IBM Systems Reference Library

Merge 7 Specifications and Operating Procedures
IBM 1401 and 1460

Program 1401-SM-061

This reference publication contains the
specifications and operating procedures for
the Merge 7 program. The Specifications
section describes the merging technique,
file requirements, exits for user program-
ming, and control cards.

   The Operating Procedures section in-
cludes a description of the Merge 7 program
deck, deck and system preparation, error
options, and a list of halts and messages.

   Schematics of Type A and Type B standard
tape labels are given in the Appendix.

   For a list of associated publications
and their abstracts, see the IBM 1401 and
1460 Bibliography, Form A24-1495.

SPECIFICATIONS

Merge 7 is a generalized tape-merging pro-
gram designed to operate on IBM 1401 and
1460 Data Processing Systems. Merge 7 can
be used to merge up to five sorted (ascend-
ing or descending sequence) tape files, each
of which can consist of up to nine tape
reels. Merge 7 can also be used to sequence-
check or reblock a single tape file.

The files are processed on the basis of
control data contained in up to ten control-
data fields. These control-data fields can
contain up to 999 characters. Control cards
prepared by the user modify the generalized
Merge 7 program to fit the requirements of
a specific merge application.

The Merge 7 program consists of an assign-
ment phase and a merge phase. The assign-
ment phase analyzes the control-card infor-
mation and then initializes and optimizes
the merge phase of the program. The merge
portion of the program combines the sorted
tape files into one file.

The Merge 7 program:

● Merges blocked or unblocked records.

● Merges fixed- or variable-length records.

● Merges according to control data con-
  tained in as many as ten fields of each
  record.

● Merges on either numeric or alphameric
  control data.

● Allows the user to insert routines that
  are to be executed during the Merge 7
  program run.

● Processes standard 120-character (Type A)
  and 80-character (Type B) header and
  trailer labels on the input file, if
  desired.

● Labels output tapes, if desired, in ac-
  cordance with control-card information.

● Reblocks a single file.

● Sequence-checks a single file without
  writing any output.

Note: In this publication, the term stand-
    ard tape labels (header or trailer) re-
    fers to Type A and Type B labels. The
    appendix to this publication contains
    schematics of Type A and Type B header
    and trailer labels.

MACHINE REQUIREMENTS

The minimum machine requirements for the
Merge 7 program are:

An IBM 1401 System with:

  8,000 positions of core storage
  Three IBM 7330, 729 II, 729 IV, or 729 V
    Magnetic Tape Units
  IBM 1402 Card Read-Punch
  IBM 1403 Printer Model 2, or IBM 1404
    Printer
  High-Low-Equal Compare special feature
  Advanced Programming special feature

An IBM 1460 System with:

  8,000 positions of core storage
  Three IBM 7330, 729 II, 729 IV, 729 V
    or 729 VI Magnetic Tape Units
  IBM 1402 Card Read-Punch
  IBM 1403 Printer Model 2
  Indexing and Store-Address-Register
    special features

The tape unit requirement depends on the
number of files to be merged. One unit is
required for the output file and for each
of the files to be merged. An additional
unit is required if unreadable record blocks
and wrong-length records are to be written
on tape.

Sense switches are required only if the
Print-Scan option is to be used for han-
dling input/output errors.

RELATED INFORMATION

The following SRL publications contain in-
formation that is related to the use of the
Merge 7 program:

  Input/Output Control System (on Tape)
Specifications and Operating Procedures for
IBM 1401 and 1460, Form C24-1462.

  Autocoder (on Tape) Specifications, IBM
1401 and 1460, Form C24-1434.

MERGING TECHNIQUE

The Merge 7 program is a single-pass program.
It operates as a two-, three-, four-, or
five-way merge, depending on the initial
number of input reels to be merged.

The merging technique used in the Merge
7 program consists of: reading into core
storage a number of records from each of

the two, three, four, or five input tape
files; comparing the control-data fields of
these records; and moving the appropriate
record to an output area. This process is
repeated until the output area is filled
with merged records. At this time, the rec-
ords in the output area are written on a
single output tape, and another merge opera-
tion is begun. When the output tape is
filled to capacity, the program stops and
rewinds the tape, permitting the operator
to mount another reel and resume operation.

USER PROGRAMMING FEATURE

Exits are provided at key points within the
main line and the input/output portions of
the program so that the user can set aside
areas for his exclusive use during the pro-
gram run.

User routines must be written in the 1401
and 1460 tape Autocoder language, assembled,
and punched into cards.

SEQUENCE-CHECK AND REBLOCKING FEATURES

A single-sorted file or the input tapes for
a merge run can be sequence-checked and/or
reblocked by the Merge 7 program. The user
specifies these options in control card 1.

If a record is found to be out of se-
quence and the user elects to continue
checking, the program proceeds as if the
record were in sequence and does not delete
it.

FILE REQUIREMENTS

This section discusses the general charac-
teristics of sorted files that can be proc-
essed by Merge 7. Records contained on
each input reel must be in even parity and
in the desired sequence. The maximum input
and output block sizes depend on the number
of files to be merged and on the core stor-
age available. See User Calculations.

ALLOWABLE RECORD CONFIGURATIONS

Merge 7 processes either fixed-length or
variable-length records. The program can
handle four different record formats. A
record mark following the last character
of each record is optional.

The following terms are used in the de-
scription of the acceptable formats:

Block Character Count Field

A four-character field at the beginning of
each block contains a count of the total

number of characters in the block, includ-
ing the four-character block character
count field itself. The count, which must
contain AB zone bits over the units position
of the field, is used for checking for wrong-
length record conditions.

Record Character Count Field

A record character count field of three or
four characters in each data record contains
a count of the number of characters in that
record, including itself. This field must
be in the same relative position in each
data record, and must be the same length in
each data record of a given file.

FORM-1 RECORDS: Form-1 records (Figure 1)
are fixed length and are written on tape
unblocked.
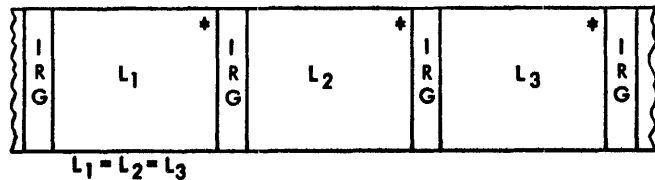
Figure 1. Form-1 Records

FORM-2 RECORDS: Form-2 records (Figure 2)
are fixed length and are written on tape in
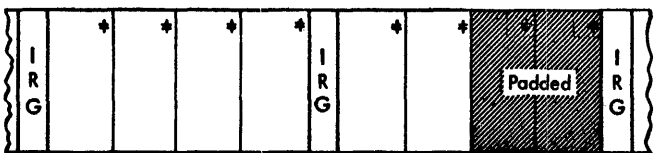blocks. Padding records must be added to
short-length blocks.

Figure 2. Form-2 Records

FORM-3 RECORDS: Form-3 records (Figures 3
and 4) are variable length and written on
tape unblocked. Each record can have a
Record Character Count (RCC) field.

If unblocked records without record
character count fields are specified for
input, a record character-count is calcu-
lated by Merge 7 for internal processing.

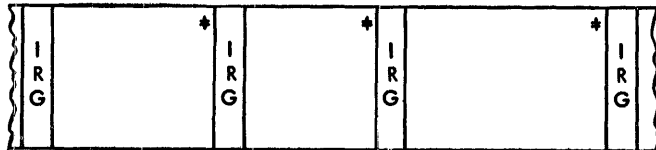Because this value is not added to the record, blocked output cannot be specified.

Figure 3. Form-3 Records without a Record-Character Count Field
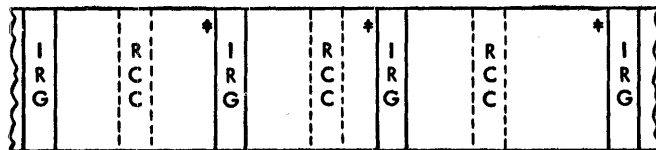
Figure 4. Form-3 Records with a Record-Character Count Field

FORM-4 RECORDS: Form-4 records (Figure 5) are variable length, and written on tape in blocks. Each record contains a record character-count field and each block contains a Block Character Count (BCC) field.
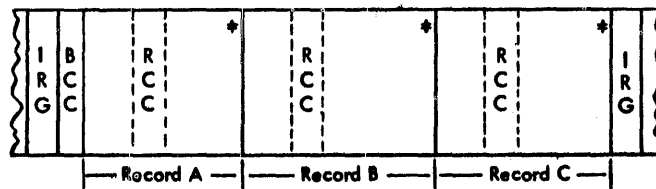
Figure 5. Form-4 Records

RESTRICTIONS: Records may contain any alphameric characters or special symbols except:

1. Tape mark as first character of a record.

2. Record mark within a record. A record mark as the last character of each record is permissible but not mandatory.

3. A group mark.

4. A word separator. It is possible to have a word-separator character on tape if the tape is to be read in load mode. In this case the word separator reads into storage as a word mark over the character it precedes on tape. This word mark must occur in either the high-order position of a control field, in the first position of the record, or, in the case of variable-length records, in the high-order position of the record character count field. Be certain that all control positions and the record length are specified correctly in this case.

CONTROL-DATA FIELDS

From one to ten fields of each input record can be specified to control the sequence of records. These fields can be located anywhere within the record provided they are in the same place in each record. The total length of all control-data fields may be as large as 999 characters.

The location of each control-data field must be specified by the user in the control cards. If more than one field is used, the user must specify which field is to be compared first, which second, and so forth.

PADDING

The term padding refers to records added to a merged output file when reblocking is wanted and the number of records is not a multiple of the output blocking factor. Padding records are composed of nines if ascending sequence, or blanks if descending sequence.

The user must specify the padding character in the control card if padding records are to be generated.

All input blocks must be the length of the input block size specified in the user's control card. If the last input block is a short block, the user is responsible for padding it.

TAPE DENSITY

The Merge 7 program processes input reels written in either high- or low-density mode. The final output reel or reels may be written in either density, although high density is recommended. The user need only set the density switch of the output tape unit to the density desired.

INPUT/OUTPUT MODE

Unless otherwise specified by the user in the control cards, the input tape(s) are assumed to be written in move mode. Tapes written in load mode can be processed by Merge 7 only if any word marks for the input data are in the high-order position of any control-data field, in the beginning of a record, or in the high-order position of the record character count field. Records with word marks in any other position, and written on tape in the load mode, cannot be processed.

Merge 7 writes the merged output on tape in either move or load mode, depending upon the needs of the user. An output file written in load mode contains word marks over: the high-order position of all control fields, the first character of each record, and the high-order position of the record character count field.

UNREADABLE INPUT RECORDS

Tape records or blocks are considered unreadable when they contain one or more characters that cause redundancy indications after one hundred attempts have been made to read them.

Input tape blocks that are unreadable may be treated in a variety of ways, depending upon information specified by the user in the control cards. The Merge 7 program:

1. Writes the unreadable block on tape

2. Punches it into cards or,

3. Prints the block on the printer.

If the user selects options 1 or 2, the program continues without halting and deletes the block as specified. If the third option is chosen (printing the block), the program halts after printing is complete. The user then can attempt to correct the block, or he can accept the block as read.

WRONG-LENGTH RECORDS

This program has been designed to detect wrong-length records when handling Form-1, Form-2 and Form-4 records. (See Allowable Record Configurations.) When Form-3 records are processed, no wrong-length record checking is done.

The option specified for a bad block is also used for a wrong-length record. Upon detection of a wrong-length record, the program prints a message stating that a wrong-length record has been detected and also indicates which tape unit it was read

from. The program halts. The operator must then press Start, and the program will continue in the same manner as it does if a bad block had been read. If the record read from tape is more than one character too long, the remaining characters will be truncated by the program. Therefore, the record written on tape (option 1), the record punched in a card (option 2), or the record printed on the printer (option 3) may not contain the full record from tape.

When Start is pressed, options 1 and 2 are automatic. The bad block is deleted from the merge and a new block read in from that tape. If trailer label checking is specified in column 24 of control card 1, the deletion of a bad block may cause the actual block count, calculated by the program, to be less than the trailer label block count. If the correct option (#3) is specified, the record and its location will be printed and the program will halt. Sense switch G is not used for a wrong-length record under option 3. The user must determine the error and correct it from the console. Upon correcting the error, or if the record is to be accepted as it appears, the operator need only press Start.

TAPE LABELS

Merge 7 can process standard 120-character (Type A) and standard 80-character (Type B) header and trailer tape labels. See the tape IOCS specifications publication for a description of tape label processing. The Appendix to this publication contains schematics of Type A and Type B header and trailer labels. The user can specify the kind of processing desired by means of the control cards.

Nonstandard header and trailer labels (not exceeding 120 characters in length) on the input tapes can be bypassed by Merge 7, or the labels can be processed by user routines. Exits are provided at convenience points to permit the inclusion of the user routines.

INPUT HEADER LABELS

The Merge 7 program, depending upon control-card information, either bypasses or checks standard header labels on the input tapes. The user can specify that full label-checking or checking of just the file name be performed on each input header label. The file serial number, reel-sequence number, file name, and creation date are checked when full label-checking is specified.

When the input tapes contain nonstandard header labels, the user must specify in the control cards that the input tapes contain

header labels and that label checking is not
to be performed. Then, if the user does
not insert a routine to process the non-
standard labels, the Merge 7 program by-
passes the header labels.

If the user specifies in the control
cards that the input tapes contain header
labels, then all input tapes must contain
a header label. A card, punched in the
control card 4 format, must be included for
each input file. The header labels on all
tapes must be in conformity with the user
specifications on the control cards.

OUTPUT HEADER LABELS

The user can specify that standard header
labels be written on the output tapes. The
user can further specify, in the control
cards, that these header labels contain
either the information from the header label
on the first input tape or information sup-
plied by the user in a control card.

The information in positions 1-80 of the
header label on the first input tape, with
the exception of the creation data, can be
duplicated in the header label written on
each output tape. The current date, which
must be punched in a control card, is writ-
ten in the creation-data field of the out-
put header labels.

If an entirely new standard header label
is to be written on the output tapes, the
user must punch the header-label information,
with the exception of the tape serial num-
ber, into a control card. The user has the
option of either punching a tape serial
number into the control card or having the
program place the tape serial number from
the output tape into the new header label.

INPUT TRAILER LABELS

Standard trailer labels on input tapes can
be either bypassed or processed by Merge 7.
If the user specifies that either 80-char-
acter or 120-character trailer labels are
to be processed, the label is read, the
label information is printed, and the block
count maintained by the program is compared
with the block count from the trailer label.

Nonstandard trailer labels can either be
bypassed; or as each label is read, either
the first 80 or 120 characters can be print-
ed as specified. The latter option must be
used if user processing is desired. The
processing of nonstandard labels must be
done by a user routine.

OUTPUT TRAILER LABELS

Merge 7 generates standard trailer labels
and writes them on the output tapes, if the
user so specifies. Each generated output
trailer label contains an end-of-reel or an
end-of-file indication and a block count
that is maintained by the program. Any fur-
ther output trailer-label processing must be
done by user-inserted routines.

LABEL ERROR PROCEDURES

The Merge 7 program prints each input tape
label the first time it is read. If an
error is detected when the program is check-
ing either an input header label or an out-
put header label, a message is printed and
the program halts. The user can then either
mount the correct tape and cause the program
to check the header label on this tape or
continue the operation with the incorrectly
labeled tape. In the latter case, the pro-
gram continues as if the tape were labeled
correctly.

Merge 7 halts if the program-generated
block count does not equal the block count
contained in the input trailer label being
checked. The user can then either accept
the program block count as valid and con-
tinue the operation, or check the input
tape by editing it or making a rerun.

USER CALCULATIONS

This section contains the formulas used to
determine the maximum block size and the
lowest position available for user routines.

MAXIMUM INPUT AND OUTPUT BLOCK SIZE

The maximum input and output block sizes for
a given file depend on the amount of avail-
able core storage and the order of merge to
be employed. Use the following formulas to
estimate maximum block lengths:

$$B_i L_{max} = \frac{ST - PS - UA - B_o L - 3(M + 1)}{M}$$

$$B_o L_{max} = ST - PS - UA - M(B_i L) - 3(M + 1)$$

Explanation of Symbols

$B_i L_{max}$ = maximum input block length.
$B_o L_{max}$ = maximum output block length.
$B_i L$ = user's specified input block length.
$B_o L$ = user's specified output block
           length.

ST   = highest addressable core position
        of the 1401 or 1460 system (15,999
        for 16K, 11,999 for 12K, 7,999
        for 8K)
PS   = core storage required by the Merge
        7 program (5,500)
UA   = number of storage positions re-
        quired by the user's program.
M   = the specified order of merge (equal
        to 1 during a run that is to se-
        quence-check or reblock a single
        input file).

Note: The maximum allowable input or out-
   put block length is 3,999 characters if
   the input file will be sequence-checked
   only or if the input file will be re-
   blocked in a two-way merge.

USER PROGRAMMING AREA

User-written routines must be loaded into
the upper positions of core storage that
are not required by Merge 7. The first
core-storage position available for user-
written routines can be calculated with the
following formula:

$$\text{Lowest position available} = PS + M(B_iL) + B_oL + 3(M + 1)$$

where:

PS   = the highest core-storage position
        required for the Merge 7 program
        instructions. This value is 5500.
M   = the order of merge
B_iL = the input block length if input is
        fixed-length records, or the length
        of the longest input block if input
        is variable-length records.
B_oL = the output block length if output
        is fixed-length records, or the
        maximum output block length if
        output is variable-length records.

   At object time, Merge 7 calculates and
prints the address of the lowest position
available for user programming.

USER PROGRAMMING

Nine exits, in the form of four-character
no-op instructions, are provided at various
points in the Merge 7 program. They permit
the insertion of user-written routines that
perform special functions. Each of these
no-op instructions can be changed easily
to an unconditional branch instruction that
causes a branch to the first instruction of
a user-written routine.

USER ROUTINES

A user routine should be written in 1401,
1460 tape Autocoder language and be as-
sembled by the tape Autocoder processor.
After the routine is assembled and a con-
densed object deck is punched, the first
three cards and the last card of the object
deck should be removed. These are the
clear-storage cards 1 and 2, the boot-strap
card, and the clear-and-branch card.

   The last instruction of each routine must
be a branch back to the next sequential
instruction of the Merge 7 program. Because
the Merge 7 program requires the advanced
programming special feature, the store B-
address register instruction can be used
to place the address of the next sequential
program instruction into the I-address of
the branch instruction at the end of the
user routine. If the symbolic label of the
branch instruction in the user routine were
LAST, an example of how the store B-address
register instruction is used would be as
shown in Figure 6.

   If the index registers, any DCW areas, or
the overflow latch are to be used during
execution of the user routine, the contents
of the register(s) must be saved, if so
specified in the description of the exit
being used. After the user routine has
been executed and before the branch back to
the next sequential instruction of the merge
program, the data that was saved must be
moved back into the proper areas.

INITIALIZATION OF EXITS

The exits in the Merge 7 program are initial-
ized by a patch card, which the user must
prepare. This card contains instructions

Label	Operation				
	S B R	L A S T+3			
	.	)			
	.	U S E R			
	.	⌐ ROUTINE			
	.	}			
	.				
LAST	B	O			

Figure 6.   Example Showing the Store B-Ad-
            dress Register Instruction

that replace the no-op instruction with a
branch instruction. The format of the
patch card is:

Column	Content	Explanation
1-4	BIII	This is the branch instruction that replaces the no-op. Punch the address (actual machine language) of the first instruction of of the user-written routine into the positions indicated by III.
5-39	Blank.	
40-46	L004XXX	This instruction loads the branch instruction from columns 1-4 of this card into core storage. The positions indicated by XXX contain the address (actual machine language) of the right-most position of the no-op instruction.
47-67	N000000N000000N000000	
68-71	1040	
72-80	Blank.	

Place each patch card in front of the
user-routine object deck with which it is
associated. Insert these cards in the
Merge 7 program deck according to the in-
structions found in the description of the
exit to be initialized.

USER-EXIT DESCRIPTIONS

The descriptions of the user exits show the
Merge 7 program-listing symbolic label of
the exit, the left-most core-storage loca-
tion of the exit, and the Merge 7 program-
listing sequence number of the exit.

1. Label--EXIT1, location 1592, sequence
    number 884. This exit is available in
    the output-tape end-of-file routine.
    The exit occurs after a tape mark has

been written on the output tape and be-
fore a trailer label, if required, is
assembled and written. This exit can be
used to write any desired information
on the output tape or to modify the out-
put tape or to modify the output trailer
label. The output trailer label can be
found in locations 0201 to 0280 (80-
character) or 0320 (120-character).

The contents of index register 2 must
be saved. Insert the patch card and
associated user-routine object deck into
the Merge 7 program deck between card
number 0611 and card number 0612 (col-
umns 72-75).

2. Label--EXIT2, location 4088, sequence
    number 1381. This exit is available in
    the routine that reads the input records.
    The exit occurs after a block of records
    has been read and the program has deter-
    mined that the block was read correctly.
    This exit can be used to update the
    records in the block or to modify the
    records. Index register 3 contains the
    core-storage address of the character
    that is one position to the left of the
    beginning of the input block that was
    just read.

The contents of index registers 1 and
2 must be saved. Insert the patch card
and associated user-routine object deck
into the Merge 7 program deck between
card number 0611 and card number 0612
(columns 72-75).

3. Label--EXIT3, location 4179, sequence
    number 1404. This exit is available
    in the routine that writes the output
    blocks on tape. The exit occurs before
    each output block is written on tape.
    It can be used to make any desired mod-
    ification to the output data. The ad-
    dress of the left-most core-storage
    position of the output block to be
    written can be found in locations 392
    to 394.

The contents of index registers 2 and
3 must be saved. Insert the patch card
and associated user-routine object deck
into the Merge 7 program deck between
card number 0611 and card number 0612
(columns 72-75).

4. Label--EXIT4, location 1653, sequence
    number 896 This exit is available
    after a trailer label has been written
    on the output tape. A tape mark has
    not been written following the label
    when this exit occurs. This exit can
    be used to write additional output
    trailer labels.

The contents of index register 2 must
be saved. Insert the patch card and

associated user-routine object deck into the Merge 7 program deck between card number 0611 and card number 0612 (columns 72-75).

5. Label--EXIT5, location 2397, sequence number 1034. This exit is available in the routine that reads and checks the input header labels. The exit occurs after an input header label has been read and the program has determined that the label was read correctly. This exit can be used to perform additional label checking or to modify the label. The left-most core-storage position of the label is 201. The label has not been printed when this exit occurs.

The contents of index registers 1, 2, and 3 must be saved. Insert the patch card and associated user-routine object deck into the Merge 7 program deck between card number 0536 and card number 0537 (columns 72-75).

6. Label--EXIT6, location 1835, sequence number 931. This exit is available in the routine that writes a header label on the output tape. The exit occurs before the header label is written on tape and can be used to modify the header label. The output header label can be found in locations 578 to 657 (only the first 80 characters of a 120-character label will be contained in this area).

The contents of index register 2 must be saved. Insert the patch card and associated user-routine object deck into the Merge 7 program deck between card number 0536 and card number 0537 (columns 72-75).

7. Label--EXIT7, location 6591, sequence number 2864. This exit is available in the routine that reads and checks the first standard header label on the initial reel of each input file. The exit occurs after each header label has been read, printed, and checked. This exit can be used to modify and update the label or to perform further label checking. The left-most core-storage position of the label just read is 201. Insert the patch card and associated user-routine object deck into the Merge 7 program deck between card number 0536 and card number 0537 (columns 72-75).

8. Label--EXIT8, location 2002, sequence number 962. This exit is available in the routine that reads and checks the input trailer labels. The exit occurs after each trailer label has been read and before the label is checked. The exit can be used to check and/or modify the label. The trailer label just read

can be found in locations 201 to 280 (80 characters) or 320 (120 characters).

The contents of index registers 1, 2, and 3 must be saved. Insert the patch card and associated user-routine object deck into the Merge 7 program deck between card number 0611 and card number 0612 (columns 72-75).

9. Label--EXIT9, location 6828, sequence number 2574. This exit is available in the assignment phase of Merge 7. The exit occurs after all tapes on tape units being used by the program have been rewound to make sure they are at load point. Insert the patch card and user-routine object deck into the Merge 7 program deck between card number 0480 and card number 0481 (columns 72-75).

Note: If EXIT5, EXIT6, EXIT7, or EXIT9 are being used, user routines for these exits must not be loaded below core position 7897.

CONTROL CARDS

The file(s) to be processed must be described to the program through control-card entries. At least one control card must be prepared by the user for each run of the Merge 7 program.

Control card one is required in all cases.

Control card two is required if more than one control-data field is used for the merge operation. This card contains the high-order positions and lengths in characters of these additional control-data fields.

Control card three is required in order to specify that special options are desired. If these options are not desired, a blank card can be used.

Control card four is required if the input tape files have header labels to be checked. A card punched in the control-card four format must be prepared for each input file.

Control card five is required if a new output standard header label is to be generated and written on each output tape.

For the user's convenience, a Merge 7 control-card coding sheet is available (Form X24-3245). This coding sheet also provides a means of documenting each merge application. See Appendix: Figure 8.

CONTROL CARD 1

This control card is required in all cases.

Column	Indicates
1	<u>The number of the tape unit on which the tape(s) of the first input file are to be mounted.</u> This column must be punched.
2	<u>The number of the tape unit on which the tape(s) of the second input file are to be mounted.</u> This column must be punched for a two-, three-, four-, or five-way merge. Leave this column blank if the program is to reblock or sequence-check a single input file.
3	<u>The number of the tape unit on which the tape(s) of the third input file are to be mounted.</u> This column must be punched for a three-, four-, or five-way merge.
4	<u>The number of the tape unit on which the tape(s) of the fourth input file are to be mounted.</u> This column must be punched for a four-, or a five-way merge.
5	<u>The number of the tape unit on which the tape(s) of the fifth input file are to be mounted.</u> This column must be punched for a five-way merge.
6	<u>Output-tape-unit number.</u> a. Leave blank if a single file is to be sequence-checked only. In this case, a 1 must be punched in column 74 of this control card. b. Punch the number of the tape unit on which the output tape is mounted when a merge operation or reblocking of a single file is being performed. If a <u>1</u> is punched in column 74 of this control card and a tape unit number is punched in this column, the output file is sequence-checked.
7,8	<u>The total number of reels (01-45) in all input files.</u>
9-12	<u>Input record length.</u> a. Punch the number of characters in each record when fixed-length records are being merged.

Column	Indicates
	b. Punch the number of characters in the longest record when variable-length records are being merged.
13-15	<u>Input blocking factor.</u> a. Leave blank for variable-length blocked records. b. Punch <u>001</u> for fixed-length or variable-length unblocked input records. c. Punch the number of records in each block for fixed-length blocked input records.
16-18	<u>Output blocking factor.</u> a. Leave blank when variable-length records are to be written in blocks. b. Punch <u>001</u> when fixed-length or variable-length records are to be written unblocked, or when the output file is to be sequence-checked only. c. Punch the number of records that are to be in each block when fixed-length records are to be written in blocks.
19	<u>Unreadable-and wrong-length-block option.</u> a. If any tape block containing an unreadable or wrong-length record is to be written on tape, punch the number of the tape unit on which the block is to be written. The tape unit specified in this column must not be an input unit or the output unit. This option cannot be used if a five-way merge is to be performed. b. Punch a <u>P</u> if any block containing an unreadable or wrong-length record is to be punched into cards. c. Punch a <u>C</u> if any block containing an unreadable or wrong-length record is to be retained in the merge through the use of the correct option.
20	<u>This column is not checked by Merge 7.</u>

Column	Indicates	Column	Indicates

Column 21 — Input-tape header labels.

a. Leave blank if the input tapes do not contain header labels.

b. Punch a 1 if the input tapes contain standard 80-character header labels and the labels are to be printed but not checked.

c. Punch a 2 if the input tapes contain standard 80-character header labels and the labels are to be checked. In this case, control card 3 must be included and a card punched in the control card 4 format must be included for each input file.

d. Punch a 3 if the input tapes contain standard 120-character header labels but the labels are not to be checked.

e. Punch a 4 if the input tapes contain standard 120-character header labels and the labels are to be checked. In this case, control card 3 must be included and a card punched in the control card 4 format must be included for each input file.

f. If nonstandard header labels are to be processed by a user routine, punch a 1 (80 characters or less) or a 3 (120 characters or less).

Note: If this column is punched, all input tapes must contain header labels.

Column 22 — Output-tape header-label option.

a. Leave blank if the output tapes are not to contain header labels.

b. Punch a 1 if the standard 80-character header label on the first input tape is to be duplicated on each output tape.

c. Punch a 2 if a standard 80-character header label is to be generated from the information punched in a card in the control-card 5 format and then written on each output tape. In this case, control card 3 must be included.

d. Punch a 3 if the contents of a card are to be written as a header label on each output tape. This card is placed in the program deck immediately following the control cards.

e. Punch a 4 if the standard 120-character header label on the first input tape is to be duplicated on each output tape.

f. Punch a 5 if a standard 120-character header label is to be generated from the information punched in a card in the control card 5 format and then written on each output tape. In this case, control card 3 must be included.

g. If a new nonstandard header label is to be generated by a user routine, punch a 1 (80 characters or less) or a 4 (120 characters or less).

Note: The first input tape is defined as the first tape read on the tape unit specified in column 1 of control card 1. Also, if the input tapes contain header labels and a 2 or 5 is specified in column 22, the header label on the first input tape is modified according to control card 3 specifications. All other information in the header label is retained.

Column 23 — Output-tape header-label tape-mark option.

a. Leave blank if a tape mark is not to be written following the header label on each output tape.

b. Punch a 1 if a tape mark is to be written after the header label on each output tape.

Column 24 — Input-tape trailer labels.

a. Leave blank if the input tapes do not contain trailer labels or if the input trailer labels are not to be processed.

b. Punch a 1 if the standard 80-character trailer labels on the input tapes are to be printed but not checked.

Column	Indicates		Column	Indicates

c. Punch a 2 if the input tapes contain standard 80-character trailer labels and checking of the block count is desired.

d. Punch a 3 if the standard 120-character trailer labels on the input tapes are to be printed but not checked.

e. Punch a 4 if the input tapes contain standard 120-character trailer labels and checking of the block count is desired.

f. If nonstandard trailer labels on the input tapes are to be processed by user routines, punch a 1 (80-characters or less) or a 3 (120-characters or less).

> Note: If column 24 is punched, all input tapes must contain trailer labels.

Note: Do not specify a mixture of label types in columns 21, 22, and 24. For example, if 80-character labels are specified in column 21, 120-character labels cannot be specified in column 24.

25   Output-tape trailer-label option.

a. Leave blank if a trailer label is not to be written on the output tapes.

b. Punch a 1 or 2 if a standard trailer label is to be generated by the program and written on each output-tape. The generated trailer label contains the program-calculated block-count for that tape.

> Note. The length of the trailer label depends on the specification in columns 21, 22, and 24.

26   Padding Character.

a. Leave blank if padding records consisting entirely of blanks are to be written, if required, at the end of a file that is in descending sequence.

b. Punch a 9 if padding records consisting entirely of 9's are to be written, if required, at the end of a file that is in ascending sequence.

27   System core-storage capacity.

a. Punch a 4 for an 8K machine.

b. Punch a 5 for a 12K machine.

c. Punch a 6 for a 16K machine.

28-29   The total number (01-10) of control-data fields in each input record.

30-32   The total number of characters (001-999) in all control-data fields.

33-36   The location, within each record, of the high-order position of control-data field 1. If control-data field 1 is in positions 1 through 10 in each record, these card columns are punched 0001.

37-39   The number of characters in control-data field 1.

40-56   These columns are not checked by Merge 7.

57   Record format.

a. Leave blank if fixed-length records are being processed.

b. Punch a 1 if variable-length records are being processed.

Note: Columns 58-73 are not punched if the input consists of fixed-length records.

58-61   The low-order position, within each record, of the record character count field when the input is variable-length blocked records or variable-length unblocked records with a record character count field. If the variable-length input records contain a record character count field, blocked output can be specified. Merge 7 calculates a block character count and adds it to the beginning of each output block.

If the input is variable-length unblocked records without a record character count field, Merge 7 calculates the record length used for internal processing. This calculated value is not added to the record. Therefore, blocked output cannot be specified in this case.

Column	Indicates
	This field must be punched if the input records have a record character-count field. (See Control Card 3: column 1.)
62-65	The minimum record length, in characters, when the input is variable-length unblocked records. This entry is optional.
66-69	Maximum input block length, in characters, when the input is variable-length blocked records. This specification must be made and must include the block character-count field. (See the note under the description of the entry in columns 70-73 of this control card.)
70-73	Maximum output block length, in characters, when the output is variable-length blocked records. This specification must be made and must include the block character-count field. Note: If the input and output consists of unblocked records, columns 66-73 can be left blank. In this case, the program uses the value specified in columns 9-12 of this control card as the maximum input and output block length.
74	Sequence check. a. Leave blank if sequence checking is not desired. b. Punch a 1 if sequence checking is desired.
75	File order. a. Leave blank if the input files are in ascending sequence. b. Punch a 1 if the input files are in descending sequence.
76	The number of reels in the input file that is being read from the tape unit specified in column 1 of this control card. This column must always be punched.
77	The number of reels in the input file that is being read from the tape unit specified in column 2 of this control card.

Columns	Indicates
78	The number of reels in the input file that is being read from the tape unit specified in column 3 of this control card.
79	The number of reels in the input file that is being read from the tape unit specified in column 4 of this control card.
80	The number of reels in the input file that is being read from the tape unit specified in column 5 of this control card.

CONTROL CARD 2

Control card 2 is used to specify the high-order position and the length of control-data fields 2-10.

Column	Indicates
1-4	The location, within each record, of the high-order position of control-data field 2.
5-7	The number of characters in control-data field 2.
8-11	The location, within each record, of the high-order position of control-data field 3.
12-14	The number of characters in control-data field 3.
15-18	The location, within each record, of the high-order position of control-data field 4.
19-21	The number of characters in control-data field 4.
22-25	The location, within each record, of the high-order position of control-data field 5.
26-28	The number of characters in control-data field 5.
29-32	The location, within each record, of the high-order position of control-data field 6.
33-35	The number of characters in control-data field 6.
36-39	The location, within each record, of the high-order position of control-data field 7.

Column	Indicates
40-42	The number of characters in control-data field 7.
43-46	The location, within each record, of the high-order position of control-data field 8.
47-49	The number of characters in control-data field 8.
50-53	The location, within each record, of the high-order position of control-data field 9.
54-56	The number of characters in control-data field 9.
57-60	The location, within each record, of the high-order position of control-data field 10.
61-63	The number of characters in control-data field 10.
64-80	These columns are not used by Merge 7.

CONTROL CARD 3

Control card 3 is used to specify various options desired during the running of the program. If control card 1 column 21 contains a 2 or a 4 and/or column 22 contains a 2 or a 5, control card 3 must be included even if blank.

Column	Indicates
1	The number of characters (3 or 4) in the record character count field. This value must be specified if variable-length records are to be read in the load mode. If columns 58-61 of control card 1 are blank, this column must be blank.
2	Input mode.
	a. Leave blank if the input records are written on tape in move mode.
	b. Punch a 0 if the input records are written on tape in load mode.
3	Output mode.
	a. Leave blank if the output records are to be written in move mode.
	b. Punch a 0 if the output records are to be written in load mode.

Column	Indicates
4, 5	These columns are not checked by Merge 7.
6-10	The run date. Punch the current date in these columns if the retention cycle of the output tapes is to be checked. The date in these columns takes precedence over the date, if any, specified in columns 41-45 of control card 5.
11, 12	These columns are not checked by Merge 7.

Note: Columns 13-14 are used only when column 21 of control card 1 contains a 2 or 4 punch.

Column	Indicates
13	Input header-label checking.
	a. Leave blank if only the file name in each input header label is to be checked.
	b. Punch a 1 if the program is to check the file serial number, reel sequence number, file name, and creation date in each input header label.
14	Input header-label reel-sequence increment option. (for multi-reel input)
	a. Leave blank if the reel sequence number is not increased.
	b. Punch a 1 if the reel sequence number, punched in columns 27-29 of control card 4, is increased by 1 for each successive input reel.

Note: Columns 15-23 are used only when column 22 of control card 1 contains a 2 or 5 punch.

Column	Indicates
15	Output header-label checking.
	a. Leave blank if the retention cycle of the output tape is not to be checked.
	b. Punch a 1 if the retention cycle in the standard header label on the output tape is to be checked. In this case, the current date must be specified either in columns 6-10 of control card 3 or in columns 41-45 of control card 5.

Column	Indicates
16	Output header-label file serial option.

a. Leave blank if the file serial number to be placed in the output header label is punched in columns 21-25 of control card 5.

b. Punch a 1 if the tape serial number punched in columns 19-23 of this card is to be placed in the file serial-number field of the output header label.

Column	Indicates
17	Output header-label reel sequence-number increment option.

a. Leave blank if the reel sequence number in the output header label is not to be increased.

b. Punch a 1 if the reel sequence number in the output header label is to be increased by 1 for each successive output reel.

Column	Indicates
18	Output header-label tape-serial assignment option.

a. Leave blank if the tape serial number in the standard header label on the output tape is to be placed in the tape serial-number field of the output header label written by Merge 7.

b. Punch a 1 if the tape serial number punched in columns 19-23 of this card is to be placed in the tape serial-number field of the output header label written by Merge 7.

Column	Indicates
19-23	New output header-label tape serial number. Punch the tape serial number that is to be placed in the new output header label. This serial number is increased by 1 for each additional output reel.
24-80	These columns are not used by Merge 7.

CONTROL CARD 4

This card is used if header labels on the input tapes are to be checked (column 21 of control card 1 must contain either a 2 or a

4). A card, punched in the control card 4 format, must be included for each input file. These cards must be placed in the program deck in the sequence indicated by the punches in columns 1-5 of control card 1. Thus, the control card for the input file that is read from the tape unit specified in column 1 of control card 1 is placed first, the card for the file specified in column 2 is placed second, and so forth.

Column	Indicates
1-20	These columns are not used by Merge 7.
21-25	The file serial number if it is to be checked.
26	Punch a minus sign (11-punch) if the reel sequence number is specified in this control card (columns 27-29). For 120-character labels punch the high-order character of the 4-character reel sequence number.
27-29	The reel sequence number if it is to be checked.
30	Blank.
31-40	The file name if it is to be checked.
41-45	The creation date of the input file if it is to be checked.
46	Punch a minus sign (11-punch) if the retention cycle is specified in this control card (columns 47-49). For 120-character labels punch the high-order character of the 4-character retention cycle.
47-49	The retention cycle of the input tapes. This number is not checked.
50	Blank.
51-80	These columns are not used by Merge 7.

CONTROL CARD 5

This card is used if a new header label is to be written on each output tape (column 22 of control card 1 must contain either a 2 or a 5). The information punched in the card is used to generate the new header label.

Column	Indicates
1-20	These columns are not used by Merge 7.

Column	Indicates
21-25	The file serial number.
26	Punch a minus sign (11-punch) if the reel sequence number is specified in this control card (columns 27-29). For 120-character labels punch the high-order character of the 4-character reel sequence number.
27-29	The reel sequence number.
30	Blank.
31-40	The file name. This file name must be ten characters long. A significant character should be present in the first and last positions of the name, and there should be no more than one blank position between any two characters in the name.
41-45	The current date. The date punched in columns 6-10 of control card 3 takes precedence over the date specified in these columns.
46	Punch a minus sign (11-punch) if the retention cycle is specified in this control card (columns 47-49). For 120-character labels punch the high-order character of the 4-character reel sequence number.
47-49	The retention cycle of the output file.
50	Blank.
51-80	These columns are not used by Merge 7.

This section describes the procedures to be used for the execution of the Merge 7 program. It includes: a description of the Merge 7 program deck; deck and system preparation; error options; halts and messages.

PROGRAM-DECK DESCRIPTION

The Merge 7 program is supplied in the form of a reel of magnetic tape. This tape contains the information from 630 cards punched in the 1401 and 1460 Autocoder condensed load format. The user must convert the information to punched cards before running the program. The format of the cards is as follows:

Column	Indicates
1-71	Merge 7 program instructions and the necessary loading instructions.
72-75	Sequential number of the card within the program deck. The cards are numbered from 0001 to 0630.
76	The version number of the program.
77, 78	SM, mnemonic for merge program.
79, 80	61, Merge 7 program number.

The program deck is composed of the cards for the two phases of Merge 7. The user must prepare control cards before using the Merge 7 program.

DECK PREPARATION

Insert the control cards, as a group and in ascending sequence, into the Merge 7 program deck between cards 0128 and 0129 (columns 72-75). If the contents of a card are to be written as a nonstandard header label on each output tape, place the card immediately after the control cards.

During the assignment phase, control-card errors, if detected, cause an indicative message to print and the program to halt. However, some errors such as overlapping of control-data fields, transposition of numbers, and specification of wrong numbers are not detected by the program. Because the program attempts to operate using the information in error, the user must make sure that the control cards are properly specified and correctly punched.

Control card 1 must always be used. Control cards 2, 3, 4, and 5 are used only if the various options and functions that they control are desired by the user.

Insert any user routines into the proper places in the Merge 7 deck.

SYSTEM PREPARATION

1. Insert forms on the printer and install an appropriately punched carriage tape.

2. If column 19 of control card 1 contains a P (meaning that unreadable and wrong-length tape blocks are to be punched into cards), place blank cards in the punch feed of the IBM 1402 Card Read-Punch and turn the punch on.

3. Mount the input and output tapes, set the address-select dial on each tape unit to the correct number, and set the density switch on each unit to the correct density.

4. Sense switches A, B, C, D, E, and F are not used by the program and should be set off. The use of sense switch G, which is used in the print-scan option, is described in Print-Scan Option.

5. Set the tape-select switch to the N-position.

6. Set the check stop and I/O check stop switches on.

7. Place the Merge 7 deck, including control cards and any user routines, in the read hopper of the 1402.

8. Load the program: Press CHECK RESET, START RESET, and LOAD.

The program runs to the end of the job unless an error occurs during processing.

ERROR OPTIONS

This section describes the options available to the user for handling input/output errors.

INPUT-ERROR OPTIONS

A tape record or block is considered to be unreadable when it contains a character or characters that give redundancy indications

after 100 attempts have been made to read them. The Merge 7 program handles an unreadable tape block in one of three ways depending upon information supplied by the user in column 19 of control card 1. The program either:

1. Writes the block on tape,

2. Punches it into cards, or

3. Prints the block on the printer.

Another tape unit, in addition to the specified input and output units, must be available before option 1 can be specified. If the user specifies options 1 or 2, the program deletes the block and continues processing without halting.

If option 3 is specified, the program halts and the user can correct the block. Option 3 is referred to as the print-scan option.

Records that are deleted from the merge when options 1 or 2 are selected are not included in the diagnostic totals printed at the end of the merge run.

PRINT-SCAN OPTION: A redundancy indicator in the 1401 or 1460 is turned on when a character is read from tape with an incorrect parity (bit count). The parity of this character is automatically corrected. The character in core storage that results from the parity adjustment may not be the same character that was originally written on tape.

If the tape-select switch on the console is set to the D-position, characters are read into core storage just as they appear on tape. The print-scan option makes use of this feature of the 1401 or 1460.

When option 3 is specified, a tape block that is found to be unreadable is printed, the beginning location of the input area is printed after the block (see halt number 14, Figure 7), and then the program halts. The user can choose to accept the block as it appears in core storage or he can attempt to correct it. He presses the start key to accept the block. The Merge program continues, and the block is processed.

If an attempt to correct the block is to be made, the user must turn sense switch G on, turn the tape-select switch to the D-position, turn the auxiliary-console check-stop switch off, and press the start key. The tape block is read into core storage exactly as it appeared on tape. If the block contained no redundant characters during this read operation, the program continues processing. The user must, in this case, press the stop key to stop processing,

then turn sense switch G off, set the tape-select switch to the N-position, turn the auxiliary-console check-stop switch on, and press the start key to continue processing. If the block still contains a redundant character(s) during the read operation, the block is printed and a programmed halt occurs with the process light on and the check-reset key lit. The invalid character(s) in core storage now must be corrected manually from the console.

Note: The diagnostic switch of the 1460 console performs the same function as the D position of the tape select switch on the 1401.

The correction procedure is:

1. Set the manual address switches to the core storage address of the first position of the input area. This position can be found by referring to the message printed before the program halted.

2. Turn the mode switch to the storage scan position.

3. Press Check Reset to Reset the error indicators and press Start.

The 1401 or 1460 begins at the address set in the manual address switches and sequentially reads the character in each core-storage position. An error halt occurs when an invalid character is read. The storage position in error is shown in the storage-address display unit. The B-register displays the contents of the storage position in which the error was detected. A valid charater must be entered into this position manually. Set the manual address switches to the address shown in the address display unit and press the enter switch to enter the desired character into core storage. Repeat this process beginning with step 3, until all invalid characters are corrected.

After all invalid characters are corrected, turn the tape-select switch to the N-position, turn the mode switch to the Run position, turn sense switch G off, turn the auxiliary-console check-stop switch on, and press the start key.

A knowledge of the record format and control-data field locations is necessary before attempting to correct a block containing a redundant character.

HEADER-LABEL READ REDUNDANCY

A header label is considered to be unreadable when it contains a character or characters that give redundancy indications after 100 attempts have been made to read them.

If a header label is found to be unreadable, the program halts. The user has the option of having the program process the label as read, or of having the program attempt to read the label 100 more times. Press the start key to have the program accept the label as read. Press the start-reset key and then the start key to have the program attempt to reread the label. If the unreadable label is an output header label, a new tape can be mounted before continuing processing.

A label that was considered unreadable and then accepted as read, may have been altered during the read because of the parity adjustment done by the 1401. If this label is to be used later in the merge operation, this fact must be considered before accepting the label as read.

WRITE REDUNDANCY

If a write redundancy occurs, the tape is backspaced, and the write is retried. If the error still exists, the backspace and the write are performed again. If there still is an error, the tape is backspaced and erased before the write operation is retried. This routine is repeated up to ten times for each write operation. After ten retries the program halts. The user has the option of pressing the start key and having the program try the write operation up to twenty more times or of mounting a new tape. The procedure to be followed if a new tape is mounted depends upon the kind of record being written. (See halt numbers 4, 6, 11, and 19 in Figure 7.)

DUMP-TAPE LABELING

If any unreadable tape blocks are to be written on tape, the user may want to have the program label this tape.

The Merge 7 program does not process any header labels on the dump tape. Therefore, any desired label processing must be done by user-inserted routines. An exit (EXIT9) is provided in the assignment phase to permit including these routines. (Refer to User Programming.)

The dump tape is not rewound during operation of the merge program. At the completion of the merge run, the dump tape is tape-marked, rewound, and unloaded.

MESSAGES NOT ACCOMPANIED BY A HALT

The following messages are printed during a run of the Merge 7 program primarily to inform the machine operator of the current status of the program.

ASSIGNMENT-PHASE MESSAGES

1. The control cards are printed in the order in which they were inserted in the program deck. The information in each control card is printed exactly as it is punched in the card.

2. USER AREA STARTS @XXXXX

   The positions designated by XXXXX in this message contain the first core-storage position available for user-written routines. This address of this position is program-calculated.

MERGE-PHASE MESSAGES

1. Header and trailer labels are printed as they are read.

2. XXX PADDED RECORDS ADDED

   This message prints when padding records have been added to the output file. The field indicated by XXX contains the number of padding records added.

3. END OF JOB XXXXXXXX REC PROC

   This message prints when the merge is complete. The message shows the program-calculated record count, which includes any padding records added to the file.

4. BAD BLOCK WRITTEN ON TAPE X

   If tape blocks containing unreadable or wrong-length records are being written on tape, this message prints each time one is written. X is the number of the tape unit on which the block was written.

HALTS AND ASSOCIATED MESSAGES

Figure 7 is a list of the halts and associated messages that may occur during running of the Merge 7 program. The information given for each halt includes four items:

● The I-address that is displayed on the 1401 console when the halt occurs. This is the core-storage address of the next sequential instruction after the halt instruction.

● The Merge 7 program-listing sequence number of the halt instruction.

● The message associated with the halt and/or the reason for the halt.

● The procedure to be followed by the machine operator.

Number	I-Address Register	Sequence Number	Message and/or Reason	Procedure
1.	1318	816	A message is not associated with this halt. Reason: A read-redundancy indication remains after 100 attempts to read the header label on an output tape other than the first.	Either mount a new tape and press the start-reset key and then the start key to have the program check the retention cycle of the tape, or press the start-reset key and then the start key to have the program attempt to read the header label on the current tape up to 100 more times. Press START to accept tape as read.
2.	1364	826	A message is not associated with this halt. Reason: A read-redundancy indication remains after 100 attempts to read the trailer label on the input tape.	Either press the start key to accept the label as read, or press the start-reset key and then the start key to have the program attempt to read the label up to 100 more times.
3.	1420	838	A message is not associated with this halt. Reason: A read-redundancy indication remains after 100 attempts to read the header label on an input tape.	Either press the start key to accept the label as read, or press the start-reset key and then the start key to have the program attempt to read the label up to 100 more times.
4.	1490	853	A message is not associated with this halt. Reason: A write-redundancy indication remains after twenty attempts have been made to write a specific output block.	Press the start key to have the program attempt to write the block twenty additional times. Press the start-reset key and then the start key to have the program write a tape mark, any required trailer labels, another tape mark, and rewind and unload the tape.
5.	1525	862	A message is not associated with this halt. Reason: A write-redundancy indication remains after twenty attempts have been made to write the header label on the output tape.	Press the start key to have the program attempt to write the label up to twenty more times or mount a new tape and press the start key.
6.	1533	865	A message is not associated with this halt. Reason: A write-redundancy indication remains after twenty attempts have been made to write the trailer label on an output tape.	Press the start key to have the program attempt to write the label up to twenty more times. Press the start-reset key and then the start key to omit the trailer label.
7.	1538	869	A message is not associated with this halt. Reason: Twenty unsuccessful attempts have been made to write a tape block on the dump tape.	Press the start key to have the program attempt to write the block twenty additional times.
8.	1835	929	(Output header label information) ** RETAIN ** Reason: The retention cycle in the header label on an output tape, other than the first, indicates that the information on the tape should be saved.	Either mount a new tape and press the start key to check the retention cycle of the new tape, or press the start reset key and then the start key to continue processing with the tape that caused the halt.
9.	2067	977	TAPE #X ACTUAL BLOCK COUNT XXXXX LABEL BLOCK COUNT XXXXX. Reason: The block count in an input trailer label does not agree with the program-calculated block count for that tape.	Press the start key to resume processing. The block count is reset.
10.	2318	1020	CHANGE TAPE X. Reason: Either end-of-file has been reached on the input tape mounted on tape unit X, or end-of-reel has been reached on the output tape mounted on tape unit X.	Mount a new tape on unit X and press the start key.

Figure 7. Merge 7: Halts and Messages (Part 1 of 4)

Number	I-Address Register	Sequence Number	Message and/or Reason	Procedure
11.	2462	1048	(Header information in error) ERROR- Reason: The file name in a header label on an input tape other than the first in a multiple-reel file does not agree with the file name in the header label on the first input reel of that file, or the file serial number is incorrect, or the creation date is incorrect, or the tape is out of sequence. The unit on which this tape is mounted is in SELECT status.	Either mount a new tape and press the start-reset key and then the start key to check the header label on the new tape, or press the start key to continue processing with the tape that caused the halt.
12.	3067	3271	END OF JOB XXXXXXXX REC PROC Reason: The merge is complete. The message shows the program calculated record count, which includes any padding records added to file.	Press the start-reset key and then the start key to load the next program from cards.
13.	4343	1431	A message is not associated with this halt. Reason: A record is out of sequence when sequence checking is specified.	Either press the start-reset key and then the start key to continue processing, or re-sort the file.
14.	4830	1522	A message is not associated with this halt. Reason: An end-of-reel condition has been reached on an input reel without having found a valid record. The unit on which the tape is mounted is in select status. The records are either wrong length or contain bad parity characters.	Correct the records and restart the merge. If records are of wrong length, change control cards to handle this length record.
15.	4960	2090	INPUT AREA STARTS XXXXX Reason: An input record has been found to be unreadable or of the wrong length and the correct option is specified. The first core-storage position of the input area is shown in the message.	Follow the procedure described in Print-Scan Option for an unreadable block. For a wrong length record (See Message # 17) the correct data should be entered from the console, then press START to continue the merge. Under either of the above conditions, if the record is to be accepted as read, press START. When merging variable length blocked records: a. If block character count is wrong, it may now be corrected. b. If block character count is correct, the length of the block may be adjusted and the 3-character machine address of the last character of the block + 1 must be placed in location 5484-5486.
16.	4982	2157	A message is not associated with this halt. Reason: End-of-reel has been reached on the tape on which unreadable records are being written.	Mount a new tape reel and press the start key to continue processing.
17.	5377	2911	WLR ON TAPE X Reason: A wrong length record has been detected on the tape unit specified in the message.	Press START. Record will be handled as specified in column 19 of control card 1.
18.	5968	3009	A message is not associated with this halt. Reason: A read-redundancy indication remains after 100 attempts to read the header label on the first output tape.	Either press the start key to accept the label as read, or press the start-reset key and (1) mount a new tape and press the start key to have the program check the retention cycle of the tape, or (2) press the start key to have the program attempt to read the header label on the current tape up to 100 more times.

Figure 7. Merge 7: Halts and Messages (Part 2 of 4)

Number	I-Address Register	Sequence Number	Message and/or Reason	Procedure
19.	6467	3092	There are two possible messages that can be associated with this halt. (1) TAPE X TO BE RETAINED XXXX MORE DAYS (2) TAPE X TO BE RETAINED INDEFINITELY Reason: The retention cycle in the header label written on the output tape indicates that this tape should be saved for the indicated number of days, or indefinitely. NOTE: The message "TAPE X TO BE RETAINED XXXX MORE DAYS" is printed to indicate that today is the last day of the retention cycle.	Either press the start-reset key and then the start key to continue processing this tape, or mount a new tape and press the start key to check the retention cycle of this tape.
20.	6628	2873	There are four possible messages that can be associated with this halt. (1) WRONG FILE SER NO TAPE NO X HDR LABEL (2) WRONG REEL SEQ NO TAPE NO X HDR LABEL (3) WRONG FILE NAME TAPE NO X HDR LABEL (4) WRONG CREATION DATE TAPE NO X HDR LABEL Reason: The header label on the input tape shown in the message has been checked and the indicated error was detected.	Either press the start key to continue processing the specified tape, or mount a new tape and press the start-reset key and then the start key to check the label on the new tape.
21.	7850	252	Sixteen possible messages can be associated with this halt. (1) NO OUTPUT TAPE SPECIFIED - SEQCK NOT BEING USED Reason: Columns 6 and 74 of control card 1 are blank. (2) WRONG NUMBER OF INPUT TAPES SPECIFIED Reason: The total number of input reels specified in columns 7-8 of control card 1 does not equal the sum of the values specified in columns 76-80 of control card 1. (3) TOTAL CONTROL FIELDS EXCEED RECORD LENGTH Reason: The total number of characters in all control data fields exceeds the specified record length. (4) TOTAL CONTROL FIELDS UNEQUAL TO CTL CARD 1 COL 30-32 Reason: The specified total number of characters in all control data fields is unequal to the program calculated number. (5) ASSIGNMENT ERROR HALT Reason: An invalid core-storage address has been read by the program. (6) MACHINE SIZE EXCEEDED Reason: The number of core-storage positions required for this merge run, based on the specified file parameters, exceeds the number of available core-storage positions. (7) TODAYS DATE UNSPECIFIED Reason: Retention cycle checking is specified, and columns 6-10 of control card 3 and columns 41-45 of control card 5 are blank. (8) OUTPUT BLOCK SIZE EXCEEDS 3999 (9) INPUT BLOCK SIZE EXCEEDS 3999 (10) ERROR TAPE ALREADY IN USE Reason: The tape unit specified in the unreadable record option (column 19 of control card 1) is specified to be an input or an output unit.	Correct the error condition and reload the program deck.

Figure 7. Merge 7: Halts and Messages (Part 3 of 4)

Number	I-Address Register	Sequence Number	Message and/or Reason	Procedure
21.			(11) NO OF CTRL CARDS INCORRECT - RESTART (12) CONTROL CARDS OMITTED - RESTART Reason: The control cards have not been inserted into the program deck. (13) CTL CARDS (1) (2) COL XXX INVALID Reason: The indicated control card contains a column, shown in the field XXX, with an incorrect character. (14) TAPE UNIT X DOUBLY USED Reason: The indicated tape unit has been specified to be used for more than one purpose. (15) INVALID TOTAL OF INPUT TAPES Reason: Columns 7-8 of control card 1 contain a number larger than 45. (16) CTL CD 3 COL 1 INVALID Reason: The punching in columns 58-61 of control card 1 indicates that each input record contains a record character count field, column 1 of control card 3 does not contain a 3 or 4, and the input is being read or the output is being written in load mode.	

Figure 7. Merge 7: Halts and Messages (Part 4 of 4)

CODING SHEET

STANDARD TAPE LABELS

Figure 8 shows the coding sheet that can be used for preparing the Merge 7 control cards.

Figure 9 shows schematics of Type A (120-character) and Type B (80-character) header and trailer labels.

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Control Card Formats for Sort 2, Merge 2, Sort 4, Sort 7, and Merge 7

IBM 1401-1460

Program _____

Date _____

	CONTROL CARD 1			CONTROL CARD 2			CONTROL CARD 3 ‖			CONTROL CARD 4 ‖			CONTROL CARD 5 ‖
Punch	Col.	Indicates	Punch	Col.	Indicates	Punch	Col.	Indicates	Punch	Col.	Indicates	Punch	Col.	Indicates
	1	Input/output tape		1	Control-data		1	No. of characters in RCC * †		1	Blank or		1	Blank or
	2	unit numbers		2	field-2		2	Input-mode indicator		2	comments		2	comments
	3			3	location		3	Output-mode indicator		3			3	
	4			4			4	Work-tape header-labels ✓		4			4	
	5			5	Control-data		5	Work-tape header-label tape mark ✓		5			5	
	6			6	field-2		6	Run date		6			6	
	7	No. of input reels		7	length		7			7			7	
	8			8	Control-data		8			8			8	
	9	Input record length		9	field-3		9			9			9	
	10			10	location		10			10			10	
	11			11			11	Rewind/unload (7330) ✓		11			11	
	12			12	Control-data		12	Retain RCC option * ✓		12			12	
	13	Input blocking		13	field-3		13	In-header check option		13			13	
	14	factor		14	length		14	In reel-sequence increment option		14			14	
	15			15	Control-data		15	Out-header check option		15			15	
	16	Output blocking		16	field-4		16	Out-header file serial option		16			16	
	17	factor		17	location		17	Out reel-sequence increment option		17			17	
	18			18			18	Out-tape serial number option		18			18	
	19	Unreadable block option		19	Control-data		19	New tape serial		19			19	
	20	Phase 2 tape density ✓		20	field-4		20	number for output		20			20	
	21	In-tape header-labels		21	length		21	header-label		21	Five-character		21	File serial
	22	Out-tape header-labels		22	Control-data		22			22	file serial		22	number for
	23	Output tape-mark option		23	field-5		23			23	number (if		23	output header
	24	In-tape trailer-labels		24	location		24	Must be blank for		24	checking)		24	labels
	25	Out-tape trailer-labels		25			25	Sort 7		25			25	
	26	Padding indicator		26	Control-data		26	Blank or comments		26	Minus **		26	Minus **
	27	Core-storage size		27	field-5		27	for Sort 4 and		27	Reel-sequence		27	Output header
	28	Total number of		28	length		28	Merge 7		28	number		28	reel-sequence
	29	control-data fields		29	Control-data		29			29	(if checking)		29	number
	30	Total number of		30	field-6		30			30	Blank		30	Blank
	31	characters of		31	location		31			31	Ten-character		31	Ten-character
	32	control-data		32			32			32	input file-		32	output-file.
	33	Control-data		33	Control-data		33			33	identification		33	identification
	34	field-1 location		34	field-6		34			34	name		34	name
	35			35	length		35			35			35	
	36			36	Control-data		36			36			36	
	37	Control-data		37	field-7		37			37			37	
	38	field-1 length		38	location		38			38			38	
	39			39			39			39			39	
	40	Expected file size		40	Control-data		40			40			40	
	41	Not checked by		41	field-7		41			41	Five-character		41	Five-character
	42	Merge 2 or Merge 7		42	length		42			42	creation		42	date
	43			43	Control-data		43			43	date (if		43	
	44			44	field-8		44			44	checking)		44	
	45			45	location		45			45			45	
	46			46			46			46	Minus **		46	Minus **
	47	Starting address		47	Control-data		47			47	Retention		47	Retention period
	48	of the Phase-1		48	field-8		48			48	period of		48	of output file
	49	user area		49	length		49			49	input file		49	
	50	Not checked by		50	Control-data		50			50	Blank		50	Blank
	51	Merge 2 or Merge 7		51	field-9		51	Blank or		51	Blank or		51	Blank or
	52	Starting address		52	location		52	comments		52	comments		52	comments
	53	of the Phase-2		53			53			53			53	
	54	user area		54	Control-data		54			54			54	
	55	Not checked by		55	field-9		55			55			55	
	56	Merge 2 or Merge 7		56	length		56			56			56	
	57	Record-format		57	Control-data		57			57			57	
	58	Low-order position		58	field-10		58			58			58	
	59	of the record		59	location		59			59			59	
	60	character count		60			60			60			60	
	61	field		61	Control-data		61			61			61	
	62	Number of characters		62	field-10		62			62			62	
	63	in the smallest		63	length		63			63			63	
	64	variable-length		64	Blank or		64			64			64	
	65	record		65	comments		65			65			65	
	66	Number of characters		66			66			66			66	
	67	in largest input		67			67			67			67	
	68	block of variable-		68			68			68			68	
	69	length records		69			69			69			69	
	70	Number of characters		70			70			70			70	
	71	in largest output		71			71			71			71	
	72	block of variable-		72			72			72			72	
	73	length records		73			73			73			73	
	74	Record mark with padding		74			74			74			74	
	75	File order		75			75			75			75	
	76	Input tape unit usage		76			76			76			76	
	77	for Merge 2, Merge 7		77			77			77			77	
	78	Blank or comments		78			78			78			78	
	79	for Sort 2, Sort 4,		79			79			79			79	
	80	and Sort 7		80			80			80			80	

‖ Control cards 3, 4, and 5 are not used by Sort 2 or Merge 2.
‡ Sequence check for Merge 7.

* RCC--Record character count field.
† Unreadable record option for Sort 4.
✓ Not checked by Merge 2 or Merge 7.

** Leave blank for Sort 4. Required for Sort 7 and Merge 7 if the next three columns are to be punched.

Figure 8. Coding Sheet

Figure 9. Schematics of Type A and Type B Labels

HEADER LABEL

Lead-In Portion | ① Label Identifier (1 H D R b, cols 1–5) | ② Retention Period (7–10) | ③ Creation Date (Yr. | Day, 11–15) | ④ File Identification (16–25) | ⑤ File Serial Number (26–30) | ⑥ Reel Serial Number (31–35) | ⑦ Reel Sequence Number (37–40) | ⑧ (Reserved Field) (42–44) | ⑨ Density Ind. (45) | ⑩ Checksum. Ind. (46) | ⑪ Block Sequence Ind. (47) | ⑫ Tape Chk./Int. Ind. (48) | ⑬ Tape Data Rec. Tchnq. Ind. (49) | ⑭ Tape Data Proc. Tchnq. Ind. (50) | ⑮ Creating System (51–54) | ⑯ Record Format (55) | ⑰ Record Length (56–60) | ⑱ Blocking Factor/Size (61–65) | ⑲ Checkpoint Ind. (66) | (Reserved Fields) (67–100) | Blank or User's Information (101–120) | TM | Data

TRAILER LABEL

Data | TM | ① Label Identifier (E O F / E O R b, cols 1–5, 6) | (Reserved Fields) | ② Block Count (67–72) | (Reserved Fields) (73–100) | Blank or User's Information (101–120) | TM | Tape End

Type B (80-Character) Labels

HEADER LABEL

Lead-In Portion | ① Label Identifier (1 H D R b, cols 1–5) | ② Tape Serial Number (x x x x x, 6–10) | ③ File Serial Number (11–15) | ④ Reel Sequence Number (- x x x b, 16–20) | ⑤ File Identification (21–30) | ⑥ Creation Date (Year, Day, x x x x x, 31–35) | ⑦ Retention Cycle (- x x x b, 36–40) | Blank or User's Information (41–80) | Data

TRAILER LABEL

Data | TM | ① Label Identifier (E O F / E O R b, 1–5) | ② Block Count (x x x x x, 6–10) | ③ Record Count (x x x x x x x x x x, 11–20) | ④ Hash Total (x x x x x x x x x x, 21–30) | Blank or User's Information (31–80) | TM | Tape End

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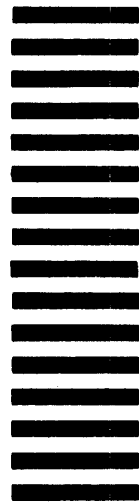
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