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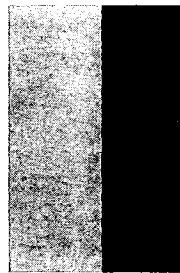
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**MAGNETIC
TAPE SORT**

PROGRAMMER
REFERENCE

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I. INTRODUCTION

1.1. GENERAL

This manual describes the tape sort program provided for use with UNIVAC 9200 II/9300/9300 II Systems Magnetic Tape Sort (sort program) and, in detail, the capabilities of the program.

For the most effective use of this manual, the reader should be familiar with the instruction repertoires of the UNIVAC 9200 II/9300/9300 II Systems. Review of the following UNIVAC 9200/9300 Systems manuals is recommended:

- UNIVAC 9200/9300 Systems Central Processor and Peripherals Programmer Reference, UP-7546 (current version)
- UNIVAC 9200/9200 II/9300/9300 II Systems Descriptions, UP-7806 (current version)
- UNIVAC 9200/9200 II/9300/9300 II Systems Card Assembler Programmer Reference, UP-4092 (current version)
- UNIVAC Systems Card Utility Programs Programmer Reference, UP-4120 (current version)
- UNIVAC 9200/9200 II/9300/9300 II Systems Card Utility Programs Programmer Reference, UP-4120 (current version)
- UNIVAC 9200 II/9300/9300 II Systems Magnetic Tape Input/Output Control System Programmer Reference, UP-4135 (current version)

Section 1 of this manual contains a summary of the structure and features of the sort program; Section 2 covers the general programming and hardware requirements; Section 3, the input stage; Section 4, the output stage; and Section 5, the procedures for using the sort program. Appendix A contains a summary of the operating procedures; Appendix B, a summary of statements and operands; Appendix C, examples of own code and cross referencing; Appendix D, programming examples; Appendix E, sort error displays; Appendix F, timing information.

1.2. SORT PROGRAM FEATURES

The UNIVAC 9200 II/9300/9300 II Systems sort program is designed to:

- provide a highly efficient and comprehensive sorting capability that can be applied to a wide range of data processing requirements; and to
- produce a sort program for which operating procedures are simple, straightforward, and not subject to exception.

1.2.1. Sort Program Structure

The sort program is in absolute loadable format. Parameters for the program are established by statement cards and own-code modules. Own-code modules are in relocatable format produced by the assembler. The card system sort program operates in conjunction with the the minimum operating system (MOS). It consists of three decks between which statement cards and own-code modules are inserted. If the input file is a deck of cards, it can be placed in the hopper of the card read unit immediately after the last sort deck.

The sort program is included in the systems tape of the nonconcurrent operating system (NCOS) or concurrent operating system (COS).

In the sort program, statement cards enter the program sort from the control stream, and own-code modules enter from the control stream or a library tape. The input data file may follow the sort parameters and own code in the control stream.

A sorting operation takes place in three stages — setup, input, and output.

During the setup stage the sort program performs the following functions:

- It reads and processes all statement cards and own-code modules. Blank cards in the statement deck are ignored.
- It adjusts itself according to the specifications on the statement cards.
- It relocates and incorporates own-code modules for later use during the input and output stages.
- It does the label checking and creation specified for the first and last work tapes.

During the input stage, the program sort performs all operations required to reach the end of the input file. Specified label checking is included. In a multicycle sort, all required ordered subfiles are produced.

During the output stage, the sort program performs all operations required to complete production of a sorted output file. This includes:

- specified label operations;
- final collation pass of the sort process in a single-cycle sort; and
- merges required to reduce the ordered subfiles produced in the input stage of a multicycle sort to one ordered output file.

1.2.2. Hardware Requirements

The user specifies, on a statement card, the number of magnetic tapes to be used. The user also may specify the amount of main storage to be used or may allow the sort program to allocate the amount of memory available at the time the sort is loaded.

Sorting is possible in a UNIVAC 9200 II/ 9300/9300 II Systems with a 12,288-byte memory and a minimum of three magnetic tape units, but if more memory and tape units are available, the sort program adjusts automatically to the expanded equipment configuration.

1.2.3. Work Tape Labels

The work tape for the program sort is not designed to be used as input to another program; however, the user may require that:

- certain security measures, such as checking the expiration date in the first file header label of a tape designated to become a work tape, must be performed;
- because the data currently recorded on a tape designated as a work tape is to be overwritten, the file header label indicating the presence of that data also must be overwritten;
- the file header label on a work tape, after its use, must be intelligible to subsequent label checking routines and must indicate the presence of sort work tape data.

Consequently, the sort program provides for execution of an output tape label check and a label creation routine for each work tape.

1.2.4. Input

The sort program enables the user to:

- provide own code to completely control delivery of input to the program;
- describe an input file in terms of statement cards similar to file description cards used in describing a tape input file to the magnetic tape input/output control system (IOCS); the sort completely controls the input from this file.

The sort program does the housekeeping involved in handling the file and delivers each input record, in turn, to own code for processing. In this case, the own code determines whether the record is to be delivered to the program and triggers the delivery of records from the input file by executing GET macro instructions and causes records to be written on the output file by executing PUT macro instructions.

1.2.5. Output

The sort program enables the user to:

- provide own code to completely control the disposition of records produced by the sort.
- describe an output file in terms of statement cards similar to the file description cards used in describing a tape output file to the IOCS. The sort program completely controls the output to this file.

The sort program performs the housekeeping involved in handling the file and delivers each sorted record, in turn, to own code for processing. In this case, the own code determines whether the record is to be written on the output file. Own code triggers the delivery of records from the program by executing GET macro instructions and causes records to be written on the output file by executing PUT macro instructions.

1.3. RECORDS

Records to be sorted may be any fixed number of bytes in length or they may be the standard variable-length record format.

1.3.1. Sequence

Key fields for sequencing records may be described to the program sort by the user. Alternatively, own code designed to do the comparisons necessary to determine record sequence may be supplied.

When key field description is chosen:

- As many key fields as desired may be described.
- Each key field may appear anywhere in the record.
- Each key field may contain alphanumeric, unpacked decimal, packed decimal, or signed binary data.
- Each key field may be tested for ascending or descending sequence.

1.3.2. Data Reduction

In some applications, records are sorted for tabulation. If the tabulation requires only subtotals and totals, the lowest level of subtotalling can take place while records are being sorted. Subtotalling occurs when the sort finds two records in sequence with identical values for all key fields. The appropriate fields of one of the records are combined with the corresponding fields of the other, and the former record is eliminated from further processing. Data volume is reduced, thereby reducing sorting time.

Data reduction is especially advantageous when it occurs early in the sort process. Early data reduction occurs when records with identical key field values tend to appear close together in the input data stream. Such batching occurs frequently.

For example:

- Source documents are batched for delivery to the data processing system.
- The input file is already sorted on a set of key fields. The more significant set of these key fields is also the more significant set of key fields for the current tape sort.
- The input file is sorted on a set of key fields the same as the set for the current tape sort; however, key fields are in a different order of significance in the two sets.

Because of the influence of input sequence on savings, it is difficult to estimate what gain can be realized by data reduction of a given input file but experience shows these savings are large in some cases.

If the user wishes to eliminate records with duplicate key field values, he specifies elimination on a statement card. The user supplies own code if he wants to process records with duplicate key field values.

1.3.3. Data Volume

The sort program functions properly with any volume of data including no data at all. The case of sorting no records may occur unexpectedly when user own code selectively deletes records from the input file.

Records are ordered by moving them from one work tape to another. If the quantity of data to be sorted exceeds the capacity of the work tapes currently mounted and available, a set of ordered subfiles is produced. Ordered subfiles are later merged to produce the sorted output file. The merging operation is an automatic feature of the sort program after all input data has been sorted down to the subfiles. To produce the subfiles, the tape program sort must enlist the operator's aid to:

- demount each intermediate output tape as soon as an ordered subfile is produced;
- mount a blank tape for the next ordered subfile; and
- remount ordered subfiles for merging at the end of the input stage.

By these means, the work tape storage accessible to the program sort is extended far beyond the number of tapes that can be mounted at one time.

Demounting and remounting of ordered subfiles is simple and systematic. Because the subfiles are written and read by the sort program, a thoroughly reliable checking procedure is incorporated to guarantee that subfiles are remounted in the correct sequence for merging.

The sort operation in which ordered subfiles are produced is known as the multicycle sort. The sort operation in which no ordered subfiles are produced is known as the single-cycle sort.

1.4. RESTART

Unpredictable interruptions in the sorting process, such as hardware failure or operator error, could make restarting the sort process necessary at the beginning. The time lost in restarting is undesirable when the quantity of data to be sorted is large.

For this reason, the sort program gives the operator the ability to restart the sort process at a recently completed point rather than at the beginning. Checkpoints are set up at the beginning of the production of each tape in an ordered subfile. The amount of data the program records on each tape in an ordered subfile may be specified by the user in a statement card; therefore, the user may determine the frequency of checkpoints.

Checkpoints at the beginning of production of each tape in an ordered subfile have another advantage. Assume that the unrecoverable error necessitating restart is the inability to read a tape in an ordered subfile during the merging operation. The restart provisions of the sort program enable the operator to restart the sort process at the point where the unreadable tape is to be produced, reproduce the tape, then restart the merging operation at the last checkpoint passed before the unreadable tape was detected.

Restart also may be necessary because a program of higher priority must be put on the processor before a sort process is completed. The operator can interrupt the sort process by making an unsolicited keyin, which causes the sort to rewind, with interlock, all tapes allocated to it. If these tapes are remounted after the emergency is over, the sort program can position the tapes at the point of interruption and resume the sort process as if the interruption had not occurred.

1.5. SEGMENTED SORTING

When large amounts of data are involved in a sort process, sorting can be scheduled in several disconnected segments of real time. For example, portions of a large volume of data to be sorted might become available at weekly intervals over a period of a month. Each of these portions can be sorted into an ordered subfile when the information is available. The ordered subfiles can then be merged at the end of the month. Segmented sorting enables the programmer to load and execute only the stage of the sort program that is desired.

1.6., STATEMENT CONVENTIONS

The conventions used to illustrate statements in the manual are as follows:

- Capital letters and punctuation marks (except braces, brackets, and ellipses) are information that must be coded exactly as shown.
- Lower case letters and terms represent information that must be supplied by the programmer.
- Information contained within braces represents necessary entries, one of which must be chosen.
- Information contained within brackets represents optional entries that (depending on program requirements) are included or omitted. Braces within brackets signify that one of the entries must be chosen if that operand is included.
- An ellipsis indicates the presence of a variable number of entries.
- In the coding of macros, commas are required after each parameter except after the last parameter specified. When a positional parameter is omitted from within a series of parameters, the comma must be retained to indicate the omission.

2. GENERAL PROGRAMMING AND HARDWARE REQUIREMENTS

2.1. PROGRAMMING REQUIREMENTS

Input to the UNIVAC 9200 II/9300/9300 II Magnetic Tape Sort (sort program) may be in the form of statement cards or own code. The majority of the statement cards and all of the own code are optional. A functional sort program can be implemented with as few as five statement cards and no own code.

2.1.1. Statement Cards

A statement card is formatted the same as a macro instruction except that a statement card never carries a label. Rules for entries in the operation field, the operand field (including positional and keyword parameters), the comments field, and continuation to the next card are identical to the entries for a macro instruction. Possible statement operation field entries are:

- TAPES
Specifies work tapes.
- IN
Describes the input file.
- ILB
Specifies the input file label.
- WLB
Specifies the work tape label.
- FIELD
Describes key fields.
- OUT
Describes the output file.
- OLB
Specifies the output file label.

- RSTRT

Specifies that restart of a sort process, rather than a start from beginning, is to be initiated.

- PART

Specifies that only a portion of the sort process is to be performed.

- SORT

A general statement describing various aspects of the sort program.

- END

Marks the end of the statement cards in the statement card deck. Unlike the other statement cards, an END statement card has no parameters.

Except for the TAPES, IN, FIELD, OUT, and END statements, all of the preceding statements are optional and are used only when the functions they perform is desired. In addition, the sort program setup stage enables submission of more than one SORT statement; thus, all of the SORT statement parameters do not need to be strung out in the operand field of a single SORT statement. They can be grouped in several SORT statements. One functional grouping would be to put all the SORT parameters not expected to change in one statement. The parameters expected to change would be grouped in as many SORT statements as required to elect the various options with a minimum of SORT statement substitution. For example, one SORT statement parameter specifies the amount of memory to be used by the sort program. The specification should be placed by itself in a SORT statement if the parameter is expected to vary.

2.1.2. Own Code

In many cases, a statement parameter is specified in terms of a label. The label specified can be externally defined in own code. Sometimes the specification of a parameter indicates that the sort program is to transfer control to the specified label to allow own code to perform a characteristic function. Such parameters occur in the IN, FIELD, SORT, and OUT statements. The names of these parameters and the own-code function associated with each follows:

- IN statement

LBAD	Specifies input file label check own code.
LBRC	Specifies special entrance to input label check own code to be used during multicycle sorting.
I PRO	Specifies input procedure own code to process input records.
ERRO	Input read error own code.
EOFA	Specifies end of input file own code.

- FIELD statement

RSOC	Specifies record sequence own code.
------	-------------------------------------

- SORT statement
 - LBAD Specifies work tape label handling own code.
 - DROC Specifies data reduction own code.
- OUT statement
 - LBAD Specifies output file label handling own code.
 - OPRO Specifies output procedure own code to process output records.
 - EOFA Specifies end of sorted data own code entered by the sort program when no more sorted records are to be delivered to the output procedure.

The sort program always transfers control to own code by way of a BAL (branch and link) specifying register 14 as the return register. The program does not preserve the own-code registers.

The sort program requires unique 4-character labels in any user own code.

Own code may consist of one or more independently assembled modules. These modules must be assembled, assigning 0 value to the operand of the START directive. Header cards must be supplied surrounding the modules to indicate to the sort program the phase during which the module is to be loaded into main storage. A module externally defining labels specified in the IN statement may be included only during the input phase. Similarly, own code pertaining to the OUT file may be included only during the output phase. All other own-code modules are common to the program and occupy main storage during the complete sort process.

Minimization of main storage space required by own code is conducive to tape sorting efficiency. This is particularly true of own code that occupies storage during the complete tape sort process; however, the user may include all own code in one module if he wishes to assemble all the own code at one time.

Own code may make external references to labels externally defined in the sort program. These labels are:

- ILBF
Specifies input file ID location.
- ILBC
Specifies input file creation date location.
- ILBG
Specifies file generation number location.
- ILBV
Specifies input file volume number location.
- IN
Specifies input filename.
- WLBF
Specifies work tape file ID location.

- WLBC
Specifies work tape creation date location.
- WLBG
Specifies work tape generation number location.
- WLBV
Specifies work tape volume number location.
- WLBX
Specifies work tape expiration date location.
- SORT
Specifies sort filename.
- DELE
Specifies record deletion routine for data reduction.
- OLBF
Specifies output file ID location.
- OLBC
Specifies output file creation date location.
- OLBG
Specifies output file generation number location.
- OLBV
Specifies output file volume number location.
- OLBX
Specifies output file expiration date location.
- OUT
Specifies output filename.
- RES
Specifies base location of a communication area common to the input and output procedures.

The input filename can be referenced only during the input stage, and the output filename can be referenced only during the output stage. All other externally defined labels are available for reference during the complete tape sort process.

An own-code module can be used to reference entries externally in another module only if:

- the reference is one requiring a 2-byte address substitution without an addend; and
- the reference is a 2-byte address plus an addend and the defining ENTRY is in a module preceding the EXTRN; that is, the element containing the ENTRY must be loaded prior to the element containing the EXTRN.

Examples are given in Appendix B.

Own code may use either indexed or direct addressing.

2.2. HARDWARE REQUIREMENTS

The hardware requirements for a tape sort operation are described in the following paragraphs. Specifications of work tapes, storage, and tape length requirements also are included.

2.2.1. Work Tapes

Sort work tapes are specified in a TAPES statement operand consisting of a number of positional parameters. Each positional parameter specifies the logical unit number of a work tape. At least three magnetic tape units must be so specified.

The sort program determines the physical characteristics of the work tape units by inspecting the appropriate physical unit table entries. If 7-track magnetic tape units are used as work tape units, the data conversion option must be incorporated in the tape control unit; however, if the input file is recorded in 7-track mode with no data conversion, the speed of the sort program is increased if the work tape units are described in the physical unit table of the supervisor program as not using the data conversion feature.

Combinations of 9- and 7-track tapes may be used in the input stage (or PART INPUT), but not in the merge (or PART OUTPUT). For variable records, 7-track tapes without the conversion option cannot be used. For fixed records, the record length given in the SORT statement must be a multiple of six if 7-track tapes are used.

The running time for a tape sort can be reduced by using the systems tape drive (logical unit 0) as a work tape drive by:

1. Entering the systems tape address (00, for example) in the TAPES statement card but not as the first or last of the parameters; that is, TAPES 01, 00, 02, 03.

NOTE:

Do not use CLRW=RWD as a keyword parameter. By not specifying this parameter, the output tape is rewound with interlock automatically at the end of the sort program.

2. Ensuring that the write enable ring is removed from the systems tape reel; if not removed, no distinct halt occurs to indicate this condition.
3. Replacing the systems tape with a work tape when the sort program stops with either a 60U2 or 60U1 halt display (Appendix E).
4. Pressing START switch on operator control panel.

Upon completing the run, the sort program attempts to read tape unit 0 in search of job control. Because the systems tape has been removed, the operator will not experience the normal termination of the sort; i.e., a job control loop (refer to UNIVAC 9200/9200 II/9300/9300 II Systems Operating System Programmer Reference, UP-7531 (current version) for possible stop conditions).

Rewinding of the output tape with interlock (LOCAL indicator lit) may be considered an indication that the tape sort is completed. When this indication appears, the process can be stopped and the systems tape can be remounted.

2.2.2. Main Storage Space

Main storage space available for running a main program is indicated in the boundary table at the time the sort program is loaded. The sort program uses this amount of memory unless instructed otherwise. If the user wishes to restrict the amount of storage to be used by the sort, he can do so by including, in a SORT statement, the keyword parameter:

STOR=n

where:

the highest numbered byte the sort program is to use is indicated in n. The amount of storage allocated in this fashion must be equal to or less than the amount listed in the boundary table of the supervisor program as available for main program use.

2.2.3. Tape Length

The sort program assumes that all tapes have a usable length of 2400 feet. Any other length can be specified to the sort by including in a SORT statement the keyword parameter:

TAPE=n

where:

n is the specified length of tape in feet.

3. SORT PROGRAM INPUT

3.1. LABEL INFORMATION

At execution time of a UNIVAC 9200 II/9300/9300 II Magnetic Tape Sort (sort program), the user may specify the values to be used to check the header label of the input file with an ILB statement. The ILB statement format is:

LABEL	OPERATION	OPERAND
	ILB	f,c,g,v

where:

- f Specifies the file identification.
- c Specifies the creation date.
- g Specifies the generation number.
- v Specifies the volume number.

The values specified are sorted in fields labeled ILBF, ILBC, ILBG, and ILBV, respectively. Field ILBF is eight bytes in length; field ILBC, five bytes; field ILBG, four bytes, and field ILBV, two bytes. The fields are found in main storage in the order listed, the dating constant ILBC preceded by a space. If an ILB statement is not presented to the sort program, ILBF will contain the value:

SORTFILE

and fields ILBC, ILBG, and ILBV will contain unsigned decimal 0's in unpacked format.

3.2. SORT CONTROL

When the sort program controls input, the input file is described in the operand field of the IN statement in the form of keyword parameters similar to those used in a DTFMT (define the file for magnetic tape) macro instruction to describe an input file to the magnetic tape IOCS. The keyword parameters are reviewed here, and the difference between the use of the parameter in the IN statement and the DTFMT macro instruction is noted.

BKSZ=n

Whether the record format of the input file is fixed, variable, or undefined, a maximum block size must be specified for the file.

CKPT=YES

The sort routine automatically bypasses the checkpoint dumps recorded on the input file.

CLRW=NORWD

The tape is not to be rewound after the input file is closed.

CLRW=RWD

This macro instruction is used for a rewind operation if additional tape drives are specified beyond the minimum three work tapes. The sort routine assumes that the tape on which the input file is recorded is to be rewound with interlock after the file is closed. If the tape is to be rewound without interlock after the file is closed, the keyword parameter, **CLRW=RWD**, must be included; however, if the logical tape unit number specified for the input file is the same as a logical tape unit number specified for a work tape or an output file, the keyword parameter, **CLRW=RWD**, cannot be used.

CRDT=symbol

If the user does not specify the creation date, the sort routine operates as if the specification were **CRDT=ILBC**.

DEVA=nn

The logical tape unit number specified for the input file may be the same as a logical tape unit number specified for a work tape or for the output file; however, the same logical tape unit number may not be specified for all three. If the logical tape unit number specified for the input file is the same as that specified for a work tape, it must be the logical unit number specified last in the **TAPES** statement.

ERRO=IGNORE

The sort routine processes the block containing the error as though no error has occurred.

ERRO=SKIP

The sort routine skips the block containing an error.

FLBL=NO

The input file is unlabeled.

FLBL=NSTD

The input file contains nonstandard labels.

FLID=label

If the user does not specify the location of the input file identification, the sort program operates as though the specification were **FLID=ILBF**.

GENO=label

If the user does not specify the location of the generation number, the sort program operates as though the specification were **GENO=ILBG**.

LBAD=label

This keyword parameter is used when nonstandard labels are to be checked on the input file. The user must define his own input area, and symbol is the symbolic label of the first byte of a user label routine to process nonstandard labels.

LBRC=label

The LBRC parameter is unique to the IN statement. The symbol specifies the symbolic label of a special entrance to the user routine for checking input labels used during multicycle sorting (5.3).

OPRW=NORWD

The tape is not to be rewound before the input file is opened. Normally, the tape on which the input file is recorded is rewound without interlock before the file is opened.

RCFM=VARBLK

The record format for the input file is variable in length and blocked.

RCFM=VARUNB

The record format for the input file is variable in length and unblocked.

RCFM=UNDEF

The record format for the input file is undefined.

RCSZ=n

If the record format for the input file is of fixed length and blocked, n is the number of bytes in the record. For an input file with an undefined record format, n is the number (8-13) of a general register containing the record size.

When 7-track tape units with data conversion are used, the RCSZ must be a multiple of six. File integrity can be maintained by adding a sort RCSZ=48 plus an OPRO to handle the larger RCSZ during output.

READ=BACK

The input file is to be read backward. A file written on a 7-track tape with data conversion can be read backward only if the size of each block written is a multiple of three bytes.

VOL=n

The VOL parameter is unique to the IN statement. If specified, the sort program reads n volumes of the input file, then takes end-of-file action on the nth volume; the trailer labels at the end of preceding volumes are ignored.

A VOL parameter must be specified if a multicycle tape sort operation is desired.

VOLN=symbol

If the user does not specify the location of the volume number, the sort program operates as though the specification were VOLN=ILBV.

3.3. OWN-CODE CONTROL

Parameters described in 3.2 do not appear in the IN statement if own code controls input. Instead, the single keyword parameter IPRO appears in the IN statement, and the specification of the parameter is the entry point to the input procedure.

The sort program transfers control to the input procedure entry point when it is ready to accept input data. The input procedure then assumes complete initiative in delivering records to the program.

Each record to be sorted is delivered by executing the imperative macro instruction:

1	LABEL	OPERATION	OPERAND
		10	16
		PUT	SORT, work area

The symbol SORT must be defined as an external reference in the input procedure. If the record to be delivered to the sort program is not in a fixed work area but is pointed to by register n, the record can be delivered with the sequence of instructions:

		STH	m, *+8
		PUT	SORT

The STH instruction stores the record address in the calling sequence generated by the PUT macro instruction.

After the last record to be sorted is delivered, the input procedure is terminated by the imperative macro instruction:

		CLOSE	SORT
--	--	-------	------

NOTE:

Do not use OPEN SORT for controlling IPRO because SORT has already been opened.

3.4. COMBINED CONTROL

If own code controls input to the sort program but delegates the task of input file control to the sort program, the IPRO parameter and the parameters described in 3.2 appear in the IN statement. In addition, the following requirements must be met:

- Either the keyword parameter

WORK=YES

or the keyword parameter

IORG=n

must appear in the IN statement. These parameters are used in the same way as in the DTFMT macro instruction.

- The keyword parameter

EOFA=label

must appear in the IN statement, where label is the label of the entry point in the input procedure to which the sort program is to transfer control when the end of the input file is reached.

The imperative macro instruction is:

1	LABEL	OPERATION	OPERAND
		10 16	
		OPEN	IN

This instruction is used in the input procedure to open the input file.

The symbol IN must be defined as an external reference in the input procedure.

The input procedure receives the next record from the input file by executing the imperative macro instruction:

	GET	IN, workarea
--	-----	--------------

The parameter workarea is optional.

Own code delivers records to the sort program as described in 3.3.

At the end of the input file, control is transferred to the label specified in the EOFA keyword parameter.

After an end-of-file return, the input file is closed by executing the macro instruction:

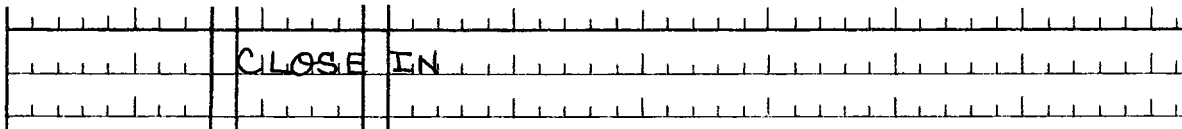
	CLOSE	IN
--	-------	----

The input procedure directs the sort program to perform the next step in the sort process by executing the macro instruction:

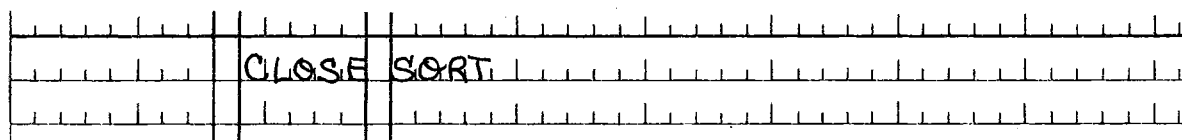
	CLOSE	SORT
--	-------	------

After this macro instruction is executed, control does not return to the input procedure for the remainder of the sort process.

The input procedure does not need to wait for an end-of-file return to perform the next step in the sort process. It can close the input file at any time by executing the macro instruction:



After closing, the input file the input procedure can, at any time, direct the sort program to perform the next step in the sort process by executing the macro instruction:



3.5. SORT RECORD SIZE

If input record size is specified in the IN statement and record size for the tape sort is the same as input record size, no further specification of sort record size is necessary. Otherwise, the SORT statement must include the keyword parameter:

RCSZ=n

where:

n is the number of bytes in the record if record format is of fixed length. If record format is of variable length, n is the number of bytes in the maximum record size.

In the case of variable-length records, maximum record size should include the 4-byte record length field. If the sort record size is variable and the keyword parameter RCSZ appears in a SORT statement, the statement also must include the keyword parameter:

RCFM=VAR

3.6. WORK TAPE LABELS

For each work tape specified in the TAPES statement, the tape sort program performs a standard output header label check and creation procedure. This procedure is automatic unless the tape sort is instructed by a keyword parameter to do otherwise.

The WLB statement is used if the user wishes to specify the values to be used in checking and creating the work tape header label. The WLB statement has the format:

LABEL	⊕ OPERATION ⊕	OPERAND
	WLB	f,c,g,v,x

where:

- f Specifies the file identification.
- c Specifies the creation date.
- g Specifies the generation number.
- v Specifies the volume number.
- x Specifies the expiration date.

The specified values are stored in fields labeled WLBF, WLBC, WLBG, WLBV, and WLBX, respectively. Field WLBF is eight bytes in length; field WLBC, five bytes; field WLBG, four bytes; field WLBV, two bytes; and WLBX, five bytes. The fields are found in main storage in the order listed; each of the dating constants WLBC and WLBX is preceded by a space. If a WLB statement is not presented to the sort program, field WLBF will contain the value:

SORTTAPE

and fields WLBC, WLBG, WLBV, and WLBX will contain unsigned decimal 0's in unpacked format.

If work tapes are to be subjected to a standard output header label check and creation procedure, the user may instruct the sort program where to locate the file ID, creation date, generation number, volume number, and expiration date for the procedure by including in a SORT statement the keyword parameters:

FLID=label

where:

label is the label of the first byte of the file identification. If the user does not specify FLID, the tape sort operates as if the specification were FLID=WLBF.

CRDT=label

where:

label is the label of the creation date. If CRDT is not specified, the sort program operates as if the specification were CRDT=WLBC.

GENO=label

where:

label is the label of the generation number. If GENO is not specified, the tape sort operates as if the specification were GENO=WLBG.

VOLN=label

where:

label is the label of the volume number. If VOLN is not specified, the tape sort operates as if the specification were VOLN=WLBV.

XPDT=label

where:

label is the label of the expiration date. If XPDT is not specified, the tape sort operates as if the specification were XPDT=WLBX.

The following keyword parameter should be included in a SORT statement if no label procedure is desired for work tapes:

FLBL=NO

If a nonstandard label procedure is desired for work tapes, the following keyword parameter should be included in a SORT statement:

LBAD=label

where:

label is the entry point to an own-code label procedure. The sort program enters the label procedure before writing on each work tape. Upon entry, register 8 contains the character 0 in the least significant byte; byte 29 under register 9 contains the logical tape unit number of the work tape for which the label procedure is entered. On exit from the label procedure, the program writes on the work tapes as it is left positioned by the label procedure. Note that an own-code label procedure can address the areas labeled WLBF, WLBC, WLBG, WLBV, and WL BX, and that a WLB statement can be used to place values in these locations for use by the own-code label procedure.

3.7. RECORD SEQUENCE

The sort program sequences records in a file based on one or more key fields in a record. A key field is described in a FIELD statement. Optionally, the programmer may supply own code to perform the sequencing operation.

3.7.1. FIELD Statements

The key fields are described in a series of FIELD statements. Each FIELD statement describes one key field and must appear in a statement deck in order of significance, major to minor. Each key field described by a FIELD statement must lie completely within the first 4096 bytes of the record.

The format of a FIELD statement is:

LABEL	⌘ OPERATION ⌘	OPERAND
	FIELD	p,n,f,s

where:

- p Specifies the number of the position in the record of the most significant byte of the key field. Bytes of the record are numbered, starting with 1, from low-order to high-order main storage. When numbering the bytes of variable-length records, the 4-byte record length field is considered to be part of the record.
- n Specifies the number of bytes in the key field.
- f Specifies the format code of the key field.

Field formats, codes, and associated maximum lengths in bytes are listed in Table 3-1.

Format	Code	Maximum Length
Character	CH	256
Binary	BI	256
Packed decimal	PD	16
Zoned decimal	ZD	16
Fixed-point integer	FI	256

Table 3-1. Field Statement, F Parameter Characteristics

If *f* is not specified, the sort program operates as if the specification were CH.

Where *s* is a code for the sequence in which a series of records (all of which contain the same values in all the more significant key fields) are to appear in the sorted output file. The code for an ascending sequence is an A; the code for a descending sequence is a D. If *s* is not specified, the tape sort program operates as though the specification were an A.

3.7.2. Own Code

The following keyword parameter must appear in a FIELD statement when the user is supplying own code to determine record sequence:

RSOC=label

where:

label is the entry point to this record sequence own code.

The sort program enters record sequence own code each time the program wishes to know which of two records is to appear first in the sorted output file. At the time of entry, register 11 points to one record, and register 12 to the other record. The records may not be stored on half-word boundaries; therefore, they may not be addressed by RX format instructions. In the case of variable-length records, the 4-byte record length field is considered a part of the record. When exiting from record sequence own code, the condition code must be set to low if the record addressed by register 11 is to precede the record addressed by register 12 in the sorted output file. The condition code should be set to high if the opposite is the case. If the sequence of the two records in the sorted output file is arbitrary, the condition code should be set to equal. Record sequence own code must not alter either the records or the contents of any registers.

3.8. DATA REDUCTION

During each data pass of the sort process, the writing of a record is postponed until the next record to be written has been selected. The sort program then determines whether data reduction procedures are to be taken with respect to the two records. Data reduction procedures are taken if the two records:

- have equal values in all key fields, or
- cause record sequence own code to return control with an equal condition code.

3.8.1. Elimination

If the user wishes data reduction procedures to be the arbitrary elimination without subtotalling of one of the two records, the following keyword parameter should appear in a SORT statement:

EQUL=DELE

3.8.2. Own Code

If the user wishes to supply data reduction procedures as own code, the following keyword parameter must appear in a SORT statement:

DROC=label

where:

label is the entry point to this data reduction own code. The sort program enters data reduction own code each time data reduction procedures are instituted.

At the time of entry, register 12 points to the record that is a candidate for elimination; register 11 points to the other record. The records may not be stored on half-word boundaries and must not be addressed by RX format instructions.

In the case of variable-length records, the 4-byte record length field is considered a part of the record.

When the two records are to be combined, data reduction own code effects this combination. The record length field of the record to be eliminated is then cleared to 0's. Instead of making a normal exit, control is transferred to the label DELE, which is defined as an externally referenced symbol in the data reduction own-code module. At DELE, the sort program eliminates 0-length record.

If data reduction own code determines that neither record is to be eliminated, the data reduction own code makes a normal exit. In any case, data reduction own code must not alter the contents of the key fields of any record that is to be retained; no alteration is to be made to the contents of any registers.

4. SORT PROGRAM OUTPUT

4.1. LABEL INFORMATION

The OLB statement must be used if it is desired to specify the values to be used in processing the header label of an output file at execution time of a UNIVAC 9200 II/9300/9300 II Magnetic Tape Sort (sort program). The format of the statement is:

LABEL	OPERATION	OPERAND
	OLB	f,c,g,v,x

where:

- f Specifies the file identification.
- c Specifies the creation date.
- g Specifies the generation number.
- v Specifies the volume number.
- x Specifies the expiration date.

The specified values are stored in fields labeled OLB_F, OLB_C, OLB_G, OLB_V, and OLB_X, respectively. Field OLB_F is eight bytes in length; field OLB_C, five bytes; field OLB_G, four bytes; field OLB_V, two bytes; and field OLB_X, five bytes. The fields are found in main storage in the order listed; each of the dating constants OLB_C and OLB_X is preceded by a space. If an OLB statement is not presented to the sort program, the field OLB_F contains the value:

SORTFILE

and fields OLB_C, OLB_G, OLB_V, and OLB_X will contain unsigned decimal 0's in unpacked format.

4.2. SORT CONTROL

If the sort program completely controls output, the output file is described in the operand field of the OUT statement in the form of keyword parameters. These parameters are similar to those used in a DTFMT (define the file for magnetic tape) macro instruction to describe an output file to the magnetic tape IOCS (input/output control system). The keyword parameters are defined here, and the differences between the use of parameters in the OUT statement and the DTFMT macro instruction are noted.

BKSZ=n

Whether the record format of the output file is fixed, variable, or undefined, a maximum block size must be specified for the file.

CKPT=YES

This keyword parameter is unique to the OUT statement. If it is included, and if the logical tape unit number specified for the output file is the same as that specified for a work tape, the sort program establishes a restart point at the beginning of each volume of the output file during a multicycle sort. The sort program records checkpoint information on each output file tape to establish this restart point.

CLRW=NORWD

The tape is not to be rewound after the output file is closed.

CLRW=RWD

The sort program assumes that the tape on which the file is recorded is to be rewound with interlock after the file is closed. If the tape is to be rewound without interlock after the file is closed, the keyword parameter, CLRW=RWD, must be included.

CRDT=label

If the user does not specify the location of the creation date, the sort program operates as if the specification were CRDT=OLBC.

DEVA=nn

The logical tape unit number specified for the output file may be the same as a logical tape unit number specified for a work tape or for the input file; however, the same logical tape unit number may not be specified for all three. If the logical tape number specified for the output file is the same as that specified for a work tape, it must be the logical unit number specified first in the TAPES statement.

FLBL=NO

The output file is unlabeled.

FLBL=NSTD

The output file contains nonstandard labels.

FLID=label

If the user does not specify the location of the output file identification, the sort program operates as though the specification were FLID=OLBF.

GENO=label

If the user does not specify the location of the generation number, the sort program operates as though the specification were GENO=OLBG.

LBAD=label

This keyword parameter is used when nonstandard labels are to be written on the output file. The user must define his own output area in which to build nonstandard labels for an output file, and label is the symbolic label of the first byte of a user routine designed to write the nonstandard labels.

OPRW=NORWD

The tape is not to be rewound before the output file is opened. Normally, the tape on which the output file is recorded is rewound without interlock before the file is opened.

RCFM=VARBLK

The record format for the output file is variable in length and blocked.

RCFM=VARUNB

The record format for the output file is variable in length and unblocked.

RCFM=UNDEF

The record format for the output file is undefined.

RCSZ=n

If the record format for the output file is fixed in length and blocked, n is the number of bytes in the record. For an output file with an undefined record format, n is the number (8-13) of a general register containing the record size.

TPMK=NO

This keyword parameter is used when a tape mark is not to be written following nonstandard header labels, at the beginning of an unlabeled file, or at the beginning of successive tapes in a multivolume unlabeled file. Otherwise tape marks are written automatically.

VOLN=label

If the user does not specify the location of the volume number, the sort program operates as though the specification were VOLN=OLBV.

XPDT=label

If the user does not specify the location of the expiration date, the sort program operates as though the specification were XPDT=OLBX.

When input label information is supplied by an ILB statement, the labels ILBF, ILBC, ILBG, and ILBV can be used to relate output label information to input label information. For example, if the output file is to have the same file identification as the input file, this is specified by including in the OUT statement the keyword parameter FLID=ILBF.

4.3. OWN-CODE CONTROL

If own code controls output from the sort program, none of the parameters described in 4.2 appear in the OUT statement. Instead, the following two keyword parameters appear in the OUT statement:

OPRO=label

where:

label is an entry point in the output procedure to which the sort program transfers control when it is ready to start delivering sorted records to the output procedure.

EOFA=label

where:

label is an entry point in the output procedure to which the sort program transfers control when there are no more sorted records to be delivered to the output procedure.

After the sort program transfers control to the OPRO label, the output procedure assumes complete initiative for the processing of sorted records. The output procedure obtains each sorted record by executing the imperative macro instruction:

1 LABEL	5 OPERATION 10	16 OPERAND	5
	GET	SORT, workarea	

The symbol SORT must be defined as an external reference in the output procedure. If the sorted record to be obtained from the sort program is fixed in length (not RCFM=VARBLK or VARUNB), it may be delivered to an area designated by register n by executing the instructions:

	STH	n, *t8	
	GET	SORT	

The STH instruction stores the record area address in the calling sequence generated by the GET macro instruction.

In response to the execution of a GET macro instruction, the sort program branches to the EOFA label when it determines that the sort operation is completed. The output procedure is terminated by executing the imperative macro instruction:

	CLOSE	SORT	
--	-------	------	--

4.4. COMBINED CONTROL

If own code controls output from the sort program but delegates the task of output file control, the parameters described in 4.2 and 4.3 appear in the OUT statement. In addition, either keyword parameter WORK=YES or the keyword parameter IORG=n must appear in the OUT statement, where they are used in the same way as in the DTFMT macro instruction.

If the record format of the output file is variable in length and blocked, the keyword parameter WORK=YES must be specified. If the record format of the output file is variable in length and unblocked, the keyword parameter IORG=n also is permissible.

The output procedure opens the output file by executing the following imperative macro instruction:

1	LABEL	OPERATION	OPERAND
		10 16	
		OPEN	OUT

The symbol OUT must be defined as an external reference in the output procedure.

The output procedure delivers the next record to the output file by executing the imperative macro instruction:

		CILOSE	OUT
--	--	--------	-----

The parameter workarea is optional.

Own code acquires records from the sort program as described in 4.3.

The output procedure closes the output file by executing the imperative macro instruction:

		PUT	OUT, workarea
--	--	-----	---------------

4.5. I/O PROCEDURE COMMUNICATION

If the input procedure has information to communicate to the output procedure and the two do not share memory, then the following keyword parameter should be included in a SORT statement:

RES=n

where:

n is the number of bytes of information to be communicated.

In response to this parameter, the sort program sets up an n byte area the first byte of which can be addressed by the externally defined label RES. Thus, the input procedure can put into the RES area information it wants to communicate to the output procedure. In such an instance, both the input procedure and the output procedure must declare the label RES as being externally referenced.

5. SINGLE AND MULTICYCLE SORTING

5.1. GENERAL

A UNIVAC 9200 II/9300/9300 II Magnetic Tape Sort (sort program) can be performed either in a single-cycle or a multicycle operation. The choice between single-cycle and multicycle operation depends upon the number of volumes of input data to be processed. If the input data exceeds one volume (reel), the sort will most likely require multicycle operation to process all the data. If the input data is a single volume, the sort will be able to process the data in a single-cycle (batch).

The sort program determines the tape capacity for each set of parameters given it. The variables affecting this computation are tape length, density, mode, and block size. The effects of the tape length and the density and mode are obvious. The effect of the sort block size is an inverse relationship so that the smaller the data block the greater the number of blocks and consequently the greater number of interblock gaps, which take tape space but contain no data. Therefore, if all the input data is accepted before the tape capacity is reached, the sort passes the data from the collation phase to the output routine, resulting in a single-cycle sort.

5.2. SETUP STAGE

During the setup stage the sort program performs the label checking and creation specified for the first and last work tapes, reads and processes all statement cards and own-code modules, and performs validity tests on the cards and modules. When a validity test fails, the appropriate message is displayed. If the error is detected during processing of statement cards, it is often possible for the sort program to continue validity testing by skipping the invalid parameter or statement. Checking for valid combinations of statements and parameters leads to a display requiring cancellation of the job in the setup stage.

5.3. SINGLE-CYCLE SORTING

A single-cycle tape sort is one that proceeds from the first operation to the last with all the data to be sorted contained within a batch. The size of a batch is that volume of data which can be contained on one sort work tape. The single-cycle sort computes the batch size and displays the end-batch signal (03FE) if the input data exceeds the batch size (A.5). The response to the end-batch display for a single-cycle is either to sort and output the batch as it is (the quantity accumulated) or to continue to accept input data until the end of file is detected. If the latter choice is made, the sort aborts if the data exceeds the tape capacity anywhere in the collation phase. When this happens, the user must re-initiate the sort program and call upon the multicycle operation.

5.3.1. Input Stage

During the input stage the sort program performs all operations required to reach the end of the input file. This includes specified label checking and handling of end-of-volume conditions. An additional operation is performed during the input stage if the logical unit number specified for the input file is also specified for a work tape or for the output file. Initially, all tape units must be provided with blank tapes to be used throughout the sort operation. When the tapes are examined and prepared, the last stated tape unit is compared with the tape unit given in the IN statement. If the tape unit is to handle the input file, the work tape is rewound with interlock and a MOUNT-INPUT is displayed. The operator then removes the work tape and mounts the input tape. When the START switch is pressed, the sort program begins accepting input records.

When the end of the input file is detected, the operation is dependent upon the further use of the input tape unit and upon the inclusion of the keyword parameter CLRW=NORWD in the IN statement. These operations are illustrated in Figure 5-1 and Figure 5-2.

CLRW=NORWD	Input File Same As	
	Work-Tape Unit	Output-File Unit
Absent	1a	1b
Present	1a	2

KEY

EXPLANATION

- 1a When the end of the input file is detected, the last volume is rewound with interlock and a MOUNT-LIBRARY is displayed. The operator dismounts the input file and remounts the work tape removed prior to mounting the input file. Pressing the START switch causes the work tape to be verified and positioned.
- 1b When the end of the input file is detected, the last volume is rewound with interlock. The operator demounts the input file and mounts a blank to be used during the output stage.
- 2 The remainder of the tape below the last volume of the input file is used by the sort program as a tape on which to record the output file if OPRW=NORWD in the OUT statement. If OPRW=NORWD is not in the OUT statement, the input tape is rewound, and the output file is recorded at the beginning of the tape, destroying the information there.

Operation 2 produces a faster tape sort than operation 1a; however, the sort program characteristically assumes that it has full tapes to use as work tapes. Consequently, it is possible that with operation 2 the sort program may decide that it cannot successfully conclude the process, in which case CANCL is displayed.

After all the data has been read from the input file, it is collated and the sort program enters the output state automatically.

A flow chart of the input stage of a single-cycle sort is illustrated in Figure 5-1.

5.3.2. Output Stage

During the output stage, the sort program performs any specified output file label operations and performs the final collation pass of the process to produce the output file. In both the card- and tape-oriented systems the sort program indicates completion of the process by executing an EOJ macro instruction.

5.4. MULTICYCLE SORTING

A multicycle sort operation permits completion of a tape sort that could not be executed successfully in a single-cycle operation. Multicycle sorting is requested by including the VOL parameter in the IN statement. This parameter indicates the number of volumes of the input file to be sorted and implies the production of more than one output volume.

A user with more than one volume of input who wishes to save on main storage allocation by using the single-cycle sort cannot use the VOL parameter to do so. He can, instead, provide an input procedure (IPRO) that determines the action to be performed on detecting end of file (EOFA). After closing the input file, a new volume can be mounted and the input file can be reopened.

The use of a PART statement also implies multicycle sorting and causes its selection and loading whether or not a VOL parameter is included in the IN statement.

5.4.1. Input Stage

The sort program counts data records accepted during the input stage. When the count reaches the calculated limit of data that can be written on a tape sort work tape as an ordered subfield, the sort program displays a CHOOSE message. For multicycle sorting, the normal response is to press START to continue. For single-cycle sorting, however, all the input data should be delivered to the sort program. By making a keyin response, then pressing the START switch, the operator can instruct the sort program to ignore the fact that the input record count has reached the cycle limit (5.5.2.1). The sort program continues to accept data until the end-of-file sentinel is detected and may go through to successful completion. However, the sort program also may be unable to complete the sort process in a single-cycle mode successfully. In this case, a tape runoff could occur, indicated by a tape dispatcher error message.

In multicycle sorting, the operator may decide to reply to the CHOOSE display if, at that point, the input file is nearly exhausted so that the remaining data can still be included in the subfile.

The steps in a cycle of multicycle sorting vary depending on whether the logical tape unit specified for the input file is the same as a logical unit number specified for a work tape.

5.4.2. Input File and Separate Work Tape

A multicycle tape sort operating with an input file and a separate work tape is described in the following paragraphs. (See Figure 5-2.)

5.4.2.1. FIRST AND INTERMEDIATE CYCLES

When the operator presses the START switch after seeing the CHOOSE display, the sort program collates the data read from the input file until all the data is written on a single work tape, which constitutes an ordered subfile. (If the logical tape unit number specified for the output file is the same as a logical unit number specified for a work tape, the ordered subfile is produced on the work tape.)

After the ordered subfile is written, it is rewound with interlock and a SUBFILE is displayed. The SUBFILE display includes the number of the ordered subfile just rewound with interlock; pressing the START switch displays the volume number, which is 0 in the input stage. The first subfile produced is numbered 1, the second subfile is numbered 2, the third is numbered 3, and so on. After the SUBFILE-VOLUME displays, the operator dismounts the ordered subfile and physically labels it with its subfile number. He then mounts a blank tape in place of the dismounted ordered subfile and presses the START switch. Any label checking and creation date specified for work tapes is done with respect to the blank tape. The sort program then accepts input records until the input record count once more reaches the cycle limit, at which point control is returned to the cycle point.

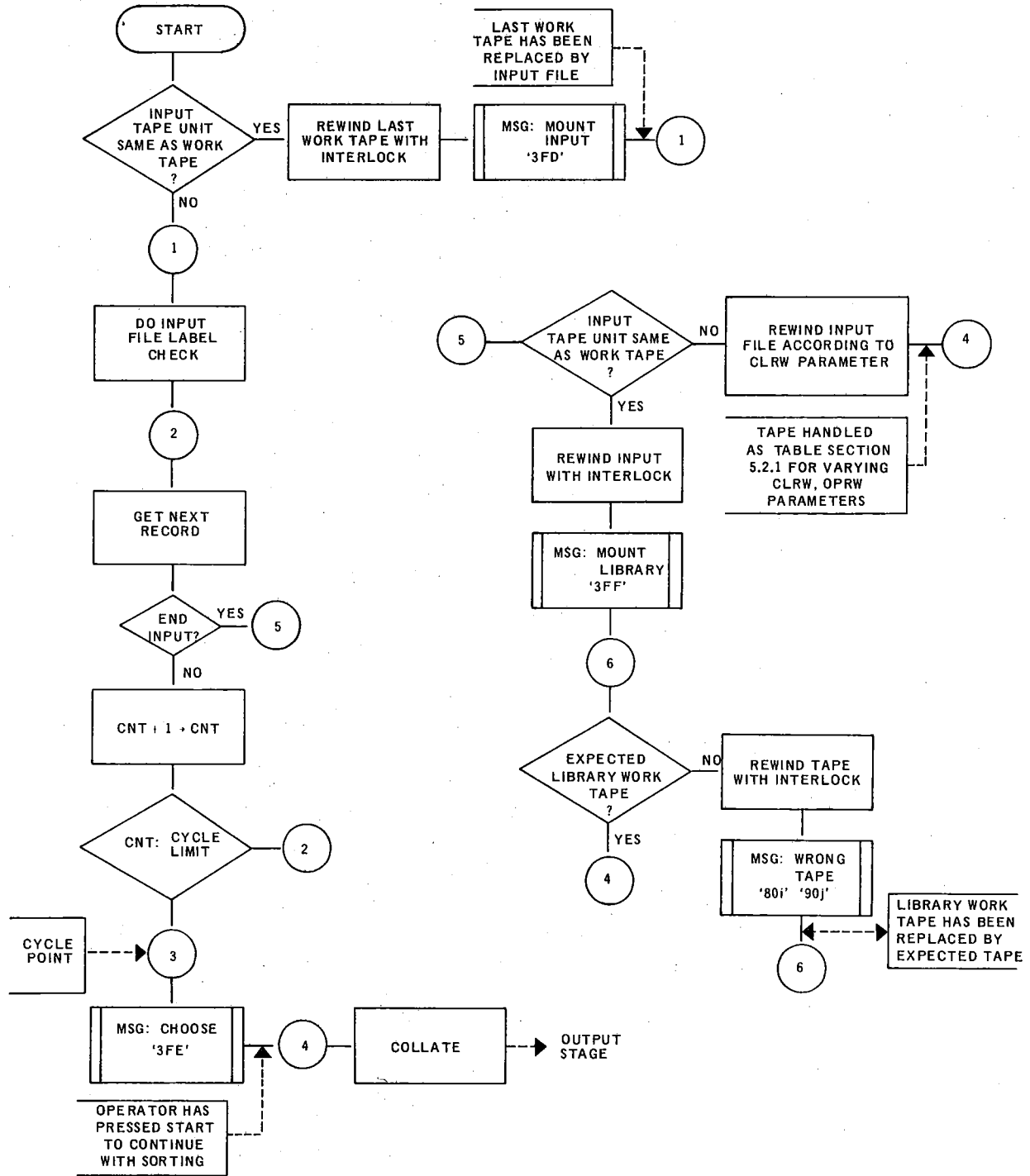
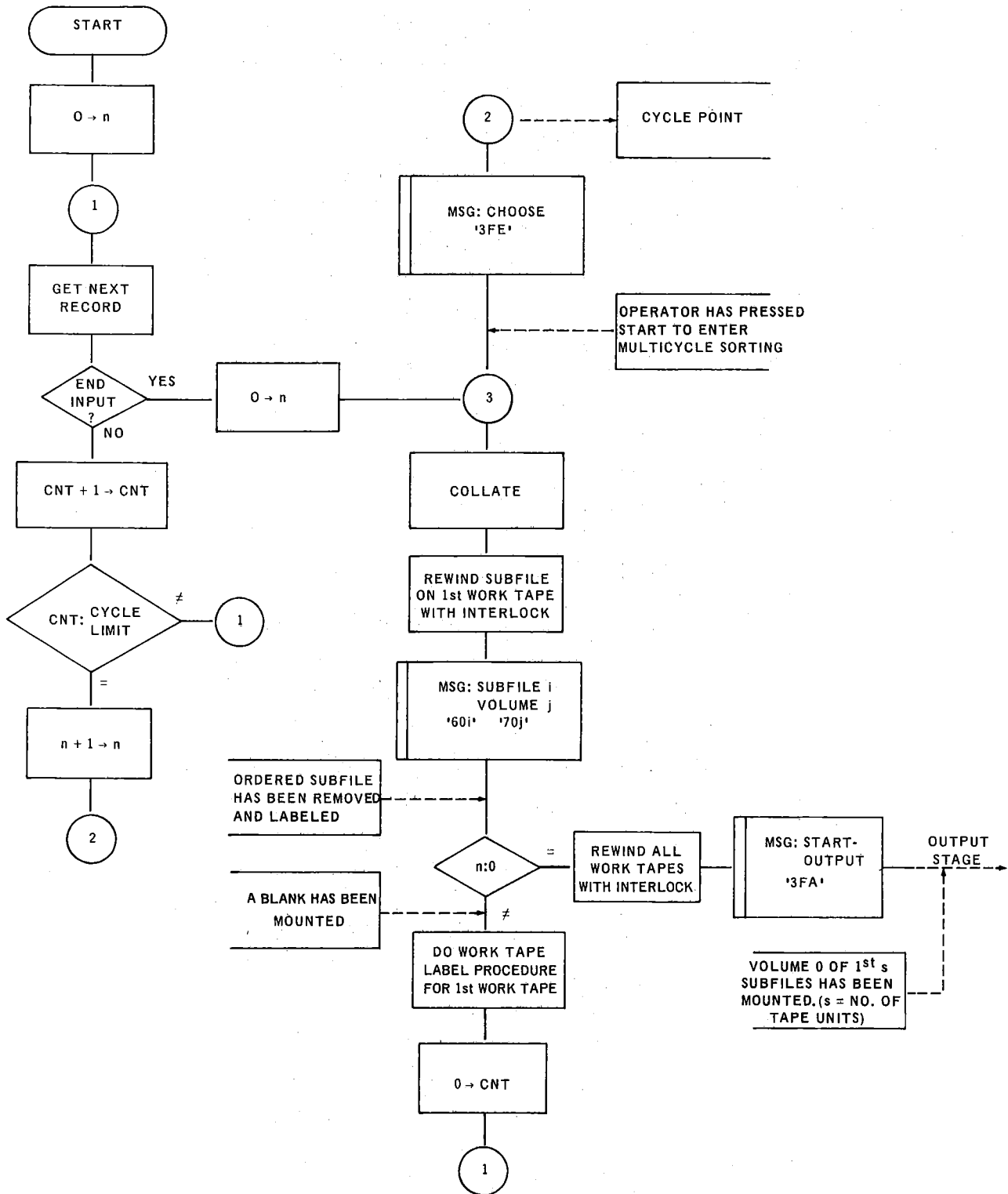


Figure 5-1. Single-Cycle Tape Sort Input Stage



NOTE:

n = i = SUBFILE number
j = VOLUME number

Figure 5-2. Separate Input and Work Tape File with Multicycle Tape Sort

5.4.2.2. LAST CYCLE

When the end of the input file is detected before the input record count reaches the cycle limit, the sort program produces the last ordered subfile from the data read. The SUBFILE display for the last ordered subfile indicates that the ordered subfile number is 0. When the operator presses the START switch after the SUBFILE-VOLUME displays, all work tapes are rewound with interlock and a START-OUTPUT is displayed. When the START switch is pressed, the sort program enters the output stage.

5.4.3. Input File Same as Work Tape

During the setup stage, the tape unit, which the input file shares with the work tape, is initially provided with a blank tape on which a tape sort library is to be created. At completion of the setup stage, the library work tape is rewound and a MOUNT-INPUT display indicates that the input tape is to be mounted. The operator presses the START switch to begin the input stage.

5.4.3.1. FIRST AND INTERMEDIATE CYCLES

After the cycle point CHOOSE display, the sort program rewinds the current volume of the input file with interlock and displays a MOUNT-LIBRARY. The operator replaces the current volume of the input file with the previous library work tape. If a tape other than the expected library work tape is mounted, the tape is rewound with interlock and a WRONG-TAPE is displayed. (The subfile and volume numbers are not significant.) The operator must then replace the rewound tape with the expected tape and press the START switch. The label is checked again and, if valid, the collation overlay is loaded from this tape. The sort program then proceeds to produce the next ordered subfile.

When the subfile is completed, the SUBFILE display indicates its number; pressing the START switch displays the VOLUME number. The ordered subfile volume is removed, labeled, and replaced with a blank tape by the operator. The operator then presses the START switch and the work tape sharing a tape unit with the input file is rewound with interlock. The MOUNT-INPUT display indicates that the library work tape is to be replaced by the current volume of the input file. Pressing the START switch causes the input file label to be rechecked and the tape to be positioned at the last cycle point. The sort program then begins dispersion of data for the current cycle of the input stage.

5.4.3.2. LAST CYCLE

At the end of the input file no special display is made. The end of the input stage is indicated by the production of subfile 0, followed by the START-OUTPUT display.

5.4.3.3. INPUT LABEL CHECKING

Each time the current volume of the input file is replaced with the work tape on their common tape unit, the label of the current volume is checked before it is repositioned. With one exception, the label check processing is the same as that performed when a new volume of the input file is opened. An input label check characteristically involves two steps:

1. The anticipated value of the volume file header label is calculated on the basis of the value of the preceding volume file header label. For example, in the standard input label check routine, this calculation takes the form of increasing the volume number by 1.
2. The volume file header label is inspected to determine that its value agrees with the anticipated value.

Step two is usually programmed to be repeatable so that when a tape fails a label check and is replaced by another tape the label check can be made with respect to the newly mounted tape. In summary, a check of an input volume file header consists of step one followed by step two. A recheck of an input volume file header consists of step two alone.

Using the preceding terms, label checking of the remounted input file volume is a recheck rather than a check.

Checking and rechecking are automatic functions of the standard input label check routine. If an own-code input label check routine is provided, the sort program transfers control to the LBAD label for a check and to the LBRC label for a recheck. If the LBRC label is not specified, control is transferred to the LBAD label for both a check and a recheck.

A flowchart of the input stage of a multicycle tape sort in which the input file and a work tape share a tape unit is illustrated in Figure 5-3.

5.4.4. Output Stage

During the output stage, the operator remounts the ordered subfiles produced by the sort program. In all other respects, the output stage of a multicycle sort is the same as the output stage of a single-cycle tape sort.

The ordered subfiles are mounted in order by subfile number on the tape units in the order in which the logical tape unit numbers are listed in the TAPES statement.

The output stage consists of merging ordered subfiles to produce the output file. If the number of subfiles is less than the number of work tapes, the process is completed with one merge. In all other cases, more than one merge is necessary.

During a multimerge output stage, the output file is produced during the final merge. Each other merge produces an ordered subfile, which must be demounted then remounted as input to a subsequent merge.

The numbering of subfiles during the output stage is carried over from the input stage. Thus, if the highest subfile number assigned to a subfile by the input stage is n , the first subfile produced by the output stage is numbered $n+1$, the second subfile is numbered $n+2$, the third is numbered $n+3$, and so on.

Subfiles produced during the input stage are one volume long; those produced during the output stage may be more than one volume long. Consequently, during the output stage the VOLUME display following a SUBFILE display is incremented to show the volume number of the tape in its subfile. The output stage produces ordered subfiles on the same work tape as the input stage.

The sort program indicates when a volume of an input ordered subfile is to be demounted and replaced by rewinding the volume with interlock. Inasmuch as the order in which input subfile volumes are to be mounted and the logical tape units on which the volumes are to be mounted are known, the sort program knows at all times what volume should be on a tape unit. Each time an input-ordered subfile volume is mounted, the tape sort examines the tape to verify that it is the right volume. Because the sort program produces all volumes of all subfiles, this verification is completely under tape sort control and is independent of the work tape labeling procedure specified by the user. If the tape does not pass verification, it is rewound with interlock, and a WRONG-TAPE is displayed. The WRONG-TAPE display also indicates subfile and volume numbers of the proper volume. The operator should then mount the indicated volume and press the START switch. The sort program then examines the newly mounted tape to verify that it is the expected volume.

To optimize output stage efficiency, the first merge might not use all available work tape areas. This does not affect tape mounting procedure. Once mounted, an input-ordered subfile volume should remain mounted until rewound with interlock.

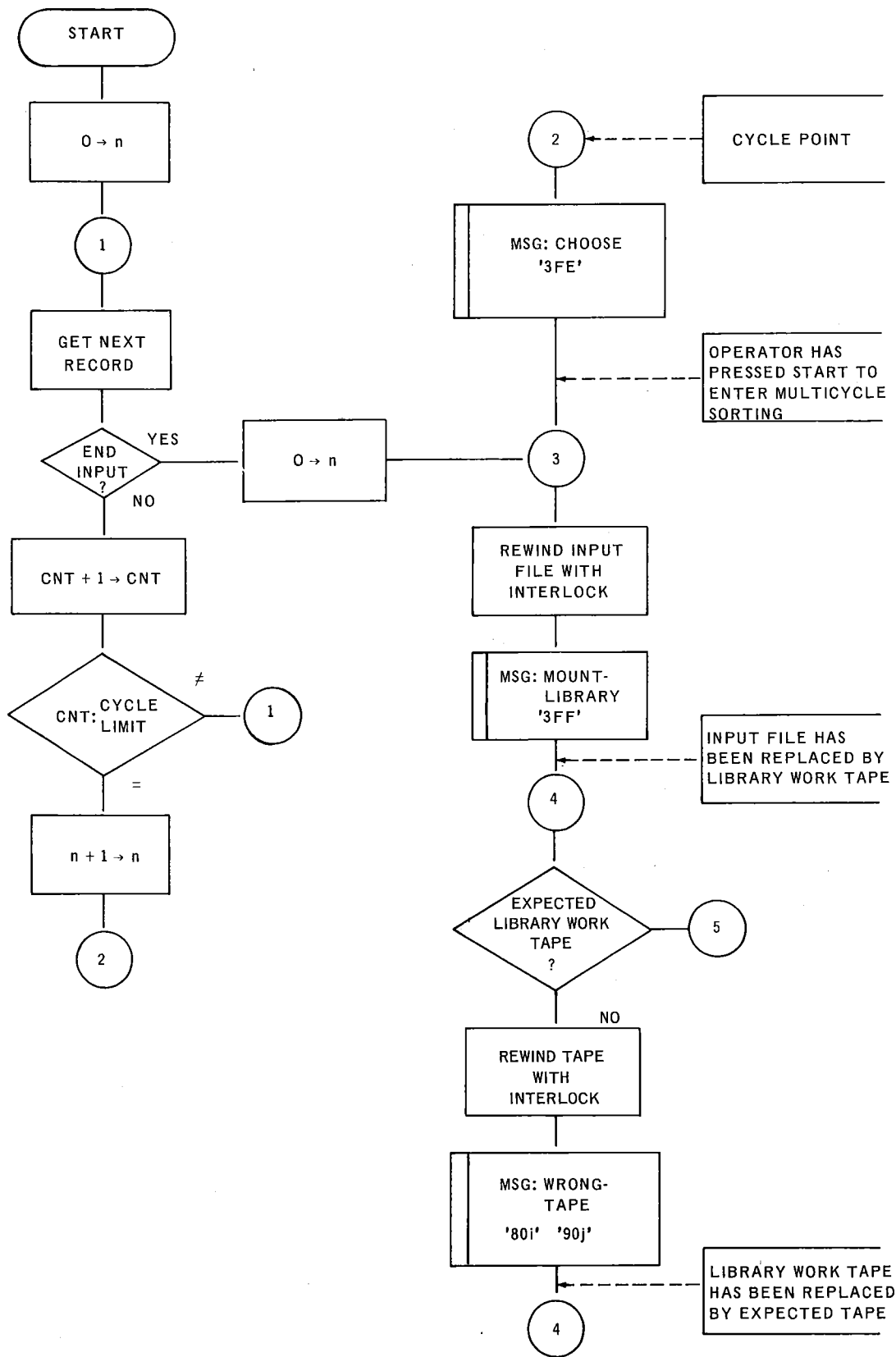
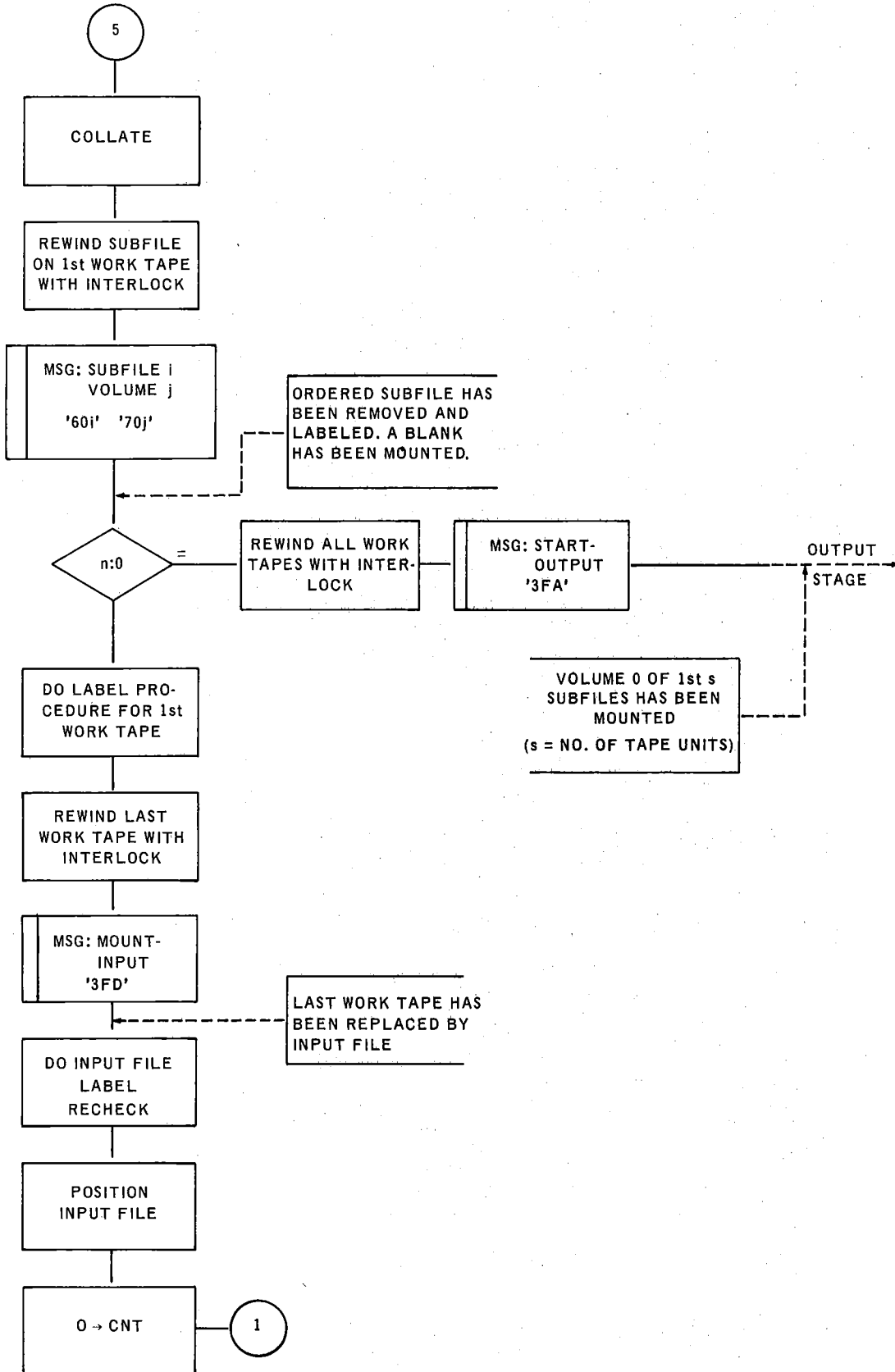


Figure 5-3. Common Input and Work Tape File with Multicycle Tape Sort (Part 1 of 2)



NOTE:

n = i = SUBFILE number
j = VOLUME number

Figure 5-3. Common Input and Work Tape File with Multicycle Tape Sort (Part 2 of 2)

The following is an example of a multimerge output stage:

The sort program has been allocated four work tapes by the following TAPES statement.

LABEL	OPERATION	OPERAND
1	TAPES	01,02,03,04

The logical tape unit number one also has been allocated to the output file by inclusion of the following keyword parameter specification in the OUT statement:

DEVA=01

The input stage produces six ordered subfiles, which are numbered 0 through 5.

In this example, the output stage consists of three merges (Figure 5-4). The operator mounts ordered subfiles 0, 1, and 2 on tape units 2, 3, and 4. The first merge reads subfiles 0 and 1 and produces subfile 6, which is two volumes long. The operator replaces subfiles 0 and 1 with subfiles 3 and 4. The second merge reads subfiles 2, 3, and 4 and produces subfile 7, which is 3 volumes long. The operator then mounts subfile 5 and volume 1 of subfiles 6 and 7. The final merge then begins. During the remainder of the output stage, volume 1 of subfile 6 rewinds with interlock and should be replaced by volume 2; volume 1 of subfile 7 rewinds with interlock to be replaced by volume 2; subsequently, volume 2 rewinds with interlock to be replaced by volume 3.

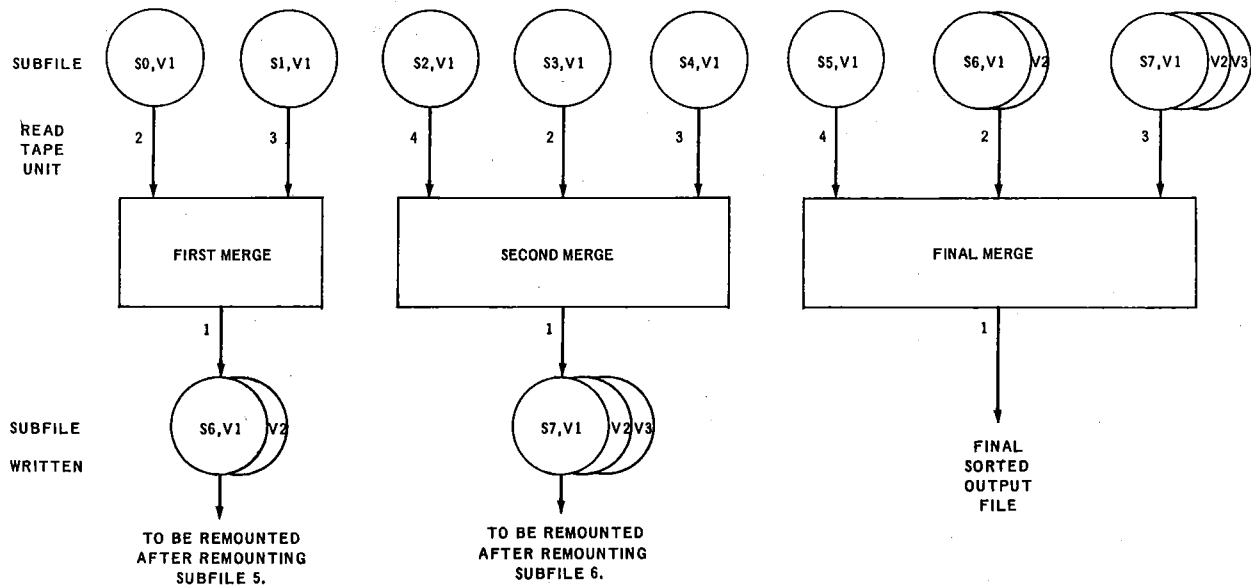


Figure 5-4. Multimerge Output Stage With Three Merges

5.5. OPERATING PROCEDURE

The preceding example illustrates the following rules for operating a multicycle tape sort.

1. Ordered subfiles are always produced on the same logical tape unit.
2. After a subfile has been produced, it is demounted, labeled with its subfile and volume numbers, and replaced by a new work tape.
3. Subfiles are numbered sequentially in the order that they are produced with the single exception that the last subfile produced by the input stage is numbered 0.
4. Each subfile is remounted as an input only once.
5. Subfiles are remounted by subfile number.
6. The logical tape units on which consecutive subfiles are mounted are themselves in a fixed order. (In the example, the order is 2, 3, 4, 2, 3, 4, 2, 3.)
7. When the highest-numbered subfile produced thus far is remounted as an input, the final merge of the output stage begins.

5.6. RESTART PROCEDURES

A restart procedure is performed through checkpoint dumps on tape. Each checkpoint actually consists of two checkpoint dumps, one at the end of a tape produced by the sort program, and the other at the beginning of the next tape produced by the sort program.

5.6.1. Establishing a Checkpoint

The sort program establishes a checkpoint by writing a checkpoint dump on a tape. With the single exception of the first ordered subfile produced, the checkpoint dump is written on each volume of each ordered subfile. It is also written on each volume of the output file if the conditions described with respect to the specification of the CKPT keyword parameter in the OUT statement are satisfied. The checkpoint dump is written as soon as the blank tape on which the volume is to be written has been processed by the specified label procedure. As part of establishing a checkpoint, the sort program also writes a checkpoint dump on each volume of each ordered subfile and, if appropriate, on each volume of the output file just before rewinding the volume with interlock.

At each checkpoint, the operator should make a record of the tapes. (From the point of view of making this record, the operator can consider the checkpoint to be the point at which the just-produced volume of the current ordered subfile is rewound with interlock.)

During input stage, the record shows:

1. The current volume of the input file if the input file is described in the IN statement.
2. The ordered subfile just produced (referred to as the previous dump tape).
3. The work tape that is to replace the ordered subfile just produced (referred to as the current dump tape).

During the output stage, the record shows:

1. The current volume of each input-ordered subfile.
2. The ordered subfile or output file volume just produced (referred to as the previous dump tape).
3. The blank tape that replaces the ordered subfile or output file volume just produced (referred to as the current dump tape).

During a restart, the sort program can restore to its state at the checkpoint only those tapes mounted on logical tape units specified in the TAPES statement and DEVA keyword parameters of the IN and OUT statements. If the input and/or output procedure controls any files other than those recorded on these tapes, the operator must make a record of the state of these other files at each checkpoint.

During the input stage, the state of such a file remains static during the time lapse between the cycle point and the checkpoint for which a record of that state is required. Thus, the operator can save time by recording this file state in anticipation of the need in the future.

5.6.2. Restart From a Checkpoint

The checkpoint from which restart is to be made is determined and the operator is directed to a particular set of information that he recorded at that checkpoint. On the basis of this information, he mounts the following tapes.

- During input stage, input file on separate tape unit:
 - current dump tape
 - current input file volume
- During input stage, input file and work tape sharing tape unit:
 - current dump tape
 - blank, which becomes a sort library
- During output stage:
 - current dump tape
 - current volume of each input-ordered subfile

If there are any special files that the sort program cannot restore to checkpoint state, the operator must follow a user-developed procedure to restore them to their checkpoint state. If restart is performed during the input stage, the operator must also mount work tapes on all work-tape units other than the work-tape unit on which the current dump tape is mounted; however, these work tapes do not need to be the same physical tapes present on the work tape units when the checkpoint was established. The only difference between restarting the sort program or initially starting it is the inclusion of one more card in the statement deck. This is the RSTRT statement, which has the following form:

LABEL	OPERATION	OPERAND
RSTRT	p	

where:

p may have several different values.

1. If p is SAME, the sort program reuses the current dump tape to write the next volume of the ordered subfile or output file.
2. If p is NEW, the sort program restarts from the checkpoint dump on the current dump tape. The sort program then rewinds the dump tape with interlock, displays a SUBFILE and VOLUME of the previous subfile, and expects a blank tape to be mounted for its use. If the input file shares a tape with a work tape, the last work tape (now containing a tape sort library) is rewound with interlock, and the input file requested.
3. If it proves impossible to read the checkpoint dump on the current dump tape, it should be replaced by the previous dump tape. The parameter p should then have the value NEXT. In this case, the sort program locates the checkpoint dump at the end of this dump tape, reestablishes itself from this dump, rewinds this tape with interlock, and makes a SUBFILE, VOLUME display of the previous subfile. The sort program then expects a blank tape to be mounted for its use. If the input file shares a tape unit with a work tape, the last work tape (now containing a tape sort library) is rewound with interlock and the input file is requested.

After reestablishing itself, the sort program verifies that correct or acceptable tapes have been mounted on all logical tape units before restarting.

If the input file and a work tape share a logical tape unit, a blank tape may be provided for the work tape when restart is executed; however, after being chosen, the same work tape must be used to replace the input file for the remainder of the input stage of the restarted sort process.

5.6.2.1. CHECKPOINT FREQUENCY

During input stage, the number of checkpoints established is equal to the number of times the input record count reaches the cycle limit. Unless otherwise instructed, the sort program establishes the cycle limit as the number of records that can be written on a full work tape.

If the user wishes checkpoints established more frequently, he may reduce the cycle limit by specifying, in a SORT statement, the keyword parameter:

CYCL=n

where:

n is used to determine the cycle limit and is the length in feet of tape that the tape sort is to use as a maximum on a work tape reel.

5.6.2.2. RESTART FROM AN INTERRUPTION

If the sort program is interrupted by an unsolicited keyin, it can be restarted at the point of interruption by:

1. Remounting on the same logical tape units the tapes that were mounted on these units when the tape sort was interrupted, including work tapes and input and output file tapes.
2. Initiating restart procedures with a RSTRT statement and no operand.

5.7. SEGMENTED SORTING

The sort program can be directed to perform only one stage of the sort process with a PART statement. The first parameter of the PART statement is a keyword parameter and is INPUT if only the input stage is to be performed and OUTPUT if only the output stage is to be performed. In both cases, the PART statement also must include the keyword parameter:

SUB=n

where:

n is the subfile number the sort program assigns to the first ordered subfile it produces. The consecutive assignment of subfile numbers to subfiles then resumes from the specified subfile number. If the sort process is to be segmented, communication between input and output procedures via the RES area is impossible.

5.7.1. Input Stage

The last ordered subfile produced by segmented running of the input stage is not assigned subfile number 0. It is assigned a subfile number in consecutive order in the same way that other subfiles are assigned numbers.

If an input procedure contains an end-of-file entry point, the sort program makes an end-of-file return when it reaches the end of the input file for this segment. When the operator presses the START switch in response to the START-OUTPUT display, the tape sort goes to EOJ. If the user wishes to control detection of end-of-input file, a VOL keyword parameter can be included in the PART statement rather than in the IN statement.

5.7.2. Output Stage

A segmented output stage merges a set of ordered subfiles numbered in unbroken sequence. A PART statement introduced to a segmented output stage must include the two keyword parameters:

SUBS=s

and

SUBG=g

where:

s is the smallest subfile number in the subfile number sequence, and g is the highest number in the subfile number sequence.

A segmented output stage starts with a START-OUTPUT display. It normally goes to EOJ after merging the given input ordered subfiles into one ordered subfile. If, however, the user desires the segmented output stage to produce the final sorted output file, the following keyword parameter specification must be included in the PART statement:

TERM=FINAL

5.7.3. Restarting

When a sort program is run in parts, the restart procedure for each part is the same as the restart procedure for a tape sort that has not been segmented. Thus, if one part of a segmented tape sort has produced subfiles n through n + i, restart procedures can be used to reproduce subfile n + 1, n + 2, n + 3, ... or n + i; to reproduce subfile n, PART must be initiated from the beginning of the run, without a RSTRT statement.

APPENDIX A. SUMMARY OF SORT OPERATING PROCEDURES

A.1. GENERAL

Three versions of the UNIVAC 9300 Magnetic Tape Sort (sort program) are available.

- Card system
Minimum operating system (MOS) with card reader
- Card system
MOS with card controller
- Tape system
Nonconcurrent operating system (NCOS), concurrent operating system (COS), with control stream

A.2. TAPE SORT INPUT DECKS

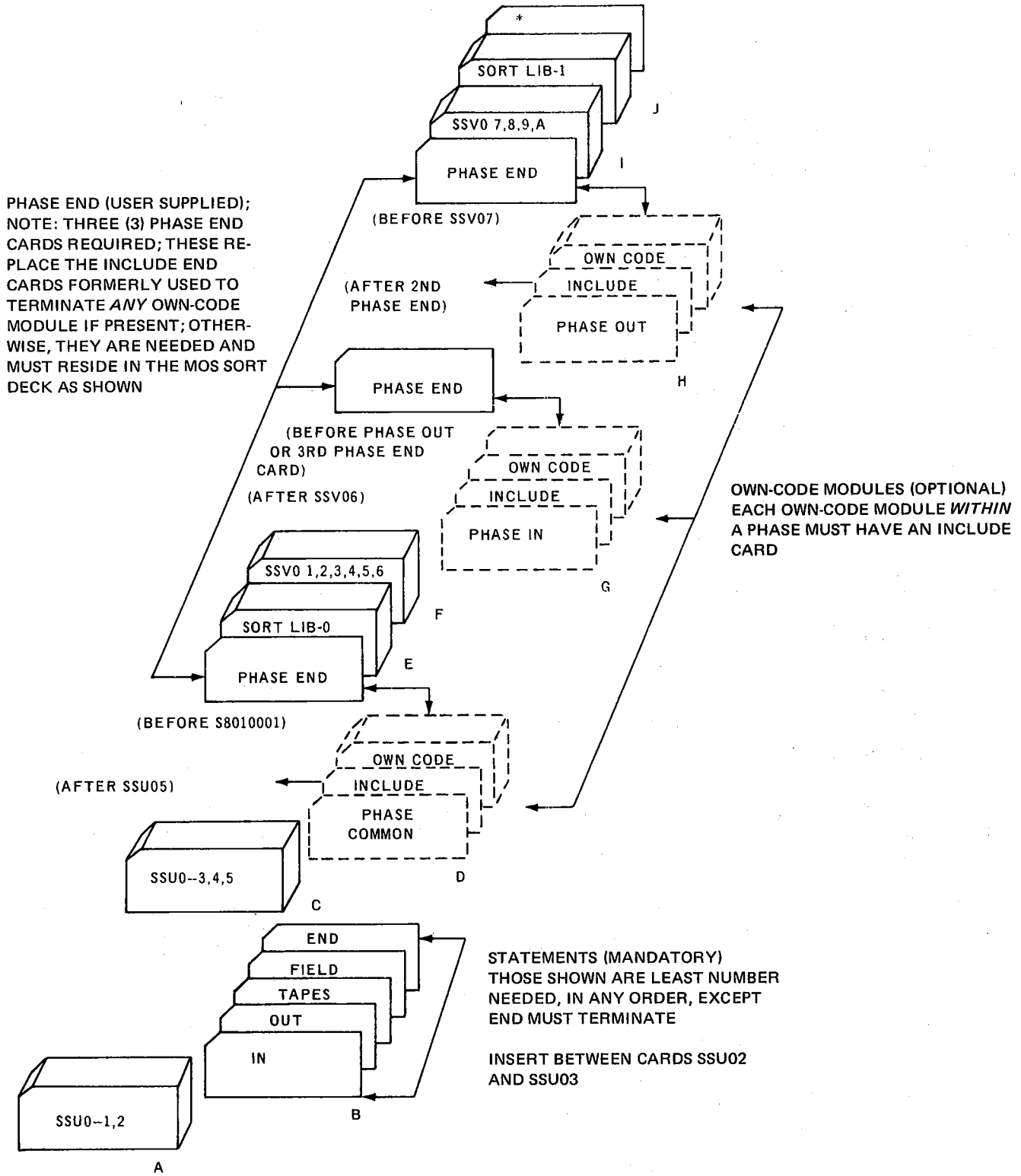
Figures A-1 and A-2 show the required input for the card and tape systems, respectively. In either system the user must supply at least the minimum set of SORT statements (deck B) plus three PHASE END cards. Figure A-3 shows the MOS: sort input deck, using an 8K memory.

In the card system, the SORT statements and END statements are inserted as shown in the self-loading sort deck. In the tape system these are the data cards of the control stream. Optional additions are described in Appendixes B and C.

A.3. MINIMUM SET OF SORT STATEMENTS

Deck B must contain the following cards:

- Multicycle
IN BKSZ= n_1 , RCSZ= n_2 , DEVA= n_3 , VOL= n_4
OUT BKSZ= n_5 , RCSZ= n_6 , DEVA= n_7
FIELD P₁, n_8
TAPES P₂, P₃, P₄
END

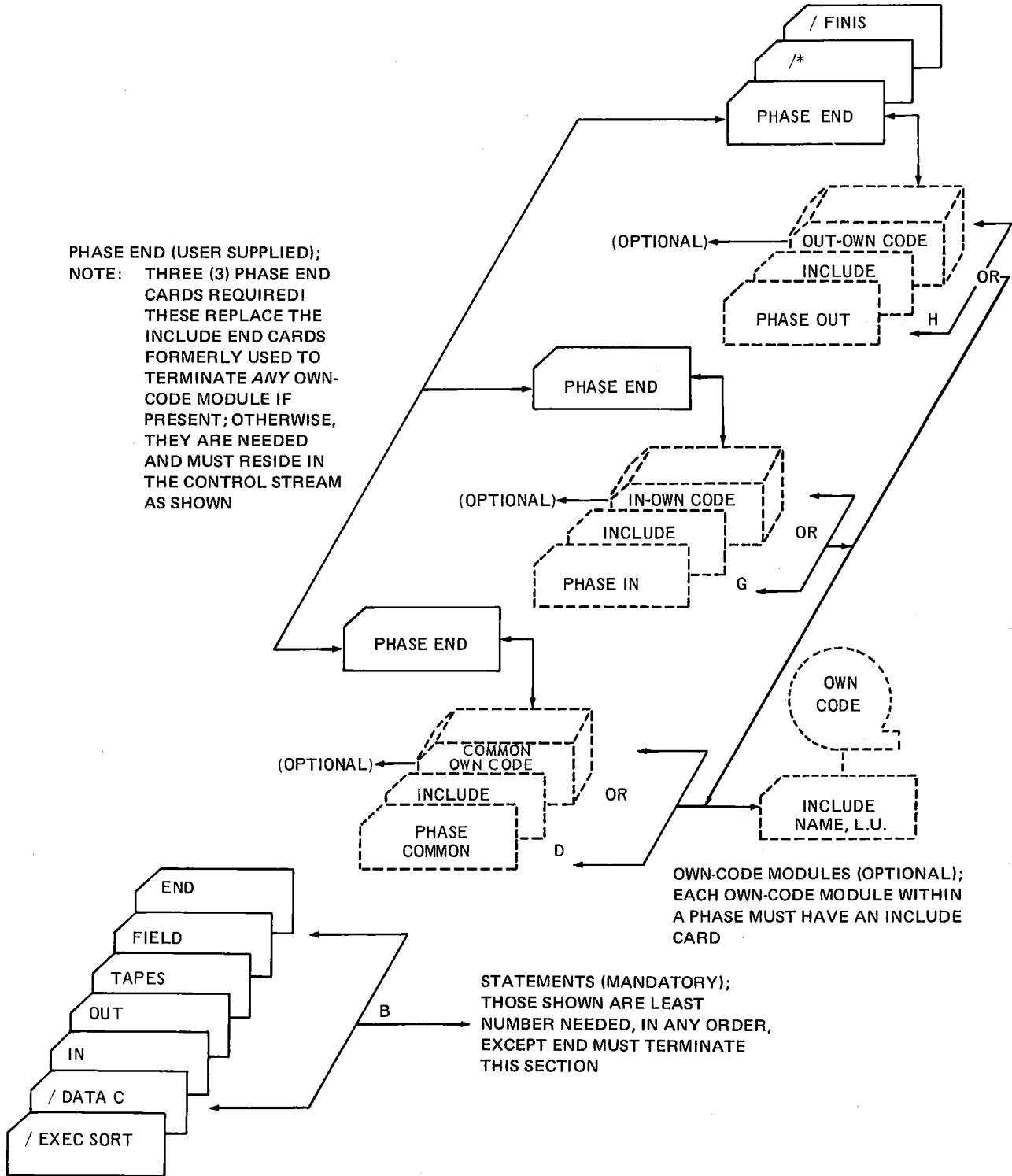


NOTE:

———— MANDATORY
- - - - - OPTIONAL

Figure A-1. MOS: Tape Sort Input Deck, Card Reader, Card Controller

PHASE END (USER SUPPLIED);
NOTE: THREE (3) PHASE END
CARDS REQUIRED!
THESE REPLACE THE
INCLUDE END CARDS
FORMERLY USED TO
TERMINATE ANY OWN-
CODE MODULE IF
PRESENT; OTHERWISE,
THEY ARE NEEDED
AND MUST RESIDE IN
THE CONTROL STREAM
AS SHOWN



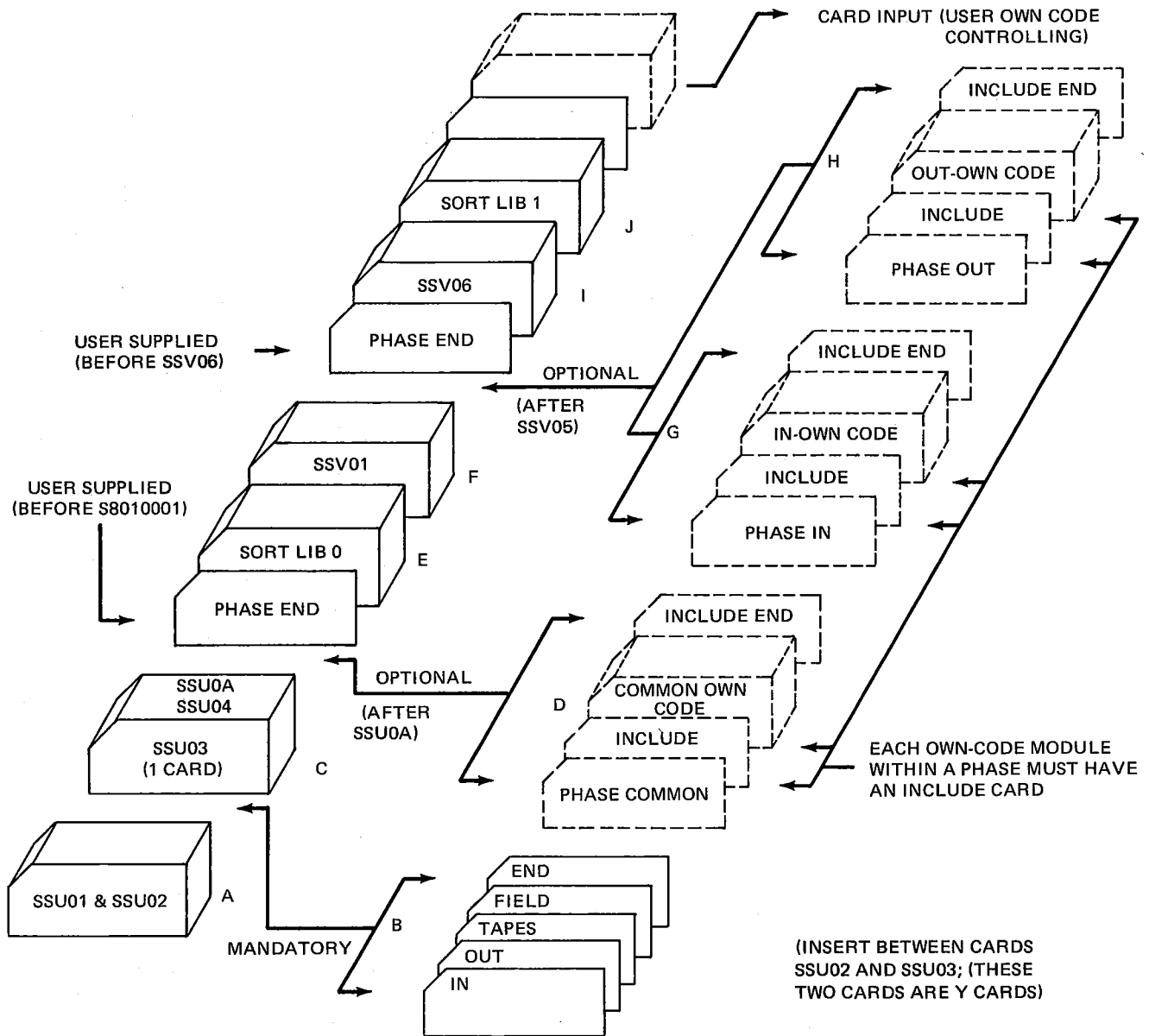
STATEMENTS (MANDATORY);
THOSE SHOWN ARE LEAST
NUMBER NEEDED, IN ANY ORDER,
EXCEPT END MUST TERMINATE
THIS SECTION

OWN-CODE MODULES (OPTIONAL);
EACH OWN-CODE MODULE WITHIN
A PHASE MUST HAVE AN INCLUDE
CARD

NOTE:

———— MANDATORY
----- OPTIONAL

Figure A-2. NCOS, COS Tape Sort Input Deck Control Stream



NOTE:

- MANDATORY
- OPTIONAL

Figure A-3. MOS: Tape Sort Input Deck, Using 8K Memory

The cards may be in any order, except that the END statement is the last.

■ Single Cycle

IN BKSZ= n_1 ,RCSZ= n_2 ,DEVA= n_3 ,VOL= n_4

OUT BKSZ= n_5 ,RCSZ= n_6 ,DEVA= n_7

FIELD P $_1$, n_8

TAPES P $_2$,P $_3$,P $_4$

END

Use the same set of statements as for multicycle, but omit the VOL= n_4 parameter from the IN statement.

A.4. OPERATING PROCEDURE

The standard operation of the sort program is summarized in the following paragraphs. Details and flowcharts are included in Section 5. Standard operating displays are included in A.5; error displays are shown in Appendix E.

A.4.1. Setup Stage Procedure

1. Mount input file if it does not share a tape unit.
2. Mount acceptable work tapes on all tape units.

(If a tape library is the source of own-code elements, it may be mounted on any but the first or last tape unit, and may be replaced prior to dispersion.)

■ For Card Operation

1. Load supervisor from appropriate unit.
2. Place sort deck in appropriate unit, and initial load.

■ For Tape Operation

1. Place sort deck in control stream reader.
2. Mount the systems tape on logical unit 0 and initial load.
3. Press START switch; replace work tape with input file when requested if they share a unit.

A.4.2. Input Stage Procedure

1. Sort makes CHOOSE display.
2. Reply None, to proceed.
3. Reply 1, to force acceptance of more data.

- Single cycle
 1. Output file is produced on specified unit: demount and label it.
 2. EOJ message is displayed.
- Multicycle
 1. Successive SUBFILES, all with one VOLUME, are produced on first-named tape unit; label and demount; replace with work tape.
 2. Recycle to first step of input stage procedure until SUBFILE 0 is produced; demount and label it; proceed to next step of output stop procedure.

A.4.3. Output Stage Procedure

- Multicycle
 1. Sort makes START-OUTPUT display. Demount all work tapes; mount work tape on first unit specified in TAPES statement; mount SUBFILE 0 to second unit, SUBFILES 1 to 3, and so forth.
 2. Press START switch.
 3. Sort makes SUBFILE_i VOLUME_j display. Demount and label new subfile volume from first unit. Replace with work tape. Record checkpoint subfiles and volumes (5.5.1). Repeat the last two steps, mounting all volumes of a subfile to the same unit. As the last volume is exhausted, mount the next numbered subfile to the freed unit.
 4. Final output file is produced when the highest-numbered subfile is mounted; demount and label output file volumes as they are written on the DEVA specified in the OUT statement.
 5. The EOJ message is displayed.

A.4.4. Restart Procedure

- Input Stage
 1. Add the RSTRT p statement to deck B.
 2. Remount the input file unless it shares a unit; remount the appropriate dump tape to first unit; mount work tapes on all other sort units.
 3. Follow setup stage procedures in second step.
- Output Stage
 1. Add the RSTRT p statement to deck B. (For RSTRT p in the output stage of the card system only, deck J (SORT LIB 1) may be removed from the input, the /* card then following card SSVOAzzz.)
 2. Remount the appropriate dump tape to first unit; remount all volumes of all subfiles listed in the operator record for this checkpoint.
 3. Follow setup stage procedures in second step.

A.4.5. Jettison Procedure

- All Stages
 1. Set data entry switches to OF.
 2. Press operator request; memory dump is executed on first unit of TAPE statement; all tapes are rewound with interlock.
 3. Record logical units for all tapes.

A.4.6. Restart After Jettison

- All Stages
 1. Add RSTRT card to deck B.
 2. Remount all tapes on previous logical units.
 3. Follow setup stage procedure of second step.

A.5. TAPE SORT STANDARD OPERATING DISPLAYS

Display	Reason	Action
3FE	CHOOSE	End of a batch of input data; reply 1 to force acceptance of more data; no reply to continue sorting.
3FD	MOUNT-INPUT	Replace work tape on last unit with the input file.
3FF	MOUNT-LIBRARY	Replace the input file with the library work tape.
3FA	START-OUTPUT	Program is about to enter the output stage; if PART INPUT is being executed, part sorting is complete.
60i	SUBFILE _i	Subfile number i has been completed.
70j	VOLUME _j	Volume number j has been completed.
80i } 90j }	WRONG-TAPE	{ In input stage, i and j are not significant; in output stage, i and j indicate the number of the required SUBFILE and VOLUME.

APPENDIX B. SUMMARY OF SORT STATEMENTS AND OPERANDS

B.1. GENERAL

The statements and options used by the sort program are summarized in Table B-1. The SORT, IN, and OUT statements are combined because they have many parameters in common. The column, Required, indicates parameters required by the sort program; no checks are in this column for the SORT statement because the SORT statement is optional. The remaining statements containing parameters not common to each other are described in parts 4 and 5 of Table B-2.

Statement			Key Word	Specification	Required	Remarks
Sort	In	Out				
	X	X	BKSZ	n=maximum block size	√	For IN and OUT; sort program block size is computed during the setup stage
	X		CKPT ^①	YES		Bypass checkpoint dumps on input files; the output tape cannot be inputted to TRPG using this keyword
	X	X	CLRWD	NORWD		No tape rewind after CLOSE
				RWD		Rewind tape without interlock after CLOSE
X	X	X	CRDT ^①			For standard label checking; address of the creation date area
X			CYCL ^①	n=length of work tape, in feet		To establish checkpoint more frequently than at cycle limit
	X	X	DEVA	n=logical unit	√	Logical tape unit number
X			DROC	Symbolic label		Address of user record sequence own code
	X	X	EOFA	Symbolic label		Address of user end of file own code; required for combined control of IN file or own code control of OUT file.

^① Not available on 8K sort.

Table B-1. Sort Statements With Common Parameters (Part 1 of 3)

Statement			Key Word	Specification	Required	Remarks
Sort	In	Out				
	X		ERRO	IGNORE		Treat error block in IN file normally.
				SKIP		Skip block containing error
				Symbolic label		Address of user error-handling own code
X			EQUL	DELE		Sort program eliminates duplicate record
X	X	X	FLID ^①	Symbolic label		For standard label checking; address of file identification area
X	X	X	FLBL	NO		For unlabeled files
				NSTD		For nonstandard labeled files
X	X	X	GENO	Symbolic label		For standard label checking; address of generation number area
	X		IPRO	Symbolic label		Address of user input procedure own code; required for combined or own code control of IN file
	X	X	IORG	n=general register 8-13		For records processed in I/O area with an alternate I/O area, or blocked records, or variable-length or undefined records read backward
X	X	X	LBAD ^①	Symbolic label		Address of user label routine; required for OUT or SORT with nonstandard labels, or for IN file with nonstandard checked labels, or for IN file with no tapemarks following header labels
	X		LBRC ^①	Symbolic label		Address of user label recheck coding; required for IN or SORT files with LBAD
		X	OPRO	Symbolic label		Address of user output procedure own code; required for combined or own code control of OUT file
	X	X	OPRW	NORWD		No tape rewind before OPEN
X			RCFM ^①	VAR		For variable sort program record size
	X	X	RCFM ^①	VARBLK		Record format is variable and blocked
				VARUNB		Record format is variable and unblocked
				UNDEF		Record format is undefined

^① Not available on 8K sort.

Table B-1. Sort Statements With Common Parameters (Part 2 of 3)

Statements			Key Word	Specification	Required	Remarks
Sort	In	Out				
X			RCSZ	n=record length		If RCFM=VAR, n is the maximum length; if not stated, obtained from IN statement
	X	X	RCSZ	n=record length	✓	Required for IN and OUT
				n=general register 8-13	✓	For undefined record format, in IN or OUT
	X		READ ^①	BACK		IN file is read backward
X			RES ^①	n=area length		To reserve a communication area in common memory which both IN and OUT may address
X			STOR ^①	n=maximum address		To restrict amount of memory to be used by the sort program
X			TAPE ^①	n=length of work tape, in feet		To shorten sort work tape length
		X	TPMK	NO		No tape mark is written after nonstandard header label or before an unlabeled file
	X		VOL ^①	n=number of volumes		End-of-file action is taken after reading n volumes of IN file; required for multicycle sorting
X	X	X	VOLN ^①	Symbolic label		For standard label checking; address of volume number area
	X	X	WORK	YES		Required for combined control of IN and OUT
X		X	XPDT ^①	Symbolic label		For standard label checking, address of the expiration date area

① Not available on 8K sort.

Table B-1. Sort Statements With Common Parameters (Part 3 of 3)

Statement	Positional Parameter of Keyword	Specification	Required	Remarks
END			✓	Required as last statement card
FIELD	p n f s RSOC	Position of most significant byte Number of bytes in field Format Sequence Symbolic label	✓ ✓ ✓	Required to specify sort keys or record sequence code To request setup stage to generate the 0 key comparison code; more than one statement may be used; at least first two positional parameters, p and n, are required Address of user own code for determining record sequence
ILB ^①	f c g v	File identification Creation date, Generation number Volume number		To substitute user values for IN label All parameters are optional
OLB ^①	f c g v x	File identification Creation date Generation number Volume number Expiration date		To substitute user values for OUT label All parameters optional
PART ^①	SUB p SUB SUBS SUBG TERM	INPUT n=number of 1st subfile OUTPUT n=number of 1st subfile n=smallest subfile number n=greatest subfile number FINAL		To request PART sorting Both positional parameter p (=INPUT) and keyword SUB required Positional parameter p (=OUTPUT), SUB, and SUBS required plus either SUBG or TERM=FINAL
RSTRT ^①	p p p p	Blank SAME NEW NEXT		To request restart Restart from unsolicited keyin Recreate subfile from first dump on tape Recreate subfile on new tape from first dump Recreate subfile from second dump on previous tape

① Not available on 8K sort.

Table B-2. Sort Statements Without Common Parameters (Part 1 of 2)

Statement	Positional Parameter of Keyword	Specification	Required	Remarks
TAPES	p ₁ p ₂ p ₃ . . p _n	Logical unit number Logical unit number Logical unit number . . .	✓ ✓ ✓	Specifies sort work tapes At least three logical units required
WLB ①	f c g v x	File identification Creation date Generation number Volume number Expiration date		To substitute user values for work tape labels; all parameters optional

① Not available on 8K sort.

Table B-2. Sort Statements Without Common Parameters (Part 2 of 2)

APPENDIX C. EXAMPLES OF OWN CODE AND CROSS REFERENCING

C.1. HEADER CARDS AND SENTINELS

Own-code modules are surrounded by fixed-format header cards and end sentinels to indicate to the setup stage the phase during which the module is to be loaded. Code that is to remain in memory at all times is preceded by the header PHASE COMMON and is followed by PHASE END. Each element within the phase is preceded by an INCLUDE card. For the tape system, the card may specify module name and logical unit number. (See Figures C-1, C-2.) Similarly, code to be resident in memory only during the input stage is preceded by a PHASE IN header card, that for the output stage by a PHASE OUT header card. Each set of modules is followed by a PHASE END sentinel card. If no own code is required for a phase, the PHASE END sentinel alone is used. (See also Appendix A, Figures A-1 and A-2.)

C.2. CROSS REFERENCING BETWEEN PHASES

A module included in PHASE IN may not reference an ENTRY defined in a module of PHASE OUT, and vice versa.

Any own-code module may reference system labels listed in Section 2.

C.3. CROSS REFERENCING BETWEEN ELEMENTS

The rules are:

- The label of the START line of an element is an ENTRY of the element (including a blank label).
- Any element within a phase may make a reference requiring a 2-byte address substitution of the value of an ENTRY in any other element of the phase.
- If, however, the reference requires a 2-byte address plus an addend, the element defining the ENTRY must be loaded before the element referencing it by way of EXTRN.

In Figure C-3, the line labeled A4 makes a valid reference to the start line of ELTB. The line labeled A3 makes two valid references to ENTRYs B2 and B3 of ELTB.

The line labeled A1, however, makes an invalid reference to the ENTRY B2 plus an addend of 10.

The line labeled B1 makes a valid reference to ENTRY A2 plus an addend because A2 will be loaded (evaluated) prior to line B1.

In Figures C-3 and C-4, each element (ELTA, ELTB, and LBL) beginning with the START card and ending with the END card must be assembled separately. The output of the assembler is inserted after the INCLUDE card.

1 LABEL	5 OPERATION 5	OPERAND	5
	10	16	
	PHASE	COMMON	
	INCLUDE		
HERE	INCLUDE	SOURCE CARDS OF FIRST COMMON E4T	
	:		
	INCLUDE		
2ND	ELT	FOLLOWS ITS OWN INCLUDE CARD	
	:		
	PHASE	END	
	:		
	PHASE	IN	
	INCLUDE		
1ST	ELT	OF INPUT PHASE OWN CODE	
	:		
	INCLUDE		
2ND	ELT	OF INPUT PHASE OWN CODE	
	:		
	PHASE	END	
	PHASE	OUT	
	INCLUDE		
1ST	ELT	OF OUTPUT STAGE OWN CODE	
	:		
	:		
	PHASE	END	

Figure C-1. Card System: Header and Sentinel Cards

LABEL	OPERATION	OPERAND	COMMENTS
1	5 10	16	72
	PHASE	COMMON	
	INCLUDE	name, l.u.	
	INCLUDE	name, l.u.	
	PHASE	END	
	PHASE	IN	
	INCLUDE	name, l.u.	
	INCLUDE		
	OWN CODE	ELT MAY ALSO COME FROM CARDS	
	:		
	INCLUDE	name, l.u.	
	PHASE	END	
	PHASE	END	IF NO PHASE OUT, FOR EXAMPLE, USE PHASE END ALONE

NOTE:

The parameter l.u. is a one-character number, O-F, logical unit number 0 is normally the systems tape; its use here would mean that the sort's own code is included on the system tape. This procedure is not recommended unless a separate system tape is maintained for the sort, and its own code elements only.

Figure C-2. Tape System: Header and Sentinel Cards

LABEL	OPERATION	OPERAND	COMMENTS
1	5 10	16	72
	PHASE	COMMON	
	INCLUDE		
ELTA	START	0	
	USING	*, 0	
	ENTRY	A1	
	ENTRY	A2	
	ENTRY	B2	
	ENTRY	B3	
A1	LH	10, B2+10	INVALID REFERENCE TO LABEL PLUS ADDEND
	:		
A2	DS	804	
A3	MVC	B2(6), B3	VALID REFERENCES TO LABELS
A4	BC	15, ELTB	VALID REFERENCE TO BLT START LINE
	END		
	INCLUDE		
ELTB	START	0	
	USING	*, 0	
	ENTRY	B2	
	ENTRY	B3	
	ENTRY	A2	
B1	LH	10, A2+10	INVALID REFERENCE TO LABEL PLUS ADDEND
	:		
B2	DS	804	
B3	DS	804	
	END		
	PHASE	END	

†Assembler output

Figure C-3. Cross References Between Own Code Elements

1	LABEL	5 OPERATION	16	OPERAND	5	COMMENTS	22	
	IN			BKSZ= <i>n</i> ₁ , RCSZ= <i>n</i> ₂ , DEVA= <i>n</i> ₃ , CRDT=ILC6				
	OUT			BKSZ= <i>n</i> ₄ , RCSZ= <i>n</i> ₅ , DEVA= <i>n</i> ₆ , CRDT=OLC6, XPDT=OLX6				
	SORT			CRDT=WLC6, XPDT=WLX6				
	:							
	:							
	:							
	* THE ABOVE STATEMENTS WOULD REQUIRE THE FOLLOWING OWN CODE							
	PHASE			COMMON				
	INCLUDE							
LBL	START			0				
	USING			*,0				
	ENTRY			ILC6				
	ENTRY			OLC6				
	ENTRY			WLC6				
	ENTRY			OLX6				
	ENTRY			WLX6				
ILC6	DC			CL6'aaaaaa'				
OLC6	DC			CL6'bbbbbb'				
WLC6	DC			CL6'cccccc'				
OLX6	DC			CL6'dddddd'				
WLX6	DC			CL6'eeeeee'				
	END							
	PHASE			END				
	:							
	:							
	:							
	* WHERE THE SYMBOLS aaaaaa THRU eeeeee ARE THE USER'S 6 CHARACTER DATES							

† Assembler output

Figure C-4. Own Code for 6-Character Label Dates

APPENDIX D. PROGRAMMING EXAMPLES

D.1. EXAMPLE 1

Logical tape unit numbers 05, 06 and 07 are available for work tapes. The work tape label is standard, and the label information supplied by the sort program is satisfactory for the work tapes. The highest-numbered byte the sort program is to use is 16,383. The input file has the following characteristics:

- Label Format – standard
- File Identification – UNSORTED
- Creation Date – 66160
- Generation Number – 0001
- Block Size – 1200 bytes
- Logical Tape Unit Number – 04
- Record Format – fixed length
- Record Size – 60 bytes
- KEY – Bytes 1–10
- Key Format – alphanumeric

Checkpoint records on the input file are to be bypassed. The input file is to be rewound at open, read forward, and rewound with interlock at close. If there is an unrecoverable read, the job is to be canceled. Input records are to be sorted into ascending order.

The output file has the following characteristics:

- Label Format – standard
- File Identification – SORTEDXX
- Creation Date – 66160
- Generation Number – 0001
- Expiration Date – 66168

- Block Size — 1200 bytes
- Logical Tape Unit Number — 05
- Record Format — fixed length
- Record Size — 60 bytes

Checkpoint dumps can be made on output file volumes. The output file is to be rewound at open and rewound with interlock at close.

1	LABEL	8	OPERATION	16	OPERAND	b	COMMENTS	72
*	STATEMENT CARDS							
*			Sort		STOR=16383			
			TAPES		05,06,07			
			ILB		UNSORTED,66160,0001,00			
			IN		BK SZ=1200,CKPT=YES,DEVA=04,RC SZ=60			
			FIELD		1,10			
			OLB		SORTEDXX,00,66168			
			OUT		BK SZ=1200,CKPT=YES,CRDT=ILBC,DEVA=05,GENC=ILBG,RC SZ=60			
			END					

Figure D-1. Sorting Program, Example 1

D.2. EXAMPLE 2

Example 2 is the same as example 1 except:

- The work tape file identification is to be SCRATCHX.
- An input procedure is to be used.
- Own code is to be used to sequence records.
- Data reduction own code is to be provided. If two records have equal keys, bytes 11-20 of the record to be deleted are to be decimally added to the corresponding bytes of the record to be retained.
- An output procedure is to be used.

NOTE:

In the second example, input procedure, record sequence own code, and output procedure are provided for illustrative purposes only. They do no more than the sort program described in Example 1.

LABEL	OPERATIONS	OPERAND	COMMENTS
1	10	16	72
* *	STATEMENT CARDS		
* *	WLB	SCRATCHX	
	SORT	STOR=16383, DROC=DROC	
	TAPES	05,06,07	
	ILB	UNSORTED,66160,0001,00	
	IN	BKSZ=1200,CKPT=YES,DEVA=04,EOFA=IEOF,RCSZ=60,IPRO=IPRO, IORG=8	X
	FIELD	RSOC=RSOC	
	OLB	SORTEDXX,,,00,66168	
	OUT	BKSZ=1200,CRDT=ILBC,DEVA=05,EOFA=OEOf GENO=ILBG,RCSZ=60,OPRO=OPRO,IORG=9	X
	END		
* *	THE FOLLOWING IS OWN CODE. IT SHOULD BE NOTED THAT, ALTHOUGH THIS OWN CODE IS SHOWN HERE IN SOURCE CODE FORM, IT MUST FIRST BE ASSEMBLED SO IT CAN BE INTRODUCED INTO THE SPOT IN RELOCATABLE FORMAT		
* *	RECORD SEQUENCE OWN CODE		
* *	RSOC	START 0	
	USING	*,0	
	CLC	0(10,11),0(12)	
	BC	15,0(14)	
	END		

Figure D-2. Sorting Program, Example 2 (Part 1 of 3)

LABEL	OPERATIONS	OPERAND	COMMENTS
1	10	16	72
* *	DATA REDUCTION OWN CODE		
DROC	START	0	
	USING	*,0	
	EXTRN	DELE	
	AP	11(10,11),11(12)	
	BC	15,DELE	
	END		
* *	INPUT PROCEDURE		
* *	IPRO	START 0	
	USING	*,0	
	ENTRY	IEOf	
	EXTRN	SORT	
	EXTRN	IN	
	OPEN	IN	
CI	GET	IN	
	STH	8,*+8	
	PUT	SORT	
	BC	15,CI	
IEOf	CLOSE	IN	
	CLOSE	SORT	
	END		

Figure D-2. Sorting Program, Example 2 (Part 2 of 3)

1 LABEL	8 OPERATION 10 16	OPERAND	COMMENTS	72
*				
*OUTPUT	PROCEDURE			
*				
OPRO	START	0		
	USING	*,0		
	ENTRY	0,00F		
	EXTRN	SORT		
	EXTRN	OUT		
	OPEN	OUT		
C2	STH	9, *+8		
	GET	SORT		
	PUT	OUT		
	BC	15, C2		
0EQF	CLOSE	OUT		
	CLOSE	SORT		
	END			

Figure D-2. Sorting Program, Example 2 (Part 3 of 3)

APPENDIX E. SORT ERROR DISPLAYS

E.1. GENERAL

The sort program error displays are listed in Table E-1. The meaning of the abbreviations in the source column are:

SU_n } Setup stage, load n
 SV_n }

T Tape dispatcher

U Sort control section

V Sort overlaps

Sort Error Displays			
Message	Source	Reason	Action
0001	SU ₂	Invalid character in parameter	Press START switch to display ccll. Press START switch to continue.
0002	SU ₂	Invalid character cycled to first position	Press START switch to display ccll. Press START switch to cancel.
0003	SU ₂	Source string greater than eight characters	Press START switch to display ccll. Press START switch to continue.
0004	SU ₂	No END statement found	Press START switch to display ccll. Press START switch to cancel.
0005	SU ₂	Label found on statement card, invalid statement, or in characters in columns 1-15 of continuation card	Press START switch to display ccll. Press START switch to continue.
0006	SU ₂	Statement name or keyword not found in SORT's known list	Press START switch to display ccll. Press START switch to continue.
0007	SU ₂	Actions not completed for a statement or parameter	Press START switch to display ccll. Press START switch to cancel.
0008	SU ₂	Too many characters in value	Press START switch to display ccll. Press START switch to cancel.
0009	SU ₂	Not enough memory for internal tables	Press START switch to display ccll. Press START switch to cancel.
000A	SU ₂	Invalid character in statement name	Press START switch to display ccll. Press START switch to continue.
0101	SU ₃	Fewer than three tape units specified	Press START switch to cancel.
0102	SU ₃	No valid RCSZ in either IN or SORT	Press START switch to cancel.
0103	SU ₃	Not enough memory for internal tables (FIELD, STOR parameters)	Press START switch to cancel.
0104	SU ₃	Invalid FIELD statement; p=0, or FI is 1 < 2	Press START switch to cancel.
0105	SU ₃	FIELD statement missing	Press START switch to cancel.
0115	SU ₃	TAPES statement missing	Press START switch to cancel.
0125	SU ₃	IN statement missing or improper	Press START switch to cancel.
0135	SU ₃	OUT statement missing or improper	Press START switch to cancel.
0145	SU ₃	OUT statement RCSZ too small	Press START switch to cancel.
0149	SU ₃	FIELD statement parameter address beyond SORT RCSZ	Press START switch to cancel.
0155	SU ₃	SORT or OUT statement contains invalid FLBL option	Press START switch to cancel.
0165	SU ₃	IN or OUT statement contains improper DEVA; 7-track and 9-track tapes mixed with multiple sort	Press START switch to cancel.

Table E-1. Sort Program Error Displays (Part 1 of 6)

Sort Error Displays			
Message	Source	Reason	Action
0175	SU ₃	Missing or invalid parameter in PART INPUT	Press START switch to cancel.
0185	SU ₃	Missing or invalid parameter in PART OUTPUT	Press START switch to cancel.
0195	SU ₃	Invalid RCSZ; 7-track tapes, fixed, requires multiple of 6	Press START switch to cancel.
0196	SU ₃	Improper physical unit; 7-track without conversion impossible for RCFM=VAR	Press START switch to cancel.
0197	SU ₃	Improper combination of physical units; merge cannot use both 7- and 9-track	Press START switch to cancel.
0200	SV ₇	SORT and own-code memory requirements too great	Reply 1 to display additional memory required. Press START switch to cancel. Reply 0 to cancel.
0201	SV ₈	RCSZ BKSZ too large for minimum SORT	Press START switch to cancel.
0202	SV ₇	IN or OUT BKSZ too small (< 16)	Press START switch to cancel.
0203	SV ₈	RCSZ too large for SORT with number of tape units requested	Reply 1 to reduce number of tape units by 1. Reply 0 to cancel.
0204	SV ₈	BKSZ greater than 8191	Press START switch to cancel.
0205	SV ₇	Not enough memory space for tape sort loader to read in overlays	Press START switch to cancel.
0301	SU ₅ , SV _A	Hole count check failure	Remove cards from input hopper; run out last card; refeed last three cards of input. NOTE: In the tape system, these cards must be preceded by a DATA C card.
0302	SU ₅ , SV _{A,6}	Sequence table exhausted Relocatable sort LIB or own code are out of sequence	Press START switch to cancel. Press START switch to cancel.
0303	SU ₅ , SV _{A,6}	Invalid card sequence	Press START switch to cancel.
0304	SU ₅ , SV _{A,6}	Too many ENTRYs and/or EXTRNs	Press START switch to cancel.
0305	SU ₅ , SV _{A,6}	Improper EXTRN, LOAD MOD KEY, or ENTRY (Appendix C)	Press START switch to cancel.
0306	SU ₅ , SV _A	Statements or own code improperly placed in sort deck (Tables A-1 and A-2)	Press START switch to cancel.

Table E-1. Sort Program Error Displays (Part 2 of 6)

Sort Error Displays			
Message	Source	Reason	Action
0307	SU ₅ , SV _{A,7}	EXTRN is not satisfied by matching ENTRY	Press START switch to cancel.
0308	SU ₅ , SV _{A,7}	Not enough memory for this SORT plus own code	Press START switch to cancel.
0309	SU ₅ , SV _{A,7}	Doubly defined ENTRY	Press START switch to cancel.
0310	SV _A	For RSTRT, present upper bound of memory greater than in check-point dump	Press START switch to cancel.
3FE 3FD 3FF 3FA			Refer to A.5, sort standard operating displays.
0400	SV ₃	Insufficient memory space to complete sort loading	Press START switch to cancel.
0401	U	EXTRN remains undefined after loading sort overlay	Press START switch to cancel.
0402	U	Sort library with needed overlay not found on work tape	Press START switch to cancel.
0410	SV ₂	For RSTRT, block just read should belong to first checkpoint dump, but does not	Reply 1 to try again with new tape mounted. Reply 0 to cancel.
0411	V	No input buffer available	Sort precautionary check has failed. Obtain memory dump.
0413	V	No output buffer available	Cancel.
0421	V	Premature end of data	Press START switch to cancel.
0422	V	Premature end of string	Press START switch to cancel.
042D	V	End of tape encountered on work tape	Press START switch to cancel.
0430	V	Sequence error	Press START switch to cancel.
0432	V	Preselect error	Press START switch to cancel.
0500	SV ₅	Not enough memory space for internal tables for own code check	Press START switch to cancel.
0501	SV ₅	Double definition of ENTRY in own code	Press START switch to cancel.
0502	SV ₅	Own code ENTRY defined or referenced in wrong PHASE	Press START switch to cancel.
0503	SV ₅	Undefined EXTRN in own code phase	Press START switch to cancel.

Table E-1. Sort Program Error Displays (Part 3 of 6)

Sort Error Displays			
Message	Source	Reason	Action
60i 70j 80i 90j			Refer to A.5, sort standard operating displays.
20U1	V	Output tape with standard labels failed to pass expiration date check	If the tape is manually rewound with interlock, another tape mounted, and the START switch pressed, the check will be made on the new tape. If something other than binary 0 is entered into memory location 4 via the ALTER switch and the START switch is pressed, magnetic tape IOCS cancels the main program.
20U2	V	Unit addressed is either allocated for some purpose other than the main program or is marked down	When the START switch is pressed in response to this display, magnetic tape IOCS cancels the main program.
20U3	V	The system is unable to read label block	When the START switch is pressed in response to this display, magnetic tape IOCS cancels the main program.
20U4	V	To-be-expected label cannot be found on file described as having standard labels	When the START switch is pressed in response to this display, magnetic tape IOCS cancels the main program.
20U6	V	Wrong length record check has failed	When the START switch is pressed in response to this display, magnetic tape IOCS cancels the main program.
20U7	V	Attempt made to advance a record from unopened file, or to close such a file	When the START switch is pressed in response to this display, magnetic tape IOCS cancels the main program.
20U8	V	Input label check failed	If the tape is manually rewound, a new tape mounted, and the START switch pressed, magnetic tape IOCS will make the label check on the new tape. If something other than binary 0 is entered into memory location 4 via the ALTER switch and the START switch is pressed, magnetic tape IOCS accepts the current tape even though the label check failed.
20U9	V	A block count error has occurred	If the START switch is pressed, magnetic tape IOCS cancels the main program. If something other than binary 0 is entered into memory location 4 via the ALTER switch before the START switch is pressed, magnetic tape IOCS continues as if the error had not occurred.
20UA	V	A TRUNC macro instruction has been executed for an unblocked file	When the START switch is pressed in response to this display, magnetic tape IOCS cancels the main program.
20UB	V	A PUT macro instruction has been executed in connection with an input-only I/O routine	When the START switch is pressed in response to this display, magnetic tape IOCS cancels the main program.

Table E-1. Sort Program Error Displays (Part 4 of 6)

Message	Source	Reason	Action
20UC	V	A GET macro instruction has been executed in connection with an output-only I/O routine	When the START switch is pressed in response to this display, magnetic tape IOCS cancels the main program.
20UD	V	End of tape encountered on an output procedure action	<p>If the START switch is pressed, magnetic tape sort IOCS cancels the sort program. If binary 0 is entered into memory location 4 via the ALTER switch before the START switch is pressed, magnetic tape sort IOCS continues processing as if end of tape was not encountered.</p> <p>NOTE:</p> <p>There is no tape swap mechanism in the sort program, therefore, ignoring end of tape can result in a tape run-off.</p>
20UE	V	Unrecoverable write error	Pressing START switch cancels the sort program.
20UF	V	Block count error recovery unsuccessfully attempted on a sort work tape	If the START switch is pressed, magnetic tape sort IOCS will cancel the sort program. If other than a binary 0 is entered into memory location 4 via the ALTER switch before the START switch is pressed, magnetic tape sort IOCS will again attempt to recover from this error.
4007	SU ₅ SV _A	Unable to read or write sort library on work tape	Press START switch to cancel.
4009	SU ₂	Improper sequence of PHASE END and INCLUDE cards within own code element	Press START switch to cancel; correct sequence of cards and resubmit.
400B	U	Unable to find sort library on SORT work tape	Press START switch to cancel.
400C	U	Data error from sort library tape	Press START switch to cancel.
400D	U	Record count error from sort library tape	Press START switch to cancel.
400E	U	Unable to read block of sort library tape	Press START switch to cancel.
41EF		End of sort	No action
4300	SU ₁	Card count error in loading setup stage overlay	Press START switch to continue despite message.
60U1	T	Tape dispatcher tried five times, unsuccessfully, to recover from a read or write tape error	To cause the tape dispatcher to retry five more times, press the START switch. To cause the tape dispatcher to skip the request packet on which the error is occurring and go to the next request packet, key a 1 into memory location 4 before pressing the START switch.

Table E-1. Sort Program Error Displays (Part 5 of 6)

Sort Error Displays			
Message	Source	Reason	Action
60U2	T	Invalid command sense bit (bit 0 of sense byte 0) set; caused by attempt to perform a write, write tape mark or erase operation on a file-protected tape unit	In this case, the operation can be effected by inserting the write enable ring in the tape reel and pressing the START switch.
60U3	T	Noise bit (bit 0 of the sense byte 1) set while erase command was being executed	Enter nonzero at location 4 via ALTER switch; press START switch to continue (error ignored). If START switch is pressed without entering nonzero, stop display 60U0 will occur; recovery is the same as for previous message.
60U4	T	Equipment check bit (bit 3 of sense byte 0) set	This is a nonrecoverable error.
60U5	T	Noise bit (bit 0 of sense byte 1) and tape-fault bit (bit 6 of sense byte 4) set during write or write tape mark operation	This is a nonrecoverable error.
60U7	T	Intervention-required bit (bit 1 of sense byte 0) set. Caused by attempt to perform a tape operation on a nonready unit	In this case, recovery consists of marking the unit ready and pressing the START switch.
60UC	T	Condition code 01 returned during initiation of current tape operation; generally occurs because function presented to control unit is invalid	To retry initiation of the operation, press the START switch; if the error persists, the job should be canceled.
60UD	T	Unit check has occurred but all bits of sense byte 0 are reset; indicates a read backward, backspace block, or backspace file operation has been attempted on a tape unit with tape at load point	This is a nonrecoverable error.
60UE	T	When the supervisor is generated, the channel(s) for the tape control units is specified as parameters. When a request is made of the tape dispatcher, the request specifies a logical unit number. The tape dispatcher verifies that the physical unit table entry specified by the logical unit number contains a channel number corresponding to one of those specified when the supervisor was generated.	If this is not the case, 60UE is displayed. This is a nonrecoverable error.
60UF	T	A condition code of 11 has been returned when initiating the current tape operation.	This indicates a nonoperational general purpose channel (GPC). Ready the GPC and press the START switch.

Table E-1. Sort Program Error Displays (Part 6 of 6)

APPENDIX F. SORT TIMING

Timing information for tape sorting in the UNIVAC 9200 II, 9300, and 9300 II Systems is listed in Tables F-1 and F-2. The tables are organized by system configuration to facilitate referencing. All timing is in minutes.

Record Size (in bytes)	Blocking Factor	Volume (in thousands)																							
		1		2		5		10		15		20		30		50		75		100		150		200	
		10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30
20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
20	20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
50	50	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
100	100	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
30	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
30	20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
40	40	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
60	60	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
50	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
50	10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
25	25	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
40	40	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
80	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
80	5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
15	15	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
25	25	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
100	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
100	5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
100	10	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
200	20	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
200	1	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
200	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
300	10	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
300	1	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
300	3	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
500	6	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
500	1	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
500	2	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
750	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
750	1	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
1000	2	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
1000	1	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
2000	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

UNISERVO VI C Subsystem: 9 Track
1 Control Unit
3 Tape Units

Table F-1. UNIVAC 9200 II System Sort Program Timing (Part 1 of 16)

UNIVAC 9200 II System
Memory Size: 12K Bytes

Record Size (in bytes)	Blocking Factor	Volume (in thousands)																									
		1		2		5		10		15		20		30		50		75		100		150		200			
		10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30		
20	1	1	0	2	0	4	0	8	0	12	0	17	0	24	0	37	0	48	0	72	0	105	0	158	0	230	0
20	20	1	0	2	0	4	0	8	0	13	0	17	0	24	0	37	0	48	0	79	0	105	0	157	0	229	0
50	50	1	0	2	0	4	0	9	0	13	0	20	0	29	0	44	0	54	0	81	0	107	0	176	0	235	0
100	100	2	0	3	0	6	0	18	0	27	0	40	0	60	0	95	0	109	0	163	0	237	0	356	0	500	0
30	1	1	1	2	2	4	5	9	10	15	17	20	23	37	38	54	63	54	63	89	104	118	138	194	227	259	302
30	20	1	1	2	2	5	5	10	11	15	17	22	25	37	37	59	69	59	69	88	103	118	137	193	224	258	299
30	40	1	1	2	2	5	6	11	12	18	20	23	27	38	44	64	73	64	73	105	120	139	161	228	262	304	350
30	60	2	2	3	3	8	8	16	16	26	27	35	36	57	59	95	98	95	98	157	161	209	214	341	350	500	500
50	1	1	1	2	2	5	6	12	13	18	20	26	30	39	44	72	82	72	82	108	122	158	179	236	268	315	358
50	10	1	1	2	2	5	6	12	13	20	22	26	30	39	44	72	81	72	81	118	134	158	179	236	268	344	390
50	25	1	2	3	3	7	8	15	17	22	25	33	36	50	54	91	100	91	100	136	149	198	217	298	326	500	500
50	40	4	4	8	8	21	22	47	48	70	72	103	105	153	158	282	287	282	287	423	429	500	500	500	500	500	500
80	1	1	1	3	3	7	7	15	17	25	28	34	37	54	61	93	102	93	102	154	168	205	224	336	367	500	500
80	5	2	2	3	3	8	9	15	17	25	28	34	37	54	61	93	102	93	102	154	168	204	224	336	367	500	500
80	15	2	2	4	4	10	10	22	23	37	38	49	50	81	83	135	138	135	138	222	227	296	303	500	500	500	500
80	25	6	6	12	12	37	38	74	75	122	124	163	165	264	271	500	500	500	500	500	500	500	500	500	500	500	500
100	1	2	2	4	4	9	10	20	21	30	31	40	42	64	69	113	115	113	115	187	191	249	254	500	500	500	500
100	5	2	2	4	4	9	10	20	21	30	31	45	46	64	69	125	127	125	127	187	191	273	279	500	500	500	500
100	10	2	2	4	4	11	11	24	25	41	42	54	55	90	92	150	153	150	153	246	251	328	335	500	500	500	500
100	20	8	8	15	15	46	47	92	93	153	155	203	206	335	339	500	500	500	500	500	500	500	500	500	500	500	500
200	1	3	3	6	6	19	20	38	39	65	66	86	87	143	145	238	242	238	242	500	500	500	500	500	500	500	500
200	5	4	4	8	8	23	24	52	53	87	88	116	117	173	175	318	322	318	322	500	500	500	500	500	500	500	500
200	10	17	17	37	38	102	103	223	226	335	339	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
300	1	5	5	10	10	28	29	64	64	95	96	141	143	212	214	339	342	339	342	500	500	500	500	500	500	500	500
300	3	6	6	12	12	37	37	73	74	122	124	163	165	270	273	500	500	500	500	500	500	500	500	500	500	500	500
300	6	14	14	32	32	88	89	194	196	291	294	443	445	664	667	1111	1113	1111	1113	1666	1667	2222	2223	3333	3334	500	500
500	1	6	9	19	19	52	53	116	118	174	176	257	259	388	391	666	669	666	669	1000	1001	1333	1334	1999	2000	500	500
500	2	12	12	23	23	71	72	141	143	234	236	312	315	466	469	888	891	888	891	1333	1334	1777	1778	2555	2556	500	500
500	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
750	1	15	16	30	31	95	96	189	191	313	316	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
750	2	27	27	60	61	166	167	362	366	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
1000	1	26	26	57	57	155	157	340	343	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
1000	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

UNISERVO VI C Subsystem: 9 Track
1 Control Unit
4 Tape Units

Table F-1. UNIVAC 9200 II System Sort Program Timing (Part 2 of 16)

UNIVAC 9200 II System
Memory Size: 12K Bytes

Record Size (in bytes)	Blocking Factor	Volume (in thousands)																							
		1		2		5		10		15		20		30		50		75		100		150		200	
		10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30
20	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
20	20	0	0	2	0	3	0	7	0	10	0	14	0	24	0	39	0	66	0	88	0	131	0	195	0
50	50	0	0	2	0	3	0	7	0	10	0	16	0	23	0	44	0	65	0	87	0	146	0	194	0
100	100	0	0	2	0	4	0	7	0	13	0	17	0	25	0	46	0	69	0	103	0	154	0	205	0
30	1	0	0	4	0	8	0	19	0	28	0	43	0	64	0	119	0	179	0	238	0	338	0	477	0
30	20	1	1	2	2	4	4	8	9	12	13	18	21	24	31	50	74	86	99	115	166	193	221	257	
30	40	1	1	2	2	4	5	8	9	14	16	18	21	27	31	50	75	87	113	130	168	195	225	260	
60	60	1	1	2	2	5	5	10	11	15	17	19	22	33	37	54	62	92	105	122	140	183	209	271	
50	1	1	1	2	2	4	6	11	12	16	18	21	24	32	36	60	68	90	101	135	152	202	228	269	
50	10	1	1	2	2	5	6	11	12	16	18	21	24	32	36	61	68	103	116	136	154	205	231	304	
80	25	1	1	3	3	7	7	14	14	24	25	32	33	47	49	89	92	134	138	178	183	299	307	398	
80	40	1	1	3	3	7	7	14	14	24	25	32	33	47	49	89	92	134	138	178	183	299	307	398	
100	1	2	2	6	6	14	14	28	28	51	51	100	100	170	173	284	288	441	445	587	593	958	1000	1300	
100	5	2	2	6	6	14	14	28	28	51	51	100	100	170	173	284	288	441	445	587	593	958	1000	1300	
100	10	2	2	6	6	14	14	28	28	51	51	100	100	170	173	284	288	441	445	587	593	958	1000	1300	
200	20	2	2	6	6	14	14	28	28	51	51	100	100	170	173	284	288	441	445	587	593	958	1000	1300	
200	1	3	3	6	6	16	17	38	39	66	67	130	132	216	220	366	370	541	545	726	730	1131	1135	1486	
200	5	3	3	6	6	16	17	38	39	66	67	130	132	216	220	366	370	541	545	726	730	1131	1135	1486	
300	10	3	3	6	6	16	17	38	39	66	67	130	132	216	220	366	370	541	545	726	730	1131	1135	1486	
300	1	4	4	10	10	28	29	56	57	96	98	128	130	192	195	316	319	466	470	641	645	966	970	1286	
300	3	4	4	10	10	28	29	56	57	96	98	128	130	192	195	316	319	466	470	641	645	966	970	1286	
500	6	4	4	10	10	28	29	56	57	96	98	128	130	192	195	316	319	466	470	641	645	966	970	1286	
500	1	8	9	16	17	48	48	110	111	164	166	219	221	366	370	606	610	876	880	1216	1220	1866	1870	2486	
750	2	10	11	24	24	59	60	137	138	205	207	271	273	441	443	726	728	1131	1133	1645	1647	2486	2488	3306	
750	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
750	1	14	14	32	32	90	91	180	182	271	273	441	443	726	728	1131	1133	1645	1647	2486	2488	3306	3308	4226	
1000	2	27	27	61	61	171	173	342	344	516	518	792	794	1188	1190	1866	1868	2811	2813	4226	4228	6346	6348	8466	
1000	1	24	24	48	48	137	138	274	275	441	443	726	728	1131	1133	1645	1647	2486	2488	3306	3308	4226	4228	5346	
2000	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2000	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

UNISERVO VI C Subsystem: 9 Track
1 Control Unit
5 Tape Units

Table F-1. UNIVAC 9200 II System Sort Program Timing (Part 3 of 16)

UNIVAC 9200 II System
Memory Size: 12K Bytes

Record Size (in bytes)	Blocking Factor	Volume (in thousands)																								
		1		2		5		10		15		20		30		50		75		100		150		200		
		10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	
20	1	1	0	1	0	4	0	7	0	12	0	15	0	23	0	44	0	66	0	87	0	131	0	198	0	
	20	1	0	1	0	4	0	7	0	12	0	15	0	23	0	44	0	65	0	87	0	149	0	199	0	
	50	1	0	2	0	4	0	8	0	12	0	16	0	26	0	47	0	70	0	106	0	159	0	212	0	
	100	2	0	4	0	11	0	21	0	31	0	49	0	73	0	121	0	209	0	279	0	411	0	571	0	
30	1	1	1	2	2	4	5	9	10	13	15	17	20	25	30	49	58	74	87	98	115	168	198	224	264	
	20	1	1	2	2	4	5	9	11	13	16	18	21	30	36	51	59	76	89	115	135	173	203	230	270	
	40	1	1	2	2	5	6	10	11	14	17	22	26	33	39	55	64	95	110	127	147	190	220	254	293	
	60	2	2	4	4	8	8	19	20	28	29	38	39	68	68	109	113	164	169	251	258	411	411	411	411	
50	1	1	1	2	2	5	5	10	12	15	18	20	23	36	41	59	68	89	102	136	156	204	234	272	311	
	10	1	1	2	2	5	5	11	12	16	18	25	26	37	42	61	69	105	120	139	159	209	239	272	311	
	25	2	2	3	3	7	7	14	14	25	26	33	34	49	51	95	98	142	146	189	195	272	272	272	272	
	40	4	5	8	9	25	25	58	59	88	89	116	118	202	205	411	411	611	611	811	811	1111	1111	1111	1111	
80	1	1	1	3	3	7	8	14	15	21	22	33	34	47	51	81	84	141	147	188	195	272	272	272	272	
	5	2	2	3	3	7	8	14	15	25	26	34	35	51	52	97	100	145	150	193	200	272	272	272	272	
	15	2	2	4	4	10	11	24	25	36	37	48	50	84	87	140	144	210	216	272	272	272	272	272	272	
	25	7	7	16	16	40	40	93	95	140	142	215	219	411	411	811	811	1211	1211	1611	1611	2011	2011	2011	2011	
100	1	2	2	3	3	9	9	17	17	30	31	40	41	57	61	115	118	172	177	229	236	272	272	272	272	
	5	2	2	3	3	9	9	18	18	32	32	42	43	63	64	122	125	182	187	236	236	272	272	272	272	
	10	2	2	5	5	11	11	26	27	39	40	52	54	92	94	152	156	228	234	272	272	272	272	272	272	
	20	8	9	20	20	58	59	116	118	202	205	269	273	411	411	811	811	1211	1211	1611	1611	2011	2011	2011	2011	
200	1	3	3	7	7	16	16	37	38	56	57	74	76	131	134	218	222	311	311	411	411	511	511	511	511	
	5	4	4	9	9	25	26	50	51	88	90	118	120	178	180	311	311	411	411	511	511	611	611	611	611	
	10	20	20	47	48	135	137	269	273	411	411	611	611	1011	1011	1411	1411	1811	1811	2211	2211	2611	2611	2611	2611	
300	1	4	4	9	10	28	28	55	56	97	98	128	131	193	196	311	311	411	411	511	511	611	611	611	611	
	3	6	6	12	12	35	36	83	84	124	126	165	167	236	236	311	311	411	411	511	511	611	611	611	611	
	6	18	18	35	36	103	105	238	242	411	411	611	611	1011	1011	1411	1411	1811	1811	2211	2211	2611	2611	2611	2611	
500	1	8	8	16	16	48	49	113	115	170	173	211	211	311	311	411	411	511	511	611	611	711	711	711	711	
	2	10	11	25	25	62	62	145	147	218	221	272	272	411	411	611	611	811	811	1011	1011	1211	1211	1211	1211	
	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
750	1	14	14	32	33	95	96	189	192	311	311	411	411	611	611	811	811	1011	1011	1211	1211	1411	1411	1411	1411	
	2	28	29	66	67	190	194	311	311	411	411	611	611	811	811	1011	1011	1211	1211	1411	1411	1611	1611	1611	1611	
1000	1	25	25	49	50	145	147	311	311	411	411	611	611	811	811	1011	1011	1211	1211	1411	1411	1611	1611	1611	1611	
	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

UNISERVO VI C Subsystem: 9 Track
1 Control Unit
6 Tape Units

Table F-1. UNIVAC 9200 II System Sort Program Timing (Part 4 of 16)

UNIVAC 9200 II System
Memory Size: 12K Bytes

Record Size (in bytes)	Blocking Factor	Volume (in thousands)																							
		1		2		5		10		15		20		30		50		75		100		150		200	
		10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30
20	1	1	0	1	0	4	0	9	0	14	0	20	0	32	0	57	0	85	0	121	0	193	0	273	0
20	20	1	0	4	0	9	0	14	0	14	0	20	0	32	0	57	0	90	0	120	0	192	0	271	0
50	50	1	0	4	0	9	0	15	0	15	0	21	0	34	0	60	0	89	0	127	0	202	0	268	0
100	100	1	0	5	0	11	0	16	0	16	0	23	0	37	0	66	0	105	0	139	0	221	0	311	0
30	1	1	1	5	6	10	12	17	19	22	25	35	40	63	72	101	115	143	164	215	246	304	347	443	585
20	20	1	1	5	6	10	12	16	19	24	27	34	43	67	77	107	123	143	163	228	261	322	367	463	585
40	40	1	1	5	6	11	13	18	20	24	27	34	44	68	77	108	124	153	175	243	277	324	369	469	585
60	60	1	1	5	6	12	14	20	22	26	30	42	47	74	84	116	134	167	189	250	284	352	400	493	585
50	1	1	1	6	7	14	15	22	24	29	32	46	52	83	92	132	147	176	197	281	313	397	443	536	585
10	10	1	1	6	7	13	15	22	24	31	35	46	52	82	92	132	147	187	209	298	332	396	443	536	585
25	25	1	1	6	7	15	16	23	26	31	35	50	55	88	99	141	157	199	222	316	352	422	469	536	585
40	40	1	2	8	9	17	18	27	29	35	39	57	63	100	111	160	176	225	249	356	393	475	524	585	585
80	1	2	2	8	9	18	20	27	30	39	43	63	69	112	122	179	195	253	276	380	414	536	585	585	
5	5	2	2	8	9	18	20	29	32	39	43	63	69	112	122	179	195	253	276	380	414	536	585	585	
15	15	2	2	9	9	20	22	32	35	42	46	64	74	120	131	191	208	255	277	404	439	536	585	585	
25	25	2	2	11	11	25	25	40	40	53	54	84	85	149	151	236	240	333	338	499	507	585	585	585	
100	1	2	2	10	11	21	23	34	36	45	48	72	78	129	138	206	222	291	313	463	499	585	585	585	
5	5	2	2	10	11	21	23	34	36	48	52	77	83	137	148	219	236	291	313	463	499	585	585	585	
10	10	2	2	10	11	22	24	36	39	48	52	77	83	136	147	217	234	307	330	486	523	585	585	585	
20	20	2	2	14	14	30	31	48	49	69	70	103	104	183	185	291	294	410	414	585	585	585	585	585	
200	1	3	3	20	20	42	42	68	68	97	98	157	157	276	279	439	443	585	585	585	585	585	585	585	
5	5	4	4	21	21	45	46	73	73	104	104	165	167	292	295	438	441	585	585	585	585	585	585	585	
10	10	5	5	29	29	67	67	100	101	142	143	227	228	400	402	585	585	585	585	585	585	585	585	585	
300	1	5	5	31	31	67	67	107	108	153	154	245	247	434	436	585	585	585	585	585	585	585	585	585	
3	3	5	5	31	31	72	72	115	116	153	154	245	247	434	436	585	585	585	585	585	585	585	585	585	
6	6	7	7	43	44	92	93	147	148	209	210	313	315	585	585	585	585	585	585	585	585	585	585	585	
500	1	9	9	55	55	126	127	189	190	269	271	429	431	585	585	585	585	585	585	585	585	585	585	585	
2	2	9	9	59	60	126	127	202	203	286	288	429	431	585	585	585	585	585	585	585	585	585	585	585	
4	4	13	14	82	83	186	187	279	280	394	396	585	585	585	585	585	585	585	585	585	585	585	585	585	
750	1	14	14	88	88	201	202	302	303	428	429	585	585	585	585	585	585	585	585	585	585	585	585	585	
2	2	17	17	104	105	237	237	354	355	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	
1000	1	20	20	125	126	285	286	427	428	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	
2	2	31	31	185	186	415	416	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	
2000	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

UNIVAC 9200 II System
Memory Size: 16K Bytes

UNISERVO V1 C Subsystem: 9 Track
1 Control Unit
3 Tape Units

Table F-1. UNIVAC 9200 II System Sort Program Timing (Part 5 of 16)

Record Size (in bytes)	Blocking Factor	Volume (in thousands)																							
		1		2		5		10		15		20		30		50		75		100		150		200	
		10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30
20	1	1	0	2	0	4	0	7	0	12	0	15	0	24	0	43	0	71	0	94	0	155	0	207	0
	20	1	0	2	0	4	0	8	0	12	0	15	0	24	0	47	0	70	0	94	0	154	0	206	0
	50	1	0	2	0	4	0	8	0	11	0	17	0	25	0	47	0	70	0	102	0	153	0	224	0
	100	1	0	2	0	4	0	9	0	13	0	20	0	29	0	54	0	81	0	107	0	174	0	235	0
30	1	1	1	2	2	4	5	9	10	13	15	19	22	24	33	52	62	78	92	115	135	173	203	230	270
	20	1	1	2	2	4	5	9	10	14	17	19	22	24	33	51	60	85	100	113	133	170	199	248	291
	40	1	1	2	2	5	5	9	10	14	17	19	22	27	37	53	61	87	101	116	135	190	222	253	296
	60	1	1	2	2	5	5	10	12	15	17	22	25	33	48	60	70	90	104	132	153	197	229	263	305
50	1	1	1	2	2	5	5	10	11	17	19	22	26	37	43	62	71	103	117	137	157	225	257	300	343
	10	1	1	2	2	5	6	10	11	17	19	22	26	37	43	62	71	102	117	137	156	225	257	300	343
	25	1	1	2	2	5	6	12	13	17	19	26	29	34	43	70	80	105	119	154	175	231	262	336	381
	40	1	1	3	3	6	7	14	16	21	23	28	31	44	51	76	85	125	141	167	188	274	309	365	411
80	1	1	1	2	3	6	7	14	16	21	23	31	34	44	51	85	95	128	143	188	209	282	314	365	411
	5	1	1	2	3	6	7	14	16	21	23	31	34	45	51	85	95	128	142	188	209	282	314	365	411
	15	2	2	3	3	7	8	14	16	24	27	32	36	53	59	88	98	146	162	195	216	320	355	399	453
	25	2	2	3	4	7	9	20	20	33	34	44	45	64	68	122	124	182	186	267	272	388	422	476	529
100	1	1	2	3	3	7	8	16	17	26	29	35	39	52	58	97	107	145	160	214	235	321	355	409	462
	5	1	2	3	3	7	8	16	17	26	29	35	39	53	64	97	107	161	177	214	235	321	355	409	462
	10	2	2	3	3	8	9	18	20	27	29	36	39	61	65	100	108	165	178	220	238	327	361	415	468
	20	2	2	4	4	11	11	24	25	41	42	54	55	91	92	150	153	246	251	328	335	444	478	532	585
200	1	2	3	5	5	14	15	32	33	48	49	72	73	104	110	200	203	300	300	388	400	532	566	620	673
	5	3	3	5	6	15	15	34	35	57	58	76	77	124	128	210	213	317	317	405	417	550	584	638	691
	10	4	4	8	9	23	24	52	53	87	88	116	117	173	173	318	322	462	462	570	570	750	784	838	891
300	1	4	4	7	8	24	24	47	48	79	80	106	107	176	178	322	322	476	476	594	594	784	818	872	925
	3	4	4	9	9	24	25	55	55	82	83	121	123	181	183	322	322	476	476	594	594	784	818	872	925
	6	6	6	11	11	35	36	70	71	118	119	157	158	253	262	444	444	634	634	794	794	1034	1068	1122	1175
500	1	6	6	14	14	39	39	87	88	145	147	193	196	293	293	493	493	703	703	883	883	1133	1167	1221	1274
	2	7	8	14	15	46	46	91	92	153	154	203	205	303	303	503	503	713	713	893	893	1143	1177	1231	1284
	4	12	12	23	23	71	72	141	143	234	236	312	315	410	410	610	610	820	820	1030	1030	1280	1314	1368	1421
750	1	10	10	23	23	65	66	144	146	216	218	288	289	410	410	610	610	820	820	1030	1030	1280	1314	1368	1421
	2	14	14	28	28	87	87	173	174	286	289	376	377	510	510	710	710	920	920	1130	1130	1380	1414	1468	1521
1000	1	16	17	32	33	101	102	202	203	333	333	444	444	610	610	810	810	1020	1020	1230	1230	1480	1514	1568	1621
	2	26	26	57	57	155	157	340	343	510	510	670	670	870	870	1070	1070	1280	1280	1490	1490	1740	1774	1828	1881
2000	1	51	51	113	113	310	313	510	510	710	710	910	910	1110	1110	1310	1310	1520	1520	1730	1730	1980	2014	2068	2121

UNIVAC 9200 II System
Memory Size: 16K Bytes

UNISERVO VI C Subsystem: 9 Track
1 Control Unit
4 Tape Units

Table F-1. UNIVAC 9200 II System Sort Program Timing (Part 6 of 16)

Record Size (in bytes)	Blocking Factor	Volume (in thousands)																							
		1		2		5		10		15		20		30		50		75		100		150		200	
		10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30
20	1	1	0	1	0	3	0	6	0	10	0	14	0	23	0	38	0	57	0	86	0	129	0	172	0
	20	1	0	1	0	3	0	7	0	10	0	14	0	23	0	38	0	57	0	85	0	128	0	170	0
	50	1	0	1	0	3	0	7	0	10	0	13	0	23	0	38	0	64	0	85	0	128	0	190	0
	100	1	0	2	0	4	0	7	0	13	0	17	0	25	0	46	0	69	0	103	0	154	0	205	0
30	1	1	1	2	2	4	4	8	9	11	13	15	18	24	30	42	50	72	84	96	112	143	168	213	250
	20	1	1	2	2	3	4	8	9	11	13	17	20	25	29	41	49	70	82	94	110	140	164	210	245
	40	1	1	2	2	4	5	8	9	13	15	17	20	24	30	49	57	73	85	97	113	163	190	217	253
	60	1	1	2	2	4	5	9	11	14	16	18	21	31	35	51	59	76	88	114	131	170	197	227	262
50	1	1	1	2	2	4	5	9	10	13	15	20	23	33	34	57	65	85	97	113	130	191	218	255	290
	10	1	1	2	2	5	5	9	10	15	17	20	23	33	34	57	65	85	97	113	129	190	218	254	290
	25	1	1	2	2	5	5	11	12	16	18	21	24	36	40	59	67	88	100	133	150	198	225	265	300
	40	1	1	3	3	6	6	12	13	18	20	28	30	42	45	78	83	117	125	156	166	262	279	***	***
80	1	1	1	2	2	6	6	11	12	19	21	25	28	43	47	71	79	106	118	159	177	239	265	***	***
	5	1	1	2	2	6	6	13	14	19	21	25	28	43	47	71	79	106	118	159	177	238	265	***	***
	15	1	1	2	2	6	6	14	15	21	22	32	33	47	50	79	83	133	141	178	187	***	***	***	***
	25	2	2	3	4	9	10	18	19	31	32	42	43	62	64	118	121	177	181	265	271	***	***	***	***
100	1	2	2	3	3	7	7	15	16	22	23	29	31	51	53	84	88	143	150	190	200	***	***	***	***
	5	1	2	3	3	7	7	15	16	22	23	29	31	51	53	84	88	142	150	190	200	***	***	***	***
	10	2	2	3	3	7	7	16	17	24	25	37	38	55	56	103	106	155	159	206	212	***	***	***	***
	20	2	2	4	4	11	12	26	26	38	39	51	52	87	89	145	148	217	222	***	***	***	***	***	***
200	1	2	2	5	5	14	14	27	28	47	48	63	64	94	96	179	181	***	***	***	***	***	***	***	***
	5	2	2	5	5	15	15	34	35	51	52	68	70	117	119	195	198	***	***	***	***	***	***	***	***
	10	4	4	9	9	25	25	49	50	84	85	112	113	167	170	***	***	***	***	***	***	***	***	***	***
300	1	4	4	7	7	20	20	46	47	69	70	92	93	157	159	***	***	***	***	***	***	***	***	***	***
	3	4	4	7	7	21	21	49	50	73	74	112	114	164	170	***	***	***	***	***	***	***	***	***	***
	6	5	5	11	12	33	33	75	76	112	114	150	151	254	257	***	***	***	***	***	***	***	***	***	***
500	1	6	6	13	13	38	38	75	76	129	131	172	174	***	***	***	***	***	***	***	***	***	***	***	***
	2	6	6	14	14	41	42	95	96	141	143	189	191	***	***	***	***	***	***	***	***	***	***	***	***
	4	10	11	24	24	59	60	137	138	205	207	***	***	***	***	***	***	***	***	***	***	***	***	***	***
750	1	10	10	20	20	58	58	133	134	199	201	***	***	***	***	***	***	***	***	***	***	***	***	***	***
	2	12	13	29	29	82	83	163	165	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
1000	1	14	14	33	33	94	94	187	188	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
	2	24	24	48	48	137	138	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
2000	1	48	48	110	111	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***

UNISERVO VI C Subsystem: 9 Track
1 Control Unit
5 Tape Units

Table F-1. UNIVAC 9200 II System Sort Program Timing (Part 7 of 16)

UNIVAC 9200 II System
Memory Size: 16K Bytes

Volume (in thousands)

Record Size (in bytes)	Blocking Factor	Volume (in thousands)																							
		1		2		5		10		15		20		30		50		75		100		150		200	
		10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30
20	1	1	0	3	0	7	0	10	0	15	0	22	0	37	0	64	0	85	0	128	0	170	0	212	0
	20	1	0	4	0	7	0	10	0	15	0	22	0	37	0	64	0	85	0	127	0	169	0	212	0
	50	1	0	4	0	7	0	11	0	15	0	22	0	43	0	64	0	85	0	128	0	194	0	212	0
	100	1	0	4	0	8	0	12	0	16	0	23	0	47	0	70	0	106	0	159	0	212	0	212	0
30	1	1	1	4	5	7	9	13	15	17	20	25	29	41	49	71	84	94	112	141	168	215	256	256	256
	20	1	1	4	4	7	8	12	15	16	19	24	29	47	55	70	83	93	110	160	189	212	252	252	252
	40	1	1	4	5	9	10	13	15	17	20	25	30	49	57	73	86	97	114	166	196	221	261	261	261
	60	1	1	4	5	9	11	13	16	18	21	31	36	51	60	76	89	117	137	175	205	233	273	273	273
50	1	1	1	4	5	10	11	15	17	19	22	24	33	56	65	83	97	111	129	191	221	255	295	295	295
	10	1	1	4	5	10	11	15	17	19	22	34	39	56	65	83	97	111	129	191	221	255	295	295	295
	25	1	1	4	5	10	12	15	17	20	23	35	41	59	67	88	101	135	155	202	232	269	309	309	309
	40	1	2	6	7	12	13	22	23	29	31	43	46	82	88	123	131	164	175	245	262	295	309	309	309
80	1	1	1	5	6	12	14	18	20	24	27	41	47	69	78	103	116	158	179	238	268	295	309	309	309
	5	1	1	5	6	12	13	18	20	24	26	41	47	69	77	119	134	158	179	237	268	295	309	309	309
	15	1	1	7	7	14	14	24	25	32	34	47	50	78	83	136	144	182	192	237	268	295	309	309	309
	25	2	2	9	10	22	22	32	33	43	44	64	66	124	127	186	191	221	221	237	268	295	309	309	309
100	1	1	1	6	6	14	15	21	22	33	35	49	52	81	87	141	151	187	201	237	268	295	309	309	309
	5	1	1	6	8	14	15	21	22	33	35	49	52	81	87	141	151	187	201	237	268	295	309	309	309
	10	2	2	8	8	16	16	27	28	36	38	54	56	105	108	158	162	210	216	237	268	295	309	309	309
	20	2	2	11	11	26	27	39	40	52	54	74	74	152	156	228	234	268	268	237	268	295	309	309	309
200	1	3	3	13	13	30	31	45	46	60	62	90	92	176	180	228	234	268	268	237	268	295	309	309	309
	5	3	3	14	15	34	35	51	52	68	69	119	122	199	203	228	234	268	268	237	268	295	309	309	309
	10	4	4	25	26	50	51	88	90	118	120	174	180	228	234	268	268	268	268	237	268	295	309	309	309
300	1	3	3	18	19	44	45	66	67	88	89	155	157	228	234	268	268	268	268	237	268	295	309	309	309
	3	4	4	24	25	48	49	73	74	114	116	171	174	228	234	268	268	268	268	237	268	295	309	309	309
	6	6	6	33	34	66	67	117	119	156	159	228	234	268	268	268	268	268	268	237	268	295	309	309	309
500	1	6	6	36	37	72	74	124	130	170	173	228	234	268	268	268	268	268	268	237	268	295	309	309	309
	2	7	7	41	42	96	98	144	146	192	195	228	234	268	268	268	268	268	268	237	268	295	309	309	309
	4	10	11	62	62	145	147	218	221	228	234	268	268	268	268	268	268	268	268	237	268	295	309	309	309
750	1	10	10	57	58	134	136	201	204	228	234	268	268	268	268	268	268	268	268	237	268	295	309	309	309
	2	12	12	72	73	169	172	228	234	268	268	268	268	268	268	268	268	268	268	237	268	295	309	309	309
1000	1	14	14	95	97	190	193	228	234	268	268	268	268	268	268	268	268	268	268	237	268	295	309	309	309
	2	25	25	145	147	228	234	268	268	268	268	268	268	268	268	268	268	268	268	237	268	295	309	309	309
2000	1	49	50	116	118	228	234	268	268	268	268	268	268	268	268	268	268	268	268	237	268	295	309	309	309

UNIVAC 9200 II System
Memory Size: 16K Bytes

UNISERVO VI C Subsystem: 9 Track
1 Control Unit
6 Tape Units

Table F-1. UNIVAC 9200 II System Sort Program Timing (Part 8 of 16)

Record Size (in bytes)	Blocking Factor	Volume (in thousands)																							
		1		2		5		10		15		20		30		50		75		100		150		200	
		10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30
20	1	1	0	1	0	3	0	8	0	13	0	17	0	27	0	48	0	78	0	103	0	166	0	236	0
	20	1	0	1	0	4	0	8	0	12	0	16	0	27	0	48	0	77	0	111	0	165	0	235	0
	50	1	0	1	0	4	0	8	0	12	0	16	0	27	0	48	0	77	0	110	0	176	0	235	0
	100	1	0	2	0	4	0	8	0	12	0	18	0	24	0	51	0	82	0	109	0	174	0	247	0
30	1	1	1	2	2	4	5	8	10	14	16	20	23	27	34	57	66	86	99	123	142	197	227	262	303
	20	1	1	2	2	4	5	8	10	13	16	19	22	37	36	56	65	91	105	121	139	194	224	275	317
	40	1	1	2	2	4	5	9	11	15	17	19	22	32	36	56	65	91	105	121	139	194	224	275	317
	60	1	1	2	2	4	5	9	11	15	17	19	22	31	36	56	65	91	105	129	149	207	238	275	317
50	1	1	1	2	2	5	6	11	12	17	20	23	26	34	43	68	76	109	123	156	176	250	281	332	375
	10	1	1	2	2	5	6	11	12	17	20	25	28	38	42	67	76	109	123	156	176	249	280	332	375
	25	1	1	2	2	5	6	11	12	17	20	25	28	41	46	73	82	117	132	156	176	249	280	353	398
	40	1	1	2	2	5	6	12	13	19	21	25	28	40	45	72	81	116	130	165	185	247	277	350	394
80	1	1	1	2	3	6	7	14	16	23	26	31	34	50	55	90	99	145	160	207	228	311	341	441	485
	5	1	1	2	3	7	7	14	16	23	26	31	34	53	55	90	99	145	160	207	228	331	363	441	485
	15	1	1	2	3	7	7	14	16	23	26	34	37	54	60	97	107	145	160	207	228	331	363	441	485
	25	1	1	2	3	7	7	16	17	23	26	34	37	54	60	97	107	156	171	207	228	331	363	468	515
100	1	1	2	3	3	8	8	16	18	26	29	38	42	62	67	110	120	165	180	236	256	377	410	515	515
	5	1	2	3	3	8	8	16	18	26	29	38	42	62	67	110	120	177	193	236	256	377	410	515	515
	10	1	2	3	3	8	8	18	19	26	29	38	42	62	67	110	120	177	193	236	256	377	410	515	515
	20	2	2	3	3	8	9	18	19	29	31	38	42	67	67	110	120	177	193	252	273	400	435	515	515
200	1	2	4	5	5	13	14	31	32	46	48	66	69	107	111	191	199	305	318	338	338	435	435	515	515
	5	2	5	5	5	13	14	31	32	50	52	66	69	107	111	191	199	305	318	338	338	435	435	515	515
	10	2	5	5	5	14	15	31	32	50	52	71	74	115	119	204	212	325	338	338	338	435	435	515	515
300	1	3	7	7	7	21	21	45	45	73	73	105	106	164	170	300	303	338	338	338	338	435	435	515	515
	3	3	7	7	7	21	21	48	49	78	79	104	105	164	170	299	302	338	338	338	338	435	435	515	515
	6	3	8	8	8	23	23	48	49	78	79	112	113	164	170	299	302	338	338	338	338	435	435	515	515
500	1	6	12	12	12	37	37	86	86	128	129	184	185	295	297	338	338	338	338	338	338	435	435	515	515
	2	6	12	12	12	37	37	86	86	138	139	184	185	295	297	338	338	338	338	338	338	435	435	515	515
	4	6	14	14	14	40	40	86	86	138	139	197	198	315	317	338	338	338	338	338	338	435	435	515	515
750	1	9	20	20	20	59	59	137	138	205	206	293	295	338	338	338	338	338	338	338	338	435	435	515	515
	2	9	22	22	22	59	59	137	138	220	221	293	295	338	338	338	338	338	338	338	338	435	435	515	515
1000	1	13	29	29	29	85	85	182	182	292	294	338	338	338	338	338	338	338	338	338	338	435	435	515	515
	2	13	32	32	32	85	85	195	195	312	313	338	338	338	338	338	338	338	338	338	338	435	435	515	515
2000	1	31	67	67	67	194	194	338	338	338	338	338	338	338	338	338	338	338	338	338	338	435	435	515	515

UNISERVO VI C Subsystem: 9 Track
1 Control Unit
3 Tape Units

Table F-1. UNIVAC 9200 II System Sort Program Timing (Part 9 of 16)

UNIVAC 9200 II System
Memory Size: 24K Bytes

Record Size (in bytes)	Blocking Factor	Volume (in thousands)																								
		1		2		5		10		15		20		30		50		75		100		150		200		
		10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	
20	1	0	1	0	1	0	3	0	6	0	13	0	23	0	37	0	62	0	83	0	138	0	183	0	0	
20	20	1	0	1	0	3	0	7	0	10	0	22	0	37	0	62	0	82	0	137	0	182	0	0	0	
50	50	1	0	1	0	3	0	7	0	10	0	22	0	41	0	62	0	82	0	137	0	182	0	0	0	
100	100	1	0	1	0	3	0	7	0	10	0	22	0	42	0	62	0	92	0	137	0	201	0	0	0	
30	1	1	1	2	2	3	4	7	9	11	13	16	19	24	29	34	45	54	68	81	100	119	150	179	200	238
20	20	1	1	2	3	4	7	9	11	13	16	19	24	29	34	45	54	68	80	100	119	150	178	220	261	
40	40	1	1	2	3	4	7	9	12	14	16	19	24	28	32	44	53	66	79	99	117	148	175	217	257	
60	60	1	1	2	3	4	7	9	12	14	16	19	27	32	44	53	74	88	99	117	148	175	217	257	0	
50	1	1	1	2	2	4	4	8	10	14	16	19	22	31	36	52	60	87	101	116	134	192	222	256	296	
10	10	1	1	2	2	4	5	8	10	14	16	19	21	31	36	52	60	87	101	116	134	192	222	255	295	
25	25	1	1	2	2	4	5	10	11	14	16	19	25	31	36	52	60	87	101	116	134	192	222	255	295	
40	40	1	1	2	2	4	5	10	11	14	16	21	24	31	36	58	67	87	101	128	148	192	222	256	296	
80	1	1	1	2	2	5	6	11	13	17	19	26	29	34	43	71	80	106	120	157	177	235	266	313	354	
5	5	1	1	2	2	5	6	11	13	17	19	25	28	34	42	70	79	105	118	155	175	233	262	310	350	
15	15	1	1	2	2	5	6	11	13	17	19	25	28	34	42	70	79	105	118	155	175	233	262	341	384	
25	25	1	1	2	2	5	6	11	13	19	22	25	29	42	48	70	79	117	132	156	176	257	290	343	386	
100	1	1	1	2	2	6	6	13	14	19	21	28	31	42	47	79	88	118	131	175	195	262	291	341	386	
5	5	1	1	2	2	6	6	13	14	21	24	28	31	47	53	79	88	131	146	175	194	262	291	341	386	
10	10	1	1	2	2	6	6	13	14	21	24	28	31	47	53	79	88	131	146	175	194	288	321	341	386	
20	20	1	1	2	2	7	7	13	14	21	24	28	32	44	53	79	88	132	146	175	195	290	322	341	386	
200	1	2	2	4	4	10	10	22	23	32	35	49	52	73	78	136	145	204	217	241	262	291	341	386		
5	5	2	2	4	4	10	10	22	23	32	35	49	52	73	78	136	145	204	217	241	262	291	341	386		
10	10	2	2	4	4	10	10	22	23	37	39	49	52	83	88	137	146	228	241	262	291	341	386	0		
300	1	3	3	5	5	14	14	31	32	53	54	71	72	119	121	198	201	262	275	301	322	341	386	0		
3	3	3	3	5	5	16	16	31	32	53	54	71	72	119	121	198	201	262	275	301	322	341	386	0		
6	6	3	3	6	6	16	16	36	36	53	54	79	80	119	120	219	222	262	275	301	322	341	386	0		
500	1	4	4	9	9	25	26	58	58	86	87	129	130	194	195	262	275	301	322	341	386	341	386	0		
2	2	4	4	9	9	25	26	58	58	86	87	129	130	194	195	262	275	301	322	341	386	341	386	0		
4	4	5	5	9	9	29	30	58	59	98	99	130	132	217	219	262	275	301	322	341	386	341	386	0		
750	1	7	7	15	15	43	43	96	96	143	144	191	192	262	275	301	322	341	386	341	386	341	386	0		
2	2	7	7	15	15	43	43	96	96	143	144	213	214	262	275	301	322	341	386	341	386	341	386	0		
1000	1	9	9	20	20	57	57	127	128	190	191	262	275	301	322	341	386	341	386	341	386	341	386	0		
2	2	9	9	20	20	57	58	129	129	214	216	262	275	301	322	341	386	341	386	341	386	341	386	0		
2000	1	20	20	45	46	128	128	262	275	301	322	341	386	341	386	341	386	341	386	341	386	341	386	0		

UNISERVO VI C Subsystem: 9 Track
1 Control Unit
4 Tape Units

Table F-1. UNIVAC 9200 II System Sort Program Timing (Part 10 of 16)

UNIVAC 9200 II System
Memory Size: 24K Bytes

Record Size (in bytes)	Blocking Factor	Volume (in thousands)																							
		1		2		5		10		15		20		30		50		75		100		150		200	
		10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30
20	1	1	0	1	0	3	0	6	0	9	0	12	0	20	0	33	0	56	0	75	0	111	0	167	0
20	20	1	0	1	0	3	0	6	0	9	0	12	0	20	0	33	0	56	0	74	0	111	0	166	0
50	50	1	0	1	0	3	0	6	0	9	0	13	0	20	0	33	0	56	0	74	0	111	0	166	0
100	100	1	0	1	0	3	0	6	0	9	0	13	0	20	0	37	0	56	0	74	0	125	0	166	0
30	1	1	1	1	2	3	3	6	8	9	11	15	17	22	26	36	42	61	72	81	96	137	162	182	216
30	20	1	1	1	2	3	3	6	8	9	11	14	17	21	25	41	48	61	72	81	96	136	161	181	215
40	40	1	1	1	2	3	4	6	7	11	13	14	17	21	25	40	47	59	70	79	94	134	158	178	211
60	60	1	1	1	2	3	4	6	7	11	13	14	17	21	25	40	47	60	71	79	94	134	159	179	212
50	1	1	1	2	2	4	4	7	8	12	14	16	19	24	28	46	54	70	80	92	107	158	182	210	242
50	10	1	1	2	2	4	4	7	8	12	14	16	19	24	28	46	54	69	80	105	121	157	182	209	242
25	25	1	1	2	2	4	4	8	10	12	14	16	19	24	32	46	54	69	80	105	121	157	182	209	242
40	40	1	1	2	2	4	4	8	10	12	14	16	19	24	33	47	54	79	92	106	122	158	183	211	244
80	1	1	1	2	2	4	5	10	11	15	17	20	22	34	38	56	64	96	109	128	145	192	217	288	325
80	5	1	1	2	2	4	5	10	11	15	17	20	22	34	38	56	64	96	109	128	145	192	217	288	325
150	150	1	1	2	2	4	5	10	11	15	16	23	25	34	38	56	63	95	107	127	143	190	214	285	320
250	250	1	1	2	2	4	5	10	11	15	17	23	26	34	38	64	72	96	108	128	144	217	243	289	324
100	1	1	1	2	2	5	5	11	12	16	18	25	28	38	42	62	69	107	119	142	159	213	237	288	325
100	5	1	1	2	2	5	5	11	12	16	18	25	28	38	42	62	69	107	119	142	158	241	268	288	325
100	10	1	1	2	2	5	5	11	12	16	18	25	28	38	42	71	79	107	119	142	158	241	268	288	325
200	20	1	1	2	2	6	6	11	12	19	21	26	28	38	42	72	80	108	120	144	160	244	271	288	325
200	1	2	2	3	3	9	9	20	21	30	31	40	41	69	71	114	118	171	176	200	200	200	200	200	200
200	5	2	2	3	3	9	9	20	21	30	31	40	41	69	71	114	118	194	200	200	200	200	200	200	200
200	10	2	2	3	3	9	9	21	21	31	32	41	42	71	73	118	121	202	206	200	200	200	200	200	200
300	1	2	2	4	4	12	13	29	29	43	44	67	68	100	101	166	168	200	200	200	200	200	200	200	200
300	3	2	2	5	5	12	13	29	29	43	44	67	68	100	101	189	192	200	200	200	200	200	200	200	200
300	6	2	2	15	15	15	15	29	30	51	52	68	69	102	103	193	196	200	200	200	200	200	200	200	200
500	1	4	4	23	24	46	47	81	82	119	120	159	160	200	200	200	200	200	200	200	200	200	200	200	200
500	2	4	4	23	24	46	47	81	82	119	120	159	160	200	200	200	200	200	200	200	200	200	200	200	200
500	4	4	4	24	25	56	57	84	85	112	113	192	194	200	200	200	200	200	200	200	200	200	200	200	200
750	1	6	6	34	34	80	80	119	120	159	160	200	200	200	200	200	200	200	200	200	200	200	200	200	200
750	2	6	6	34	35	80	81	120	121	183	185	200	200	200	200	200	200	200	200	200	200	200	200	200	200
1000	1	8	8	53	53	105	106	181	182	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
1000	2	8	8	55	55	110	110	189	190	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
2000	1	19	19	108	109	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200

UNIVAC 9200 II System
Memory Size: 24K Bytes

UNISERVO VI C Subsystem: 9 Track
1 Control Unit
5 Tape Units

Table F-1. UNIVAC 9200 II System Sort Program Timing (Part 11 of 16)

Record Size (in bytes)	Blocking Factor	Volume (in thousands)																							
		1		2		5		10		15		20		30		50		75		100		150		200	
		10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30
20	1	1	0	1	0	3	0	5	0	10	0	13	0	14	0	36	0	54	0	72	0	108	0	165	0
20	20	1	0	1	0	3	0	5	0	9	0	12	0	15	0	36	0	54	0	71	0	123	0	164	0
50	50	1	0	1	0	3	0	6	0	9	0	12	0	14	0	36	0	54	0	71	0	123	0	164	0
100	100	1	0	1	0	3	0	7	0	10	0	13	0	19	0	36	0	54	0	72	0	124	0	165	0
30	1	1	1	1	1	3	4	7	8	10	12	13	16	20	24	39	47	58	70	77	93	134	161	178	215
30	20	1	1	1	1	3	4	7	8	10	12	13	16	23	28	39	47	58	70	77	93	133	161	178	214
40	40	1	1	1	1	3	4	7	8	10	12	13	16	23	28	39	47	58	70	89	107	133	161	178	214
60	60	1	1	1	2	3	4	7	8	10	12	13	16	23	28	38	46	57	69	88	106	132	159	176	211
50	1	1	1	2	2	3	4	8	9	11	13	15	18	27	31	44	52	66	77	102	120	153	180	204	239
50	10	1	1	2	2	3	4	8	9	11	13	15	18	27	31	44	52	66	77	102	120	153	180	204	239
50	25	1	1	2	2	4	5	8	9	11	13	18	21	27	31	44	52	77	90	102	120	153	179	204	239
40	40	1	1	2	2	4	5	8	9	11	13	18	21	27	31	44	52	77	91	103	121	154	181	206	241
80	1	1	1	2	2	5	5	9	10	16	18	21	24	32	36	53	60	92	106	123	141	184	211	282	323
80	5	1	1	2	2	5	5	9	10	16	18	21	24	32	36	53	60	92	106	123	141	184	211	282	323
15	15	1	1	2	2	5	5	9	10	16	18	21	24	32	36	61	70	91	104	121	139	182	208	279	319
25	25	1	1	2	2	5	5	9	10	16	18	21	24	32	36	62	71	93	106	124	141	213	243	319	319
100	1	1	1	2	2	5	6	10	11	18	20	23	26	35	39	68	77	102	115	136	153	203	229	319	319
100	5	1	1	2	2	5	6	10	11	18	20	23	26	35	39	68	77	102	115	136	153	203	229	319	319
10	10	1	1	2	2	5	6	10	11	18	20	23	26	35	39	68	77	102	115	136	153	203	229	319	319
200	20	2	2	4	4	8	8	18	19	27	28	36	36	64	67	106	111	159	167	203	203	239	269	319	319
200	5	2	2	4	4	8	8	18	19	27	28	36	45	64	67	106	111	185	193	203	203	239	269	319	319
10	10	2	2	4	4	10	10	19	20	28	29	45	46	67	69	112	115	195	200	203	203	239	269	319	319
300	1	2	2	5	5	13	14	26	27	46	47	62	63	92	94	154	157	203	203	203	203	239	269	319	319
300	3	2	2	5	5	13	14	26	27	46	47	62	63	92	94	179	183	203	203	203	203	239	269	319	319
500	6	3	3	5	5	14	14	27	27	48	49	64	65	96	98	186	190	203	203	203	203	239	269	319	319
500	1	4	4	7	7	21	21	50	51	75	76	99	101	149	151	203	203	203	203	203	203	239	269	319	319
500	2	4	4	7	7	21	21	50	51	75	76	99	101	175	177	203	203	203	203	203	203	239	269	319	319
750	4	4	4	9	9	22	22	53	54	79	80	105	107	185	188	203	203	203	203	203	203	239	269	319	319
750	1	5	5	13	13	31	31	74	74	110	111	147	148	203	203	203	203	203	203	203	203	239	269	319	319
750	2	5	5	13	13	38	38	75	76	113	114	176	178	203	203	203	203	203	203	203	203	239	269	319	319
1000	1	7	7	16	17	49	49	97	98	171	173	203	203	203	203	203	203	203	203	203	203	239	269	319	319
1000	2	9	9	17	18	52	52	103	104	182	184	203	203	203	203	203	203	203	203	203	203	239	269	319	319
2000	1	17	17	41	42	102	103	203	203	203	203	203	203	203	203	203	203	203	203	203	203	239	269	319	319

UNISERVO VI C Subsystem: 9 Track
1 Control Unit
6 Tape Units

Table F-1. UNIVAC 9200 II System Sort Program Timing (Part 12 of 16)

UNIVAC 9200 II System
Memory Size: 24K Bytes

Record Size (in bytes)	Blocking Factor	Volume (in thousands)																							
		1		2		5		10		15		20		30		50		75		100		150		200	
		10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30
20	1	0	1	0	0	3	0	7	0	12	0	15	0	25	0	45	0	72	0	96	0	155	0	222	0
	20	1	0	1	0	3	0	7	0	11	0	15	0	25	0	44	0	72	0	103	0	154	0	221	0
	50	1	0	1	0	3	0	7	0	11	0	15	0	25	0	44	0	72	0	103	0	166	0	221	0
	100	1	0	1	0	3	0	7	0	11	0	16	0	24	0	47	0	71	0	102	0	163	0	218	0
30	1	1	1	2	4	4	4	8	9	12	14	18	21	29	34	52	61	78	91	113	131	181	210	242	280
	20	1	1	2	4	4	4	8	10	12	14	18	21	29	34	52	61	84	98	112	130	181	210	258	298
	40	1	1	2	4	4	4	8	10	12	14	18	21	29	34	52	61	84	98	112	130	181	210	257	298
	60	1	1	2	4	4	4	8	10	14	16	18	21	29	34	52	61	84	98	112	130	181	210	257	298
50	1	1	1	2	5	5	5	10	11	16	18	23	26	34	39	62	70	100	114	144	163	231	262	308	349
	10	1	1	2	5	5	5	10	11	16	18	23	26	34	39	67	76	100	114	144	163	231	262	308	349
	25	1	1	2	5	5	5	10	11	16	18	23	26	37	42	67	76	108	123	144	163	231	262	329	372
	40	1	1	2	5	5	5	11	12	16	18	23	26	37	42	66	75	107	121	142	161	229	259	325	367
80	1	1	2	2	6	7	7	13	14	21	23	28	31	46	50	82	91	133	147	190	210	305	337	407	449
	5	1	2	2	6	7	7	13	14	21	23	28	31	46	50	82	91	133	147	190	210	305	336	406	449
	15	1	2	2	6	7	7	13	14	21	23	31	34	46	50	89	98	133	147	190	210	305	336	406	449
	25	1	2	2	6	7	7	13	14	21	23	31	34	46	50	89	98	133	147	190	210	305	336	406	449
100	1	1	2	2	6	7	7	13	14	21	23	31	34	50	55	89	98	143	158	190	210	305	336	433	478
	5	1	2	3	7	7	7	14	16	24	26	34	38	54	61	101	110	150	164	216	236	346	377	492	536
	10	1	2	3	7	7	7	14	16	24	26	34	38	54	61	100	110	162	177	216	235	346	377	491	536
	20	1	2	3	7	7	7	16	17	24	26	34	38	56	61	100	110	162	177	216	235	346	377	491	536
200	1	2	4	4	11	12	13	27	29	40	43	58	62	95	100	170	180	274	289	364	385	411	411	411	411
	5	2	4	5	11	12	13	27	29	44	46	58	62	95	100	170	180	274	289	389	411	411	411	411	411
	10	2	4	5	12	13	13	27	29	44	46	63	67	95	100	170	180	274	289	389	411	411	411	411	411
300	1	3	6	6	17	17	17	38	38	61	62	89	90	144	145	257	260	389	389	389	389	389	389	389	389
	3	3	6	6	17	17	17	41	42	61	62	89	90	144	145	257	260	389	389	389	389	389	389	389	389
	6	3	6	6	17	17	17	41	42	67	68	89	90	144	145	257	260	389	389	389	389	389	389	389	389
500	1	5	10	10	31	31	31	73	73	109	110	157	158	253	255	445	445	666	666	666	666	666	666	666	666
	2	5	10	10	31	31	31	73	73	117	118	157	158	252	254	445	445	666	666	666	666	666	666	666	666
	4	5	11	11	34	34	34	73	73	117	118	157	158	252	254	445	445	666	666	666	666	666	666	666	666
750	1	8	17	17	50	50	50	107	108	175	175	250	252	445	445	666	666	666	666	666	666	666	666	666	666
	2	8	17	17	50	50	50	116	117	188	189	250	252	445	445	666	666	666	666	666	666	666	666	666	666
1000	1	10	24	24	72	72	72	155	155	249	250	356	358	555	555	888	888	888	888	888	888	888	888	888	888
	2	11	24	24	72	72	72	155	155	249	250	356	358	555	555	888	888	888	888	888	888	888	888	888	888
2000	1	24	57	57	154	154	154	354	355	555	555	888	888	1111	1111	1666	1666	1666	1666	1666	1666	1666	1666	1666	1666

UNIVAC 9200 II System
Memory Size: 32K Bytes

UNISERVO VI C Subsystem: 9 Track
1 Control Unit
3 Tape Units

Table F-1. UNIVAC 9200 II System Sort Program Timing (Part 13 of 16)

Record Size (in bytes)	Blocking Factor	Volume (in thousands)																								
		1		2		5		10		15		20		30		50		75		100		150		200		
		10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	
20	1	0	1	0	1	0	3	0	6	0	9	0	14	0	20	0	38	0	56	0	84	0	125	0	184	0
20	20	1	0	1	0	3	0	6	0	9	0	13	0	20	0	37	0	56	0	83	0	124	0	183	0	0
50	50	1	0	1	0	3	0	6	0	10	0	13	0	20	0	37	0	56	0	83	0	124	0	183	0	0
100	100	1	0	1	0	3	0	6	0	10	0	13	0	22	0	37	0	61	0	81	0	122	0	180	0	0
30	1	1	1	2	2	3	4	6	7	11	13	14	17	24	29	40	47	67	79	89	106	148	176	197	235	0
20	20	1	1	2	2	3	4	6	7	11	13	14	17	24	28	39	47	67	79	88	105	147	176	196	234	0
40	40	1	1	2	2	3	4	6	7	11	13	14	17	24	28	39	47	66	79	88	105	147	176	196	234	0
60	60	1	1	2	2	3	4	7	9	11	13	14	17	24	28	39	47	66	79	88	105	147	176	196	234	0
50	1	1	2	2	2	4	4	8	10	12	14	19	22	28	32	52	60	77	90	115	133	171	200	229	266	0
10	10	1	1	2	2	4	4	8	10	12	14	18	22	27	32	51	60	77	90	114	133	171	199	228	266	0
25	25	1	1	2	2	4	4	8	10	12	14	18	22	27	32	51	60	77	90	114	133	171	199	252	294	0
40	40	1	1	2	2	4	4	8	9	12	14	18	21	27	31	51	59	76	88	113	131	169	196	249	289	0
80	1	1	2	2	2	4	5	10	11	16	19	22	25	37	42	61	70	103	117	137	155	228	258	304	344	0
5	5	1	1	2	2	4	5	10	11	16	19	22	25	37	42	61	69	103	117	137	155	228	258	304	344	0
15	15	1	1	2	2	5	6	10	11	16	19	22	25	37	42	61	69	103	117	137	155	228	258	304	344	0
25	25	1	1	2	2	5	6	10	11	16	19	22	25	37	42	61	69	103	117	137	155	228	258	304	344	0
100	1	1	2	2	2	6	6	11	12	18	20	24	27	41	46	68	76	115	129	153	171	255	285	304	344	0
5	5	1	1	2	2	6	6	12	14	18	20	24	27	41	46	68	76	115	129	153	171	255	285	304	344	0
10	10	1	1	2	2	6	6	12	14	18	20	24	27	41	46	77	86	115	129	153	171	255	285	304	344	0
20	20	1	1	2	2	6	6	12	14	18	20	28	31	41	46	77	86	115	129	153	171	255	285	304	344	0
200	1	2	3	3	3	8	9	18	20	31	33	41	45	70	75	116	125	194	209	255	285	304	344	0	0	
5	5	2	3	3	3	9	10	18	20	31	33	41	45	70	75	116	125	194	209	255	285	304	344	0	0	
10	10	2	3	4	4	9	10	18	20	31	33	41	45	70	75	116	125	194	209	255	285	304	344	0	0	
300	1	2	5	5	5	13	13	28	29	42	44	64	66	96	99	178	184	255	285	304	344	0	0	0	0	
3	3	2	5	5	5	13	13	28	29	42	44	64	66	96	99	178	184	255	285	304	344	0	0	0	0	
6	6	2	5	5	5	13	13	28	29	42	44	64	66	96	99	178	184	255	285	304	344	0	0	0	0	
500	1	4	7	7	7	23	23	46	46	78	78	103	104	174	175	304	344	0	0	0	0	0	0	0	0	
2	2	4	7	7	7	23	23	46	46	78	78	103	104	174	175	304	344	0	0	0	0	0	0	0	0	
4	4	4	7	7	7	23	23	46	46	78	78	103	104	174	175	304	344	0	0	0	0	0	0	0	0	
750	1	5	12	12	12	34	34	76	77	114	115	172	172	304	344	0	0	0	0	0	0	0	0	0	0	
2	2	5	12	12	12	34	34	76	77	114	115	172	172	304	344	0	0	0	0	0	0	0	0	0	0	
1000	1	7	15	16	16	44	45	101	102	171	171	304	344	0	0	0	0	0	0	0	0	0	0	0	0	
2	2	8	15	16	16	51	51	101	102	170	171	304	344	0	0	0	0	0	0	0	0	0	0	0	0	
2000	1	18	35	35	35	113	113	255	285	304	344	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

UNIVAC 9200 II System
Memory Size: 32K Bytes

UNISERVO VI C Subsystem: 9 Track
1 Control Unit
4 Tape Units

Table F-1. UNIVAC 9200 II System Sort Program Timing (Part 14 of 16)

		Volume (in thousands)																							
		Key Size (in bytes)																							
Record Size (in bytes)	Blocking Factor	1		2		5		10		15		20		30		50		75		100		150		200	
		10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30
20	1	1	0	1	0	3	0	5	0	9	0	12	0	17	0	33	0	50	0	66	0	112	0	149	0
	20	1	0	1	0	3	0	5	0	9	0	12	0	17	0	33	0	49	0	65	0	111	0	148	0
	50	1	0	1	0	3	0	5	0	9	0	12	0	17	0	33	0	49	0	65	0	111	0	148	0
	100	1	0	1	0	3	0	6	0	9	0	11	0	20	0	32	0	48	0	73	0	109	0	145	0
30	1	1	1	1	1	3	3	6	8	9	11	12	15	21	25	35	42	52	62	80	94	119	141	159	188
	20	1	1	1	1	3	3	6	7	9	11	12	14	21	25	35	41	60	71	79	94	119	141	158	188
	40	1	1	1	1	3	3	6	7	9	11	12	14	21	25	35	41	60	71	79	94	119	141	158	188
	60	1	1	1	1	3	3	6	7	9	11	12	14	21	25	35	41	60	71	79	94	119	141	178	211
50	1	1	1	2	2	3	4	7	8	11	12	16	19	24	28	40	47	69	80	92	107	137	160	207	241
	10	1	1	2	2	3	4	7	8	11	12	16	19	24	28	40	46	69	80	91	106	155	180	206	240
	25	1	1	2	2	3	4	7	8	10	12	16	19	24	28	46	53	69	80	91	106	155	180	206	240
	40	1	1	2	2	4	4	7	8	12	14	16	19	24	28	46	53	69	80	91	106	155	180	206	240
80	1	1	1	2	2	4	5	8	9	14	16	19	22	24	32	55	62	81	92	109	123	185	210	247	280
	5	1	1	2	2	4	5	8	9	14	16	19	22	24	32	54	62	81	92	108	123	185	210	247	280
	15	1	1	2	2	4	5	8	9	14	16	19	22	24	32	54	62	81	92	124	140	185	210	247	280
	25	1	1	2	2	4	5	10	11	14	16	19	22	33	37	54	62	81	92	124	140	185	210	247	280
100	1	1	1	2	2	5	5	11	12	16	18	21	24	37	41	61	68	91	102	138	154	207	232	300	300
	5	1	1	2	2	5	5	11	12	16	18	21	24	37	41	61	68	91	102	138	154	207	232	300	300
	10	1	2	3	3	7	7	16	17	23	25	37	39	55	59	105	113	156	169	207	232	300	300	300	300
200	5	1	2	3	3	8	8	16	17	28	30	37	39	55	59	105	113	156	169	207	232	300	300	300	300
	10	1	2	3	3	8	9	16	17	28	30	37	39	55	59	105	113	156	169	207	232	300	300	300	300
300	1	2	2	4	4	11	11	22	22	38	39	51	52	76	78	147	149	156	169	207	232	300	300	300	300
	3	2	2	4	4	11	11	26	26	38	39	51	52	88	90	147	149	156	169	207	232	300	300	300	300
	6	2	2	4	4	11	11	26	26	38	39	51	52	88	90	147	149	156	169	207	232	300	300	300	300
500	1	3	3	6	6	17	18	41	42	61	62	95	96	143	144	207	232	300	300	300	300	300	300	300	300
	2	3	3	7	7	17	18	41	42	61	62	95	96	143	144	207	232	300	300	300	300	300	300	300	300
	4	3	3	7	7	17	18	41	41	61	62	95	96	142	144	207	232	300	300	300	300	300	300	300	300
750	1	4	4	10	11	30	31	60	61	105	106	140	141	207	232	300	300	300	300	300	300	300	300	300	300
	2	4	4	10	11	30	31	60	61	105	106	140	141	207	232	300	300	300	300	300	300	300	300	300	300
1000	1	7	7	14	14	40	40	93	94	139	140	207	232	300	300	300	300	300	300	300	300	300	300	300	300
	2	7	7	14	14	40	40	93	93	139	140	207	232	300	300	300	300	300	300	300	300	300	300	300	300
2000	1	13	13	32	32	92	92	207	232	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300

UNIVAC 9200 II System
Memory Size: 32K Bytes

UNISERVO VI C Subsystem: 9 Track
1 Control Unit
5 Tape Units

Table F-1. UNIVAC 9200 II System Sort Program Timing (Part 15 of 16)

Record Size (in bytes)	Blocking Factor	Volume (in thousands)																							
		1		2		5		10		15		20		30		50		75		100		150		200	
		10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30
20	1	1	0	1	0	3	0	6	0	8	0	13	0	14	0	31	0	54	0	72	0	108	0	144	0
20	20	1	0	3	0	6	0	10	0	8	0	13	0	19	0	31	0	54	0	72	0	107	0	143	0
50	50	1	0	3	0	6	0	10	0	8	0	13	0	19	0	31	0	54	0	72	0	107	0	143	0
100	100	1	0	3	0	6	0	10	0	10	0	13	0	19	0	31	0	54	0	72	0	107	0	143	0
30	1	1	1	3	4	6	7	10	12	10	12	13	16	20	24	32	39	57	69	76	92	114	137	175	211
30	20	1	1	3	4	6	7	10	12	10	12	13	16	20	23	38	46	57	69	76	91	113	137	174	210
40	40	1	1	3	4	6	7	10	12	10	12	13	16	20	23	38	46	57	68	75	91	113	136	174	210
60	60	1	1	3	4	6	7	10	12	10	12	13	16	20	23	38	46	57	68	75	91	113	136	174	210
50	1	1	1	3	4	6	7	10	12	10	12	13	16	22	26	44	51	65	77	87	102	150	177	200	237
50	10	1	1	3	4	6	7	10	12	10	12	13	16	22	26	43	51	65	77	86	102	150	177	200	236
50	25	1	1	3	4	6	7	10	12	10	12	13	16	22	26	43	51	65	77	86	102	150	177	200	236
80	40	1	1	3	4	6	7	10	12	10	12	13	16	26	31	43	51	65	77	100	118	150	177	200	236
80	1	1	1	4	4	9	10	13	15	13	15	17	20	31	35	51	58	76	87	118	136	177	203	236	271
80	5	1	1	4	4	9	10	13	15	13	15	17	20	31	35	51	58	76	87	118	136	177	203	236	271
100	15	1	1	4	4	9	10	13	15	13	15	17	20	31	35	51	58	89	102	118	136	177	203	236	271
100	25	1	1	4	4	9	10	13	15	13	15	17	20	31	35	51	58	89	102	118	136	177	203	236	271
100	1	1	1	4	5	10	11	14	16	14	16	23	26	34	38	56	64	98	112	131	149	196	223	271	
100	5	1	1	5	6	10	11	14	16	14	16	23	26	34	38	56	64	98	112	131	149	196	223	271	
100	10	1	1	5	6	10	11	14	16	14	16	23	26	34	38	56	64	98	112	131	149	196	223	271	
200	20	1	1	5	6	10	11	14	16	14	16	23	26	34	38	56	64	98	112	131	149	196	223	271	
200	1	2	2	7	8	17	18	25	27	33	36	44	54	70	82	118	137	175	203	236	271	336	400	471	
200	5	2	2	7	8	17	18	25	27	33	36	44	54	70	82	118	137	175	203	236	271	336	400	471	
200	10	2	2	7	8	17	18	25	27	33	36	44	54	70	82	118	137	175	203	236	271	336	400	471	
300	1	2	2	7	8	17	18	25	27	33	36	44	54	70	82	118	137	175	203	236	271	336	400	471	
300	3	2	2	7	8	17	18	25	27	33	36	44	54	70	82	118	137	175	203	236	271	336	400	471	
300	6	2	2	7	8	17	18	25	27	33	36	44	54	70	82	118	137	175	203	236	271	336	400	471	
500	1	3	3	6	6	18	19	36	37	65	66	86	88	129	131	196	206	336	366	446	516	616	716	816	
500	2	3	3	6	6	18	19	36	37	65	66	86	88	129	131	196	206	336	366	446	516	616	716	816	
500	4	3	3	6	6	18	19	36	37	65	66	86	88	129	131	196	206	336	366	446	516	616	716	816	
750	1	5	5	9	9	27	27	64	64	95	96	127	128	196	206	336	366	446	516	616	716	816	916	1016	
750	2	5	5	9	9	27	27	64	64	95	96	127	128	196	206	336	366	446	516	616	716	816	916	1016	
1000	1	6	6	14	14	35	35	84	85	126	127	166	167	236	246	376	406	516	546	646	716	816	916	1016	
1000	2	6	6	14	14	35	35	84	85	126	127	166	167	236	246	376	406	516	546	646	716	816	916	1016	
2000	1	14	14	28	28	84	84	196	206	336	366	446	516	616	716	816	916	1016	1116	1216	1316	1416	1516	1616	

UNIVAC 9200 II System
Memory Size: 32K Bytes

UNISERVO VI C Subsystem: 9 Track
1 Control Unit
6 Tape Units

Table F-1. UNIVAC 9200 II System Sort Program Timing (Part 16 of 16)

Record Size (in bytes)	Blocking Factor	Volume (in thousands)																							
		1		2		5		10		15		20		30		50		75		100		150		200	
		10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30
20	1	0	1	0	3	0	5	0	8	0	11	0	14	0	29	0	46	0	66	0	104	0	139	0	
	20	1	0	1	3	0	5	0	8	0	11	0	14	0	31	0	49	0	65	0	104	0	146	0	
	50	1	0	1	3	0	6	0	8	0	12	0	19	0	33	0	53	0	70	0	111	0	156	0	
	100	2	0	3	7	0	15	0	24	0	33	0	53	0	93	0	147	0	196	0	310	0	434	0	
30	1	1	1	1	3	3	7	7	11	11	14	14	22	23	39	41	63	45	83	86	133	137	188	193	
	20	1	1	1	3	3	7	7	10	11	15	15	24	24	42	43	66	68	88	90	140	143	197	202	
	40	1	1	2	4	4	9	9	13	13	18	19	29	30	52	53	82	84	109	112	173	177	244	249	
	60	1	1	3	7	7	14	14	23	23	32	33	51	52	90	92	144	145	191	193	302	305	424	428	
50	1	1	2	2	5	5	10	10	16	16	23	23	37	37	65	67	105	106	139	142	222	226	314	319	
	10	1	2	2	5	5	11	11	17	18	25	25	37	37	65	67	105	106	148	151	236	239	314	319	
	25	1	3	3	7	7	14	14	22	23	32	32	51	51	89	91	142	144	189	192	300	304	423	427	
	40	3	3	7	19	19	40	40	64	64	85	86	135	136	238	239	375	377	527	529	888	891	1244	1247	
80	1	2	3	3	8	8	16	17	26	27	38	38	61	62	108	110	173	175	231	233	367	371	500	500	
	5	2	3	3	8	8	18	18	28	29	38	38	61	61	108	109	172	174	244	246	366	369	500	500	
	15	2	4	4	11	11	22	23	36	36	51	52	77	77	136	137	217	218	306	309	485	488	600	600	
	25	5	11	11	30	30	68	68	102	102	144	145	228	229	401	402	600	600	800	800	1200	1200	1600	1600	
100	1	2	4	4	9	9	22	22	35	35	47	47	75	76	133	135	214	215	302	305	400	400	500	500	
	5	2	4	4	10	10	22	22	35	35	50	51	80	81	142	144	227	229	302	305	400	400	500	500	
	10	2	4	4	12	12	26	26	41	41	59	59	88	88	156	156	248	250	350	352	450	450	550	550	
	20	7	14	14	40	40	85	85	135	136	190	191	301	302	527	528	800	800	1100	1100	1400	1400	1800	1800	
200	1	4	7	7	21	21	45	46	73	74	105	105	168	169	297	299	450	450	650	650	850	850	1100	1100	
	5	4	9	9	25	25	58	58	86	87	123	123	195	196	345	346	500	500	700	700	900	900	1150	1150	
	10	14	32	32	85	85	190	191	301	302	401	402	600	600	800	800	1100	1100	1400	1400	1800	1800	2300	2300	
300	1	6	12	12	34	34	73	73	117	118	167	168	267	267	400	400	550	550	750	750	950	950	1200	1200	
	3	6	14	14	39	39	83	83	133	133	188	189	283	283	400	400	550	550	750	750	950	950	1200	1200	
	6	15	33	33	87	88	195	196	309	310	412	413	600	600	800	800	1100	1100	1400	1400	1800	1800	2300	2300	
500	1	10	21	21	61	61	139	140	209	209	296	297	450	450	650	650	900	900	1200	1200	1600	1600	2100	2100	
	2	12	25	25	72	72	163	163	244	245	345	345	500	500	700	700	950	950	1250	1250	1650	1650	2150	2150	
	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
750	1	17	37	37	106	106	224	225	357	357	500	500	700	700	950	950	1250	1250	1650	1650	2150	2150	2800	2800	
	2	27	60	60	160	160	359	359	550	550	750	750	1000	1000	1300	1300	1700	1700	2200	2200	2800	2800	3600	3600	
1000	1	27	62	62	163	163	365	365	550	550	750	750	1000	1000	1300	1300	1700	1700	2200	2200	2800	2800	3600	3600	
	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2000	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

UNIVAC 9300/9300 II Systems
Memory Size: 12K Bytes

UNISERVO VI C Subsystem: 9 Track
1 Control Unit
3 Tape Units

Table F-2. UNIVAC 9300/9300 II Systems Tape Sort Timing (Part 1 of 16)

Volume (in thousands)

Record Size (in bytes)	Blocking Factor	Key Size (in bytes)																										
		10	30	10	30	10	30	10	30	10	30	10	30															
20	1	1	0	1	0	2	0	4	0	6	0	9	0	13	0	24	0	36	0	48	52	64	69	105	114	140	151	
	20	1	0	1	0	2	0	4	0	7	0	9	0	15	0	24	0	40	0	53	52	65	69	106	112	142	150	
	50	1	0	1	0	2	0	5	0	7	0	10	0	15	0	27	0	41	0	54	52	65	69	106	112	142	150	
	100	1	0	1	0	2	0	14	0	21	0	31	0	46	0	84	0	126	0	184	124	163	166	267	271	336	339	
30	1	1	1	1	1	2	3	5	5	8	9	11	12	18	19	29	32	48	52	64	69	105	114	140	151	199	199	
	20	1	1	1	1	3	3	6	6	8	9	12	13	18	19	33	35	49	52	65	69	106	112	142	150	199	199	
	40	1	1	1	1	3	3	7	7	11	12	15	15	24	25	40	42	67	69	89	91	146	149	194	199	241	241	
	60	1	1	1	1	6	6	12	12	20	21	27	27	45	45	74	75	122	124	163	166	267	271	336	339	418	418	
50	1	1	1	2	2	4	4	8	8	12	12	18	18	27	27	49	50	74	75	109	111	163	166	217	221	280	280	
	10	1	1	2	2	4	4	8	8	14	14	18	18	27	27	49	50	81	83	108	111	162	166	217	221	280	280	
	25	1	1	2	2	5	6	12	12	18	18	26	27	39	40	72	73	108	110	158	161	237	241	300	300	369	369	
	40	3	3	6	6	17	17	37	38	56	56	82	83	123	124	224	226	336	339	458	461	666	670	866	870	1066	1066	
80	1	1	1	2	2	5	6	12	12	20	21	27	28	45	46	75	77	125	127	167	170	275	280	344	344	418	418	
	5	1	1	2	2	6	6	12	12	20	21	27	28	45	46	75	77	125	127	167	170	275	280	344	344	418	418	
	15	2	2	3	3	8	8	18	18	30	30	39	40	66	67	109	111	180	183	240	243	336	339	418	418	500	500	
	25	5	5	10	10	30	30	60	60	99	99	131	132	215	217	336	339	458	461	666	670	866	870	1066	1066	1266	1266	
100	1	1	2	3	3	8	8	17	17	25	25	33	33	56	56	92	93	154	156	205	208	300	300	369	369	444	444	
	5	1	2	3	3	8	8	17	17	25	25	33	38	56	56	103	104	154	156	205	208	300	300	369	369	444	444	
	10	2	2	3	3	9	9	20	20	33	34	44	45	73	74	122	123	201	204	268	272	369	369	444	444	533	533	
	20	6	6	12	12	37	38	74	75	123	124	164	165	269	271	418	418	666	670	866	870	1066	1066	1266	1266	1566	1566	
200	1	3	3	5	5	16	16	32	32	54	54	72	72	120	121	200	201	300	300	400	400	500	500	600	600	700	700	
	5	3	3	7	7	19	19	43	43	72	73	96	97	144	145	265	266	400	400	500	500	600	600	700	700	800	800	
	10	14	14	30	30	82	83	180	181	269	271	369	369	566	566	866	866	1266	1266	1666	1666	2066	2066	2466	2466	2866	2866	
300	1	4	4	9	9	24	24	54	54	81	81	120	121	180	180	269	269	400	400	500	500	600	600	700	700	800	800	
	3	5	5	10	10	31	31	62	62	103	104	138	138	228	229	369	369	500	500	600	600	700	700	800	800	900	900	
	6	12	12	26	26	72	72	158	159	237	239	318	318	498	498	737	737	1076	1076	1415	1415	1854	1854	2293	2293	2732	2732	
500	1	7	7	16	16	45	45	100	100	150	151	221	221	336	336	500	500	737	737	1076	1076	1415	1415	1854	1854	2293	2293	
	2	10	10	19	19	60	61	120	121	198	200	265	266	400	400	566	566	866	866	1266	1266	1666	1666	2066	2066	2466	2466	
	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
750	1	13	13	26	26	61	62	162	163	269	270	369	369	566	566	866	866	1266	1266	1666	1666	2066	2066	2466	2466	2866	2866	
	2	23	23	50	51	138	139	302	303	498	498	737	737	1076	1076	1415	1415	2066	2066	2732	2732	3498	3498	4264	4264	5030	5030	
1000	1	22	22	48	49	133	133	290	291	458	458	666	666	1000	1000	1415	1415	2066	2066	2732	2732	3498	3498	4264	4264	5030	5030	
	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

UNISERVO VI C Subsystem: 9 Track
1 Control Unit
4 Tape Units

Table F-2. UNIVAC 9300/9300 II Systems Tape Sort Timing (Part 2 of 16)

UNIVAC 9200 II System
Memory Size: 12K Bytes

Record Size (in bytes)	Blocking Factor	Volume (in thousands)																							
		1		2		5		10		15		20		30		50		75		100		150		200	
		10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30
20	1	1	0	1	0	2	0	4	0	5	0	7	0	12	0	20	0	33	0	44	0	66	0	98	0
20	50	1	0	1	0	2	0	4	0	5	0	7	0	12	0	22	0	33	0	44	0	66	0	97	0
20	100	1	0	1	0	2	0	4	0	7	0	9	0	13	0	25	0	38	0	56	0	84	0	112	0
30	1	1	0	3	0	6	0	14	0	21	0	33	0	49	0	92	0	137	0	183	0	270	0	384	0
30	1	1	1	2	2	4	4	7	5	11	7	10	11	15	16	29	30	43	45	57	59	96	100	127	133
30	20	1	1	3	3	6	6	12	10	20	14	16	17	23	24	38	39	54	56	70	70	101	105	135	140
30	40	1	1	3	3	6	6	12	10	20	14	16	17	23	24	38	39	54	56	70	70	101	105	135	140
30	60	1	1	2	2	4	4	7	7	14	14	21	21	27	27	42	42	63	66	84	88	128	132	192	197
50	1	1	1	2	2	4	4	7	7	14	14	21	21	27	27	42	42	63	66	84	88	128	132	192	197
50	10	1	1	2	2	4	4	7	7	14	14	21	21	27	27	42	42	63	66	84	88	128	132	192	197
50	25	1	1	2	2	4	4	7	7	14	14	21	21	27	27	42	42	63	66	84	88	128	132	192	197
50	40	1	1	2	2	4	4	7	7	14	14	21	21	27	27	42	42	63	66	84	88	128	132	192	197
80	1	1	1	2	2	4	4	7	7	14	14	21	21	27	27	42	42	63	66	84	88	128	132	192	197
80	5	1	1	2	2	4	4	7	7	14	14	21	21	27	27	42	42	63	66	84	88	128	132	192	197
80	15	1	1	2	2	4	4	7	7	14	14	21	21	27	27	42	42	63	66	84	88	128	132	192	197
80	25	1	1	2	2	4	4	7	7	14	14	21	21	27	27	42	42	63	66	84	88	128	132	192	197
100	1	1	1	3	3	6	6	12	10	20	14	16	17	23	24	38	39	54	56	70	70	101	103	151	155
100	5	1	1	3	3	6	6	12	10	20	14	16	17	23	24	38	39	54	56	70	70	101	103	151	155
100	10	1	1	3	3	6	6	12	10	20	14	16	17	23	24	38	39	54	56	70	70	101	103	151	155
100	20	1	1	3	3	6	6	12	10	20	14	16	17	23	24	38	39	54	56	70	70	101	103	151	155
200	1	1	1	3	3	6	6	12	10	20	14	16	17	23	24	38	39	54	56	70	70	101	103	151	155
200	5	1	1	3	3	6	6	12	10	20	14	16	17	23	24	38	39	54	56	70	70	101	103	151	155
200	10	1	1	3	3	6	6	12	10	20	14	16	17	23	24	38	39	54	56	70	70	101	103	151	155
300	1	1	1	3	3	6	6	12	10	20	14	16	17	23	24	38	39	54	56	70	70	101	103	151	155
300	3	1	1	3	3	6	6	12	10	20	14	16	17	23	24	38	39	54	56	70	70	101	103	151	155
300	6	1	1	3	3	6	6	12	10	20	14	16	17	23	24	38	39	54	56	70	70	101	103	151	155
500	1	1	1	3	3	6	6	12	10	20	14	16	17	23	24	38	39	54	56	70	70	101	103	151	155
500	2	1	1	3	3	6	6	12	10	20	14	16	17	23	24	38	39	54	56	70	70	101	103	151	155
500	4	1	1	3	3	6	6	12	10	20	14	16	17	23	24	38	39	54	56	70	70	101	103	151	155
750	1	1	1	3	3	6	6	12	10	20	14	16	17	23	24	38	39	54	56	70	70	101	103	151	155
750	2	1	1	3	3	6	6	12	10	20	14	16	17	23	24	38	39	54	56	70	70	101	103	151	155
1000	1	1	1	3	3	6	6	12	10	20	14	16	17	23	24	38	39	54	56	70	70	101	103	151	155
1000	2	1	1	3	3	6	6	12	10	20	14	16	17	23	24	38	39	54	56	70	70	101	103	151	155
2000	1	1	1	3	3	6	6	12	10	20	14	16	17	23	24	38	39	54	56	70	70	101	103	151	155

UNIVAC 9300/9300 II Systems
Memory Size: 12K Bytes

UNISERVO VI C Subsystem: 9 Track
1 Control Unit
5 Tape Units

Table F-2. UNIVAC 9300/9300 II Systems Tape Sort Timing (Part 3 of 16)

Record Size (in bytes)	Blocking Factor	Volume (in thousands)																							
		1		2		5		10		15		20		30		50		75		100		150		200	
		10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30
20	1	1	0	1	0	2	0	4	0	6	0	8	0	12	0	22	0	33	0	44	0	66	0	99	0
20	20	1	0	1	0	2	0	4	0	6	0	8	0	12	0	22	0	33	0	44	0	66	0	99	0
50	50	1	0	1	0	2	0	5	0	7	0	9	0	15	0	25	0	38	0	58	0	86	0	115	0
100	100	1	0	3	0	8	0	16	0	24	0	37	0	55	0	92	0	158	0	211	0	311	0	444	0
30	1	1	1	1	1	2	3	5	5	7	8	10	10	14	15	28	29	41	44	55	58	94	99	125	132
30	20	1	1	1	1	3	3	5	6	8	8	10	11	18	19	30	31	45	47	68	71	102	107	136	142
40	40	1	1	2	2	4	4	7	7	10	10	16	16	23	24	38	40	67	69	89	92	133	137	177	183
60	60	1	1	3	3	6	6	14	15	21	22	28	29	50	51	83	85	124	126	190	195	281	286	381	387
50	1	1	1	2	2	3	3	7	8	11	11	14	15	25	26	41	43	62	64	96	99	144	148	192	197
10	10	1	1	2	2	3	3	8	8	11	12	18	18	26	27	44	45	76	79	102	105	152	157	206	211
25	25	1	1	2	2	6	6	11	11	19	19	25	26	37	38	73	74	109	111	145	148	211	215	281	286
40	40	4	4	7	7	20	20	46	47	69	70	92	93	158	160	281	286	444	449	644	649	911	916	1221	1226
80	1	1	1	2	2	6	6	11	11	16	16	25	26	38	39	63	64	110	113	147	150	211	215	281	286
5	5	2	2	6	6	11	11	20	20	26	27	39	40	76	77	113	116	151	154	211	215	281	286	381	387
15	15	2	2	3	3	8	8	19	19	28	29	37	38	66	67	109	111	164	166	211	215	281	286	381	387
25	25	6	6	13	13	31	32	73	74	110	111	169	171	301	303	511	513	711	713	911	913	1211	1213	1511	1513
100	1	2	2	3	3	7	7	13	13	23	24	31	32	46	47	91	92	136	139	181	184	241	244	301	304
5	5	2	2	3	3	7	7	14	14	25	25	33	33	49	50	96	98	144	146	201	204	261	264	321	324
10	10	2	2	4	4	9	9	21	21	31	31	41	41	72	73	120	121	179	182	241	244	301	304	361	364
20	20	7	7	16	16	46	47	92	93	158	160	211	213	361	363	511	513	711	713	911	913	1211	1213	1511	1513
200	1	2	2	5	5	13	13	30	31	45	46	60	61	106	107	177	178	241	244	301	304	361	364	421	424
5	5	3	3	7	7	21	21	41	41	72	73	96	97	143	145	201	204	261	264	321	324	381	384	441	444
10	10	16	16	37	37	106	107	211	213	361	363	511	513	711	713	911	913	1211	1213	1511	1513	1811	1813	2111	2113
300	1	3	3	8	8	23	23	45	46	80	81	106	107	159	161	241	244	301	304	361	364	421	424	481	484
3	3	5	5	10	10	29	29	68	69	102	103	136	137	201	204	261	264	321	324	381	384	441	444	501	504
6	6	14	14	28	28	82	83	189	191	331	333	461	463	611	613	761	763	911	913	1061	1063	1211	1213	1361	1363
500	1	7	7	13	14	40	41	95	96	142	143	201	204	261	264	321	324	381	384	441	444	501	504	561	564
2	2	9	9	21	21	51	51	120	121	179	181	241	244	301	304	361	364	421	424	481	484	541	544	601	604
4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
750	1	11	11	27	27	79	80	158	159	241	244	301	304	361	364	421	424	481	484	541	544	601	604	661	664
2	2	23	23	54	54	153	155	301	303	451	453	601	603	751	753	901	903	1051	1053	1201	1203	1351	1353	1501	1503
1000	1	21	21	41	41	120	121	241	244	301	304	361	364	421	424	481	484	541	544	601	604	661	664	721	724
2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

UNISERVO VI C Subsystem: 9 Track
1 Control Unit
4 Tape Units

Table F--2. UNIVAC 9300/9300 II Systems Tape Sort Timing (Part 4 of 16)

UNIVAC 9300/9300 II Systems
Memory Size: 12K Bytes

Record Size (in bytes)	Blocking Factor	Volume (in thousands)																								
		1		2		5		10		15		20		30		50		75		100		150		200		
		10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	
20	1	0	1	0	1	0	2	0	5	0	7	0	10	0	16	0	29	0	43	0	61	0	97	0	137	0
	20	1	1	0	2	0	2	0	5	0	7	0	10	0	16	0	29	0	45	0	60	0	96	0	136	0
	50	1	1	0	2	0	2	0	5	0	8	0	11	0	17	0	30	0	45	0	64	0	101	0	134	0
	100	1	1	0	3	0	3	0	6	0	9	0	12	0	19	0	33	0	53	0	70	0	111	0	156	0
30	1	1	1	1	3	3	3	3	6	6	9	10	11	13	18	20	33	36	52	58	74	82	111	123	157	174
	20	1	1	1	3	3	3	6	6	6	9	10	12	14	20	22	35	39	55	62	74	82	117	131	166	184
	40	1	1	1	3	3	3	6	7	7	10	10	13	14	20	22	36	39	57	62	80	88	127	139	170	185
	60	1	1	2	3	3	3	7	7	7	11	12	15	16	24	25	42	44	68	69	95	98	143	146	201	206
50	1	1	2	2	4	4	4	9	9	9	14	15	19	19	30	31	54	55	86	88	115	118	184	188	261	266
	10	1	2	2	4	4	4	9	9	9	14	15	20	21	30	31	54	55	86	88	123	126	196	200	261	266
	25	1	2	2	4	4	4	10	10	10	16	16	21	21	33	34	59	60	95	96	134	137	213	217	284	289
	40	1	2	2	6	6	6	13	13	13	20	20	27	27	43	43	76	77	121	122	171	173	271	274	361	364
80	1	1	2	2	6	6	6	14	15	15	21	22	31	31	50	50	89	90	142	144	189	191	301	305	427	431
	5	1	3	3	6	6	6	14	15	15	23	24	31	31	50	50	89	90	141	144	201	203	301	305	427	431
	15	1	3	3	7	7	7	16	16	16	26	26	34	34	54	55	97	98	154	156	206	207	327	330	442	447
	25	2	3	3	9	9	9	21	21	21	33	34	44	44	71	72	126	127	200	202	283	285	424	427	542	547
100	1	1	3	3	8	8	8	18	18	18	28	29	38	38	61	62	109	110	175	177	249	251	396	400	542	547
	5	2	3	3	8	8	8	18	18	18	28	29	41	41	66	66	117	118	187	189	249	251	396	400	542	547
	10	2	3	3	8	8	8	19	19	19	31	31	41	41	65	66	117	118	186	188	264	266	418	422	542	547
	20	2	4	4	12	12	12	26	26	26	41	41	59	59	88	88	156	156	248	250	350	352	542	547	542	547
200	1	3	6	6	17	17	17	37	37	37	59	60	85	86	137	138	243	245	387	390	542	547	542	547	542	547
	5	3	6	6	19	19	19	40	40	40	64	64	91	92	146	147	258	260	387	389	542	547	542	547	542	547
	10	4	9	9	25	25	25	58	58	58	86	87	123	123	195	196	345	346	542	547	542	547	542	547	542	547
300	1	4	9	9	27	27	27	59	59	59	95	95	135	136	217	218	384	386	542	547	542	547	542	547	542	547
	3	4	10	10	27	27	27	63	64	64	102	102	135	136	217	218	384	386	542	547	542	547	542	547	542	547
	6	6	13	13	38	38	38	80	81	81	129	129	182	183	273	274	442	444	542	547	542	547	542	547	542	547
500	1	8	17	17	49	49	49	113	113	113	169	169	241	241	384	385	542	547	542	547	542	547	542	547	542	547
	2	8	18	18	53	53	53	113	113	113	181	181	256	257	384	385	542	547	542	547	542	547	542	547	542	547
	4	12	25	25	72	72	72	163	163	163	244	244	345	345	542	547	542	547	542	547	542	547	542	547	542	547
750	1	13	27	27	79	79	79	181	181	181	271	271	384	385	542	547	542	547	542	547	542	547	542	547	542	547
	2	15	32	32	93	93	93	210	211	211	315	316	442	444	542	547	542	547	542	547	542	547	542	547	542	547
1000	1	18	39	39	113	113	113	256	257	257	384	385	542	547	542	547	542	547	542	547	542	547	542	547	542	547
	2	27	62	62	163	163	163	365	365	365	542	547	542	547	542	547	542	547	542	547	542	547	542	547	542	547
2000	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

UNIVAC 9300/9300 II Systems
Memory Size: 16K Bytes

UNISERVO VI C Subsystem: 9 Track
1 Control Unit
3 Tape Units

Table F-2. UNIVAC 9300/9300 II Systems Tape Sort Timing (Part 5 of 16)

Record Size (in bytes)	Blocking Factor	Volume (in thousands)																							
		1		2		5		10		15		20		30		50		75		100		150		200	
		10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30
20	1	1	0	1	0	2	0	4	0	6	0	8	0	13	0	22	0	36	0	47	0	78	0	104	0
	20	1	0	1	0	2	0	4	0	6	0	8	0	13	0	24	0	35	0	47	0	77	0	103	0
	50	1	0	1	0	2	0	4	0	6	0	9	0	13	0	24	0	35	0	51	0	77	0	112	0
	100	1	0	1	0	2	0	5	0	7	0	10	0	15	0	27	0	41	0	54	0	88	0	118	0
30	1	1	1	2	3	5	5	5	5	7	8	10	11	14	17	26	31	39	46	58	68	87	102	115	135
	20	1	1	2	3	5	5	5	5	7	9	10	11	14	17	26	30	43	50	57	67	85	100	124	146
	40	1	1	3	3	5	5	6	6	8	9	10	11	17	19	27	31	45	51	60	68	98	111	131	148
	60	1	1	3	3	5	6	6	6	9	9	13	13	19	19	34	36	51	53	75	78	113	116	150	155
50	1	1	1	3	3	6	7	11	11	11	11	14	14	23	24	38	40	64	66	85	88	141	145	187	193
	10	1	1	3	4	6	7	11	11	11	14	14	14	23	24	38	40	64	66	85	88	141	145	187	192
	25	1	1	4	4	8	8	11	12	17	17	25	26	42	43	70	71	116	118	155	157	254	259	328	333
	40	1	1	5	5	11	11	16	16	21	21	35	35	53	54	98	100	148	150	217	220	354	359	458	463
80	1	2	2	5	5	10	11	15	16	23	24	35	35	53	54	98	100	148	150	217	220	354	359	458	463
	5	2	2	5	5	10	11	15	16	23	24	35	35	53	54	98	100	148	150	217	220	354	359	458	463
	15	2	2	6	6	11	12	19	19	28	29	42	43	70	71	116	118	155	157	254	259	354	359	458	463
	25	2	2	7	7	16	16	27	27	36	36	53	54	98	100	148	150	217	220	354	359	458	463	557	562
100	1	2	2	6	6	13	13	21	22	28	29	42	43	70	71	116	118	155	157	254	259	354	359	458	463
	5	2	2	6	6	13	13	21	22	28	29	42	43	70	71	116	118	155	157	254	259	354	359	458	463
	10	2	2	7	7	15	15	22	23	29	30	49	50	82	83	137	139	201	204	268	272	354	359	458	463
	20	2	2	9	9	20	20	33	34	44	45	73	74	122	123	201	204	268	272	354	359	458	463	557	562
200	1	4	4	12	12	27	28	41	41	61	62	91	92	169	171	268	272	354	359	458	463	557	562	656	661
	5	4	4	13	13	28	29	48	48	64	64	107	107	177	179	268	272	354	359	458	463	557	562	656	661
	10	5	5	19	19	43	43	72	73	96	97	144	145	265	266	354	359	458	463	557	562	656	661	750	755
300	1	6	6	20	20	40	40	68	68	91	91	151	152	268	272	354	359	458	463	557	562	656	661	750	755
	3	6	6	21	21	47	47	70	70	104	104	155	156	268	272	354	359	458	463	557	562	656	661	750	755
	5	6	6	30	30	59	60	99	100	132	133	219	220	354	359	458	463	557	562	656	661	750	755	844	849
500	1	12	12	33	34	75	76	126	127	168	168	268	272	354	359	458	463	557	562	656	661	750	755	844	849
	2	12	13	40	40	79	79	132	133	176	176	268	272	354	359	458	463	557	562	656	661	750	755	844	849
	4	10	10	60	61	120	121	198	200	265	266	354	359	458	463	557	562	656	661	750	755	844	849	933	938
750	1	20	20	57	57	126	127	189	190	268	272	354	359	458	463	557	562	656	661	750	755	844	849	933	938
	2	24	24	75	75	149	150	247	249	354	359	458	463	557	562	656	661	750	755	844	849	933	938	1022	1027
1000	1	28	28	88	88	176	176	268	272	354	359	458	463	557	562	656	661	750	755	844	849	933	938	1022	1027
	2	48	49	133	133	290	291	458	463	656	661	933	938	1022	1027	1311	1316	1699	1704	2187	2192	2871	2876	3550	3555
2000	1	96	97	265	266	557	562	844	849	1131	1136	1519	1524	2007	2012	2687	2692	3550	3555	4419	4424	5571	5576	6719	6724

UNIVAC 9300/9300 II Systems
Memory Size: 16K Bytes

UNISERVO VI C Subsystem: 9 Track
1 Control Unit
4 Tape Units

Table F-2. UNIVAC 9300/9300 II Systems Tape Sort Timing (Part 6 of 16)

Record Size (in bytes)	Blocking Factor	Volume (in thousands)																							
		1		2		5		10		15		20		30		50		75		100		150		200	
		10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30
20	1	1	0	1	0	2	0	3	0	5	0	7	0	12	0	19	0	29	0	43	0	65	0	86	0
20	20	1	0	1	0	2	0	4	0	5	0	7	0	12	0	19	0	29	0	43	0	64	0	85	0
50	50	1	0	1	0	2	0	4	0	5	0	7	0	12	0	19	0	32	0	43	0	64	0	95	0
100	100	1	0	1	0	2	0	4	0	5	0	9	0	13	0	25	0	38	0	56	0	84	0	112	0
30	1	1	1	1	1	2	2	4	5	6	7	8	9	14	15	22	25	37	42	50	56	74	84	111	125
30	20	1	1	1	1	2	2	4	5	6	7	9	10	13	15	22	25	37	41	49	55	73	82	109	123
40	40	1	1	1	1	3	3	5	5	8	8	10	10	15	15	27	29	41	43	54	57	91	95	122	127
60	60	1	1	1	1	3	3	6	6	9	9	11	12	19	20	32	33	47	47	71	74	107	110	142	147
50	1	1	1	1	1	3	3	6	6	9	9	13	14	19	20	37	38	55	57	74	76	125	129	167	172
50	10	1	1	1	1	3	3	6	6	10	10	13	14	19	20	37	38	55	57	74	76	125	129	166	172
25	25	1	1	1	1	2	3	4	8	11	11	15	15	25	26	42	43	62	64	94	97	141	145	188	193
40	40	1	1	2	2	4	4	10	10	14	14	22	22	32	33	61	63	91	93	122	125	205	209	288	300
80	1	1	1	2	2	4	5	8	9	15	15	19	20	33	34	55	56	82	84	126	128	188	192	266	288
80	5	1	1	2	2	4	5	10	10	15	15	19	20	33	34	55	56	82	84	126	128	188	192	266	288
15	15	1	1	2	2	5	5	11	11	16	17	25	26	38	38	62	64	107	109	142	145	209	215	288	300
25	25	1	1	3	3	7	7	14	14	25	25	33	33	49	50	94	95	141	143	212	215	288	300	388	400
100	1	1	1	2	2	5	5	12	12	18	18	23	24	41	42	68	69	116	118	154	157	215	221	288	300
100	5	1	1	2	2	5	5	12	12	18	18	23	24	41	42	68	69	116	118	154	157	215	221	288	300
10	10	1	1	3	3	6	6	13	13	19	19	30	30	44	45	84	85	125	128	167	170	231	237	288	300
20	20	2	2	3	3	9	9	21	21	31	31	41	41	70	71	116	118	174	176	231	237	300	306	388	400
200	1	2	2	4	4	11	12	22	23	39	39	52	52	77	78	149	150	215	215	288	288	350	356	400	400
200	5	2	2	4	4	12	12	28	29	43	43	56	57	97	98	161	163	231	231	288	288	350	356	400	400
10	10	3	3	7	7	20	20	40	40	69	70	92	93	138	139	215	215	288	288	350	356	400	400	400	400
300	1	3	3	6	6	17	17	39	39	58	58	77	77	133	133	215	215	288	288	350	356	400	400	400	400
300	3	3	3	6	6	18	18	41	41	62	62	95	95	142	142	215	215	288	288	350	356	400	400	400	400
6	6	4	4	10	10	28	28	63	63	94	95	125	126	213	214	288	288	350	356	400	400	400	400	400	400
500	1	5	5	11	11	32	32	64	64	111	111	148	148	215	215	288	288	350	356	400	400	400	400	400	400
500	2	5	5	12	12	35	35	81	81	121	122	161	162	215	215	288	288	350	356	400	400	400	400	400	400
4	4	9	9	20	20	50	50	115	116	172	173	215	215	288	288	350	356	400	400	400	400	400	400	400	400
750	1	9	9	17	17	50	50	114	115	172	172	215	215	288	288	350	356	400	400	400	400	400	400	400	400
750	2	11	11	25	25	70	70	140	140	215	215	288	288	350	356	400	400	400	400	400	400	400	400	400	400
1000	1	12	12	28	28	81	81	161	162	215	215	288	288	350	356	400	400	400	400	400	400	400	400	400	400
2	2	20	20	40	40	115	116	215	215	288	288	350	356	400	400	400	400	400	400	400	400	400	400	400	400
2000	1	40	40	92	93	215	215	288	288	350	356	400	400	400	400	400	400	400	400	400	400	400	400	400	400

UNIVAC 9300/9300 II Systems
Memory Size: 16K Bytes

UNISERVO VI C Subsystem: 9 Track
1 Control Unit
5 Tape Units

Table F-2. UNIVAC 9300/9300 II Systems Tape Sort Timing (Part 7 of 16)

Record Size (in bytes)	Volume (in thousands)																							
	1		2		5		10		15		20		30		50		75		100		150		200	
	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30
Blocking Factor	Key Size (in bytes)																							
20	1	0	1	0	2	0	4	0	5	0	8	0	11	0	19	0	32	0	43	0	64	0	85	0
20	1	0	1	0	2	0	4	0	5	0	8	0	11	0	19	0	32	0	43	0	64	0	85	0
50	1	0	1	0	2	0	4	0	5	0	8	0	11	0	22	0	32	0	43	0	64	0	97	0
100	1	0	1	0	2	0	5	0	7	0	9	0	15	0	25	0	38	0	58	0	86	0	115	0
30	1	1	1	1	2	3	4	5	7	8	9	10	13	15	21	25	36	42	47	56	71	84	108	128
20	1	1	1	1	2	2	4	4	7	8	9	10	13	15	24	28	36	42	47	55	81	95	108	126
40	1	1	1	1	2	3	5	5	7	8	9	10	14	15	27	29	40	43	53	57	91	98	122	131
60	1	1	1	1	3	3	6	6	8	9	11	11	19	20	32	33	47	49	73	75	109	113	145	150
50	1	1	1	1	3	3	6	7	9	10	12	13	18	19	35	37	52	55	70	73	121	125	161	167
10	1	1	1	1	3	3	6	7	9	10	12	13	21	22	35	37	53	55	70	73	121	126	161	167
25	1	1	2	2	3	3	7	7	11	11	14	14	25	25	41	42	61	63	94	97	141	146	188	194
40	1	1	2	2	5	5	9	10	16	17	22	22	32	33	63	64	94	96	125	128	188	192	244	250
80	1	1	2	2	4	4	9	9	13	14	18	18	31	32	52	53	78	80	121	124	182	186	234	240
5	1	1	2	2	6	6	11	11	16	17	26	26	39	39	64	65	112	114	149	152	214	218	274	280
15	1	1	2	2	6	6	12	12	22	22	29	29	43	44	83	85	125	127	166	169	234	238	294	300
25	2	2	3	3	7	7	17	17	25	25	33	34	49	50	97	99	145	147	194	197	274	278	334	340
100	1	1	2	2	5	5	11	11	16	17	26	26	38	39	64	65	112	114	149	152	214	218	274	280
5	1	1	2	2	6	6	11	11	16	17	26	26	39	39	64	65	112	114	149	152	214	218	274	280
10	1	1	2	2	6	6	12	12	22	22	29	29	43	44	83	85	125	127	166	169	234	238	294	300
20	2	2	4	4	9	9	21	21	31	31	41	41	72	73	120	121	179	182	244	247	334	338	414	420
200	2	2	4	4	10	10	25	25	37	37	49	49	73	74	143	145	214	218	274	278	354	358	434	440
5	2	2	5	5	12	12	28	28	41	42	55	55	97	98	161	162	234	238	294	297	374	378	454	460
10	3	3	7	7	21	21	41	41	72	73	96	97	143	145	234	238	294	297	374	378	454	458	534	540
300	3	3	6	6	15	15	37	37	55	55	73	73	129	130	214	218	274	278	354	358	434	438	514	520
3	3	3	7	7	20	21	40	41	60	61	95	95	141	143	234	238	294	297	374	378	454	458	534	540
6	5	5	9	9	28	28	55	55	97	98	129	130	214	218	354	358	434	438	514	518	594	598	674	680
500	5	5	10	10	31	31	61	61	108	109	144	145	214	218	354	358	434	438	514	518	594	598	674	680
2	6	6	12	12	34	35	81	81	121	122	161	162	234	238	354	358	434	438	514	518	594	598	674	680
4	9	9	21	21	51	51	120	121	179	181	234	238	354	358	434	438	514	518	594	598	674	678	754	760
750	8	8	20	20	48	49	114	115	171	172	234	238	354	358	434	438	514	518	594	598	674	678	754	760
2	10	10	24	25	60	61	142	143	214	218	234	238	354	358	434	438	514	518	594	598	674	678	754	760
1000	12	12	28	28	81	81	161	162	234	238	234	238	354	358	434	438	514	518	594	598	674	678	754	760
2	21	21	41	41	120	121	234	238	354	358	434	438	514	518	594	598	674	678	754	758	834	838	914	920
2000	41	41	96	97	234	238	354	358	434	438	514	518	594	598	674	678	754	758	834	838	914	918	994	1000

UNIVAC 9300/9300 II Systems
Memory Size: 16K Bytes

UNISERVO VI C Subsystem: 9 Track
1 Control Unit
6 Tape Units

Table F-2. UNIVAC 9300/9300 II Systems Tape Sort Timing (Part 8 of 16)

Record Size (in bytes)	Volume (in thousands)																							
	1		2		5		10		15		20		30		50		75		100		150		200	
	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30
20	1	0	1	0	2	0	4	0	7	0	9	0	14	0	24	0	39	0	52	0	83	0	118	0
50	1	0	1	0	2	0	4	0	6	0	8	0	14	0	24	0	39	0	55	0	83	0	118	0
100	1	0	1	0	2	0	4	0	6	0	9	0	14	0	26	0	41	0	55	0	87	0	124	0
30	1	1	1	1	2	3	4	5	7	8	10	12	15	17	29	33	43	50	62	71	99	114	131	152
40	1	1	1	1	2	3	4	5	7	8	10	11	16	18	28	33	46	53	61	70	97	112	138	159
60	1	1	1	1	2	3	5	6	8	9	10	11	16	18	28	33	46	53	61	70	97	112	138	159
50	1	1	1	1	3	3	6	7	10	11	13	14	22	22	39	40	62	65	89	92	143	147	191	196
10	1	1	1	1	3	3	6	7	10	11	15	15	22	22	39	40	62	64	89	92	143	147	190	196
25	1	1	1	1	3	3	6	7	10	11	15	15	23	24	42	43	67	69	89	92	143	147	203	208
40	1	1	1	1	3	3	7	7	11	11	14	15	23	24	41	43	66	68	95	97	142	145	201	206
80	1	1	2	2	4	4	10	10	16	17	21	22	35	36	63	64	101	103	145	147	217	220	309	313
5	1	1	2	2	5	5	10	10	16	17	21	22	35	36	63	64	101	103	145	147	232	235	309	313
15	1	1	2	2	5	5	10	10	16	17	23	24	38	39	68	69	101	103	145	147	232	235	309	313
25	1	1	2	2	5	5	11	11	16	17	23	24	38	39	68	69	101	103	145	147	232	235	328	333
100	1	1	2	2	6	6	12	12	20	20	29	29	46	47	83	84	124	126	178	180	285	288	388	393
5	1	1	2	2	6	6	12	12	20	20	29	29	46	47	83	84	124	126	178	180	285	288	393	398
10	1	1	2	2	6	6	13	14	20	20	29	29	46	47	83	84	133	135	178	180	285	288	393	398
20	1	1	2	2	6	6	13	14	22	22	29	29	46	47	83	84	133	135	190	192	303	307	393	398
200	2	2	4	4	11	12	27	28	41	41	59	59	96	96	172	173	276	277	393	393	493	493	593	593
5	2	2	4	4	11	12	27	28	44	45	59	59	96	96	172	173	276	277	393	393	493	493	593	593
10	2	2	4	4	13	13	27	28	44	45	64	64	103	104	184	185	294	296	393	393	493	493	593	593
300	3	3	6	6	18	19	40	40	66	66	95	95	153	154	273	274	393	393	493	493	593	593	693	693
3	3	3	6	6	18	19	44	44	71	71	95	95	153	153	273	274	393	393	493	493	593	593	693	693
6	3	3	7	7	20	20	44	44	71	71	102	102	153	153	273	274	393	393	493	493	593	593	693	693
500	5	5	11	11	33	33	78	79	117	117	168	169	271	271	493	493	593	593	693	693	793	793	893	893
2	5	5	11	11	33	33	78	79	126	127	168	169	271	271	493	493	593	593	693	693	793	793	893	893
4	6	6	12	12	36	36	78	78	126	126	180	181	289	290	493	493	593	593	693	693	793	793	893	893
750	8	8	18	18	54	54	126	126	189	189	270	270	493	493	593	593	693	693	793	793	893	893	993	993
2	8	8	20	20	54	54	126	126	203	203	270	270	493	493	593	593	693	693	793	793	893	893	993	993
1000	12	12	27	27	78	78	168	168	270	270	493	493	593	593	693	693	793	793	893	893	993	993	1093	1093
2	12	12	29	29	78	78	180	180	289	289	493	493	593	593	693	693	793	793	893	893	993	993	1093	1093
2000	29	29	63	63	180	180	493	493	593	593	693	693	793	793	893	893	993	993	1093	1093	1193	1193	1293	1293

UNIVAC 9300/9300 II Systems
Memory Size: 24K Bytes

UNISERVO VI C Subsystem: 9 Track
1 Control Unit
3 Tape Units

Table F-2. UNIVAC 9300/9300 II Systems Tape Sort Timing (Part 9 of 16)

Record Size (in bytes)	Blocking Factor	Volume (in thousands)																							
		1		2		5		10		15		20		30		50		75		100		150		200	
		10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30
20	1	1	0	1	0	2	0	3	0	5	0	7	0	12	0	19	0	31	0	42	0	69	0	92	0
20	20	1	0	1	0	2	0	4	0	5	0	7	0	11	0	19	0	31	0	41	0	69	0	91	0
50	50	1	0	1	0	2	0	4	0	5	0	8	0	11	0	21	0	31	0	41	0	69	0	91	0
100	100	1	0	1	0	2	0	4	0	5	0	8	0	11	0	21	0	31	0	46	0	69	0	101	0
30	1	1	1	1	1	2	2	4	4	5	7	8	10	12	15	23	27	34	41	50	60	75	90	100	119
20	20	1	1	1	1	2	2	4	4	5	6	7	8	10	12	15	23	34	40	50	60	75	90	110	131
40	40	1	1	1	1	2	2	4	4	5	6	7	8	10	12	14	22	33	40	50	59	74	88	109	129
60	60	1	1	1	1	2	2	4	4	5	6	7	8	10	14	16	22	37	44	50	59	74	88	109	129
50	1	1	1	1	1	2	2	5	5	8	8	10	11	17	18	28	30	46	51	62	67	102	111	137	148
10	10	1	1	1	1	3	3	5	5	8	8	10	11	17	18	28	30	46	51	62	67	102	111	136	148
25	25	1	1	1	1	3	3	5	5	6	8	8	10	11	17	18	28	46	51	62	67	102	111	136	148
40	40	1	1	1	1	3	3	5	5	6	8	8	11	12	17	18	31	47	51	69	74	103	111	138	148
80	1	1	1	1	1	2	3	4	7	8	11	11	17	25	25	46	47	69	71	102	105	153	157	203	209
5	5	1	1	1	1	3	4	4	7	8	11	11	16	24	25	45	47	68	70	101	104	152	155	202	207
15	15	1	1	1	1	3	4	7	8	11	11	16	17	24	25	45	47	68	70	101	104	152	155	223	228
25	25	1	1	1	1	3	4	7	8	13	13	17	17	28	29	46	47	77	79	102	105	169	173	226	231
100	1	1	1	1	1	4	4	9	9	13	13	20	20	29	30	55	57	83	85	124	126	185	189	203	209
5	5	1	1	1	1	4	4	9	9	15	15	20	20	29	30	55	57	93	95	124	126	185	189	203	209
10	10	1	1	1	1	4	4	9	9	15	15	20	20	33	34	55	57	93	95	124	126	205	209	203	209
20	20	1	1	1	1	5	5	9	9	15	15	20	20	34	35	56	57	94	96	125	128	207	212	203	209
200	1	2	2	3	3	8	8	19	19	28	28	42	42	63	63	118	119	176	178	203	207	203	207	203	209
5	5	2	2	3	3	8	8	19	19	28	28	42	42	63	63	118	119	176	178	203	207	203	207	203	209
10	10	2	2	3	3	8	8	19	19	32	32	42	43	72	72	119	120	198	201	203	207	203	207	203	209
300	1	2	2	4	4	12	12	27	27	46	47	62	62	104	105	173	175	203	207	203	207	203	207	203	209
3	3	2	2	4	4	14	14	27	27	46	47	62	62	104	105	173	175	203	207	203	207	203	207	203	209
6	6	2	2	5	5	14	14	31	31	46	47	70	70	104	105	194	194	203	207	203	207	203	207	203	209
500	1	4	4	8	8	22	22	51	51	76	76	114	115	171	172	203	207	203	207	203	207	203	207	203	209
2	2	4	4	8	8	22	22	51	51	86	86	114	115	171	172	203	207	203	207	203	207	203	207	203	209
4	4	4	4	8	8	26	26	51	51	87	87	116	116	193	194	203	207	203	207	203	207	203	207	203	209
750	1	6	6	14	14	38	38	86	86	128	129	171	171	203	207	203	207	203	207	203	207	203	207	203	209
2	2	6	6	14	14	38	38	86	86	128	129	191	191	203	207	203	207	203	207	203	207	203	207	203	209
1000	1	8	8	18	18	51	51	114	114	171	171	203	203	203	207	203	207	203	207	203	207	203	207	203	209
8	8	8	8	18	18	51	51	116	116	193	194	203	203	203	207	203	207	203	207	203	207	203	207	203	209
2000	1	18	18	41	41	116	116	203	203	203	207	203	203	203	207	203	207	203	207	203	207	203	207	203	209

UNIVAC 9300/9300 II Systems
Memory Size: 24K Bytes

UNISERVO VI C Subsystem: 9 Track
1 Control Unit
4 Tape Units

Table F-2. UNIVAC 9300/9300 II Systems Tape Sort Timing (Part 10 of 16)

Record Size (in bytes)	Blocking Factor	Volume (in thousands)																							
		1		2		5		10		15		20		30		50		75		100		150		200	
		10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30
Key Size (in bytes)																									
20	1	1	0	1	0	2	0	3	0	5	0	6	0	10	0	17	0	28	0	38	0	56	0	84	0
	20	1	0	1	0	2	0	3	0	5	0	6	0	10	0	17	0	28	0	37	0	56	0	83	0
	50	1	0	1	0	2	0	3	0	5	0	7	0	10	0	17	0	28	0	37	0	56	0	83	0
	100	1	0	1	0	2	0	3	0	5	0	7	0	10	0	19	0	28	0	37	0	63	0	83	0
30	1	1	1	1	1	2	2	3	4	5	6	8	9	11	13	18	21	31	36	41	48	69	81	91	108
	20	1	1	1	1	2	2	3	4	5	6	7	9	11	13	21	24	31	36	41	48	68	81	91	108
	40	1	1	1	1	2	2	3	4	6	7	7	9	11	13	20	24	30	35	40	47	67	79	89	106
	60	1	1	1	1	2	2	3	4	6	7	7	9	11	13	20	24	30	36	40	47	67	80	90	106
50	1	1	1	1	1	2	2	4	4	7	7	9	10	13	14	26	27	38	40	51	54	87	91	115	121
	10	1	1	1	1	2	2	4	4	7	7	9	10	13	14	26	27	38	40	58	61	86	91	115	121
	25	1	1	1	1	2	2	5	5	7	7	9	10	16	16	26	27	38	40	58	61	86	91	115	121
	40	1	1	1	1	2	2	5	5	7	8	9	10	16	17	26	28	45	47	62	62	89	93	118	124
80	1	1	1	1	1	3	3	7	7	10	10	13	13	22	23	37	38	64	66	85	88	127	132	192	198
	5	1	1	1	1	3	3	7	7	10	10	13	13	22	23	37	38	64	66	85	88	127	131	192	198
	15	1	1	1	1	3	3	7	7	10	10	15	15	22	23	37	38	63	65	84	87	126	130	191	196
	25	1	1	2	2	3	3	7	7	10	10	15	16	23	24	44	45	65	67	87	89	148	152	197	202
100	1	1	1	1	1	3	4	8	8	12	12	18	19	27	28	44	46	77	79	102	105	153	157	200	202
	5	1	1	1	1	3	4	8	8	11	12	18	19	27	28	44	46	77	79	102	105	175	179	200	202
	10	1	1	1	1	3	4	8	8	11	12	18	19	27	28	51	53	77	79	102	105	175	179	200	202
	20	1	1	1	1	3	4	8	8	14	14	19	19	28	28	53	54	79	81	106	108	180	184	200	202
200	1	1	1	3	3	7	7	17	17	25	25	33	34	58	59	96	98	144	146	200	200	280	280	350	350
	5	2	2	3	3	7	7	17	17	26	26	33	34	58	59	96	98	166	168	200	200	280	280	350	350
	10	2	2	3	3	7	7	17	18	26	26	34	35	60	61	99	101	171	173	200	200	280	280	350	350
300	1	2	2	4	4	10	10	24	25	36	37	57	57	85	86	142	143	200	200	280	280	350	350	420	420
	3	2	2	4	4	10	10	24	25	36	37	57	57	85	86	163	165	200	200	280	280	350	350	420	420
	6	2	2	4	5	13	13	25	25	44	44	58	58	87	88	166	168	200	200	280	280	350	350	420	420
500	1	3	3	7	7	20	20	40	40	70	70	93	94	140	140	200	200	280	280	350	350	420	420	500	500
	2	3	3	7	7	20	20	40	40	70	70	93	94	161	162	200	200	280	280	350	350	420	420	500	500
	4	4	4	7	7	21	21	49	49	73	73	97	97	167	167	200	200	280	280	350	350	420	420	500	500
750	1	5	5	10	10	30	30	70	70	105	105	139	140	200	200	280	280	350	350	420	420	500	500	600	600
	2	5	5	10	10	30	30	70	71	105	106	162	162	200	200	280	280	350	350	420	420	500	500	600	600
1000	1	7	7	16	16	47	47	93	93	161	161	200	200	280	280	350	350	420	420	500	500	600	600	700	700
	2	7	7	17	17	49	49	97	97	167	167	200	200	280	280	350	350	420	420	500	500	600	600	700	700
2000	1	17	17	39	39	97	97	200	200	350	350	500	500	700	700	1000	1000	1400	1400	2000	2000	2800	2800	3500	3500

UNIVAC 9300/9300 II Systems
Memory Size: 24K Bytes

UNISERVO VI C Subsystem: 9 Track
1 Control Unit
5 Tape Units

Table F-2. UNIVAC 9300/9300 II Systems Tape Sort Timing (Part 11 of 16)

Record Size (in bytes)	Blocking Factor	Volume (in thousands)																																																									
		1			2			5			10			15			20			30			50			75			100			150			200																								
		10	30	10	10	30	10	10	30	10	10	30	10	10	30	10	10	30	10	10	30	10	10	30	10	10	30	10	10	30	10	10	30	10																									
20	1	1	0	1	0	2	0	3	0	5	0	7	0	10	0	18	0	27	0	36	0	54	0	83	0	117	121	180	186	1	1	1	0	1	0	2	0	3	0	5	0	7	0	10	0	18	0	27	0	36	0	54	0	83	0	117	121	180	186
30	1	1	0	1	0	2	0	3	0	5	0	7	0	10	0	18	0	27	0	36	0	54	0	83	0	117	121	180	186	1	1	1	0	1	0	2	0	3	0	5	0	7	0	10	0	18	0	27	0	36	0	54	0	83	0	117	121	180	186
40	1	1	0	1	0	2	0	3	0	5	0	7	0	10	0	18	0	27	0	36	0	54	0	83	0	117	121	180	186	1	1	1	0	1	0	2	0	3	0	5	0	7	0	10	0	18	0	27	0	36	0	54	0	83	0	117	121	180	186
50	1	1	0	1	0	2	0	3	0	5	0	7	0	10	0	18	0	27	0	36	0	54	0	83	0	117	121	180	186	1	1	1	0	1	0	2	0	3	0	5	0	7	0	10	0	18	0	27	0	36	0	54	0	83	0	117	121	180	186
60	1	1	0	1	0	2	0	3	0	5	0	7	0	10	0	18	0	27	0	36	0	54	0	83	0	117	121	180	186	1	1	1	0	1	0	2	0	3	0	5	0	7	0	10	0	18	0	27	0	36	0	54	0	83	0	117	121	180	186
80	1	1	0	1	0	2	0	3	0	5	0	7	0	10	0	18	0	27	0	36	0	54	0	83	0	117	121	180	186	1	1	1	0	1	0	2	0	3	0	5	0	7	0	10	0	18	0	27	0	36	0	54	0	83	0	117	121	180	186
100	1	1	0	1	0	2	0	3	0	5	0	7	0	10	0	18	0	27	0	36	0	54	0	83	0	117	121	180	186	1	1	1	0	1	0	2	0	3	0	5	0	7	0	10	0	18	0	27	0	36	0	54	0	83	0	117	121	180	186
200	1	1	0	1	0	2	0	3	0	5	0	7	0	10	0	18	0	27	0	36	0	54	0	83	0	117	121	180	186	1	1	1	0	1	0	2	0	3	0	5	0	7	0	10	0	18	0	27	0	36	0	54	0	83	0	117	121	180	186
300	1	1	0	1	0	2	0	3	0	5	0	7	0	10	0	18	0	27	0	36	0	54	0	83	0	117	121	180	186	1	1	1	0	1	0	2	0	3	0	5	0	7	0	10	0	18	0	27	0	36	0	54	0	83	0	117	121	180	186
500	1	1	0	1	0	2	0	3	0	5	0	7	0	10	0	18	0	27	0	36	0	54	0	83	0	117	121	180	186	1	1	1	0	1	0	2	0	3	0	5	0	7	0	10	0	18	0	27	0	36	0	54	0	83	0	117	121	180	186
750	1	1	0	1	0	2	0	3	0	5	0	7	0	10	0	18	0	27	0	36	0	54	0	83	0	117	121	180	186	1	1	1	0	1	0	2	0	3	0	5	0	7	0	10	0	18	0	27	0	36	0	54	0	83	0	117	121	180	186
1000	1	1	0	1	0	2	0	3	0	5	0	7	0	10	0	18	0	27	0	36	0	54	0	83	0	117	121	180	186	1	1	1	0	1	0	2	0	3	0	5	0	7	0	10	0	18	0	27	0	36	0	54	0	83	0	117	121	180	186
2000	1	1	0	1	0	2	0	3	0	5	0	7	0	10	0	18	0	27	0	36	0	54	0	83	0	117	121	180	186	1	1	1	0	1	0	2	0	3	0	5	0	7	0	10	0	18	0	27	0	36	0	54	0	83	0	117	121	180	186

UNISERVO VI C Subsystem: 9 Track
1 Control Unit
6 Tape Units

Table F-2. UNIVAC 9300/9300 II Systems Tape Sort Timing (Part 12 of 16)

UNIVAC 9300/9300 II Systems
Memory Size: 24K Bytes

Record Size (in bytes)	Volume (in thousands)																									
	Key Size (in bytes)																									
	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30								
20	1	0	1	0	2	0	0	4	0	6	0	8	0	13	0	23	0	36	0	48	0	78	0	111	0	
30	1	1	1	1	2	2	4	5	6	7	9	11	15	17	26	31	39	46	57	66	79	82	126	131	168	175
50	1	1	1	1	2	2	4	5	6	7	9	11	15	17	26	31	42	49	56	65	79	82	126	131	168	175
80	1	1	1	1	2	2	4	5	6	7	9	11	15	17	26	31	42	49	56	65	79	82	126	131	168	175
100	1	1	1	1	2	2	4	5	6	7	9	11	15	17	26	31	42	49	56	65	79	82	126	131	168	175
200	2	2	2	2	4	4	8	9	14	14	14	18	19	30	31	54	56	88	90	126	129	203	207	270	275	360
300	2	2	2	2	4	4	8	9	14	14	14	18	19	30	31	54	56	88	90	126	129	203	207	270	275	360
500	4	4	4	4	8	8	16	17	17	17	24	25	40	41	72	73	108	110	155	157	249	253	355	360	360	
750	7	7	7	7	14	14	28	28	35	35	50	51	82	83	148	149	239	241	319	321	499	503	755	760	960	
1000	9	9	9	9	18	18	36	36	46	46	64	65	104	105	192	193	288	291	387	391	587	593	875	880	1200	
2000	22	22	22	22	44	44	88	88	112	112	156	157	256	257	480	481	720	723	1056	1063	1632	1641	2448	2460	3600	

UNISERVO VI C Subsystem: 9 Track
1 Control Unit
3 Tape Units

Table F-2. UNIVAC 9300/9300 II Systems Tape Sort Timing (Part 13 of 16)

UNIVAC 9300/9300 II Systems
Memory Size: 32K Bytes

Record Size (in bytes)	Blocking Factor	Volume (in thousands)																							
		1		2		5		10		15		20		30		50		75		100		150		200	
		10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30
20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
20	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
20	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
20	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
30	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
30	20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
30	40	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
30	60	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
50	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
50	10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
50	25	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
50	40	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
80	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
80	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
80	15	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
80	25	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
80	40	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
100	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
100	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
100	10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
100	20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
200	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
200	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
200	10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
300	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
300	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
300	6	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
500	1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
500	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
500	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
750	1	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
750	2	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
1000	1	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	
1000	2	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
2000	1	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	

Volume (in thousands)

Key Size (in bytes)

UNIVAC 9300/9300 II Systems
Memory Size: 32K Bytes

UNISERVO VI C Subsystem: 9 Track
1 Control Unit
4 Tape Units

Table F-2. UNIVAC 9300/9300 II Systems Tape Sort Timing (Part 14 of 16)

Record Size (in bytes)	Volume (in thousands)																							
	1		2		5		10		15		20		30		50		75		100		150		200	
	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30
	Key Size (in bytes)																							
Blocking Factor	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30
20	1	0	1	0	2	0	3	0	5	0	6	0	9	0	17	0	25	0	33	0	56	0	75	0
20	1	0	1	0	2	0	3	0	5	0	6	0	9	0	17	0	25	0	33	0	56	0	74	0
50	1	0	1	0	2	0	3	0	5	0	6	0	9	0	17	0	25	0	37	0	56	0	74	0
100	1	0	1	0	2	0	3	0	5	0	6	0	10	0	16	0	24	0	37	0	55	0	73	0
30	1	1	1	1	2	2	3	4	6	6	8	11	13	18	21	26	31	40	47	60	71	80	94	94
20	1	1	1	1	2	2	3	4	5	6	7	11	13	18	21	30	36	40	47	60	71	79	94	94
40	1	1	1	1	2	2	3	4	5	6	7	11	13	18	21	30	36	40	47	60	71	79	94	94
60	1	1	1	1	2	2	3	4	5	6	7	11	13	18	21	30	36	40	47	60	71	89	106	106
50	1	1	1	1	2	2	4	4	6	6	9	10	13	14	21	24	36	40	47	54	71	80	107	121
10	1	1	1	1	2	2	4	4	6	6	9	10	13	14	21	23	36	40	47	53	80	90	107	120
25	1	1	1	1	2	2	4	4	6	6	9	10	13	14	24	27	36	40	47	53	80	90	107	120
40	1	1	1	1	2	2	4	4	7	7	9	10	13	14	24	27	36	40	47	53	80	90	107	120
80	1	1	1	1	3	3	5	5	9	9	12	12	17	18	34	35	50	53	67	70	116	120	154	159
5	1	1	1	1	3	3	5	5	9	9	12	12	17	18	34	35	50	52	67	70	115	120	154	159
15	1	1	1	1	3	3	5	5	9	9	12	12	17	18	34	35	50	52	77	80	115	120	154	159
25	1	1	1	1	3	3	6	6	9	9	12	12	20	21	34	35	50	52	77	80	115	120	154	159
100	1	1	1	1	3	3	7	8	11	11	14	15	25	25	41	42	61	63	93	96	140	144	154	159
5	1	1	1	1	3	3	7	8	11	11	14	15	25	25	41	42	61	63	93	96	140	144	154	159
10	1	1	1	1	3	3	7	8	11	11	14	15	25	25	41	42	61	63	93	96	140	144	154	159
20	1	1	1	1	3	3	7	8	11	11	14	15	25	25	41	42	70	72	93	96	140	144	154	159
200	1	1	2	2	5	5	13	13	19	19	30	30	45	46	87	88	130	132	132	132	140	144	154	159
5	1	1	2	2	7	7	13	13	23	23	30	30	45	46	87	88	130	132	132	132	140	144	154	159
10	1	1	2	2	7	7	13	13	23	23	30	30	45	46	87	88	130	132	132	132	140	144	154	159
300	2	2	3	3	9	9	18	18	33	33	43	44	65	66	127	128	127	128	127	128	140	144	154	159
3	2	2	3	3	9	9	22	22	33	33	43	44	76	77	127	128	127	128	127	128	140	144	154	159
6	2	2	3	3	9	9	22	22	33	33	43	44	76	77	127	128	127	128	127	128	140	144	154	159
500	3	3	5	5	15	15	36	36	53	53	83	84	125	126	127	128	127	128	127	128	140	144	154	159
2	3	3	6	6	15	15	36	36	53	53	83	84	125	126	127	128	127	128	127	128	140	144	154	159
4	3	3	6	6	15	15	36	36	53	53	83	84	125	125	127	128	127	128	127	128	140	144	154	159
750	4	4	9	9	27	27	53	53	93	93	124	124	124	124	127	128	127	128	127	128	140	144	154	159
2	4	4	9	9	27	27	53	53	93	93	124	124	124	124	127	128	127	128	127	128	140	144	154	159
1000	6	6	12	12	35	35	83	83	124	124	124	124	124	124	127	128	127	128	127	128	140	144	154	159
2	6	6	12	12	35	35	83	83	124	124	124	124	124	124	127	128	127	128	127	128	140	144	154	159
2000	12	12	28	28	83	83	124	124	124	124	124	124	124	124	127	128	127	128	127	128	140	144	154	159

UNIVAC 9300/9300 II Systems
Memory Size: 32K Bytes

UNISERVO VI C Subsystem: 9 Track
1 Control Unit
5 Tape Units

Table F-2. UNIVAC 9300/9300 II Systems Tape Sort Timing (Part 15 of 16)

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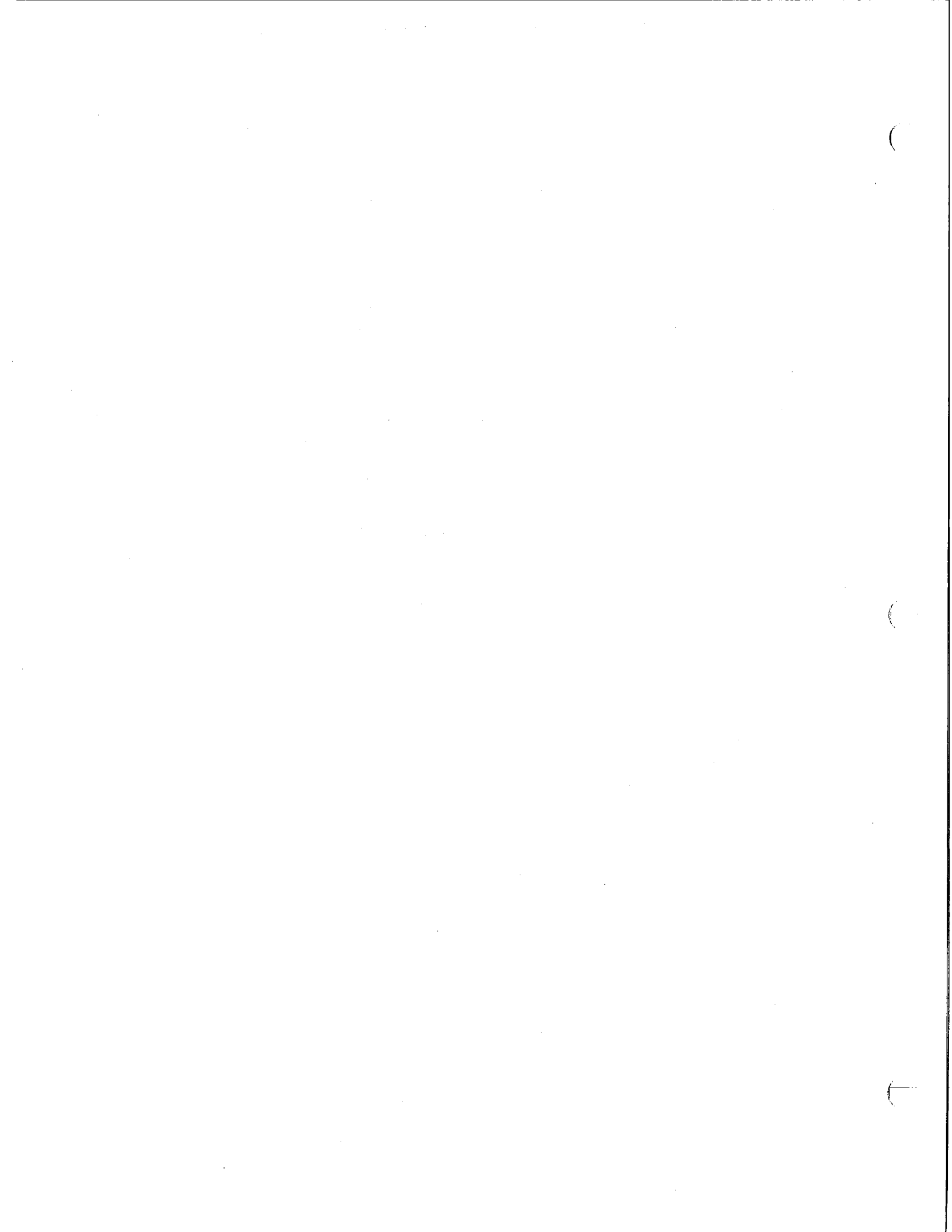
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