File Number S360(Mod.20)-20
Form C24-9010-3

TPS

IBM Systems Reference Library

DAPS COPY

IBM System/360 Model 20 Tape Programming System Performance Estimates

This manual contains performance estimates for the Model 20 Tape Programming System. Internal and external storage requirements, as well as time requirements, are listed in tables or provided in the form of formulas with which the needed information can be obtained.

Readers of this publication should be familiar with the contents of the System Reference Library (SRL) publication IBM System/360 Model 20, Tape Programming System, Control and Service Programs, Form C24-9000.

Readers should also have read those SRL publications that are concerned with the particular program or programs for which performance estimates are needed.

Fourth Edition (March 1969)

This is a major revision of, and obsoletes, C24-9010-2. Changes have been made throughout the manual, mainly to reflect the availability of the IBM System/360 Model 20 Submodel 5. Changes to the text, and small changes to illustrations, are indicated by a vertical line to the left of the change; changed or added illustrations are denoted by the symbol • to the left of the caption.

This edition applies to the following program version and modification levels of the IBM System/360 Model 20 Tape Programming System, and to all subsequent versions and modifications until otherwise indicated in new editions or Technical Newsletters.

Program No.	V/M	Program No.	V/M
360U-UT-131	3/0	360U-AS-149	3/0
360U-UT-132	3/0	360U-SM-150	3/0
360U-UT-133	3/0	360U-IO-151	4/0
360U-UT-134	3/0	360U-IO-152	4/0
360U-UT-135	2/2	360U-CQ-154	1/1
360U-SL-144	3/0	360U-SL-155	1/0
360U-SL-145	3/0	360U-SL-156	1/0
360U-SL-146	3/0	360U-CL-157	1/0
360U-SL-147	3/0	360U-CL-158	1/0
360U-RG-148	3/0	360U-CL-159	1/0

Changes are continually made to the specifications herein; before using this publication in connection with the operations of IBM equipment, consult the latest SRL Newsletter, Form N20-0361, for the editions that are applicable and current.

This publication was prepared for production using an IBM computer to update the text and to control the page and line format. Page impressions for photo-offset printing were obtained from an IBM 1403 printer using a special print chain.

Requests for copies of IBM publications should be made to your IBM representative or to the IBM branch office serving your locality.

A form for readers' comments is provided at the back of this publication. If the form has been removed, comments may be addressed to IBM Laboratory, Publications Dept., P.O. Box 24, Uithoorn, Netherlands.

CONTENTS

ILLUSTRATIONS

This publication provides information to be used in systems planning, analysis, and evaluation. It lists external and internal storage requirements as well as time requirements. The storage requirement listings are arranged so that the reader can look up the basic requirement of the program for which he needs the performance estimates and add the additional requirements that apply to the individual characteristics of his program or configuration.

The time requirements not listed in tables can be computed from formulas provided in the various sections. Some of the more complex formulas are illustrated with examples.

Readers of this publication should be familiar with the contents of the Systems Reference Library (SRL) publication: IBM System/360 Model 20, Tape Programming System, Control and Service Programs, Form C24-9000.

Readers should also have read those of the following SRL publications that are concerned with the particular program or programs for which performance estimates are needed:

IBM System/360 Model 20, Disk and Tape Programming Systems:

Report Program Generator, Form C24-9001

Assembler Language, Form C24-9002

Input/Output Control System for the IBM 1419 and 1259 Magnetic Character Readers, Form C33-6001

Tape Sort/Merge Program, Form C26-3804

Tape Utility Programs, Form C26-3808.

IBM System/360 Model 20, Tape Programming System: Input/Output Control System, Form C24-9003.

INTERNAL STORAGE REQUIREMENTS

This section contains the data required to estimate the amount of main storage occupied by IBM-supplied programs and, accordingly, the size of the available problem program area, where applicable.

BASIC MONITOR STORAGE REQUIREMENTS

The Basic Monitor is the main control program; it remains in main storage throughout the system run. The main-storage requirements for the different modes of the Basic Monitor are shown in Figure 1. The Basic Monitor area extends through the various positions shown in Figure 1. The area must not be used for any other program. The first storage position available is, in each case, the next higher address.

Mode of Basic Monitor	Card Resident	Tape Resident
Nonoverlap Mode	1661	1661
Nonoverlap Mode with Loader Function:		
Tape Input	--	1999
Card Input	--	2099
Overlap Mode	2099	2099
Overlap Mode with Loader Function:		
Tape Input	--	2399
Card Input	--	2499

- Figure 1. Main-Storage Requirements of the Basic Monitor (in bytes)

Note 1: The Loader Input Area may be overlaid by any phase of a user program. This frees an extra 72 or 22 bytes, depending whether the card-resident or tape-resident Basic Monitor, respectively, is in use.

Note 2: During the execution of the last phase of a job stream, the area occupied by the Fetch routine in the Basic Monitor may be used by the problem program. In such a case, the first available storage position is 350 bytes lower than the end address of the Basic Monitor given in Figure 1 for the overlap and nonoverlap modes (1661 and 2099).

JOB CONTROL STORAGE REQUIREMENTS

The Job Control program is read into the problem-program area of main storage between jobs and then overlaid again. It does not require any main storage during the execution of a job. However, there is a limitation on the number of TPLAB statements that can be accommodated in main storage. The number of TPLAB statements that can be processed varies with main-storage capacity:

Capacity	No. of TPLAB Statements	
	Card Resident	Tape Resident
4K	2	--
8K	70	50
12K	140	120
16K	210	190
24K	350	330
32K	490	470

where K = 1024 bytes

IOCS STORAGE REQUIREMENTS

At assembly time, the IOCS macro instructions in a user's program are expanded into sets of routines. These routines can be grouped in three different classes according to the functions they perform:

- Linkage routines.
- File-processing routines.
- DTFEN routines.

Linkage Routines

The linkage routines are generated from the imperative IOCS instructions (GET, PUT, etc.). For main-storage requirements refer to Figure 2.

File Processing Routines

The file-processing routines are generated from the file definition statements (DTFSR, DTFMT). Each data file processed by the program has one definition statement and, consequently, one set of processing routines is generated for each file.

Macros		Lengths (bytes)
CLOSE	file 1, file 2...file N	N x 4[1]
CNTRL	file 1	6
CRDPR,	workarea cardprintarea	8
EOM	file 1	4
FEOV	file 1	4
GET	file 1	4
GET	file 1, workarea	6
LBRET	1	4
LBRET	2	2
LOM	file 1	4
OPEN	file 1, file 2...file N	N x 4[1]
PRTOV	file 1	8
PUT	file 1	4
PUT	file 1, workarea	6
RELSE	file 1	4
TRUNC	file 1	4

[1]Only if no OVLAY specified in DTFEN. If OVLAY is specified, add the values in Figures 9 to 13 to the storage requirements listed above

Figure 2. Main-Storage Requirements (in bytes) of Imperative Macros

TAPE FILE (DTFMT): Main-storage requirements are listed in Figures 3 and 4.

Besides the basic storage space requirements of input and output tape file processing routines, Figures 3 and 4 list the additional requirements of DTFMT entries such as FILABL=STD, READ=BACK, CONTROL=YES. Whenever one or more of these entries are specified, the corresponding values must be added to the basic requirements in order to arrive at the total storage space requirements.

CARD FILE AND PRINTER FILE (DTFSR): The basic storage requirement for all programs using the IOCS routines for card/printer files is 210 bytes. Additional main-storage requirements depend on the input/output devices used and the IOCS features chosen. The requirements listed in Figures 5 and 6 can be used to calculate the approximate storage requirements of the object program routines.

Output Files 1 and 2 I/O areas DTFMT	Basic	
	1 I/O Area	2 I/O Areas
FIXBLK		
no work area	218	232
1 work area record size ≤ 256	204	240
1 work area record size > 256	212+6n*	248+6n*
VARBLK		
no work area	218	232
1 work area record size ≤ 256	264	304
1 work area record size > 256	292	332
FIXUNB		
no work area	102	120
1 work area record size ≤ 256	120	136
1 work area record size > 256	128+6n*	144+6n*
VARUNB		
no work area	126	156
1 work area record size ≤ 256	142	156
1 work area record size > 256	152+6n*	168+6n*
UNDEF		
no work area	106	124
1 work area record size ≤ 256	122	138
1 work area record size > 256	132+6n*	148+6n*
For FILABL=STD add 70 bytes		
For CONTROL=YES add 8 bytes		

* n=1 for records ≤ 512
n=2 for records ≤ 768
n=3 for records ≤ 1024

&c for increments of 256 bytes

• Figure 3. Main-Storage Requirements (in bytes) of Tape Output File Processing Routines

				WLRERR = NAME ERROPT =				WLRERR = blank ERROPT =					
Input files, 1 and 2 I/O areas DTFMT	Basic		** WLRERR = NAME	** NAME	SKIP	IGNORE	** NAME	SKIP	IGNORE		READ = BACK	
	1 I/O	2 I/O							1 I/O	2 I/O	1 I/O	2 I/O
FIXBLK												
no work area	194	236	2	16	12	0	14	10	-30	-30	2	6
1 work area record size ≤ 256	260	284	2	16	12	0	14	10	-30	-30	2	6
1 work area record size > 256	270 +6n*	294 +6n*	2	16	12	0	14	10	-30	-30	2	6
VARBLK												
no work area	184	214	2	16	12	0	14	10	-18	-22	-	-
1 work area record size ≤ 256	268	300	2	16	12	0	14	10	-18	-22	-	-
1 work area record size > 256	312	344	2	16	12	0	14	10	-18	-22	-	-
FIXUNB												
no work area	110	148	2	16	12	0	14	10	-14	-14	0	6
1 work area record size ≤ 256	150	170	2	16	12	0	14	10	-14	-14	0	6
1 work area record size > 256	160 +6n*	176 +6n*	2	16	12	0	14	10	-14	-14	2	6
VARUNB												
no work area	118	168	2	16	12	0	14	10	-22	-28	46[1]	52[4]
1 work area record size ≤ 256	158	184	2	16	12	0	14	10	-22	-28	46[2]	58[5]
1 work area record size > 256	168 +6n*	190 +6n*	2	16	12	0	14	10	-22	-28	42[3]	58[6]
UNDEF												
no work area	104	142	-	-	-	-	16	12	0	0	0	10
1 work area record size ≤ 256	144	164	-	-	-	-	16	12	0	0	10	20
1 work area record size > 256	154 +6n*	170 +6n*	-	-	-	-	16	12	0	0	6	20

Notes: If WLRERR=blank and ERROPT=IGNORE are specified, READ=BACK requires only:
[1] 10 bytes [3] 6 bytes [5] 18 bytes
[2] 10 bytes [4] 12 bytes [6] 18 bytes

For FILABL=STD add 70 bytes
For CONTROL=YES add 8 bytes
For CKPTREC=YES and 1 I/O area add 50 bytes, if FILABL=STD, add 6 bytes
For CKPTREC=YES and 2 I/O areas add 58 bytes, if FILABL=STD, add 6 bytes
if READ=BACK, add 6 bytes

* n=1 for records ≤ 512 bytes, n=2 for records ≤ 768 bytes,
n=3 for records ≤ 1024 bytes, &c for increments of 256 bytes

** If ERRIO=NAME is specified with 2 I/O areas, add 6 bytes

• Figure 4. Main-Storage Requirements (in bytes) of Tape Input File Processing Routines

Device	Mode of Operation		Bytes
Basic Routines			210
1403 Printer or 2203 with Standard Carriage	No CONTROL, no PRINTOV		90
	With CONTROL		170
	With PRINTOV		200
	with CONTROL and PRINTOV		310
2203 Printer with Dual-Feed Carriage	No CONTROL, no PRINTOV		260
	With CONTROL		380
	With PRINTOV		480
	With CONTROL and PRINTOV		630
2501 Card Reader	Models A1 and A2 nonoverlap		100
	Model A1, overlap		150
	Model A2, overlap		200
2520 Card Punch	Nonoverlap		100
	Overlap		150
2520 Card Read Punch	Input file	min.*	160
		max.*	350
	Output file	min.*	140
		max.*	330
	Combined file	min.*	370
		max.*	610
2560 MFCM	One input file	min.**	650
		max.**	1000
	One output file	min.**	700
		max.**	1050
	One combined file	min.**	950
		max.**	1170

Figure 5. Approximate Main-Storage Requirements (in bytes) of the IOCS Routines for Card and Printer Devices, Part 1 of 2

Device	Mode of Operation		Bytes
2560 MFCM (cont.)	Two input files	min.**	800
		max.**	1250
	Two output files	min.**	970
		max.**	1250
	Two combined files	min.**	1050
		max.**	1500
1442 Model 5 Card Punch	Nonoverlap		100
	Overlap		150

*Minimum stands for files with nonoverlap and no CONTROL specified; maximum for overlap and CONTROL.
**Minimum stands for files with nonoverlap and no Card Print specified; maximum for overlap and Card Print.

Figure 5. Approximate Main-Storage Requirements (in bytes) of the IOCS Routines for Card and Printer Devices, Part 2 of 2

Program Feature	Main-Storage Requirements			
	Basic	For Each File		For
		Exit Entry	No Exit Entry	Field
RFORMTn detail entry	130	22	MFCM,2520: 44 2501: 32	4
PFORMTn detail entry	70*	26	MFCM,2520: 48	
SEQNCE detail entry	-	24 bytes plus length of sequence field		-

*130 bytes are required for the joint use of RFORMTn and PFORMTn detail entries.

Figure 6. Approximate Main-Storage Requirements (in bytes) of Additional IOCS Features

DTFEN Routines

The DTFEN routines comprise the Scheduling routines, the Initilization/Termination routines, the OPEN and CLOSE routines, and the CONTROL routine. The four groups of routines are normally generated when the Assembler encounters the DTFEN definition statement.

If the DTFEN statement includes the operand OVLAY, the OPEN and CLOSE routines are generated in-line. If RWC=YES (read/compute, write/compute overlap) is specified in the DTFBG definition, the Assembler does not generate the Scheduling routine. For RWC=YES, the Scheduler routine is part of the Basic Monitor.

Scheduling Routines. These routines handle the various conditions that can occur when a CCW for a tape I/O operation is to be executed. In addition, these routines queue requests for tape I/O operations whenever a CCW cannot be executed at the time the tape I/O operations are requested.

The length of the scheduling routines varies with the characteristics of the problem program files as indicated below.

No tape files in problem program: 0 bytes

Tape files only or card/printer files plus tape files without work area: 300 bytes

Card/printer files plus tape files with work area: 360 bytes

Initialization/Termination Routines. The lengths of these routines are determined by the type of labels specified for the tape file(s) to be processed in the user's program.

The storage requirements for the Initialization/Termination routines are the same for (1) programs processing only tape input files and (2) programs processing both tape input and tape output files. These storage requirements are shown in Figure 7.

Figure 8 shows the storage requirements for the Initialization/Termination routines for programs processing only tape output files.

OPEN and CLOSE Routines. Figures 9 through 13 show the storage requirements for the OPEN and CLOSE routines. These routines are generated in-line if OVLAY has been specified in the DTFEN definition statement. In this case, the OPEN routine can be overwritten by the problem program and all or part of the problem program can be overwritten by the CLOSE routine. Therefore, the storage requirements shown for the two routines must be taken into account when the overlay programming technique is not used. When the overlay programming technique is used, some or all of the storage requirements for the two routines can be disregarded. The number of bytes that can be disregarded is determined by the extent of overwriting.

CONTROL Routine. The CONTROL routine is generated if CONTROL=YES is specified in the DTFMT definition statement. The CONTROL routine handles tape-drive functions such as tape rewind, rewind and unload, backspace, etc. The main-storage requirements for the CONTROL routine depend on whether input, output, or input and output operations are performed, as follows:

	Storage Requirements (bytes)
Input	
Read forward	50
Read backward	50
Read forward and backward	58
Output	34
Input and Output	
Read forward	62
Read backward	62
Read forward and backward	70

FILABL	Forward files only		Backward files only		Forward + Backward files	
	no label exit	label exit	no label exit	label exit	no label exit	label exit
STD	500	560	480	530	580	700
NO	280	-	300	-	280	-
NSTD	270	-	280	-	280	-
STD + NO	510	580	470	540	590	710
STD + NSTD	510	580	470	540	600	720
NO + NSTD	280	-	270	-	280	-
STD+NO+NSTD	510	580	470	540	600	720

Figure 7. Main-Storage Requirements (in bytes) of Initialization/Termination Routines -- Only Tape Input Files and Both Tape Input and Tape Output

FILABL	Forward Files only	
	no label exit	label exit
STD	390	360
NO	260	-
STD + NO	400	370

Figure 8. Main-Storage Requirements (in bytes) of Initialization/ Termination Routines with Output Files Only

FILABL	Forward files only		Backward files only		Forward + Backward files	
	no label exit	label exit	no label exit	label exit	no label exit	label exit
STD	280	340	110	160	360	490
NO	50	-	60	-	100	-
NSTD	40	-	50	-	80	-
STD + NO	300	370	150	200	420	540
STD + NSTD	290	360	130	180	400	520
NO + NSTD	70	-	90	-	140	-
STD+NO+NSTD	320	390	170	220	460	590

Figure 9. Main-Storage Requirements for OPEN Routine, Input Files Only

FILABL	Forward files only		Forward + Backward files	
	no label exit	label exit	no label exit	label exit
STD	490	620	590	760
NO	70	-	110	-
NSTD	40	-	80	-
STD + NO	540	670	670	830
STD + NSTD	510	640	620	800
NO + NSTD	70	-	150	-
STD+NO+NSTD	560	690	690	890

Figure 10. Main-Storage Requirements for OPEN Routine, Input and Output Files

FILABL	Forward files only	
	no label exit	label exit
STD	340	400
NO	40	-
STD + NO	350	510

Figure 11. Main-Storage Requirements for OPEN Routine, Output Files Only

FILABL	Forward files only		Forward + Backward files	
	no label exit	label exit	no label exit	label exit
STD	140	200	150	200
NO	70	-	70	-
NSTD	70	-	70	-
STD + NO	140	200	150	200
STD + NSTD	140	200	150	200
NO + NSTD	70	-	70	-
STD+NO+NSTD	140	200	140	200

Figure 12. Main-Storage Requirements for CLOSE Routines, Input and Output Files

FILABL	Forward files only	
	no label exit	label exit
Output Files		
STD	130	190
NO	70	-
STD + NO	130	190

Note: CLOSE routines for input files only require 48 bytes of storage. If an alternate drive is specified, the main-storage requirement is 74 bytes.

Figure 13. Main-Storage Requirements for CLOSE Routines, Input or Output Files

Examples of IOCS Main-Storage Requirements

The following examples show the calculations necessary to determine the main-storage requirements for the given input and output files.

The calculations are performed for one and two I/O areas. The read/compute, write/compute overlap feature (RWC) is necessary when two I/O areas are used for tape-file processing, but not for one I/O area. The source of the information is indicated on each line of the calculation, for example, "Monitor program (Fig. 1)."

Example 1

Problem:

1. Create a tape output file A (VARUNB, BLKSIZE=800, work area, STD labels).
2. Create a tape output file B (FIXBLK).

Main-storage requirements (in bytes):

	1 I/O area no RWC	2 I/O areas with RWC
Monitor program (Fig. 1)	1661	2099
Tape file A (Fig. 3)		
152+18+70	240	-
168+18+70	-	256
Tape file B (Fig. 3)	218	232
General routines for tape in DTFEN:		
Scheduler (Page 10)	300	-
Init./Term. (Fig.8)	400	400
OPEN rout. (Fig.11)	350	350
CLOSE rout. (Fig.13)	130	130
Total	3299	3467

On a 16K machine, therefore, 13,085 and 12,917 bytes, for one and two I/O areas respectively, will be available for the user's processing program, including imperative macro instructions, I/O areas, and work areas.

Example 2

Problem:

1. Tape input file A (FIXUNB, BLKSIZE=400, work area, READ=BACK, WLRERR=name, ERROPT=SKIP, CONTROL=YES, STD labels).
2. Tape input file B (FIXBLK, ERROPT=IGNORE, CONTROL=YES, STD labels).
3. Printer (CONTROL=YES).

Main-storage requirements (in bytes):

	1 I/O area no RWC	2 I/O areas with RWC
Monitor program (Fig. 1)	1661	2099
Tape file A (Fig. 4)		
160+6+2+12+2+70+8	260	-
176+6+2+12+6+70+8	-	280
Tape file B (Fig. 4)		
194-30+70+8	242	-
236-30+70+8	-	284
Printer (Fig. 5)		
210+170	380	380
General routines for tape in DTFEN:		
Scheduler (Page 10)	360	-
Init./Term. (Fig.7)	580	580
OPEN rout. (Fig.9)	360	360
CLOSE rout. (Fig.13)	48	48
Control rout. (P.10)	58	58
Total	3949	4089

On a 16K machine, therefore, 12,435 and 12,295 bytes will be available for the user's processing program, including imperative macro instructions, I/O areas, and work areas.

Example 3

Problem:

1. 2501 Card Reader (1 I/O area, overlap).
2. MFCM1 (output, OVERLAP=NO).
3. Printer (PRINTOV=YES, CONTROL=YES).

Main-storage requirements (in bytes):

Monitor program (Figure 1)	1661
Basic routines for card and printer I/O devices (Fig. 5)	210
2501 Card Reader (Fig. 5)	150
MFCM1 (Fig. 5)	700
Printer (Fig. 5)	310
Total	3031

On a 16K machine, therefore, 13,353 bytes will be available for the user's processing program, including imperative macro instructions, I/O areas, and work areas.

BASIC MONITOR MACRO STORAGE REQUIREMENTS

The main-storage requirements of the four monitor macro instructions are as follows:

Monitor macro	Bytes
COMRG	4
MVCOM	10
FETCH	22
EOJ	4

REPORT PROGRAM GENERATOR (RPG) STORAGE REQUIREMENTS

The main-storage requirements of the Model 20 tape RPG for both program generation and processing of the object program depend on the number and type of specifications used by the programmer in the source program.

PROGRAM GENERATION

The monitor and the protected storage area require 1664 bytes. The rest of main storage is occupied by RPG phases and the compression.

The following area (in bytes) is available for the compression if 8K of main storage are available for generation:

1. Available for the total of all compressions -- 3650 bytes
2. Available for the compression of the file description, file extension -- 442 bytes

File description and file extension compression and the symbol table, together with:

the input compression
or the calculation compression
or the output compression

must not exceed -- 3200 bytes

For each additional 4K of storage available for program generation, add 4096 to the above values.

The information from each source card is compressed in storage by the RPG compiler. The requirements for each card punched from the specification forms are shown in Figure 14.

Description	No. of Bytes Required	
	Basic	Added
1. File description card	26	
2. File extension card	22	
3. Input Specification card		
Record identification	7	
For each card code		4
Field description	8	
If the specification FIELD RECORD RELATION or FIELD INDICATORS is used		4
If STERLING is specified		3
4. Calculation specification card	5	
If no more than two of the fields FACTOR1, FACTOR2 and RESULT FIELD contain an entry		8
If there is an entry in all three of these fields		12
If resulting indicators are used		3
For each literal whose overall length (including sign and quotation marks) is greater than 6 characters		10
5. Output specification card		
File identification	7	
If output indicators are used		3

Figure 14. Main-Storage Requirements (in bytes) for Each Card Punched from RPG Specification Forms, Part 1 of 2

Description	No. of Bytes Required	
	Basic	Added
Field description	8	
If the specification OUTPUT INDICATORS or BLANK AFTER is used		4
For each use of a constant		4
For each character of a constant field, excluding the quotation marks (this requirement is to be counted only once for each constant specified)		1
If STERLING is specified		3
6. Defined fields		
For each field name defined on the input or calculation form	8	
For each literal defined on the calculation form and not exceeding six characters (if such a field name or type of literal is used more than once in a source program, it still requires only eight bytes).	8	

Figure 14. Main-Storage Requirements (in bytes) for Each Card Punched from RPG Specification Forms, Part 2 of 2

OBJECT PROGRAM

Nearly all available main storage can be used by the object program. The storage requirements for the object program are based upon six factors:

1. The basic routines
2. The Input/Output routines
3. Fields, literals, indicators, and areas used
4. The Processing routines
5. The End, Start, and DTFEN routines
6. The use of tape error statistics.

Basic Routines

The basic routines contain the general logic of the object program. Their approximate storage requirements are shown in Figure 15.

Description	No. of Bytes Required	
	Basic	Added
Basic requirements, without work areas, and without protected storage	200	
If one matching file is used		20
If two matching files are used		100
For each further matching file		14
If numeric-sequence type records are used		66
If H1 or H2 indicator is used		44
For an altered collating sequence (incl. 256-byte table)		262
For Sterling input routines		240
For Sterling output routines		240
For Sterling input and output routines		420
For card input only (more than one input file)		60
For tape input only		44
For card and tape input		100
For Test Zone subroutine		30
For Translate subroutine (needed if COMP occurs in calculations with altered collating sequence)		160
For each EOF condition		8

• Figure 15. Main-Storage Requirements (in bytes) for Basic RPG Routines

Input/Output Routines

The main-storage requirements of card and tape input/output routines differ. However, all I/O routines make use of the Basic Monitor and the PIOCS (Physical Input/Output Control System), which forms a part of the Basic Monitor. The main-storage requirement for the complete Basic Monitor need only be considered inasmuch as it represents an area at the beginning of main storage that must not be used for any other program. The location of the first available main-storage position following the Basic Monitor is accordingly dependent on the size of the Basic Monitor (see the section headed Basic Monitor Storage Requirements).

CARD INPUT/OUTPUT. The main-storage requirements of the card I/O routines amount to the size of the input or output work areas used, plus the requirements of the particular I/O units used in the program. The unit-dependent storage requirements are listed in Figure 16.

TAPE INPUT/OUTPUT. This section lists the main-storage requirements of the input/output routines for tape files. To obtain the total for a particular program, add the basic requirements to whatever additional requirements apply to the specific files under consideration. The storage requirements referring to the record format of the files must be counted only once, even if more than one file is used. The storage requirements dependent on the properties of the specific files must be counted separately for each file.

The 400 bytes taken up by the scheduler must also be considered. The scheduler area must be added to the I/O-routine requirement except when read/compute, write/compute overlap is specified for the job (i.e., when column 38 of the RPG control card contains a W punch).

For example, the input routine for two fixed-length blocked input files, using two input areas, requires 326 bytes of main storage, as follows:

```
          160   Basic routines
           34   Fixed-length blocked records
2 x 66 =  132   2 files: fixed blocked,
          326 bytes     /2 input areas
```

To obtain the complete I/O storage requirements, add the length of the I/O areas and the DTF blocks (counted separately for each file) to the requirements for the I/O routines already calculated.

Description	No. of Bytes Required	
	Basic	Added
1. IBM 2560 Multifunction Card Machine (MFCM)	240	
If both hoppers are used		30
For input using one hopper		60
For Input using two hoppers		80
For punched output		70
For Card printing		150
2. IBM 2520 Card Read-Punch, Model A1		
For input only	200	
For input and output	240	
3. IBM 2501 Card Reader	100	
4. IBM 2501 Card Reader plus IBM 2520 Card Read-Punch for input	60	
5. IBM 2520 Card Punch, Models A2 and A3	110	
6. IBM 1442 Card Punch	80	
7. IBM 2203 Printer	90	
If Dual-Feed Carriage is used		30
If the special print routine is generated		30
8. IBM 1403 Printer	90	

Note: In addition to the above storage requirements, the space taken up by the DTF blocks, the I/O areas, the scheduler, and the I/O work areas must also be taken into consideration (see DTF Blocks and Areas).

Figure 16. Unit-Dependent Main-Storage Requirements (in bytes) for RPG Card I/O

DTF Blocks. DTF blocks for tape input files occupy:

102 bytes for each file with labels
54 bytes for each file without labels.

DTF blocks for tape output files occupy:

92 bytes for each file with labels
44 bytes for each file without labels.

Description	No. of Bytes Required	
	Basic	Added
* Basic requirements Tape Input (fixed-length unblocked records)	160	
* Fixed-length blocked records		34
Variable-length records:		
* Unblocked		68
* Blocked		150
* Longer than 256 bytes		32
* Fixed and variable-length records		8
For each tape-input file of the following types:		
(a) Fixed-length records:		
** Unblocked, 1 input area		20
** Unblocked, 2 input areas		38
** Blocked, 1 input area		52
** Blocked, 2 input areas		66
(b) Variable-length records:		
** Unblocked, 1 input area		
0 or 1 matching file		24
2 or more matching files		44
** Unblocked, 2 input areas		
0 or 1 matching file		38
2 or more matching files		58
** Blocked, 1 input area		
0 or 1 matching file		44
2 or more matching files		64
** Blocked, 2 input areas		
0 or 1 matching file		58
2 or more matching files		78
**For records longer than 256 bytes, add for every additional 256 bytes		6

* Add these values only once per job

**Add these values once per file

Figure 17. Main-Storage Requirements (in bytes) for RPG Tape Input Routines

TAPE INPUT. The main-storage requirement of the input routine of a tape file is shown in Figure 17.

TAPE OUTPUT. The main-storage requirements of the output routines of a tape file are shown in Figure 18.

Fields, Literals, Indicators and Areas Used

The number of bytes for alphameric and packed fields is zero, if the fields are not assigned. Otherwise, alphameric fields require one byte for each character and packed fields require one byte for each position. The number of bytes for numeric fields can be computed with the following formula:

If N is odd $\frac{N + 1}{2}$

If N is even $\frac{N + 2}{2}$

Where N = the number of characters in the field.

The main-storage requirements for alphameric and numeric literals are the same as for the fields described above. A literal that is used repeatedly in calculation specifications is stored only once, regardless of the number of times it is used. The same applies to literals and edit words in output format specifications.

An edit control field is always treated as an alphameric field when determining main-storage requirements. The actual length exceeds the specified length by one or two bytes.

The number of bytes required for each control level equals the total number of characters of the control field pertaining to this level.

Each matching field (M1-M9) requires additional main-storage. The number of bytes required is computed by means of the formula,

No. of bytes = (N + 1) (M + 1)

where N stands for the number of characters of the respective fields and M is the number of input files.

The basic requirement for indicators is five bytes (H1, H2, MR, 00, L0). Each additional indicator used in the program requires an additional byte.

Description	No. of Bytes Required	
	Basic	Added
* Basic requirement Tape Output	48	
* Unblocked records		18
* Unblocked records, 2 output areas		20
Fixed-length blocked records:		
* 1 output area		134
* 2 output areas		128
Variable-length records:		
* Unblocked		42
* Blocked		60
* Blocked, 1 output area		104
* Blocked, 2 output areas		122
For each tape-output file of the following types:		
(a) Fixed-length records:		
** Unblocked, 1 output area		26
** Unblocked, 2 output areas		26
** Blocked, 1 output area		38
** Blocked, 2 output areas		42
(b) Variable-length records:		
** Unblocked, 1 output area		26
** Unblocked, 2 output areas		26
** Blocked, 1 output area		46
** Blocked, 2 output areas		34
**For records longer than 256 bytes, add for every additional 256 bytes		6

* Add these values only once per job

**Add these values once per file

● Figure 18. Main-Storage Requirements (in bytes) for RPG Tape Output Routines

AREAS: The sizes of the I/O areas are determined by the characteristics of the file. The block length of each file must be entered in columns 20-24 of the File Description specifications. If this entry is omitted, a block length of 80 bytes is assumed.

One I/O area is assigned to each file. Two I/O areas may be specified for tape files or files read by the IBM 2501 Card Reader. Therefore, to determine the I/O area requirements of an input or output routine, the sum of the input and output areas of all the files involved must be taken.

An input work area is also required, equal in length to the longest input record. An output work area is required only for card and printer files. The output work area must be as long as the longest card or printer output record (specified in columns 25-28 of the File Description specifications). Records are put into these areas successively; therefore, these areas must be counted only once per input or output routine, and not once per file.

AREA SIZES. The minimum and maximum I/O area sizes are as follows:

	Minimum	Maximum
Card Input	2 bytes	80 bytes
Card Output	1 byte	80 bytes
Tape I/O	18 bytes	4095 bytes

If Card Print is used, the size of the area reserved is determined by the line using the greatest number of print heads simultaneously, with a 64-byte document-print area assigned to each head.

The printer uses the output work area and does not require a special output area of its own. The output areas may overlay the Start routine (see End, Start, and DTFEN Routines).

Processing Routines

Processing routines contain the instructions created from the source specifications. Therefore, the storage requirements for these routines depend on the degree of complexity of the program and the number of statements used. There are no hard-and-fast rules for the computation of these requirements. Figure 19 shows the approximate storage requirements of the more important entries. The storage requirements for processing routines are obtained by adding up the requirements of all entries used.

Description	No. of Bytes Required	
	Basic	Added
1. Input Format Specifications		
(a) Input Line Entries		
Basic for each record	14	
For each sequential record		2
For test of record identification code "C"		8
For test of record identification code "D"		14
For test of record identification code "Z"		8
For resulting indicator		4
(b) Input Field Entries		
For alphabetic or packed fields	0	
For numeric fields	6	
For special assignment of alphabetic or packed fields		*
For normal assignment of alphabetic or packed fields		6
For field record relation different from previous one		8

* Variable number of bytes. Movement of fields is optimized by moving several fields at one time. Each MVC operation takes six bytes.

Figure 19. Main-Storage Requirements (in bytes) for RPG Processing Routines (Part 1 of 11)

Description	No. of Bytes Required	
	Basic	Added
For first field-status indicator		18
For second field-status indicator		12
For third field-status indicator		12
If sign test needed for numeric fields		4
For END branch		4
(c) Matching Fields		
For one matching level	10	
For each normal higher level	6	
For each special higher level	*	
For the first level with packed fields		8
For all following levels with packed fields		4
(d) Control Fields		
For the first control level used	10	
For each higher level	6	
For each packed level		6
For each record that contains split control fields	6	
For each packed split control field		6
For each record that contains split control field with field record relation (per record)		10

* variable number of bytes. Movement of fields is optimized by moving several fields at one time. Each MVC operation takes six bytes.

● Figure 19. Main-Storage Requirements (in bytes) for RPG Processing Routines (Part 2 of 11)

Description	No. of Bytes Required	
	Basic	Added
2. Calculation Specifications		
For ADD/SUB		
(a) If the same name is used for one factor field and the result field and the packed length of the other factor is equal to or shorter than the packed length of the result field and the fields have the same number of decimal positions	6	
(b) If the name of the result field is not the same as that of either factor and if neither the packed length of factor 1 nor the packed length of factor 2 is greater than the packed length of the result field, and all three fields have the same number of decimal positions	12	
(c) If the packed length of factor 1 and/or factor 2 is greater than the packed length of the result field and all fields have the same number of decimal positions	18	
(d) If the same name is used for one factor field and the result field and the other factor has less decimal positions than the result field and		
1. the difference in the number of decimal positions is odd	24	
2. the difference in the number of decimal positions is even	30	

● Figure 19. Main-Storage Requirements (in bytes) for RPG Processing Routines (Part 3 of 11)

Description	No. of Bytes Required	
	Basic	Added
(e) If the same name is used for one factor field and the result field and the other factor has more decimal positions than the result field and		
1. the difference of decimal positions is odd	36	
2. the difference of decimal positions is even	42	
(f) General ADD, SUB (cases not referenced under (2a) to (2e))	24	
If the number of decimal positions of factor 1 is smaller than the number of decimal positions of factor 2 and the difference is odd		6
If the number of decimal positions of factor 1 is smaller than the number of decimal positions of factor 2 and the difference is even		12
If the number of decimal positions of factor 1 is greater than the number of decimal positions of factor 2 and the difference is odd		12
If the number of decimal positions of factor 1 is greater than the number of decimal positions of factor 2 and the difference is even		18
If the number of decimal positions of the result field is smaller than the maximum of decimal positions of factors 1 and 2		14

• Figure 19. Main-Storage Requirements (in bytes) for RPG Processing Routines (Part 4 of 11)

Description	No. of Bytes Required	
	Basic	Added
For Z-ADD		
(a) If both fields have the same number of decimal positions	6	
(b) If the number of decimal positions of the result field is smaller than the number of decimal positions of factor 2 and/or if the difference of decimal positions of result field and factor 2 is odd	24	
(c) If the number of decimal positions of the result field is greater than the number of decimal positions of factor 2 and the difference of decimal positions is even	30	
For Z-SUB		
(a) If the same name is used for both factor fields	24	
(b) If the name of factor 2 is not the same as that of the result field but both factors have the same number of decimal positions	12	
(c) If the number of decimal positions of the result field is smaller than the number of decimal positions of factor 2 and/or if the difference of decimal positions of result field and factor 2 is odd	30	
(d) If the number of decimal positions of the result field is greater than the number of decimal positions of factor 2 and the difference of decimal positions is even	36	

• Figure 19. Main-Storage Requirements (in bytes) for RPG Processing Routines (Part 5 of 11)

Description	No. of Bytes Required	
	Basic	Added
For MULT		
(a) If the number of decimal positions of result field equals the sum of decimal positions of factor 1 and factor 2	18	
(b) If the number of decimal positions of result field is greater than the sum of decimal positions of factor 1 and factor 2	38	
(c) If the number of decimal positions of result field is smaller than the sum of decimal positions of factor 1 and factor 2	24	
For DIV		
(a) If decimal adjustment not necessary	18	
(b) If adjustment factor A* greater than zero and odd (padding of dividend)	24	
(c) If adjustment factor A* greater than zero and even (padding of dividend)	36	
(d) If adjustment factor A* smaller than zero and odd (padding of divisor)	36	
(e) If adjustment factor A* smaller than zero and even (padding of divisor)	42	

*A= DRF-DF1+DF2 without half adjust
DRF-DF1+DF2+1 with half adjust

where DRF = number of decimal positions in result field
DF1,DF2 = number of decimal positions in factor 1, factor 2

● Figure 19. Main-Storage Requirements (in bytes) for RPG Processing Routines (Part 6 of 11)

Description	No. of Bytes Required	
	Basic	Added
For MVR		
(a) If result field and remainder have the same number of decimal positions	6	
(b) If the number of decimal positions of result field is smaller than the number of decimal positions of remainder	18	
(c) If the number of decimal positions of result field is greater than the number of decimal positions of remainder	26	
For MOVE		
From alphameric to alphameric field	6	
From numeric to alphameric field	6	
From numeric to numeric field		
if length of factor 2 is smaller than length of result field and length of factor 2 is odd	6	
if length of factor 2 is smaller than length of result field and length of factor 2 is even	12	
if length of factor 2 is not smaller than length of result field and length of result field is odd	6	
if length of factor 2 is not smaller than length of result field and length of result field is even	10	

● Figure 19. Main-Storage Requirements (in bytes) for RPG Processing Routines (Part 7 of 11)

Description	No. of Bytes Required	
	Basic	Added
From alphameric to numeric field		
(a) If length of factor 2 is odd and smaller than length of result field	10	
(b) If length of factor 2 is even and smaller than length of result field	16	
(c) If length of factor 2 is greater than or equal to length of result field and length of result field is odd	10	
(d) If length of factor 2 is greater than or equal to the length of result field and length of result field is even	14	
For MOVEL		
From alphameric to alphameric field	6	
From numeric to alphameric field		
(a) If length of factor 2 is not greater than length of result field	6	
(b) If length of factor 2 is greater than length of result field	12	
From numeric to numeric field		
(a) If length of factor 2 is greater than length of result field	24	
(b) If length of factor 2 is not greater than length of result field	30	
From alphameric to numeric field		
(a) If length of factor 2 is smaller than length of result field	24	
(b) If length of factor 2 is not smaller than length of result field	28	

● Figure 19. Main-Storage Requirements (in bytes) for RPG Processing Routines (Part 8 of 11)

Description	No. of Bytes Required	
	Basic	Added
For MLLZO, MLHZO, MHLZO, MHHZO		
From alphameric to alphameric field	6	
From numeric to numeric field	6	
From numeric to alphameric field	12	
From alphameric to numeric field	16	
For COMP		
Numeric fields:		
(a) If both factors have the same number of decimal positions and		
1. packed length of factor 1 is smaller than the packed length of factor 2	12	
2. packed length of factor 1 is not smaller than the packed length of factor 2	6	
(b) If the number of decimal positions of factor 1 is greater than the number of decimal positions of factor 2 and		
1. the difference is odd	30	
2. the difference is even	36	
(c) If the number of decimal positions of factor 1 is smaller than the number of decimal positions of factor 2 and		
1. the difference is odd	24	
2. the difference is even	30	

● Figure 19. Main-Storage Requirements (in bytes) for RPG Processing Routines (Part 9 of 11)

Description	No. of Bytes Required	
	Basic	Added
Alphameric fields:		
If both fields are of equal length	6	
If field lengths are unequal	24	
For EXIT	4	
For RLABL	0	
For GOTO		
If not conditioned by an indicator	4	
If conditioned by an indicator	0	
For TAG	0	
For TEST		
for each indicator High or Low (incl. requirements for indicator)	20	
for indicator Equal	32	
For SETOF, SETON		
For each indicator	4	
For half-adjusting:		
If the difference between the number if decimal positions in the calculated result and the specified result field is		
odd	6	
even	16	
Instructions for testing the indicators (columns 7 through 17) are generated only if the indicators differ from those specified in the preceding statement. In such a case each indicator takes up	8	
3. For common subroutine for test zone both calculation and input routines (once per program, if used):		
Input and/or calculation		
plus*	16	
minus*	16	
Input only		
no zone	16	
not card zone	16	

* For No Zone in calculations, both plus and minus are used

● Figure 19. Main-Storage Requirements (in bytes) for RPG Processing Routines (Part 10 of 11)

● Figure 19. Main-Storage Requirements (in bytes) for RPG Processing Routines (Part 11 of 11)

Output Format Specifications

Description	No. of Bytes Required	
	Basic	Added
(a) Output-Line Entries		
Basic for each main record	8	
For each stacker select or space and skip entry, but not if the record was preceded by another record containing the same entry in the same output time (detail, total, or overflow)		4
For each indicator		8
For card printing		6
For card punching		2
For tape output:		6
Fixed-length blocked records, 1 output area		8
Fixed-length blocked records, 2 output areas		6
(b) Output Fields		
Basic requirements *	6	
For each indicator		8
For zero suppression		6 or 8
For editing		6 or 8
For blank after		6
Additional requirement for blank after if an indicator is involved		4

* Variable number of bytes. Movement of fields is optimized by moving several fields at one time. Each MVC operation takes six bytes.

● Figure 20. Main-Storage Requirements (in bytes) for Output Format Specifications

END, START, AND DTFEN ROUTINES

This section lists the main-storage requirements for the End, Start, and DTFEN (Define The File: ENd) routines. In the listings below, the end routine appears before the start routine, because the space taken up by the start routine is less significant: it can be overwritten later and used as I/O area.

End Routine

The function of the End Routine is to close the tapes. Main-storage requirements depend primarily on the number of tapes and whether tables are written out. (Refer to Figure 21.)

Description	No. of Bytes Required	
	Basic	Added
Data Only, no tables	16	
For output on 2520/2560		10
For card printing		4
For output on 1442		6
For each tape output file, blocked records		14
For each tape output file, unblocked records		20
For Table Output	300	
Per table (not alternating)		16
Per table (alternating)		22
Per table written on tape		6
For each tape reel with tables		16
Per card punch used		38
For print-table routine		108
For write-table-on-tape routine		64

● Figure 21. Main-Storage Requirements (in bytes) for the RPG End Routine

Start Routine

The function of the Start routine is to open the tapes. Tables (if any) are always opened before data tapes. As with the end routine, the storage requirement depends primarily on the number of tapes and on whether tables are processed. (Refer to Figure 22.)

Description	No. of Bytes Required	
	Basic	Added
Data Only, no tables	32	
If card I/O or printer specified		24
If RWC not specified		6
If TES specified and no standard labels		24
If 2520/2560 input		4
If 2501 input		4
For each data-tape file, if not open overlay		8
For each data-tape input file		6
If begin address of object program < 2256		up to 22
If card print area in upper storage		4
If output-work area in upper storage		4
If output areas in upper storage		28
If output areas in upper storage ≤ 257		10
If output areas in upper storage > 257		34
For each 256 bytes of the Start routine		6
For Table Input	366	
Tables on tape		56
Per tape reel with tables		22
Per table (not alternating)		14
Per table (alternating)		20
Per table on tape		4
Per card reader		36
For tape-read routine		102

• Figure 22. Main-Storage Requirements (in bytes) for RPG Start Routine

During execution of the object program, the area first occupied by the Start routine may be used for output areas. In that case, the storage requirements for the Start routine need not be added to the above figures.

DTFEN Routines

The DTFEN (Define The File ENd) routine is made up of the OPEN and the CLOSE/EOF/EOV (End of File, End of Volume) routines. The main-storage requirements depend on which of the following types of labels are used:

Standard labels
Non-standard labels
No labels
Standard user labels

In the listings below, the main-storage requirements for files with no labels are lumped with those for files with non-standard labels because the difference between the two is negligible.

Standard labels:

Input files	770 bytes
Output files	780 bytes
Input and output files	1060 bytes

Non-standard labels or no labels:

Input files	370 bytes
Output files	340 bytes
Input and output files	400 bytes

Standard user labels (these are in addition to the requirements for standard labels):

Input:	EOF routine	80 bytes
	OPEN routine	70 bytes
Output:	CLOSE routine	60 bytes
	OPEN routine	110 bytes

TAPE ERROR STATISTICS

When the tape error statistics option is requested, 280 bytes are required in upper main storage.

UTILITY PROGRAM STORAGE REQUIREMENTS

The tape utility programs can use up to 32,768 bytes of main storage. The maximum amount of main storage available as I/O area begins at the end of the program being run and extends to the end of main-storage (see Figure 23). The available storage area is reduced by:

- Field selection or hexadecimal output
- Header lines for the Tape-to-Printer Utility program
- Label processing for multi-volume files
- User routines
- Tape error statistics.

FIELD SELECTION OR HEXADECIMAL OUTPUT

When the Tt operand on the Utility-Modifier card is specified as TC or TD with OC, there is no additional main storage requirement for processing, and the numbers in Figure 23 apply. If any other specification is made, however, additional storage is required. The amount of main storage required can be calculated from the formulas given in this section, where

R = length of input record
W = length of output record
L = storage requirement for field-select, reblock or list
D = R or W/2, whichever is the smallest

Note: The / (slash) above and in the following formulas represents integer division, i.e., the remainder is dropped.

When Tt is specified as TF, TRF or TLF

$$L = (10)\,a + L_B + \left(\frac{L}{M}\right)c + \left(\frac{L}{P}\right)p + \left(\frac{L}{U}\right)u + \left(\frac{L}{H}\right)h$$

where L_B = length of blanking code and return instruction (generated only once)

L_M = length of move code generated for one r,s,t

L_P = length of pack code generated for one r,(P,n,m),t

L_U = length of unpack code generated for one r,(U,n,m),t

L_H = length of hex code generated for one r,(X,n),t

a = number of field selections
c = number of move-type field selections
p = number of pack-type field selections
u = number of unpack-type field selections
h = number of hex-type field selections

$$L_B = 6\left[1 + (W+254)/256\right] + 2$$

$$L_M = 6\left[(s+255)/256\right]$$

For $n+2/2 \leq m$:

$$L_P = 4 + 6\left[\left(\frac{B_P + 254}{256}\right) + \left(\frac{D_P + 5}{7}\right) + 1/D_P\right]$$

where $B_P = m-(n+2)/2$ and $D_P = (n+2)/2$

For $(n+2)/2 > m$:

$$L_P = 6\left[(m+5)/7 + 1/m\right]$$

For $(2n-1) \leq m$:

$$L_U = 4 + 6\left[\left(\frac{B_U + 254}{256}\right) + (n+5)/7 + 1/n\right]$$

where $B_U = m-(2n-1)$

For $(2n-1) > m$:

$$L_U = 6\left[\left(\frac{D_U + 5}{7}\right) + 1/D_U\right]$$

where $D_U = (m+2)/2$

$$L_H = 20 + 6\left[(n+5)/7 + 1/n\right]$$

When Tt is specified as TD with OX or TL with OX

For TD with OX, $L = 22 + 6\left\{\left[(W-20)/2+5\right]/7\right\}$
For TL with OX, $L = 22 + 6\left[(D+5)/7 + 1/D\right]$

HEADER LINES (TAPE-TO-PRINTER UTILITY PROGRAM)

76 bytes of main-storage are required for each header line. This storage requirement is also necessary in phase 3 (program execution phase).

The storage required during phase 2 of any utility program is calculated with the above formulas. The amount of storage available for the generation of these instructions is 722 bytes (600 bytes for Tape-to-Tape) in a machine with 4K bytes of main storage, and 4818 bytes (4696 bytes for Tape-to-Tape) in a machine with 8K bytes of main storage.

An additional consideration is that phase 1 generates and stores a ten-byte field for each field select. Header lines for the Tape-to-Printer program are also stored by phase 1. For 4K storage, the areas available for this purpose are as follows:

Tape-to-Tape:	310 bytes
Tape-to-Card:	346 bytes
Tape-to-Printer:	248 bytes
Card-to-Tape:	338 bytes

For 8K storage, add 4096 to the above numbers.

Figure 23 shows the I/O area available during phase 3. The numbers listed in the first three columns of Figure 23 assume the use of the Tape Copy (TC) option. The numbers in the fourth column assume that tape

display (TD) with character output (OC) for Tape-to-Printer are used. Record lengths are assumed to be 256 bytes or less. Thus, for all but the Tape-to-Tape program, eight bytes are included in the figures for an MVC instruction to move the data from the input area to the output area and a BCR instruction to return to the main-line program. Note that these eight bytes (or their equivalent) are repeated in the formulas given above.

To calculate the storage required during phase 3, all the above formulas can be used, with one exception: when field selection is specified, the expression for L becomes

$$L = L_B - \left(\frac{L}{M}\right)c + \left(\frac{L}{P}\right)p + \left(\frac{L}{U}\right)u + \left(\frac{L}{H}\right)h$$

where all of the symbols retain their previous meanings.

As an example, consider a tape-to-card job with four field selects that require 402 bytes of storage during phase 2. These 402 bytes are within the 722-byte phase 2 limit, so the phase 3 requirements can be calculated. The computation yields a requirement of 362 bytes. Eight of these bytes duplicate the assumed number of bytes used in calculating the numbers in Figure 23, so the 354 bytes (362 less 8) must be subtracted from the number listed in the appropriate column of Figure 23. In other words, if field selection is used, another eight bytes have to be added to the numbers in Figure 23 before calculation. This last adjustment of 8 bytes would not be necessary if the Tape-to-Tape program were being used (see below, I/O Area Assignment).

The remainder of this section deals with the core storage requirements of other Utility program options implemented during phase 3 of the Utility programs.

TAPE LABEL PROCESSING

If a multi-volume input file is being processed, label routines are in main storage. However, if a single-volume input file is being processed, label routines are not kept in main storage.

If the input file contains standard labels, a check is made as to whether there is sufficient space for both the I/O area and the label routines. If so, the label routines are in main storage at all times. If not, the label routines are not kept in main storage and a warning message is printed to indicate that a multi-volume output file cannot be created.

The input-label routine requires no more than 1350 bytes of storage. The output-label routine requires no more than 1200 bytes of storage. When both input and output labeling are performed (Tape-to-Tape Utility), the routines require no more than 1775 bytes of storage. Each TPLAB card requires 56 bytes of main storage, but these are included in the multi-volume processing figures.

USER ROUTINES

If user routines are present, they are always assigned to a fixed starting location. This limits the available I/O area as reflected in Figure 23.

Description	Tape-to-Tape	Tape-to-Card	Card-to-Tape	Tape-to-Printer
4096 Bytes of Main Storage				
No user routines and no multi-volume processing	1203	1089	1093	727
User routines only*	285	611	815	511
8192 Bytes of Main Storage				
No user routines and no multi-volume processing	5299	5185	5189	4823
Multi-volume only	3553	3825	4015	3281
User routines only*	4381	4707	4911	4607
User routines and multi-volume*	2678	3409	3807	3223

*If the user's last address is an odd number, the available area is increased by one byte.

Figure 23. Maximum Utility I/O Areas (in bytes) Before Reduction

TAPE ERROR STATISTICS

When the tape error statistics option is requested, the upper 280 bytes of main storage are used.

I/O AREA ASSIGNMENT

The entire available I/O area is allocated to the input block. The areas for the card images in the Tape-to-Card and Card-to-Tape programs are reserved within the programs. Likewise, the available I/O area is allocated to the tape input block and tape output block, respectively. If the TC option is selected for the Tape-to-Tape program, the input block and the output block occupy the same core storage locations. For the other options of the Tape-to-Tape program, space for both input and output blocks must be allocated from the available area.

SORT/MERGE STORAGE REQUIREMENTS

The Sort/Merge Program can process fixed-length or variable-length records. They can be either unblocked or blocked in fixed or variable-length blocks. The most efficient input file configuration is fixed-length records in optimum fixed-length blocks, and the least efficient is unblocked variable-length records. There are certain limits on record lengths, input/output block sizes, and file sizes, which the user must observe when using the Sort/Merge Program.

Maximum record and block lengths, together with formulas for determining optimum block lengths, are given below. The symbols used are defined in Figure 24.

USER-SPECIFIED INPUT AND OUTPUT BLOCK LENGTHS

The tables in this section give the maximum input and output block sizes which the user can specify, based on the following assumptions:

1. 80-byte fixed-length records
2. No control-field translation
3. No user programming
4. No label checking
5. One control field
6. No tape error statistics

If any one of assumptions two through five is untrue or if the user has very small records (e.g. 20 bytes), he will not be able to achieve maximum input blocking. The small-record restriction applies because the Sort/Merge program requires two additional bytes per record during the internal sort processing.

If the user cannot achieve maximum input blocking, he should determine his optimum blocking factor by performing the same calculation that the program performs (given below in the sections headed Sort Block Length and Sort Input Block Length). Note that this situation may also affect the output block size, which cannot exceed the internal sort block size.

Minimum block length is 18 bytes. Maximum block lengths are given in Figure 25.

Sort Block Length

The sort blocks are the physical records written by the internal sort program and merged in the external sort program. Most efficient use of the program can be obtained if the user specifies output block lengths that are equal to the optimum sort block lengths as calculated with the following expressions:

Fixed-length records:

$$BL2 = \left\lfloor \frac{ST-PS2-UA2-(PS2\ Options)}{K*L2} \right\rfloor * L2$$

Variable-length records:

$$BL2 = \left\lfloor \frac{ST-PS2-UA2-(PS2\ Options)}{K} \right\rfloor$$

Sort Input Block Length

The sort input block length for the sort program can be determined on the basis of the sort block size as obtained from the expressions given below.

Minimum: 1 record or 18 bytes, whichever is greater

Optimum and maximum:

$$BL1 = \left\lfloor \frac{ST-PS1-UA1-BL2-(PS1\ Options)}{(L1+2)} \right\rfloor * L1$$

For variable-length records, use L4 instead of L1.

Symbol	Explanation
*	multiplied by (e.g. 2*3=6)
⌊ ⌋	rounded low (e.g. 0.7 =0)
BL1	input block length, in bytes
BL2	sort block length, in bytes
BL3	output block length, in bytes
K	number of work drives available for sorting
L1	number of bytes in a single input record
L2	number of bytes in a single record to be sorted
L3	number of bytes in a single output record
L4	minimum number of bytes in a variable-length record
M	order of merge (number of input drives)
PSx Options	total number of main-storage bytes required by the selected program options for a given phase
PS1	phase 1 size in bytes; for planning only, use 4200 for the program
PS2	phase 2 size in bytes; for planning only, use 3800 for the program
PS3	phase 3 size in bytes; for planning only, use 4800 for the program
ST	processor main-storage capacity in bytes: 8,192 for 8K; 16,384 for 16K; or whatever value is specified in the storage entry of the OPTION statement
UA1	total size in bytes of phase 1 user-written routines
UA2	total size in bytes of phase 2 user-written routines
UA3	total size in bytes of phase 3 user-written routines

Figure 24. Symbol Table for Block Size Formulas

Sort Output Block Length

The output block length for the sort program can be determined from the expression given below.

Minimum: 1 record or 18 bytes, whichever is greater

Optimum and maximum: $BL3 = \left\lfloor \frac{BL2}{L3} \right\rfloor * L3$

Merge-Only Input/Output Block Length

The merge-only input/output block length must conform to the following conditional expression:

ST≥PS3+UA3+M*BL1*BL3+(PS3 Options)

INPUT FILE SIZE

The safe maximum input file size (MFS) for any sort job is the number of records that can be written on a single reel of magnetic tape at the given sort block size (BL2, above).

A number of variable parameters (machine size, record length, number of tape drives, etc.) can influence the MFS for a particular job. For example, on a reel containing small blocks of records, more space will be taken up by interblock gaps than if the reel contained larger blocks, because there must always be an interblock gap between blocks of records. The amount of space taken up by interblock gaps is accordingly in direct relation to the number of blocks on the reel.

Number of work drives	Maximum input block length (bytes)	Maximum output block length (bytes)
Main Storage = 8192 Bytes		
3	2400	1400
4	2800	1000
5	3000	800
6	3100	700
Main Storage = 12,288 Bytes		
3	4095	2800
4	4095	2100
5	4095	1600
6	4095	1400
Main Storage = 16,384 Bytes		
3	4095	4095
4	4095	3100
5	4095	2500
6	4095	2000
Main Storage = 24,576 bytes		
3	4095	4095
4	4095	4095
5	4095	4095
6	4095	3400
Main Storage = 32,768 bytes		
3	4095	4095
4	4095	4095
5	4095	4095
6	4095	4095

● Figure 25. Maximum User-Specified I/O Block Lengths for Sort/Merge

Another variable parameter that can influence the MFS is the frequency of occurence of block length (BL) fields and record length (RL) fields in variable length blocked and unblocked records. Each BL field requires four bytes and each RL field requires four bytes. In many cases, a sort can be carried out successfully even though the MFS value is exceeded; in this event a warning message is printed, but the run can be continued.

The following formula can be used for calculating the MFS:

$$MFS = \frac{28800}{\frac{BL2}{D}+IBG} * \frac{BL2}{L}$$

where

D = the tape density (bytes per inch)

BL2 = optimum sort block size

L = the L2 for fixed-length records or the average record length for variable-length records

IBG = the length of an interblock gap (.6 inches for a 9-track tape, .75 inches for a 7-track tape)

28800 = the length, in inches, of a reel of tape

Note: This formula results in the minimum, or safe MFS. Actually, the MFS that can be handled by the sort program may exceed the result of this calculation.

PROGRAM OPTIONS

Figure 26 gives the storage required when the various options are specified by the user.

Program Options	PS1 (bytes)	PS2 (bytes)	PS3 (bytes)
Input label processing	750	0	50
Output label processing	0	450	50
Variable-length records	250	170	200
Fixed-point control fields	80*	80*	90*
Decimal control fields	320**	360**	600**
Two or more control fields	0***	0***	0***
Tape error statistics	280	280	280

*Add two bytes for each control field
**Add six bytes for each control field
***Add ten bytes for each control field after the first

Figure 26. Storage Requirements for PSx Options

The storage requirements are cumulative for all options selected. For example, the phase 1 storage requirements for a file of variable-length records with four fixed-point control fields on which output processing is to be performed will be calculated as follows:

Output label processing	0	
Variable-length records	250	
Fixed-point control fields	88	(80+8)
Multiple control fields	30	(10x3)
Total storage required	368	bytes

1419/1259 STORAGE REQUIREMENTS

The basic 1419/1259 IOCS main-storage requirements depend on the user-written specifications and are shown in Figures 27 and 28.

Feature	Approximate Storage Requirements
Basic 1419 IOCS with 1403	1460
Basic 1419 IOCS with 2203	1370
Basic 1259 IOCS with 1403	1120
Basic 1259 IOCS with 2203	1080
Each field tested	8
DSPLACE	6
BATCHNO (1419 only)	16
POKLITE (1419 only)	172
USERBLK	12
CHTEST	16
CONTROL (selective tape listing)	72
CONTROL (page printing)	138
ERREXIT-Main program (specified in DTFBG)	290

Figure 27. Approximate Main-Storage Requirements (in bytes) for Basic 1419/1259 IOCS and Various Options

Macro Instruction	Storage Requirements
GET	4 bytes
PUT (1403)	4 bytes
PUT (2203)	4 bytes
OPEN	4 bytes
CLOSE	4 bytes
CNTRL (page printing)	6 bytes
CNTRL (selective tape listing)	6 bytes
DSENG	4 bytes

Figure 28. Main-Storage Requirements (in bytes) for 1419/1259 Macro Instructions

BSCA IOCS STORAGE REQUIREMENTS

The main-storage requirements for basic BSCA IOCS configurations, with no options and no error statistics (DTFBT entry ERRSTAT=NO) are given in Figure 29.

Mode	Configuration		
	PTP	MPT	SW
Transmit (T)	3010	3120	3160
Receive (R)	3080	3200	3320
Transmit and Receive (TR)	3310	3450	3520
Tete-a-tete (TAT)	3450	3660	3750

Figure 29. Main-Storage Requirements (in bytes) for BSCA IOCS Basic Configuration, with No Options and No Error Statistics

Main-storage requirements for BSCA IOCS options are given in Figure 30. Unless otherwise indicated, these figures are to be added to the basic requirements of Figure 29. Main-storage requirements for options not listed in Figure 30 are insignificant.

All BSCA IOCS macro instructions take six bytes in main storage except OPEN, CLOSE, WAITB, and DSITB which take four bytes.

DTFBT entry	extra bytes	Remarks
LGRAPH=YES	70	- - -
TRANSP=YES	100	- - -
HISPEED=BRST	230	- - -
ERRSTAT=YES[1]	130	- - -
ITBMODE=YES[2] ITBRTMN=COMPL[2]	150	Complete retransmission, ITB
ITBMODE=YES[2] ITBRTMN=PARTL[2] LGRAPH=YES[2]	210	Partial retransmission, ITB. Note LGRAPH mandatory
AUTCALL=YES[3] CALL=SIW[4] ANSWER=RIW[5]	330	Options as shown are for SW configuration. Options with different specifications take less storage.

[1] Or no ERRSTAT entry (i.e. default value)
[2] Add to MODE=R, MODE=TR, or MODE=TAT
[3] Add for MODE=TR or MODE=TAT.
For MODE=T or MODE=R the number of bytes is shown below.
[4] For MODE=T -- 398 bytes.
[5] For MODE=R -- 156 bytes.

Figure 30. Additional Main Storage Needed for BSCA IOCS Options

This section lists the number of records or blocks required to store each library component on the system tape. The size, in bytes, of each component is also listed.

CORE-IMAGE LIBRARY STORAGE REQUIREMENTS

Figure 31 lists the sizes of the individual phases or programs in the core-image library. It also lists the number of records forming each program or phase, since some of the programs are too large for a single record.

Phase Name	Length (bytes)	No. of Records	Program Name
SYSEOJ	1600	1	
SYSEOJ1	700	1	
SYSEOJ2	2500	1	Job Control
SYSEOJ3	2500	1	
ASSEMB	3500	2	Assembler
CARTAP	2100	1	
CART01	2000	1	
CART02	1600	1	
CART03	1500	1	Card-to-Tape
CART04	1400	1	Utility
CART05	1500	1	
CART06	1300	1	
CART07	1000	1	
CMAINT	1500	1	
CMAINT1	1700	1	
CMAINT2	500	1	Core-Image
CMAINT3	700	1	Maintenance
CMAINT4	4500	2	
CMAIN1	4800	2	
CSERV	2700	1	
CSERV2	1500	1	Core-Image
CSERV3	1000	1	Service
CSERV4	1300	1	
DSERV	4000	2	Directory Service
INITTP	2500	1	Initialize Tape Utility
LNKEDT	4200	2	
LNKED2	2400	1	Linkage Editor
LNKED3	1000	1	
MMAINT	2200	1	
MMAIN1	3500	2	
MMAIN11	2300	1	Macro Maintenance
MMAIN2	3000	1	
MMAIN21	1500	1	

● Figure 31. Length of Phases and Number of Records, Part 1 of 5

Phase Name	Length (bytes)	No. of Records	Program Name
MMAIN22	1600	1	
MMAIN23	1000	1	
MMAIN24	400	1	
MMAIN25	1000	1	
MMAIN26	200	1	Macro Maintenance
MMAIN3	8400	3	(cont.)
MMAIN4	2000	1	
MMAIN41	1300	1	
MMAIN5	2500	1	
MSERV	3100	1	
MSERV2	2000	1	
MSERV3	2400	1	Macro Service
MSERV4	1300	1	
RPG	1400	1	
RPG011	3900	2	
RPG012	2500	1	
RPG013	1400	1	
RPG014	1000	1	
RPG015	1500	1	
RPG016	1300	1	
RPG020	2000	1	
RPG021	600	1	
RPG023	1200	1	
RPG025	2000	1	
RPG026	1500	1	
RPG027	1000	1	
RPG028	1700	1	
RPG029	1900	1	
RPG030	400	1	
RPG031	1700	1	
RPG032	1500	1	
RPG033	1900	1	
RPG034	1700	1	
RPG035	1900	1	Report Program
RPG036	1000	1	Generator
RPG037	1900	1	
RPG038	800	1	
RPG051	900	1	
RPG0511	1400	1	
RPG052	900	1	
RPG053	1500	1	
RPG054	900	1	
RPG055	1500	1	
RPG056	700	1	
RPG057	1200	1	
RPG0571	700	1	
RPG058	1700	1	
RPG0581	300	1	
RPG059	1700	1	
RPG060	1600	1	
RPG061	1000	1	
RPG062	600	1	
RPG063	600	1	
RPG064	400	1	
RPG065	1300	1	

● Figure 31. Length of Phases and Number of Records, Part 2 of 5

Phase Name	Length (bytes)	No. of Records	Program Name
RPG066	500	1	
RPG067	700	1	
RPG101	3900	2	
RPG102	2600	1	
RPG103	1200	1	
RPG104	900	1	
RPG105	1200	1	
RPG106	700	1	
RPG107	1200	1	
RPG108	600	1	
RPG109	900	1	
RPG110	300	1	
RPG111	500	1	
RPG112	300	1	
RPG113	900	1	
RPG114	700	1	
RPG115	1500	1	
RPG116	400	1	
RPG117	1200	1	
RPG122	3100	1	
RPG123	1600	1	
RPG131	1500	1	
RPG132	1300	1	
RPG133	2000	1	
RPG134	1900	1	
RPG135	700	1	
RPG136	1300	1	
RPG137	1600	1	
RPG138	1600	1	
RPG139	1200	1	Report Program Generator (cont.)
RPG140	2000	1	
RPG151	2400	1	
RPG152	1400	1	
RPG153	2100	1	
RPG154	2000	1	
RPG155	2100	1	
RPG156	1100	1	
RPG157	1500	1	
RPG158	2000	1	
RPG159	1800	1	
RPG160	1400	1	
RPG161	1300	1	
RPG162	800	1	
RPG163	1100	1	
RPG164	1300	1	
RPG165	1800	1	
RPG166	600	1	
RPG1661	1900	1	
RPG167	2000	1	
RPG168	400	1	
RPG171	2300	1	
RPG172	1300	1	
RPG173	800	1	
RPG174	1500	1	
RPG175	1700	1	
RPG176	1500	1	
RPG186	2700	1	
RPG187	3600	2	
RPG188	3200	2	
RPG189	1600	1	

● Figure 31. Length of Phases and Number of Records, Part 3 of 5

Phase Name	Length (bytes)	No. of Records	Program Name
RPG190	1600	1	
RPG191	2500	1	
RPG192	600	1	Report Program Generator (cont.)
RPG197	2500	1	
RPG198	500	1	
RPG199	500	1	
SORT	400	1	
SORT01	4400	2	
SORT02	2200	1	
SORT03	3800	2	
SORT04	5000	2	
SORT05	2300	1	
SORT06	3800	2	Sort/Merge
SORT07	3300	2	
SORT08	5000	2	
SORT09	2300	1	
SORT10	4400	2	
SORT11	3800	2	
SORT12	5200	2	
SORT13	400	1	
TAPCAR	2100	1	
TAPC01	2000	1	
TAPC02	1600	1	
TAPC03	1500	1	Tape-to-Card
TAPC04	1300	1	Utility
TAPC05	1700	1	
TAPC06	1300	1	
TAPC07	1200	1	
TAPPRT	2200	1	
TAPP01	2000	1	
TAPP02	1600	1	
TAPP03	1500	1	
TAPP04	1500	1	Tape-to-Printer
TAPP05	1700	1	Utility
TAPP06	1600	1	
TAPP07	1800	1	
TAPP08	1200	1	
TAPTAP	2000	1	
TAPT01	2000	1	
TAPT02	1600	1	
TAPT03	1500	1	Tape-to-Tape
TAPT04	1700	1	Utility
TAPT05	1600	1	
TAPT06	1000	1	
TAPT07	1200	1	
TAPT08	1400	1	
Z99980	3400	2	
Z99981	3100	1	
Z99982	3800	2	
Z99983	3700	2	
Z99984	2300	1	Assembler
Z99985	200	1	
Z999851	2300	1	
Z999852	600	1	
Z999853	800	1	

● Figure 31. Length of Phases and Number of Records, Part 4 of 5

Phase Name	Length (bytes)	No. of Records	Program Name
Z999854	2100	1	
Z999855	2100	1	Assembler
Z99990	5400	2	(cont.)
Z99991	4500	2	
Z999911	600	1	
Z999912	600	1	
Z99992	3700	2	
Z99993	1700	1	

• Figure 31. Length of Phases and Number of Records, Part 5 of 5

MACRO LIBRARY STORAGE REQUIREMENTS

The macro library is divided into priority sections and macros are assigned to these sections in accordance with the frequency of their use. A macro that is needed relatively seldom will accordingly be assigned to a lower priority section (3 or 4) than one that is more frequently used. IBM-supplied macros are in priority sections 1 to 4, user macros can go into any of the four priority sections.

Figure 32 lists the IBM macros in the macro library and the number of blocks for each one by priority section. A block, in turn, is made up of 272 bytes.

Priority Section 1		Priority Section 2		Priority Section 3		Priority Section 4	
Macro name	No. of Blocks	Macro name	No. of Blocks	Macro name	No. of Blocks	Macro name	No. of Blocks
CNTRL	7	CLOSE	15	DTFBN	24	DTFEN	254
COMRG	1	DTFBG	2	DTFSN	34		
CRDPR	2	DTFBT	160				
DSENG	1	DTFBU	31				
DSITB	1	DTFBV	22				
ENITB	1	DTFBW	12				
EOJ	2	DTFBX	18				
EOM	1	DTFBY	59				
FEOV	1	DTFCF	65				
FETCH	4	DTFCG	44				
GET	1	DTFMM	2				
LBRET	1	DTFMT	52				
LOM	1	DTFMU	38				
MVCOM	3	DTFMV	25				
PRTOV	2	DTFMW	25				
PUT	1	DTFMX	21				
READ	3	DTFMY	28				
RELSE	1	DTFNA	14				
TRUNC	1	DTFNB	17				
WAITB	1	DTFNC	16				
WAITC	1	DTFND	18				
WRITE	3	DTFNE	18				
		DTFNF	21				
		DTFPA	167				
		DTFPC	55				
		DTFPD	40				
		DTFPF	3				
		DTFSR	70				
		DTFST	35				
		DTFSU	19				
		DTFSV	16				
		DTFSW	17				
		DTFSX	36				
		DTFSY	129				
		DTFSZ	67				
		OPEN	45				

• Figure 32. Number of Blocks per IBM-Supplied Macro Instruction

TIME REQUIREMENTS

This section lists the time requirements of IBM-supplied programs as an aid for estimating total machine-time requirements. Whenever significant differences in time requirements exist between Submodel 2 and Submodel 5, both times are shown.

JOB CONTROL TIME REQUIREMENTS

The time required for the execution of the Job Control program normally does not exceed 30 seconds. If the FILES function is used, the additional time required depends on the number of files and records skipped. The time required to fetch a job depends on the position of the tape when the command is given and on the number of records that have to be read before the requested phase is found. For details and methods of calculation, see the sections headed Core Image Library Storage Requirements and Core Image Library Time Requirements.

IOCS TIME REQUIREMENTS

Execution of IOCS Routines for Tape Files

The time requirements of some of the GET and PUT routines can be calculated by means of the formulas given in this section.

If WORK=YES is specified in the file definition statements, the values calculated here must be increased by the amount of the record move time. The time requirements for the Move instruction can be found in the SRL publication: IBM System/360 Model 20, Functional Characteristics, Form A26-5847.

For building a file, the time requirement is that of the total number of PUTs (T_p). For retrieving, the time requirement is that of the total number of GETs issued (T_g). The time requirements for label processing and the user's processing must be added. The total time requirement (T) is as follows:

$$T = T_1 + \left\{ \begin{matrix} T_g \\ T_p \end{matrix} \right\} + N * X$$

where:

T = total time required for one file

T_1 = time for execution of OPEN and CLOSE macro instructions (i.e., label processing and initialization) = 10 sec.

$$\left\{ \begin{matrix} T_g \\ T_p \end{matrix} \right\} = B * (T_{io} + P_q + [N_{rec} * P_r])$$

N = the number of records

B = the number of blocks to be handled

$$= \left\lceil \frac{N}{N_{rec}} \right\rceil$$

N_{rec} = the number of records per block

T_{io} = the I/O time

$$= T_{ss} + \frac{53^1 * M}{BPI} * (RECSIZE * N_{rec} + A)$$

T_{ss} = the basic time for one tape request

= PIOCS + START.

PIOCS = time required for physical I/O routines
= 11.7 msec. for Subm.2 or 5.2 msec. for Subm.5 } with no tape error statistics
= 14.0 msec. for Subm.2 or 6.2 msec. for Subm.5 } with tape error statistics

START = 40 msec. for 7-track tape

= 32 msec. for 9-track tape

RECSIZE= the number of bytes per record

BPI = the number of bytes per inch of the tape used

= 1600 or 800 for 9-track tape

= 800, 556, or 200 for 7-track tape

M = the mode of data conversion

---

[1] 53 is the speed of the tape in msec. per inch; it is equivalent to 18.75 inch per sec.

= 1.0 for data converter off (i.e., all 9-track tapes)

= 1.33 for data converter on

A = 82 for 1600 bpi tape only

= 0 for all tape densities except 1600 bpi

P_r = I/O processing time per record
see Figure 33 for values of P_r

P_q = additional I/O processing per block
see Figure 34 for values of P_q

X = user processing time per record.

Note: When the read/compute, write/compute overlap feature of the Submodel 5 is in use, the user processing time may be overlapped to some extent by tape reading or writing.

Note: Additional user's processing time per program (e.g. initialization) is neglected.

		Values of P_r (msec.)			
Macro/Recform		Submodel 2		Submodel 5	
		1 I/O	2 I/O	1 I/O	2 I/O
GET	FIXUNB	1.6	2.1	0.5	0.7
	FIXBLK	1.6	2.1	0.4	0.6
PUT	FIXUNB	1.4	1.8	0.4	0.6
	FIXBLK	1.7	2.2	0.4	0.5

● Figure 33. Values of I/O Processing Time per Record (P_r) for Use in the Tape Processing Time Formula

		Values of P_q (msec.)			
Macro/Recform		Submodel 2		Submodel 5	
		1 I/O	2 I/O	1 I/O	2 I/O
GET	FIXUNB	0	0	0	0
	FIXBLK	1.9	2.2	0.5	0.6
PUT	FIXUNB	0	0	0	0
	FIXBLK	1.4	1.6	0.5	0.5

● Figure 34. Values of I/O Processing Time per Block (P_q) for Use in the Tape Processing Time Formula

EXAMPLE: Retrieve a file of 1000 records (FIXUNB, 1 I/O area).

Assumptions:

B = 1000
N_{rec} = 1
RECSIZE = 500
X = 12 msec.
Tape = 9-track , phase-encoded, 1600 bpi, no tape error stats.
Submodel = 2

Solution:

$$T_{io} = 11.7 + 32 + \frac{53 * 1}{1600} * (500 * 1 * 82)$$

$$= 63.0 \text{ msec.}$$

$$T_g = 1000 * [63.0 + 0 + (1 * 1.6)]$$

$$= 64.6 \text{ sec.}$$

$$T = T_1 + T_g + N * X$$

$$= 10 + 64.6 + 12$$

Time = 86.6 sec.

Execution of IOCS Routines for Card/Printer Files

Figures 35 and 36 show the approximate average times (in milliseconds) required for the execution of IOCS features and of macro instructions for card/printer files for Submodels 2 and 5.

Program Feature		Time per 10-char. Field to be checked	
		Subm.2	Subm.5
SEQNCE detail entry		1.5	0.45
RFORMTn detail entry	numeric	(min) 5.0 (max) 13.0	(min) 1.5 (max) 3.9
	blank	4.0	1.2
PFORMTn detail entry		4.0	1.2

• Figure 35. Approximate Average Times (in ms) Required by the IOCS Features for Card/Printer Files

BASIC MONITOR MACRO TIME REQUIREMENTS

The time requirements for the routines generated by monitor macros are as follows:

Macro	Time	
	Submodel 2	Submodel 5
FETCH	0.5	0.15
COMRG	0.15	0.05
EOJ	0.15	0.05
MVCOM	0.5	0.15

The FETCH time shown in the above table must be increased by the amount of time the monitor needs to start the I/O device, plus the actual I/O time needed to locate and read the records in question. The latter time requirement is dependent on the location of the record to be fetched with respect to the last record read. If the direction of reading must be reversed to fetch the record, 0.41 sec must be added to the FETCH time requirement listed in the table. For calculation of the search and read time requirements, refer to the formulas given in section Core Image Library Time Requirements and the values listed in the section headed Core Image Library Storage Requirements.

Device	File type	operation	GET Time Required (ms)		PUT Time Required (ms)	
			Subm.2	Subm.5	Subm.2	Subm.5
1403 Printer	simple	standard carriage	--	--	12	3.6
2203 Printer	simple	standard carriage	--	--	16	4.8
		dual feed carriage	--	--	15[2]	4.5[2]
2501 Card Reader Models A1 and A2	simple	nonoverlap	9*	2.7*	--	--
2501 Card Reader Model A1	simple	overlap	10	3.0	--	--
2501 Card Reader Model A2	simple	overlap	12	3.6	--	--
2520 Card Punch	simple	nonoverlap	--	--	10**	3.0**
		overlap	--	--	11	3.3
1442 Card Punch, Model 5	simple	nonoverlap	--	--	8**	2.4**
		overlap	--	--	9	2.7
2520 Card Read - Punch	simple	nonoverlap	12*	3.6*	14**	4.2**
		overlap	13	3.9	15	4.5
	combined	nonoverlap	15*	4.5*	20**[13]	6.1**[13]
		overlap	18	5.5	24[1]	7.3[1]
2560 Multi Function Card Machine	simple	nonoverlap	18*	5.5*	18 plus punch-feed time	5.5 plus punch-feed time
		overlap	20	6.1	20	6.1
	combined	nonoverlap	19*	5.8*	28***[13]	8.5***[13]
		overlap	20	6.1	28[1]	8.5[1]

* Plus read time ** plus punch time *** plus read and punch times

[1]PUT macros for combined files contain a punch command and a read command

[2]Assumes alternate lower and upper carriage print operations

[3]If a GET follows a PUT for a combined file in nonoverlap mode, the two macros require 28 ms plus punch time for 2520, and 35 ms plus punch and read time for 2560 on the Submodel 2. On the Submodel 5, the times are 8.5 ms plus punch time for the 2520, and 10.5 ms plus punch and read times for the 2560.

● Figure 36. Approximate Average Times Required by the GET and PUT Macro-Instructions for Card/Printer Files

REPORT PROGRAM GENERATOR TIME REQUIREMENTS

The time requirements for the compilation of the Tape Report Program Generator (RPG) on a Submodel 2 include the time needed to read in and compile a source program at the rate of about 50 statements per minute, plus 0.5 minute to read the compiler phases. A 150-statement source program, accordingly, takes about 3.5 minutes to compile. The time required for compilation on a Submodel 5 is 20% less than that for the Submodel 2.

Not included in these figures is the time required by the control programs prior to the actual RPG compilation. For details and the formulas for calculating these time requirements see the sections headed Job Control Time Requirements, Core Image Library Time Requirements, and Core Image Library Storage Requirements.

Another element not included in the above figures is the time required for punching out of the object program. The time required for the execution of the object program depends on the type and size of program, the I/O functions performed, and other factors. I/O functions are overlapped wherever possible.

UTILITY TIME REQUIREMENTS

The time requirements of the utility programs depend on the time requirements of the input/output units used and the block size of the records on tape. Figure 37 lists the minimum block sizes that allow the card units or printer to run with the indicated speed.

I/O Unit	Block Size (Bytes)	Speed (cpm)
Card-to-Tape		
IBM 2560 Multi-Function Card Machine	320	500
IBM 2520 Card Read-Punch	480	500
IBM 2501 Card Reader Model A1	400	600
IBM 2501 Card Reader Model A2	400	1000
Tape-to-Card		
IBM 2560 Multi-Function Card Machine	1520	91
IBM 2520 Card Read-Punch Model A1	500	480
IBM 2520 Card Punch Model A2	480	500
IBM 2520 Card Punch Model A3	480	300
IBM 1442 Card Punch	240	91
Tape-to-Printer		(lpm)
IBM 2203 Printer (63-char. set)	240	300
IBM 1403 Printer (48-char. set)	1200	600
IBM 1403-N1 Printer (48-char. set)	480	950
Tape-to-Tape		
Input/Output-Limited		

Figure 37. Relation of Block Sizes to Speed for Utility Programs

SORT/MERGE TIME REQUIREMENTS

The Appendix lists execution times for the Sort/Merge program for Submodels 2 and 5 of the Model 20. Figures 46-69 refer to Submodel 2, the remaining figures refer to the Submodel 5. More than 7000 sorting applications are covered for each submodel.

The tables can also be used for estimating execution times for other sorting applications. The times shown are total execution times, but they do not include the time requirements for control program execution, initial rewinding of the tapes, rewinding of the final output tape, or collection of tape error statistics.

The times shown are for fixed-length record sorts in fixed-length blocks. Time requirements for variable-length record sorts can best be estimated from the table values by using the average length as the data record length.

The times shown reflect the following assumptions:

(1) The logical records in the input data set are in random order. For an otherwise identical input data set in better than random order, the actual sorting time may be less than that shown. If

the input data is in less than random order (that is, has some degree of sequencing inversely related to the desired output sequencing), the actual sorting time may be greater than that shown.

(2) Logical records are ordered into ascending or descending sequence on the basis of a single, 10-byte character control field. Sorting time requirements may exceed those shown in the table if

(a) a longer control field is used

(b) a fixed-point, packed-decimal or zoned-decimal field is used

(c) multiple control fields are used

(3) No user routines have been added to the program. For sorting applications that require user routines to be executed, the user-routine time requirements should be added to the times shown. Note that the existence of user routines subtracts from the available I/O area and may affect the sort block size, which will, in turn, affect the sort time requirements for large files.

(4) Input/output operations are error-free, no checkpoints are taken.

(5) The input/output block sizes were determined by using the equations presented in the section headed Sort/Merge Storage Requirements.

(6) No Sort/Merge program options (see Figure 26) are reflected in the time requirements given in Figures 46 to 57 and 70 to 81. None of the program options has a significant effect on the processing time required for the Sort/Merge program itself. The label processing options, however, can have a significant effect on the available I/O area and thus restrict the block size for large files. This will increase the number of levels required in phase 2. The tables in Figures 58 to 69 and 82 to 93 illustrate the effect of label processing. These time requirement estimates are again based on assumptions 1 to 5 above, but include the label-processing options.

The tables are arranged according to the following hierarchy:

(1) Submodel Used: Time requirements for Submodel 2 appear in the first 24 tables, and for Submodel 5 in the following 24.

(2) Tape units used: Time requirements are shown for 9-track tapes and 7-track tapes, both for 800-bpi (15 KB/sec) and 1600 bpi (30 KB/sec).

(3) Number of work-tapes: Time requirements shown are for 3, 4, 5, and 6 work-tapes.

(4) Main storage used: Time requirements are shown for 8K, 12K, and 16K for the Submodel 2; and 8K, 12K, 16K, 24K, and 32K for the Submodel 5.

(5) Record length: Time requirements are shown for logical record lengths of 20, 50, 80, 100, 200, and 400 bytes.

(6) File size: Time requirements for up to 22 file sizes (in thousands of records) are given in each case. In some cases, certain file sizes may exceed the maximum possible file size. No time is charted if sort capacity has been exceeded.

The time requirements are rounded to the nearest minute. If the estimated time requirement is less than one minute, the charted time is one minute. These time requirements do not include system overhead or the time required to load the program. For the card-resident program this requires about 3.5 additional minutes if the programs are loaded from a 2501 Model A1 Card Reader, a 2520 Card Read Punch or a 2560 Multifunction Card Machine and 2 additional minutes if the programs are loaded from a 2501 Model A2 Card Reader.

For the time required by the tape-resident control programs, see the section headed Job Control Time Requirements Core Image Library Time Requirements, and Core Image Library Storage Requirements.

ASSEMBLER TIME REQUIREMENTS

This section gives the time requirements of the Assembler, assuming that the source code has the following composition:

1. 10% of all statements contain literals
   10% of all statements are declaratives
   50% of the source statements contain comments, and that

   the average operand field contains four terms.

2. The program library consists of all IBM-supplied programs.
   The macro library consists of the IBM-supplied IOCS and Basic Monitor macros.

Variable	Card Input (cpm)	List (lpm)	Value of Variable: 2415-2 Tape	2415-5 Tape
a_0			0.75	0.75
	300	350	75	80
	300	1100	90	96
a_1	1000	350	95	102
	1000	1100	130	140
a_2		350	80	86
		1100	105	115
a_3			1.2	1.2
a_4			1200	1300

Figure 38. Variable Values for Insertion in the Formula to Determine the Assembly Time

The time required for assembly with a Submodel 2 can be computed by inserting the applicable values from Figure 38 in the following formula:

$$\text{Time (min)} = a_0 + \frac{\text{No. of source cards}}{a_1} + \frac{\text{No. of all generated statements}}{a_2} + a_3 * \text{No. of DTF's} + \frac{(x-1)\,(\text{total No. of lines})}{a_4}$$

where x is determined by dividing the total number of symbols by N and adding one if there is a remainder.

N = 180 for 8 K
450 for 12 K
720 for 16 K
1200 for 24 K
1700 for 32 K

Note: For Submodel 5 time requirements, multiply the Submodel 2 time by 0.8

Examples

The assembly of a source program with 1000 source statements and 250 symbols requires:

$$a_0 + \frac{1000}{a_1} + \frac{1000}{a_4} \approx$$ 9 minutes for the Submodel 2, or 7.2 minutes for the Submodel 5.

(1000 cpm, 1100 lpm, double-density tapes)

To assemble a source program fitting into 8K with IOCS instructions supporting a printer file, a combined file (on 2520 Card Read Punch) and four tape files using I/O areas totalling 2000 bytes requires:

$$a_0 + \frac{750}{a_1} + \frac{1250}{a_2} + a_3 * 7 + \frac{(3-1)\ 2000}{a_4}$$

$\approx$ 28.5 min for the Submodel 2, or 22.8 min for the Submodel 5.

(1000 cpm, 1100 lpm, double-density tapes)

MACRO LIBRARY TIME REQUIREMENTS

The Macro Library is divided into priority sections and macro instructions are assigned to these sections in accordance with the frequency of their use. A macro instruction that is needed relatively seldom is accordingly assigned to priority section 3 or 4, and a frequently used macro goes into section 1 or 2. IBM-supplied macros are in priority sections 1 to 4, user macros can go into any of the four priority sections.

The time required to access a macro instruction, then, depends on its priority, i.e. on its location in the library. In the library, a macro instruction can occupy several blocks of 272 bytes each. The access time for a specific macro instruction is the time required to read over the number of blocks intervening between the location of the head at the time the search starts and the location of the needed macro instruction. Thus the access time is the number of intervening blocks times the read time for each block. The read time per 272-byte block is 50 ms with 1600-bpi tape or 56 ms with 800-bpi tape.

If the direction of reading must be reversed to fetch a macro, 0.41 sec is added to the access time.

The number of 272-byte blocks taken up by each IBM-supplied macro instruction in the Macro Library is listed in the section headed Macro Library Core Storage Requirements.

CORE-IMAGE LIBRARY TIME REQUIREMENTS

The following formula provides the time required by the Basic Monitor to retrieve (FETCH) or skip individual programs (phases) in the Core-Image Library:

T = 0.182n for 800-bpi tape

T = 0.126n for 1600-bpi tape

where T is the time in seconds and n is the number of records.

To find the values for n, refer to the section headed Core-Image Library Storage Requirements.

If the direction of reading must be reversed to fetch a record, add 0.41 sec to the time requirements obtained by means of the above formulas.

SERVICE PROGRAM TIME REQUIREMENTS

MACRO MAINTENANCE TIME REQUIREMENTS

The Macro Maintenance (MMAINT) program keeps the Macro Library up to date by cataloguing and deleting macro definitions.

The formula below gives the time requirements of an MMAINT run with the assumption that a system tape as delivered by IBM with all IBM-supplied programs and macros is used:

$$\text{Average MMAINT time (min)} = a_0 + \frac{\text{No. of statements}}{a_1} * a_2$$

The value of a_0 is 4.5 for 2415-2 tape.

The value of a_0 is 4.0 for 2415-5 tape.

The value of a_1 is shown in Figure 39.

The value of a_2 is as follows:

	8K	12K or more
Submodel 2	$a_2 = 1$	$a_2 = 0.6$
Submodel 5	$a_2 = 0.7$	$a_2 = 0.4$

Card Input (cpm)	Tape Input 2415-2	Tape Input 2415-5	Output List (lpm)	Value: if tape = 2415-2	Value: if tape = 2415-5
300	--	--	350	90	100
300	--	--	1100	90	100
1000	--	--	350	95	105
1000	--	--	1100	120	130
--	YES	--	350	95	105
--	YES	--	1100	120	130
--	--	YES	350	95	105
--	--	YES	1100	120	130

Figure 39. Values of a_1 for Calculation of MMAINT Time

CORE-IMAGE MAINTENANCE TIME REQUIREMENTS

The time requirements for the Core-Image Maintenance (CMAINT) routine depend on the number of phases to be cataloged and replaced and on the size of the system tape to be updated.

The examples below give representative time requirements for replacing CMAINT by CMAINT in the following system configuration, using both Submodels 2 and 5:

SYSDR, SYSIPT: 2501 Card Reader, reading at 600 cpm

SYSRES, SYSOPT, SYS000: 9-track tape units

Examples:

	Submodel 5	Submodel 2	Submodel 2
	1600 bpi	1600 bpi	800 bpi
(a) CMAINT on complete system tape	4 min 40 sec	5 min 10 sec	6 min 20 sec
(b) CMAINT on system tape without macros	3 min 10 sec	3 min 20 sec	4 min

LINKAGE EDITOR TIME REQUIREMENTS

The Linkage Editor resolves all linkages between separately compiled modules and relocates program phases to load at specified main-storage locations.

The average time requirement for a LNKEDT (Linkage Editor) run is 20 seconds for both Submodels 2 and 5 with 1600 bpi tape and 24 seconds for the Submodel 2 with 800 bpi tape. This includes the time required for printing a storage map as well as the SEEK time on the systems tape. Each LNKEDT card requires 350 additional milliseconds. This is assuming that a 2501 Card Reader, reading at 600 cards per minute, and a 2520 Card Punch, punching at 500 cards per minute, are used.

CORE-IMAGE SERVICE TIME REQUIREMENTS

The time requirements for the Core-Image Service program (CSERV) depend on the number and length of phases to be punched or printed.

The time required can be computed by inserting the applicable values from Figure 40 in the following formula:

$$\text{Average CSERV Time (sec)} = {}_{0}a + {}_{1}a \times \text{No. of control statements} + {}_{2}a \times \text{No. of thousands of bytes}$$

It is assumed, that the output of most phases is requested in alphabetical order.

Variable	CARD Output (cpm)	LIST Output (lpm)	VALUE OF VARIABLE: 2415-1 Tape	VALUE OF VARIABLE: 2415-4 Tape
a_0	--	--	12	10
a_1	--	--	8	5
	300	-	13.5	12.9
	500	-	5.3	5.0
a_2	-	350	7.7	6.5
	-	1100	3.7	3.1

Figure 40. Variable Values for Insertion in the Formula to Determine the CSERV Time

MACRO SERVICE TIME REQUIREMENTS

The time requirements for the Macro Library Service Program (MSERV) depend on the number and length of the macro definitions to be punched and/or printed.

The time required can be computed by inserting the applicable value from Figure 41 in the following formula:

$$\text{Average MSERV Time (sec)} = {}_{0}a + {}_{1}a \times \text{No. of control statements} + {}_{2}a \times \frac{\text{No. of statements output}}{}$$

It is assumed that the output of most macro definitions is requested in order of priority and for each priority in alphabetical order.

			VALUE OF VARIABLE	
Variable	CARD Output (cpm)	LIST Output (lpm)	2415-1 Tape	2415-4 Tape
a 0	--	--	16	12
a 1	--	--	17	14
	300	-	1.3	1.5
	500	-	3.2	3.7
	-	350	3.3	4.1
	-	1100	7.1	9.1
a 2	300	350	1.3	1.5
	500	350	3.3	3.7
	300	1100	1.3	1.5
	500	1100	3.2	3.7

• Figure 41. Variable Values for Insertion in the Formula to Determine the MSERV Time

1419/1259 IOCS TIME REQUIREMENTS

Stacker-Select Time Requirements

The available stacker-select time for 6-inch documents using the IOCS options is shown in Figure 42.

For each field error that occurs, the available stacker-select time is decreased by 0.2 milliseconds. Other types of error which decrease the available stacker-select time are:

- Auto-Select.....0.3 msec
- Transmission Error.....0.3 msec

Throughput Characteristics

Figure 43 shows approximate throughput characteristics of the IOCS for 6-inch documents for IBM 1403 and 2203 printers. These values are true only if no card and/or tape and/or disk files are processed in addition to the reader-sorter and printer files. All card, tape, and disk I/O requests disengage the 1259 or 1419 and

OPTION	CONFIGURATION			
	1419 with 1403	1419 with 2203	1259 selector-pocket 0	1259 selector-pocket 1 to R
BATCHNO	10.46	10.46	---	---
BLKSIZE				
1403,48 chars	10.9934	---	18.4934	31.5-(0.0066F)
1403, numeric	10.9895	---	18.4895	31.5-(0.0105F)
2203	---	11.0-(0.045F)	18.5	31.5
CHTEST (1403 page printing only)	10.55	---	18.05	31.05
DSPLACE	10.79	10.79	18.29	31.29
Each document field selected, exceeding two	10.885	10.885	18.385	31.385
Each tape rewind or not-ready to ready interrupt (after rewind and unload)	10.26	10.26	17.76	30.76
BATCHNO feature, to update the batch number	10.5	10.5	18.0	31.0
F = the number of characters specified in the printer-file BLKSIZE entry				

Figure 42. Available Stacker-Select Time (in ms.) for 6-inch Documents with the 1419/1259

Printer	Blocking Factor	Documents per Minute	Process Time Per Document, Including User Stacker-Select Time (in msec)
1419 and 1403 Models 2 and 7	Two items per line	1200	18
1419 and 1403 Model N1 with UCS** (PCS AN or HN train)	One item per line	1400	16
	Two items per line	1520*/1600	15
1419 and 2203 (13-character type-bar)	Two items per line	1140*	14
1259 and 1403 or 2203 (13-character type-bar)	One item per line	600	50

*On a 1419 with 51-column sort feature.
**The values indicated are attained only if 14 of the 15 characters that the 1419 can recognize are associated with the 14 printable characters that are presented on the print train 8 times, while the 15th character is associated with a blank.

Figure 43. Printer Throughput Characteristics for 6-inch Documents

thus reduce throughput on these machines. The exact value of throughput reduction depends on the frequency of the card/tape disk I/O requests.

Time Requirements for Macro Instructions

The time requirements for macro instructions associated with the 1419/1259 IOCS are shown in Figure 44.

Macro Instruction	Average Processing Time Required (in msec)
GET	3.7+.032R
PUT (1403)	3.8
PUT (2203)	4.0
OPEN	.9+B+.016BR
CLOSE	1.4
CNTRL (page printing)	2.1
CNTRL (selective tape listing)	1.1
DSENG	1.1

These time requirements do not include the I/O operation time requirements.
R=Number of bytes in a reader-sorter record
B=Number of reader-sorter records in the input buffer (IOAREA1)

Figure 44. 1419/1259 IOCS Macro Instruction Time Requirements

BSCA IOCS TIME REQUIREMENTS

Figure 45 shows the times required for execution of BSCA IOCS macro instructions. The times given are for normal outcomes; where more than one outcome is possible, the most common has been used for the calculation.

Times for error recovery procedures, data transmission, and line turnabouts are not included.

Macro	Time (ms)
Control Macros	
OPEN	5.929
CLOSE	5.462
WAITB	5.867
ENITB	5.688
DSITB	5.401
Transmission Initialization Macros	
WRITE Initial	50.315
WRITE Initial Transparent	51.220
READ Initial	45.893
READ Initial Inquiry	24.076
WRITE Connect (no ID-exchange)	36.913
READ Connect (no ID-exchange)	44.580
Transmission Macros	
WRITE Continue	30.793
WRITE Continue Transparent	31.696
READ Continue	24.997
READ Continue with Leading Graphics	28.121
READ Repeat	25.003
READ Repeat with Leading Graphics	27.356
Transmission Ending and Utility Macros	
WRITE Disconnect	17.127
WRITE Negative Acknowledgement	27.672
WRITE End of Transmission	27.672
WRITE Stop ACK (SAK)	42.962
WRITE Reverse Interrupt (RVI)	35.118
WRITE Inquiry	27.672
READ Inquiry	24.076

Figure 45. Time Required for Execution of BSCA IOCS Macro Instructions

APPENDIX: SORT/MERGE PROGRAM TIME REQUIREMENTS

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	2	2	3	6	12	1	2	2	2	5	10	1	2	2	2	4	8
2000	3	4	6	7	13	27	3	4	5	6	10	22	3	3	4	5	9	19
5000	8	12	17	20	38	77	7	11	14	17	31	64	8	10	13	15	28	56
10000	17	26	36	44	84	170	17	24	32	37	69	139	18	23	30	34	63	124
15000	27	42	58	69	133	263	27	38	49	60	107	221	28	36	47	55	97	197
20000	38	59	81	97	185	368	37	52	70	83	151	306	37	49	65	77	138	274
25000	49	75	104	122	236	464	48	67	90	106	191	391	49	64	85	98	179	351
30000	60	91	125	153	285	579	58	83	111	129	239	472	59	78	104	118	219	425
35000	72	110	152	180	345	683	68	97	131	157	283	572	71	92	122	145	259	515
40000	83	128	176	207	399	782	80	114	150	181	325	661	83	110	144	168	304	596
45000	93	144	199	241	451	908	92	131	176	206	378	748	94	125	165	190	348	675
50000	107	165	222	271	502	0	103	147	197	229	424	832	104	140	184	217	390	752
55000	119	183	252	300	570	0	113	162	218	260	470	0	117	154	204	242	432	0
60000	131	202	277	328	627	0	127	177	239	287	515	0	129	173	228	266	472	0
65000	142	220	303	356	684	0	138	197	259	313	559	0	142	189	249	290	525	0
70000	154	238	327	394	739	0	150	215	288	339	618	0	153	206	271	313	571	0
75000	165	255	352	425	793	0	161	232	311	364	668	0	164	221	292	336	616	0
80000	181	278	376	456	847	0	173	248	334	388	717	0	176	237	313	368	661	0
85000	193	298	409	487	923	0	184	265	357	423	765	0	187	252	333	394	705	0
90000	206	317	436	518	983	0	195	281	379	451	813	0	202	268	354	420	748	0
95000	218	337	463	548	0	0	206	297	401	479	860	0	214	283	374	446	791	0
100000	230	356	489	578	0	0	223	313	422	507	907	0	228	306	404	471	834	0

Figure 46. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 7-Track Tapes. 3 Work Tapes. No Labels. (Submodel 2)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	2	2	3	6	12	1	2	2	2	5	9	1	2	2	2	4	8
2000	3	4	6	7	13	26	3	4	5	6	10	22	3	3	4	5	9	19
5000	8	12	16	19	37	74	7	10	14	17	30	62	8	10	13	15	27	55
10000	17	26	36	43	81	164	17	24	31	37	68	136	18	22	29	34	62	122
15000	27	41	57	67	129	253	27	37	49	59	105	216	28	36	47	54	96	195
20000	38	57	79	94	178	355	36	51	69	82	149	299	37	49	64	76	136	270
25000	48	73	101	118	228	446	48	67	89	105	187	383	49	64	84	97	177	347
30000	60	89	122	148	275	558	58	82	109	127	235	462	59	78	103	117	217	420
35000	71	108	148	175	333	657	67	96	129	154	278	560	71	92	121	144	256	508
40000	82	125	171	201	385	753	80	113	148	179	319	647	82	109	143	166	300	588
45000	92	141	194	234	436	874	91	129	173	203	371	732	93	124	163	188	343	666
50000	106	161	216	263	485	0	102	145	195	226	417	815	104	139	183	215	385	742
55000	118	179	245	291	551	0	113	160	216	256	462	0	117	153	202	239	426	0
60000	129	197	270	319	606	0	126	175	236	282	506	0	129	171	226	263	467	0
65000	141	215	295	346	660	0	137	195	256	308	549	0	141	188	247	287	518	0
70000	152	232	319	383	713	0	149	212	284	334	607	0	153	204	268	310	564	0
75000	163	249	342	413	766	0	161	229	307	358	656	0	164	220	289	333	609	0
80000	179	272	366	444	817	0	172	246	330	383	704	0	175	236	310	364	653	0
85000	191	291	398	474	891	0	183	262	352	417	752	0	186	251	330	390	696	0
90000	203	310	425	503	949	0	194	278	374	445	799	0	201	266	350	416	740	0
95000	215	329	451	532	1006	0	205	294	395	472	845	0	214	281	370	442	782	0
100000	227	348	476	561	0	0	221	310	417	500	891	0	227	304	400	467	824	0

Figure 47. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 9-Track Tapes. 3 Work Tapes. No Labels. (Submodel 2)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	2	2	4	8	1	1	2	2	3	6	1	1	2	2	3	5
2000	3	3	4	5	9	17	2	3	4	4	7	14	3	3	3	4	6	12
5000	7	9	12	14	26	50	7	9	10	12	20	40	8	8	10	11	18	35
10000	15	21	27	32	57	110	15	19	24	27	45	87	16	18	22	25	41	77
15000	24	33	43	49	90	170	24	30	37	43	71	138	25	29	35	40	64	122
20000	34	46	60	69	124	238	33	42	52	60	100	191	34	40	48	55	91	169
25000	43	59	77	88	159	299	43	54	67	76	126	245	44	52	63	71	117	217
30000	53	71	93	110	192	374	52	66	82	93	158	295	54	63	77	85	144	263
35000	64	87	112	130	232	440	61	77	97	112	186	357	65	74	90	104	170	317
40000	73	100	130	149	268	504	72	91	111	130	214	413	75	88	107	120	199	368
45000	83	114	147	173	303	585	82	104	130	147	249	467	85	100	122	136	228	416
50000	95	129	164	194	338	656	92	116	146	164	279	520	95	112	137	155	255	464
55000	105	144	186	215	383	726	102	129	162	186	310	591	106	124	151	173	283	526
60000	115	158	204	236	421	794	114	141	177	205	339	650	117	138	169	190	309	579
65000	126	173	223	256	459	861	124	156	192	224	368	708	128	151	185	208	343	632
70000	136	187	241	283	496	952	134	170	213	242	407	765	139	165	201	224	373	683
75000	145	200	259	305	533	1027	145	184	230	260	439	822	149	177	216	241	403	734
80000	159	218	276	327	569	1101	155	197	247	278	472	877	159	190	232	263	432	784
85000	170	234	301	350	620	0	165	210	263	302	504	956	169	202	247	282	461	852
90000	181	249	321	371	660	0	175	223	280	322	535	1018	183	214	262	300	490	909
95000	192	264	341	393	700	0	184	236	296	342	566	1080	194	226	276	319	518	965
100000	203	279	360	414	740	0	199	248	312	362	597	0	206	244	299	337	545	1020

Figure 48. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 30 KB/sec 9-Track Tapes. 3 Work Tapes. No Labels. (Submodel 2)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	2	2	3	5	10	1	1	2	2	4	7	1	1	2	2	3	6
2000	2	3	4	6	11	21	3	3	4	5	8	16	3	3	4	4	7	14
5000	7	10	13	16	31	62	7	9	12	13	23	44	7	9	11	12	21	42
10000	15	21	29	36	68	134	16	19	25	29	50	100	16	19	24	28	47	93
15000	24	35	47	56	107	212	24	31	41	47	81	157	26	30	38	43	73	147
20000	33	47	64	79	147	289	34	42	56	63	114	220	35	42	52	61	104	201
25000	42	62	83	100	185	374	43	56	70	84	146	280	46	55	69	78	132	252
30000	53	76	102	121	233	458	53	68	89	103	177	338	55	66	84	94	165	321
35000	63	88	120	147	276	539	63	80	106	120	207	410	65	80	98	115	196	379
40000	72	105	137	171	317	618	73	92	121	143	248	476	74	93	116	134	227	435
45000	82	120	161	193	357	715	82	108	136	164	282	540	86	106	133	151	257	489
50000	94	135	181	216	410	0	92	121	158	183	316	603	97	118	149	169	286	567
55000	104	149	201	238	456	0	104	135	176	203	349	0	108	130	165	186	326	0
60000	115	163	220	267	502	0	114	147	194	221	381	0	118	142	181	210	360	0
65000	125	176	239	293	547	0	125	160	211	240	413	0	128	159	196	231	393	0
70000	135	196	258	318	591	0	136	173	228	268	462	0	138	173	211	250	426	0
75000	145	212	277	343	634	0	145	185	245	289	499	0	148	187	235	270	458	0
80000	155	228	304	367	677	0	156	205	261	311	536	0	158	200	253	289	490	0
85000	165	244	326	391	720	0	166	219	277	332	572	0	173	214	270	308	522	0
90000	174	259	347	415	783	0	176	234	304	353	608	0	184	227	288	327	553	0
95000	191	274	369	439	832	0	185	248	324	374	644	0	196	240	305	346	584	0
100000	202	289	390	462	0	0	195	262	343	395	679	0	207	253	322	364	634	0

Figure 49. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 7-Track Tapes. 4 Work Tapes. No Labels. (Submodel 2)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	2	2	5	9	1	1	2	2	3	7	1	1	2	2	3	6
2000	2	3	4	5	10	20	3	3	4	5	8	15	3	3	4	4	7	14
5000	7	10	13	15	30	59	7	9	11	13	22	43	7	9	11	12	21	41
10000	15	21	28	35	65	128	16	19	25	28	49	98	16	18	23	27	47	91
15000	24	34	45	54	102	202	24	31	40	46	80	153	26	30	38	43	72	145
20000	33	45	62	76	141	274	34	42	55	62	111	214	35	42	51	60	103	198
25000	42	61	81	97	177	355	43	55	69	83	143	273	45	54	68	77	130	248
30000	53	74	99	117	222	434	53	67	88	101	173	330	55	65	83	93	162	315
35000	62	86	116	142	263	512	63	79	104	118	202	400	65	79	97	114	193	372
40000	71	103	133	165	302	587	72	91	119	141	243	464	74	92	115	132	224	427
45000	81	117	156	187	341	678	82	107	134	161	276	527	86	105	132	150	253	480
50000	93	131	175	208	391	0	91	120	156	180	309	588	97	117	148	167	282	557
55000	103	145	194	229	435	0	104	133	173	199	342	0	108	129	164	184	321	0
60000	113	159	213	258	479	0	114	146	191	217	373	0	117	140	179	208	354	0
65000	124	172	232	283	521	0	124	158	207	236	404	0	128	158	194	228	387	0
70000	134	191	250	307	564	0	135	171	224	263	452	0	138	172	209	247	420	0
75000	143	207	268	331	605	0	144	183	241	284	488	0	148	185	233	267	451	0
80000	153	222	295	354	646	0	155	202	257	305	525	0	158	199	250	286	483	0
85000	163	238	316	378	686	0	165	217	273	326	560	0	172	212	268	305	514	0
90000	172	252	336	401	747	0	175	231	299	347	595	0	184	225	285	323	545	0
95000	188	267	357	423	794	0	184	245	318	367	630	0	195	238	302	341	575	0
100000	199	282	378	446	0	0	194	259	337	388	664	0	206	251	319	360	624	0

Figure 50. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 9-Track Tapes. 4 Work Tapes. No Labels. (Submodel 2)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	2	2	3	6	1	1	1	2	2	5	1	1	1	2	2	4
2000	2	3	3	4	7	14	3	3	3	4	6	10	3	3	3	3	5	9
5000	7	8	10	12	22	41	7	7	9	10	16	28	7	7	9	9	15	27
10000	14	18	22	27	48	90	15	16	20	22	34	64	15	16	19	21	32	59
15000	22	28	36	42	75	142	22	26	32	35	56	100	24	26	30	33	50	93
20000	30	38	49	59	103	193	31	35	43	47	78	141	33	36	40	46	71	128
25000	38	51	64	75	130	250	39	46	54	63	100	179	43	46	53	59	90	160
30000	48	62	78	90	163	306	49	56	69	77	121	216	51	55	65	71	112	203
35000	57	72	92	110	193	361	58	66	81	90	141	262	60	67	76	86	133	240
40000	66	86	105	127	221	413	67	76	93	107	169	304	69	77	90	100	154	276
45000	74	98	123	144	250	478	76	89	105	122	192	346	80	88	103	113	174	310
50000	85	110	138	161	286	538	84	100	122	137	215	386	90	99	116	127	194	359
55000	94	121	153	177	319	597	96	111	135	151	238	425	100	109	128	139	221	400
60000	104	132	168	199	350	655	105	122	149	165	260	463	109	118	140	157	244	439
65000	113	143	183	218	382	712	115	132	162	179	281	521	119	133	152	173	266	478
70000	122	160	197	237	413	768	124	142	175	199	315	566	128	144	164	187	288	516
75000	131	172	211	255	443	824	133	152	188	215	340	610	138	156	182	202	310	554
80000	140	185	232	274	473	878	143	169	201	231	365	654	147	167	196	216	332	591
85000	149	198	249	292	502	961	152	180	213	247	389	697	160	178	209	230	353	627
90000	158	210	265	309	547	0	161	192	234	263	414	740	171	189	223	244	374	689
95000	172	223	281	327	581	0	170	204	249	278	438	782	181	200	236	258	395	732
100000	182	235	297	344	615	0	179	215	263	293	462	0	192	211	249	272	429	774

Figure 51. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 30 KB/sec 9-Track Tapes. 4 Work Tapes. No Labels. (Submodel 2)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	2	2	5	12	1	1	2	2	3	6	1	1	2	2	3	5
2000	2	3	5	5	10	26	2	3	4	4	7	14	3	3	4	4	6	12
5000	7	9	13	15	30	71	7	9	11	12	21	40	8	9	10	12	20	37
10000	15	21	29	35	66	153	16	19	24	27	46	88	17	19	22	26	44	82
15000	25	34	46	54	101	247	25	31	39	45	75	143	26	29	36	41	67	126
20000	33	46	62	76	144	342	34	42	53	60	101	192	35	41	49	58	96	180
25000	42	61	82	97	182	437	43	55	67	80	135	256	46	53	65	74	122	228
30000	53	74	100	118	218	528	54	67	85	97	165	311	56	64	80	89	146	274
35000	63	87	118	137	268	617	64	79	101	114	193	364	66	77	93	109	180	338
40000	73	99	136	165	310	733	74	91	116	130	221	415	75	90	106	127	209	391
45000	82	118	152	188	351	834	84	106	131	155	261	492	88	102	127	144	237	443
50000	91	132	177	210	390	0	93	120	145	174	293	552	98	114	143	161	265	494
55000	105	147	197	232	429	0	106	133	168	193	325	0	109	126	158	177	292	0
60000	115	160	217	254	486	0	117	146	185	211	356	0	119	138	173	193	318	0
65000	126	174	236	275	531	0	127	159	202	230	387	0	130	149	188	218	360	0
70000	136	188	255	296	576	0	138	171	219	247	417	0	140	168	202	237	391	0
75000	146	201	274	331	621	0	148	184	235	265	447	0	150	181	217	256	422	0
80000	156	223	292	356	665	0	159	196	252	294	476	0	160	195	240	275	453	0
85000	166	239	310	380	708	0	169	216	268	315	528	0	176	208	258	293	483	0
90000	176	254	328	405	751	0	179	230	283	336	563	0	187	221	275	312	513	0
95000	185	270	361	428	793	0	189	245	299	356	598	0	199	234	291	329	543	0
100000	203	285	382	452	0	0	198	259	326	377	632	0	211	246	308	347	572	0

Figure 52. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 7-Track Tapes. 5 Work Tapes. No Labels. (Submodel 2)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	2	2	4	11	1	1	2	2	3	6	1	1	2	2	3	5
2000	2	3	4	5	10	24	2	3	4	4	7	14	3	3	4	4	6	12
5000	7	9	12	14	29	65	7	9	11	12	21	39	8	8	10	12	19	37
10000	15	20	28	33	63	141	16	19	24	27	45	86	17	19	22	26	43	81
15000	24	33	44	52	95	227	25	30	38	44	74	139	26	29	36	40	66	123
20000	33	44	60	73	136	315	34	41	52	59	99	187	35	41	48	57	94	176
25000	41	59	79	93	172	402	43	54	66	78	132	248	46	52	65	73	120	224
30000	53	72	96	113	206	487	54	66	84	95	160	302	55	63	79	88	144	268
35000	62	85	114	132	253	569	64	78	99	112	188	354	66	77	92	108	177	331
40000	72	96	131	158	293	676	74	90	114	128	215	403	75	89	105	125	205	383
45000	81	114	147	180	331	769	83	105	129	152	254	478	87	101	125	142	233	434
50000	89	129	171	202	369	0	92	118	143	171	286	536	98	113	141	158	260	484
55000	103	142	190	223	406	0	105	131	165	189	317	0	108	125	156	174	287	0
60000	114	156	209	244	459	0	116	144	182	207	347	0	119	137	171	190	312	0
65000	124	170	227	264	502	0	127	157	198	225	377	0	130	147	186	215	353	0
70000	134	183	246	284	545	0	137	169	215	242	407	0	140	166	200	234	384	0
75000	144	195	264	318	587	0	148	181	231	259	436	0	149	179	214	253	415	0
80000	154	217	282	341	628	0	158	193	247	288	464	0	159	193	238	271	445	0
85000	164	232	299	365	669	0	168	213	263	308	515	0	175	206	254	289	475	0
90000	173	247	316	388	710	0	178	227	278	328	549	0	186	219	271	307	504	0
95000	183	262	348	411	750	0	187	242	293	349	583	0	199	232	288	325	533	0
100000	200	277	368	434	0	0	197	256	320	369	616	0	210	244	305	342	562	0

Figure 53. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 9-Track Tapes. 5 Work Tapes. No Labels. (Submodel 2)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	2	2	3	8	1	1	1	1	2	4	1	1	1	1	2	4
2000	2	3	4	4	7	18	2	3	3	3	5	9	3	3	3	3	5	8
5000	6	8	10	12	22	50	7	7	9	10	15	26	8	7	8	9	14	24
10000	14	17	22	27	48	108	15	16	19	21	33	58	16	16	18	20	30	53
15000	23	28	36	41	72	174	23	26	31	34	53	94	25	25	29	31	47	82
20000	31	38	49	58	103	241	32	36	42	46	71	126	33	35	39	45	67	117
25000	39	51	64	74	130	308	40	47	53	61	94	167	43	45	52	57	85	148
30000	49	62	78	90	156	373	51	57	67	75	115	203	52	54	63	68	102	177
35000	58	72	93	105	193	436	60	67	80	87	135	238	62	66	74	84	125	218
40000	66	82	106	126	222	518	69	77	92	100	154	272	71	77	85	97	145	253
45000	75	98	119	144	252	589	78	90	104	118	182	322	83	87	101	111	165	286
50000	83	110	139	161	280	659	86	101	115	133	205	361	92	97	113	123	184	319
55000	96	122	154	178	308	728	98	112	132	147	227	400	102	107	126	136	203	352
60000	105	133	170	194	349	796	108	123	146	162	249	438	112	117	138	148	221	383
65000	115	145	185	210	381	862	118	134	159	175	270	475	122	127	149	168	250	434
70000	125	156	200	226	414	928	128	145	173	189	291	512	132	143	161	182	272	472
75000	134	167	214	253	445	1028	138	155	185	202	312	548	141	154	172	197	293	509
80000	143	185	229	272	477	1104	148	165	198	224	332	607	150	165	191	211	314	545
85000	152	198	243	291	508	1180	157	182	211	240	369	650	165	177	204	225	336	581
90000	161	211	257	309	539	0	167	194	223	256	393	692	175	188	218	239	356	617
95000	169	224	283	327	569	0	175	206	235	272	417	734	187	199	231	253	377	652
100000	185	237	299	346	599	0	184	218	257	287	441	775	197	209	245	266	397	687

Figure 54. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 30 KB/sec 9-Track Tapes. 5 Work Tapes. No Labels. (Submodel 2)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	2	2	4	11	1	1	2	2	3	6	1	1	1	2	3	5
2000	3	4	4	5	10	23	3	3	4	4	8	15	1	3	3	4	7	12
5000	8	10	12	16	28	67	7	9	10	13	22	42	8	8	10	11	19	35
10000	16	22	28	35	61	146	16	20	23	28	48	91	17	19	23	26	42	78
15000	25	34	46	55	97	226	26	30	38	43	76	144	26	30	35	41	68	125
20000	36	49	64	76	133	314	34	43	51	62	106	199	37	41	51	56	92	170
25000	46	62	82	96	168	402	45	55	69	79	134	250	46	51	64	74	121	222
30000	55	77	100	120	210	486	55	66	84	95	167	313	55	66	77	91	149	273
35000	65	92	117	142	250	567	64	81	99	117	199	373	68	78	95	108	176	322
40000	78	107	139	165	288	675	76	95	117	136	230	430	79	89	111	124	202	370
45000	88	121	159	186	326	768	87	108	135	154	260	486	88	100	125	139	227	416
50000	99	134	178	207	363	0	98	120	151	172	290	541	99	116	140	162	263	483
55000	110	148	197	228	398	0	108	133	168	190	319	0	109	130	154	181	294	0
60000	120	168	216	259	453	0	118	144	184	207	363	0	123	143	174	199	324	0
65000	130	184	234	284	496	0	128	162	199	233	397	0	134	156	191	217	353	0
70000	140	200	252	308	538	0	138	177	215	254	431	0	145	169	208	234	382	0
75000	156	215	270	332	579	0	148	191	230	274	464	0	157	181	224	252	410	0
80000	168	231	301	355	620	0	164	205	255	295	497	0	169	194	241	269	438	0
85000	179	246	322	379	660	0	176	219	274	314	530	0	179	206	257	285	466	0
90000	191	261	343	402	700	0	187	233	292	334	562	0	190	218	272	302	493	0
95000	203	276	364	425	740	0	199	246	310	354	594	0	201	230	288	332	519	0
100000	214	290	384	447	0	0	210	260	327	373	625	0	212	252	303	352	571	0

Figure 55. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 7-Track Tapes. 6 Work Tapes. No Labels. (Submodel 2)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	2	2	4	10	1	1	2	2	3	6	1	1	1	2	3	5
2000	3	3	4	5	9	22	3	3	4	4	7	14	1	3	3	4	6	12
5000	7	10	12	15	26	62	7	9	10	12	21	40	8	8	10	11	18	34
10000	16	22	27	33	58	134	16	19	23	28	47	88	17	19	23	25	41	76
15000	25	33	44	52	92	209	25	30	38	42	74	139	26	30	34	41	66	122
20000	35	47	61	72	126	290	34	43	50	61	103	192	37	40	50	56	91	166
25000	45	60	79	92	159	371	45	54	68	77	129	241	46	50	63	73	118	217
30000	55	75	96	114	199	448	54	65	83	93	162	302	55	65	76	90	146	267
35000	64	89	112	136	236	523	63	80	97	114	193	359	68	77	94	106	172	315
40000	76	103	134	158	273	623	76	93	115	133	223	415	79	89	109	122	198	362
45000	87	117	153	178	308	709	87	106	132	151	252	469	88	99	124	137	223	407
50000	98	130	172	198	343	794	97	118	148	169	281	522	98	115	138	160	258	472
55000	108	143	190	218	377	0	107	131	164	186	309	0	108	129	152	178	288	0
60000	118	163	208	248	429	0	118	142	180	202	351	0	122	142	172	196	317	0
65000	128	178	226	271	469	0	128	160	195	228	385	0	133	155	189	213	346	0
70000	138	193	243	295	509	0	137	174	210	248	418	0	145	167	205	231	374	0
75000	153	208	260	317	548	0	147	188	225	268	450	0	156	180	221	248	402	0
80000	165	224	289	340	587	0	163	202	250	288	482	0	168	192	237	265	430	0
85000	177	238	310	362	625	0	175	216	268	307	514	0	178	204	253	281	457	0
90000	188	253	330	384	663	0	186	229	286	327	545	0	189	216	269	297	483	0
95000	200	267	350	406	700	0	197	243	304	346	576	0	200	228	284	327	509	0
100000	211	281	370	428	737	0	208	256	321	364	606	0	211	250	299	346	560	0

Figure 56. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 9-Track Tapes. 6 Work Tapes. No Labels. (Submodel 2)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	2	2	3	8	1	1	1	1	2	4	1	1	1	1	2	4
2000	2	3	4	4	7	17	3	3	3	3	5	10	1	3	3	3	5	8
5000	7	9	10	12	20	48	7	8	9	10	16	28	7	7	8	9	13	23
10000	15	19	22	27	45	104	15	17	19	22	35	61	16	16	19	20	30	51
15000	23	28	37	43	70	161	24	26	31	34	55	97	25	26	28	33	48	82
20000	33	41	51	59	97	224	32	37	41	49	76	133	35	35	41	44	66	112
25000	42	52	66	75	122	286	42	47	56	62	96	168	44	44	52	58	86	146
30000	51	65	80	93	153	346	51	57	68	74	120	210	52	57	62	72	106	180
35000	60	78	93	111	181	403	60	70	79	92	142	250	65	67	77	85	125	212
40000	72	90	111	128	209	480	72	81	94	106	165	288	75	77	90	97	144	244
45000	82	102	127	145	237	547	82	92	108	121	186	326	84	87	101	109	162	274
50000	92	113	142	162	263	612	92	103	121	135	207	362	93	101	113	127	188	318
55000	101	125	158	178	289	676	101	114	135	148	228	398	103	112	125	141	209	354
60000	111	141	173	202	329	739	111	124	147	162	259	453	116	123	141	156	230	389
65000	120	155	187	221	360	801	120	139	160	182	284	495	126	135	155	170	251	424
70000	130	168	202	240	391	862	130	151	172	198	308	537	137	145	168	183	272	459
75000	144	181	216	258	421	955	139	163	185	214	332	579	148	156	181	197	292	493
80000	155	194	240	277	450	1026	154	176	205	230	355	619	159	167	194	210	312	526
85000	166	207	257	295	480	1096	165	187	220	245	379	660	169	178	207	223	331	559
90000	176	220	274	313	509	0	175	199	234	261	401	700	179	188	220	236	351	591
95000	187	232	290	330	537	0	186	211	248	276	424	739	190	198	233	259	369	647
100000	197	244	307	348	566	0	196	222	263	291	447	778	200	217	245	275	406	685

Figure 57. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 30 KB/sec 9-Track Tapes. 6 Work Tapes. No Labels. (Submodel 2)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	2	3	3	6	14	1	2	2	2	5	10	1	1	2	2	4	9
2000	3	4	6	7	14	32	3	4	5	6	11	22	3	4	5	5	9	20
5000	8	12	18	21	41	90	8	10	14	17	31	64	8	10	13	16	28	58
10000	18	28	39	47	90	194	17	24	32	37	70	139	17	23	30	34	64	126
15000	28	43	61	75	140	306	27	38	51	60	111	221	27	36	47	55	101	201
20000	39	61	86	104	196	426	37	52	70	84	152	306	37	50	65	78	139	280
25000	50	76	108	133	247	539	48	68	91	107	198	391	48	65	85	99	181	357
30000	62	96	135	161	308	668	58	83	111	132	242	472	58	79	104	124	221	442
35000	72	113	160	195	364	789	71	97	131	158	285	572	70	95	122	147	260	525
40000	85	130	184	226	417	906	81	115	155	182	335	661	81	111	145	169	308	605
45000	97	151	213	255	484	0	92	131	177	206	382	748	92	126	165	191	351	683
50000	109	170	240	285	543	0	103	146	198	236	429	832	102	140	185	220	393	783
55000	120	188	266	322	601	0	116	162	219	262	474	0	116	155	204	245	434	0
60000	131	206	291	355	659	0	128	182	244	288	518	0	128	175	230	269	474	0
65000	146	224	315	387	715	0	140	199	268	314	577	0	139	191	251	292	530	0
70000	159	248	349	419	788	0	151	215	291	339	626	0	151	207	272	315	576	0
75000	171	267	377	450	851	0	163	232	313	364	675	0	162	223	293	347	621	0
80000	183	287	404	481	913	0	174	248	336	399	724	0	173	238	314	374	666	0
85000	196	306	432	522	974	0	185	264	358	427	772	0	188	254	335	400	709	0
90000	207	326	459	557	0	0	201	280	379	455	819	0	200	269	355	425	752	0
95000	219	344	485	591	0	0	214	303	401	482	866	0	213	292	384	451	795	0
100000	231	363	512	625	0	0	225	321	433	510	911	0	225	309	407	476	857	0

Figure 58. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 7-Track Tapes. 3 Work Tapes. With Labels. (Submodel 2)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	2	3	3	6	14	1	2	2	2	5	9	1	1	2	2	4	9
2000	3	4	6	7	14	30	3	4	5	6	10	22	3	3	5	5	9	20
5000	8	12	17	21	39	86	8	10	14	17	30	62	8	10	13	15	28	57
10000	18	27	38	45	86	184	17	23	31	37	69	136	17	23	29	34	63	124
15000	28	42	59	72	134	291	27	37	50	59	109	216	27	36	47	55	100	198
20000	38	59	83	100	188	404	36	51	69	82	150	299	37	49	64	77	137	276
25000	50	74	105	128	237	511	48	67	90	105	194	383	48	64	84	98	179	351
30000	61	93	131	156	296	634	58	82	110	130	237	462	58	78	103	122	219	436
35000	71	110	155	188	349	748	70	95	129	155	279	560	70	94	121	145	257	517
40000	84	127	178	218	401	860	81	114	153	179	329	647	81	110	144	167	304	596
45000	96	147	207	247	464	990	92	129	174	202	375	732	92	125	164	189	346	673
50000	107	166	232	275	521	0	102	145	195	232	420	815	102	139	183	218	388	771
55000	118	183	257	311	577	0	116	160	215	258	464	0	116	154	202	242	429	0
60000	129	201	282	343	632	0	127	179	241	284	508	0	127	173	227	266	468	0
65000	144	218	306	374	686	0	139	196	264	309	566	0	139	190	249	289	524	0
70000	156	241	338	404	756	0	151	213	286	334	614	0	150	205	270	312	569	0
75000	169	260	365	434	817	0	162	229	309	358	662	0	161	221	291	344	613	0
80000	181	280	392	464	876	0	173	245	331	392	710	0	172	237	311	370	657	0
85000	193	298	418	504	935	0	184	261	352	420	757	0	187	252	331	395	700	0
90000	204	317	444	537	993	0	200	277	373	447	803	0	199	267	351	421	743	0
95000	216	336	470	570	0	0	212	299	395	475	849	0	212	290	380	446	785	0
100000	227	354	496	603	0	0	224	317	427	501	894	0	224	307	403	471	846	0

Figure 59. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 9-Track Tapes. 3 Work Tapes. With Labels. (Submodel 2)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	2	2	4	10	1	1	2	2	3	6	1	1	1	2	3	5
2000	2	3	4	5	10	21	3	3	4	4	7	14	3	3	3	4	6	12
5000	7	10	13	15	28	60	7	8	10	12	20	40	7	8	10	11	18	36
10000	16	22	29	34	61	128	16	19	24	27	46	87	16	19	22	25	42	78
15000	25	34	45	54	95	202	25	30	38	43	73	138	25	29	36	40	66	124
20000	34	48	63	75	133	282	33	41	52	60	100	191	34	40	48	56	91	173
25000	44	60	80	96	167	356	43	54	67	76	130	245	44	52	63	71	119	221
30000	54	75	100	116	209	441	53	66	82	95	159	295	53	64	77	89	145	273
35000	64	89	118	140	246	521	63	77	97	113	187	357	64	76	91	105	171	324
40000	75	102	136	163	283	599	73	91	115	130	221	413	74	89	108	121	202	374
45000	85	119	158	184	328	689	83	104	130	147	252	467	83	101	123	137	230	422
50000	96	133	177	205	368	774	93	116	146	168	282	520	93	113	137	158	258	484
55000	106	147	196	232	407	858	104	128	161	187	312	591	105	124	152	175	285	538
60000	116	162	215	256	446	940	115	144	180	206	341	650	116	140	170	193	311	591
65000	128	175	233	279	484	1021	125	157	197	224	379	708	126	153	186	209	347	642
70000	139	194	258	302	534	1100	136	170	214	242	412	765	136	166	202	226	377	693
75000	150	209	278	324	576	1207	146	183	231	259	444	822	146	178	217	248	407	743
80000	161	225	299	346	618	0	156	196	247	284	476	877	156	191	233	267	436	816
85000	172	240	319	376	660	0	166	209	263	304	508	956	170	203	248	286	464	872
90000	182	255	339	401	701	0	180	221	279	324	538	1018	181	215	263	304	493	928
95000	193	270	358	425	741	0	191	239	295	344	569	1080	192	233	284	322	520	984
100000	203	284	378	450	782	0	202	253	319	363	599	0	203	247	301	340	561	1039

Figure 60. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 30 KB/sec 9-Track Tapes. 3 Work Tapes. With Labels. (Submodel 2)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	2	2	3	5	10	1	1	2	2	4	7	1	1	2	2	3	6
2000	3	4	5	6	11	21	2	3	4	5	8	17	3	3	4	4	7	14
5000	7	11	14	17	31	62	7	9	12	13	23	49	7	8	11	13	22	42
10000	15	23	30	37	68	134	16	20	26	29	53	107	16	19	24	28	48	93
15000	25	36	49	57	107	212	24	32	42	47	83	169	25	30	38	43	76	147
20000	33	51	68	81	147	289	33	43	57	66	117	232	34	42	52	62	106	201
25000	44	64	88	102	185	374	42	57	74	85	149	291	44	54	69	78	133	252
30000	54	80	106	127	233	458	53	69	91	103	180	366	55	65	84	98	168	321
35000	63	95	124	151	276	539	63	81	107	121	219	433	64	80	98	117	199	379
40000	72	110	149	175	317	618	72	96	122	145	254	499	73	92	117	135	229	435
45000	85	124	169	197	357	715	81	110	143	165	288	562	85	104	134	153	259	489
50000	95	139	190	219	410	0	93	124	161	185	322	645	96	117	150	170	287	567
55000	105	158	210	250	456	0	103	136	179	204	354	0	106	128	166	193	331	0
60000	116	174	229	276	502	0	114	149	196	223	399	0	116	145	182	214	364	0
65000	125	190	248	301	547	0	123	162	213	249	437	0	126	158	197	233	398	0
70000	135	206	277	326	591	0	134	180	230	271	474	0	136	172	220	253	430	0
75000	149	221	299	350	634	0	144	195	247	293	511	0	145	186	238	272	462	0
80000	160	237	321	375	677	0	153	209	272	314	547	0	160	199	255	292	494	0
85000	172	252	343	399	720	0	163	224	291	336	584	0	171	212	273	310	525	0
90000	183	267	365	422	783	0	172	238	310	356	619	0	182	225	290	329	556	0
95000	194	282	386	446	0	0	188	252	329	377	654	0	193	237	307	347	607	0
100000	205	306	407	484	0	0	200	266	348	398	689	0	204	250	324	365	643	0

Figure 61. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 7-Track Tapes. 4 Work Tapes. With Labels. (Submodel 2)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	2	2	2	5	9	1	1	2	2	4	7	1	1	2	2	3	6
2000	2	3	5	6	10	20	2	3	4	5	8	16	3	3	4	4	7	14
5000	7	10	13	16	30	59	7	9	12	13	23	47	7	8	11	12	21	41
10000	15	23	29	36	65	128	16	19	25	29	52	104	16	19	23	28	47	91
15000	24	35	47	54	102	202	24	31	41	47	81	164	25	30	38	43	75	145
20000	33	49	66	78	141	274	33	42	56	65	114	225	34	42	51	61	104	198
25000	43	62	85	98	177	355	42	56	73	84	145	283	44	53	69	77	131	248
30000	53	78	103	122	222	434	52	68	89	101	175	356	54	64	83	97	165	315
35000	62	92	120	145	263	512	62	80	105	118	214	421	63	79	97	115	196	372
40000	71	107	144	168	302	587	71	95	120	142	248	484	73	91	116	133	226	427
45000	83	121	163	190	341	678	80	109	141	162	281	545	85	103	133	151	255	480
50000	94	134	183	211	391	0	92	122	158	181	314	626	95	116	149	168	283	557
55000	104	153	202	240	435	0	102	135	176	200	346	0	105	127	164	191	326	0
60000	114	168	221	265	479	0	113	147	193	219	389	0	116	144	180	211	359	0
65000	123	184	239	289	521	0	123	160	210	244	426	0	125	157	195	230	391	0
70000	133	199	267	313	564	0	133	178	226	266	463	0	135	171	217	250	423	0
75000	147	215	289	337	605	0	143	192	242	287	499	0	144	184	235	269	455	0
80000	158	229	310	360	646	0	152	206	267	308	535	0	159	197	252	288	486	0
85000	169	244	331	383	686	0	162	220	286	329	570	0	171	210	270	306	517	0
90000	180	259	351	406	747	0	171	235	305	350	605	0	181	223	287	325	547	0
95000	191	273	372	428	494	0	187	248	324	370	639	0	193	235	304	343	597	0
100000	201	296	392	465	0	0	198	262	342	390	673	0	203	248	321	361	633	0

Figure 62. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 9-Track Tapes. 4 Work Tapes. With Labels. (Submodel 2)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	2	2	3	6	1	1	1	2	3	5	1	1	1	1	2	4
2000	2	3	4	4	7	14	2	3	3	4	6	11	3	3	3	3	5	9
5000	6	9	11	13	22	41	7	7	9	10	16	32	7	7	8	10	15	27
10000	14	19	23	28	48	90	14	16	20	22	37	69	15	16	19	21	33	59
15000	22	29	38	42	75	142	22	26	32	36	57	109	24	25	30	33	52	93
20000	30	41	52	60	103	193	31	35	44	50	80	150	32	36	40	47	72	128
25000	40	52	67	76	130	250	39	47	57	64	102	188	41	45	54	59	91	160
30000	49	65	82	95	163	306	48	57	70	77	123	237	51	54	65	74	114	203
35000	57	77	95	113	193	361	57	67	82	90	150	280	59	66	77	87	135	240
40000	65	89	114	130	221	413	66	80	94	108	174	322	68	77	91	101	156	276
45000	76	101	130	147	250	478	74	91	110	123	197	363	79	87	104	114	176	310
50000	86	112	145	164	286	538	85	102	124	138	220	416	89	97	117	127	195	359
55000	95	128	160	186	319	597	95	112	138	152	242	463	98	107	129	145	224	400
60000	104	141	175	205	350	655	104	123	151	166	272	509	108	120	141	160	247	439
65000	113	154	190	224	382	712	113	133	164	185	298	555	116	132	153	175	270	478
70000	122	167	212	243	413	768	123	148	177	202	323	600	126	143	170	189	292	516
75000	134	179	229	261	443	824	132	160	190	218	349	644	134	154	184	204	314	554
80000	144	192	246	279	473	878	140	172	209	234	373	688	148	165	197	218	335	591
85000	154	204	263	297	502	0	149	184	224	250	398	731	159	176	211	232	356	627
90000	164	216	279	315	547	0	158	195	238	265	422	795	168	187	225	246	377	689
95000	174	228	295	332	581	0	172	207	253	281	446	845	179	197	238	259	411	732
100000	184	247	311	361	615	0	183	218	267	296	470	0	188	208	251	273	436	774

Figure 63. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 30 KB/sec 9-Track Tapes. 4 Work Tapes. With Labels. (Submodel 2)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	2	2	2	5	12	1	1	2	2	3	7	1	1	2	2	3	6
2000	2	3	5	6	10	26	3	3	4	4	8	15	3	3	4	4	6	13
5000	7	10	13	17	30	71	7	8	11	12	21	46	7	9	10	12	20	39
10000	15	23	29	36	66	153	16	19	24	27	50	100	16	19	22	27	44	85
15000	25	35	48	56	101	247	25	31	39	45	78	152	26	29	36	41	67	136
20000	33	50	64	79	144	342	34	41	54	63	109	217	34	42	49	59	97	186
25000	44	63	85	101	182	437	42	55	67	81	139	274	45	53	66	74	123	233
30000	54	76	104	121	218	528	54	67	86	99	169	328	55	64	80	89	154	297
35000	63	93	122	149	268	617	63	79	102	115	197	405	64	78	94	110	184	351
40000	72	108	139	172	310	733	73	94	117	138	237	468	76	91	112	128	212	404
45000	85	123	164	195	351	834	82	107	132	157	270	529	87	103	127	145	240	455
50000	96	137	184	217	390	0	94	120	153	177	302	589	97	115	143	161	268	504
55000	106	151	204	239	429	0	105	133	170	195	334	0	107	127	159	177	294	0
60000	116	165	224	261	486	0	116	145	187	214	365	0	118	138	174	201	335	0
65000	126	186	243	296	531	0	126	158	204	232	395	0	128	156	188	220	367	0
70000	136	202	262	321	576	0	136	170	221	249	425	0	138	170	203	239	398	0
75000	146	218	281	346	621	0	146	182	237	278	476	0	147	183	217	258	429	0
80000	155	234	299	371	665	0	156	203	253	299	511	0	162	196	242	277	459	0
85000	172	249	332	395	708	0	166	217	269	320	546	0	174	209	259	295	489	0
90000	183	265	353	419	751	0	176	231	285	341	581	0	185	222	276	313	519	0
95000	195	280	375	443	0	0	191	245	312	361	616	0	197	235	293	331	549	0
100000	206	295	397	467	0	0	203	259	331	381	650	0	207	248	310	349	577	0

Figure 64. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 7-Track Tapes. 5 Work Tapes. With Labels. (Submodel 2)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	2	2	4	11	1	1	2	2	3	7	1	1	1	2	3	6
2000	2	3	5	5	10	24	3	3	4	4	7	15	3	3	3	4	6	13
5000	7	10	13	16	29	65	7	8	11	12	21	44	7	9	10	12	20	38
10000	15	22	28	35	63	141	15	19	24	27	48	96	16	19	22	26	44	83
15000	24	34	46	53	95	227	25	30	39	44	75	146	26	29	36	40	66	133
20000	33	48	61	76	136	315	34	41	53	62	106	209	34	41	48	58	96	182
25000	43	61	82	96	172	402	42	55	66	79	135	264	45	53	65	73	121	228
30000	53	73	99	115	206	487	53	66	85	96	164	316	55	63	79	88	151	290
35000	62	90	117	142	253	569	63	77	100	113	191	390	64	77	92	109	180	343
40000	71	105	133	164	293	676	73	92	115	135	230	451	76	90	110	126	208	394
45000	83	119	157	186	331	769	82	105	129	154	262	510	87	102	126	143	236	444
50000	94	132	177	207	369	0	94	118	150	173	293	568	96	114	141	159	262	492
55000	104	146	196	228	406	0	105	131	167	191	324	0	107	125	157	175	288	0
60000	114	159	215	249	459	0	115	143	184	209	354	0	117	136	171	198	329	0
65000	124	180	233	282	502	0	125	156	200	227	384	0	127	155	186	217	360	0
70000	134	195	252	306	545	0	135	167	217	244	413	0	137	168	200	236	390	0
75000	143	211	269	330	587	0	145	179	233	272	462	0	146	182	214	255	421	0
80000	153	226	287	354	628	0	155	200	248	292	497	0	162	194	239	273	451	0
85000	169	241	318	377	669	0	165	214	264	313	531	0	173	207	256	291	480	0
90000	180	256	339	400	710	0	174	228	279	333	565	0	184	220	273	309	509	0
95000	191	271	360	423	750	0	190	242	306	353	598	0	196	233	290	326	538	0
100000	202	285	381	446	0	0	201	255	324	373	632	0	206	245	306	344	566	0

Figure 65. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 9-Track Tapes. 5 Work Tapes. With Labels. (Submodel 2)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	2	2	3	8	1	1	1	1	2	5	1	1	1	1	2	4
2000	2	3	4	4	7	18	3	3	3	3	5	10	3	3	3	3	5	9
5000	6	9	11	13	22	50	7	7	9	10	15	30	7	8	8	9	14	25
10000	14	19	23	28	48	108	15	16	19	21	35	66	15	16	18	21	31	56
15000	23	29	37	43	72	174	23	26	31	35	54	101	24	25	29	31	47	89
20000	30	41	50	61	103	241	32	35	43	48	76	144	32	36	39	45	68	121
25000	40	52	67	77	130	308	39	47	53	62	98	181	42	46	53	57	86	152
30000	49	63	81	92	156	373	50	57	68	75	118	217	51	55	64	69	107	193
35000	58	77	95	114	193	436	59	66	81	88	138	268	60	67	75	85	128	228
40000	66	90	109	132	222	518	68	79	93	106	166	310	71	78	89	98	148	263
45000	77	102	128	149	252	589	76	90	104	120	189	350	81	88	101	111	167	296
50000	87	113	144	166	280	659	88	101	120	135	212	390	91	98	114	124	186	328
55000	97	125	160	183	308	728	98	112	134	149	234	429	100	108	126	136	205	379
60000	106	136	175	199	349	796	107	122	148	163	255	486	110	117	138	154	233	417
65000	115	154	191	226	381	862	117	133	161	177	277	531	120	133	150	169	255	455
70000	124	167	205	245	414	928	126	143	174	190	298	576	129	144	161	184	277	492
75000	133	180	220	264	445	1028	136	153	187	212	333	620	137	156	172	198	298	529
80000	142	193	234	283	477	1104	145	170	200	228	358	664	152	167	192	212	320	565
85000	157	206	260	302	508	1180	154	182	212	244	383	708	163	178	206	226	340	600
90000	167	219	277	321	539	0	163	194	224	260	407	751	173	189	219	240	361	636
95000	177	232	294	339	569	0	177	206	246	276	431	793	184	200	233	254	382	670
100000	187	244	311	357	599	0	188	218	260	291	455	0	193	211	246	267	402	732

Figure 66. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 30 KB/sec 9-Track Tapes. 5 Work Tapes. With Labels. (Submodel 2)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	2	2	3	5	11	1	1	2	2	3	6	1	1	1	2	3	6
2000	2	4	5	6	12	23	3	3	4	4	8	15	1	3	4	4	7	13
5000	7	10	14	16	34	67	7	9	11	13	22	42	8	9	10	12	19	36
10000	17	23	32	36	74	146	16	20	25	28	48	91	17	19	23	26	42	84
15000	25	37	50	58	115	226	25	31	39	43	76	144	27	31	37	42	69	132
20000	36	51	70	79	161	314	35	43	55	63	106	199	36	41	51	57	93	184
25000	46	66	88	103	206	402	45	55	70	79	134	250	45	54	64	75	123	236
30000	55	82	110	127	249	486	54	69	85	99	167	313	57	66	81	92	151	286
35000	68	97	131	150	291	567	62	82	99	118	199	373	67	78	96	108	177	334
40000	79	111	152	172	347	675	76	95	120	137	230	430	77	90	111	124	203	399
45000	89	125	171	194	396	768	86	108	136	155	260	486	87	101	126	145	238	455
50000	100	145	191	224	443	0	97	120	153	172	290	541	97	118	140	164	269	511
55000	110	161	210	250	490	0	107	131	170	189	319	0	106	131	154	183	299	0
60000	120	177	239	275	536	0	117	150	185	215	363	0	121	144	176	201	328	0
65000	135	193	261	300	581	0	127	164	201	236	397	0	132	157	193	219	357	0
70000	147	209	283	324	625	0	136	178	216	256	431	0	144	170	210	236	385	0
75000	159	225	305	348	693	0	152	192	241	276	464	0	155	182	226	253	413	0
80000	170	240	327	371	745	0	163	206	260	296	497	0	165	194	242	270	440	0
85000	182	255	349	395	796	0	175	220	278	316	530	0	177	207	258	286	467	0
90000	193	270	370	418	848	0	186	233	296	335	562	0	187	218	274	316	516	0
95000	204	285	391	456	0	0	197	246	314	354	594	0	197	240	289	336	549	0
100000	215	312	411	484	0	0	208	259	332	373	625	0	208	255	304	356	581	0

Figure 67. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 7-Track Tapes. 6 Work Tapes. With Labels. (Submodel 2)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	2	2	2	5	10	1	1	2	2	3	6	1	1	1	2	3	6
2000	2	4	5	5	11	22	3	3	4	4	7	14	1	3	4	4	7	13
5000	7	10	14	16	32	62	7	9	11	13	21	40	8	9	10	11	19	35
10000	16	22	30	34	69	134	16	19	24	28	47	88	16	19	23	25	41	82
15000	25	36	48	55	107	209	25	31	38	42	74	139	27	30	36	41	67	128
20000	36	49	66	75	150	290	35	43	54	61	103	192	36	41	50	56	91	178
25000	45	64	84	98	192	371	45	54	69	77	129	241	45	54	63	74	121	229
30000	54	79	105	121	232	448	54	68	83	96	162	302	57	66	80	91	148	278
35000	67	93	125	142	271	523	62	81	97	115	193	359	67	78	95	107	174	325
40000	77	107	144	164	323	623	75	93	117	133	223	415	76	89	110	122	199	388
45000	88	120	163	184	368	709	86	106	134	151	252	469	87	100	124	143	233	442
50000	98	139	182	213	412	0	96	118	150	168	281	522	96	117	138	161	263	496
55000	108	155	200	237	456	0	106	129	166	185	309	0	105	130	152	180	292	0
60000	118	171	227	261	499	0	116	148	181	210	351	0	121	143	174	197	321	0
65000	133	186	249	285	541	0	126	162	197	230	385	0	132	155	190	215	349	0
70000	144	202	270	308	582	0	135	175	212	250	418	0	143	168	207	232	377	0
75000	156	217	291	330	644	0	151	189	236	270	450	0	154	180	223	249	404	0
80000	167	232	312	353	693	0	162	202	254	289	482	0	164	193	239	265	431	0
85000	178	246	332	375	741	0	173	216	272	308	514	0	176	204	254	282	457	0
90000	190	260	352	397	788	0	185	229	290	327	545	0	186	216	270	311	505	0
95000	200	274	372	434	836	0	196	242	307	346	576	0	196	238	285	331	537	0
100000	211	301	392	460	0	0	207	255	325	364	606	0	207	252	300	350	569	0

Figure 68. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 9-Track Tapes. 6 Work Tapes. With Labels. (Submodel 2)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	2	2	4	8	1	1	1	1	2	4	1	1	1	1	2	4
2000	2	3	4	5	9	17	3	3	3	3	5	10	1	3	3	3	5	9
5000	7	9	12	13	25	48	7	8	9	10	16	28	7	8	9	9	14	24
10000	15	20	26	28	55	104	15	17	20	22	35	61	16	17	19	20	30	56
15000	23	32	40	45	85	161	23	27	31	34	55	97	25	27	30	33	49	87
20000	33	43	56	62	119	224	33	37	44	49	76	133	34	36	41	45	66	122
25000	42	56	70	81	152	286	42	47	57	62	96	168	43	47	52	59	88	157
30000	51	69	88	99	184	346	51	59	68	77	120	210	54	57	65	72	107	190
35000	63	81	105	117	215	403	59	70	80	92	142	250	63	68	78	85	126	222
40000	73	94	121	134	256	480	71	81	96	106	165	288	73	78	90	97	144	264
45000	82	105	137	151	292	547	81	92	110	120	186	326	82	87	102	114	169	302
50000	92	122	152	175	327	612	90	102	123	134	207	362	91	102	114	129	191	339
55000	101	136	167	194	362	676	100	112	136	148	228	398	100	113	125	143	212	375
60000	110	149	190	214	396	739	109	128	149	168	259	453	114	124	143	157	233	410
65000	124	163	208	233	429	801	118	140	161	184	284	495	125	136	156	171	254	445
70000	135	176	226	252	462	862	127	152	174	199	308	537	136	146	169	185	274	479
75000	146	189	244	271	512	955	142	164	194	215	332	579	146	157	183	198	293	512
80000	157	202	261	289	550	1026	153	176	208	231	355	619	156	168	196	211	313	570
85000	167	215	278	307	588	1096	163	187	223	246	379	660	166	178	209	224	332	610
90000	177	227	295	325	626	0	174	198	237	261	401	700	176	188	221	247	367	650
95000	188	240	312	355	663	0	184	210	252	276	424	739	186	207	234	263	390	689
100000	198	263	328	376	701	0	194	221	266	290	447	0	196	219	246	278	413	728

Figure 69. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 30 KB/sec 9-Track Tapes. 6 Work Tapes. With Labels. (Submodel 2)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	2	2	5	13	1	1	1	2	4	9	1	1	1	1	3	7
2000	1	3	4	6	12	28	1	2	3	4	9	20	1	2	3	4	8	18
5000	4	8	13	16	36	80	3	6	10	13	27	58	3	6	9	11	23	51
10000	9	18	29	37	78	176	8	15	23	29	60	128	7	13	21	25	53	113
15000	14	29	47	58	124	271	12	24	37	46	94	203	12	22	33	41	83	181
20000	20	41	65	82	172	380	17	33	51	65	132	276	17	30	46	58	118	251
25000	25	53	84	105	219	478	22	43	67	83	167	361	21	39	60	74	153	322
30000	31	65	103	129	265	598	27	53	82	100	210	438	26	48	73	92	187	390
35000	37	78	123	153	321	704	32	62	96	122	248	526	31	56	86	110	221	472
40000	42	90	142	179	371	0	38	74	114	142	285	610	36	67	103	127	260	547
45000	49	101	160	205	420	0	43	84	130	160	331	692	41	77	117	143	297	619
50000	56	116	184	230	467	0	48	94	146	178	372	0	46	86	131	164	334	690
55000	62	130	204	254	531	0	54	104	161	204	413	0	52	95	145	183	369	0
60000	67	142	225	278	584	0	60	114	176	224	452	0	58	107	162	202	404	0
65000	73	155	245	308	636	0	66	128	197	245	490	0	63	117	178	220	449	0
70000	81	168	264	335	687	0	71	139	214	265	543	0	68	127	194	238	489	0
75000	88	180	284	362	738	0	77	150	231	284	586	0	73	137	209	255	528	0
80000	94	197	311	388	788	0	82	161	248	304	629	0	78	147	224	279	566	0
85000	101	211	333	414	0	0	87	171	265	332	672	0	85	156	238	299	604	0
90000	107	225	354	440	0	0	94	182	281	354	714	0	91	166	253	319	641	0
95000	113	239	376	465	0	0	101	192	297	376	0	0	97	180	267	339	678	0
100000	120	252	397	490	0	0	107	207	313	398	0	0	102	191	289	358	714	0

FILE SIZE (RECORDS)	24K STORAGE RECORD SIZE (BYTES)						32K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	1	3	6	1	1	1	1	3	6
2000	1	2	3	3	7	15	1	2	2	3	6	14
5000	3	6	8	10	21	45	4	5	7	9	20	42
10000	8	12	18	23	47	103	8	12	17	22	43	96
15000	12	20	30	37	76	160	12	19	28	35	71	154
20000	17	28	42	51	107	227	17	27	40	48	101	213
25000	22	36	54	68	138	295	22	34	51	64	128	279
30000	26	45	68	83	166	362	27	44	65	78	161	341
35000	31	54	81	98	204	427	32	51	76	95	192	401
40000	36	62	94	117	236	502	38	59	88	111	222	477
45000	42	72	105	134	267	574	43	70	103	127	250	544
50000	47	81	122	150	306	645	48	78	117	142	290	609
55000	53	90	136	165	342	0	53	87	130	156	323	0
60000	57	99	150	186	376	0	58	96	142	178	355	0
65000	62	108	163	204	410	0	64	104	154	194	387	0
70000	69	117	176	222	443	0	71	116	171	211	417	0
75000	75	129	194	239	476	0	75	126	186	227	460	0
80000	80	139	210	257	521	0	81	134	200	243	496	0
85000	85	149	224	273	559	0	87	144	214	259	531	0
90000	91	159	239	290	596	0	92	153	228	274	565	0
95000	96	168	254	307	633	0	98	162	241	300	600	0
100000	101	178	268	332	669	0	105	171	254	318	634	0

• Figure 70. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 7-Track Tapes. 3 Work Tapes. No Labels. (Submodel 5)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	2	2	5	12	1	1	1	2	4	8	1	1	1	1	3	7
2000	1	3	4	5	12	26	1	2	3	4	9	19	1	2	3	4	8	17
5000	4	8	13	16	34	75	3	6	10	13	26	56	3	6	9	11	23	50
10000	9	18	28	35	74	165	8	14	22	28	58	124	7	13	20	25	52	111
15000	13	28	45	55	117	255	12	23	36	45	91	197	12	21	33	40	81	177
20000	19	39	62	77	162	357	17	32	50	63	128	267	16	29	45	56	115	245
25000	24	50	79	100	208	449	22	42	65	81	162	349	21	39	59	72	149	314
30000	30	62	98	123	251	562	26	51	80	97	203	423	25	47	72	90	183	381
35000	36	74	117	145	304	662	32	60	94	119	240	509	31	55	84	107	216	461
40000	41	86	135	170	351	758	37	72	110	137	276	590	36	66	100	124	254	534
45000	48	97	153	194	397	0	42	82	126	156	321	669	41	76	115	140	290	604
50000	54	111	175	218	442	0	47	92	142	173	361	0	46	84	128	161	326	673
55000	60	124	195	241	502	0	53	101	157	198	400	0	51	93	142	179	361	0
60000	65	136	214	264	553	0	59	111	171	218	438	0	57	105	159	197	395	0
65000	71	148	233	293	602	0	64	124	191	237	475	0	62	115	174	215	439	0
70000	78	160	252	318	651	0	70	135	208	257	526	0	67	125	190	232	477	0
75000	85	172	270	344	699	0	75	146	225	276	568	0	72	135	204	249	515	0
80000	91	189	296	369	746	0	80	156	241	295	610	0	77	144	219	273	553	0
85000	97	202	316	393	813	0	85	167	257	322	651	0	84	154	233	293	590	0
90000	104	215	337	418	0	0	93	177	273	343	692	0	90	163	248	312	626	0
95000	110	228	357	442	0	0	99	187	288	365	732	0	96	176	262	331	662	0
100000	116	241	378	465	0	0	105	202	304	386	0	0	101	187	283	350	698	0

FILE SIZE (RECORDS)	24K STORAGE RECORD SIZE (BYTES)						32K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	1	3	6	1	1	1	1	3	6
2000	1	2	3	3	7	15	1	2	2	3	6	13
5000	3	5	8	10	21	44	4	5	7	9	19	41
10000	8	12	18	23	46	100	8	12	17	21	42	94
15000	12	20	29	37	75	156	12	19	27	34	69	151
20000	17	28	42	50	105	222	17	26	39	47	99	208
25000	22	35	53	67	134	288	22	34	50	63	126	272
30000	26	44	67	81	162	353	27	43	64	77	157	333
35000	31	53	79	96	199	417	31	51	75	93	188	391
40000	35	61	92	114	230	490	38	58	86	109	217	465
45000	42	71	103	131	261	561	42	69	101	124	244	531
50000	47	80	120	147	299	629	48	77	114	139	284	595
55000	52	89	134	162	334	0	52	86	127	153	316	0
60000	56	97	147	182	367	0	58	94	140	174	347	0
65000	61	107	160	199	401	0	64	102	151	190	378	0
70000	68	115	173	217	433	0	70	114	168	206	408	0
75000	74	127	190	234	465	0	75	123	182	222	449	0
80000	79	137	205	251	509	0	81	132	196	238	485	0
85000	84	146	220	268	546	0	86	142	210	253	519	0
90000	90	156	234	284	582	0	91	151	224	268	552	0
95000	95	165	248	300	618	0	97	159	236	294	586	0
100000	100	175	262	325	653	0	104	168	249	312	619	0

● Figure 71. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 9-Track Tapes. 3 Work Tapes. No Labels. (Submodel 5)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	2	3	8	1	1	1	1	2	5	1	1	1	1	2	4
2000	1	2	3	4	8	18	1	1	2	3	6	12	1	1	2	2	5	10
5000	3	6	9	11	23	52	3	4	7	8	16	35	3	4	6	7	14	30
10000	7	13	20	25	51	115	6	10	15	18	37	77	6	9	13	16	32	66
15000	11	21	32	38	80	177	10	16	24	30	57	121	10	15	21	26	49	105
20000	15	29	44	54	111	248	13	22	33	41	81	165	13	20	29	36	70	146
25000	19	37	56	70	143	312	17	29	43	53	102	216	17	27	38	46	91	187
30000	24	46	70	86	172	390	21	36	53	64	128	262	21	33	47	57	112	227
35000	29	54	83	102	208	459	25	42	62	78	151	314	25	38	55	68	132	274
40000	33	63	96	119	241	526	30	50	74	90	174	364	29	46	65	79	155	318
45000	38	71	108	136	273	611	34	57	84	102	202	413	33	52	75	89	177	360
50000	43	81	124	153	303	685	38	64	94	113	227	461	37	58	84	102	199	401
55000	48	90	138	169	345	758	42	71	104	129	252	519	41	64	92	114	220	454
60000	52	99	151	185	379	830	47	77	114	142	276	572	45	72	103	126	240	501
65000	57	108	165	205	413	0	51	87	127	155	299	625	50	79	113	137	267	546
70000	63	117	178	223	447	0	55	94	138	168	331	677	54	86	123	148	291	591
75000	68	125	191	241	479	0	60	102	149	180	358	728	58	93	133	159	314	635
80000	73	138	209	259	512	0	64	109	160	193	384	778	62	99	142	174	337	678
85000	78	147	224	276	558	0	68	116	171	211	410	827	67	106	152	186	359	737
90000	83	157	238	293	594	0	73	123	181	225	436	0	72	112	161	199	381	786
95000	88	166	253	310	630	0	78	130	191	238	461	0	76	121	170	211	403	0
100000	92	176	267	327	666	0	83	140	202	252	486	0	81	129	184	223	425	0

FILE SIZE (RECORDS)	24K STORAGE RECORD SIZE (BYTES)						32K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	1	2	4	1	1	1	1	2	3
2000	1	1	2	2	4	9	1	1	2	2	4	8
5000	3	4	5	6	13	26	3	4	5	6	12	24
10000	6	9	12	15	28	60	7	9	11	14	26	56
15000	10	14	20	24	46	93	11	14	18	23	43	90
20000	14	20	28	33	64	132	15	19	26	31	61	124
25000	18	25	35	43	82	171	19	24	34	41	77	162
30000	22	31	44	53	99	211	23	31	43	50	96	198
35000	26	37	52	62	122	248	27	36	50	61	115	233
40000	30	43	61	74	141	292	32	42	58	71	133	277
45000	35	50	68	84	160	334	36	49	68	81	150	316
50000	39	56	79	94	183	375	40	55	76	90	174	354
55000	43	62	88	104	204	415	44	61	85	99	193	391
60000	47	69	97	117	224	454	49	67	93	113	212	438
65000	51	75	105	128	245	505	54	73	101	123	232	481
70000	56	81	114	140	264	549	59	81	112	134	250	522
75000	61	89	125	150	284	593	63	88	121	144	275	563
80000	65	96	135	162	311	636	68	94	130	154	297	603
85000	69	103	145	172	333	678	73	101	140	164	318	643
90000	74	109	154	183	355	720	76	107	149	174	338	681
95000	78	116	163	193	377	0	81	113	157	190	359	0
100000	82	122	173	209	399	0	87	120	166	202	379	0

• Figure 72. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 30 KB/sec 9-Track Tapes. 3 Work Tapes. No Labels. (Submodel 5)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	2	4	10	1	1	1	1	3	7	1	1	1	1	3	6
2000	1	2	4	5	10	22	1	2	3	3	7	15	1	2	2	3	6	13
5000	3	7	10	13	28	65	3	5	8	10	20	42	3	5	7	8	18	38
10000	7	14	23	30	61	141	7	12	18	21	44	96	6	11	15	20	40	84
15000	12	24	37	46	95	216	10	19	29	35	72	149	10	17	25	31	61	129
20000	16	33	50	65	133	306	15	25	39	47	100	209	14	24	34	44	88	185
25000	21	43	66	83	169	386	18	34	49	63	128	267	18	31	46	56	111	233
30000	26	52	81	101	204	481	23	41	63	77	155	322	23	37	56	67	139	292
35000	31	60	95	122	249	0	27	49	75	90	188	391	26	46	66	83	165	347
40000	35	73	109	142	289	0	32	55	86	107	218	453	30	53	78	96	191	400
45000	40	83	128	161	327	0	36	66	96	123	249	0	36	60	89	109	216	451
50000	46	93	144	180	364	0	40	74	112	138	278	0	40	67	100	121	241	0
55000	52	102	160	199	401	0	46	82	125	152	307	0	44	74	111	133	274	0
60000	57	112	175	216	453	0	50	90	137	166	335	0	49	81	122	152	303	0
65000	62	121	190	244	496	0	55	98	150	180	375	0	53	92	132	166	331	0
70000	67	136	205	265	538	0	60	105	162	201	408	0	57	100	142	181	359	0
75000	72	147	220	286	0	0	64	117	174	218	441	0	61	108	159	195	386	0
80000	76	158	243	307	0	0	68	126	185	234	473	0	67	116	171	209	413	0
85000	84	168	260	327	0	0	73	135	197	250	504	0	72	123	183	222	440	0
90000	90	179	277	347	0	0	77	144	217	266	0	0	77	131	195	236	466	0
95000	95	189	294	367	0	0	84	153	230	282	0	0	82	139	207	249	492	0
100000	101	200	311	387	0	0	89	161	244	298	0	0	86	146	218	262	0	0

FILE SIZE (RECORDS)	24K STORAGE RECORD SIZE (BYTES)						32K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	1	2	5	1	1	1	1	2	4
2000	1	2	2	3	5	11	1	2	2	2	4	10
5000	3	4	6	8	16	33	3	4	5	7	14	30
10000	7	10	14	17	35	74	8	10	14	16	32	68
15000	11	16	23	27	54	117	11	16	21	27	52	110
20000	14	22	31	39	77	162	16	22	31	37	72	149
25000	19	29	41	50	98	203	20	27	39	46	95	199
30000	23	34	51	60	123	258	24	35	47	60	116	243
35000	27	42	59	75	147	306	28	41	59	71	138	285
40000	31	49	72	87	170	352	33	48	68	81	158	339
45000	36	56	82	98	192	397	37	54	78	92	186	388
50000	41	62	92	109	213	459	42	62	87	108	210	436
55000	45	69	102	120	246	0	46	69	95	120	233	0
60000	49	75	111	138	271	0	51	77	109	132	256	0
65000	54	86	120	151	296	0	56	83	119	143	279	0
70000	58	93	135	164	321	0	62	90	130	155	300	0
75000	62	100	146	177	346	0	66	97	140	166	322	0
80000	69	108	157	189	369	0	71	103	150	178	357	0
85000	73	115	168	202	393	0	76	110	160	196	383	0
90000	78	122	179	214	416	0	80	117	170	209	408	0
95000	83	129	189	226	439	0	85	128	179	223	434	0
100000	88	136	200	237	481	0	89	136	188	236	459	0

• Figure 73. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 7-Track Tapes. 4 Work Tapes. No Labels. (Submodel 5)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	2	4	9	1	1	1	1	3	6	1	1	1	1	3	6
2000	1	2	3	4	9	21	1	2	2	3	7	14	1	2	2	3	6	12
5000	3	6	10	12	26	60	3	5	8	9	19	40	3	4	7	8	17	37
10000	7	14	22	28	57	131	7	11	17	21	42	92	6	11	15	19	39	82
15000	12	22	35	44	88	200	10	18	28	34	69	143	10	17	25	30	59	125
20000	16	31	47	61	125	283	14	25	38	45	96	201	14	24	33	43	85	179
25000	20	40	62	78	159	357	18	33	48	61	123	256	18	30	45	54	108	225
30000	25	49	76	94	191	444	23	40	61	74	149	308	22	36	55	65	135	283
35000	30	57	90	115	233	527	27	47	72	87	180	374	26	45	64	80	160	336
40000	34	69	103	133	270	0	31	54	83	103	210	434	30	52	76	93	185	387
45000	38	78	121	151	306	0	35	64	93	118	239	493	35	59	87	106	210	437
50000	45	88	136	169	341	0	39	72	108	133	267	0	39	66	98	118	234	0
55000	50	97	151	186	375	0	45	80	120	147	294	0	44	73	108	130	266	0
60000	55	106	165	203	424	0	49	87	133	161	321	0	48	79	119	148	294	0
65000	60	115	179	229	464	0	54	95	144	174	360	0	52	90	129	162	321	0
70000	64	129	193	249	503	0	58	102	156	194	392	0	56	98	139	176	348	0
75000	69	139	207	268	542	0	63	114	168	210	423	0	60	105	155	190	375	0
80000	74	149	229	288	0	0	67	122	179	226	454	0	67	113	167	203	401	0
85000	81	160	245	307	0	0	71	131	190	241	484	0	71	121	179	216	427	0
90000	86	170	261	326	0	0	76	139	209	257	514	0	76	128	190	230	452	0
95000	92	180	277	345	0	0	82	148	222	272	0	0	81	136	202	243	478	0
100000	97	189	293	363	0	0	87	156	235	287	0	0	85	143	213	255	0	0

FILE SIZE (RECORDS)	24K STORAGE RECORD SIZE (BYTES)						32K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	1	2	5	1	1	1	1	2	4
2000	1	2	2	2	5	11	1	1	2	2	4	10
5000	3	4	6	8	15	32	3	4	5	7	14	30
10000	7	10	14	17	34	72	8	10	13	16	31	66
15000	11	15	23	27	52	115	11	16	21	26	51	108
20000	14	22	30	38	76	158	16	21	30	36	70	146
25000	19	28	41	49	96	198	19	27	39	45	93	194
30000	23	34	50	59	121	252	24	34	47	59	114	237
35000	27	42	58	73	144	299	28	40	58	69	135	278
40000	31	48	70	85	166	344	33	47	67	80	154	331
45000	36	55	80	96	188	387	37	53	76	90	181	378
50000	41	61	90	107	209	448	42	61	85	105	205	425
55000	45	68	100	118	240	0	46	68	94	118	228	0
60000	49	74	109	135	265	0	50	75	107	129	250	0
65000	53	84	118	148	290	0	56	82	117	141	272	0
70000	57	92	132	161	314	0	61	89	127	152	294	0
75000	61	99	143	173	338	0	65	96	137	163	314	0
80000	68	106	154	185	361	0	70	102	147	174	349	0
85000	72	113	165	197	384	0	76	108	157	192	374	0
90000	77	120	175	210	407	0	80	115	167	205	399	0
95000	82	127	186	221	429	0	85	126	176	218	424	0
100000	87	133	196	233	470	0	89	134	185	231	448	0

• Figure 74. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 9-Track Tapes. 4 Work Tapes. No Labels. (Submodel 5)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	1	3	7	1	1	1	1	2	4	1	1	1	1	2	3
2000	1	2	3	3	7	15	1	1	2	2	4	9	1	1	2	2	4	8
5000	3	5	7	9	19	45	2	4	5	6	13	26	3	3	5	5	11	23
10000	6	11	16	21	42	97	6	8	12	14	28	59	5	8	10	13	25	51
15000	10	17	26	32	64	148	8	13	19	23	45	93	9	12	17	20	38	78
20000	13	24	35	45	91	210	12	18	27	31	64	130	12	17	23	28	54	111
25000	17	31	47	58	115	265	15	24	33	42	82	165	15	22	31	36	68	140
30000	21	38	57	70	138	331	19	30	43	51	99	200	19	27	37	44	85	176
35000	25	44	67	85	169	392	22	35	50	59	119	242	22	32	44	54	102	209
40000	29	53	77	99	196	452	26	40	58	71	139	281	25	38	52	62	118	241
45000	32	60	90	113	222	510	29	47	65	81	158	319	30	43	59	71	133	272
50000	38	68	101	126	247	567	32	53	76	91	177	356	33	48	67	79	148	302
55000	42	75	112	139	272	0	37	59	84	101	195	392	37	53	74	87	169	346
60000	46	82	123	151	308	0	41	64	93	110	213	428	40	58	81	99	187	382
65000	50	88	134	170	337	0	45	70	101	119	238	482	44	65	88	108	204	416
70000	54	99	144	185	365	0	49	75	109	133	259	523	47	71	95	117	221	450
75000	58	107	155	199	393	0	52	83	117	144	280	564	50	76	106	126	238	484
80000	62	115	171	214	421	0	56	90	125	154	300	0	56	82	114	135	254	517
85000	68	123	183	228	448	0	59	96	133	165	320	0	59	87	122	144	271	550
90000	72	131	195	242	475	0	63	102	146	176	340	0	63	93	129	153	287	0
95000	77	138	207	256	502	0	68	108	155	186	360	0	67	98	137	162	303	0
100000	81	146	219	270	528	0	72	114	164	196	379	0	71	104	145	170	329	0

FILE SIZE (RECORDS)	24K STORAGE RECORD SIZE (BYTES)						32K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	1	1	3	1	1	1	1	1	2
2000	1	1	2	2	3	6	1	1	1	2	3	6
5000	3	3	4	5	9	19	3	3	4	5	9	18
10000	6	7	9	11	21	43	7	7	9	11	20	40
15000	9	11	16	18	33	69	10	12	15	18	32	65
20000	13	16	21	25	47	95	14	16	21	24	44	88
25000	16	21	28	33	60	119	17	20	27	30	58	117
30000	19	25	34	39	75	152	21	26	32	39	71	142
35000	23	31	40	49	89	179	25	30	40	46	84	167
40000	26	35	48	56	103	207	29	35	46	53	96	199
45000	31	40	55	64	117	233	32	40	53	60	113	227
50000	35	45	61	71	129	269	37	45	59	70	128	256
55000	39	49	68	78	149	300	40	51	65	78	142	283
60000	42	54	74	89	164	330	44	56	74	86	156	310
65000	45	61	80	98	180	359	49	61	80	94	170	336
70000	49	67	90	106	195	389	53	66	87	101	183	362
75000	53	72	97	114	209	417	57	71	94	109	196	404
80000	58	77	105	122	224	445	61	76	101	116	217	435
85000	62	82	112	130	238	473	66	80	108	128	233	465
90000	66	87	119	138	252	518	69	85	114	137	248	495
95000	70	92	126	146	266	0	73	93	121	145	264	0
100000	74	97	133	153	291	0	77	99	127	154	279	0

● Figure 75. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 30 KB/sec 9-Track Tapes. 4 Work Tapes. No Labels. (Submodel 5)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	2	2	4	9	1	1	1	1	3	6	1	1	1	1	2	5
2000	1	2	3	4	9	20	1	2	2	3	6	14	1	1	2	3	5	11
5000	3	6	10	12	25	57	3	5	7	9	18	38	3	5	6	8	16	34
10000	7	14	22	27	55	123	6	11	16	20	40	84	6	10	14	18	36	75
15000	12	23	36	44	90	190	10	18	26	33	66	137	10	16	23	28	55	115
20000	16	30	49	59	126	267	14	24	36	44	88	184	13	22	31	40	79	165
25000	20	41	61	79	161	340	18	32	46	59	118	245	18	29	42	51	101	210
30000	25	49	78	96	196	409	22	39	58	72	144	298	22	35	52	61	121	252
35000	30	58	93	113	229	0	27	46	69	84	169	349	25	43	61	76	150	310
40000	35	69	107	134	273	0	31	53	80	96	192	398	29	50	69	88	174	359
45000	39	79	120	154	311	0	35	62	90	114	228	0	34	56	82	100	197	407
50000	45	89	139	172	349	0	38	70	100	129	257	0	39	63	93	112	220	0
55000	50	98	155	191	386	0	44	78	116	143	284	0	43	69	103	123	243	0
60000	56	108	170	209	422	0	49	86	128	157	312	0	47	76	113	134	264	0
65000	61	117	186	227	457	0	53	93	139	170	338	0	51	86	122	152	299	0
70000	66	126	201	244	0	0	58	101	151	184	365	0	55	93	132	165	326	0
75000	70	135	216	261	0	0	62	108	162	197	390	0	59	101	141	178	352	0
80000	75	150	231	291	0	0	66	115	174	210	433	0	65	108	157	192	377	0
85000	80	161	245	312	0	0	71	128	185	233	0	0	70	115	168	205	402	0
90000	84	171	260	332	0	0	75	136	196	248	0	0	74	123	180	217	427	0
95000	93	182	274	352	0	0	79	145	206	264	0	0	79	130	191	230	0	0
100000	98	192	301	372	0	0	86	153	225	279	0	0	84	137	202	243	0	0

FILE SIZE (RECORDS)	24K STORAGE RECORD SIZE (BYTES)						32K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	1	2	4	1	1	1	1	2	4
2000	1	1	2	2	4	10	1	1	2	2	4	9
5000	3	4	6	7	14	29	3	4	5	6	12	26
10000	7	9	13	16	31	64	7	9	12	14	28	59
15000	10	14	21	25	49	103	11	15	20	24	46	96
20000	14	21	29	35	68	141	15	19	28	33	63	130
25000	18	26	38	44	86	178	19	26	35	44	84	174
30000	22	33	46	56	109	226	24	32	45	54	103	212
35000	25	39	53	67	130	268	28	38	53	63	121	249
40000	31	45	65	78	150	309	32	43	62	72	138	284
45000	35	51	74	88	169	348	36	51	70	86	164	338
50000	39	57	83	98	188	387	40	58	78	97	185	381
55000	43	63	92	107	216	0	45	64	90	108	206	0
60000	47	72	100	124	239	0	50	71	99	118	226	0
65000	51	79	108	135	261	0	54	77	108	128	246	0
70000	57	86	122	147	283	0	59	83	117	139	265	0
75000	62	92	132	158	305	0	63	89	127	149	283	0
80000	66	99	142	170	327	0	68	95	136	158	302	0
85000	70	105	152	181	348	0	73	105	144	176	337	0
90000	75	112	161	192	368	0	77	112	153	188	359	0
95000	80	118	171	202	389	0	82	119	161	200	382	0
100000	84	124	181	213	409	0	85	126	169	212	405	0

• Figure 76. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 7-Track Tapes. 5 Work Tapes. No Labels. (Submodel 5)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	2	4	8	1	1	1	1	3	6	1	1	1	1	2	5
2000	1	2	3	4	8	18	1	2	2	3	6	13	1	1	2	3	5	11
5000	3	6	9	11	23	52	3	5	7	9	17	37	3	4	6	8	16	33
10000	7	13	21	25	51	114	6	10	16	19	38	80	6	10	14	17	35	73
15000	11	21	33	41	84	176	10	17	25	31	63	131	10	15	23	27	54	111
20000	15	29	46	55	117	247	14	23	35	42	84	175	13	22	30	39	77	159
25000	19	38	57	74	150	314	17	31	44	56	113	233	17	28	41	49	98	202
30000	24	47	73	90	182	379	22	38	56	69	137	283	21	34	50	60	117	243
35000	29	55	87	105	212	459	26	45	67	81	161	332	25	42	59	73	145	299
40000	33	65	100	125	253	0	30	51	77	92	183	379	29	48	67	85	168	346
45000	37	74	112	143	289	0	34	60	87	109	218	0	34	55	80	97	191	392
50000	43	84	130	161	324	0	37	68	96	123	245	0	38	61	90	108	213	0
55000	48	93	145	178	358	0	43	76	111	137	271	0	42	68	100	119	234	0
60000	53	102	159	195	391	0	48	83	123	150	297	0	46	74	109	130	255	0
65000	58	110	174	211	424	0	52	90	134	163	323	0	50	83	119	147	289	0
70000	63	119	188	228	456	0	56	97	145	176	348	0	54	91	128	160	315	0
75000	68	127	202	243	0	0	61	104	156	189	372	0	58	98	137	173	340	0
80000	72	141	216	272	0	0	65	111	167	201	413	0	64	105	153	186	364	0
85000	77	152	229	291	0	0	69	123	178	223	442	0	69	113	164	199	389	0
90000	81	162	243	310	0	0	73	132	188	238	0	0	73	120	175	211	413	0
95000	89	171	256	328	0	0	77	140	198	253	0	0	78	127	185	223	437	0
100000	94	181	281	347	0	0	84	148	217	268	0	0	82	134	196	235	0	0

FILE SIZE (RECORDS)	24K STORAGE RECORD SIZE (BYTES)						32K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	1	2	4	1	1	1	1	2	4
2000	1	1	2	2	4	10	1	1	2	2	4	9
5000	3	4	6	7	13	28	3	4	5	6	12	26
10000	7	9	13	15	30	63	7	9	12	14	27	57
15000	10	14	20	25	48	100	11	15	20	24	45	94
20000	14	20	29	34	67	138	15	19	27	32	61	127
25000	18	26	37	44	84	173	19	26	35	43	82	170
30000	21	32	45	55	106	220	24	32	44	53	100	207
35000	25	39	52	66	127	261	27	37	52	62	118	243
40000	30	45	64	76	146	301	32	43	61	71	135	277
45000	35	50	73	86	166	340	35	51	69	84	160	330
50000	39	56	81	96	184	377	40	57	76	95	181	372
55000	43	62	90	105	211	0	45	63	88	106	201	0
60000	47	71	98	121	233	0	50	70	97	116	221	0
65000	51	78	106	133	256	0	54	76	106	126	240	0
70000	57	85	120	144	277	0	59	82	115	136	259	0
75000	61	91	129	155	298	0	63	88	124	146	277	0
80000	66	98	139	166	319	0	68	93	133	155	295	0
85000	70	104	149	177	340	0	73	103	142	173	329	0
90000	74	110	158	188	360	0	76	111	150	185	351	0
95000	79	116	168	198	380	0	81	117	158	196	374	0
100000	83	122	177	209	400	0	85	124	167	208	396	0

• Figure 77. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 9-Track Tapes. 5 Work Tapes. No Labels. (Submodel 5)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	1	3	6	1	1	1	1	2	4	1	1	1	1	1	3
2000	1	2	3	3	6	14	1	1	2	2	4	9	1	1	2	2	3	7
5000	3	5	7	9	18	39	2	4	5	6	12	25	2	3	4	5	10	21
10000	6	10	16	19	39	85	5	8	11	14	26	54	5	8	10	12	23	46
15000	10	17	26	32	63	131	9	13	18	22	43	88	9	12	16	19	35	71
20000	13	23	36	43	88	185	12	18	25	30	58	117	11	17	22	27	50	101
25000	16	31	45	57	113	235	15	24	32	40	77	156	15	21	29	34	64	129
30000	21	37	57	69	137	283	19	29	41	49	94	190	19	26	35	41	77	154
35000	25	44	68	81	160	342	22	34	48	58	110	222	22	31	42	51	95	190
40000	29	52	78	97	191	397	26	39	56	66	126	254	25	36	47	59	110	220
45000	32	59	88	110	218	451	29	46	63	78	149	300	29	41	56	67	125	250
50000	37	67	101	124	244	504	32	52	70	88	168	337	33	46	64	75	139	278
55000	42	74	113	137	270	0	37	58	80	98	186	374	36	51	70	82	153	306
60000	46	81	124	150	295	0	41	63	89	107	204	409	40	55	77	90	167	334
65000	50	88	135	163	320	0	44	69	97	116	221	444	43	62	84	101	189	379
70000	54	95	147	176	344	0	48	74	105	126	238	478	46	68	90	110	206	411
75000	58	101	157	188	383	0	52	79	113	134	255	0	50	73	97	119	222	444
80000	62	113	168	210	412	0	55	85	121	143	283	0	55	79	107	128	238	475
85000	66	121	179	224	440	0	59	94	128	159	303	0	59	84	115	137	254	0
90000	70	129	189	239	469	0	62	100	136	169	323	0	63	90	123	145	270	0
95000	76	136	199	253	497	0	66	106	143	180	342	0	66	95	130	153	286	0
100000	81	144	219	268	524	0	71	113	156	190	362	0	70	100	138	162	301	0

FILE SIZE (RECORDS)	24K STORAGE RECORD SIZE (BYTES)						32K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	1	1	2	1	1	1	1	1	2
2000	1	1	1	1	3	6	1	1	1	2	3	5
5000	3	3	4	5	8	17	3	3	4	4	8	16
10000	6	7	9	10	19	38	7	7	9	10	17	35
15000	9	10	14	17	30	61	10	11	14	16	29	57
20000	13	15	20	23	42	84	14	15	19	22	39	77
25000	16	19	26	30	53	105	17	20	25	29	52	103
30000	19	24	31	37	67	133	21	24	31	36	63	125
35000	22	29	36	44	80	158	24	28	37	42	75	147
40000	27	33	44	51	92	182	28	33	43	48	85	168
45000	30	38	50	58	104	206	32	39	48	57	101	200
50000	34	42	56	65	116	228	35	43	54	65	114	225
55000	38	46	63	71	133	263	40	48	62	72	127	250
60000	41	53	68	82	147	290	44	53	68	79	139	273
65000	44	58	74	89	160	317	48	57	75	86	151	297
70000	49	63	83	97	174	343	52	62	81	92	163	320
75000	53	68	90	104	187	369	56	67	87	99	175	343
80000	57	73	97	112	200	395	60	71	93	106	186	381
85000	61	77	103	119	213	420	64	78	99	117	207	408
90000	64	82	110	126	226	445	67	84	105	125	221	435
95000	68	87	116	133	239	0	71	89	111	133	235	0
100000	72	91	123	140	251	0	75	94	117	141	249	0

• Figure 78. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 30 KB/sec 9-Track Tapes. 5 Work Tapes. No Labels. (Submodel 5)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	2	4	11	1	1	1	1	3	6	1	1	1	1	2	5
2000	1	2	3	4	9	24	1	2	2	3	6	13	1	2	2	3	5	11
5000	3	6	9	13	27	72	3	5	7	9	18	40	3	4	6	8	15	32
10000	7	14	22	28	60	158	7	11	16	20	40	88	7	10	14	17	34	71
15000	12	22	35	42	92	240	10	17	26	31	62	135	10	16	22	28	55	115
20000	17	32	49	61	132	343	14	25	35	45	89	192	14	22	32	38	76	156
25000	21	41	63	77	167	0	19	31	47	57	113	244	18	28	41	48	99	204
30000	26	48	76	92	200	0	23	38	57	68	135	293	22	35	49	62	122	251
35000	30	60	89	115	247	0	26	47	67	84	167	358	27	42	61	74	144	296
40000	36	70	106	133	286	0	31	54	76	98	193	0	31	48	71	85	166	340
45000	42	79	122	151	324	0	36	62	92	111	219	0	35	54	80	95	186	0
50000	47	89	136	168	361	0	41	69	103	124	245	0	38	63	89	111	216	0
55000	52	97	151	185	398	0	45	76	114	137	269	0	42	70	98	123	241	0
60000	56	106	165	209	0	0	49	83	125	149	293	0	48	77	107	136	266	0
65000	61	121	179	229	0	0	53	94	136	169	333	0	53	84	122	149	290	0
70000	66	132	193	249	0	0	57	102	147	184	362	0	57	91	133	161	314	0
75000	74	142	214	269	0	0	61	110	157	199	390	0	62	98	144	173	337	0
80000	79	152	231	288	0	0	69	118	174	213	419	0	66	105	154	185	360	0
85000	85	162	247	307	0	0	74	127	187	228	0	0	71	111	165	196	383	0
90000	90	172	263	326	0	0	79	134	200	242	0	0	75	118	175	208	0	0
95000	96	182	279	344	0	0	83	142	212	256	0	0	79	124	185	219	0	0
100000	101	192	295	363	0	0	88	150	224	270	0	0	83	137	195	241	0	0

FILE SIZE (RECORDS)	24K STORAGE RECORD SIZE (BYTES)						32K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	1	2	4	1	1	1	1	2	3
2000	1	1	2	2	4	9	1	1	2	2	4	9
5000	3	4	6	7	13	27	1	4	5	6	12	25
10000	7	9	13	15	28	59	7	9	12	14	27	57
15000	10	14	21	24	47	98	11	14	19	22	41	86
20000	14	19	28	32	63	131	15	20	27	32	61	126
25000	17	26	35	44	85	176	19	25	35	41	77	159
30000	22	32	45	54	104	215	23	30	42	49	92	199
35000	26	37	54	63	122	252	27	37	49	61	116	238
40000	30	42	62	72	139	287	32	43	60	71	135	276
45000	34	51	70	86	166	341	36	49	68	81	153	312
50000	39	57	77	97	187	0	41	55	77	90	171	348
55000	44	64	90	108	207	0	45	60	85	99	188	0
60000	48	70	100	119	227	0	49	66	93	108	204	0
65000	53	76	109	129	247	0	53	75	101	124	234	0
70000	56	82	118	139	267	0	58	82	109	135	255	0
75000	61	88	127	149	285	0	64	89	116	146	275	0
80000	65	93	136	159	304	0	69	95	131	157	295	0
85000	69	104	145	177	339	0	74	101	141	167	315	0
90000	73	111	153	189	362	0	78	108	150	178	335	0
95000	77	119	162	201	384	0	83	114	159	188	354	0
100000	85	125	170	213	0	0	87	120	168	198	373	0

• Figure 79. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 7-Track Tapes. 6 Work Tapes. No Labels. (Submodel 5)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	2	4	10	1	1	1	1	2	6	1	1	1	1	2	5
2000	1	2	3	4	8	22	1	2	2	3	6	12	1	1	2	3	5	11
5000	3	6	9	12	25	65	3	5	7	9	17	38	3	4	6	7	15	31
10000	7	14	21	26	55	142	6	11	15	19	38	83	6	9	14	17	33	68
15000	11	21	32	39	84	215	10	16	25	30	59	127	10	15	21	27	53	110
20000	16	30	45	57	121	307	14	24	33	43	84	181	14	21	31	37	73	150
25000	20	38	59	72	153	388	18	30	45	54	107	230	18	28	39	46	95	196
30000	25	46	71	86	184	0	22	36	55	65	128	276	22	34	47	60	117	241
35000	29	57	83	107	227	0	26	45	64	81	159	338	26	41	59	71	139	284
40000	35	66	99	124	262	0	31	52	73	94	184	392	30	47	68	82	159	326
45000	40	74	113	140	297	0	35	59	88	106	209	0	34	53	78	92	179	367
50000	45	83	127	156	331	0	40	66	99	119	233	0	38	61	87	107	208	0
55000	49	91	141	172	365	0	44	73	109	131	256	0	42	68	95	119	232	0
60000	54	99	154	194	397	0	48	80	120	143	279	0	47	75	104	132	256	0
65000	59	114	167	213	0	0	52	90	130	161	316	0	52	82	119	144	279	0
70000	63	123	180	231	0	0	56	98	140	176	344	0	56	89	129	156	302	0
75000	71	133	200	250	0	0	60	106	150	190	371	0	61	95	139	167	324	0
80000	76	143	215	267	0	0	67	114	167	204	398	0	65	102	150	179	346	0
85000	81	152	230	285	0	0	72	122	179	217	425	0	69	108	160	190	368	0
90000	87	162	246	303	0	0	77	129	191	231	0	0	74	115	169	201	389	0
95000	92	171	260	320	0	0	81	137	203	245	0	0	78	121	179	212	0	0
100000	97	180	275	337	0	0	86	144	214	258	0	0	82	134	189	233	0	0

FILE SIZE (RECORDS)	24K STORAGE RECORD SIZE (BYTES)						32K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	1	2	4	1	1	1	1	2	3
2000	1	1	2	2	4	9	1	1	2	2	4	8
5000	3	4	6	6	12	26	1	4	5	6	12	25
10000	7	8	12	14	27	58	7	9	12	14	27	55
15000	10	14	20	24	46	95	11	14	19	22	40	84
20000	14	19	27	32	61	127	15	19	27	32	60	123
25000	17	26	34	43	83	171	19	25	34	40	76	155
30000	22	31	44	53	101	209	23	30	42	48	90	194
35000	26	37	53	62	119	244	26	37	48	60	114	233
40000	30	42	61	71	135	279	32	43	59	70	132	269
45000	34	50	68	84	162	332	36	49	67	79	149	305
50000	39	56	76	95	182	373	41	54	76	89	167	340
55000	44	63	88	106	202	0	45	59	84	98	183	0
60000	48	69	97	116	222	0	49	65	92	106	200	0
65000	52	75	107	126	241	0	53	74	99	122	229	0
70000	56	81	116	136	260	0	57	81	107	132	249	0
75000	60	86	124	146	278	0	63	88	114	143	269	0
80000	65	92	133	155	296	0	68	94	129	154	289	0
85000	68	103	142	173	330	0	74	100	139	164	308	0
90000	73	110	150	185	353	0	78	106	148	174	327	0
95000	76	117	158	196	375	0	83	112	157	184	346	0
100000	84	123	166	208	396	0	87	118	166	194	365	0

• Figure 80. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 9-Track Tapes. 6 Work Tapes. No Labels. (Submodel 5)

FILE SIZE (RECORDS)	8K STORAGE						12K STORAGE						16K STORAGE					
	RECORD SIZE (BYTES)						RECORD SIZE (BYTES)						RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	1	3	8	1	1	1	1	2	4	1	1	1	1	1	3
2000	1	2	3	3	6	18	1	1	2	2	4	9	1	1	1	2	3	7
5000	3	5	7	9	20	54	2	4	5	6	12	26	3	3	5	5	10	20
10000	6	11	16	20	44	118	6	8	11	14	27	58	6	7	10	12	22	45
15000	10	17	26	31	67	179	9	13	19	22	41	89	9	12	15	19	36	72
20000	14	25	36	45	96	256	12	19	25	31	59	127	12	16	23	26	49	98
25000	18	31	47	57	121	324	16	24	34	40	75	161	15	21	29	33	64	128
30000	22	37	56	68	145	388	19	28	41	48	90	193	19	26	34	43	79	157
35000	25	46	66	84	179	0	22	35	48	59	111	237	23	31	43	50	93	186
40000	31	54	79	98	207	0	27	41	55	68	129	275	26	36	50	58	107	213
45000	35	61	90	111	235	0	31	46	65	78	146	312	30	40	56	65	121	240
50000	39	68	101	123	262	0	35	52	73	87	163	348	33	47	63	76	140	278
55000	43	75	112	136	288	0	38	57	81	96	180	383	36	52	69	85	156	310
60000	47	81	123	154	314	0	42	62	89	104	195	418	41	58	75	93	172	341
65000	51	93	133	168	356	0	45	70	97	118	222	0	45	63	86	102	188	372
70000	55	101	143	183	387	0	49	77	105	128	241	0	49	68	94	110	203	402
75000	62	109	159	197	417	0	52	83	112	139	260	0	53	73	101	118	218	431
80000	67	117	171	211	447	0	58	89	124	149	279	0	57	78	108	127	233	0
85000	71	125	183	225	477	0	62	95	133	159	298	0	60	83	116	134	248	0
90000	76	132	195	239	0	0	67	101	142	169	316	0	64	88	123	142	262	0
95000	81	140	207	253	0	0	70	107	151	179	334	0	68	93	130	150	276	0
100000	85	147	219	266	0	0	75	112	160	188	352	0	71	102	137	165	304	0

FILE SIZE (RECORDS)	24K STORAGE						32K STORAGE					
	RECORD SIZE (BYTES)						RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	1	1	2	1	1	1	1	1	2
2000	1	1	1	2	3	6	1	1	1	1	2	5
5000	3	3	4	4	8	16	1	3	4	4	8	15
10000	6	7	9	10	18	36	7	7	9	10	17	34
15000	9	11	14	16	30	59	10	11	14	15	26	51
20000	13	15	20	22	40	79	14	15	19	22	38	75
25000	15	20	24	30	54	106	17	19	25	28	48	95
30000	20	24	32	36	65	130	21	23	30	33	58	119
35000	23	28	38	43	77	152	24	29	35	42	72	142
40000	27	32	43	49	87	173	29	33	42	48	84	164
45000	30	38	49	58	104	206	32	38	48	55	95	186
50000	34	43	54	66	117	232	37	42	54	61	106	207
55000	38	48	63	73	130	257	40	46	60	67	117	228
60000	42	52	69	80	143	282	44	50	66	73	127	259
65000	46	57	76	87	155	306	47	57	71	84	146	284
70000	49	61	82	94	167	330	51	62	76	91	159	309
75000	53	66	88	100	179	353	56	67	82	99	171	333
80000	57	70	95	107	191	376	61	72	92	106	184	357
85000	60	78	101	119	213	419	65	77	99	113	196	381
90000	64	83	107	127	227	0	69	82	105	120	208	404
95000	67	89	112	135	241	0	73	86	111	127	220	0
100000	73	94	118	143	255	0	77	91	118	134	232	0

• Figure 81. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 9-Track Tapes. 6 Work Tapes. No Labels. (Submodel 5)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	2	3	6	13	1	1	1	2	4	9	1	1	1	2	3	8
2000	1	3	5	6	13	29	1	2	4	4	9	21	1	2	3	4	8	18
5000	4	9	14	18	38	82	4	7	11	13	27	61	3	6	9	12	23	52
10000	9	20	32	39	86	179	8	15	24	29	62	133	7	13	21	25	54	114
15000	15	32	51	63	135	283	12	25	38	47	99	211	12	22	34	41	86	183
20000	21	43	69	88	185	383	17	33	52	66	135	292	17	30	46	58	118	255
25000	27	57	90	112	240	499	22	44	68	84	176	374	21	40	61	74	155	325
30000	32	69	110	139	292	605	28	54	83	105	215	452	26	48	74	93	189	402
35000	39	81	129	165	343	725	33	65	100	125	252	547	31	58	90	111	221	478
40000	45	97	153	190	404	0	38	75	117	144	299	632	36	68	104	127	264	551
45000	51	110	174	214	460	0	43	86	133	162	340	715	41	77	118	148	300	622
50000	57	123	195	245	515	0	49	96	148	187	380	0	47	86	132	167	336	713
55000	65	135	215	273	569	0	55	108	164	208	420	0	52	98	149	185	370	0
60000	72	152	240	300	621	0	60	120	185	229	469	0	57	108	165	203	416	0
65000	78	166	263	326	692	0	66	131	202	249	514	0	62	118	181	221	455	0
70000	85	180	285	352	750	0	71	142	219	268	557	0	68	128	196	238	494	0
75000	91	194	307	377	809	0	76	152	236	295	601	0	73	137	211	263	532	0
80000	97	208	329	414	0	0	84	163	252	318	643	0	80	147	225	283	569	0
85000	106	221	350	443	0	0	90	173	268	340	685	0	85	156	240	303	606	0
90000	113	235	372	471	0	0	96	189	291	361	727	0	91	171	261	322	642	0
95000	120	254	392	499	0	0	101	201	310	383	0	0	96	181	277	341	695	0
100000	127	269	424	527	0	0	107	212	328	404	0	0	102	192	294	360	737	0

FILE SIZE (RECORDS)	24K STORAGE RECORD SIZE (BYTES)						32K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	1	3	7	1	1	1	1	3	6
2000	1	2	3	3	7	15	1	2	2	3	6	13
5000	4	5	8	10	21	45	3	5	8	9	19	41
10000	8	12	18	23	47	104	8	12	18	22	44	97
15000	12	20	30	38	76	166	13	19	28	35	71	155
20000	16	28	42	52	108	228	17	27	40	48	101	213
25000	21	36	54	68	138	297	22	36	50	64	129	279
30000	26	46	68	84	172	364	27	44	65	79	162	342
35000	31	54	81	98	205	428	31	52	76	95	193	401
40000	37	62	93	118	237	507	38	60	87	112	222	478
45000	42	73	109	134	268	578	43	70	103	127	258	545
50000	47	82	122	150	308	648	47	79	116	142	292	610
55000	52	91	136	166	343	0	53	88	129	161	325	0
60000	56	100	150	187	378	0	59	96	142	178	356	0
65000	63	108	163	205	411	0	64	104	154	195	387	0
70000	69	120	176	223	444	0	70	117	172	211	418	0
75000	74	130	195	240	477	0	76	126	186	228	463	0
80000	79	140	210	257	524	0	80	136	200	243	498	0
85000	85	150	225	274	562	0	86	145	214	259	533	0
90000	90	160	239	291	599	0	91	154	227	283	568	0
95000	95	169	253	315	635	0	96	163	240	301	601	0
100000	100	178	267	335	671	0	104	171	254	320	635	0

● Figure 82. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 7-Track Tapes. 3 Work Tapes. With Labels. (Submodel 5)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	2	3	6	12	1	1	1	2	4	9	1	1	1	2	3	8
2000	1	3	4	6	12	27	1	2	3	4	9	20	1	2	3	4	8	18
5000	4	8	13	17	36	77	3	7	10	13	26	58	3	6	9	11	23	51
10000	9	19	30	37	81	169	8	15	23	28	60	128	7	13	21	25	53	112
15000	14	30	48	60	127	266	12	24	37	46	95	203	12	22	33	40	84	178
20000	20	41	66	83	174	360	17	32	50	64	131	282	16	29	45	57	115	249
25000	26	54	85	106	225	469	22	43	66	82	170	360	21	39	59	73	151	317
30000	31	66	104	131	275	569	27	52	81	102	208	435	26	47	72	91	185	393
35000	38	77	122	156	323	681	32	63	97	121	244	527	31	57	88	108	216	466
40000	44	92	145	180	380	789	37	73	113	139	288	609	36	66	102	124	258	538
45000	49	104	165	203	433	0	42	83	129	157	328	689	40	76	116	144	293	607
50000	55	117	184	232	484	0	48	93	144	181	368	0	46	84	129	163	328	696
55000	63	129	204	258	535	0	54	105	159	201	406	0	52	96	146	181	361	0
60000	69	145	227	284	584	0	59	116	179	221	453	0	57	106	162	199	406	0
65000	75	158	249	308	651	0	65	127	196	241	496	0	62	115	177	216	444	0
70000	82	172	270	333	706	0	70	138	212	260	539	0	67	125	192	233	482	0
75000	88	185	291	357	761	0	75	148	229	286	580	0	72	135	206	258	519	0
80000	94	198	312	392	815	0	82	158	245	307	622	0	79	144	220	277	556	0
85000	102	211	332	419	0	0	88	169	260	329	662	0	84	153	235	296	592	0
90000	109	223	352	446	0	0	94	183	282	350	702	0	90	167	255	315	627	0
95000	116	241	372	472	0	0	99	195	300	371	742	0	95	178	272	334	679	0
100000	122	256	401	499	0	0	105	207	318	392	0	0	101	189	288	352	719	0

FILE SIZE (RECORDS)	24K STORAGE RECORD SIZE (BYTES)						32K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	1	3	7	1	1	1	1	3	6
2000	1	2	3	3	7	15	1	2	2	3	6	13
5000	4	5	8	10	21	44	3	5	7	9	19	40
10000	8	12	18	23	46	102	8	12	17	22	43	94
15000	12	19	29	37	75	162	13	19	27	35	70	152
20000	16	28	42	51	105	223	17	27	39	47	99	208
25000	21	35	53	67	135	290	22	35	49	63	126	273
30000	26	45	67	82	168	355	27	43	63	77	158	333
35000	31	53	79	96	200	418	31	51	75	93	188	391
40000	36	61	91	115	231	494	37	59	86	109	217	466
45000	41	71	106	132	261	564	43	69	101	124	252	532
50000	46	80	120	147	301	632	47	78	114	139	285	595
55000	51	89	134	162	335	0	52	86	126	158	317	0
60000	56	98	147	183	369	0	59	94	139	174	348	0
65000	62	106	159	201	402	0	64	102	151	191	378	0
70000	68	118	172	218	434	0	69	115	169	207	408	0
75000	73	128	191	235	465	0	75	124	182	223	453	0
80000	79	138	206	252	512	0	80	133	196	238	486	0
85000	84	147	220	268	549	0	85	142	210	254	521	0
90000	89	157	234	284	585	0	91	151	223	277	555	0
95000	94	166	248	309	620	0	95	160	236	295	587	0
100000	99	175	262	328	655	0	103	169	249	313	620	0

• Figure 83. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 9-Track Tapes. 3 Work Tapes. With Labels. (Submodel 5)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	2	4	8	1	1	1	1	3	6	1	1	1	1	2	5
2000	1	2	3	4	9	19	1	2	2	3	6	13	1	1	2	2	5	10
5000	3	6	10	12	25	54	3	5	7	8	17	37	3	4	6	7	14	30
10000	7	14	22	27	57	117	6	10	16	19	38	80	6	9	13	16	32	66
15000	12	22	34	42	89	185	10	17	25	30	61	128	9	15	22	26	52	106
20000	16	30	47	59	122	250	14	23	34	42	83	177	13	20	29	37	70	148
25000	21	40	61	75	158	326	17	30	44	54	108	227	17	27	39	46	92	189
30000	25	49	75	93	193	395	22	37	54	67	132	274	21	33	47	58	112	234
35000	30	57	88	111	227	473	26	44	65	80	155	331	25	40	57	69	132	278
40000	35	68	104	128	267	548	30	51	76	92	183	383	29	46	66	79	157	320
45000	40	77	118	144	304	622	34	58	86	103	209	433	32	52	75	92	178	361
50000	44	86	132	165	340	693	38	65	96	119	233	482	37	58	84	104	200	414
55000	50	95	146	183	376	778	43	74	106	133	258	548	41	66	95	115	220	460
60000	55	107	163	201	411	857	47	81	120	146	288	603	45	73	105	127	247	506
65000	61	117	179	219	457	0	51	89	131	158	315	657	49	79	115	138	271	550
70000	66	127	194	236	496	0	55	96	142	171	342	710	53	86	125	148	294	594
75000	70	136	209	253	534	0	59	104	153	188	368	762	57	93	134	164	316	636
80000	75	146	224	278	572	0	65	111	163	202	394	813	63	99	143	176	338	698
85000	82	155	238	297	610	0	70	118	174	216	420	0	67	105	153	189	360	747
90000	87	165	253	316	647	0	74	128	188	230	446	0	71	115	166	201	382	795
95000	93	178	267	335	683	0	79	136	200	244	471	0	76	122	176	213	413	0
100000	98	188	288	354	734	0	83	144	212	257	508	0	80	129	187	224	438	0

FILE SIZE (RECORDS)	24K STORAGE RECORD SIZE (BYTES)						32K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	1	2	4	1	1	1	1	2	3
2000	1	1	2	2	4	9	1	1	2	2	4	8
5000	3	4	5	6	13	26	3	4	5	6	12	24
10000	6	9	12	15	28	61	7	9	12	14	26	56
15000	10	14	19	24	46	96	11	14	18	23	43	91
20000	14	20	28	33	64	133	14	20	26	31	61	124
25000	18	25	35	43	82	173	19	25	33	41	77	163
30000	21	32	44	53	103	212	23	31	42	50	97	199
35000	26	37	52	62	122	249	26	37	50	61	116	233
40000	30	43	60	74	141	295	31	42	57	71	133	278
45000	34	50	70	85	160	336	36	50	68	81	155	317
50000	38	57	79	95	184	376	40	56	76	90	175	355
55000	42	63	88	104	205	416	44	62	84	103	194	392
60000	46	69	97	118	225	454	49	68	92	113	213	440
65000	51	75	105	129	245	509	53	73	100	124	232	482
70000	56	83	113	140	265	553	58	82	112	134	250	523
75000	60	90	125	151	284	596	63	88	121	145	277	564
80000	64	97	135	162	313	639	67	95	130	154	298	604
85000	69	103	145	172	335	681	71	101	139	164	319	643
90000	73	110	154	183	357	722	76	108	148	179	340	682
95000	77	116	163	198	379	0	79	114	156	191	360	0
100000	81	122	172	210	400	0	86	120	165	203	380	0

● Figure 84. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 30 KB/sec 9-Track Tapes. 3 Work Tapes. With Labels. (Submodel 5)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	2	2	5	10	1	1	1	1	3	7	1	1	1	1	3	6
2000	1	2	4	5	11	23	1	2	3	3	7	15	1	2	2	3	6	13
5000	3	7	11	14	31	66	3	5	8	10	20	45	3	5	7	9	18	39
10000	7	16	25	32	69	144	7	12	18	23	46	98	6	11	16	20	40	85
15000	12	24	39	50	109	227	11	19	29	36	72	150	10	17	26	31	64	136
20000	17	35	55	69	148	309	15	27	40	50	102	213	14	24	36	44	88	186
25000	22	44	70	87	192	400	19	35	52	65	129	269	18	31	46	56	111	233
30000	26	56	84	110	236	490	23	42	64	78	156	335	22	37	56	70	141	296
35000	31	66	103	130	278	0	28	49	75	95	191	398	26	46	66	84	167	350
40000	37	76	119	150	319	0	32	59	86	110	221	459	31	53	79	97	192	402
45000	42	86	135	169	370	0	36	67	102	125	251	0	35	60	91	110	217	452
50000	48	96	151	194	416	0	41	76	114	140	279	0	40	67	101	122	250	0
55000	52	110	166	216	462	0	46	84	127	154	307	0	44	74	112	140	278	0
60000	57	121	187	238	507	0	51	91	139	168	348	0	48	84	122	154	306	0
65000	62	132	205	259	551	0	55	99	151	190	381	0	52	92	133	169	334	0
70000	70	143	223	280	0	0	60	111	163	207	413	0	56	100	149	183	362	0
75000	75	154	240	301	0	0	64	120	174	223	445	0	62	108	161	197	388	0
80000	81	164	257	321	0	0	68	129	193	239	477	0	67	115	173	211	415	0
85000	86	175	274	341	0	0	75	138	207	255	508	0	72	123	185	224	441	0
90000	92	185	291	373	0	0	80	147	221	271	0	0	77	130	197	237	466	0
95000	97	202	307	396	0	0	85	155	234	287	0	0	81	138	208	250	512	0
100000	103	214	324	419	0	0	90	164	248	302	0	0	86	145	220	273	0	0

FILE SIZE (RECORDS)	24K STORAGE RECORD SIZE (BYTES)						32K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	1	2	5	1	1	1	1	2	4
2000	1	1	2	3	5	11	1	1	2	2	5	10
5000	3	4	6	8	16	33	3	5	6	7	14	30
10000	7	10	14	18	35	74	7	10	14	17	32	68
15000	11	16	23	27	56	119	11	16	21	27	53	111
20000	14	22	32	39	78	162	15	22	31	37	72	149
25000	19	29	41	50	98	211	20	27	39	48	95	199
30000	23	34	51	63	124	260	24	35	47	60	117	243
35000	27	42	59	75	148	307	28	42	59	71	138	285
40000	32	49	71	87	170	353	33	48	68	81	157	340
45000	36	56	82	99	192	397	38	54	77	95	187	389
50000	40	63	91	109	214	462	41	63	86	108	211	436
55000	44	69	101	125	247	0	46	70	94	120	234	0
60000	49	79	111	139	273	0	50	77	109	132	256	0
65000	53	86	120	152	298	0	56	84	119	144	279	0
70000	57	93	135	165	322	0	61	91	130	155	301	0
75000	63	101	146	177	346	0	66	97	140	167	322	0
80000	68	108	157	190	370	0	70	104	149	177	359	0
85000	73	115	168	202	393	0	75	110	159	197	384	0
90000	77	122	178	214	416	0	80	122	169	210	410	0
95000	82	129	189	226	456	0	84	129	178	224	435	0
100000	87	135	199	246	484	0	88	137	187	237	460	0

● Figure 85. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 7-Track Tapes. 4 Work Tapes. With Labels. (Submodel 5)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	2	2	4	9	1	1	1	1	3	7	1	1	1	1	3	6
2000	1	2	4	4	10	21	1	2	3	3	7	15	1	2	2	3	6	13
5000	3	7	10	13	29	61	3	5	8	9	19	43	3	5	7	9	17	38
10000	7	15	23	30	64	133	7	11	17	22	44	94	6	11	15	19	39	83
15000	12	23	37	47	101	210	11	19	28	34	69	143	10	16	25	30	62	131
20000	16	33	51	65	137	286	14	26	38	49	98	204	14	23	35	43	86	180
25000	21	42	66	81	178	370	19	34	50	62	124	258	18	30	45	55	108	225
30000	25	52	79	103	218	453	23	41	62	75	149	321	22	36	55	68	137	286
35000	30	62	97	122	257	533	27	48	72	91	183	381	26	45	64	82	162	338
40000	36	72	112	140	295	0	31	57	83	106	212	440	31	52	77	94	187	389
45000	41	81	127	158	342	0	35	65	98	121	241	497	35	59	88	107	210	437
50000	46	90	142	182	385	0	41	73	110	135	268	0	39	66	99	119	242	0
55000	50	104	156	202	428	0	45	81	122	149	295	0	43	72	109	136	270	0
60000	55	114	176	222	469	0	50	88	134	162	334	0	48	82	119	150	297	0
65000	60	125	193	242	511	0	54	96	146	183	366	0	52	90	129	164	324	0
70000	67	135	209	262	551	0	58	108	157	199	397	0	55	98	145	178	351	0
75000	72	145	225	281	0	0	63	116	168	215	427	0	62	105	157	191	377	0
80000	78	155	242	300	0	0	67	125	186	230	458	0	67	113	169	205	403	0
85000	83	165	258	319	0	0	73	133	200	246	488	0	71	120	180	218	428	0
90000	88	175	273	348	0	0	78	142	213	261	517	0	76	128	192	231	453	0
95000	93	190	289	370	0	0	83	150	226	276	0	0	80	135	203	244	497	0
100000	98	202	304	392	0	0	88	158	239	291	0	0	85	142	214	266	0	0

FILE SIZE (RECORDS)	24K STORAGE RECORD SIZE (BYTES)						32K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	1	2	5	1	1	1	1	2	4
2000	1	1	2	3	5	11	1	1	2	2	5	10
5000	3	4	6	8	15	33	3	5	6	7	14	30
10000	7	10	14	17	34	72	7	10	13	16	32	66
15000	10	15	22	27	55	116	11	16	21	26	52	108
20000	14	22	32	39	76	159	15	22	30	36	70	145
25000	18	28	41	49	96	206	19	27	38	47	93	195
30000	22	34	50	62	121	254	24	35	46	59	114	237
35000	27	42	58	74	144	300	28	41	58	69	135	278
40000	31	49	70	85	167	344	33	47	67	80	154	332
45000	36	55	80	97	188	387	37	53	76	93	183	379
50000	40	62	90	107	209	451	41	62	84	106	206	426
55000	44	68	99	123	242	0	45	69	93	118	229	0
60000	48	77	108	136	266	0	50	76	107	129	251	0
65000	52	84	117	149	291	0	55	83	117	141	272	0
70000	57	92	132	161	315	0	60	89	127	152	294	0
75000	63	99	143	174	339	0	65	96	137	163	315	0
80000	67	106	154	186	361	0	69	102	146	174	350	0
85000	72	113	165	198	384	0	74	109	156	193	376	0
90000	77	120	175	210	407	0	79	120	165	206	401	0
95000	81	127	185	221	446	0	83	127	175	219	425	0
100000	86	133	195	241	473	0	88	135	184	232	450	0

• Figure 86. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 9-Track Tapes. 4 Work Tapes. With Labels. (Submodel 5)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	2	3	7	1	1	1	1	2	4	1	1	1	1	2	3
2000	1	2	3	3	7	16	1	1	2	2	5	9	1	1	2	2	4	8
5000	3	5	8	10	22	46	3	4	6	7	13	28	3	4	5	6	11	23
10000	6	12	18	22	48	99	6	8	12	15	30	61	5	8	11	13	25	51
15000	10	18	28	35	76	156	9	14	20	24	46	93	9	12	17	20	40	82
20000	14	26	39	49	103	213	12	19	27	34	65	132	12	17	24	29	55	112
25000	18	33	50	61	134	276	16	25	35	43	82	167	15	22	31	37	69	140
30000	21	41	60	77	164	337	19	30	43	52	99	208	18	26	38	46	87	178
35000	25	48	73	92	194	397	23	35	51	63	121	247	22	32	44	55	103	211
40000	30	56	85	106	222	455	26	42	58	73	141	285	26	38	53	63	119	242
45000	34	63	96	119	257	527	29	48	69	83	159	322	29	43	60	71	134	272
50000	38	70	107	137	290	593	34	54	77	93	178	358	33	48	68	79	154	315
55000	42	81	118	152	322	0	38	60	86	102	195	408	36	52	75	91	171	351
60000	46	89	133	168	353	0	41	65	94	112	221	449	40	59	82	100	189	385
65000	50	97	146	183	384	0	45	70	102	126	242	490	43	65	88	110	206	419
70000	56	105	158	197	415	0	48	79	110	137	263	531	46	71	99	119	223	453
75000	61	113	170	212	444	0	52	86	118	148	283	571	51	76	107	128	239	486
80000	65	121	182	226	474	0	55	92	130	159	303	0	55	82	115	137	256	519
85000	69	128	195	241	520	0	61	98	140	169	323	0	59	87	123	146	272	550
90000	74	136	206	262	554	0	65	104	149	180	342	0	63	92	131	154	287	0
95000	78	148	218	279	588	0	69	110	158	190	361	0	66	97	139	163	315	0
100000	82	157	230	295	622	0	73	116	167	200	380	0	70	102	146	177	334	0

FILE SIZE (RECORDS)	24K STORAGE RECORD SIZE (BYTES)						32K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	1	1	3	1	1	1	1	1	2
2000	1	1	1	2	3	6	1	1	1	2	3	6
5000	3	3	4	5	9	20	3	4	4	5	9	18
10000	6	7	9	12	21	44	7	8	9	11	20	40
15000	9	11	15	18	34	70	10	12	15	18	32	65
20000	12	16	22	26	47	95	13	16	21	24	44	88
25000	16	21	28	33	60	124	17	20	26	32	58	117
30000	19	25	34	41	75	153	21	26	32	39	71	143
35000	23	31	40	49	90	180	24	31	40	46	84	167
40000	27	36	48	56	103	207	29	35	46	53	96	199
45000	31	40	54	64	117	233	33	40	52	62	114	228
50000	34	45	61	71	130	271	36	46	58	71	128	256
55000	38	50	67	81	150	302	40	51	64	79	142	284
60000	41	57	74	90	165	331	43	56	73	86	156	310
65000	45	62	80	98	180	361	48	61	80	94	170	336
70000	48	67	90	106	195	390	52	66	87	102	183	362
75000	53	72	97	115	210	418	57	71	94	109	196	405
80000	57	77	104	123	224	446	60	76	100	116	218	435
85000	61	82	111	131	238	490	64	81	107	129	234	466
90000	65	88	118	138	252	523	69	89	113	137	249	496
95000	69	92	125	146	276	0	72	94	119	146	264	0
100000	73	97	132	159	293	0	76	100	126	155	280	0

• Figure 87. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 30 KB/sec 9-Track Tapes. 4 Work Tapes. With Labels. (Submodel 5)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	2	2	5	12	1	1	1	1	3	6	1	1	1	1	2	5
2000	1	2	4	5	10	27	1	2	3	3	7	14	1	1	2	3	5	11
5000	3	7	11	14	31	79	3	5	8	9	18	41	3	5	6	8	16	35
10000	7	15	23	31	68	173	6	11	17	21	42	89	6	10	14	18	36	76
15000	12	24	38	47	103	268	10	18	27	33	66	138	10	16	24	28	55	121
20000	17	34	51	67	147	376	14	25	37	47	93	194	14	23	33	41	80	167
25000	22	43	68	85	186	0	18	33	49	60	119	248	18	29	43	52	102	210
30000	26	52	83	102	223	0	23	40	60	73	145	300	22	35	52	62	127	264
35000	31	64	97	126	275	0	26	46	71	85	169	349	25	43	61	77	151	313
40000	37	74	116	146	317	0	30	55	81	102	203	421	31	50	73	89	175	362
45000	42	84	132	165	359	0	34	63	91	117	231	0	35	57	84	101	198	409
50000	47	93	149	184	400	0	40	71	107	131	259	0	39	63	94	113	221	0
55000	52	103	164	202	440	0	44	79	119	144	286	0	43	70	104	124	243	0
60000	57	112	180	220	0	0	49	86	131	158	313	0	47	76	114	141	277	0
65000	62	127	195	250	0	0	53	94	142	171	339	0	51	87	123	155	303	0
70000	67	138	210	272	0	0	58	101	154	184	364	0	55	94	133	168	329	0
75000	74	149	225	293	0	0	62	113	165	206	409	0	61	102	148	181	355	0
80000	80	160	251	314	0	0	66	121	176	222	439	0	66	109	160	194	380	0
85000	86	171	269	335	0	0	70	130	187	237	0	0	71	117	171	207	405	0
90000	91	181	286	356	0	0	77	138	205	253	0	0	75	124	182	220	429	0
95000	97	192	303	376	0	0	82	147	219	268	0	0	80	131	193	232	0	0
100000	102	202	321	396	0	0	87	155	232	283	0	0	84	138	204	245	0	0

FILE SIZE (RECORDS)	24K STORAGE RECORD SIZE (BYTES)						32K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	1	2	4	1	1	1	1	2	4
2000	1	1	2	2	5	10	1	1	2	2	4	9
5000	3	4	6	7	14	29	3	4	6	6	12	26
10000	7	9	13	16	31	65	7	9	12	15	28	59
15000	10	15	20	25	50	104	11	15	20	24	47	97
20000	14	21	29	35	68	142	15	20	28	33	62	129
25000	18	26	38	44	86	177	19	27	35	44	84	174
30000	21	33	45	57	110	227	24	32	45	54	103	212
35000	26	39	56	67	130	269	27	38	53	63	121	249
40000	31	45	65	78	150	309	32	44	61	72	138	296
45000	35	51	74	88	170	349	36	52	69	86	165	339
50000	39	57	83	97	188	403	39	58	77	97	186	382
55000	43	66	91	113	218	0	45	65	89	108	206	0
60000	46	73	99	124	240	0	50	71	99	118	226	0
65000	50	79	107	136	263	0	54	77	108	129	246	0
70000	56	86	122	148	285	0	59	83	117	139	265	0
75000	61	93	132	159	306	0	63	89	126	149	284	0
80000	66	99	142	170	327	0	67	95	135	158	316	0
85000	70	106	152	181	348	0	72	106	144	177	339	0
90000	74	112	161	192	369	0	76	113	152	189	361	0
95000	79	118	171	202	389	0	80	120	160	201	384	0
100000	83	124	180	213	425	0	84	127	168	213	406	0

● Figure 88. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 7-Track Tapes. 5 Work Tapes. With Labels. (Submodel 5)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	2	2	4	11	1	1	1	1	3	6	1	1	1	1	2	5
2000	1	2	3	4	9	25	1	2	2	3	6	13	1	1	2	3	5	11
5000	3	6	10	13	28	71	3	5	7	9	17	39	3	5	6	8	16	33
10000	7	14	22	28	62	155	6	10	16	20	41	85	6	10	14	18	35	74
15000	11	22	35	43	94	240	10	17	26	32	63	132	10	15	23	27	54	116
20000	16	32	47	62	135	337	14	24	36	45	89	185	14	22	32	39	78	161
25000	21	40	64	79	170	429	18	31	47	57	114	236	18	28	42	50	98	203
30000	25	48	77	95	204	0	22	38	57	70	138	285	22	34	51	60	123	254
35000	29	60	91	116	251	0	26	45	68	81	161	332	25	42	59	75	146	302
40000	35	69	108	135	291	0	30	54	78	98	194	401	30	49	71	86	169	349
45000	40	79	123	153	329	0	33	61	87	112	221	0	34	55	81	98	192	394
50000	45	88	138	171	366	0	39	69	102	125	247	0	38	62	91	109	213	0
55000	50	97	153	188	403	0	43	76	114	138	273	0	43	68	101	120	234	0
60000	55	105	167	204	456	0	48	83	125	151	299	0	46	74	110	137	268	0
65000	59	119	182	232	0	0	52	90	137	164	324	0	50	85	120	150	293	0
70000	64	130	196	252	0	0	56	97	148	176	348	0	54	92	129	163	318	0
75000	71	140	209	272	0	0	60	109	158	198	390	0	60	100	144	176	343	0
80000	77	150	233	291	0	0	64	117	169	213	419	0	65	107	155	188	367	0
85000	82	160	250	310	0	0	69	125	179	227	448	0	70	114	166	201	391	0
90000	87	170	266	329	0	0	75	133	197	242	0	0	74	121	177	213	415	0
95000	93	180	282	348	0	0	80	141	210	257	0	0	79	128	188	225	438	0
100000	98	189	298	367	0	0	85	149	222	271	0	0	83	134	198	237	0	0

FILE SIZE (RECORDS)	24K STORAGE RECORD SIZE (BYTES)						32K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	1	2	4	1	1	1	1	2	4
2000	1	1	2	2	4	10	1	1	2	2	4	9
5000	3	4	6	7	13	28	3	4	5	6	12	26
10000	7	9	13	15	30	63	7	9	12	14	27	57
15000	10	15	20	25	49	101	11	15	20	24	46	94
20000	14	20	29	35	67	139	15	19	27	32	61	126
25000	18	26	37	44	84	173	18	26	34	43	82	170
30000	21	33	44	56	107	222	23	32	44	53	101	207
35000	26	39	55	66	127	263	27	38	52	62	118	243
40000	30	45	64	76	147	302	31	43	60	71	135	289
45000	34	51	73	86	166	340	35	51	68	84	161	331
50000	38	56	81	96	184	393	39	57	76	95	182	373
55000	42	65	90	110	213	0	45	64	87	106	202	0
60000	46	72	98	122	235	0	50	70	97	116	221	0
65000	50	78	105	133	257	0	54	76	106	126	240	0
70000	56	85	120	145	278	0	58	82	115	136	259	0
75000	61	91	129	156	299	0	63	88	124	146	277	0
80000	65	98	139	167	320	0	67	93	132	155	309	0
85000	69	104	149	178	340	0	71	104	141	174	331	0
90000	74	110	158	188	360	0	76	111	149	185	353	0
95000	78	116	168	198	380	0	79	118	157	197	375	0
100000	82	122	177	208	415	0	84	125	165	209	397	0

• Figure 89. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 9-Track Tapes. 5 Work Tapes. With Labels. (Submodel 5)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	1	3	9	1	1	1	1	2	4	1	1	1	1	1	3
2000	1	2	3	3	7	20	1	1	2	2	4	9	1	1	2	2	3	7
5000	3	5	8	10	22	59	2	4	5	6	12	26	2	3	4	6	10	21
10000	6	12	17	22	49	129	5	8	12	14	28	57	5	8	10	12	23	47
15000	10	18	28	34	74	200	9	13	19	23	43	88	9	12	16	19	35	74
20000	14	26	37	49	106	281	12	19	26	32	61	124	12	17	23	27	51	103
25000	18	32	50	62	134	357	15	24	34	41	78	158	15	21	30	35	64	129
30000	22	39	61	74	161	431	19	29	42	50	95	191	19	26	36	41	80	162
35000	25	48	72	91	198	0	22	34	49	58	110	223	22	32	42	52	96	192
40000	30	56	85	106	229	0	25	41	57	70	133	269	26	37	50	60	111	222
45000	35	63	97	120	260	0	28	47	64	80	151	306	29	42	57	68	126	251
50000	39	71	109	134	289	0	33	52	74	89	169	342	33	46	64	75	140	279
55000	43	78	121	147	318	0	37	58	83	99	187	377	36	51	71	83	154	307
60000	47	85	132	160	360	0	41	63	91	108	205	412	40	56	78	94	175	351
65000	51	96	144	182	394	0	44	69	99	117	222	446	43	63	85	104	192	383
70000	55	104	155	198	427	0	48	74	107	126	238	498	46	69	91	112	208	416
75000	61	113	165	213	460	0	51	83	115	141	267	0	52	75	102	121	224	447
80000	66	121	184	229	493	0	55	89	123	151	287	0	56	80	109	130	240	479
85000	71	129	197	244	525	0	58	95	130	162	307	0	59	85	117	139	256	0
90000	75	137	210	259	0	0	64	101	143	173	327	0	63	91	125	147	272	0
95000	80	145	223	274	0	0	68	107	152	183	346	0	67	96	132	155	287	0
100000	84	153	235	288	0	0	72	113	161	193	365	0	71	101	140	164	302	0

FILE SIZE (RECORDS)	24K STORAGE RECORD SIZE (BYTES)						32K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	1	1	3	1	1	1	1	1	2
2000	1	1	1	2	3	6	1	1	1	2	3	5
5000	3	3	4	5	8	17	3	3	4	4	8	16
10000	6	7	9	11	19	38	6	7	9	10	17	35
15000	9	11	14	17	31	61	10	11	14	16	29	57
20000	12	15	20	23	42	84	13	15	19	22	39	77
25000	15	19	26	30	53	105	17	20	24	29	52	103
30000	19	25	31	38	67	135	21	25	31	36	64	126
35000	22	29	38	45	80	159	24	29	37	42	75	147
40000	26	34	44	52	92	183	28	33	42	48	85	175
45000	30	38	50	58	104	206	31	39	48	57	102	201
50000	33	42	56	64	116	238	34	44	53	65	115	226
55000	37	48	62	74	134	265	40	48	61	72	127	250
60000	40	53	68	82	148	292	44	53	68	79	139	274
65000	43	58	73	90	161	319	47	58	74	86	151	297
70000	48	63	83	97	175	345	51	62	81	93	163	320
75000	53	68	90	105	188	371	55	67	87	99	175	343
80000	56	73	96	112	201	396	59	71	92	106	194	382
85000	60	78	103	119	214	421	63	79	99	118	208	409
90000	64	82	110	126	226	445	67	84	104	126	222	436
95000	67	87	116	133	239	0	70	89	110	134	236	0
100000	71	91	122	140	261	0	74	94	116	142	250	0

• Figure 90. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 30 KB/sec 9-Track Tapes. 5 Work Tapes. With Labels. (Submodel 5)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	2	2	5	12	1	1	1	1	3	6	1	1	1	1	2	5
2000	1	2	4	5	10	26	1	2	3	3	7	14	1	2	2	3	5	11
5000	4	7	11	14	28	73	3	5	8	9	19	41	3	4	6	8	15	32
10000	8	15	24	30	62	160	7	11	17	21	43	89	6	10	14	17	34	72
15000	12	24	36	48	100	254	10	18	27	33	67	141	10	16	23	28	56	116
20000	17	33	53	66	135	347	15	25	38	46	93	194	14	22	32	38	76	157
25000	22	44	67	86	177	0	19	32	48	58	118	245	18	29	41	51	100	207
30000	27	54	80	106	216	0	22	40	58	73	148	306	22	36	52	63	123	253
35000	33	63	99	125	255	0	27	48	68	87	176	364	26	42	62	74	145	298
40000	38	73	115	143	292	0	32	55	83	101	203	0	30	48	71	85	166	341
45000	43	82	130	161	327	0	36	62	94	114	230	0	34	54	80	95	194	0
50000	47	95	145	187	382	0	41	70	106	127	256	0	38	64	90	112	219	0
55000	52	106	159	208	425	0	45	76	117	139	282	0	44	71	98	125	243	0
60000	60	117	180	229	0	0	49	88	128	159	321	0	48	78	113	138	267	0
65000	65	127	197	250	0	0	53	96	138	174	351	0	53	85	124	150	291	0
70000	71	138	214	270	0	0	60	104	149	189	381	0	57	92	135	162	314	0
75000	76	148	231	290	0	0	64	112	167	204	411	0	61	99	145	174	337	0
80000	82	158	248	310	0	0	69	121	180	219	0	0	66	105	155	185	360	0
85000	87	168	264	329	0	0	74	128	193	233	0	0	70	112	166	197	382	0
90000	93	177	280	349	0	0	79	136	205	247	0	0	74	123	176	217	0	0
95000	98	195	296	381	0	0	84	144	218	261	0	0	78	131	186	231	0	0
100000	103	206	312	404	0	0	88	152	230	275	0	0	82	139	195	245	0	0

FILE SIZE (RECORDS)	24K STORAGE RECORD SIZE (BYTES)						32K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	1	2	4	1	1	1	1	2	3
2000	1	1	2	2	4	9	1	1	2	2	4	9
5000	3	4	6	6	13	26	1	4	5	6	12	25
10000	6	9	13	15	28	59	7	9	12	15	27	57
15000	10	15	21	24	47	98	11	15	19	22	41	91
20000	14	19	28	32	63	137	15	20	27	32	61	126
25000	19	26	35	44	86	176	19	25	35	41	77	159
30000	23	32	46	54	104	215	23	32	42	52	98	200
35000	26	37	54	63	122	251	26	38	49	61	117	239
40000	30	45	62	72	139	300	32	44	59	72	135	276
45000	34	51	70	87	167	343	37	49	68	81	153	313
50000	40	58	81	98	188	0	40	55	76	90	171	348
55000	44	64	91	108	208	0	45	60	85	99	188	0
60000	49	70	100	119	228	0	49	69	93	114	215	0
65000	53	76	109	129	248	0	53	76	100	125	236	0
70000	57	82	119	139	267	0	59	83	108	136	256	0
75000	61	88	127	149	286	0	64	89	122	147	276	0
80000	65	98	136	166	318	0	68	96	131	157	296	0
85000	69	105	145	178	341	0	73	102	141	168	316	0
90000	73	112	153	190	364	0	78	108	150	178	335	0
95000	80	119	162	202	387	0	82	114	159	188	354	0
100000	85	126	178	214	0	0	86	120	168	198	373	0

• Figure 91. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 7-Track Tapes. 6 Work Tapes. With Labels. (Submodel 5)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	2	4	10	1	1	1	1	3	6	1	1	1	1	2	5
2000	1	2	3	4	9	23	1	2	2	3	6	13	1	2	2	3	5	11
5000	3	6	10	13	26	66	3	5	7	9	18	38	3	4	6	7	15	31
10000	7	14	22	28	57	143	7	11	16	20	40	84	6	10	14	17	33	69
15000	12	23	34	45	92	228	10	17	25	32	64	133	10	16	22	27	54	112
20000	16	31	49	61	124	311	14	24	36	44	88	183	14	21	31	37	73	150
25000	21	41	62	79	162	389	18	30	46	55	111	231	17	28	39	49	96	199
30000	26	50	74	98	199	0	22	39	56	70	139	289	22	35	50	61	118	243
35000	31	59	92	115	234	0	27	46	65	83	166	343	26	41	60	71	139	286
40000	36	68	106	132	268	0	31	53	79	96	192	396	30	47	69	82	159	327
45000	41	76	120	149	300	0	35	60	90	108	217	0	34	53	78	92	186	383
50000	45	89	134	173	350	0	40	67	101	121	242	0	37	62	87	108	210	0
55000	50	99	148	192	389	0	44	73	112	132	266	0	43	69	95	121	234	0
60000	57	109	167	212	428	0	48	84	122	152	303	0	47	76	109	133	257	0
65000	62	119	183	231	0	0	52	92	132	166	332	0	52	83	120	145	280	0
70000	68	129	199	249	0	0	58	100	142	180	360	0	56	90	130	156	302	0
75000	73	138	214	268	0	0	63	108	160	194	388	0	60	96	140	168	324	0
80000	78	148	230	286	0	0	68	116	172	208	416	0	65	102	150	179	346	0
85000	83	157	245	304	0	0	72	123	184	222	0	0	69	109	160	190	367	0
90000	88	166	260	321	0	0	77	131	196	235	0	0	73	120	170	210	405	0
95000	93	182	275	352	0	0	82	138	208	249	0	0	77	128	180	223	0	0
100000	98	193	290	373	0	0	86	146	219	262	0	0	81	135	189	236	0	0

FILE SIZE (RECORDS)	24K STORAGE RECORD SIZE (BYTES)						32K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	1	2	4	1	1	1	1	2	3
2000	1	1	2	2	4	9	1	1	2	2	4	8
5000	3	4	6	6	12	26	1	4	5	6	12	25
10000	6	9	12	14	27	57	7	9	12	14	27	55
15000	10	14	20	24	46	95	11	14	19	22	40	89
20000	14	19	27	32	61	133	15	20	27	32	60	123
25000	18	26	34	43	83	172	19	25	34	40	76	155
30000	23	31	45	53	102	209	23	31	41	51	95	195
35000	26	37	53	62	119	244	26	37	48	60	114	233
40000	30	44	61	71	136	291	32	43	58	70	132	270
45000	34	51	69	85	163	333	36	49	67	79	150	305
50000	39	57	79	96	183	374	40	54	75	89	167	340
55000	44	63	89	106	203	0	44	59	83	98	184	0
60000	48	69	98	116	222	0	49	68	91	112	210	0
65000	52	75	107	126	242	0	52	75	99	123	230	0
70000	56	81	116	136	260	0	58	81	106	133	251	0
75000	60	86	125	146	279	0	63	88	120	144	270	0
80000	64	97	134	163	310	0	67	94	129	154	290	0
85000	69	104	142	174	332	0	72	100	138	165	309	0
90000	72	111	150	186	355	0	77	107	147	174	328	0
95000	80	117	158	198	376	0	81	113	156	185	346	0
100000	84	124	174	209	398	0	86	119	165	195	365	0

• Figure 92. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 15 KB/sec 9-Track Tapes. 6 Work Tapes. With Labels. (Submodel 5)

FILE SIZE (RECORDS)	8K STORAGE RECORD SIZE (BYTES)						12K STORAGE RECORD SIZE (BYTES)						16K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	2	3	9	1	1	1	1	2	4	1	1	1	1	2	3
2000	1	2	3	4	7	19	1	1	2	2	4	9	1	1	2	2	4	7
5000	3	5	8	10	21	55	3	4	5	7	13	27	2	3	5	5	10	20
10000	7	12	18	22	45	120	6	9	12	15	29	59	6	7	10	12	22	45
15000	10	19	27	36	73	190	9	14	19	23	46	93	9	12	16	20	36	73
20000	14	26	39	49	98	259	12	19	27	32	63	128	12	16	23	26	49	98
25000	18	34	50	64	129	325	16	24	35	41	80	162	15	22	29	35	65	130
30000	23	41	60	79	157	411	19	30	42	51	100	202	19	27	36	43	80	159
35000	27	49	74	93	185	0	23	36	49	61	119	241	22	32	43	51	94	187
40000	32	56	86	107	212	0	27	42	59	70	138	278	26	36	50	58	107	214
45000	36	63	97	120	238	0	31	47	68	80	156	314	29	41	57	65	126	250
50000	40	73	108	139	278	0	34	52	76	89	173	349	33	48	63	77	142	282
55000	44	82	119	155	309	0	38	57	84	97	190	384	37	53	69	86	157	313
60000	50	90	135	170	339	0	41	66	91	112	217	437	41	59	79	94	173	344
65000	55	98	148	186	369	0	45	72	99	122	237	0	45	64	87	103	188	374
70000	59	106	160	201	398	0	51	78	106	133	258	0	49	69	94	111	203	404
75000	64	114	173	216	427	0	54	84	120	143	278	0	52	74	102	119	218	433
80000	69	122	185	230	456	0	59	90	129	153	297	0	56	79	109	127	233	0
85000	73	129	198	245	484	0	63	96	138	163	317	0	60	84	116	135	247	0
90000	78	137	210	259	0	0	67	102	147	173	336	0	63	92	123	148	272	0
95000	82	150	222	283	0	0	71	108	155	183	355	0	67	98	130	158	290	0
100000	86	159	234	300	0	0	75	114	164	192	374	0	70	104	137	167	307	0

FILE SIZE (RECORDS)	24K STORAGE RECORD SIZE (BYTES)						32K STORAGE RECORD SIZE (BYTES)					
	20	50	80	100	200	400	20	50	80	100	200	400
1000	1	1	1	1	1	2	1	1	1	1	1	2
2000	1	1	1	2	3	6	1	1	1	1	3	5
5000	3	3	4	4	8	16	1	3	4	4	8	15
10000	6	7	9	10	18	36	6	7	9	10	17	34
15000	9	11	15	17	30	59	10	11	14	15	26	54
20000	12	15	20	22	40	83	13	15	19	22	38	75
25000	16	20	24	30	54	107	17	19	24	28	48	95
30000	20	24	32	37	66	130	21	24	30	35	61	119
35000	23	28	38	43	77	152	23	29	34	42	73	142
40000	27	34	44	49	88	181	28	33	42	49	84	164
45000	30	39	49	59	105	207	32	38	48	55	96	186
50000	35	43	57	66	118	232	36	42	54	61	106	207
55000	39	48	63	73	131	257	40	46	59	67	117	228
60000	42	53	70	80	143	282	43	53	65	77	134	260
65000	46	57	76	87	156	306	47	58	70	85	147	285
70000	49	62	83	94	168	329	52	63	76	92	159	310
75000	53	66	89	101	180	352	56	68	85	99	172	334
80000	57	74	95	112	200	393	60	73	91	106	184	357
85000	60	79	101	120	214	420	64	77	98	113	197	381
90000	64	84	107	128	228	0	68	82	104	120	209	404
95000	70	89	113	136	242	0	72	87	111	127	220	0
100000	74	94	124	144	257	0	76	91	117	134	232	0

● Figure 93. Time Requirements (in minutes) for Sort/Merge Program. Data Transmission Rate: 30 KB/sec 9-Track Tapes. 6 Work Tapes. With Labels. (Submodel 5)

INDEX

READER'S COMMENT FORM

IBM System/360 Model 20
Tape Programming System
Performance Estimates

Form C24-9010-3

- How did you use this publication?

  As a reference source ..... ☐
  As a classroom text ..... ☐
  As a self-study text ..... ☐

- Based on your own experience, rate this publication . . .

	.....	.....	.....	.....	.....
As a reference source:	Very Good	Good	Fair	Poor	Very Poor
As a text:	Very Good	Good	Fair	Poor	Very Poor

- What is your occupation? .....

- We would appreciate your other comments; please give specific page and line references where appropriate. If you wish a reply, be sure to include your name and address.

- Thank you for your cooperation. No postage necessary if mailed in the U.S.A.

YOUR COMMENTS, PLEASE . . .

This SRL manual is part of a library that serves as a reference source for systems analysts, programmers and operators of IBM systems. Your answers to the questions on the back of this form, together with your comments, will help us produce better publications for your use. Each reply will be carefully reviewed by the persons responsible for writing and publishing this material. All comments and suggestions become the property of IBM.

Please note: Requests for copies of publications and for assistance in utilizing your IBM system should be directed to your IBM representative or to the IBM sales office serving your locality.

Fold

Fold

FIRST CLASS
PERMIT NO. 1359
WHITE PLAINS, N. Y.

BUSINESS REPLY MAIL

NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

POSTAGE WILL BE PAID BY . . .

IBM Corporation

112 East Post Road

White Plains, N. Y. 10601

Attention: Department 813 U

Fold

Fold

IBM

International Business Machines Corporation
Data Processing Division
112 East Post Road, White Plains, N.Y. 10601
[USA Only]

IBM World Trade Corporation
821 United Nations Plaza, New York, New York 10017
[International]

CUT ALONG THIS LINE

IBM System/360 Printed in U.S.A. C24-9010-3

IBM System/360 Printed in U.S.A. C24-9010-3

IBM®

International Business Machines Corporation
Data Processing Division
112 East Post Road, White Plains, N.Y. 10601
[USA Only]

IBM World Trade Corporation
821 United Nations Plaza, New York, New York 10017
[International]