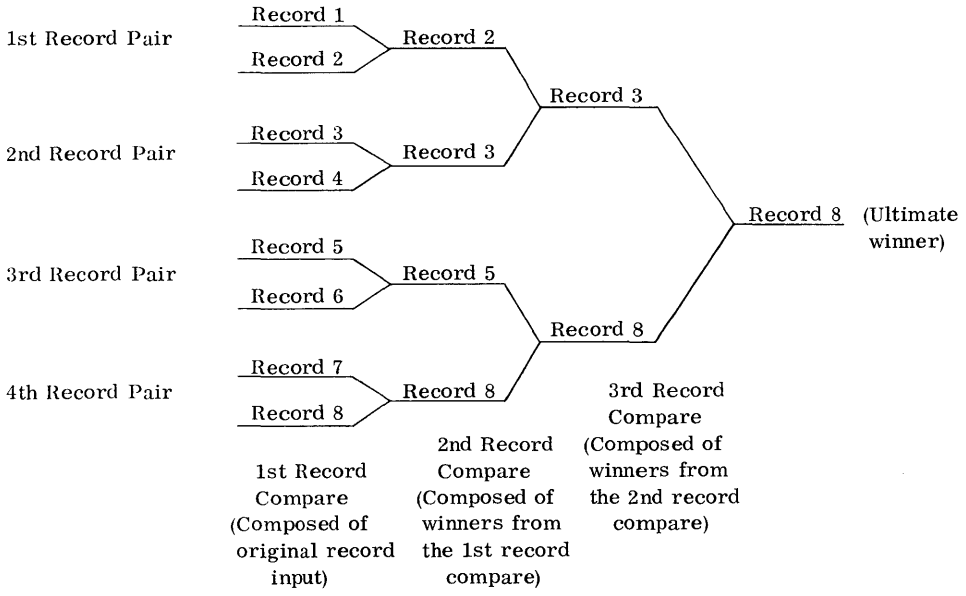
The steps involved in the sort phase are as follows:

1. Reads records from a logical input unit onto two program assigned buffers.

2. From the buffer areas the records transfer to the tournament selection area where the sorting of the records takes place.

3. The sorting of records is based on a replacement selection technique Records are compared in pairs on the basis of user specified sort keys. The sort-key-compare routine cycles through the sort keys, character by character, until an inequality between characters occurs. If the first sort key of both records compare equally, the compare routine moves to the next sort key. When an inequality occurs, the lower ordered record (if ascending sequencing has been specified) is declared the winner of the first level comparison. This record in turn is moved to the next level of comparison where it is compared with the winner of the adjoining pair of records. This compare and advance routine continues until one record out of the records being compared is declared the ultimate winner.

Example of the replacement selection technique:

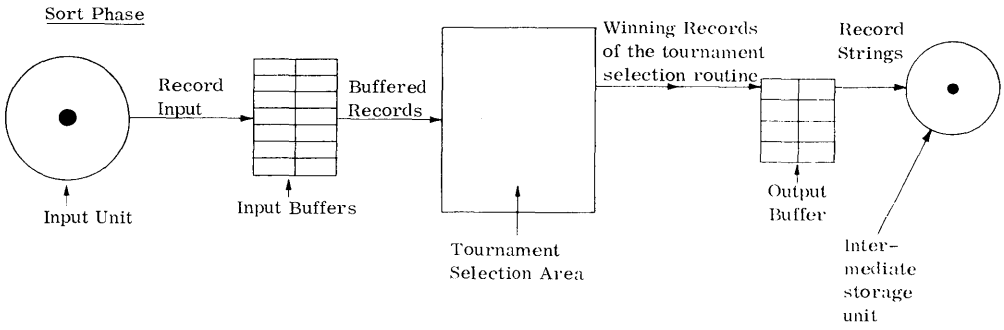


4. The winning record from the compare routine is transferred to the output buffers. Its location in the tournament selection area is taken by a new record from the input buffer, and the replacement selection technique continues with the new record.

5. Winning records are placed in the output buffers until a break in sequence occurs, that is the winner of a record comparison routine being lower ordered (in the case of ascending sequencing; higher ordered for descending) than the records in the buffer. The program then structures the records within the output buffer into a record string. The winning record causing the sequence break is placed onto the output buffers to begin a new string.

6. The record string formed in the output buffer is written on the intermediate storage unit.

The sort routine continues until all records from the input unit have been compared and sequenced into record strings and placed on the appropriate intermediate storage unit(s).



NOTE

The first program exit, if specified by the user, is called into the program by Sort/Merge at the end of this phase.

6.4 INTERMEDIATE MERGE PHASE

The intermediate merge phase consists of the following operational steps.

1. The intermediate storage area(s) containing the record string output from the internal sort phase distributes these record strings back into the input buffers.

2. The records located in the buffer areas are read into the merge selection area where a modification of the replacement selection routine employed during the sort phase resequences the records into a new order.

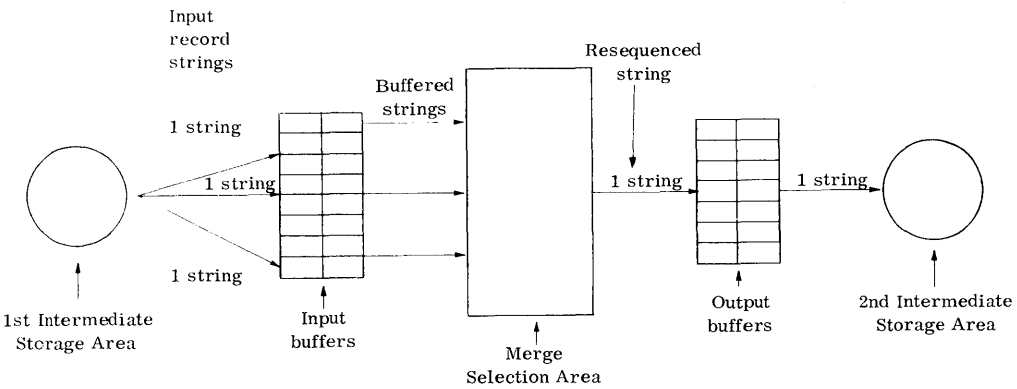
3. The winning records from each record comparison are placed in the output buffers for a new record string formation.

4. The construction of a record string during the intermediate sort phase differs from the sort phase construction of record strings in that a record string is completed and a new string is started when all records from each of the input record string groups are compared and resequenced onto the output buffers. This restructuring of records results in the merging or reduction of a specific number of record strings into a single record string.

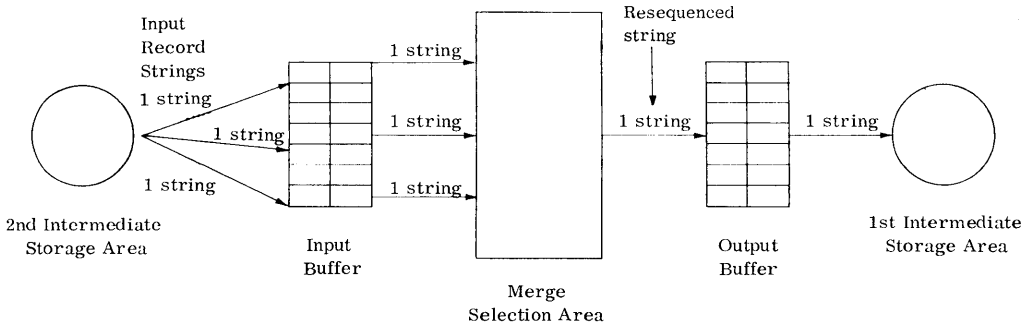
5. Each newly merged record string is transferred from the output buffers onto the alternate intermediate storage area(s).

6. When the alternate intermediate storage area(s) has received all available output record strings it reverses operations and reads its record strings back into the same intermediate merge routine for the next level of merging. The recycling of records strings back into the compare and merge routine (Steps 1 - 6) continues until the number of record strings remaining on the intermediate storage area(s) culminate in a final record string when merged during the final merge phase.

Example:



When all record strings are transferred from intermediate storage area 1 and merged on intermediate storage area 2, both intermediate storage areas reverse operations. That is, storage area 2 provides the input record strings and storage area 1 receives the merges output strings.



6.5 FINAL MERGE PHASE

The steps involved in the final merge phase are:

1. The record strings from the intermediate storage area(s) combined with any presorted sorted record strings are transferred into the input buffers.

2. Records from the input buffers are relocated into the merge selection area where they are processed through a final merge selection routine.

3. The sequenced records are transferred into the output buffer where they are structured into the final record string.

4. The final record string is written onto the output unit.

This review has provided a basic description of operations for each phase of the Sort/Merge program. The following sections of this chapter take the Sort/Merge program to a more specific level of explanation in which the last three Sort/Merge program phases (internal sort, intermediate merge and final merge) are related to both Mass Storage Sort and Tape Sort/Merge.

6.6 MASS STORAGE SORT

6.6.1 INTERNAL SORT PHASE

During the internal sort phase, Mass Storage Sort rearranges the input records from either a mass storage or tape input unit into sequence strings and writes these record strings onto one of two intermediate merge files.

If tag record sorting is specified by the user (column 4, primary control card, section 7.3.1), MSS constructs tag records by extracting the specified sort keys from each logical record and combining these with its file storage address (block number in the file followed by its character position in the block). As each tag record is sorted in the tournament selection area it is sequenced in the output buffer by the assignment of a new storage address. This new address indiciates its sequential position in relation to the other tag records in the record string. The tag record strings are distributed onto the intermediate merge file.

The operational steps within the internal full record sort and tag record sort correspond with the general program operations outlined at the beginning of this chapter.

NOTE

For tag record sorting to be effective in terms of increased sorting speed,the total size of all sort keys specified for each record must be less than 40% of the record.

6.6.2 INTERMEDIATE MERGE PHASE

During the intermediate merge phase, MSS resequences and merges the record strings (full-records or tag records) into successively longer sequenced strings until the number of strings remaining plus the number of presorted merge files is less than or equal to the merge order computed during the edit phase.

Merging is accomplished by a minor modification of the replacement selection technique used by the internal sort. A balanced merge is used in that, during each merge pass, the strings on one intermediate merge file are merged into longer strings on the alternate intermediate merge file. Maximum merging speed is achieved if the two merge files are specified on different disk packs.

At the beginning of each intermediate merge pass MSS prints the following message on CTO:

I MSRT 119 B MERGE PASS no.

6.6.3 FINAL MERGE PHASE

The final merge phase for Mass Storage Sort includes the following user options.

Full record output

The remaining record strings from the intermediate merge phase and presorted merge files are merged into a single sorted string and transferred to the output file, located on either a mass storage disk or magnetic tape.

Tag Record Sort

For a tag record sort (primary control card, section 7.3.1) MSS merges the strings of tag records from the intermediate merge phase into a single string of tag records on the output file.

If the user specifies full record output MSS uses the tag record to retrieve the entire record to which it referes and writes the full record onto the output file.

For chained record output, MSS referes to the chained record through its corresponding tag record. MSS then changes the chain address and writes the record back into its original location with a new chain address indicating the record's sequential position in relation to the other records in the file.

Merge-Only

A merge only operation involves merging the presorted merge files into a single sorted output file.

At the beginning of the final merge, MSS types the following message on CTO:

I MSRT 120 B FINAL MERGE

6.7 TAPE SORT/MERGE

The following section gives a graphic description of the three program phases of the Tape Sort/Merge program:

Internal Sort Phase

Intermediate Merge Phase

Final Merge Phase

6.7.1 INTERNAL SORT PHASE

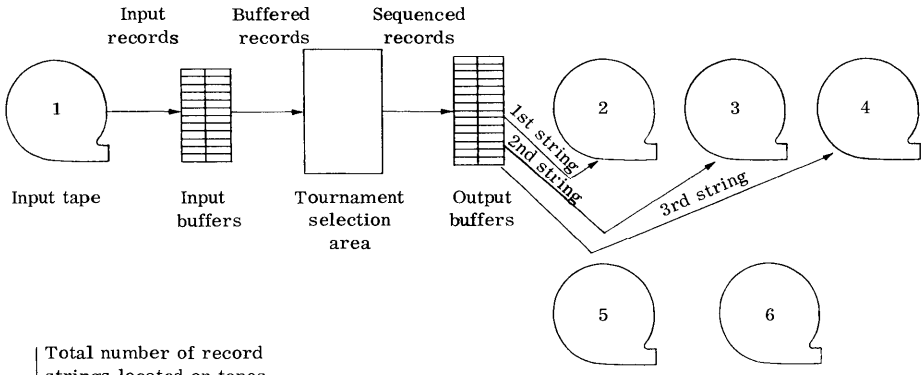
The internal sort phase uses the replacement selection technique to arrange input records into sequenced strings and writes them on merge tapes in one pass. The distribution pattern of record strings and the number of work tapes specified are dependent on whether the user has specified a balanced or a polyphase merge on the master control card (column 4, section 7.4.1).

Balanced Merge

In the balanced merge, strings are alternately written onto T/2 tapes (see section 5.2.1) in the internal sort.

Example:

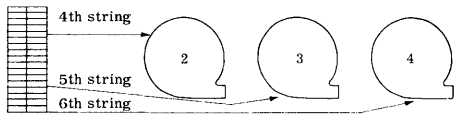
Record string distribution for the internal sort phase using the balanced merge forward read routine. The output for this example consists of nine record strings.



These two tapes are unused during the internal sort phase.

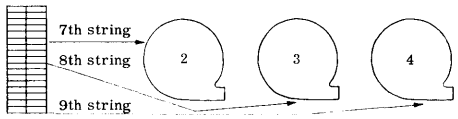
Tape No.	Total number of record strings located on tapes after each subpass
	Sort Subpass 1
2	1
3	1
4	1

Sort Subpass 2



Tape No.	Total number of strings located on tapes after each subpass	
	Sort Subpass 1	Sort Subpass 2
2	1	1
3	1	1
4	1	1

Sort Subpass 3



Tape No.	Total number of strings located on tapes after each subpass		
	Sort Subpass 1	Sort Subpass 2	Sort Subpass 3
2	1	1	1
3	1	1	1
4	1	1	1

Polyphase Merge

The polyphase merge routine requires a string distribution onto T minus 1 tapes where the distribution is based on the Fibonacci sequence of numbers. The internal sort phase distributes the sequenced record strings in the following manner:

1. Reverse the last tape (T_n) in a list of n tapes on the EQUIP control card (section 7.1.3) for the first merge output. No strings are written on this tape during the internal sort phase distribution.

2. Writes one string on each tape in the list T_1, T_2, T_3. . . T-1.

3. Skips T, and distributes the number of strings which are on T onto each of the other tapes in the list, T_2, T_3, T_4, . . . T-1.

4. Skips the next tape (T_2) in the list and distributes the number of strings which are on T_2, onto each tape in the list T_3, T_4 . . . T_A-1, T_1.

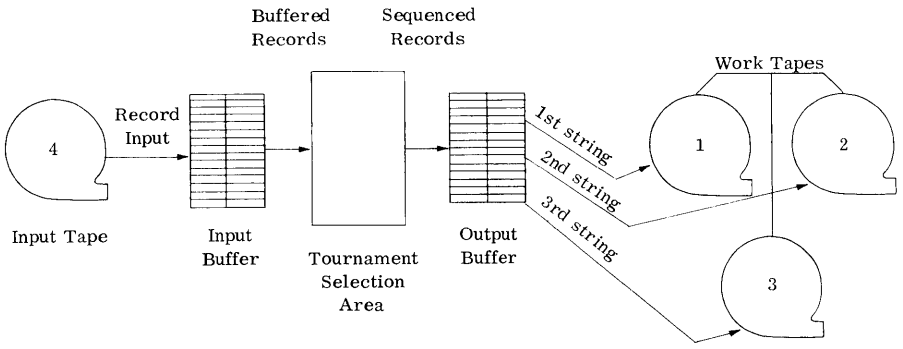
The following section gives a graphic example of this distribution pattern.

Example:

Distribution pattern of record strings for the internal sort phase using a polyphase merge. Output for this example consists of 17 record strings.

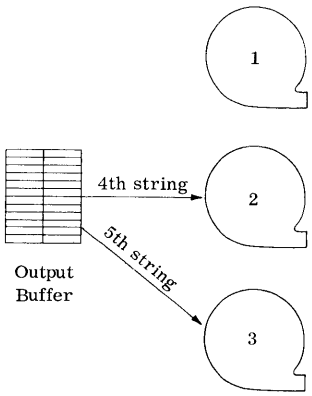
Sort Pass 1

First Subpass.



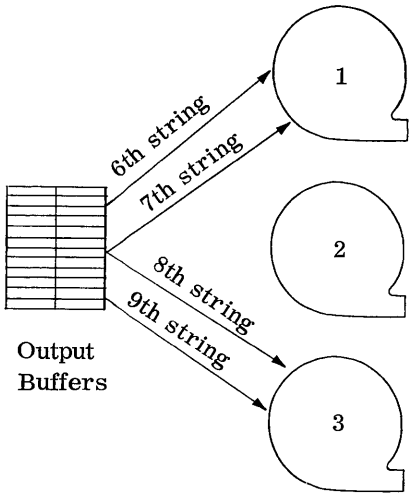
Tape No.	Number of strings/ subpass
1	1
2	1
3	1

Second Subpass. For the second subpass, work tape 1 is bypassed and the fourth and fifth record strings are placed on tapes 2 and 3.



Tape No.	Number of strings/subpass	
1	1	0
2	1	1
3	1	1

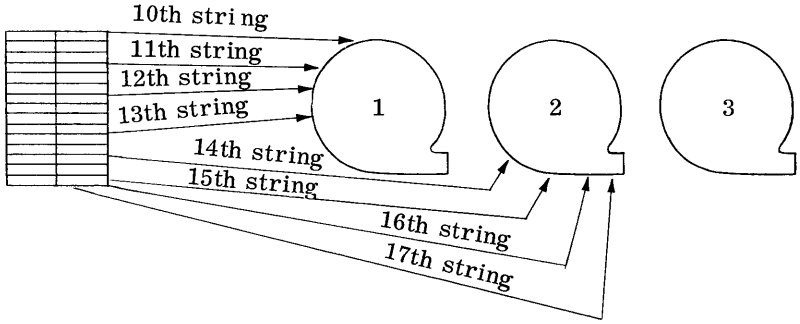
Third Subpass. The third subpass results in tape 2 being bypassed and the number of record strings transferred to tapes 1 and 3 incremented by the number of record strings on tape 2 at the completion of subpass 2. That is, two record strings are placed on tapes 1 and 3.



Tape No.	Number of strings/subpass		
1	1	0	2
2	1	1	0
3	1	1	2
	Subpass 1	Subpass 2	Subpass 3

Fourth Subpass. Tape 3 is skipped during the 4th subpass and tapes 1 and 2 each receive four record strings (based on an increment equal to the number of record strings located on tape 3 at the completion of subpass 3).

Output buffers



Tape No.	Number of strings/subpass			
1	1	0	2	4
2	1	1	0	4
3	1	1	2	0
	Sub-pass 1	Sub-pass 2	Sub-pass 3	Sub-pass 4

The total number of record strings on tapes 1, 2, and 3 at the completion of the internal sort phase consists of the following distribution pattern:

Tape No.	Total number record strings
1	7
2	6
3	4
	Total

If a larger number of record strings were constructed during this internal sort phase, sort passes 2, 3, . . . would continue to distribute the remaining record strings starting back at subpass 2 by bypassing tape 1 and incrementing the number of strings distributed to tapes 2 and 3 by the number of strings located on tape 1 at the end of the previous pass.

A backward read balanced merge involves the same distribution pattern as the forward read, the difference being that record strings are placed onto the work tapes in a reversed character order (last character of a record first) to eliminate rewinding of the work tape for the first merge pass. The distribution of strings for a backward polyphase consists of the same distribution pattern as for a forward polyphase sort. The type of record string distribution to the output tapes, however, is different. In a forward read polyphase merge, ascending strings are generated; the backward polyphase must have alternate ascending-descending strings on each of the output tapes thus eliminating tape rewinding for subsequent passes of the program.

6.7.2 INTERMEDIATE MERGE PHASE

The intermediate merge phase accepts strings from the internal sort phase and performs successive merge passes until the number of remaining strings (plus the number of any presorted merge files) is less than or equal to the order of the merge, established during the edit phase.

Balance Merge

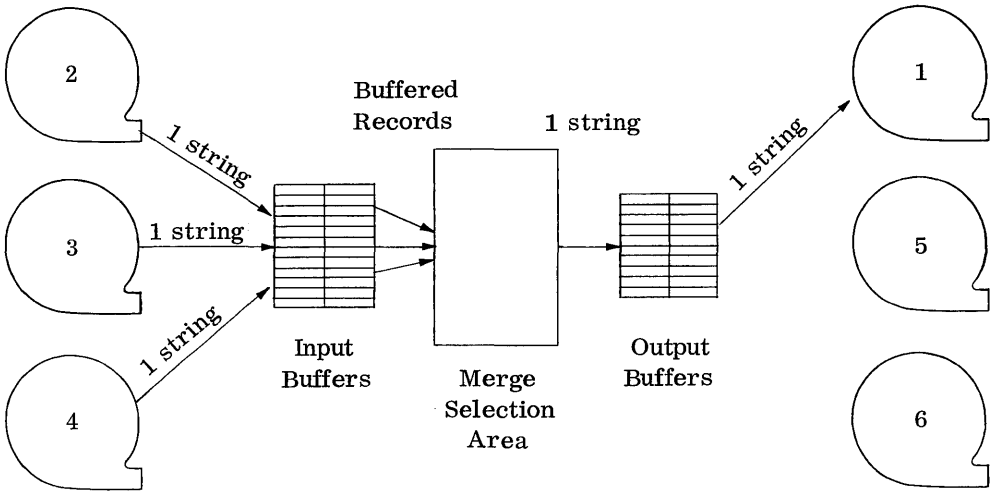
During each pass in a balanced merge, half of the tapes are used for input to the merge and half are used as output.

For a forward read tapes are rewound after each pass and the output tapes from one pass become input tapes for the next pass.

For a backward read no rewinding is required in that after the first pass and any alternate passes subsequent to this first pass, records are read back into the merge selection routine starting with the last character of the last record written onto the tape during the previous pass.

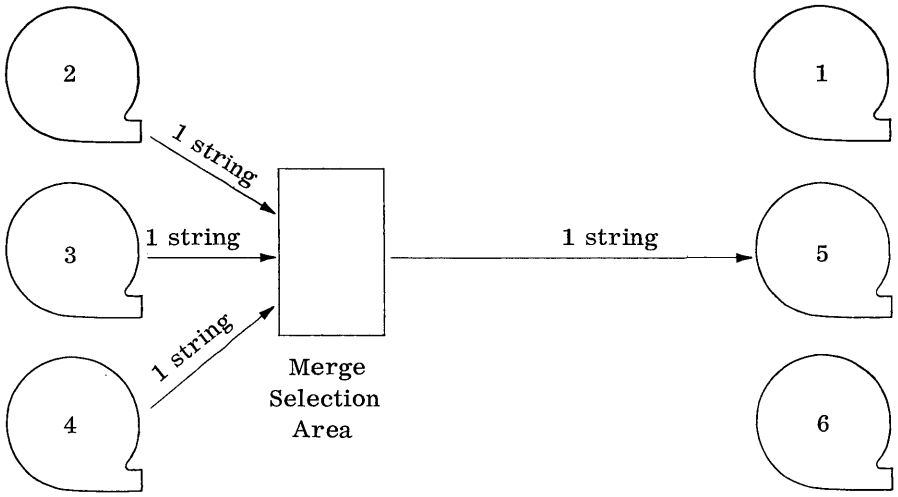
Merge Pass 1. The following example of the balance merge with a forward read uses the record string distribution from the internal sort example (section 6.7.1). For the intermediate merge phase, tapes 5 and 6 are combined with tape unit 1 (initially the input unit) to function as output tapes for the first series of merge passes. Tapes 2, 3, and 4 will serve as input units for this series of passes. The distribution pattern involves record strings read off tapes 2, 3, and 4 and merged into a single string in the merge selection area. The newly merged strings are then alternately written on tapes 1, 5, and 6. At the end of the internal sort phase three strings are located on tapes 2, 3, and 4 resulting in a total of nine record strings.

First Subpass



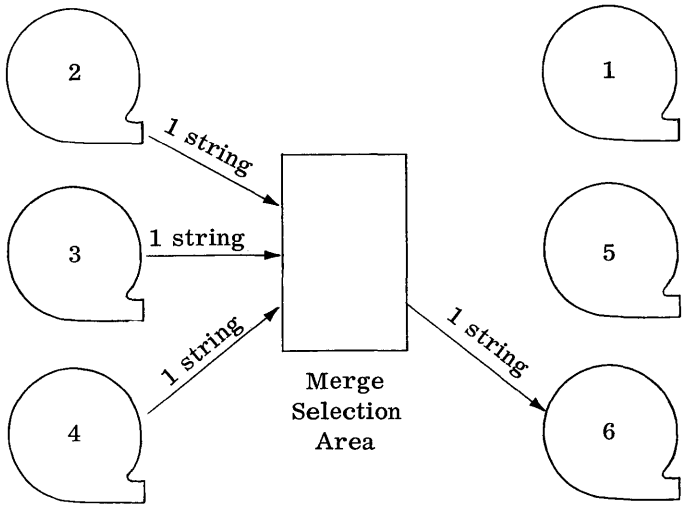
Tape No.	Number of strings located on tapes after each subpass
1	1
2	2
3	2
4	2
5	0
6	0

Second Subpass



Tape No.	Number of strings located on tapes after each subpass	
1	1	1
2	2	1
3	2	1
4	2	1
5	0	1
6	0	0

Third Subpass



Tape No.	Number of strings located on tapes after each subpass		
1	1	1	1
2	2	1	0
3	2	1	0
4	2	1	0
5	0	1	1
6	0	0	1

If in this example more record strings were located on tape 2, 3, and 4, the intermediate merge pass would continue with merge pass 2, 3, . . . etc., following the same subpass distribution pattern until all record strings were read off these three tapes. The two sets of work tapes reverse operations; that is, the input tapes become output tapes and the output tapes become input tapes. The reversal of tape functions continues until a single record string is located on each tape of a work tape group.

Polyphase Merge

For a polyphase merge, the intermediate merge phase performs successive merge passes until one string remains on each of the input tapes. The distribution pattern for this phase involves the following operations:

1. The last tape listed on the EQUIP control statement is reserved as the output unit for the record string output from the first intermediate merge pass.

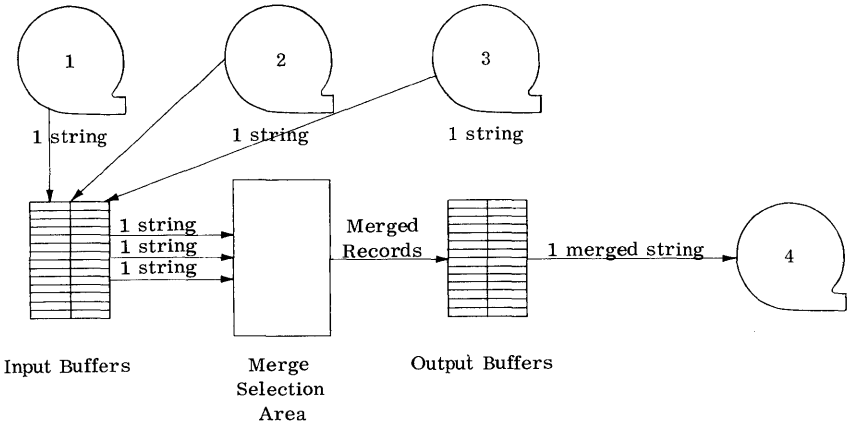
2. Each tape containing record string output during the internal sort phase distributes onto the output tape a number of strings remaining on one of the input tapes at the beginning of the intermediate merge phase.

3. For the second merge pass and subsequent merge passes the tape with no record strings at the completion of the previous merge pass is reassigned by the system as the output tape for the particular pass.

4. The number of strings distributed from each of the input tapes to the output tape during a particular merge pass is based on the smallest number of strings remaining on one of the input tapes at the beginning of that merge pass.

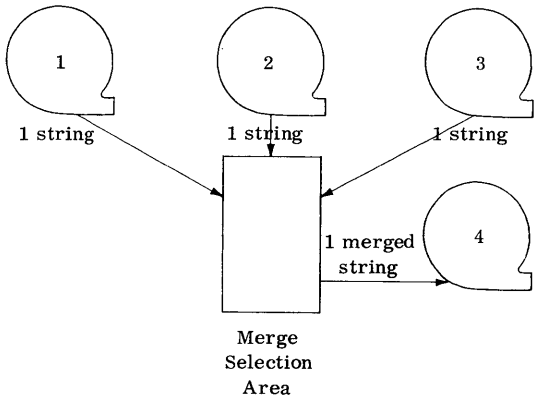
Merge Pass 1. The following example used the record string distribution from the internal sort example for a polyphase merge (section 6.7.1). Input tape unit 4 is reassigned as the output tape for the 1st merge subpass. The number of record strings read off tapes 1, 2, and 3 for merging onto tape 4 equal the lowest number of record strings located on any one of the input tapes at the beginning of the merge pass (in this case tape 3 and 4 record strings). Therefore, four record strings are read from each tape (a record string from each tape per subpass) and merged into 4 record strings to be distributed on tape 4.

First Subpass



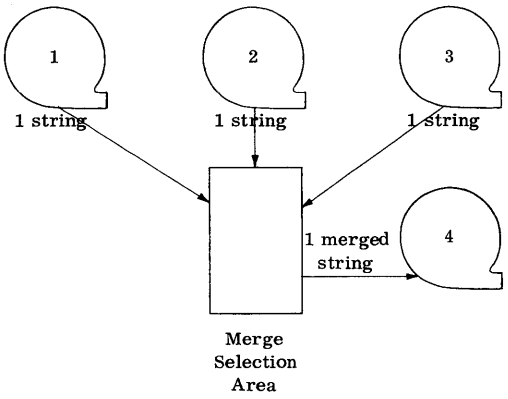
Tape No.	Number of strings remaining after each subpass
1	6
2	5
3	3
4	1

Second Subpass



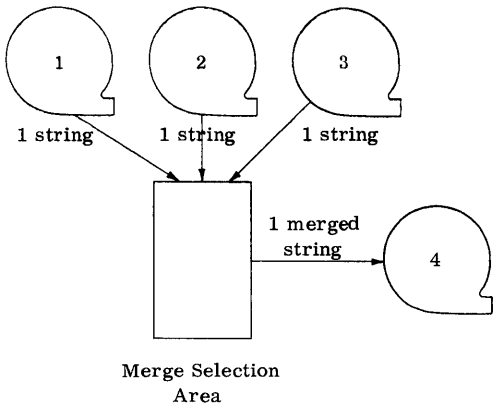
Tape No.	Number of strings remaining after each subpass	
1	6	5
2	5	4
3	3	2
4	1	2

Third Subpass



Tape No.	Number of strings remaining after each subpass		
1	6	5	4
2	5	4	3
3	3	2	1
4	1	2	3

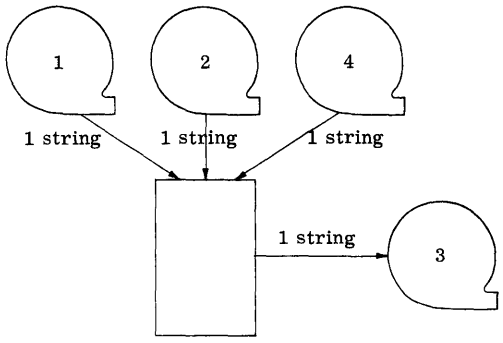
Fourth Subpass



Tape No.	Number of strings remaining after each subpass			
1	6	5	4	3
2	5	4	3	2
3	3	2	1	0
4	1	2	3	4
	Merge Pass 1			

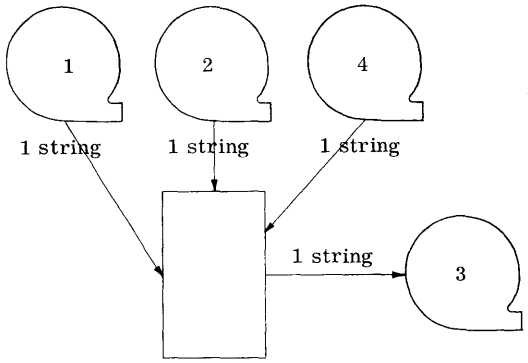
Merge Pass 2. For the second merge pass, tape 3 is assigned as the output tape. The two record strings located on tape 2 determine the number of record strings to be read from tapes 1, 2, and 4 during this merge pass.

First Subpass



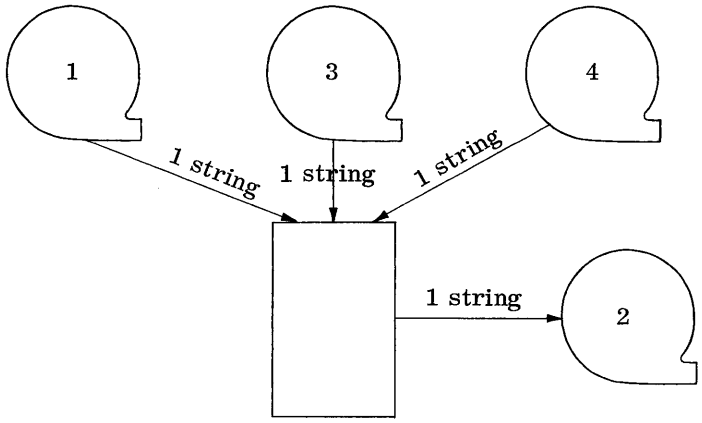
Tape No.	Number of strings remaining after each subpass				
1	6	5	4	3	2
2	5	2	3	2	1
3	3	2	1	0	1
4	1	2	3	4	3
	Merge Pass 1				

Second Subpass



Tape No.	Number of strings remaining after each subpass					
1	6	5	4	3	2	1
2	5	4	3	2	1	0
3	3	2	1	0	1	2
4	1	2	3	4	3	2
	Merge Pass 1				Merge Pass 2	

Merge Pass 3. One record string is read from tapes 1, 3, and 4, merged, and relocated on tape 2.



Merge Selection Area

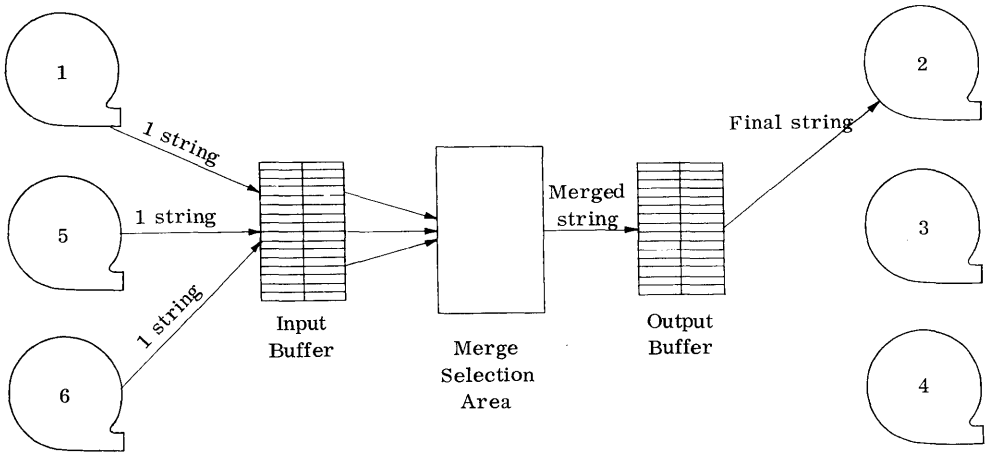
Tape No.	Number of strings remaining after each subpass						
1	6	5	4	3	2	1	0
2	5	4	3	2	1	0	1
3	3	2	1	0	1	2	1
4	1	2	3	4	3	2	1
	Merge Pass 1				Merge Pass 2		Merge Pass 3

6.7.3 FINAL MERGE PHASE

The final merge involves merging of the record strings from the intermediate merge phase with any presorted files into a single record string, and writing this final string onto a magnetic tape.

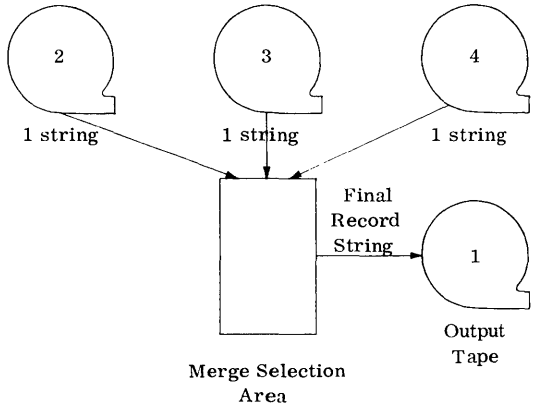
Balanced Merge

The single record strings located on tapes 1, 5, and 6 at the completion of the intermediate merge phase are merged into a final record string and written onto output tape 2.



Polyphase Merge

The single record strings remaining on tapes 2, 3, and 4 at the completion of the intermediate merge phase are merged into the final record string which is written onto tape 1.



Tape No.	Number of strings remaining after final merge
1	1
2	0
3	0
4	0

CONTROL CARDS 7

Chapter 7 discusses the specifications and user formulation of control cards for both Mass Storage Sort and Tape Sort/Merge programs. The presentation of each control card related to its respective Sort/Merge program is supplemented with a sample Mass Storage Sort MSOS and Tape Sort/Merge MSOS program. For example, the primary control card required for the mass storage sample program is presented within the more general discussion of the primary control card, to provide the reader with a practical application of the more general control card specifications to a specific example. The sample programs are then progressively built up within the discussions of each control card group culminating in two complete and operable programs at the completion of the control card presentation.

Sample Program Objectives

Mass Storage Sort MSOS sample program has the following objectives:

Sort mass storage file C

Merge C with presorted file D

Write the output on file LEDGER

The specifications for the required control cards are described in the MSOS, MSIO, and MSS control card sections (sections 7.1, 7.2, and 7.3 respectively).

The sample tape Sort/Merge program executing under MSOS begins with the sort of input file A. File A is then merged with presorted file B and written onto output file C. Control card requirements and specifications are presented within the MSOS and master control card sections (sections 7.1 and 7.4 respectively).

7.1 MSOS CONTROL CARDS

Mass Storage Sort/Merge and Tape Sort/Merge executing under MSOS require MSOS control cards. The MSOS control cards primarily associated with both Sort/Merge programs are as follows:

- SEQUENCE (section 7.1.1)
- JOB (section 7.1.2)
- EQUIP (section 7.1.3)
- MSSORT (MSS - section 7.1.4)
- SORT or SORTK (TSM - section 7.1.5, 7.1.6)
- 9ENDMSS (MSS - section 7.3.6)
- 9ENDSORT (TSM - section 7.4.6)
- EOF (section 7.1.7)

With the exceptions of both the SEQUENCE control card (7.1.1) and a variation of the SORT control card (section 7.1.6) Tape Sort/Merge under RTS uses the same control cards as when running under MSOS.

The following is a description of each control card with specific reference in terms of the Mass Storage Sort and Tape Sort/Merge sample programs.

7.1.1 SEQUENCE (MSOS ONLY)

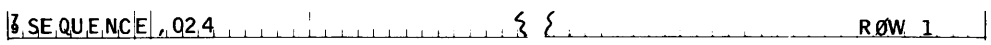
The SEQUENCE card is the first card of the input deck unless the sort/merge job appears in the job stack immediately after a priority job.

$\begin{cases} 7 \\ 9 \end{cases}$SEQUENCE,j

j job identification number 1-3 digits; must be present

Sequence control card specifications for the Mass Storage Sort Sample Program are as follows:

The job identification number for this program is 024 (columns 11-13).

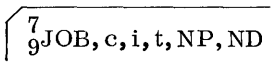


Sequence control card specifications for the tape sort/merge sample program.

The job identification number for the sample program is 003 (columns 11-13).

7.1.2 JOB

The JOB card immediately follows the SEQUENCE card or, if there is no SEQUENCE card (when a batch job immediately follows a priority job), the JOB card must be the first card of the input deck. The JOB card signals the beginning of a batch job to MSOS or RTS.



c Account number; 0-8 characters

i Programmer identification; any number of characters, provided that all parameters appear on a single card

t Estimated running time in minutes; 1-999

NP Specifies no system unit protection; when omitted, system unit protection is in effect

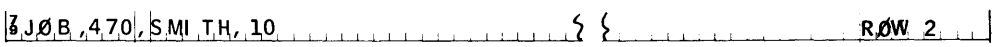
ND Specifies no dump; when omitted, a recovery dump is taken on abnormal termination

Job control card specifications for the Mass Storage Sort sample program are as follows:

1. The account number for the sample Sort/Merge program is 470 (columns 6-8).

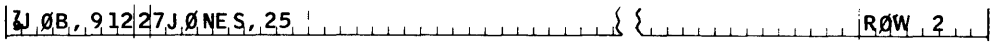
2. The programmer identification for the program is SMITH (columns 10-14).

3. The estimated running time for the program is 10 minutes (columns 16, 17).



Job control card specifications for the Tape Sort/Merge sample program are as follows:

1. The account number is 91227 (columns 6-10).
2. The programmer identification is JONES (columns 12-16).
3. The estimated running time for the program is 25 minutes (columns 18, 19).



7.1.3 EQUIP (MSOS AND RTS)

All input or output tapes used in either Sort/Merge programs must be equipped as logical units, through EQUIP statements, before Sort/Merge is loaded. All EQUIP statements must appear after the JOB statement and before the MSSORT or SORT statement. EQUIP parameters are specified in three forms, any or all of which can be on a single EQUIP statement.

$$\begin{matrix}7\\9\end{matrix}\text{EQUIP},u_1\text{=MT},u_2\text{=MT},u_3\text{=MT},\ldots,u_n\text{=MT}$$

u_i Logical unit number

MSOS assigns an available magnetic tape (MT) to u_i and logs the assignment on the CTO in the following format:

$$u_1\text{=MTCxEyUzz}_1,\ldots,u_n\text{=MTCxEyUzz}_n$$

u_i Logical unit number

x Channel number

y Equipment number

zz Unit number

MSOS assigns to u_i the specific tape described by the hardware code CxEyUzz_i.

$$\begin{matrix}7\\9\end{matrix}\text{EQUIP},u_1=u_2,\ldots,u_m=u_n$$

The logical unit on the left of = is assigned to the same physical unit as the logical unit on the right. The unit on the right of = must have been previously assigned. If the logical unit on the left has been previously assigned, the physical unit is released and the new assignment is made.

Equipment Control Card Specifications for a mass storage sort sample program

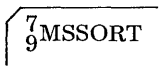
The EQUIP card is not used with this sample program in that no tape input or output is specified.

The specifications for the EQUIP control card used in the Tape Sort Merge sample program are as follows:

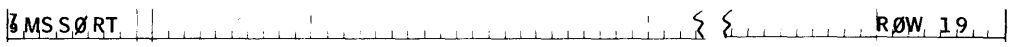
1. Logical unit number 7 is specified for the first tape (columns 8-11).
2. The second tape is assigned logical unit number 8 (columns 13-16).
3. The third work tape is assigned logical unit number 9 (columns 18-21).
4. The logical unit number 10 is assigned to the final tape (columns 23-26).

7.1.4 MSSORT

The MSSORT card is the MSOS library name card that directs MSOS to load and give control to the MSS monitor. The MSSORT control card is found in the deck immediately after the MSIO cards (section 7.2).



The following shows the MSSORT control card for the Mass Storage Sort Sample program.



7.1.5 SORT (TSM/MSOS ONLY)

7 9 SORT

This card directs Tape Sort/Merge MSOS to load the sort monitor and gives control to the sort monitor.

7.1.6 SORTK (TSM/RTS ONLY)

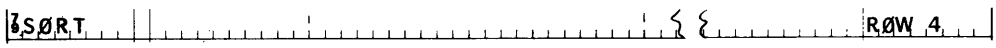
Operating procedures for SORTK

1. Equate input unit to library on equip statement.
2. Assign input to unit equated to library.
3. Action messages dictate when to mount a different tape, the precedin tape will be unloaded.
4. Leave unit serving dual purpose dialed to zero. No physical changing of units is required.

7 9 SORTK

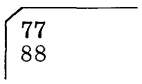
The SORTK control card is selected only when the user specifies his library unit as the initial input unit with its subsequent use as a work unit. The control card directs RTS to load the sort monitor and gives control to a special point in the sort monitor for a three tape configuration.

The following SORT control card specifications are for the Tape Sort/Merge sample program.



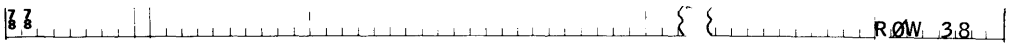
7.1.7 END-OF-FILE (EOF)

An end-of-file card is the last card of the sort/merge input deck. It is characterized by rows 7 and 8 being punched in columns 1 and 2.

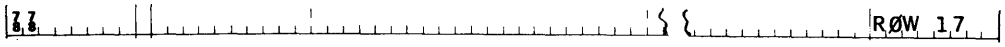


Both Mass Storage Sort and Tape Sort/Merge sample programs require this control card to indicate the termination of the Sort/Merge program.

This end-of-file control card specification is for the Mass Storage sort sample program.



This end-of file control card specification is for the Tape Sort/Merge sample program.



7.2 MSIO CONTROL CARDS (MSS ONLY)

The user must allocate and open any mass storage input and output files before MSS is loaded. The user may also allocate and open the intermediate merge files (section 5.1).

The sequence of control statements for opening mass storage files is as follows:

RAT	Optional
FET	Required
ALLOCATE	Must be present if the file has not been previously allocated; must be omitted if the file has been previously allocated
OPEN	Required

To close a mass storage file, the following statement is required:

CLOSE

MSS automatically closes and releases the restart dump file and the intermediate merge files. The user may close the input and output file at the end of the MSS run. If he does not, MSOS closes them before beginning the next job.

A file must be closed before a user can release it, expand it, or modify its label. The following sequences are required for release, expansion, and modification, respectively:

FET	FET	FET
RELEASE	EXPAND	MODIFY
		FET (optional)

These MSIO control statements are described below. If an optional parameter is omitted, its trailing comma must appear unless no other parameters follow.

7.2.1 RAT

The RAT statement enters mass storage devices in the MSOS resident allocation table. ALLOCATE statements cause MSOS to allocate files on the device or devices named in the last preceding RAT statement.

$$\left\{\begin{matrix}7\\9\end{matrix}\right\}\text{RAT}, dt_1/dn_1, \ldots, dt_n/dn_n$$

dt device type; 852, 853, 854, 813, 814, or 863

dn device number; any positive integer less than 262144_{10}

When the RAT statement names more than one device, MSOS attempts to allocate the file on a device which can contain the complete file without segmentation. When this is not possible, MSOS segments the file across devices named in the RAT statement, selecting devices with the largest areas of available core so as to create the smallest possible number of segments in the file.

At SEQUENCE time, MSOS clears the resident allocation table. In order to clear the table during a job, the user inserts a RAT statement with a blank parameter field. For example, the following sequence of statements opens files on separate devices:

$^{7}_{9}$SEQUENCE

$^{7}_{9}$JOB

$^{7}_{9}$RAT, dt_1/dn_1

$^{7}_{9}$FET

$^{7}_{9}$ALLOCATE

$^{7}_{9}$OPEN

$^{7}_{9}$RAT

$^{7}_{9}$RAT, dt_2/dn_2

$^{7}_{9}$FET

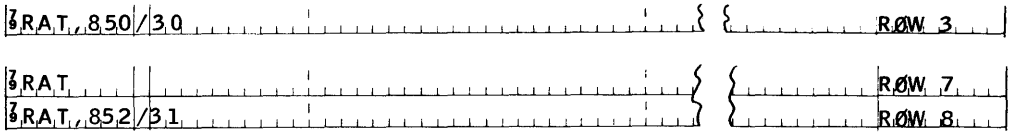
$^{7}_{9}$ALLOCATE

$^{7}_{9}$OPEN

The first file is allocated on dt_1/dn_1; the second file is allocated on dt_2/dn_2.

The following shows RAT control card specifications for the Mass Storage Sort sample program.

RAT Control Card	File Type	Device Type (columns 6-8)	Device Number (columns 10, 11)
1	Intermediate Merge File	852	30
2	This control card clears the allocation table for this job. The user enters the 7/9 RAT characters only.		
3	Intermediate Merge File	852	31



7.2.2 FET

FET parameters are used by MSOS to construct a file label for an unallocated file. For an existing file, the FET statement is used to identify the file referenced by a following OPEN, EXPAND, RELEASE, or MODIFY statement.

7/9FET, owner, name, blksize, edition, accsec, modsec

owner	1-8 character identification
name	1-30 character file name
blksize	Number of characters in each data block; for MSS file, may not exceed 4095
edition	Two decimal digits specifying edition number; set to zero if omitted
accsec	1-4 character access security code; optional
modsec	1-4 character modification security code; optional

Imbedded blanks are not permitted in the parameters.

These are the FET control card specifications for the Mass Storage Sort sample program.

FET Control Card	File Type	Owners Name (columns 6-11)	File Name	Characters Per Block
1	Intermediate Merge	ACMECO	MERGEONE (columns 13-20)	1208 (columns 22-25)
2	Intermediate Merge	ACMECO	MERGETWO (columns 13-20)	1208 (columns 22-25)
3	Input	ACMECO	DUNCAN (columns 13-18)	80 (columns 20-23)
4	Presorted Input	ACMECO	SCHEER (columns 13-28)	80 (columns 20-23)
5	Output	ACMECO	LEDGER (columns 13-28)	80 (columns 20-23)
6	Intermediate Merge	ACMECO	MERGEONE (columns 13-20)	1208 (columns 20-23)
7	Intermediate Merge	ACMECO	MERGETWO (columns 13-20)	1208 (columns 22-25)

```
7FET,ACMECØ,MERGEØNE,1208 . . . . . { { . . . . . RØW 4
7FET,ACMECØ,MERGETWØ,1208 . . . . . { { . . . . . RØW 9
7FET,ACMECØ,DUNCAN,0080 . . . . . { { . . . . . RØW 12
7FET,ACMECØ,SCHEER,0080 . . . . . { { . . . . . RØW 14
7FET,ACMECØ,LEDGER,0080 . . . . . { { . . . . . RØW 16
7FET,ACMECØ,MERGEØNE,1208 . . . . . { { . . . . . RØW 34
7FET,ACMECØ,MERGETWØ,1208 . . . . . { { . . . . . RØW 36
```

7.2.3 ALLOCATE

The ALLOCATE subroutine allocates space for a mass storage file, creates a file label, and enters the label in the FLD. The ALLOCATE control card must always follow its corresponding FET control card.

```
7
9ALLOCATE,n,exp,mode,NOSEG,dt
```

n — number of mass storage tracks to allocate for the file; a positive integer not exceeding 262143

exp — expiration date to be inserted in the file label, a six-digit decimal integer in the form yymmdd. If omitted, the current date is used.

mode — recording mode for mass storage file. S in this field specifies sector mode. Any other symbol is interpreted as a request for track mode.

NOSEG — specifies contiguous allocation. Any other term or value indicates the file may be segmented.

dt — specifies the type of mass storage device.

When the combination of owner, file name, and edition number duplicate those of a previous ALLOCATE statement, the job is terminated.

ALLOCATE control card specifications for the Mass Storage Sort sample program are as follows:

ALLOCATE Control Card	File Type	Mass Storage Tracks	File Mode	Device Type
1	Intermediate Merge	6 tracks (column 11)	Sector (column 15)	852 (columns 19-21)
2	Intermediate Merge	6 tracks (column 11)	Sector (column 15)	852 (columns 19-21)
3	Output	12 tracks (columns 11, 12)	Sector (column 16)	852 (columns 20-22)

```
7
9ALLØCATE,6,,S,,852 . . . . . { { . . . . . RØW 5
7
9ALLØCATE,6,,S,,852 . . . . . { { . . . . . RØW 10
7
9ALLØCATE,12,,S,,852 . . . . . { { . . . . . RØW 17
```

7.2.4 OPEN

With this statement, previously reserved mass storage space is prepared for I/O processing. Parameter values are passed to routines which locate the file label, check device labels to insure that correct mass storage devices are on-line, and initialize mass storage tables.

The OPEN control card must always follow its corresponding FET control card.

```
7/9OPEN,fo,use
```

fo — unique file ordinal (0-62) supplied by the user; referenced by subsequent I/O requests to this file

use — I specifies a read only file when it is open. Any other symbol indicates file is available for reading and writing.

The following consists of the OPEN control card specifications for the Mass Storage Sort sample program:

OPEN Control Card	File Type	File Ordinal (columns 7, 8)	File Use (column 10)
1	Intermediate Merge	01	Read/Write
2	Intermediate Merge	02	Read/Write
3	Input	03	Read Only
4	Presorted Input	04	Read Only
5	Output	05	Read/Write

```
7ØPEN,01,0 ..... ROW 6
7ØPEN,02,0 ..... ROW 11
7ØPEN,03,1 ..... ROW 13
7ØPEN,04,1 ..... ROW 15
7ØPEN,05,0 ..... ROW 18
```

7.2.5 EXPAND

With the EXPAND statement, the user can reserve additional space for an existing file. The EXPAND control card must always follow its correspondent FET control card.

```
7/9EXPAND,n,NOSEG
```

n — Number of additional tracks to allocate for the existing file

NOSEG — Specifies contiguous expansion; any other term indicates that the expansion may be segmented

7.2.6 MODIFY

The MODIFY statement is used when a change to the preceding FET control card specifications is required. The modify control card must always follow its corresponding FET control card.

```
7/9MODIFY,prot,exp,newfet
```

prot — Changes file protection indicator in file label

- I — Read only indicator
- O — Read/write indicator. No other value will change an existing read only indicator.

exp — Changes expiration date of file label; 6-digit decimal integer in the form yymmdd (yy=year, mm=month, dd-day). If omitted or zero, the expiration date in the label is not changed.

newfet — Hollerith character $\neq 0$ Insert the contents of the immediately following FET statements into the file label

$= 0$ No FET for label modification follows.

7.2.7 CLOSE

MSOS processes a CLOSE statement by updating the label of the specified file and releasing associated mass storage tables. The CLOSE statement follows the last card on INP associated with MSS processing (ENDMSS or MSS loader control card).

```
7/9CLOSE,fo
```

fo — File ordinal assigned when the file was opened.

CLOSE control card specifications for the Mass Storage Sort sample program are as follows:

CLOSE Control Card	File Type	File Ordinal (Columns 8, 9)
1	Input	03
2	Presorted Input	04

```
7/9CLOSE,03                                                    ROW 32
7/9CLOSE,04                                                    ROW 33
```

7.2.8 RELEASE

The RELEASE statement is used to eliminate obsolete as unused files. The RELEASE control card must always follow its corresponding FET control card.

```
7/9RELEASE,n
```

The parameter references the mass storage file established by the preceding FET statement; it may be specified in one of three forms:

n	decimal integer indicating the number of tracks of mass storage to release
ALL	releases the entire mass storage file
UNUSED	releases all unused mass storage space beyond the highest written block number

RELEASE control card specifications for the Mass Storage sample program are as follows:

RELEASE Control Card	File Type	Release statement (columns 10-12)
1	Intermediate Merge	All
2	Intermediate Merge	All

```
7/9RELEASE,ALL                                                 ROW 35
7/9RELEASE,ALL                                                 ROW 37
```

7.3 MSS CONTROL CARDS

MSS Control cards provide parameters relevant to the requested sort and/or merge operations. The following control cards are provided:

Primary control cards

File control cards

Nonstandard output label control cards

Collating sequences control card

Modification control cards

ENDMSS

ELD loader control cards

7.3.1 PRIMARY CONTROL CARDS

The primary control cards contain fundamental information concerning the sort keys and other options available to the user. These options include:

Type of run (sort, merge, sort and merge)

Type of sort (record, tag)

Type of output (full record, tag record, chained record)

Primary Control Card 1

This card is required for all MSS runs.

Card Columns	Contents
1,2	01 Card identifier
3	Type of run 1 Sort only 2 Merge only (legal for record sort of tag sort with full record output options) 3 Sort and merge
4	Type of sort 0 Record 1 Tag (legal when the input file is on mass storage only)

Card Columns	Contents
5	Parity error option; 1 Accept record, print on standard output unit 2 Reject record, print on standard output unit 3 Accept record, do not print 4 Reject record, do not print 5 Stop run; operator may abort the job (press MI, type/A, press MI) restart at the beginning of the current merge pass if column 7 of primary control card 1-0 (press MI, type/S, press MI) or cause a reread of the record (press MI, type/R, press MI).
6	Buffer length read error 1 Accept record, print on standard output unit 2 Reject record, print on standard output unit 3 Accept record, do not print 4 Reject record, do not print 5 Stop run; operator may abort the job (press MI, type/A, press MI) restart at the beginning of the current merge pass if column 7 of primary control card 1-0 (press MI, type/S, press MI) or cause a reread of the record (press MI, type/R, press MI).
7	Restart option. † When option 1 is chosen, there is no restart capability. 0 Write restart dump. 1 Do not write restart dump.
8	Output format (applies to tag sorting only) 0 Full record file 1 Tag record 2 Chained record Blank Option not applicable
9	Output tape rewind option R Rewind only U Rewind and unload N No rewind Blank Option not applicable
10	Blank

† No restart option for a merge only operation.

Card Columns	Contents
11	End-of-input option (tape input only) 0 Operator control†† 1 Reel count control; MSS requests a new input reel until it has read the number of reels specified in the file control card, columns 27, 28. 2 Standard trailer label; MSS requests new input tape when trailer label is EOT; a trailer label of EOF indicates end of input. Blank option not applicable
12-22	Blank

Columns 23-32 describe the major sort key. The order of dominance of sort keys is from left to right; any sort key is major to the following key and minor to a preceding key.

23	Type of collaring sequence 1 Standard BCD or user's BCD if collating sequence control card is present. 2 3300 internal BCD (blank has lowest value; other characters sort as in type 3). 3 Logical magnitude binary Example: Sort key of two 6-bit bytes, ascending sequence. The lowest number is 0000_8 and the largest number 7777_8. 4 Sign magnitude binary (negative numbers are lower than positive.) 5 Numeric BCD. Sign is carried in upper 2 bits of least significant character in the field. Bit configuration 10nnn is negative; any other configuration is positive. Negative numbers are lower than positive.

†† For operator control specified for the end-of-input option the operator performs the following steps:

To signal end of input:

1. Press MI on console
2. Type /F on CTO
3. Press MI on console

To read input from another reel:

1. Press MI on console
2. Type /T on CTO
3. Press MI on console

Card Columns	Contents	
24	Order of sequence 1 Ascending 2 Descending	
25-28	Character length of sort key	
29-32	Location of first sort key character relative to first character (0001--first character) of a logical record; for universal records, the first character of the record header is the first character of the record.	
33-42	Second sort key	If additional sort keys are required, all keys have the same format as the major sort key in columns 23-32.
43-52	Third sort key	
53-62	Fourth sort key	
63-72	Fifth sort key	

Primary Control Card 2

If more than five sort keys are required, use this card to describe sort keys 6 through 12. The sort keys for this card are specified according to the sort key format in primary control card 1.

Card Columns	Contents
1-2	02 Card identifier
3-12	Sixth sort key
13-22	Seventh sort key
⋮	⋮
63-72	Twelfth sort key

The requirements for primary control card specifications for the Mass Storage Sort sample program consist of the following:

1. The program is a sort/merge operation (column 3).
2. The program consists of a record sort (column 4).
3. If a parity error is realized the program stops (column 5).

4. A buffer length read error encountered during the Sort/Merge run requires a program stop (column 6).

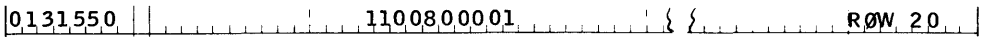
5. A restart option is specified for the program (column 7).

6. The collating sequence for the major sort key is user's BCD (column 23).

7. The order of sequence is ascending (column 24).

8. Total character length of the sort keys is 80 characters (columns 25-28).

9. The location of the first sort key character relative to the first character of the logical records in the file is character position 1 (columns 29-32).



7.3.2 FILE CONTROL CARD

File control cards describe the characteristics for the following type files:

Sort input files

Presorted merge input files

Two intermediate merge files (if allocated by the user)

Restart file (if allocated by the user)

Card Column	Contents
1	1 Card identifier
2	A-Z; file identification character to identify merge input files at program exit 2.
3, 4	Type of file RS Restart (uses column 20, 21 only) DS Mass storage sort input DM Mass storage merge input TS Tape sort input TM Tape merge input DO Mass storage output TO Tape output IT Intermediate merge
5-8	Maximum logical record length in characters nnnn. For variable length records, length includes the record character count or record mark (for universal records, length excludes the four characters of the record header). For tag and chained records, length includes record address.
9-12	For blocked records, mass storage data block size, or maximum physical record length for tape files, in the form nnnn with leading zeroes. For all blocked mass storage files or intermediate files, allow 2 extra words. For unblocked records, columns 9-11 are blank and column 12 contains U.

13	Record type F Fixed record size V Variable record size
14	Type of variable length record control 0 Record character count 1 Record mark 2 Interrecord gap (tape files only) 3 Universal
15	Size of record character count in 6-bit bytes, 1 to 4. 1 to 4 Binary mode A to D (A=1,. . . , D=4) BCD mode
16-19	Location of the first character of the variable record character count field. The location is specified relative to the first character of the record (0001=first character position of a logical record).

For mass storage files, columns 20-70 have the following specifications:

Card Columns	Contents
20-21	File ordinals (fo) designated by OPEN control card columns 22-69 (section 7.2.4), are always required for the intermediate merge files, and are required for the output file when it is necessary for MSS to expand the output file size. Columns 22-69 are not used for input files.
22-29	Owner (if less than 8 characters, use trailing blanks; imbedded blanks are illegal)
30-59	File name (trailing blanks, no imbedded blanks)
60-61	Edition number
62-65	Access security
66-69	Modification security
70	Disk mode (applicable to 852 devices only) S Sector T Track
71	N=No two-word preamble on blocked mass storage

For a tape file, columns 20-70 contain the following specifications:

Card Columns	Contents
20	Blank
21	Tape recording mode B Binary C BCD If N is specified, portion of block not used must be zero filled.
22	Tape density H 800 bpi M 556 bpi L 200 bpi
23-24	Logical unit number of this file
25-26	Alternate logical unit number for this file; used for mounting additional reel when input or output requires more than one. MSS alternates between the alternate and standard units.
27-28	Number of input reels; optional for sort or presorted merge input tapes (see column 11, primary control card 1).
29	Label type S Standard; columns 30-58 contain label information N Nonstandard without trailer label T Nonstandard with trailer label X None C Copy input header label onto output tape (legal only for tape output file when sort input file is on tape).

Card Columns	Contents
30-31†	Logical unit number
32-45	File name (14 alphanumeric characters)
46-47	Reel number (2 numeric BCD characters)
48-53	Date written (6 numeric BCD characters, mmddyy)
54-55	Edition number (2 numeric BCD characters)
56-58	Retention cycle (3 numeric BCD characters)
59-70	Blank

File control card specifications for the Mass Storage Sort sample program are as follows:

Control Card Specification	Card Columns	FILE Control Cards				
		1	2	3	4	5
1. Character identifier	2	A	B	C	D	E
2. File type	3,4	IT	IT	DS	DM	DO
3. Maximum logical record length	5-8	80	80	80	80	80
4. Number of characters per block	9-12	1208	1208	U	U	U
5. Record type	18	F	F	F	F	F
6. File ordinal	20,21	01	02	03	04	05
7. File owner	22-27	ACMECO	ACMECO			ACMECO
8. File name	30-59	MERGE ONE	MERGE TWO			LEDGER
9. Disk Mode	70	S	S	S	S	S

```
1AIT00801208F      01ACMECØ, MERGEØNE    ...  S  RØW 21
1BIT00801208F      02ACMECØ, MERGETWØ    ...  S  RØW 22
1CDS0080    UF     03                    ...  S  RØW 23
1DDM0080    UF     04                    ...  S  RØW 24
1ED00080    UF     05AMECØ, LEDGER       ...  S  RØW 25
```

† Card columns 30 through 58 are used only when an S is in column 29.

7.3.3 NONSTANDARD OUTPUT LABEL CONTROL CARD

A nonstandard output label control card describes a nonstandard label for the output file. It is used only when option T or N is specified in column 29 of the tape output file control card. Maximum size of a nonstandard label is 120 characters.

First Label Card

Card Columns	Contents
1,2	30
3,4	Number of characters on card (01-60) used as the first part of label
5-10	Blank
11-70	Contents of label (must start in column 11)

Second Label Card

Card Columns	Contents
1,2	31
3,4	Number of characters on card (01-60) following those in card 30
5-10	Blank
11-70	Contents of label (must start in column 11)

The nonstandard output label control card, if specified, follows the output file control card in the program deck.

7.3.4 COLLATING SEQUENCE CONTROL CARD

The user may specify an arbitrary collating sequence with this optional control card. The user's collating sequence replaces the standard BCD collating sequence described in appendix B. It is used for comparison if collating sequence 1 is specified in any sort key of primary control cards 1 and 2.

The collating sequence control card is not a requirement of Mass Storage Sort/Merge programs, but can be selected by the user as an optional control card.

Card Columns	Contents
1,2	00 Card identifier
3	Type of Hollerith conversion E External format I Internal format Each character is converted from Hollerith to internal BCD. If external format is specified and the fifth bit is 1, the character is reconverted by complementing the sixth bit before it is inserted into the sequence table. Example: A, internal format = 21 If external format is specified, A is reconverted to 61, before being inserted into the collating sequence (appendix F).
4-67	64 characters, representing the collating sequence, with the lowest order character in column 4 and each succeeding character major to the preceding character.
68	S when a short list of characters is to be sorted. The edit program scans the characters in the control card from columns 4 to 67. The end of the list is signaled when a blank is encountered the second time. All characters not accounted for in the control card are sorted as highest collating sequence if they are encountered during the sort.

The specification for the collating sequence control card selected for the sample program consists of the following:

1. Internal format is specified for the Hollerith conversion (column 3).

2. The characters representing the collating sequence consist of 0 in column 4 as the lowest order character up through Z in column 39 as the highest sequenced character on the control card (columns 4-39).

3. The short list of characters involved in the program requires an S in column 68 for internal processing.

```
00I 0123456789ABCDEFGHIJKLMNØPQRSTUVWXYZ    S    RØW 26
```

7.3.5 MODIFICATION CONTROL CARD

This control card indicates to the MSS program that a user's modification routine is to be executed. The modification routines must be in order (EXIT1, EXIT2, EXIT3). MSS requires a control card and loader card for each routine provided.

Modification control cards and corresponding modification routines are not a requirement of Mass Storage Sort/Merge programs but are used only as an optional choice of the user.

Card Columns	Contents
1,2	60
3	Program exit number (1-3)
4-11	Name of modification routine (1-8 Hollerith characters)
12-16	Decimal number of locations required by user's modification routine.
17-18	Logical unit number (or file ordinal) containing this user modification routine. If no logical unit number is present, the modification program is loaded from the standard input unit. The user modification routine cannot be loaded from the MSOS library unit.

The following modification control cards, although not requirements of Mass Storage Sort/Merge programs, were selected for use in this sample program. The specifications for both control cards are as follows:

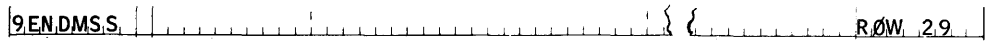
Modification Control Card	Program Exit number (column 3)	Names of Modification Routine (columns 4-11)	Size of Routine in characters (columns 12-16)
1	2	EXIT 2	100
2	3	EXIT 3	50

```
602EXIT2   00100                                        RØW 27
603EXIT3   00050                                        RØW 28
```

7.3.6 9ENDMSS CONTROL CARD

A 9 ENDMSS control card must be the last MSS control card in the deck. It indicates that all control cards have been read and sorting can begin.

The 9ENDMSS control card entry for the Mass Storage Sort sample program appears below.



7.3.7 ELD LOADER CONTROL CARDS

The ELD loader control or cards must be included in the job deck whenever modification routines are specified for the internal sort or merge phases. These control cards, recognized by MSOS, indicate to the loader that the routines are completely loaded.

If the modification routine or routines are loaded from the standard input unit the ELD control card or cards must follow the binary decks of their respective modification routines.

If the modification routine or routines are loaded from a unit other than the standard input unit the ELD card or cards must follow the ENDMSS control card in the job deck.

The format of the ELD loader control card is:

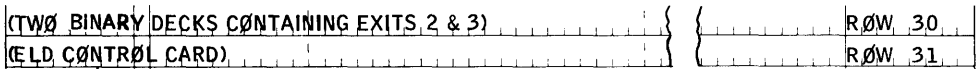
Card Column	Contents
1	Punches in rows 12, 11, 0, 1, 2, 3, 7, 9 (binary card with word count - 77)

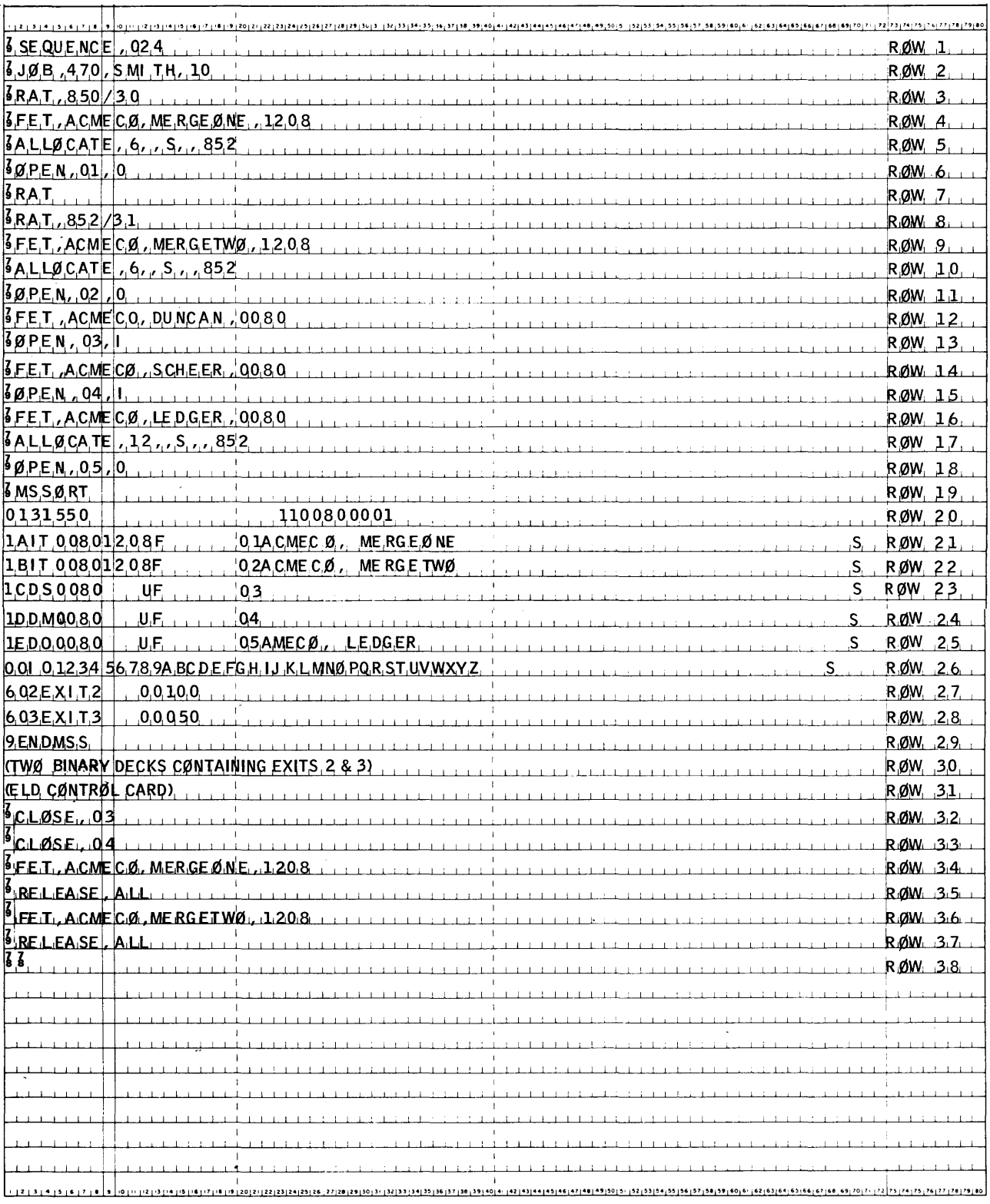
The number and position of the ELD loader control card depends on the number and input location of the modification routine as follows:

Input Location of Modification Routines	Number of ELD Loader Control Cards	ELD Control Card Position in Job Deck
Individual modification routines for exit 1, 2, or 3 or a combination of 2 and 3 (both exits are loaded as one routine) located on the standard input unit.	1	Follows the binary deck of their respective modification routines.

Input Location of Modification Routines	Number of ELD Loader Control Cards	ELD Control Card Position in Job Deck
Individual modification routine for exits 1, 2, or 3 or a combination of exits 2 & 3 (both exits are loaded as one routine) located on a unit other than the standard input unit.	1	Follows the 9ENDMSS control card. An end-of-file mark must appear at the end of the routine.
Routines for all three exits located on the standard input unit	2	One ELD card follows the binary routine deck for exit 1; one ELD card follows the binary routine deck for deck for exits 2 and 3.
Routines for all three exits located on a unit other than the standard input unit	2	Two ELD cards follow the 9ENDMSS control card. An EOF mark follows each modification routine.

ELD loader control card specifications for the Mass Storage Sort are as follows:





Completed Mass Storage Sort/Merge/MSOS Sample Program and Card Deck

7.4 TSM CONTROL CARDS

TSM control cards provide parameters required to run sort and/or merge jobs. The control cards available under TSM consist of the following:

Master Control Cards
File Control Cards
Nonstandard Output Label Control Cards
Collating Sequence Control Card
Modification Control Cards
ELD Loader Control Cards
ENDSORT Control Cards

7.4.1 MASTER CONTROL CARDS

The master control cards contain information indicating:

Type of run

- sort only
- merge only
- sort and merge

Type of merge

- balanced or polyphase
- forward or backward read

Option on parity error while attempting to read

Option for buffer length error

End of input option

Logical tape units available to Sort/Merge

Type and order of collating sequence

Sort keys specifications

Master Control Card 1 (required for all Tape Sort/Merge operations)

Card Columns	Contents
1,2	0
3	Type of run 1 Sort only 2 Merge only 3 Sort and merge
4	Type of merge 0 Balanced, forward read 1 Balanced, backward read (604 and 607 units only) 2 Polyphase, forward read 3 Polyphase, backward read (604 and 607 units only)
5	Parity error option 1 Accept record, print on standard output unit 2 Reject record, print on standard output unit 3 Accept record, do not print 4 Reject record, do not print 5 User option†
6	Buffer length read error 1 Accept record, print on standard output unit 2 Reject record, print on standard output unit 3 Accept record, do not print 4 Reject record, do not print 5 User option†
7	Restart option 0 Normal case, write restart dump 1 Do not write restart dump When option 1 is chosen there is no restart capability.

† The message A TSRT 326 BTO ACCEPT, RETRY, TERMINATE, RESTART, or PRINT and RETRY,X,R,A,S,B is printed on CTO. Refer to appendix of this manual for desired operations.

Card Columns	Contents
8	End of input option 0 Operator control † 1 Reel count control Sort requests a new input reel until it has read the number of reels specified in the File control card, columns 27-28. 2 Standard trailer label Sort requests a new input tape when trailer label is EOT. When trailer label is EOF, Sort accepts it as the end of input.
9	Output tape rewind option R Rewind only U Rewind/unload N No rewind
10	Blank
11,12 : 41-42	Logical work tape units available to the Sort program. Does not inlcude those assigned for presorted merge input tapes. Sort input and output units may be included (see section 5.1.2).

† The message A TSRT 301 B UNIT xx. EOT. T, F is typed on the CTO. If this is an end of file (end of input) respond by pressing MI, typing /F, and pressing MI. If more reels are to be mounted (EOT), respond by pressing MI, typing /T, and pressing MI.

Card Columns	Contents
43	Type of collating sequence 1 Standard BCD (appendix F) or user's BCD if the collating sequence control card is present 2 3200 internal BCD (appendix F) 3 Logical magnitude binary (differs from 3200 internal BCD in the position of the blank) Example: Sort key of two 6-bit bytes, ascending sequence. The lowest number is 0000_8 and the largest number is 7777_8. 4 Sign magnitude binary (negative numbers are lower than positive). Example: -2, -1, -0, +0, +1, +2 5 Numeric BCD. Sign is carried in upper 2 bits of least significant character in field. Bit configuration 10nnn is negative; any other configuration is positive. Negative numbers are lower than positive.
44	Order of Sequence 1 Ascending 2 Descending
45-48	Character length of sort key
49-52	Location of first sort key character with relation to first character of record (001 = first character) of a logical record The order of dominance of sort keys goes from left to right: any sort key is major to the following key and minor to the preceding key, if there is one.
53-62	Second sort key; constructed same as major sort key (columns 43-52)
63-72	Third sort key; constructed same as major sort key (columns 43-52)

Master Control Card 2

If more than three sort keys are required, this card must be used to describe sort keys 4 through 10. The format of these sort keys follows the same format specified for the major sort key on Master Control Card 1 (column 43-52).

Card Columns	Contents
1,2	02
3-12	Fourth sort key
13-22	Fifth sort key
⋮	⋮
63-72	Tenth sort key

Master Control Card 3

The user may indicate the maximum block size to be used for the intermediate sort files and for input files. This card is optional.

Card Columns	Contents
1,2	03
3,6	Maximum block size in characters.

Listed are the following Tape Sort/Merge sample program requirements that are specified for Master control card 01.

1. A sort/merge operation is specified (column 3).
2. A backward read polyphase merge routine is selected for this program (column 4).
3. For a parity error, reject the record and print it on the standard output unit (column 5).
4. For a read buffer length error, accept the record but do not print it on the standard output (column 6).
5. A restart dump option is specified (column 7).
6. Request operator control upon end-of-input reel (column 8).

7. The final output tape does not require a rewind (column 9).

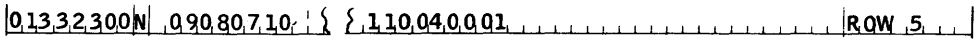
8. Assign logical tape units 9, 8, 7, and 10 in that order. Work tape 10 is assigned as the output unit for the first intermediate merge pass in this example (columns 11-16).

9. User BCD collating sequence is specified (column 43).

10. The order of sequence is ascending (column 44).

11. The character length is 4 characters (columns 45-48).

12. Location of first key character is first character of record (columns 49-52).



7.4.2 FILE CONTROL CARDS

The function of the file control card is to describe file characteristics. A file control card is required for each of the following files:

Sort input file

Presorted input file

Output file

Card Columns	Contents
1	1 (Card identifier)
2	A-Z; file identification character This unique character used in tape mounting messages for merge input files is indicated to the user in program exit 2.
3,4	Type of file SI Sort input MI Merge input BO Output

5-8	Maximum logical record length, in characters of the form xxxx. For variable length records, length includes the record character count or record mark.
9-12	Maximum physical record length or block size, in characters of the form xxxx. For unblocked variable length records, a U must be specified in column 12. When the U is present, column 14 is ignored. U is unacceptable for fixed length records.
13	Record type F Fixed record size V Variable record size
14	Type of variable length record control 0 Record character count 1 Record mark
15	Size of variable record count in 6-bit bytes, 1-4
16	Mode of variable record character count B Binary C BCD
17-20	Location of the first character of the variable record relative to the first character of the record (0001 = first character position of the logical record).
21	Tape record mode B Binary C BCD
22	Tape density H 800 bpi M 556 bpi L 200 bpi

Card Columns	Contents
23, 24	Logical unit number for this file. This field must be specified for a sort input or merge only input and output file, but is optional for sort output and presorted merge input files, during a sort.
25, 26	Alternate logical unit number for input or output reels
27, 28	Number of input reels This optional field specifies the number of input reels to be sorted or merged. The option in master control card 1, column 8 must be a 1 before Sort will use this reel count.
29	Label type S Standard columns 30-58 contain label information N Non-standard without trailer label T Non-standard with trailer label X None C Copy input header label onto output tape. Option C is valid only for an output file control card.
30, 31†	Logical unit number (2 numeric BCD characters)
32, 45	File name (14 alphanumeric characters)
46, 47	Reel number (2 numeric BCD characters)
48-53	Date written (6 numeric BCD characters, mmddyy)
54, 55	Edition number (2 numeric BCD characters)
56-58	Retention cycle (3 numeric BCD characters)

Any blank portion of Standard Label Description is ignored.

† Card columns 30 through 58 are used only when an S is in column 29.

Three file control cards are required for this sample Sort/Merge program:

Sort Input File A (unsorted)

Merge Input File B (presorted)

Output File C

The control card specifications for the sample program requirements are as follows:

File Specifications	Card Columns	File Control Cards 1	2	3
1. File identification character	2	A	B	C
2. File type	3, 4	Sort Input	Merge Input	Output
3. Maximum length per record	5-8	1000	1000	1000
4. Maximum number of characters per block	9-12	2000	1000	1000
5. Record type	13	Fixed	Fixed	Fixed
6. Tape recording mode	21	BCD	BCD	Binary
7. Tape density	22	556	556	800 bpi
8. Logical unit number of file	23, 24	7	10	9
9. Label type	29	None	Nonstandard with trailer	Nonstandard header with no trailer

```
1ASI10002000F       CM07    X        ...        RØW 6
1BMI10001000F       CM10    T        ...        RØW 7
1CBO10001000F       BH09    N        ...        RØW 8
```

7.4.3 NONSTANDARD OUTPUT LABEL CONTROL CARDS

These control cards describe a nonstandard output label for the output file. They are used only when option T or N is specified in column 29 of the output file control card. Maximum size of a nonstandard output label is 120 characters.

First Label Card

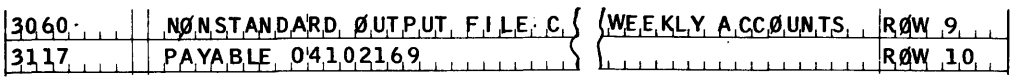
Card Columns	Contents
1, 2	30
3, 4	Number of characters on card (01-60) used as the first part of label
5-10	Blank
11-70	Contents of label (must start in column 11)

Second Label Card

1, 2	31
3, 4	Number of characters on card (01-60) following those in card 30
5-10	Blank
11-70	Contents of label (must start in column 11)

The specifications for the nonstandard output label control card describing the nonstandard header label to be written on out file C are as follows:

Control Cards	Number of character per label per card	Contents of Label (starting in column 11)
1	60	NONSTANDARD OUTPUT FILE C..... .....WEEKLY ACCOUNTS
2	17	PAYABLE 04/02/69



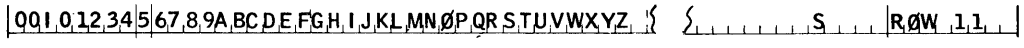
7.4.4 COLLATING SEQUENCE CONTROL CARD

The collating sequence control card is not a requirement of Tape Sort/Merge programs. The user may specify an arbitrary collating sequence with this optional control card. The standard BCD collating sequence, described in Appendix E, is replaced by the user's collating sequence only if type 1 collating sequence is specified for any sort key of master control cards 1 and 2 (section 7.4.1).

Card Columns	Contents
1,2	00
3	Type of Hollerith conversion E external format I internal format Each character is converted from Hollerith to internal BCD. If external format is specified, the character is reconverted by complementing the sixth bit (if the fifth bit is one) before inserting the character into the sequencing table. Example: A, internal format = 21 If external format is specified, A is reconverted to 61 before being inserted into the collating sequence table.
4-67	64 characters, representing the collating sequence, with the lowest order character in column 4, and each succeeding character major to the preceding character.
68	S when a short list of characters is to be sorted. The edit program scans the characters in the control card from columns 4 to 67. The end of the list is signalled when a blank is encountered the second time. All characters not accounted for in the control card will be sorted as highest if they are encountered during the sort.

The specifications for the collating sequence control card optionally selected for the Tape Sort Merge sample program are as follows:

1. The character conversion is internal (column 3).
2. Character 0 in column 4 is sequenced lowest with the sequence progression leading to character Z in column 39 as the highest order character listed on the card (columns 4-39).
3. An S is in column 68.



7.4.5 MODIFICATION CONTROL CARDS

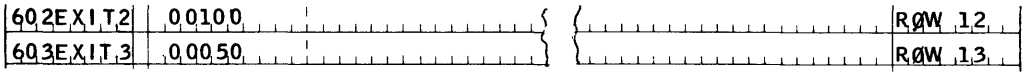
This control card indicates to the Sort/Merge program that a user modification routine is to be executed. One control card is required for each routine.

Modification control cards and corresponding modification routines are not a requirement of Tape Sort/Merge programs but are used only as an optional choice of the user.

Card Columns	Contents
1,2	60
3	Program exit number (1,3)
4-11	Name of modification routine (8 Hollerith characters)
12-16	Decimal number of locations required by user subprogram (includes numbered common).
17,18	Logical unit number containing this user modification routine. If no logical unit number is present, the modification program is loaded from the standard input unit. The user modification routine cannot be loaded from the library or a mass storage device.

The following modification control cards, although not requirements of Tape Sort/Merge programs, were selected for use in this sample program. The specifications for both control cards are as follows:

MODIFICATION Control Cards	Program Exit (column 3)	NAME (columns 4-11)	Number of locations required by routine (columns 12-16)
1	2	EXIT 2	100
2	3	EXIT 3	50

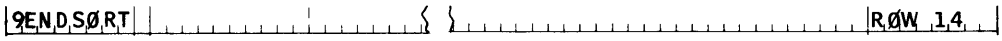


7.4.6 9ENDSORT CONTROL CARD

The 9ENDSORT card indicates that all control cards have been read and sorting can begin.

Card Columns	Contents
1	9
2-8	ENDSORT

9ENDSORT control card specifications for the Tape Sort/Merge sample program follow.



7.4.7 ELD LOADER CONTROL CARDS

The ELD control card or cards must be included in the job deck whenever the internal sort phase or merge phases require modification routines. These control cards, recognized by MSOS indicate to the loader that the routines are completely loaded.

If the modification routine or routines are loaded from the standard input unit the ELD control card or cards must follow the binary decks of their respective modification routines.

If the modification routine or routines are loaded from a unit other than the standard input unit the ELD card or cards must follow the 9ENDSORT control card in the job deck.

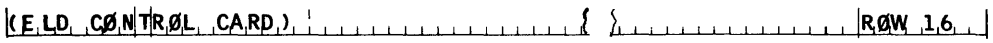
The format of the ELD loader control card is:

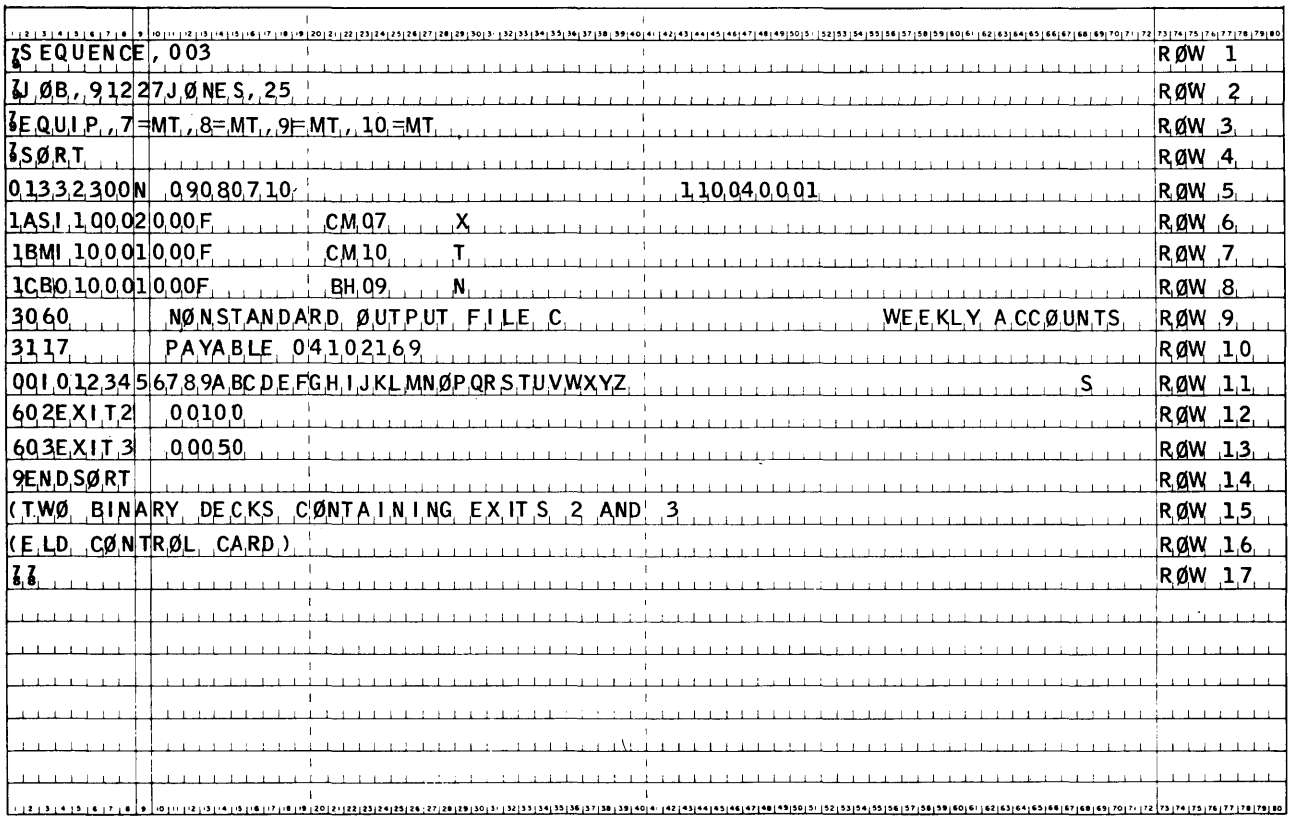
Card Column	Contents
1	Punch in rows 12, 11, 0, 1, 2, 3, 7, 9 (binary card with word count= 77)

The number and position of the ELD loader control card depends on the number and input location of the modification routine as follows:

Input Location of Modification Routines	Number of ELD Loader Control Cards	ELD Control Card Position in Job Deck
Individual modification routines for exit 1, 2, or 3 or a combination of 2 and 3 (both exits are loaded as one routine) located on the standard input unit.	1	Follows the binary deck of their respective modification routines.
Individual modification routine for exits 1, 2, or 3 or a combination of exit 2 and 3 (both exits are loaded as one routine) located on a unit other than the standard input unit.	1	Follows the 9ENDSORT control card. An end-of-file mark must appear at the end of the routine.
Routines for all three exits located on the standard input unit	2	One ELD card follows the binary routine deck for exit 1; one ELD card follows the binary routine deck for exits 2 and 3.
Routines for all three exits located on a unit other than the standard input unit	2	Two ELD cards follow the 9ENDSORT control card. An EOF mark follows each modification routine.

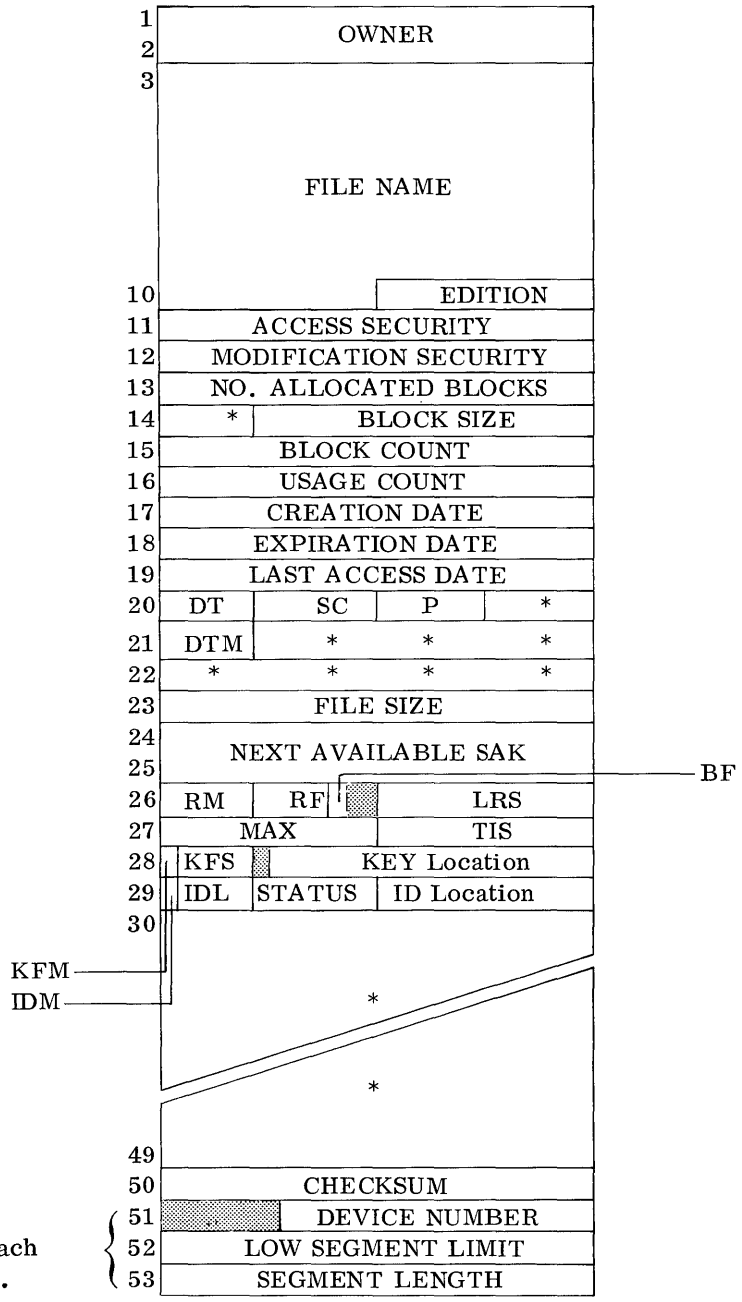
ELD control card specifications for the Tape Sort/Merge sample program are as follows:





Completed Tape Sort/Merge/MSOS Sample Program and Card Deck

APPENDIX SECTION



* Denotes reserve

Field Name	Size	Description
File identifier	40 characters	Uniquely identifies a file in FLD; consists of: Owner identification - 8 characters File name - 30 characters Edition number - 2 characters Field may be divided differently at installation.
Access security	4 characters	Supplied when file is allocated; must be supplied for each succeeding OPEN request
Modification security	4 characters	Supplied when file is allocated; must be supplied for each RELEASE, EXPAND, and MODIFY request
Number blocks allocated	4 characters	Contains, as a binary integer, number of blocks allocated to the file
Block size	3 characters	Contains, as a binary integer, number of 6-bit characters in each record block (0<block size< 131072)
Block count	4 characters	Binary integer; highest block number written. If file is processed sequentially, this corresponds to number of blocks written into the file ($0 \leq$ block count $< 2^{23}$).
Usage count	4 characters	Binary count of the number of times file has been opened
Creation date	4 characters	Date supplied by I/O system when file is allocated; stored as a binary integer in the form yymmdd
Expiration date	4 characters	Date supplied by user when file is allocated; stored as a binary integer in the form yymmdd. This field determines when a file may be deleted.
Last access date	4 characters	Date supplied by I/O system each time file is opened or changed; stored as a binary integer in the form yymmdd
DT (device type)	1 character	6-bit code indicating type of mass storage device containing the file 40_8 1311 disk packs 41_8 852 disk packs 50_8 853 disk packs 51_8 854 disk packs 60_8 813, 814 disk files 70_8 863 drum
SC (segment count)	1 character	Binary integer; number of segments in the file (0<SC<64)

Field Name	Size	Description
P (protection)	1 character	Contains protection flags for use by I/O system; currently defined values: 0 file may be read or written 1 file may not be written
DTM (device type modifier)	1 character	6-bit code which provides further device information. Values for 1311 and 852 disk packs are: xxxxx0 track mode xxxxx1 sector mode Value for 853, 854, 813, 814, and 863 is: xxxxx1 sector mode
File size	4 characters	Binary integer; number of allocatable units (tracks) assigned to the file ($0<$file size$<2^{23}$)
Next available SAK	8 characters	Block and record positions where next record can be written within file
RM (record mark)	1 character	Character which terminates each record when record format is record delimiter
RF (record format)	3 bits	Type of records within file 0 fixed length records 1 key field contains total number of characters 2 key field contains number of occurrences of a fixed length trailer item 3 universal format 4 record mark specified by RM terminates each record
BF (block format)	1 bit	1 one logical record per block 0 logical records are blocked. Each block contains a two-word header specifying next block number (NBN) and position of first available character within block (POFAC).
LRS (logical record size)	2 characters	Logical record size, in characters, of fixed length record; the size of the fixed portion of variable records which have trailer items. This is zero if records vary by key field or record mark.
MAX (maximum logical record size)	2 characters	Maximum size in characters of the variable portion of logical records. For variable records with trailers, this is the size of the trailer item times the maximum number of occurrences. For all others, this is the maximum size of a record within the file.

Field Name	Size	Description
TIS (trailer item size)	2 characters	Trailer item size in characters if RF is 2; otherwise this field is zero
KFM (key field mode)	1 bit	0 key field is within each record 1 key field is outside the record (does not appear in the file)
KFS (key field size)	5 bits	Number of characters in the key field
Key location	17 bits	Character position of key field relative to beginning of the record if key field is within the record
IDM (ID mode)	1 bit	Type of record identification associated with every record in the file 0 numeric 1 alphanumeric
IDL (ID length)	5 bits	Length in characters of record identification field of every record in the file
Status	1 character	Reserved to reflect current status of file as defined by each operating system or library program
ID location	2 characters	Starting character position of identification field in each record of file
Checksum	4 characters	24-bit checksum of the entire label; checked by the I/O system to detect accidental modification of label
Device number	3 characters	Number of device on which file segment is stored; checked against device label to insure that proper packs are mounted.
Low segment limit	4 characters	Binary hardware address at which file segment begins
Segment length	4 characters	Number of allocatable units (tracks) in this segment
* (Reserved)	89 characters	Fields reserved for future use by the I/O system

STANDARD FILE LABELS B

Standard Header Labels

All information used in the standard header label is provided by the user. This information is written from the user program as the first record of a tape. Standard header labels are always read or written in BCD mode in the following format:

Character Position	Contents
1	Density; 2, 5, or 8 (indicating 200, 556, or 800 bpi)
2-3	Unique standard label identifier, ()
4-5	Logical unit number, two BCD digits
6-8	Retention cycle, three BCD digits
9-22	File name, 14 alphanumeric characters
23-24	Reel number, two BCD digits
25-30	Date written; month, day, year in BCD
31-32	Edition number, two BCD digits
33-80	User supplied information

Standard Trailer Labels

Standard trailer labels consist of 16 to 80 characters, preceded and followed by end-of-file marks. These trailer labels are written in the following format:

Character Position		Contents
1-3	EOT	end of tape on intermediate reel of a file
	EOF	end of file on final tape
4-8	nnnnn	number of data blocks written on the tape
9-80	User supplied information	

MODIFICATION ROUTINES C

This appendix consists of a summation of the modification routine discussed in chapter 3.

EXITS 1 and 2

To User At	Return	Description	Contents When Control Returns to Sort†	
			A Register	Q Register
Entry (logical record)	Normal	Accept logical record	Character address of logical record	Character count (binary)
	p+1	Insert record	Character address of insert record	Character count (binary)
	p+2	Delete logical record		
Entry+2	Normal	Accept header label	Word address of header label††	Character count (binary)
	p+1	Retry with new tape		
	p+2	Reject label and terminate job		
Entry+4	Normal	Accept trailer label	Word address of trailer label	Character count (binary)
	p+1	Reject label and terminate job		
Entry+6	Normal	Continue sort		
	p+1	Insert record	Character address of input record	Character count (binary)
	p+2	Terminate job		

†When the user receives control, the information in the A and Q registers is the same as indicated for all normal returns.

††When the user receives control at entry from exit 2, bits 23-18 of the A register contain the file identification character.

EXIT 3

To User At	Return	Description	Contents When Control Returns to Sort†		Index Register 1
			A Register	Q Register	
Entry (logical records)	Normal	Accept logical record	Character address of current record	Character address of previous record	Number of characters in current logical record
	p+1	Insert logical record	Character address of insert record	Character address of previous record	Number of characters in logical record to be inserted
	p+2	Delete logical record			
Entry+2 (header label)	Normal	Accept header label	Word address of header label	Character count (binary)	
	p+1	Terminate job			
	p+2	Terminate job			
Entry+4 (trailer label with end of reel or output flag)	Normal	Accept trailer label	Word address of trailer label Bit 23=0 End of reel Bit 23=1 End of final output reel	Character count (binary)	
	p+1	Terminate output	Word address of trailer label	Character count (binary)	
Entry+6 (end of job)	Normal	Return control to MSOS			

† When the user receives control, the information in the A and Q registers is the same as indicated for all normal returns.

ALLOCATION OF INTERMEDIATE MERGE FILES D

Two parameters which the user must select for allocation of intermediate merge files are the block size and the number of blocks.

Block size should be chosen to contain an integral number of logical records and a total number of words as close as possible to 64, 128, 256, 512, or 1024 words (equivalent to 1, 2, 4, 8, and 16 sectors respectively). The total number of words in a block is equal to the number of logical records times the number of words in a logical record plus two words of sort identification information.

Algebraically, this is:

$$B = n_b \cdot \ell + 2$$

where B = block size in words

n_b = number of logical records (per block)

ℓ = length of logical record in words

A desirable goal is to choose n_b such that $\log_2 B$ is an integer.

After determining the block size to be used for the intermediate merge files, the user must select the proper number of blocks. This is not simply the number of records in the file divided by the number of records per block. The files to be allocated holds intermediate merge strings which could be terminated by partially filled blocks (containing less than n_b logical records).

The following formula assists in determining the number of blocks to allocate:

$$A = INT^+ [(N-s)/n_b] + s$$

A = number of blocks to allocate

N = number of logical records in the file

s = number of intermediate merge strings

The function INT^+ (x) is evaluated:

x, a rational number, equals an integer plus a remainder (which may be zero).

$INT^+(x)$ = integer, if remainder = 0

$INT^+(x)$ = integer plus 1, if remainder $\neq 0$

The number of intermediate merge strings can be taken from a previous sort run with the same data file or it can be estimated by the following formula:

$$s = \frac{N(\ell+3)}{8192}$$

where s = number of intermediate merge strings

N = number of logical records in the file

ℓ = length of logical record in words

Example:

Assume the user wants to allocate intermediate merge files for sorting of a file containing 2000 logical records, each record consisting of 20 words.

Thus, N = 2000

ℓ = 20

In choosing block size (B), the choice should give a value close to 64, 128, 256, 512, or 1024, determined by the following formula:

$$B = n_b \cdot \ell + 2$$

The closest we can get is:

n	B	Physical length	B/Physical length (usage)
3	62	64	0.97
6	122	128	0.95
12	242	256	0.95
25	502	512	0.98
51	1022	1024	0.99+

This indicates that the best choice for block size would be 1022 words, filling 16 sectors (a full track). Sort versions before version 1.1 perform a compare after every write option. With record size of a full track, there is an additional latency charge to switch from write to compare. (This additional latency occurs for records over 13 sectors in length.)

Keeping this possibility in mind, let us continue the calculations with a block size of 1022 words. This means that:

$N_b = 51$

For an estimate of the number of strings that are generated:

$$s = \frac{N(\ell+3)}{8192}$$

$$s = \frac{2000(20+3)}{8192}$$

$$s = 5.6$$

Let $s = 6$

To estimate the number of blocks to be allocated:

$$A = INT^{+} [(N-s)/n_b] + s$$

$$A = INT^{+} [(2000-6)/51] + 6$$

$$A = INT^{+} [39.1] + 6$$

$$A = 40 + 6 = 46 \text{ blocks}$$

Thus, the user in this case, sorting 2000 records of 20 words each allocates 46 blocks of 1022 words each for each intermediate merge file. Two merge files must be allocated, even though only one will actually be used in this case.

STANDARD BCD COLLATING SEQUENCE

E

Printer Character	BCD Tape Code	3000 Internal BCD Code	Card Punches	Seq. No. ††	Printer Character	BCD Tape Code	3000 Internal BCD Code	Card Punches	Seq. No. ††
BLANK	20	60	BLANK	00	G	67	27	12,7	40
:	†00	†12	8,2	01	H	70	30	12,8	41
≤	15	15	8,5	02	I	71	31	12,9	42
%	16	16	8,6	03	∨	52	52	11,0	43
[	17	17	8,7	04	J	41	41	11,1	44
→	35	75	0,8,5	05	K	42	42	11,2	45
≡	36	76	0,8,6	06	L	43	43	11,3	46
∧	37	77	0,8,7	07	M	44	44	11,4	47
↑	55	55	11,8,5	10	N	45	45	11,5	50
↓	56	56	11,8,6	11	O	46	46	11,6	51
>	57	57	11,8,7	12	P	47	47	11,7	52
≥	75	35	12,8,5	13	Q	50	50	11,8	53
¬	76	36	12,8,6	14	R	51	51	11,9	54
.	73	33	12,8,3	15	]	32	72	0,8,2	55
)	74	34	12,8,4	16	S	22	62	0,2	56
;	77	37	12,8,7	17	T	23	63	0,3	57
+	60	20	12	20	U	24	64	0,4	60
$	53	53	11,8,3	21	V	25	65	0,5	61
*	54	54	11,8,4	22	W	26	66	0,6	62
-	40	40	11	23	X	27	67	0,7	63
/	21	61	0,1	24	Y	30	70	0,8	64
,	33	73	0,8,3	25	Z	31	71	0,9	65
(	34	74	0,8,4	26	0	12	00	0	66
=	13	13	8,3	27	1	01	01	1	67
≠	14	14	8,4	30	2	02	02	2	70
<	72	32	12,0	31	3	03	03	3	71
A	61	21	12,1	32	4	04	04	4	72
B	62	22	12,2	33	5	05	05	5	73
C	63	23	12,3	34	6	06	06	6	74
D	64	24	12,4	35	7	07	07	7	75
E	65	25	12,5	36	8	10	10	8	76
F	66	26	12,6	37	9	11	11	9	77

† 00 is an illegal character when written in even parity. If a 12 is generated in core and written in even parity, it will appear on tape as a 12; and when it is read in even parity, it will be converted to 00 internally.

†† Seq. No. 00 is lowest order (minor)
Seq. No. 77 is highest order (major)

MASS STORAGE SORT/MERGE

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
D	MSRT	001	B LOADER ERROR	CTO OUT	MSRT sort monitor encountered an error in loading subprograms or modification routines.	Job terminates; error may be due to a CHECKSUM error 1. Re-autoload system 2. Replace bad subprogram
D	MSRT	002	B JOB DELETED	CTO OUT	When major errors occur or operator accepts an option to terminate job, this message appears following the edit phase diagnostics	1. Correct all control card errors 2. Resubmit job.
D	MSRT	003	B FOS NO. INSUFFICIENT MERGE AREA AVAILABLE	CTO OUT	MSRT is unable to expand intermediate merge files to meet requirements of the job. no. is the ordinal of the first intermediate merge file which MSRT unsuccessfully attempts to expand	Job terminates; user has not allocated enough for intermediate files and due to the blocking factor, insufficient use is made of space allocated.
D	MSRT	004	B FO no. LOCATE ERROR	CTO OUT	MSRT encountered an error in attempting to locate for a mass storage read or write request. Error may be due to incorrect information on a user file card.	Job terminates. 1. Correct control cards 2. Resubmit job
D	MSRT	005	B OUT OF SEQUENCE	CTO OUT	Input records are not in sequence according to the sort keys specified.	Job terminates; undetected disk parity errors. Resubmit job.
D	MSRT	006	B UNENDING MERGE	CTO OUT	During each merge pass, MSRT determines if the number of sequences is less than the number for the preceding merge pass. If it is not, an unending merge condition has been encountered.	Decrease blocking factor of intermediate files. Job terminates
D	MSRT	007	B END OF INT MERGE DISK FILE, SYSTEM ERROR	CTO OUT	A status check on WRITE operation indicates end-of-tape. Since the intermediate merge file is on the disk, this condition should not occur.	Job terminates

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
D	MSRT	008	B CANNOT RESTART - INSUFFICIENT FOS	CTO OUT	MSRT cannot open restart file because no file ordinals are available to assign to it	Job terminates; rerun job with user allocated files
D	MSRT	009	B FO no. IRRECOVERABLE WRITE ERROR	CTO OUT	MSRT attempted MSIO WRITE function, but cannot complete because: 1. Request to write on read-only file 2. Request specifies illegal file ordinal 3. Irrecoverable I/O error occurred	Job terminates 1. Check control cards 2. Resubmit job
D	MSRT	010	B SEC. CODE ON FET DOES NOT AGREE WITH FILE LABEL	CTO OUT	Error on either FET card or a sort FILE control card; information does not agree	Job terminates 1. Correct control card 2. Resubmit job
D	MSRT	011	B FILE PARAMETER MISSING OR INVALID parameter	CTO OUT	Parameter in FILE control card missing or invalid. Variable parameters in the message are listed in message column.	Job terminates in each case. The erroneous control card is printed on OUT following the message. 1. Correct control card 2. Resubmit job
			ACCESS SECURITY CODE FILE IDENTIFIER			
			ALT LOGICAL UNIT		Alternate logical unit	
			FILE IDENT CHARACTER		File identification character	
			FILE ORDINAL			
			LABEL DATE		Standard label date	
			LABEL LOGICAL UNIT		Standard label logical unit	
			LABEL TYPE			
			LOGICAL UNIT		Logical unit number of this file	

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
			MAX LOGICAL RCD LEN		Maximum logical record length	
			MAX PHYSICAL RCD LEN		Mass storage data block size, or maximum physical record length for tape files	
			NUM INPUT REELS		Number of input reels	
			RECORD MARK CONTROL			
			RECORD TYPE			
			REEL SEQUENCE NUMBER			
			UNIVERSAL-OP FILE		Universal records specified for output file; input records are not universal	
			RETENTION COUNT		Standard label retention code	
			SORT IP LOGICAL UNIT/FILE ORDINAL		File ordinal or logical unit number for SORT input files	
			TAPE DENSITY			
			TAPE MODE			
			VAR REC CHAR CNT POS		Location of first character of variable record count field	
			VAR REC CHAR CNT SIZ		Variable record character count size	
D	MSRT	012	B PARAM MISSING OR INV-PARAMETER	CTO OUT	Parameter missing or invalid on control card other than file control card. Variable parameters in the message column.	1. Correct control card 2. Resubmit job
			SORTING METHOD			
			END OF INPUT OPTION			

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
			FINAL OP REWIND-OPT		Final output rewind option	
			RD BUF LEN ERROR OPT		Buffer length read error option	
			RD PARITY ERROR OPT		Parity error option	
			O/P CONFIGURATION		Output configuration; tag sort output not full record, tag record, or chained record.	
			RESTART OPTION			
			USERS SEQ E-I CODE		Type of Hollerith conversion in collating sequence card.	
			MODIFICATION no. UNIT		Specified number denotes modification routine 1, 2, or 3. Message appears if specified unit for loading of modification unit is unassigned, nonnumeric, or invalid; or if modification unit is same as input unit or alternate input unit.	
D	MSRT	013	B COPY OPTION INV	CTO OUT	Output file control card specifies copy option, but input file control card (or first merge file control card for merge-only run) specifies no label.	Erroneous control card appears on OUT; job terminates 1. Correct control card 2. Resubmit job
D	MSRT	014	B INV CARD ID	CTO OUT	Control card identification in columns 1 and 2 invalid.	Erroneous card listed on OUT; job terminates 1. Correct control card 2. Resubmit job
D	MSRT	015	B NO NS OP LABEL CD	CTO OUT	File control card specified nonstandard labeling but there is no nonstandard label control card.	Job terminates 1. Correct control card 2. Resubmit job

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
D	MSRT	016	B NO OP CD	CTO OUT	Output file card missing.	Job terminates 1. Correct control card 2. Resubmit job
D	MSRT	017	B NO SRT KEYS	CTO OUT	Columns 23-32 of primary control card are blank.	Erroneous card printed on OUT; job terminates 1. Correct control card 2. Resubmit job
D	MSRT	018	B NO SI CD	CTO OUT	Primary control card specifies sort-only or sort-and-merge run but there is no sort input file control card.	Job terminates 1. Correct control card 2. Resubmit job
D	MSRT	019	B NEED EXIT 1	CTO OUT	Input and output records are not same type. User modification required at exit 1	Job terminates 1. Correct control card 2. Resubmit job
D	MSRT	020	B NEED EXIT 2	CTO OUT	Merge input files contain records not same length and type as output file. User modification routine for exit 2 missing.	Job terminates 1. Correct control card 2. Resubmit job
D	MSRT	021	B NEED EXIT 3 for NS TRL LABEL	CTO OUT	User specified label option T on output file control card. User modification routine for exit 3 missing.	Job terminates 1. Correct control card 2. Resubmit job
D	MSRT	022	B NO ENDMSS CARD	CTO OUT	MSRT encountered 7_9 card before encountering ENDMSS card.	Job terminates 1. Correct control card 2. Resubmit job
D	MSRT	023	B NO MERGE IP CDS	CTO OUT	Primary control card specifies merge-only or sort-and-merge run but no merge input file control card.	Job terminates 1. Correct control card 2. Resubmit job
D	MSRT	024	B LOG REC LEN NOT A FACTOR OF PHYS REC LEN	CTO OUT	User specified fixed length records but specified physical record length not even multiple of fixed length record size.	Erroneous control card appears on OUT; job terminates 1. Correct control card 2. Resubmit job

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
D	MSRT	025	B LOGICAL RECORD TOO SMALL	CTO OUT	A file control card specifies a maximum length of less than 17 characters.	Erroneous control card appears on OUT; job terminates 1. Correct control card 2. Resubmit job
D	MSRT	026	B MEMORY TOO SMALL	CTO OUT	Requirements of run specified exceed available memory. (Sizes of modification routines, input and output buffers, merge input buffers, and the merge order are considered in calculating memory requirements for an MSRT run.)	Job terminates 1. Decrease length of exits 2. Decrease blocking factor
D	MSRT	027	B MOD UNIT CANNOT= SRT IP UNIT	CTO OUT	Unit specified for loading a modification routine is also specified as a sort input unit.	Job terminates 1. Correct control card 2. Resubmit job
D	MSRT	028	B MOD UNITS 2,3 MUST BE =	CTO OUT	User did not specify same logical unit for loading modification routines 2 and 3.	Job terminates 1. Correct control card 2. Resubmit job
D	MSRT	029	B OP RCC MISSING	CTO OUT	User specified variable length record output files with out record character count. Input file records are not under interrecord gap or record mark control.	Job terminates 1. Correct control card 2. Resubmit job
D	MSRT	030	B SORT KEY no. INV	CTO OUT	Sort key number (01-12) is invalid: sequence type, order, key size, or location is nonnumeric; sequence type is not 1, 2, 3 or 4; or sequence order is not 1 or 2.	Erroneous control card appears on OUT; job terminates 1. Correct control card 2. Resubmit job
D	MSRT	031	B SRT KEY no. TOO LONG	CTO OUT	Sort key number (01-12) extends beyond the maximum record length.	Erroneous control card appears on OUT; job terminates 1. Correct control card 2. Resubmit job

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
D	MSRT	032	B VAR RCC EXCEEDS REC LEN	CTO OUT	Variable record character count field extends beyond maximum record length.	Erroneous file control card is printed on OUT; job terminates 1. Correct control card 2. Resubmit job
D	MSRT	033	B 1st NS OP LABEL CD MISSING	CTO OUT	MSRT encountered nonstandard label control card 2 before encountering nonstandard label control card 1.	Erroneous card appears on OUT; job terminates 1. Correct control card 2. Resubmit job
D	MSRT	034	B FO'S OF INT MERG MIXED	CTO OUT	File ordinals of intermediate merge files switched erroneously by programmer.	Job terminates 1. Correct control card 2. Resubmit job
D	MSRT	035	B SEQ TABLE DUP CHAR, char	CTO OUT	MSRT encountered nonblank duplicate character in user's optional collating sequence control card.	Erroneous card is printed on OUT; job terminates 1. Correct control card 2. Resubmit job
D	MSRT	036	B LABEL CHR CNT ERR	CTO OUT	Character count on nonstandard output label control card is nonnumeric.	Erroneous control card is printed on OUT; job terminates 1. Correct control card 2. Resubmit job
D	MSRT	037	B REC LEN EXCEEDS MAX	CTO OUT	Physical record on specified file is larger than maximum allowed (4095).	File control card is printed on OUT; job terminates 1. Alter physical record size 2. Resubmit job
D	MSRT	038	B LOG REC LEN EXCEEDS PHYS ON	CTO OUT	Record size exceeds block size on specified control card.	Job terminates 1. Correct error 2. Resubmit the job
D	MSRT	039	B TAG OUTPUT MUST BE FIXED	CTO OUT	Tag record consists of the 8 character preamble plus the lay fields. This is always fixed in length and invalid if specified otherwise.	Job terminates 1. Correct control card 2. Resubmit job
D	MSRT	040	B UNIT no. REJECT	CTO OUT	Illegal function with UNIT no. attempted.	

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
D	MSRT	041	B UNIT no. DOWNED	CTO OUT	Operator declared UNIT no. down	
D	MSRT	042	B UNIT no. READ ERR	CTO OUT	Read parity on UNIT no. declared irrecoverable	
D	MSRT	043	B UNIT no. WRITE ERR	CTO OUT	Write parity on UNIT no. declared irrecoverable	
D	MSRT	044	B CANNOT RESTART	CTO OUT	Restart file not available.	
D	MSRT	045	B FILE ORDINAL NOT AVAILABLE (PRR)	CTO OUT	All available file ordinals have been used.	
D	MSRT	046	B 16K MSSORT CANNOT HANDLE FILE CONTROL	CTO OUT	User must sufficiently define intermediate files.	
D	MSRT	047	B MS REJECT CODE ON LIBFILE DRS	CTO OUT	MSIO rejected a READ attempt on the file specified with the specified reject code. See 3.4 for code description.	Job terminates.
D	MSRT	048	B LIB ERRORS no.	CTO OUT		Job terminates.
			1		One of SORT routines not found in DRS	
			2		The first block specified in the SORT routines doesn't begin with the IDC card.	
I	MSRT	100	B RCC PARAMS IGNORED IF UNBLOCKED, RCD MARK CONTROL OR UNIVERSAL	CTO OUT	User specified record character count field parameters in file control card and also specified file contains unblocked, record mark or universal records. MSRT ignores character count information.	
I	MSRT	101	B INSUFFICIENT INTERNAL MERGE FILES SPECIFIED	CTO OUT	User allocated only one intermediate merge file. MSRT allocates additional file.	Processing continues
I	MSRT	102	B SEQ TABLE - number of CHARS	CTO OUT	User included collating sequence control card which contains less than 64 characters and does not contain S in column 68. The number in the message indicates number of characters in user's collating sequence.	

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
I	MSRT	103	B SI CD ILLEGAL	CTO OUT	User specified merge-only run but included sort input file control card.	Card is ignored; job continues.
I	MSRT	104	B NS OP LABEL CD IGNORED	CTO OUT	Output file control card label option specifies S, X, or C.	Nonstandard output label card is ignored.
I	MSRT	105	B CANNOT ALLOCATE - ERROR CODE no.	CTO OUT		
			51		Another ocarem function has not yet run to completion (OPEN, CLOSE, ALLOCATE, RELEASE, EXPAND, MODIFY)	
			52		Illegal device type or recording mode (ALLOCATE)	
			53		Illegal value for L or N in the alpha parameter string (OPEN, CLOSE)	
			54		Maximum file size exceeded (ALLOCATE, EXPAND)	
			55		File id in fet already exists (ALLOCATE, MODIFY)	
			56		File label directory is full (ALLOCATE)	
			57		Illegal device number in resident allocation table (ALLOCATE, EXPAND)	
			58		N tracks are not available (ALLOCATE, EXPAND)	
			59		This allocation would cause maximum segment count to be exceeded (ALLOCATE, EXPAND. Maximum segment count is installation parameter in MSIO routine.)	

(continued)

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
			(continued)			
			B CANNOT ALLOCATE - ERROR CODE no.			
			60		Contiguousness of n tracks not available (ALLOCATE, EXPAND)	
			61		File id in the fet could not be located in the label directory (OPEN, RELEASE, EXPAND, MODIFY)	
			62		File is currently open (RELEASE, EXPAND, MODIFY)	
			63		Security in fet does not match security label (OPEN, RELEASE, EXPAND, MODIFY)	
			64		The specified file ordinal has been assigned (OPEN)	
			65		Too many files are open (OPEN. Maximum of open files are set through installation option.)	
			66		The file is already open for output (OPEN)	
			67		Use indicates output but file label says read-only (OPEN)	
			68		Use indicates output but file is already open (OPEN)	
			69		Not enough drives to place file on line (OPEN)	
			70		Illegal control value in calling sequence (RELEASE)	
			71		The specified fo has not been assigned but execution continued (CLOSE)	
					(continued)	

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
			(continued)			
			B CANNOT ALLOCATE - ERROR CODE no.			
			72		Fet missing	
			73		Request would exceed maximum length of rat	
			74		Parameter x too long	
			75		Illegal punch	
			76		Control function too long	
			77		Illegal device type	
			78		Illegal file ordinal	
			79		Illegal block size (ALLOCATE)	
			80		Illegal device number	
			81		Illegal n	
			82		Illegal expiration date	
			83		New fet missing	

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
I	MSRT	109	B MI CDS ILLEGAL	CTO OUT	User specified sort-only run but included merge input file control cards.	Cards are ignored; job continues
I	MSRT	111	B no. records IN	CTO OUT	MSRT read number of records in current pass.	
I	MSRT	112	B no. records ADDED	CTO OUT	Modification routine added number of records indicated in message.	
I	MSRT	113	B no. records DELETED	CTO OUT	Modification routine or parity error with reject option deleted number of records specified in the message.	
I	MSRT	114	B no. records OUT	CTO OUT	MSRT wrote number of records indicated in message. Message appears after internal sort phase and after final merge phase. This message also appears after any intermediate merge pass when number of records written differs from number of records read.	
I	MSRT	115	B no. SEQ	CTO OUT	During the internal sort phase, MSRT generated the number of sequences (strings) specified in the message.	
I	MSRT	116	B no. records DUMPED	CTO OUT	MSRT wrote specified number of records in message on restart dump file.	
I	MSRT	117	B UNIT no. FINAL OUTPUT REEL no.	CTO OUT	Final output reel number specified in message on unit number specified in message is complete.	
I	MSRT	118	B no. INTERMEDIATE MERGE PASSES	CTO OUT	Number of intermediate merge passes specified in the message are required for this sort run.	
I	MSRT	119	B MERGE PASS no.	CTO OUT	MSRT completed merge pass specified in message.	
I	MSRT	120	B FINAL MERGE	CTO OUT	MSRT began final merge pass.	
I	MSRT	121	B FO IS MERGE INPUT	CTO OUT	MSRT identifies each merge input file with this message.	

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
I	MSRT	122	B RECORD / BLOCK CNT EXCEEDS MAX	CTO OUT	Block or record count exceeds the maximum specified.	MSRT writes the record or block on OUT; processing continues
I	MSRT	123	B RCD EXTENDS PAST END OF BLOCK	CTO OUT	Record size exceeds maximum specified.	MSRT writes the record on OUT; processing continues
I	MSRT	124	B NO RESTART DUMP	CTO OUT	MSRT detected parity error when writing restart dump.	Program continues, but there is no restarting capability until the next restart dump is written successfully.
I	MSRT	125	B CANT ALLOCATE, OPEN - NO RESTART DUMP	CTO OUT	MSRT is unable to allocate or open restart file.	No restart dumps will be taken and there is no restarting capability.
I	MSRT	126	B ASSUMED ENDMSS CARD	CTO OUT	MSRT encountered 7/9 card which was not ENDMSS.	Card is listed on OUT; mass storage sort assumes an ENDMSS card.
I	MSRT	127	B DUP CD TYPE	CTO OUT	Certain control cards, such as a primary control card, may appear only once in input deck.	When MSRT encounters duplicates of these cards, the first card read is accepted; duplicates are ignored.
I	MSRT	128	B SURPLUS MERGE FILE	CTO OUT	User specified more than 14 merge files for sort-and-merge run, or more than 15 merge files for merge-only run.	MSRT ignores the surplus merge files; processing continues
I	MSRT	129	B DUP FILE ID	CTO OUT	Merge input file control cards contain duplicate identifiers in column 2.	
I	MSRT	130	B READ PARITY / BUFFER LENGTH			
I	MSRT	131	B MSS RESTART DUMP no.	CTO OUT	MSRT just completed restart dump specified in message.	
A	MSRT	201	B ABOVE ERRORS MAY BE IGNORED. X, A	CTO OUT	Only minor errors (listed above this message on CTO and OUT) were detected during edit phase.	1. Press MANUAL INTERRUPT 2. Type /X to continue /A to abort 3. Press MANUAL INTERRUPT

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
A	MSRT	202	B UNIT no. END OF TAPE OR END OF FILE T, F	CTO	MSRT detected an end-of-file mark on a sort input file; user requested operator control for end-of-input option.	1. Press MANUAL INTERRUPT 2. Type /T if another input reel /F if no reel; return to mass storage sort 3. Press MANUAL INTERRUPT
A	MSRT	203	B UNIT no. MOUNT NEXT INPUT REEL. X	CTO	Operator signaled existence of another input reel, or MSRT read an EOT trailer label on a sort or merge input and the end-of-input option is standard trailer label control.	1. Mount next reel 2. Press MANUAL INTERRUPT 3. Type /X to continue 4. Press MANUAL INTERRUPT
A	MSRT	204	B UNIT no. LABEL ERROR. X, A	CTO	MSRT detected an error in trailer label	1. Press MANUAL INTERRUPT 2. Type /X to continue /A to terminate 3. Press MANUAL INTERRUPT
A	MSRT	205	B UNIT no. LABEL ERROR. X, A, R LABEL READ (label) LABEL EXPECTED (label)	CTO	MSRT detected header label error	1. Press MANUAL INTERRUPT 2. Type /X to continue /R to reread /A to terminate 3. Press MANUAL INTERRUPT
A	MSRT	206	B TO RESTART SET JK6 OFF TO CONTINUE	CTO OUT	MSRT wants to know if RESTART is wanted	1. Set JK6 to RESTART Press MANUAL INTERRUPT Type /X Press MANUAL INTERRUPT 2. Leave JK6 OFF to continue
A	MSRT	207	B RECORD COUNTS DO NOT AGREE. X, A	CTO OUT	MSRT encountered discrepancy between record count at end of one pass and record count at end of a preceding pass.	1. Press MANUAL INTERRUPT 2. Type/X to accept discrepancy /A to terminate job 3. Press MANUAL INTERRUPT

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
A	MSRT	208	B READY 61	CTO OUT	UNIT 61 is not READY	1. Ready UNIT61 2. Press MANUAL INTERRUPT 3. Type /X 4. Press MANUAL INTERRUPT
A	MSRT	209	B UNIT no. END OF TAPE OR END OF FILE. T, F	CTO OUT	MSRT detected end-of-file mark on merge input file; user specified operator control for end-of-file input option.	1. Press MANUAL INTERRUPT 2. Type /T to signal input reel /F no input reel 3. Press MANUAL INTERRUPT
A	MSRT	210	B UNIT no. MOUNT O/P TAPE. X	CTO OUT	MSRT began final merge pass and is ready to write on final output tape.	To continue: 1. Mount output tape on requested unit 2. Press MANUAL INTERRUPT 3. Type /X 4. Press MANUAL INTERRUPT
A	MSRT	211	B INTERPHASE RECORD COUNTS DO NOT AGREE. X, A	CTO OUT	Record count at end-of-merge disagrees with combined record counts of sort phase.	1. Press MANUAL INTERRUPT 2. Type /X to accept discrepancy /A to terminate 3. Press MANUAL INTERRUPT
A	MSRT	212	B NON-RETRIEVABLE RECORD. X, A	CTO OUT	MSRT encountered error attempting to reread a record from an input file for a full record output from tag sort.	1. Press MANUAL INTERRUPT 2. Type /X to reread record /A to terminate 3. Press MANUAL INTERRUPT
A	MSRT	213	B MSS RESTART ENTERED - CLEAR JK6	CTO OUT	MSRT is ready to restart.	1. Set SELECT JUMP6 OFF 2. Press MANUAL INTERRUPT 3. Type / 4. Press MANUAL INTERRUPT

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
A	MSRT	214	B CANNOT RESTART. X, A	CTO OUT	MSRT attempted to restart but restart dump file contained errors.	1. Press MANUAL INTERRUPT 2. Type /X to continue without re-starting /A to terminate 3. Press MANUAL INTERRUPT
A	MSRT	215	B UNIT no. READ PARITY or BUFFER LENGTH R, A, S	CTO OUT	MSRT encountered parity error in five attempts to read record, or encountered buffer length error. This message appears only if option 5 is selected.	1. Press MANUAL INTERRUPT 2. Type /R to reread record /A to abort /S to restart 3. Press MANUAL INTERRUPT
A	MSRT	216	B LUN no. WRITE PARITY. R, A	CTO OUT	MSRT made five unsuccessful attempts to write a record on unit specified in message.	1. Press MANUAL INTERRUPT 2. Type /R to rewrite record /A to abort 3. Press MANUAL INTERRUPT
A	MSRT	217	B OPERATOR TYPING ERR.	CTO	A non-valid character response was given from the operator.	1. Press MANUAL INTERRUPT 2. Retype correct response 3. Press MANUAL INTERRUPT
A	MSRT	219	B ENTER DEVICE TYPE OF INTERMEDIATE MERGE FILES MI, /DT, MI 1311 = 40, 852 = 41 853 = 50, 854 = 51, 813 = 60, 863 = 70	CTO OUT	MSRT began restart and needs to know device type of user (allocated intermediate merge files).	1. Press MANUAL INTERRUPT 2. Type / code number 3. Press MANUAL INTERRUPT
A	MSRT	220	B IRRECOVERABLE DISK ERROR. R, A, S	CTO OUT	MSRT encountered irrecover-able I/O error.	1. Press MANUAL INTERRUPT 2. Type /R to retry /A to terminate /S to restart 3. Press MANUAL INTERRUPT
A	MSRT	223	IF TYPING ERROR, SET JK1	CTO		If a typing error was made on previous attempt, set Jump Key 1 to reenter device type

TAPE SORT/MERGE

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
D	TSRT	100	B EOF ERROR	OUT	End-of-file encountered on the system input unit.	The control cards must be followed by an ENDSORT card. 1. Correct condition 2. Press MANUAL INTERRUPT 3. Type TERM to terminate GO to continue 4. Press MANUAL INTERRUPT
D	TSRT	101	B NEED EXIT$^{1}_{2}$	OUT	Modification Exit 1 is needed if input and output records are not the same length and type. Exit 2 is needed if all records on MERGE input files are not the same length and type as the output file.	Job terminates
D	TSRT	102	B ERR, INTERNAL MRG UNIT	OUT	This message is given for each incorrect logical unit specified on master control card. (i.e., unassigned unit, systems unit, nonnumerical unit)	Job terminates
D	TSRT	103	B TOO FEW TAPE UNITS	OUT	The number of logical units specified on master control card 1 is less than 3 for a polyphase merge, less than 4 for a balanced merge, or less than the number of unassigned merge input files for a sort and merge.	Job terminates
D	TSRT	104	B NO ENDSORT CARD	OUT	Edit phase read a $^{7}_{9}$ card before encountering an ENDSORT card.	Job terminates
D	TSRT	105	B NO MRG IP CDS	OUT	Either merge only or sort and merge was specified in column 3 of master control card 1, but no merge input files were specified.	Job terminates

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
D	TSRT	106	B NO SRT KEYS	OUT	There are not sort keys specified on master control card 1, columns 43-52	Erroneous control card appears on OUT; job terminates.
D	TSRT	107	B NO OP CD	OUT	An output card must be present for a merge only run.	Job terminates
D	TSRT	108	B NO SI CD	OUT	A sort input FILE control card is required for a sort only or a sort and merge run.	Job terminates
D	TSRT	109	B SORT KEY no. INV	OUT	Sequence type, order, key size, or location is non-numeric; sequence type is not 1, 2, 3, 4, or 5 or sequence order is not 1 or 2.	Erroneous control card appears on OUT; job terminates.
D	TSRT	110	B SRT KEY no. TOO LONG	OUT	Sort key number (01-10) extends beyond the maximum record length.	Erroneous control card appears on OUT; job terminates.
D	TSRT	111	B NO NS OP LABEL CD	OUT	N or T label type on the output FILE control card requires a nonstandard output LABEL control card.	Job terminates
D	TSRT	112	B COPY OPTION INV	OUT	Label option C is valid only for an output FILE card, when the input FILE card (or first merge input FILE card for a merge-only) specifies other than no label option.	Erroneous control card appears on OUT; job terminates.
D	TSRT	113	B 1st NS OP LABEL CD MISSING	OUT	Nonstandard output LABEL card 2 cannot be accepted without nonstandard output LABEL card 1.	Erroneous control card appears on OUT; job terminates.

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
D	TSRT	114	B MEMORY TOO SMALL	OUT	Available memory is not sufficient for the type of run specified. This calculation considers the sizes of modification routines, input and output buffers, merge input file buffer, and merge order.	Job terminates. 1. Decrease length of exits 2. Decrease blocking factor
D	TSRT	115	B MOD UNITS 2,3 MUST BE =	OUT	Modification routines 2 and 3 must be loaded from the same logical unit.	Job terminates
D	TSRT	116	B MOD UNIT CANNOT= SRT IP UNIT	OUT	The unit specified for loading a modification routine cannot also be specified as a SORT input unit.	Job terminates
D	TSRT	117	B NEED EXIT 3 FOR NS TLR LABEL	OUT	If label option T is specified on the output FILE control card, modification exit 3 must be specified.	Job terminates
D	TSRT	118	B OP RCC MISSING	OUT	A variable length record output file is specified with no record character count which is only allowed if the input file is unblocked variable or under record mark control.	Job terminates
D	TSRT	119	B PARAM MISSING OR INV-	OUT	This message is printed for errors in all control cards except FILE and is followed by the parameter in error as listed below with TSRT 120 B FILE PARAM MISSING OR INV message.	Erroneous control card appears on OUT; job terminates.
D	TSRT	120	B FILE PARAM MISSING OR INV-	OUT	Error in a FILE control card, followed by one of the following parameters and the erroneous control card.	Job terminates in each case. The erroneous control card is printed on OUT following the message.

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
			(continued)			
			ALT LOGICAL UNIT		Alternate logical unit	
			END OF INPUT OPTION			
			FILE IDENT CHARACTER		File identification character	
			FINAL O/P REWIND-OPT			
			LABEL DATE		Standard label date	
			LABEL LOGICAL UNIT		Standard label logical unit	
			LABEL TYPE			
			LOGICAL UNIT		Logical unit number of this file	
			LOGICAL UNIT FILE M			
			MAX LOGICAL RCD LEN		Maximum logical record length	
			MAX PHYSICAL RCD LEN		Mass storage data block size or maximum physical record length for tape files	
			MAX SORT BLOCK SIZE			
			MERGE OP LOG UNIT			
			MODIFICATION SIZE			
			MODIFICATIONS UNIT		Parameter missing or invalid modification on specified unit 1. Unassigned, nonnumeric, or invalid systems unit 2. Modifications unit is the same as the input or alternate input unit 3. Any modification unit is on the wrong side of the merge	
			NUM INPUT REELS			
			RCD MARK CTL-OP FILE			
					(continued)	

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
			(continued)			
			RD BUF LEN ERROR OPT			
			RD PARITY ERR OPTION			
			RECORD MARK CONTROL			
			RECORD TYPE			
			REEL SEQUENCE NUMBER			
			RESTART OPTION			
			RETENTION COUNT		Standard label retention code	
			SORT IP LOGICAL UNIT/		File ordinal or logical unit number for SORT input files	
			TAPE DENSITY			
			TAPE MODE			
			TYPE OF MERGE			
			TYPE OF SORT			
			USERS SEQ E-I CODE			
			VAR REC CHAR CNT MOD			
			VAR REC CHAR CNT POS		Location of first character of variable record count field	
			VAR RCD CHAR CNT SIZ		Variable record character count size	
D	TSRT	121	B SEQ TABLE DUP CHAR, char	OUT	A duplicate character, other than blank, was encountered on the optional collating sequence control card.	Erroneous control card appears on OUT; job terminates

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
D	TSRT	122	B LOG REC LEN NOT A FACTOR OF PHYS REC LEN ON no.	OUT	For fixed length files only.	Job terminates
D	TSRT	123	B REC LEN EXCEEDS MAX-ON SORT IP FILE B REC LEN EXCEEDS MAX-ON MERG M FILE	OUT	Physical record length is larger than the maximum allowed.	Job terminates 1. Alter physical record size 2. Resubmit job
D	TSRT	124	B LABEL CHR CNT ERR	OUT	Character count on the non-standard output LABEL control card is nonnumeric.	Job terminates
D	TSRT	125	B VAR RCC EXCEEDS REC LEN ON no.	OUT	Variable record character count field extends beyond the maximum record length.	Job terminates
D	TSRT	126	B LOGICAL RECORD LENGTH TOO SMALL ON no.	OUT	Logical record size must be greater than 16 characters.	Job terminates
D	TSRT	127	B LOG REC LEN EXCEEDS PHYS ON no.	OUT	Logical record length cannot be greater than the physical record length.	Job terminates
D	TSRT	128	B INV CARD ID	OUT	Control card identification in columns 1 and 2 is invalid.	Job terminates
D	TSRT	129	B INTERNAL MERGE UNIT no. GIVEN TWICE	OUT	Specified logical unit is duplicated in the file list on master control card 1.	Job terminates
D	TSRT	130	B JOB DELETED	OUT	This message appears when Tape Sort must terminate the job because of one or more major control card errors or if the operator has accepted an option to delete the job.	Job terminates
D	TSRT	131	B UNENDING MERGE. JOB DELETED	CTO OUT	During each merge pass of a balanced merge, a test is made to see if the number of sequences was reduced from the previous pass.	If number of sequences was not reduced, an unending MERGE occurred and the job is deleted. 1. Specify more tapes 2. Resubmit job.

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
D	TSRT	132	B LOADER ERROR - JOB DELETED	CTO OUT	The sort monitor encountered a loading error when loading one of the SORT subprograms or a modification routine.	Job is deleted; loading is attempted three times for a SORT subprogram.
D	TSRT	133	B ILLEGAL EOT COPYING ON FILE	CTO OUT	An end-of-tape reflective spot was encountered during a MERGE copy pass.	Job is deleted
D	TSRT	134	B INSUFFICIENT WORK TAPES FOR UNASSIGNED MERGE FILES	CTO OUT	Not enough units are available for the external merge input files which were not assigned a logical unit.	Job is deleted
D	TSRT	135	B IP UNIT CANNOT = LIB UNIT	CTO	The physical unit specified for the sort input file cannot be the same as the library unit.	Job terminates
D	TSRT	136	B LIB UNIT CANNOT BE WORK UNIT IF IP OR ALT IP IS	CTO OUT	For a polyphase merge, the physical unit assigned to the library unit (logical 63) cannot be the same as any of the units specified on master control card 1 if the logical unit assigned to the sort input or alternate input is included in that list.	Job terminates
D	TSRT	137	B HDWE DISTRIBUTION ERROR	CTO OUT	The number of strings on a drive does not agree with the number calculated for it.	Job terminates
D	TSRT	138	B LUN no. CANNOT SPECIFY LUN GRTH no.	CTO OUT	A system assigned logical unit number was specified as a user assigned logical unit number.	Job terminates
D	TSRT	139	B UNIT no. CALL REJECTED	CTO OUT	Restart message. A CIO call was rejected.	Job terminates
D	TSRT	141	B NO EXIT 1 ALLOWED ON MERGE ONLY	CTO OUT	Exit 1 is used to modify sort input data. A merge-only does not have sort input.	1. Press MANUAL INTERRUPT 2. Type /R to call for RESTART identification /A to abandon RESTART 3. Press MANUAL INTERRUPT

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
D	TSRT	142	file type INV	CTO	Column 3 and 4 of file control card invalid.	Job terminates
D	TSRT	144	MS REJECT code on {LIBFILE / DRS}	CTO OUT	MSIO rejected a READ attempt on the file specified with the specified reject code. See section 3.4	Job terminates
D	TSRT	145	B LIB ERRORS no. 1 2		One SORT routine not in DRS. Two of first blocks specified in DRS for a SORT routine doesn't begin with IDC card.	Job terminates
I	TSRT	200	B MI CDS ILLEGAL	CTO OUT	Merge input FILE control cards are illegal for a sort only run.	
I	TSRT	201	B SI CD ILLEGAL	CTO OUT	SORT input FILE control card is illegal for a merge only run.	
I	TSRT	202	B DUP FILE CD	CTO OUT	Duplicate merge input file identification. (column 2)	
I	TSRT	203	B MRG TYPE CHANGED BAL-FOR M.O.	CTO OUT	The merge type for merge only is changed to balanced forward.	
I	TSRT	204	B NS OP LABEL CD IGNORED	CTO OUT	The LABEL option specified on the output FILE control card is S, X, or C. This option overrules the non-standard output LABEL card.	
I	TSRT	205	B ALT OP UNIT CHANGED TO UNIT no.	CTO OUT	Output and alternate output units must be on the same side of the available work units for a balanced merge.	
I	TSRT	206	B MRGE FILE no. DUP (LOG/ALT) UNIT no. UNIT IGNORED	CTO OUT	Specified merge input file logical unit was previously assigned to another merge input file or was included in the list on master control card 1.	Edit phase ignores the unit assignment

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
I	TSRT	207	B ALT (IP/OP) UNIT CHANGED SAME AS PRIMARY	CTO OUT	Both primary and alternate input or output units in a polyphase merge cannot be work units.	In a balanced MERGE when input, output, and the library unit must be on the same side of the MERGE, it may be necessary to change an alternate unit.
I	TSRT	208	B ASSUMED END SORT CARD card	CTO OUT	A type 9 card is not END-SORT.	
I	TSRT	209	B DUP CD TYPE card	CTO OUT	Specified first card read will be accepted.	
I	TSRT	210	B RCC PARAMS IGNORED card	CTO OUT	When an unblocked file or record mark control is specified, it takes preference over record character count.	
I	TSRT	211	B SEQ TABLE - no. CHARS	CTO OUT	Less than 64 characters are contained on the SEQUENCE TABLE card and an S was specified in column 68.	
I	TSRT	212	B SURPLUS MERGE FILE card	CTO OUT	For a sort and merge, only 14 merge files are allowed. For a merge only, 15 MERGE files are allowed.	For a MERGE only, the surplus card is ignored. For a SORT and MERGE run, the job is deleted.
I	TSRT	213	B INTERNAL MERGE IP LOG UNITS no., no.,.....	CTO OUT	If a job was not deleted at the end of the EDIT phase, this message appears for sort only and sort and merge runs. Two or more unit no.'s may appear.	
I	TSRT	214	B INTERNAL MERGE OP LOG UNITS no., ...	CTO OUT	If a job was not deleted at the end of the EDIT phase, this message appears for sort only and sort and merge runs. One or more unit no.'s may appear.	
I	TSRT	216	B UNIT no. FINAL OUTPUT REEL no.	CTO OUT	Specified final output reel is complete.	
I	TSRT	217	B UNIT no. READ PARITY	CTO OUT	Sort is unable to read a record after five attempts. Sort will treat the record according to the parity error option on master control card 1.	

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
I	TSRT	218	B UNIT no. BUFFER LENGTH	CTO OUT	A buffer length error was encountered in reading a record. SORT will treat the record according to the buffer length error option on master control card 1.	
I	TSRT	219	B LABEL READ	CTO OUT		
I	TSRT	220	B LABEL EXPECTED	CTO OUT		
I	TSRT	221	B UNIT no. WRITE PARITY	CTO OUT	Sort cannot write a record after 5 attempts. An operator option message follows.	
I	TSRT	222	B no. IN	CTO OUT	This record count gives the number of logical records read by each pass.	
I	TSRT	223	B no. OUT	CTO OUT	The number of logical records written during the internal sort phase, the final merge pass and any intermediate merge pass of a balanced merge where the number of records read differs from the number of records written.	
I	TSRT	224	B no. ADDED	CTO OUT	Record count of the number of logical records inserted by a modification routine.	
I	TSRT	225	B no. DELETED	CTO OUT	Record count of the number of physical records deleted by a modification routine.	
I	TSRT	226	B no. DUMPED	CTO OUT	Record count of the number of logical records dumped.	
I	TSRT	227	B OUTPUT TAPES FULL. MOUNT LARGER SCRATCH TAPES ON O/P UNITS	CTO OUT	An end-of-tape reflective spot was reached during the internal sort phase on one output tape for a polyphase merge or M output tapes for a balanced merge. This is probably caused by short tapes.	The job will be deleted. An operator action message follows. The operator should put up larger scratch tapes before replying. If full tapes are already mounted, the SORT input is too large for the system.

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
I	TSRT	228	B no. INTERMEDIATE MERGE PASSES	CTO OUT	Number of intermediate merge passes required for this sort run is given.	
I	TSRT	229	B OUT OF SEQUENCE	CTO OUT	The merge phase requires all input records to be in sequence according to the sort key specified.	
I	TSRT	230	B RESTART IDENT lurc	CTO OUT	lu Logical unit number rc Restart code Printed after the RESTART.	Dump was taken.
I	TSRT	231	B NO RESTART DUMP	CTO OUT	A parity error was detected when writing the RESTART dump.	Program continues; there is no restarting capability until the next restart dump is written successfully.
I	TSRT	232	B no. SEQ	CTO OUT	Number of sequences created by internal sort phase.	
I	TSRT	233	B UNIT no. BLK	CTO OUT	Identifies the block dumped.	
I	TSRT	234	B UNIT no. LABEL ERROR.	CTO OUT	The label read from the unit mentioned is not equal to the label expected.	
I	TSRT	235	B MERGE PASS no.	CTO OUT	The number of merge passes currently being processed.	
I	TSRT	236	B FINAL MERGE	CTO OUT	Sort entered the final merge pass and is emitting the final output.	
I	TSRT	237	B { LOGICAL RECORD / BLOCK COUNT / RECORD COUNT } EXCEEDS MAX.	CTO OUT	Record count message	
I	TSRT	238	B RCD EXTENDS PAST END OF BLOCK	CTO OUT	The logical record, block, or variable record character count exceeds the maximum specified.	The record or block is written on OUT; processing continues.
I	TSRT	239	B IB no. OB no. G no.	CTO OUT	IB SORT input block size. OB Work tape block size G Tournament, in number of records	

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
I	TSRT	240	B EQUIPMENT DOWN JOB DELETED	CTO OUT	Equipment problems	Job terminates
I	TSRT	241	B MAY BE SAVED FOR RESTART	CTO OUT	Unit or units specified in restart dump; may be dismounted and saved if user wishes.	Either: 1. Dismount and save, or continue 2. Press MANUAL INTERRUPT 3. Type / 4. Press MANUAL INTERRUPT
A	TSRT	301	B UNIT no. EOT. T. F.	CTO OUT	An end-of-file was detected while reading a sort or a merge input file; the end of input option is operator control.	1. Press MANUAL INTERRUPT 2. Type /F if no more input If unit is needed by the MERGE phase, unload the tape. A message appears to mount a scratch tape. Type /T if more input reels on a multi-reel file A message is printed to mount the next input reel 3. Press MANUAL INTERRUPT
A	TSRT	302	B UNIT no. MOUNT NEXT INPUT REEL.	CTO OUT	Either: 1. The operator responded to the message TSRT 301 by typing the option, or 2. EOT trailer label was read on a sort or merge input file where the end of input option is standard trailer label control.	1. Mount next input reel 2. Press MANUAL INTERRUPT 3. Type / 4. Press MANUAL INTERRUPT
A	TSRT	303	B UNIT no. MOUNT SCRATCH	CTO OUT	The end of an input file was reached.	If the unit is needed by the MERGE phase: 1. Unload the tape. The program does not stop. 2. Mount scratch tape

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
A	TSRT	304	B UNIT no. MOUNT MERGE INPUT	CTO OUT	Sort is ready to start the final merge pass and requests presorted merge input files to be mounted. Tape is actually the file identification character from the input file control card.	1. Mount specified tape 2. Press MANUAL INTERRUPT 3. Type / 4. Press MANUAL INTERRUPT
A	TSRT	305	B UNIT no. MOUNT O/P TAPE REEL	CTO OUT	Sort began the final merge pass and is ready to write on the final output tape. Sort will loop until response is entered to permit the operator to mount an output reel	When the unit is ready: 1. Press MANUAL INTERRUPT 2. Type / 3. Press MANUAL INTERRUPT
I	TSRT	306	B (MOUNT SCRATCH).	CTO OUT	MOUNT SCRATCH appears if output is multireel. The tape will be rewound or unloaded according to the option in master control card 1. If an alternate output unit is specified, sort will alternate multireel output between the two units.	The program halts only if MOUNT SCRATCH is printed. 1. Remove the reel 2. Mount a scratch tape.
A	TSRT	307	B SORT CAPACITY REACHED A, G, F	CTO OUT	The maximum number of records that can be sorted is computed by Edit phase.	When the maximum number is reached in the internal phase: 1. Press MANUAL INTERRUPT 2. Type /A to delete job Type /G to ignore SORT capacity warning and continue reading the input file (This could result in an unending MERGE) Type /F to continue sorting records already read (assume that the end of input was reached) 3. Press MANUAL INTERRUPT

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
A	TSRT	309	B TO ACCEPT, RETRY, OR TERMINATE X,R,A	CTO OUT	An error was found when comparing a standard header (or trailer label read) with the label expected.	1. Press MANUAL INTERRUPT 2. Type /X to accept the label read /R to try reading label again /A to terminate job 3. Press MANUAL INTERRUPT
A	TSRT	310	B UNIT no. UNABLE TO WRITE (EOT/EOF) LABEL	CTO OUT	Sort cannot write an EOT or EOF trailer label.	1. Press MANUAL INTERRUPT 2. Type / 3. Press MANUAL INTERRUPT
A	TSRT	311	B UNIT no. BLOCK SEQUENCE	CTO OUT	Each internal sort file contains a block sequence number in each physical record. This message is printed when a block is read out of sequence.	To continue the SORT: 1. Press MANUAL INTERRUPT 2. Type / 3. Press MANUAL INTERRUPT
A	TSRT	312	B INTERPHASE RECORD COUNTS DO NOT AGREE. X,A	CTO OUT	Record counts are compared at the end of each phase. Interphase record counts are counted at the end of pass 1 of a balanced merge or at the end of the final merge pass for a polyphase merge.	1. Press MANUAL INTERRUPT 2. Type /X to continue the SORT /A to delete the job 3. Press MANUAL INTERRUPT
A	TSRT	315	B ENTER RESTART IDENT, lurc	CTO OUT	The restart program is ready to restart the sort. lu Logical unit number of tape containing dump rc Restart code or serial number indicating restart dump.	1. Press MANUAL INTERRUPT 2. Enter the restart ident (lurc) of the restart dump last written on typewriter 3. Press MANUAL INTERRUPT
A	TSRT	316	B INVALID-REENTER RESTART IDENT. lurc	CTO OUT	lu Logical unit number of tape containing dump rc Restart code or serial number indicating restart dump.	1. Press MANUAL INTERRUPT 2. Type 4 character restart ident (lurc) 3. Press MANUAL INTERRUPT

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
A	TSRT	317	B UNITS no., no., no., MAY BE SAVED FOR RESTART	CTO OUT		1. Remove the last set of intermediate MERGE input tapes for later use. 2. Label each with the unit from which it was removed 3. Note the last restart ident printed. 4. Replace each tape with a scratch reel. 5. Press MANUAL INTERRUPT 6. Type / 7. Press MANUAL INTERRUPT
A	TSRT	318	B MOUNT SCRATCH ON 63	CTO OUT	The library unit is being used by the sort during the merge phase	1. Remove the library tape 2. Mount a scratch tape 3. Press MANUAL INTERRUPT 4. Type / 5. Press MANUAL INTERRUPT
A	TSRT	319	B MOUNT LIBRARY ON 63	CTO OUT	The final merge pass was completed and the library tape must be remounted before sort can return to RTS.	1. Mount the library tape on 63 2. Press MANUAL INTERRUPT 3. Type / 4. Press MANUAL INTERRUPT
A	TSRT	320	B ABOVE ERRORS MAY BE IGNORED. X, A	CTO OUT	Appears if minor errors were detected during the EDIT phase.	1. Press MANUAL INTERRUPT 2. Type /X to continue /A to terminate 3. Press MANUAL INTERRUPT
A	TSRT	321	B TO RESTART SET JK6			1. Set SELECT JUMP 6. 2. Press MANUAL INTERRUPT 3. Type / 4. Press MANUAL INTERRUPT

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
A	TSRT	322	B WITHOUT PRINTER. X,A	CTO OUT	The printer is down.	1. Press MANUAL INTERRUPT 2. Type /X to continue SORT /A to terminate 3. Press MANUAL INTERRUPT
A	TSRT	323	B UNIT no. FOR ALT SORT IP.	CTO OUT	For a merge only run, tape mounting messages are printed after the merge phase is loaded.	If all units are READY and the SORT input file is mounted, 1. Press MANUAL INTERRUPT 2. Type / to continue 3. Press MANUAL INTERRUPT
A	TSRT	324	B RETRY ON ABANDON. R/A	CTO OUT	Appears after either: 1. Write parity irrecoverable error 2. Read parity error 3. Buffer length error It appears when option 5 was specified on master control card 01.	1. Press MANUAL INTERRUPT 2. Type /R to retry /A to abandon 3. Press MANUAL INTERRUPT
A	TSRT	325	B ABOVE ERRORS MAY BE IGNORED. /A.	CTO OUT	Minor errors were discovered by the Edit phase.	1. Press MANUAL INTERRUPT 2. Type / to continue the job /A to delete job 3. Press MANUAL INTERRUPT
A	TSRT	326	B TO ACCEPT, RETRY, TERMINATE, RESTART, OR BYPASS OR PRINT AND RETRY X,R,A,S,B	CTO OUT	Read parity error or buffer length error.	1. Press MANUAL INTERRUPT 2. Type / followed by one of these respond letters: X to accept R to retry A to terminate S to restart B to bypass P to print and retry 3. Press MANUAL INTERRUPT

TYPE	SOURCE	NO.	MESSAGE	UNIT	SIGNIFICANCE	RESULT/ACTION
A	TSRT	327	B TO ACCEPT OR TERMINATE. X,A	CTO OUT	Label error.	1. Press MANUAL INTERRUPT 2. Type /A to terminate /X to accept and continue 3. Press MANUAL INTERRUPT
A	TSRT	328	B RETRY, ABANDON, OR RESTART. R,A,S	CTO OUT	WRITE parity error.	1. Press MANUAL INTERRUPT 2. Type /A to abandon /R to retry /S to restart 3. Press MANUAL INTERRUPT
A	TSRT	330	B TO ACCEPT, RETRY, TERMINATE, OR RESTART. X,R,A,S	CTO OUT	READ parity error or buffer length error.	1. Press MANUAL INTERRUPT 2. Type /X to accept /R to retry /A to terminate /S to bypass 3. Press MANUAL INTERRUPT
A	TSRT	331	B DISMOUNT LIBRARY	CTO OUT	Restart has been loaded.	1. Remove library tape 2. Mount tape which was on at time restart was called.
A	TSRT	332	B MOUNT INPUT ON 63	OUT	LIBRARY will unload after loading phase 1. SORT is ready for input tape. Internal sort phase was loaded; library tape was unloaded. System is ready to begin sorting input.	1. Mount input tape on 63. 2. Press MANUAL INTERRUPT 3. Type / 4. Press MANUAL INTERRUPT

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COMMENT SHEET

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