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IBM 1410/7010 GENERALIZED TAPE SORTING PROGRAM

This Technical Newsletter amends the publication IBM 1410/7010 Operating System; Generalized Tape Sorting Program, Form C28-0354-2, to make changes concerning the Sort Common area, SIU input, linkage symbols, and other necessary changes and additions.

The attached replacement pages (7-8, 17-20, 27-28, 47-52) should be substituted for the corresponding pages now in the publication. Text changes are indicated by a vertical line to the left of the affected text; figure and table changes are indicated by a bullet (•) to the left of the affected figure/table caption.

Please file this cover letter at the back of the publication. It provides a method of determining if all changes have been received and incorporated into the publication.

Features and Specifications

Features of the Generalized Tape Sorting Program

To facilitate program scheduling within the Operating System, the Generalized Tape Sorting Program permits input from tape unit(s) on either channel or from the Standard Input Unit (SIU). The program will use any merge tape units specified by the user. Output of the sort program will be on one of the two merge files (see "Glossary") specified. The output file address will be placed in the IPI field (see the *System Monitor* publication) in the Resident Monitor for use as input by a subsequent program.

Data records may be unblocked or blocked fixed-length records, or unblocked or blocked variable-length records.

The blocking used during intermediate passes by the sort program is independent of the blocking of the input file, the blocking of the output file, and the number of records internally sorted at one time.

The control data word upon which the sort or merge program is based can consist of as many as ten control data fields. Maximum length of each such field is 999 characters. The control data fields can be contiguous or scattered throughout the record, but must not overlap.

In each phase a limited amount of core storage can be occupied by user-written subroutines.

Linkage points are provided at logical junctures in the program to facilitate the performance of non-sorting functions, such as the alteration, addition, deletion, summarization, expansion, or contraction of data records, and the activation of IOCS label and error exits for the user's special processing routines.

The merge order in the sort program can be from two to five in a balanced merge, or from one to five in an unbalanced merge; the desired merge order is communicated to the sort program via control cards. The merge order for the merge program can be from one to eight.

The program will sort in either ascending or descending standard BCD Interchange Code collating sequence, as specified in the control information supplied by the user.

The option of having checkpoints taken can be specified through the control information. These checkpoints are taken by means of the Resident IOCS checkpoint routine. Restart procedures are provided by the System Monitor.

Equipment Requirements

Basic Machine Requirements

The Generalized Tape Sorting Program requires either an IBM 1410 with 40,000, 60,000 or 80,000 positions of core storage and the Processing Overlap and Priority special features; or an IBM 7010 with 40,000, 60,000, 80,000 or 100,000 positions of core storage. One data transmission channel will satisfy the minimum requirements of the program. However, the program attains optimum efficiency when two data transmission channels are used; it will automatically take advantage of the overlap of reading and writing with processing made possible by having two channels.

Tape Unit Requirements

The required and optional tape units used by the program are shown in Figure 2. IBM 7330, 729 II, 729 IV, 729 V, and/or 729 VI Magnetic Tape Units can be used.

The four units (three if an unbalanced merge is used) required for the merging tapes, plus the unit required for the System Operating File, can be the five tape units (four if an unbalanced merge is used) specified as the minimum required for the

<u>Function</u>	<u>Number of Units Required</u>
Program Tape Unit (MJB)	One (Not required if the program is stored on the System Operating file, or on disk storage in a disk-oriented system.)
Merging Tape Units (for sort program only)	m tape units for each of two merge files, where m is the merge order employed in Phase 2 (a minimum of four tape units). If an unbalanced merge is used, m tape units for one merge file and m' tape units for the other merge file (a minimum of three tape units). The program will operate if all the tape units are on one channel. All the units for one merge file need not be on the same channel.
Sort Program Input Tape Unit(s)	One, for one reel of input; one or more, for two or more reels of input, on either channel. Merging tape units may be used. No input tape units are required if the input is from the SIU.
Merge Program Input Tape Unit(s)	One for each merge program input file (multiple units may be used for each file).
Sort Program Output Tape Unit(s)	None (merging tape units will be used for output from the sort program).
Merge Program Output Tape Unit(s)	One (multiple units may be used).

Figure 2. Tape Unit Requirements

Operating System. Any other tape units required during the operation of the program must be in addition to these. In a disk-oriented system, the four tape units (three if an unbalanced merge is used) required for the merging tapes must be in addition to the basic system requirements. A description of the Operating System machine requirements can be found in the publication *System Generation*.

Input Specifications

Input data may be unblocked or blocked fixed-length records, or unblocked or blocked variable-length records. The input file may be on any specified tape units or the svu.

Input Data-Record Formats

A detailed description of the required formats for input data records appears in the publication *Basic Input/Output Control System*. For the Generalized Tape Sorting Program, unblocked variable-length data records, with or without a Block Character-Count field, may also have Record Character-Counts specified. Form 3 fixed-length records must be handled by defining them to the sort or merge program as Form 1 records (the record length specified will include the four-position Block Character-Count field).

The program will accept data records containing any valid 1410/7010 characters, with the following restrictions:

1. A record mark can appear only as the last character of a record.
2. Group marks with word marks must never appear in a record, and group marks or word separator characters must not appear in the high-order position of any control data field.

The minimum permissible tape record length is 13 characters. The maximum permissible tape record length is 9,989 characters. If the sort program is run under control of the Tele-processing Supervisor, it is recommended that the maximum tape-record length be less than 3,000 characters. The user may specify on the SORTTYPE control card (see the "Program Operation" section) the maximum sort blocking or sort block length of tape records to be used during the Phase 2 merge passes of the sort program. The minimum permissible data-record length for variable-length records is 13 characters. The maximum permissible data-record length depends on available core storage in each of the three phases. The estimates of maximum data-record lengths shown in Figure 3 are based on the following assumptions:

1. No space has been reserved in any phase for added programming.

Merge Order	Maximum Data-Record Length (In Characters) Per Core-Storage Size			
	40,000 Positions of Core Storage	60,000 Positions of Core Storage	80,000 Positions of Core Storage	100,000 Positions of Core Storage
2	4,800	8,800	9,989	9,989
3	4,400	8,400	9,989	9,989
4	3,600	7,000	9,989	9,989
5	3,100	6,000	8,800	9,989
6*	2,800	5,300	7,800	9,989
7*	2,500	4,700	7,000	9,200
8*	2,300	4,300	6,300	8,300

* Merge program only

Figure 3. Maximum Sort Data-Record Length

2. Only single input areas are being used by the program.
3. The size of the Resident Monitor is 11,500 positions.
4. Single control data fields are specified.

Parity and Mode

Input data records can be read in even or odd parity, and can be read in Move or Load mode. Within the sort program, records are processed in the Load mode.

If input data records are read in the Load mode, there must be a word mark in the high-order position of each control data field specified; no other positions in a control data field can have word marks. The absence of a word mark in the high-order position of a control data field, or its presence in any other position of the field, can result in undetected sequencing errors.

If input data records are variable length and are read in the Load mode, there must be a word mark in the high-order position of the Block Character-Count field and the Record Character-Count field, if these fields are part of the record.

Sort Capacity

The maximum capacity of the sort program is one full reel of records at sort blocking less than the merge order ($m-1$, where m represents the merge order). In an unbalanced merge, m represents the larger of the two merge orders. While it may be possible to sort up to m full reels, successful completion of such a program cannot be assured. In an unbalanced merge, when the smaller of the merge orders is one, the maximum capacity is one full reel at sort blocking.

Output Specifications

Output records must conform to the same form, content and length specifications as input records. The sort program output file will be on one or more of the merge work tapes. For a merge program, the user specifies the symbolic unit on which the output file is to be written.

CARD TYPE	DESCRIPTION
SORTTYPE	This card is used to provide general information about the file to be sorted or the files to be merged, and the manner of processing.
INPUTFILE	This card supplies information pertaining to the input file.
OUTPUTFILE	This card supplies information pertaining to the output file.
CNTLFLDS	The control data fields upon which the sort or merge program will operate are indicated on this card.
LABELDES	The tape-label requirements of the input, merge and output files are described on this card. This card type is required <i>only</i> if tape labels are used.

In the following paragraphs, the parameters that can be used for each control card type are described. In each case, the parameter itself (parameter label, hyphen, and parameter value) is given, followed by an indication as to whether the parameter is required, optional, or required only under or for certain conditions. Following this is a description of the structure and use of the parameter.

If the contents of the parameter-value field are variable, an "n" is used to represent each position of the field. When the user is preparing the control cards, he must punch the appropriate value in this field. A capital letter in the parameter-value field is the specific code for that field.

SORTTYPE Parameters

RECLEN-nnnn (Required)

The parameter-value field is numeric, with a maximum length of four characters, and specifies the data-record length for fixed-length records, or the maximum data-record length for variable-length records, including the terminal record mark if specified in either case. (If the record length is changed by user modification, the parameter-value field must specify the length of the data records as processed by the program; if input is specified as SIU or 0000, the parameter value field must specify the length of the data record without terminal record marks.) The maximum and minimum values possible are specified in "Features and Specifications," under "Input and Output Specifications."

MERGEORD-n (Required)

The single-character parameter-value field is numeric, and specifies the merge order to be employed in a merge or sort using a balanced merge. If the program is a sort using an unbalanced merge, the field specifies the greater of the merge orders to be employed. For a sort, the value may be from two to five. For a merge, the value may be from one to eight.

UNBALANCED-n (Optional)

The single-character parameter-value field is numeric and specifies the lesser of the merge orders to be employed in a sort using an unbalanced merge. The value may be from one to four.

OPTIMB-n (Optional)

The single-character parameter-value field is alphabetic. This parameter applies to sort programs only. The sort will determine an optimum sort blocking factor (B) and internal sort size (G), based on core availability, merge order, an assumed random sequencing of the input file, the input blocking factor, the output blocking factor, data-record length, etc. If the user desires, he may use this parameter to influence the B and G calculations. The following parameter values can be used:

PARAMETER VALUE	MEANING
Y	Compute B and G, making B as large as possible while not reducing G to an inefficient point. This option might be specified if, for example, the input file is known to have a high degree of sequencing (see "Glossary"). In case a smaller G would not necessarily increase the number of Phase 2 merge passes but would reduce the Phase 1 processing time, the larger B would reduce the tape processing time. The effect would be a possible reduction of over-all sort time.
N	Compute B and G, making G as large as possible while not reducing B to an inefficient value. This option might be used if the input file was known to have some degree of inverse sequencing. The larger G may reduce the number of sequences produced by Phase 1, thereby possibly saving a Phase 2 merge pass.
M	This option instructs the sort to use the sort blocking factor specified by the SORTBLK parameter for fixed-length records, or the maximum sort block length specified by the BLKLEN parameter for variable-length records. If the value specified is found to be too large, the program will take the next largest value that can be used. One situation in which this option might be used would be where the sort was to operate in a system that included Tele-processing equipment; in this case, it might be desired that tape record lengths be limited.

SORTBLK-nnnn

(Required only with option "M" of the OPTIMB parameter, with fixed-length records)

The parameter-value field is numeric, with a maximum length of four characters. The user places the desired sort blocking factor in this field.

BLKLEN-nnnn

(Required only with option "M" of the OPTIMB parameter, with variable-length records)

The parameter-value field is numeric, with a maximum length of four characters. The user places the maximum sort block length desired in this field. This specified length must include the four-character Block Character-Count field.

CHKPOINT-Y (Optional)

This parameter is used to specify that the sort or merge program should activate its linkages to the IOCS checkpoint routine. "Y" is the only valid entry.

DESCEND-D (Optional)

This parameter is used to specify that the sort or merge program should arrange the output file in descending collating sequence. If the parameter is not provided, the file will be processed in ascending collating sequence. "D" is the only valid entry.

TAPEDEN-n (Optional)

The single-character parameter-value field is numeric, and specifies the density of the merge tapes being used. The following parameter values can be used:

PARAMETER VALUE	MEANING
2	200 characters per inch
5	556 characters per inch
8	800 characters per inch

If this parameter is not provided, a density of 556 characters per inch will be assumed.

UNLOAD-Y (Optional)

This parameter, used with a sort only, requests that the input and output merge tapes be rewound and unloaded at the completion of each pass in Phase 2. This option is of value in relatively large-volume sorts using 7330 tape drives; it forces high-speed rewinding of the drives at the end of each pass. "Y" is the only valid entry. If this option is not specified, the merge tapes will be rewound but not unloaded (i.e., option RRRR — see "REWIND" under "INPUTFILE Parameters").

1sIZMOD-nnnnn (Optional)

The parameter-value field is numeric, with a maximum length of five characters. This parameter is used to specify the total number of positions of core storage that will be reserved for added programming during execution of Phase 1 of a sort program; the actual number should be placed in the parameter-value field. This parameter should be used only if added programming is present during Phase 1.

2sIZMOD-nnnnn (Optional)

The parameter-value field is numeric, with a maximum length of five characters. This parameter is used to specify the total number of positions of core storage that will be reserved for added programming during execution of Phase 2 of a sort program; the actual number should be placed in the parameter-value field. This parameter should be used only if added programming is present during Phase 2.

3sIZMOD-nnnnn (Optional)

The parameter-value field is numeric, with a maximum length of five characters. This parameter is used to specify the total amount of core storage that will be reserved for added programming during execution of Phase 3 of a sort program; the actual number should be placed in the parameter-value field. This parameter

should be used only if added programming is present during Phase 3.

ERROPTION-n (Optional)

The single-character parameter-value field is alphabetic. This parameter allows the user to communicate to the IOCS, through the sort or merge program, the error option desired. The options are those offered by the ERROPTNS DTF entry of the IOCS.

The following parameter values can be used:

PARAMETER VALUE	MEANING
A	This parameter value will cause the IOCS to process all uncorrectable, erroneous records in the file as if they were error free (i.e., release them to the sort or merge program as the IOCS would release a record read into core storage without error).
S	This parameter value will cause the IOCS to read the next tape record into the same input area that contains the uncorrectable erroneous record, thereby destroying that record.

If this parameter is not included, the "A" value will be assumed.

CNSLMSG-Y (Optional)

This parameter is used to specify that the sort or merge program should issue console messages for messages 10310, 10321, and 10330, in addition to the information printed out on the SPR. The wording of each console message can be found under "Messages" in the "Program Operation" section.

INPUTFILE Parameters

RECFORM-n (Required)

The single-character parameter-value field is numeric, and specifies the record format. The parameter values (which generally correspond to IOCS Form definitions), and the nature of the record formats represented, are as follows:

PARAMETER VALUE	NATURE OF RECORD FORMAT
1	Unblocked fixed- or variable-length records that may or may not terminate in a record mark (Form 1 records). This parameter value should also be used for Form 3 fixed-length records.
2	Blocked fixed-length records. Each record <i>must</i> terminate in a record mark (Form 2 records).
3	Identical to Form 1 records, with the exception that the first four positions of every Form 3 record contain a Block Character-Count as specified by IOCS (Form 3 records). A "1" should be used for Form 3 fixed-length records.
4	Blocked variable-length records that contain a terminal record mark and a Record Character-Count, as specified by IOCS (Form 4 records). In addition, the first four positions of each block of Form 4 records contain a Block Character-Count.

INPBLKNG-nnnn (Required only for Form 1, 2 and 3 records)

The parameter-value field is numeric (unless the input is on the SIU), with a maximum length of four characters; it specifies the blocking factor of the input file for fixed-length records, indicates the type of unblocked variable-length records, or indicates that the input is on the SIU. The following parameter values can be used:

PARAMETER VALUE	TYPE OF RECORDS
0000	Unblocked, without terminal record marks (Form 1 or 3)
0001	Unblocked, with terminal record marks (Form 1 or 3)
SIU	The input is in the SIU and is unblocked, without terminal record marks (Form 1). (The parameters LENMODREC and RECFORM will be disregarded; the corresponding fields in Sort Common for these parameters and the INPBLKNG parameter will be set to conform to this type record.)

NOTE: When using SIU input, and the records are less than 80 characters, each record must terminate with a record mark that can be punched in the cards or added at modifying point P11.

(Number of Blocked, with terminal record marks (Form 2) Data Records)

This parameter is not used for Form 4 records.

BLKLEN-nnnn (Required only for Form 4 records)

The parameter-value field is numeric, with a maximum length of four characters. This parameter is required to specify the maximum input block length for Form 4 records only. The maximum input block length possible is described under "Input Specifications," in "Features and Specifications." This parameter is not used for Form 1, 2, or 3 records.

CHARCNTSIZ-n (Required only for Form 4 records)

The single-character parameter-value field is numeric, and specifies the number of characters in the Record Character-Count field, if present. This parameter is required for Form 4 data records. Since the sort or merge program can use a Record Character-Count field with Form 1 and 3 variable-length records to improve efficiency in processing wherever possible, this parameter is optional for records of those types. If used with Form 1 and 3 variable-length records, this parameter must be accompanied by the parameter LOCCHARCNT.

LOCCHARCNT-nnnn (Required only for Form 4 records)

The parameter-value field is numeric, with a maximum length of four characters. This parameter specifies the location of the low-order position of the Record Character-Count field (if present) in the record, relative to the beginning of the data record. This parameter is required with Form 4 data records, and is op-

tional with Forms 1 and 3 variable-length records. If this parameter is provided along with the parameter CHARCNTSIZ for Form 1 or Form 3 variable-length records, the program will use the Record Character-Count field to improve efficiency wherever possible.

LENMODREC-nnnn (Optional)

The parameter-value field is numeric, with a maximum length of four characters. This parameter specifies the input data-record length for fixed-length records or maximum input data-record length for variable-length records, if the length is changed through a Phase 1 modification. It is not required if the input data-record length is not changed. The minimum and maximum values possible are described under "Input Specifications," in "Features and Specifications."

FILESIZE-nnnnnnn (Optional)

The parameter-value field is numeric, with a maximum length of seven characters. This parameter specifies the total number of records (including padding records, if any) in the input file, if this information is known. When this parameter is specified, the general assignment routine will check to see whether or not this number of records will exceed sort capacity (the number of records that can fit on $m - 1$ tape reels at sort blocking), and the program will check to see if it has received the total number of records.

PARITY-n (Optional)

The single-character parameter-value field is alphabetic, and specifies the parity in which the input file is to be read. If the parameter is omitted, even parity will be assumed. The parameter values that can be used are as follows:

PARAMETER VALUE	MEANING
E	Even parity
O	Odd parity

MODE-n (Optional)

The single-character parameter-value field is alphabetic, and specifies the mode in which the input file is to be read. If the parameter is omitted, Move mode will be assumed. The parameter values that can be used are as follows:

PARAMETER VALUE	MEANING
M	Move mode
L	Load mode

REELCNT-nn (Optional)

The parameter-value field is numeric, and can be one or two characters. This parameter specifies to a sort program the number of reels of tape to be processed in the input file. If "99" is specified, a message is typed instructing the operator to enter the number of

reels of input to the sort program. If the REELCNT parameter is omitted, the sort will process input records until an end-of-file trailer label is recognized, or, with unlabeled files, until the first tape mark is reached. This parameter is valid only with a sort program.

1REELCNT-*nn* (Optional)

The parameter-value field is numeric, and can be one or two characters. This parameter specifies to a merge program the number of reels of tape to be processed in the first input file. If this parameter is omitted and a Y is entered in the sixth position of the MCHCKLBL parameter-value field (see "LABELDES Parameters"), the merge processes input records from this file until the end-of-file trailer label is recognized. If this parameter is omitted and Y is not entered (or if unlabeled tapes are used), the merge processes input records from this file only until the first tape mark is reached.

- 2REELCNT-*nn* (Optional) 6REELCNT-*nn* (Optional)
- 3REELCNT-*nn* (Optional) 7REELCNT-*nn* (Optional)
- 4REELCNT-*nn* (Optional) 8REELCNT-*nn* (Optional)
- 5REELCNT-*nn* (Optional)

Each of these parameters is identical in function to 1REELCNT-*nn* for the second through eighth input files, respectively. These parameters are valid only with a merge program. The number of these REELCNT parameters used must be equal to the number of input files.

REWIND-*nnnn* (Optional)

The four-character parameter-value field is alphabetic, and specifies the IOCS rewind options desired for the sort or merge input file(s).

Each of the four parameter-value characters must be one of the following:

PARAMETER VALUE	MEANING
R	Rewind the tape reels
U	Rewind and unload the tape reels
N	Take no action

The character in the first (left-hand) parameter-value field position causes the IOCS to perform the specified action (or no action) on the first reel of each input file, at the beginning of the reel. The character in the second position causes the IOCS to act on all subsequent reels of each file, at the beginning of each reel. The character in the third position causes the IOCS to act on all the reels of the file (except the last reel) when the end of each reel is reached. The character in the fourth position causes the IOCS to act on the last reel of each file when the end of that reel is reached.

If this parameter is included, all four selected characters must appear in the parameter-value field. If

the parameter is omitted, the options RRUU are assumed.

OUTPUTFILE Parameters

OUTBLKNG-*nnnn* (Required only for Form 1, 2 and 3 records)

The parameter-value field is numeric, with a maximum length of four characters. It either specifies the blocking factor of the output file for fixed-length records, or indicates the type of unblocked variable-length records. The parameter values that can be used are as follows:

PARAMETER VALUE	MEANING
0000	Unblocked, without terminal record marks (Form 1 or 3)
0001	Unblocked, with terminal record marks (Form 1 or 3)
(Number of Data Records)	Blocked, with terminal record marks (Form 2)

This parameter is not used for Form 4 records.

BLKLEN-*nnnn* (Required for Form 4 records only)

The parameter-value field is numeric, with a maximum length of four characters. This parameter is required to specify the maximum output block length for Form 4 variable-length records only. This length must include four positions for the Block Character-Count field. (Sort sets a plus sign in the low-order position of this Block Character-Count.) Maximum output block length possible is described under "Output Specifications," in "Features and Specifications." This parameter is not used for Form 1, 2, or 3 records.

LENMODREC-*nnnn* (Optional)

The parameter-value field is numeric, with a maximum length of four characters. This parameter specifies the *output* data-record length for fixed-length records or maximum *output* data-record length for variable-length records, if the length is changed through a Phase 3 or merge-program modification. It is not required if the output data-record length is not changed. The minimum and maximum values possible are described under "Output Specifications," in "Features and Specifications."

PADDING-*n* (Optional)

The single-character parameter-value field is numeric, and indicates the padding option desired with blocked fixed-length output records. For an ascending sort or merge, a low padding record is one consisting of all blank characters (except the terminal record mark) and a high padding record is one consisting of all nines (except for the terminal record mark). For a

- TTTT high padding records have been added.
UUUU low padding records have been added.
VVVV high padding records have been dropped.
WWWW low padding records have been dropped.
XXXXXXX records have been written on the output file.
YYYY high padding records are included in the output.
ZZZZ low padding records are included in the output.
The console message will be issued only if the user has specified the CNSLMSG-Y parameter in the SORTTYPE control card; otherwise, no message will be written on the console.
Action: None required.
- 10331 *Console:* 10331- OUTPUT CU
SPR: None
Explanation: "C" is the channel and "U" the unit of the first output reel.
Action: None required.
- 10332 *Console:* 10332 - LAST OUTPUT UNIT CU
SPR: None
Explanation: "C" is the channel, and "U" is the unit of the last output reel.
Action: None required.
- 20301 *Console:* 20301- . . . (Field) . . . (Assumed Value) . . .
SPR: 20301- SORT (MERGE) CONTROL INFORMATION CHANGED IF RUN GOES . . . (specific error) . . .
Explanation: The control card diagnostic routine has detected an error or inconsistency in the control data supplied by the user as indicated in the SPR message. If the option to continue the sort or merge is taken, the field indicated in the console message will be altered to the assumed value shown in the console message.
Action: Press INQUIRY REQUEST, then type:
\$31 - to accept the assumed value and continue execution.
\$32 - to reject the assumed value and cause the sort or merge to terminate as with a "cannot proceed" condition.
Press INQUIRY RELEASE. The typing of any other units digit will not break the waiting loop.
- 20302 *Console:* 20302- N GREATER THAN NMAX
SPR: 20302- N GREATER THAN NMAX
Explanation: The file size specified by the user is greater than the estimated maximum. If execution is continued, successful completion of the sort may be reached but cannot be guaranteed.
Action: Press INQUIRY REQUEST, then type:
\$31 - to continue with the sort.
\$32 - to cause the sort to terminate as with a "cannot proceed" condition.
Press INQUIRY RELEASE. The typing of any other units digit will not break the waiting loop.
- 20303 *Console:* 20303- REELCNT
SPR: None
Explanation: Control card information (REELCNT-99) indicated that the exact number of input reels are to be specified during execution of the sort program. The operator must now enter the number of reels to be sorted.
Action: Press INQUIRY REQUEST, then type:
\$31nn - where nn is the number of input reels to be sorted.
Press INQUIRY RELEASE.
- 20311 *Console:* 20311- XXXXXXXX.YYYYYYY
SPR: 20311- XXXXXXXX IN YYYYYYY OUT.
RECORD COUNT OFF
Explanation: In reconciling the Phase 1 record count (YYYYYYY) against the file size specified by the user (XXXXXXX), the counts were found to be unequal. This may be due to an incorrect file size being specified, operational failure, or the skipping of unreadable tape records when the SKIP option has been specified to the IOCS.
Action: Press INQUIRY REQUEST, then type:
\$31 - to accept the new record count (YYYYYYY) and continue processing.
\$32 - to cause the sort to terminate as with a "cannot proceed" condition.
Press INQUIRY RELEASE. The typing of any other units digit will not break the waiting loop.
- 20321 *Console:* 20321- XXXXXXXX.YYYYYYY
SPR: 20321- XXXXXXXX IN YYYYYYY OUT.
RECORD COUNT OFF
Explanation: In reconciling the record count at the end of a Phase 2 pass, the output count (YYYYYYY) was found to be unequal to the input count (XXXXXXX). This may be due to operational failure or the skipping of unreadable tape records when the SKIP option has been specified to the IOCS.
Action: Press INQUIRY REQUEST, then type:
\$31 - to accept the new record count (YYYYYYY) and continue processing.
\$32 - to cause the sort to terminate as with a "cannot proceed" condition.
Press INQUIRY RELEASE. The typing of any other units digit will not break the waiting loop.
- 20331 *Console:* 20331- XXXXXXXX.YYYYYYY
SPR: 20331- XXXXXXXX IN YYYYYYY OUT.
RECORD CNT OFF
Explanation: In reconciling the record count at the end of Phase 3 or a merge program, the output count (YYYYYYY) was found to be unequal to the input count (XXXXXXX). This may be due to an incorrect input file size being specified for the merge, operational failure, or the skipping of unreadable tape records when the SKIP option has been specified to the IOCS.
Action: Press INQUIRY REQUEST, then type:
\$31 - to accept the new record count and continue processing.
\$32 - to cause the sort or merge to terminate as with a "cannot proceed" condition.
Press INQUIRY RELEASE. The typing of any other units digit will not break the waiting loop.
- 30301 *Console:* 30301- . . . (Columns 16-20 of the card) . . .
SPR: 30301- NOT SORT CONTROL CARD . . . (card in question) . . .
Explanation: A card, read by the control card reading routine, does not contain the identification SORTb in columns 16-20.
Action: Press INQUIRY REQUEST, then type:
\$31 - to accept the card in question, and attempt to process it.
\$32 - to reject the card and cause the sort or merge to terminate as with a "cannot proceed" condition.
\$33 - to bypass the card and attempt to continue execution of the program.
Press INQUIRY RELEASE. The typing of any other units digit will not break the waiting loop.

Program Description

The following information on the Sort Definition program and the phases of the sort or merge programs created is provided to give the user a more detailed picture of the structure of these programs. This information is also necessary if user-written modification routines are to be included.

The Sort Definition Program

The Sort Definition program selects, from the set of modules provided, those modules necessary to produce the sort or merge program specified by the Sort Definition (DSORT) control card. It also prepares the Linkage Loader load cards that specify the symbolic units to be used by the sort or merge program, and indicate the type of program defined. The Monitor, upon reading an EXEQ (execute) card specifying the Sort Definition program, will load and execute the program.

Input to the Sort Definition program consists of the Sort Definition control cards and user routines to be added. The operational procedures are as follows:

1. The program reads the first card and scans it for its parameters.
2. The parameters, upon being identified, cause the setting or resetting of indicators in the program. These are preset to signify a fixed-length sort program with multiple control fields and without modifications (these parameters will be assumed if no parameters to the contrary are entered).
3. A table lookup is performed against the indicator set to find a key for the list of all necessary PHASE, BASE and CALLN statements to be included for the defined sort or merge program. (If user routines are to be included, a check is made before the writing of each statement on symbolic unit mw2 to see if the added routines should be included at that point. If they should, the cards on the su for the added routines are copied onto mw2.)
4. When the program completes the definition of a sort or merge program, it looks for the next pair of control cards on the su. If none is found, control is returned to the Monitor.

The Sort Definition program consists of the single module IBSRTDEFIN.

Phases of the Sort or Merge Programs

The sort programs produced, each "built" from several modules, are each divided into four phases. These are known as the *General Assignment Phase*, *Phase 1*, *Phase 2* and *Phase 3*. Merge programs consist of only the General Assignment Phase and Phase 3. Each phase will perform a specific function for the sort or merge program produced.

Figure 16 shows the modules that may be used for each phase in the sort/merge program(s) produced. Certain modules may be included and their alternates excluded, depending on the nature of the program desired and the data to be processed; i. e., the program may be a sort or merge program, the data may be of fixed- or variable-length, and there may be single or multiple control data fields.

General Assignment Phase

The General Assignment Phase does the initial house-keeping for the sort or merge program. This phase reserves the Sort Common area used by all phases of the sort. This area, which exists in core storage during the entire program, is then initialized with predetermined constants, and word marks are placed in the proper locations. The user's control cards are read, and the Common is further set up according to this data. Information in Common is checked for both validity and consistency. In a sort program, the last function of the General Assignment Phase is the calculation of B (sort blocking factor) and G (internal sort size) from the information in Common. Purpose of the B and G calculation is to optimize the sort with respect to both core storage and running time.

When these functions have been completed, the next phase is called in; this will be Phase 1 for a sort, or Phase 3 for a merge.

The modules that can be used by the General Assignment Phase are: COMAN, PRIME, CTLCD, GASSR, GASM3, and DUM00.

Phase 1

Phase 1 performs the initial sorting of the input file. This phase consists of two parts: the assignment program and the running program. Functions of each of these parts are described below.

LINKAGE SYMBOL	DESCRIPTION
SO65/	Address of an instruction which should be returned to if the user, in a Phase 3 or merge program modification routine at exit P32, lengthens, shortens, or alters a record in the user's work area. This instruction remains in core storage throughout Phase 3 or the merge.
SM62/	The core-storage location containing a word mark switch. The word mark is set by the sequence check in the merge network if the current record coming out of the merge is equal to the preceding record out. The program does not clear the word mark. The user must clear the word mark if the switch is being used. No other bit position in the character should be altered by the user. The one-position field remains in core storage throughout Phase 3 or the merge.
SIO1/	Address of an instruction to which the user's routine should branch if an unblocked, variable-length record is to be inserted in the output file during Phase 3 or the merge. This instruction remains in core storage throughout Phase 3 or the merge.
SIO2/	B-address of an instruction that sets a group mark with word mark at the end of an unblocked, variable-length record. This instruction remains in core storage throughout Phase 3 or the merge.
SI54/	Address of a seven-digit, unsigned numeric field used for counting the total number of data records processed by the output routine. This counter remains in core storage throughout Phase 3 or the merge.
SI55/	Address of an instruction which the user's routine in Phase 3 or the merge should return to if (1) the routine, located at exit P31, has summarized records or (2) the routine, located at exit point P32, has deleted a record in either the input area or the user's work area. The instruction remains in core storage throughout Phase 3 or the merge.
SIN5/	Address of an instruction to which the user's routine should return after inserting a blocked variable-length record into the output file. Reference may be made to this linkage symbol throughout Phase 3 or the merge.
SOKS/	Address of a four-digit, unsigned numeric field into which the user's routine must place the Record Character-Count of an inserted blocked, variable-length record. If the user is deleting a record, this field will contain the Record Character-Count of the record being deleted. The field remains in core storage throughout Phase 3 or the merge.
SI88/	Address of a five-digit, positively signed numeric field used for Form 4 records to determine whether or not the next record can fit in the output area. This field remains in core storage throughout Phase 3 or the merge.
SO08/	Address of a five-digit, positively signed numeric field that contains the maximum output block length for Form 4 records.

	This constant remains in core storage throughout Phase 3 or the merge.
SOPR/	Address of the high-order position (carriage-control character) of a 134-position print field which may be used by added programming routines. The last character of the field is a group mark with word mark. The word mark in the high-order position of the field must not be destroyed. Word marks should not appear in any other position in the field. The field remains in core storage throughout the execution of Phase 3 or the merge.
SO07/	Address of the output routine instruction issuing a write tape command. This field remains in core storage throughout Phase 3 or the merge.
SO10/	Address of a print routine which will accomplish the printing of the field at SOPR/. The first instruction of the routine is an SBR to the operand of the exit branch. The routine remains in core storage throughout the execution of Phase 3 or the merge.

Input/Output Modification

Because the sort or merge programs produced provide the user with access to the IOCS File Tables and IORW's, he can modify the IOCS error, tape-label, service, and end-of-file routines, if desired.

At specific sort or merge program exits, the user may either alter the contents of the input, merge, and output File Tables and IORW's, or may completely replace those provided with ones contained in his added programming. However, only certain fields are completely available to the user; the sort or merge program requires specific values in many of the fields to enable execution.

The full description of the arrangement and contents of the File Tables, File Table Extensions and IORW's is contained in the publication *Basic Input/Output Control System*. The following discussion assumes that the reader has an understanding of the information contained therein.

The sort or merge program uses the File Tables and IORW's in the Sort Common area as a basis for setting up those actually used when the program is executed. By modifying the common fields, the user is effectively modifying related fields used throughout the program. There is one File Table, one IORW and three File Table Extensions in Sort Common. The File Table and IORW are used to set up File Tables for the input, merge and output files in each phase of the program. They are set up, as desired, in the assignment routines and then moved to the working File Table and IORW areas. One tape-label File Table Extension is for the input file, one for the merge files, and one for the output files.

The following assumptions and requirements apply to the File Tables, File Table Extensions, and IORW's, as set up by the program:

1. They are initially set for no labels. This condition may be altered by LABELDES control card entries.

2. They are initially set for Move mode, even parity. This condition may be altered by control card entries.

3. All error conditions will be specified to be checked (except for WLR which is set during the running program to check for wrong-length-records on fixed-length records only).

4. All uncorrectable errors will be accepted. This condition may be altered by control card information to skip uncorrectable errors.

5. The rewind option RRUU is assumed for Phase 1 input and Phase 3 output, and RRRR for all the merge files. This condition may be changed by control card information.

6. The end-of-file address is set to the sort or merge program end-of-file routine. If the address is changed to a user address, the user's routine must save the sort or merge program address for the return to the running program.

7. The File Tables and File Table Extensions are set for Form 1 records and *must not be changed*. Any other entry will prevent proper execution of the program.

The contents of the fields contained in the File Table, File Table Extension and IORW areas are described in the "Sort Common Area" subsection. These descriptions also indicate whether a field may or may not be changed by the user.

Record Length Changes by the Sort or Merge Program

Under certain conditions, the General Assignment routines will alter Sort Common area fields that stipulate record and block lengths. The user must be aware of these changes if he is including modifications. For a sort program, the pertinent fields that may be changed are 11, 12, 13, 15, 17, 25, 27, 29, 31, 33, 35, 37, 39, 41 and 43. For a merge, the record-length field that may be changed is 13. The contents of the fields will indicate the length of the records or blocks as they appear after adjustment. For a description of the changes that may occur, consult the individual field descriptions in the "Sort Common Area" subsection.

Exit Point Descriptions

The exit points provided in the program are described in detail in this subsection. For a summary of the exit point locations and suggested uses, see Figure 18 in the "Execution of Added Programming" subsection. Significant conditions governing the use of each exit point are specified in the descriptions. In each case, the description is limited to covering those factors that

are essential to satisfactory program performance. To meet the user's individual requirements, each modification will, of course, include the additional instructions necessary. The programming technique to be used within the framework of the specifications for each exit is left to the discretion of the user.

The format used for the description of each of the exit points is as follows:

Description: Describes the location of the exit point.

Return Linkages: Describes the possible return points from the exit point.

Linkage Symbols: Lists those linkage symbols that may be referenced by the user's routine at the specific exit point.

Required Index Register Conditions: Specifies those index registers whose contents must be restored by the added programming, or left undisturbed.

Comments on Use: Describes some of the applications that may be performed at the exit point.

General Assignment Phase Exit Points

EXIT CAL

Description: This exit point provides access to an area in which the user may retain information throughout the execution of the sort or merge program. It is physically located below all the program routines, two positions above Sort Common.

Return Linkages: Routines executed in the CAL area can be entered only from a routine at one of the other exit points or from an IOCS exit. The return from these routines must, therefore, be provided by the routine from which it was entered, or through an SBR instruction.

Linkage Symbols: Routines in the CAL area have access to those linkage symbols which are available at the time the routines are relocated by the Linkage Loader. These include SBS1/, SBS2/, SMGA/, and SMCB/.

Required Index Register Conditions: The index register conditions that apply to routines executed in CAL are determined by when the routines are executed in the program. Routines in CAL that are branched to from other sort exit points must adhere to the restrictions at those points. If the routines in CAL are branched to from any other point, all index registers used should be saved and restored.

Comments on Use: The primary purpose of CAL is to provide the user with an area in which he may save constants, counters, and routines to be used

throughout the execution of a sort program. These may include, for example, the user's iocs tape-label, service, and error routines.

EXIT GA1

Description: This is the first General Assignment Phase exit point for either a sort or merge. It occurs following the initialization of common and prior to reading the sort control cards. Routines at this point are entered once and are executed in line after the preceding instructions.

Return Linkages: The normal return is to the next instruction following the routine. If the control card reading routine is to be bypassed, the return can be to the linkage symbol SMGA/. If the user wishes to bypass the routine that checks the Sort Common control information for validity and consistency, and in a sort, calculates B and G, the return can be to linkage symbol SMGB/ or to the user's added routine at exit point GA3.

Linkage Symbols: Routines at exit point GA1 may use linkage symbols SBS1/, SBS2/, SMGA/, and SMGB/.

Required Index Register Conditions: Routines at this exit point may use index registers 01 through 13 without having to save and restore the contents.

Comments on Use: The purpose of this exit point is to enable the user to supply his own control information in Sort Common, eliminating the necessity for reading some or all of the sort control cards. If the user completely sets up Sort Common himself he may bypass the common area checking and B and G calculation routine. This, however, should be done only if the user is familiar with all the functions and properties of the Sort Common area.

EXIT GA2

Description: If activated, this exit point occurs in the General Assignment Phase of both sort and merge programs. The exit point follows the routine that reads the sort control cards and sets up the control card information in the Sort Common area. It precedes the common area checking and B and G calculation routine. Routines at this point are entered once, and are executed in line after the preceding instructions.

Return Linkages: The normal return is to the next instruction following the routine. If the common area checking and B and G calculation routine is to be bypassed, the return can be to the linkage symbol SMGB/ or to the user's added routine at exit point GA3.

Linkage Symbols: Routines at exit point GA2 may use linkage symbols SBS1/, SBS2/, SMGA/, and SMGB/.

Required Index Register Conditions: Routines at GA2 may use index registers 01 through 13 without having to save and restore the contents.

Comments on Use: This exit may be used separately, or in conjunction with exits GA1 and GA3, to set up or modify the contents of Sort Common. Bypassing the common area checking routine should be done with caution.

EXIT GA3

Description: If activated, this exit point follows the execution of the General Assignment Phase of a sort or merge program, and is followed only by the link to the Resident Monitor to load the next phase. Routines at this point are entered once, and are executed in line after the preceding instructions.

Return Linkages: The normal return is to the next instruction following the routine.

Linkage Symbols: Routines at exit point GA3 may use linkage symbols SBS1/, SBS2/, SMGA/, and SMGB/.

Required Index Register Conditions: Routines at GA3 may use index registers 01 through 13 without having to save and restore the contents.

Comments on Use: This exit point is provided to enable the user to perform any final general assignment function prior to entering Phase 1 of the sort or merge program.

Phase 1 Exit Points

EXIT P11

Description: If activated, this exit point occurs at the point in the running program when each record is about to be moved from the input area to the Record Storage Area. Routines at this exit point are entered for each input record, and are executed in line after the preceding instructions.

Return Linkages: The normal return is to the next sequential instruction. If a record is deleted at this exit, the return should be to SO0T/. If a record is moved to the Record Storage Area by the user, the return should be to SI95/.

Linkage Symbols: In addition to the return linkage symbols, the added routine may refer to linkage symbols SBS1/, SBS2/, SOGY/, SOVC/, SIHA/, and SIHB/.

Required Index Register Conditions: At the time this exit is entered, the contents of index registers 11, 08, and 12 are as follows: Index register 11 contains the address of the high-order position of the current input record; index register 08 contains the address of the high-order position of the field in the Record Stor-

age Area to which the current input record is to be moved, and index register 12 contains the address of the high-order position of the last record moved to the output area from the Record Storage Area. (Until the record storage area is filled, this will not reference a valid record, and the B and A bits of the hundreds position of index register 08 will be present.) Index registers 08 and 11 may be altered as described under "Comments on Use." Routines at P11 may use index registers 01 through 04 without having to save and restore the contents. The contents of the other index registers must be saved and restored.

NOTE: If the input is specified as Form 1, variable length records with no record character count, index register 11 contains the address of the high-order position of the four-position record character count of the current input record. This record character count is added to the record by the sort program.

Comments on Use: To delete input records, the following functions must be performed:

1. Increment the counter at SIHA/ by one.
2. Add the sort record length of the data record being deleted to index register 11 (see Field 11). When SIU input is used, the user must add the actual record length including record mark to index register 11.
3. The return to the sort program must be an unconditional branch to so0r/.

The exit will be re-entered prior to moving the following record to the Record Storage Area. At least one record must be accepted into the sort.

To insert records into the sort, the following functions must be performed:

1. Increment the counter at SIHB/ by one.
2. Using an MRCWR instruction if the input is in Load mode, or an MRCR instruction if in Move mode, move the record from where it is located to the address "0+X8".
3. The return to the sort program must be an unconditional branch to sr95/.

The exit will be re-entered prior to moving the input record to the Record Storage Area, to enable the insertion of more than one record between records.

The user may alter or shorten records in the input area location specified in index register 11, and return via the next sequential instruction. If variable length records are being shortened, the user must adjust the Record Character-Count field before returning to the sort program.

To lengthen records (which requires the use of a work area) or use a work area to shorten or alter records, the following functions must be performed:

1. Using an MRCWR instruction if the input is in Load mode, or an MRCR instruction if the input is in

Move mode, move the record from the address "0+X11" to the work area.

2. If variable length records are being processed, adjust the Record Character-Count of the record being modified.

3. After performing the desired record modification, move the record to the address "0+X8", using the appropriate move operation specified above. If sru input is specified, the input record must be moved with an MRCM or MRCG instruction. The record will not have a terminal record mark in the input area. A group mark with word mark will stop the move. When the record is moved into the Record Storage Area, a terminal record mark must be placed on the record.

4. Add the input data-record length to index register 11. For input blocking parameter-0000, add the data-record length +1.

5. The return to the sort program must be an unconditional branch to sr95/.

EXIT P12

Description: If activated, this exit point occurs immediately after the loading of Phase 1 of a sort and before any assignment routines are executed. It is in core storage only during the assignment portion of Phase 1. Routines at this exit point are entered once, and are executed in line following the preceding instructions.

Return Linkages: The return from this exit point should be to the next sequential instruction.

Linkage Symbols: Routines at exit point P12 may use linkage symbols sbs1/, sbs2/, sogx/, and sovc/.

Required Index Register Conditions: Routines at P12 may use index registers 01 through 13 without having to save and restore the contents.

Comments on Use: This exit point is provided to facilitate execution of user assignment functions for Phase 1 modifications, prior to the execution of the Phase 1 assignment program.

EXIT P13

Description: Exit P13, if activated, is located in the Phase 1 assignment program at a point where the user may alter the File Table of the input file. Routines at this exit point are entered once, and will reside in core storage only during the execution of the assignment program. The routines are executed in line after the preceding instructions.

Return Linkages: The return from this exit point should be to the next sequential instruction.

Linkage Symbols: This exit point may refer to linkage symbols sbs1/, sbs2/, sogx/, sovc/.

Required Index Register Conditions: Routines at exit point P13 may use index registers 01 through 13 without having to save and restore the contents.

Comments on Use: The user may, at this exit point, modify the File Table, File Table Extension, and iorw in the Sort Common area to conform to the input file configuration required for his application. Following exit P13, the Phase 1 assignment program will move the File Table, File Table Extension, and iorw to their

respective running program areas. Prior to moving them, but after the exit, the assignment routine will perform the following:

1. A B bit will be placed in Sort Common Field 118 for wrong-length-record checking on fixed-length input.
2. The reel-count field will be moved in from its location in Sort Common.
3. Mode and parity will be set as specified in Sort Common.
4. The File Table Extension address in the File Table will be set.
5. The symbolic unit field will be moved in from Sort Common.
6. The File Table address will be set in the `IORW`, and the `IORW` address in the File Table.
7. The input area address will be set in the `IORW`.

EXIT P14

Description: This exit point, if activated, is located in the Phase 1 assignment program at a point where the user may alter the File Table to be used for the merge files in Phases 1, 2, and 3 of a sort. Routines at this exit point are entered once and reside in core storage only during execution of the assignment routines. The added programming is executed in line after the preceding instructions.

Return Linkages: The return from exit point P14 should be to the next sequential instruction.

Linkage Symbols: Routines at exit point P14 may use linkage symbols `sbs1`, `sbs2/`, `socy/`, and `sovc/`.

Required Index Register Conditions: Routines at exit point P14 may use index registers 01 through 13 without having to save and restore the contents.

Comments on Use: The comments on exit point P13, with the exception of item 1, apply to exit point P14 for modifying the File Table, File Table Extension, and `IORW` in the Sort Common area for the merge files in Phase 1, Phase 2, and Phase 3 of a sort.

Phase 3 and Merge Program Exit Points

EXIT P31

Description: This exit point, if activated, is positioned to provide the user access to each data record as it comes out of the merge network in Phase 3 or the merge program. In addition, the previous record to come out of the merge network is still available in the output area. Exit P31 resides in core storage throughout execution of Phase 3 or the merge program. Routines at this exit point are entered for each output data record after the first, and are executed in line after the preceding instructions.

Return Linkages: If the current record coming out of the merge network is to be summarized with the preceding record in the output area, the return to the merge should be to linkage symbol `si55/`. If not, the return should be to the next sequential instruction.

Linkage Symbols: Routines at exit point P31 may use linkage symbols `sbs1/`, `sbs2/`, `si55/`, `so26/`, `so30/`, `so65/`, `sm62/`, `so10/`, and `sopr/`.

Required Index Register Conditions: At the time routines at exit P31 are entered, index register 08 contains the address of the high-order position of the next record in the output sequence. Index register 12 contains the address of the high-order position of the previous data record out of the merge network. In a merge program, all index registers must be saved and restored. In a sort program, index registers 02 and 03 may be used without having to save and restore their contents.

Comments on Use: This exit point has been provided to enable data records to be summarized. The user may examine each record (other than the first) as it comes out of the merge network, in its proper final sequence, through the use of index register 08, which contains the address of the high-order position. The preceding record in the output file is also available. (The address of its high-order position is in index register 12.) If the current record is to be summarized with the preceding record and deleted, the following steps should be followed:

1. Increment the counter at `so30/` by one.
2. Add the data-record length to the address in index register 08 (sort data-record length if the program is a sort, input data-record length if the program is a merge).
3. Branch unconditionally to `si55/`.

To assist in the summarization of equal records, a word mark switch has been provided at the location `sm62/`. If the control data word of the current record out of the merge is equal to that of the preceding record out, the word mark will have been set by the sequence check in the merge network routine. The word mark, if set, is *not* cleared by the program and the user must provide the coding to clear it after interrogation.

Exit P31 occurs after the sequence check is performed by the program; therefore, the user must be sure that he does not inadvertently alter the sequence of the output file.

EXIT P32

Description: This exit point, if activated, occurs at the point in Phase 3 or the merge when the record is

about to be moved from the input area to the output area. Routines at this exit point are entered for each input record, and are executed in line after the preceding instructions.

Return Linkages: The normal return is to the next sequential instruction. If a record is inserted by routines at this exit, the return should be to so01/. If a record is deleted, in either the input or work areas, the return should be to si55/. If a user lengthens, shortens, or alters a record in his work area, the return should be to so65/. If a record is altered to the input area (i.e., user does not move the record to the output area), the return should be to the next sequential instruction.

Linkage Symbols: In addition to the return linkage symbols, the added routines may refer to linkage symbols sbs1/, sbs2/, si54/, si55/, si88/, sin5/, si01/, si02/, so07/, so10/, soks/, soo8/, and sopr/.

Required Index Register Conditions: At the time routines at exit P32 are entered, index register 08 contains the address of the high-order position of the next record in the output sequence. Index register 12 contains the address to which the next output record is to be moved. For a merge, all index registers must be saved and restored. For a sort, the contents of index registers 02 and 03 need not be restored; all the other index registers must be saved and restored.

Comments on Use: To *insert* a fixed-length record into the output file, the user's added routine must perform the following functions:

1. Determine whether or not a record should be inserted at the current point in the output file. If a record should be inserted, perform steps 2, 3, 4, and 5. If a record should not be inserted, branch to the next sequential sort program instruction.

2. Use one of the following two methods to move the record being inserted to the output area:

- a. If the input file was read in the Move mode, use an MRCR instruction to move the record from the user area to "0+X12" in the output area.

- b. If the input file was read in the Load mode, use an MRCWR instruction to move the record from the user area to "0+X12" in the output area.

3. Increment the counter at so26/ by one.

4. Increment the counter at si54/ by one.

5. Return to the sort or merge program via an unconditional branch to so01/. Use of this return enables the sort program to re-enter the exit prior to moving the current low record to the output area. Thus, more than one record can be inserted at the desired point in the output file.

If the output file consists of unblocked, variable-length records, the user's added routine for *inserting*

a variable-length record must perform the following functions:

1. Determine whether or not a record should be inserted at the current point in the output file. If a record should be inserted, perform steps 2, 3, 4, 5, 6, and 7. If a record should not be inserted, branch to the next sequential sort program instruction.

2. Make an unconditional branch to si01/. The return from this linkage symbol will be to the next sequential added routine instruction after the branch.

3. Use one of the two following methods to move the record being inserted to the output area:

- a. If the input file was read in the Move mode, use an MRCR instruction to move the record from the user area to "0+X12" in the output area.

- b. If the input file was read in the Load mode, use an MRCWR instruction to move the record from the user area to "0+X12" in the output area.

4. Store the B-address register in si02/.

5. Increment the counter at so26/ by one.

6. Increment the counter at si54/ by one.

7. Return to the sort program via an unconditional branch to sin5/. Use of this return enables the program to re-enter the exit prior to moving the current low record to the output area. Thus, more than one record can be inserted at the desired point in the output file.

If the output file consists of blocked, variable-length records, the user's routine for *inserting* a variable-length record must perform the following functions:

1. Determine whether or not a record should be inserted at the current point in the output file. If a record should be inserted, perform steps 2, 3, 4, 5, 6, 7, and 8. If a record should not be inserted, branch to the next sequential sort program instruction.

2. Add to si88/ the Record Character-Count of the record being inserted.

3. Compare soo8/ with si88/ and branch high to user-written instructions that must:

- a. Subtract the Record Character-Count (of the record to be inserted) from si88/.

- b. Branch unconditionally to so07/.

NOTE: The branch high in step 3 indicates that the record to be inserted could not fit in the current output block. After executing the instructions at so07/, the sort program re-enters exit P32. At this point the current input record is still available to the user's routine.

4. Using an MLNA instruction, move the Record Character-Count of the record being inserted to soks/.

5. Use one of the two following methods to move the record being inserted to the output area:

- a. If the input file was read in the Move mode,