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**Multiple Tape Utility Program  
Specifications and Operating Procedures  
IBM 1401**

Program Number: 1401-UT-039

This publication presents the multiple utility program for IBM 1401 tape systems, which perform concurrently three off-line utility operations: card-to-tape, tape-to-card, and tape-to-printer. Any one of these operations can be performed singly, or any two, or all three simultaneously. This program simulates present off-line operations and can accommodate, within limitations, magnetic tapes and card decks prepared on any IBM system.

This publication, J24-1428-2, obsoletes Multiple Utility Program for IBM 1401 Tape Systems: Specifications, Form J24-1428-1. Included in this publication are the operating procedures for this program.

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MULTIPLE TAPE UTILITY PROGRAM  
SPECIFICATIONS FOR IBM 1401

**MACHINE REQUIREMENTS**

The minimum machine configuration and special features for the Multiple Utility Program are:

- IBM 1401 Processing Unit, Model C3 (tape system with 4000 storage positions, Read and Punch Release special feature, and six additional sense switches).
- IBM 1402 Card Read-Punch.
- IBM 1403 Printer, Model 2.
- IBM 7330 or IBM 729 Magnetic Tape Unit, Model 2 or 4 (a minimum of one for each concurrent tape operation).
- High-Low-Equal Compare special feature.
- Column Binary special feature (if processing binary tape records or column-binary cards).
- Advanced Programming special feature.

NOTE: The Print-Storage special feature, although not required, can increase overall operating speed of the tape-to-printer function.

**OPERATING FORM**

The operating form of the Multiple Utility program is controlled by seven sense switches on the IBM 1401 Model C3 and by a control card. When the sense switches are on, they control the following functions:

<u>Sense Switch</u>	<u>Function</u>
A	Terminates a card-to-tape operation after the last card has been transcribed, and places a tape mark after the last record.
B	Controls the card-to-tape operation (BCD mode).
C	Controls the tape-to-printer operation.
D	Controls the tape-to-card operation (BCD mode).
E	Interrupts all operations at the end of a complete input-output cycle.
F	Controls the column binary tape-to-card operation.
G	Controls the card-to-tape operation (column binary mode).
B & G	Controls a mixed column binary and BCD card-to-tape operation.

The sense switches are set at the beginning of a program run. To change from one operation to another, or to add or delete an operation, sense switch E must be turned on. Sense switch E causes operations to halt at the completion of an input-output cycle. After the desired sense switches are set, switch E is turned off and the program continues as instructed by the new settings. Each operation continues until its function is completed or until the program is interrupted.

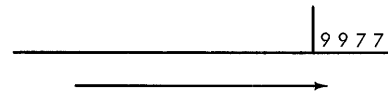
**OPERATING SPECIFICATIONS**

Card-to-Tape Operation

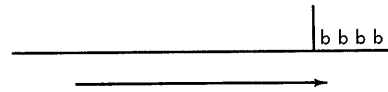
Tapes are written in card image only on a single-record per block basis. In the BCD mode, an 80 column card will produce an 80 character tape record. In the column binary mode, an 80 column card will produce a 160 character tape record. In a mixed binary and BCD mode, an 80 column card will produce either an 84 or 168 character tape record, depending upon the type of record being written. The extra four positions of a BCD record and the extra eight positions of a column binary record represent the "look-ahead" coding necessary for processing the file at a later time.

The "look-ahead" coding used when operating in a mixed binary and BCD mode is:

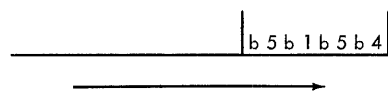
1. When current record is BCD and following record is column binary:



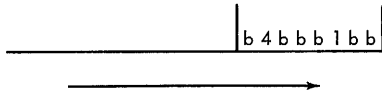
2. When current record is BCD and following record is also BCD:



3. When current record is column binary and following record is BCD:



- When current record is column binary and following record is also column binary:



When a number of files are created by the card-to-tape operation, it is possible to batch files with a file card separator between each file. In this manner, as many files as is desired can be written without re-starting the card-to-tape operation after each file has been written. The end-of-file card is identified in column one by a seven and eight punch only. When other punches are in column one in addition to a seven and eight punch, the card will not be recognized as an end-of-file card. File card operation is permitted in both the binary and BCD modes of operation. The program writes a tape mark each time an end-of-file card is encountered. If an end-of-file card is the last card to be processed, two successive tape marks are written, one for the end-of-file card and one representing last card processing.

Tape Unit 1 must always be used for any card-to-tape operation.

Program Restrictions: The following restrictions apply to mixed mode (BCD-Binary) card-to-tape operations:

- The last card record is not placed on tape if the next to last record is an end-of-file card (tape mark).
- An end-of-file card cannot be the first card record.
- Two end-of-file cards cannot occur successively.

#### Tape-to-Card Operation

Cards are punched on a one card per record basis. BCD tape records must not exceed 80 characters; binary records must not exceed 160 characters. Only one 80 column card can be punched from a tape record. Tape Unit 3 must be used for any tape-to-card operation. Only one tape-to-card function may be performed, either by itself or in conjunction with some other utility function. Tape-to-card operation in both the BCD and column binary modes cannot be specified to occur at the same time.

#### Tape-to-Printer Operation

Tapes can contain either fixed or variable length records and can have fixed or variable blocking. Each record within a block, except the last record, must end with a record mark. Singly blocked records do not need record marks.

NOTE: Tape records with record marks as data will be considered as variable length blocked records. The data between each record mark will be printed on a separate line. The record marks will not print.

The maximum block length is 1001 characters when no binary operation is being performed at the same time, and 666 characters when a binary operation is being processed. The maximum size of any record within a block is 132 characters.

Spacing or skipping between records can be controlled either by the control card, or by the first character of the record.

Records are printed on the basis of one record per line in exact tape image, except when using first character forms control. The first character will not be printed when using first character forms control. Tape Unit 2 must always be used for any tape-to-printer operation.

MULTIPLE TAPE UTILITY PROGRAM  
OPERATING PROCEDURES FOR IBM 1401

OPERATING INSTRUCTIONS

A. Setup

1. Tape-to-Printer
  - a. Place proper form in printer.
  - b. Place proper forms control paper tape in printer.
  - c. Ready printer.
  - d. Ready Tape Unit 2.
  - e. Set sense switch C to on.
2. Tape-to-Card
  - a. Place proper card form in punch hopper.
  - b. Ready punch.
  - c. Ready Tape Unit 3.
  - d. If operation is in BCD mode, set sense switch D to on.
  - e. If operation is in Column Binary mode, set sense switch F to on.
3. Card-to-Tape
  - a. Place control card, then the data cards in read hopper.
  - b. Ready card reader.
  - c. Ready Tape Unit 1.
  - d. Set sense switch A to on.
  - e. If operating in BCD mode, set sense switch B to on.
  - f. If operating in column binary mode, set sense switch G to on.
  - g. If operating in mixed BCD and column binary modes, set sense switches B and G to on.

NOTE: When the last card has left the read hopper, the machine will automatically halt. The Start key must then be pressed to process the last card.

4. All Utilities

- a. Set mode switch to RUN.
- b. Set tape selector switch to N.
- c. Press Start Reset switch.
- d. Place program deck in read hopper.
- e. Place control card in read hopper.
- f. Press the Load key.

NOTE: This program should not be manually halted (depression of the Stop key).

B. Redundancy Records

The 1401 makes ten attempts at reading a redundant record in tape-to-card or tape-to-printer mode. If the record remains redundant after ten attempts, the operator can either accept the record as is and continue processing, or he can correct the record as follows:

1. Set the tape select switch to the number of the selected tape drive.
2. Manually backspace the tape.
3. Set the tape select switch to D.
4. Restart the program at one of the following locations to read the record again:
  - a. Location 1031 for tape-to-printer operations.
  - b. Location 0900 for tape-to-card operations in BCD mode.
  - c. Location 2276 for tape-to-card operations in Column Binary mode.
5. Set the mode switch to STORAGE SCAN and scan one of the following tape read-in areas to locate the redundant characters:
  - a. Locations 0101-0180 for tape-to-card operations in BCD mode.
  - b. Locations 2995-3995 for tape-to-printer operations.
  - c. Locations 2995-3665 for tape-to-printer operations in Column Binary mode.
6. Set the tape select switch to N, depress the start reset key, and restart the program at one of the following locations:
  - a. Location 1072 for T to P.
  - b. Location 0938 for T to C in BCD mode.
  - c. Location 2321 for T to C in Column Binary mode.

When the operator locates the redundant characters, he can make the necessary corrections manually.

When tape redundancies occur during a card-to-tape operation, an additional attempt is made to rewrite a record. If the redundancy persists, the program erases forward and tries again. When a total of 50 erase-forward conditions have occurred, the program halts. (The count of 50 refers to attempts within a reel, not within a file.) After 50 write redun-

dancies, the card-to-tape operation should be restarted on a new tape reel.

To restart on a new reel, set the interrupt switch (E) on, and press START. When the program halts (location 2038), dismount reel on Tape Unit 1, replace with a new reel, set appropriate sense switches, set E off, and press START.

## CONTROL CARD

When loading the program deck into the machine, a control card should immediately follow the program deck. Punches in the control card can specify forms control for the tape-to-printer operation, convert the group-mark punching from IBM 1401 coding (12-7-8) to IBM 705 coding (12-5-8) or vice versa, and control skipping of files on the tape reel. If the program needs no control information, a blank card must follow the program deck.

### Control Card Format

Column 1: Punch a one (1) in column 1 when column 2 or 3 is punched, or the print storage special feature is not installed. When columns 2 and 3 are not punched and print storage special feature is installed, leave column 1 blank.

Column 2: Tape-to-printer forms control:

- Blank - Single space
- 2 - Double space
- 3 - Triple space
- 4 - Program governs forms control (space-suppress character causes single spacing)
- 5 - Program governs forms control (space-suppress character causes record bypass)

When the control card specifies that the program governs forms control, the first character of each tape record determines line spacing. The forms control characters are:

<u>Character</u>	<u>Operation</u>
&	Suppress spacing
Blank	Single space
0	Double space
- (11 punch)	Triple space
1-9 or J-R	Skip to channels 1-9

Column 3: 705 Group-mark conversion:

Blank - No group-mark conversion.

1 - (Card-to-tape operation) convert 705 group marks (12-5-8) to 1401 group marks (12-7-8).

2 - (Tape-to-card operation) convert 1401 group marks to 705 group marks.

3 - Make both group-mark conversions.

Column 4: Unused.

Columns 5-6: The number of files to be skipped at program load time on Tape Unit 1 (card-to-tape).

Columns 7-8: The number of files to be skipped at program load time on Tape Unit 2 (tape-to-printer).

Columns 9-10: The number of files to be skipped at program load time on Tape Unit 3 (tape-to-card).

## PROGRAM INTERRUPTION

Interruption of the program may be desired for either of two reasons:

1. To enter a new control card (a new control card is only required when the information from the old control card is no longer applicable).
2. To change processing functions.

### Entering a New Control Card

- a. Turn sense switch E on. (Program will halt at 2052.)
- b. Leave E on and press START. (Program halts at 2122.)
- c. Run out cards from the card reader (only necessary when interruption occurs during a card-to-tape operation).
- d. Remove the last two (2) cards from the read stacker and place them in front of the unprocessed cards.
- e. Place new control card as the first card in the read hopper (only insert the control card in the read hopper when card-to-tape is not in operation).
- f. Turn sense switch E off and press START.

### Changing the Processing Function

To change the processing functions:



- a. Turn sense switch E on (program halts at 2052).
- b. Set the appropriate sense switches on.
- c. Set sense switch E off and press START (if the information in the initial control card is still valid).
- d. To enter a new control card, leave sense switch E on and press START. The program will halt at location 2122.

During the tape-to-printer function, the interruption occurs after a complete blocked record has been processed. An interruption never occurs in the middle of a blocked record.

Whenever a card-to-tape mixed binary function is in operation, the user should not attempt to interrupt for purposes of processing another card-to-tape operation with the intention of returning to the interrupted card-to-tape mixed binary operation later on. Because of the necessity of holding a card image in core (for "look-ahead" purposes), an attempt to process a different card-to-tape operation during interrupt will cause this card image, or effectively, one record, to be lost.

The program will halt when all operations are complete (End of Job halt, 2774).

#### PROGRAM HALTS

##### I-Address Register

- 1292 Fifty (50) erasures have occurred on Tape 1. The job must be re-started.
- 1302 End of reel condition for BCD records on Tape 1. Rewind tape, insert new reel and press START to continue.

2052 Interrupt switch (sense switch E) has been set. To change the operation(s), set sense switches to appropriate settings. Reset sense switch E off and press START to continue if no control card change is desired.

To enter a new control card, leave sense switch E on and press START. The program will halt at location 2122.

2122 A change in the control card is desired. Refer to Program Interruptions for restart procedure. If this halt was reached due to a failure to reset sense switch E, and a new control card is not desired, the same procedure should be followed, re-inserting the initial control card.

2774 End of Job halt. All operations called for by the sense switch settings have been completed. The operation may be continued by setting sense switches to the desired mode and pressing START. To enter a new control card, set sense switch E on and follow the procedure for entering a new control card.

2984 The same as 1302 for binary records.

2988 Signifies that the program has unsuccessfully tried to read Tape Unit 3 (binary) ten (10) times. See Redundancy Records for restart procedure.

1353 The same as 2988 for BCD records.  
2992 The program has unsuccessfully tried to read Tape Unit 2 ten (10) times. See Redundancy Records for restart procedure.



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