



## Systems Reference Library

### Utility Programs for IBM 1401 Tape Systems – Specifications

Describes three utility programs that facilitate translating data: card-to-tape, tape-to-card, and tape-to-printer. These programs enable 1401 tape systems to perform operations now done off-line by 700/7000 series auxiliary equipment. Minimum machine requirements are the 1401 Model C3 and the high-low-equal compare feature. To process binary tape records or column-binary cards requires also the column-binary feature.

MINOR REVISION (April, 1963)

This publication, J24-1411-2, is a minor revision of J24-1411-1 with the format changed to conform to that of the Systems Reference Library.

Changes and corrections have been made to:

*Card-to-Tape Program*

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2. Intermixed BCD and column binary records, page 4
3. Terminal record mark option, Figure 5 and page 10
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*Tape-to-Card Program*

1. First control card field changed from "characters per block" to "characters per record," pages 14 and 15

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1. Use of control-card column 80, page 34

## Utility Programs for IBM 1401 Tape Systems — Specifications

Three IBM 1401 utility programs that facilitate the transcription of data between tape, cards, and printed reports are:

1. Card-to-Tape
2. Tape-to-Card
3. Tape-to-Printer

These operations, currently being performed on IBM 700/7000 Series auxiliary equipment as off-line operations, can now be performed on the IBM 1401 tape system. Although the primary function of these programs is to simulate present off-line operations, the programs offer many features that make them much more flexible than off-line operations. The programs can, within limitations, accommodate magnetic tapes and card decks prepared on any IBM system.

The minimum machine configuration required by these utility programs, for the 1401 system, is:

IBM 1401 Processing Unit, Model C3 (4,000 storage positions)

IBM 1402 Card Read-Punch

IBM 1403 Printer, Model 2

IBM 7330 or 729 Magnetic Tape Unit, Model II or IV (at least one)

High-Low-Equal Compare special feature

Column Binary special feature (needed only if binary tape-records or column-binary cards are to be processed).

Sense Switches special feature

### Organization of Data on Tape — BCD Mode

Information is recorded on magnetic tape as magnetized spots, or bits, located in seven parallel channels, or tracks, along the length of the tape. A single character in the binary-coded-decimal (BCD) mode is written on tape in a single column across the width of the tape. The seven bit-locations in the tape width correspond to seven magnetic cores in a single storage location (Figure 1). The word-mark bit location is absent on tape. The only difference is in the function of the check (C) bit. When a character is recorded on tape, even-parity is maintained. In other words, if the character in question contains an odd number of

bits, the check bit is recorded to make the number even. In core storage the opposite is true; odd parity is maintained.

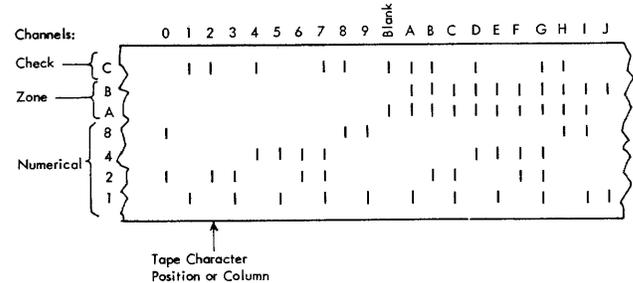


Figure 1. Magnetic Tape Data in the BCD Code

### Tape Records, Inter-Record Gaps

A tape record is a group of characters that is physically separated from other groups of characters on the tape. Characters within a tape record are contiguous; there is no unused tape between them. (Note: A "blank" character on tape is not void of bits. It is written as an A-bit and a C-bit.) Tape records are separated from each other by an inter-record gap — a length of unused tape about  $\frac{3}{4}$ -inch long. During writing, the gap is automatically produced at the end of a tape record. During reading, the tape record begins with the first character sensed after an inter-record gap and continues without interruption until the next gap is reached. A single tape-record is therefore recognized by inter-record gaps before and after data (Figure 2).

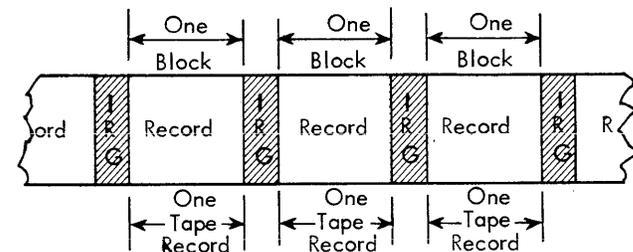


Figure 2. Fixed Length, Single-Record Blocks

## Blocking

A *tape record* (contiguous characters on tape preceded and followed by inter-record gaps) should be distinguished from a *data record* (more often referred to as a *record*). A record in the latter sense contains information treated as an individual unit by the program during input and output. During normal card-to-tape operation, a single card-input record is usually written on tape as a single tape-record. This procedure is often uneconomical, however, in terms of processing time and tape space. Therefore, it is sometimes advisable to perform blocking of input records before output on tape.

Blocking is the process of writing two or more input records on tape, without inter-record gaps. In this case, a tape record contains more than one input record. When blocking on tape is performed, the terms *tape record* and *block* are often used interchangeably. Figure 3 shows four input-records that have been blocked on tape to form a single tape-record, or block.

## Record Marks

The card-to-tape program in this bulletin specifies that blocking can be performed only with fixed-length input records (Figure 3). Tapes written on other systems, however, may contain tape records composed of blocked, variable-length data records (Figure 4). In these cases, each data record within the tape record, except the last, must end with a *record mark* ( $\neq$ ), so that the tape-to-printer program in this bulletin can

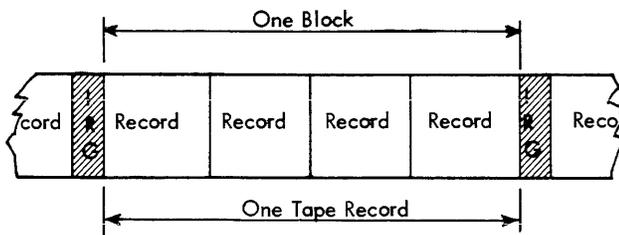


Figure 3. Fixed Length, Multiple-Record Blocks

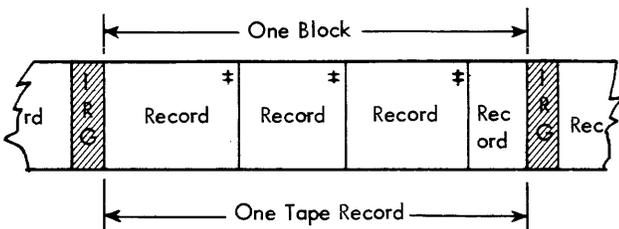


Figure 4. Variable Length, Multiple-Record Blocks

distinguish data records within the tape record prior to printing. The BCD bit-configuration of a record mark on tape is C, A, 8, 2.

The tape-to-card program described here will not accommodate tape records containing variable-length data records. Record marks are unnecessary for tape records containing multiple fixed-length data records.

## Tape Mark

A tape mark is written on tape to indicate the end of a file of information. The tape mark is a single character with a bit configuration of 8, 4, 2, 1. The tape mark, although it is only a single character, is considered a tape record, because it is preceded and followed by an inter-record gap.

## Tape File

A tape file is a series of related tape records that are written on tape during one pass in a card-to-tape operation. The last tape-record of a file is always followed by a tape mark.

## End-of-File, End-of-Reel

A single tape-reel may contain any number of files of information. When this is the case, an inter-record gap, a tape mark, another inter-record gap, and the first tape-record of the succeeding file follow the last tape-record of a file. Therefore, the presence of a tape mark always indicates an end-of-file condition. In addition to an end-of-file identification, every tape reel must have its end-of-reel identified so that the program can prevent the tape from running off the spool during tape reading. The tape-to-card and tape-to-printer utility programs in this bulletin have several provisions for recognizing an end-of-reel:

1. Multiple tape marks — two or more tape marks in succession, after a tape record, indicate both an end-of-file and an end-of-reel, and cause the program to enter an end-of-reel routine.
2. Trailer label — a trailer label, usually preceded and followed by tape marks, indicates an end-of-reel. A trailer label is recognized as such, however, only if its specifications are included in the control cards, which must accompany each program.
3. A single tape-mark signifies an end-of-reel, *if*:
  - a. the exact number of files to be read by the program is specified in the control card(s); or,
  - b. the number of files on the tape is unknown and the machine is instructed by the program to halt after each file is read; in this case, the operator must manually inspect the tape to determine if an end-of-reel has been reached.

### Header and Trailer Labels

Header and trailer labels are often written on magnetic tape so the operator can identify the contents of the reel and learn other pertinent information about the tape. These labels, in the form of tape records, are usually written as the first and next-to-last tape record on the reel. (The last tape-record is, of course, a tape-mark.) A header label can have a maximum of 160 characters. It usually contains a tape serial number, a sequence number, creation date, retention cycle, and an indication of the format of the tape records on the reel. It can also contain any information the user wants to include. The trailer label is limited to eighty characters. It, too, can contain any information the user desires.

Although the use of header and trailer labels is not mandatory, it frequently facilitates tape handling. The three utility programs described in this bulletin all make provision for the optional use of header and trailer labels.

### Card-to-Tape Program

The card-to-tape program provides for writing information, contained in punched cards, on magnetic tape. Its primary purpose is to perform in the 1401 system card-to-tape operations that are currently being performed as auxiliary or off-line operations. Input operations that have been performed in the IBM 714 Card Reader and the IBM 759 Card Reader Control can now be performed in the IBM 1402 Card Read-Punch.

In addition to single card-to-tape record output, this program provides these options, which increase the flexibility of card-to-tape operations:

- An input record can consist of any fixed number of cards up to 99.
- Data within input card records can be rearranged before output.
- Up to 16 fields can be selected for output on tape.
- Data records can be blocked on tape.
- More than one card file can be written on a single tape reel without reloading the program.
- An exception procedure is provided so that certain input records can be treated differently from the usual procedure.
- Sequence-checking of input records before output can be performed.
- Cards within multiple-card input records can be sequence-checked before output.
- A header label and a trailer label can be written at the beginning and end of a job, respectively. Or, header and trailer labels can precede and follow each file.
- An IBM 705 group mark in cards can be converted to an IBM 1401 group mark when it is written on tape.

- If the 1401 system being used has the column binary device, the card-to-tape program can accommodate column binary cards, and can write binary tape records. This program does not accommodate row binary cards. If row binary cards are erroneously read in, the resulting output on tape is meaningless.
- A count of the number of data cards read (exclusive of header and trailer labels) and the number of data records written on tape (exclusive of header and trailer labels) are printed out after each file is processed.

### General Description

The card-to-tape program performs various card-to-tape operations in accordance with specifications punched by the user in up to three control cards.

For convenience, data cards can be grouped into records. The program treats these records as individual units. The length of an input record is left to the discretion of the user and can consist of 1 to 99 cards. However, all input records within a single job must contain the same number of cards. Otherwise, although the program will not halt, the output on tape will be incorrect. Header- and trailer-label records do not have to be the same length as data records.

After processing, all control cards and data cards are selected into stacker 1 of the IBM 1402 Card Read-Punch.

### BLOCKING

Data records can be blocked during output. A block consists of two or more data records not separated by inter-record gaps. The number of data records in one block is called the *blocking factor*. Blocks must be fixed in length for this program.

Files composed entirely of BCD records can have a maximum block length of 1499 characters. Files composed entirely of binary records can have a maximum block length on tape of 1599 characters. Note that because a binary record requires twice as many locations in storage as it does in cards, the maximum block length for binary input records is 798 characters. Thus, input blocking of 798 in column binary card records will result in a block length of 1596 characters when written on tape. Files containing intermixed BCD and binary records cannot have output blocking.

### MULTIPLE FILES

It is possible to write several files on a single tape-reel without reloading the program. If more than one file is to be written, all files in the job must have identical control card specifications. When more than one file is being processed in a single run, only one card file can be fed into the read hopper at a time. When the machine has completed action on the first file, a program

stop occurs. The user then places the second card-file in the read hopper and presses the start key. This process is repeated for each card file to be written.

Because this program automatically tests for the end-of-reel reflective spot after writing each tape record, it is possible to write files that occupy more than one reel. When an end-of-reel is reached, the machine stops. Pressing the start key causes the machine to process a trailer record, if sense switch B is on, and to stop at the end-of-file halt. Remove the remainder of the cards from the hopper and run out the two cards in the reader by pressing the non-process run-out key. Place the two cards, which were selected into the normal stacker, in front of the remaining cards in the file. If header or trailer cards are to be used, place them in front of the file. Place the file in the reader, ready a new tape reel, and press the start key to continue processing. If input card-files are unlike, separate control-cards should be prepared for each, and the program should be reloaded for each.

#### LABELS

This program writes header labels and/or trailer labels, if the user desires them. A header label and a trailer label can be written at the beginning and end, respectively, of a job. If more than one file is being written on a reel, the user can precede each file with a header label and/or follow each file with a trailer label. A tape mark can be written after each header label. A tape mark is written automatically after each trailer label. Also, a tape mark is written after the last data record of each file, whether or not a trailer label is included.

#### EXCEPTION RECORDS

It is often desirable, during a card-to-tape operation, to treat certain input records differently from the usual procedure. The user may wish to bypass certain input records, or perhaps he may wish to print them out or punch them into cards. A feature of this program makes such action possible. A code punched in the first control card enables the program to recognize card records that are to be excepted from normal card-to-tape procedure. These bypassed records can be printed, punched, selected into a particular stacker, or bypassed entirely.

#### GROUP-MARK CONVERSION

An IBM 705 group mark (12-5-8) in cards can be converted to an IBM 1401 group mark (12-7-8) when it is written on tape. This conversion, if desired, is specified by the user in the control card.

#### SEQUENCE CHECKING

This program can perform two types of sequence checks: inter-record and intra-record. Inter-record sequence checking is performed by comparing one, two,

or three fields from record to record. These fields can be called major, intermediate, and minor. Their functions are described in the discussion of control-card format. Intra-record sequence checking can be performed on input records containing more than one card. One or two columns of each card in the record can be used for this purpose. In intra-record sequence checking, the program tests only the numerical portion of the sequencing characters.

#### SELECTIVE OUTPUT

This program permits tape output of certain, selected fields from each input record. These fields can vary in length from one to eighty columns. A maximum of 16 fields (including fields of blanks and fields of single repeated characters) can be selected for output. Fields of blanks and fields of selected characters can contain a maximum of 99 characters. Fields of group marks cannot be selected for output.

When a selected field is written on tape, a word mark is placed at its high-order position. Therefore, a 1401 group mark should not be the first character of a selected field, because this forms a group mark with a word mark and causes tape writing to stop. This restriction also applies to IBM 705 group marks (12-5-8) if the user has specified that they are to be converted to 1401 group marks.

#### COLUMN BINARY CARDS

(Note: This section is applicable only if the column binary device is available in the IBM 1401 system being used.)

The IBM 1401 Data Processing System is often used with other IBM systems, such as the IBM 704, 709, and 7090. All these systems operate with data in absolute binary form. It therefore may be necessary to write tapes on the 1401 in binary as well as binary-coded-decimal (BCD). This utility program is capable of writing column binary cards on tape in a form compatible with other IBM data processing systems. Input may consist entirely of column binary cards, or column binary cards intermixed with BCD cards. In the intermixed mode, column binary and BCD records cannot be blocked on tape. Column binary cards must have 7 and 9 punches in column one. The resulting tape records will be 84 characters long for BCD cards and 168 characters for column binary cards. The last four characters of BCD records and the last eight characters of column binary records are written automatically by this program to provide a *look ahead* feature that enables the machine to distinguish BCD records from column binary records during tape reading.

Files containing all column binary cards can be blocked on tape. In this case, the 7 and 9 punches are not required.

With the tape-to-card utility program described elsewhere in this bulletin, binary records are punched as column-binary cards and BCD records are punched as BCD cards. The program, prior to punching, inspects the look-ahead characters to determine whether the following tape-record is binary or BCD. During punching, however, the look-ahead characters are not punched. These look-ahead characters are utilized only during punch output, and they are acted upon internally by the machine. The user of this program need never concern himself with these characters. (*Note:* The tape-to-printer utility program in this bulletin makes no provision for binary records. Any attempt to print out binary tape records on the 1403 printer produces meaningless data.)

### Control Cards

This utility program requires a maximum of three control cards to specify the necessary information about the cards being read and the tape records to be written. Individual applications can require one, two, or three of the control cards. Figures 5, 6, and 7 show the formats of control cards 1, 2, and 3 respectively.

When the control cards are prepared, punch leading zeros in fields that contain information. For example,

in control card 1, the record-length field (columns 1-4) should be punched 0300 if the output records contain 300 characters. Unused fields should always be blank.

The user prepares the control cards according to the formats shown. Figure 5 shows the card columns of the first control card.

### RECORD BLOCKING (COLUMNS 1-8)

*Columns 1-4:* These are punched with the number of characters per output record. This program accommodates only fixed-length records. If intermixed binary and BCD records are processed, these columns are punched 0168. (*Note:* If input is composed entirely of column binary records *without the look-ahead feature*, columns 1-4 are punched with the number of characters per *input* record.)

*Columns 5 and 6:* These are punched with the number of cards per input record. If the input file contains any column binary records, these columns must be punched 01.

*Columns 7 and 8:* These are punched with the blocking factor. This is the number of records per block on tape. When you establish the blocking factor,

Record Blocking								Files Ctrl		Exception Identification and Action										Intra-Rec Seq Ck	Tape Labels																								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40						
Characters per Output Data Record				Cards per Rec.		Block-ing Factor		No. of Files		Group Mark Conversion		Exception Procedure Code		Logical Comparison Option		1st Exception Char. Code		1st Exception Char. Code		First Exception Character Location		2nd Exception Character		2nd Exception Char. Code		Second Exception Character Location		Seq. Num-bering Field (High-Order)		Unused Column		Column Binary Card Control		Header Label Length		Trailer Label Length		Trailer Label Location Code		Tape Mark Option		Padding Character		Record Mark Option	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40						

Inter-Record Sequence Checking								Selective Field Output																															
Tape Unit Number	No. of Flds to be Seq. Chkd	No of 1st Field to be Seq. Chkd	No of 2nd Field to be Seq. Chkd	No of 3rd Field to be Seq. Chkd	No. of Sel. Fields	Field No. 1						Field No. 2						Field No. 3																					
						Card No.	First (High-Order) Character Location		Na of Characters		Card No.	First (High-Order) Character Location		Na of Characters		Card No.	First (High-Order) Character Location		Na of Characters																				
						Card Col.	Tape Position (Within Record)				Card Col.	Tape Position (Within Record)				Card Col.	Tape Position (Within Record)																						
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

Figure 5. Control Card 1 — Card-to-Tape

remember that a block can contain no more than 1499 characters. If an input file contains intermixed binary and BCD records, blocking is not permitted and these columns must be punched 01. If an input file is composed entirely of binary records, maximum tape record (block) length is 1599 characters.

**FILES CONTROL (COLUMNS 9 AND 10)**

Columns 9 and 10 are punched with the number of card files to be processed. If more than one file is to be handled, the input card files must be placed in the read hopper one by one. A program stop occurs when one file is completed. The user then places the next card file in the read hopper and presses the start key. This is repeated for each file.

**GROUP MARK CONVERSION (COLUMN 11)**

An IBM 705 group mark (12-5-8) in cards can be converted to an IBM 1401 group mark (12-7-8) when it is written on tape. If this conversion is desired, 12-5-8 punches are placed in column 11. If the conversion is

not desired, column 11 is left blank. Note that if the converted group mark is the high-order character in a field selected for output, the record containing that field will be written incorrectly on tape.

**EXCEPTION IDENTIFICATION AND ACTION (COLUMNS 12-25)**

By using columns 12-25 of the first control card, entire records can be excepted (excluded) from the usual card-to-tape operation. These exception records can be printed-out, punched in cards, selected into specified stackers, or simply bypassed, at the discretion of the user. The program causes the machine to inspect one or two locations in each card record to determine whether the record is to be excepted from normal procedure. The characters in these locations are compared with constant exception characters punched in the control card. Exception characters may be any alphanumerical character or special symbol. The exception character locations must be the same in each record. If exception records are to be *printed, punched,*

Field No. 4										Field No. 5										Field No. 6										Field No. 7									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Card No.	First (High-Order) Character Location		No. of Chars.							Card No.	First (High-Order) Character Position		No. of Chars.							Card No.	First (High-Order) Character Location		No. of Chars.						Card No.	First (High-Order) Character Location		No. of Chars.							
	Card Col.	Tape Position (within Record)									Card Col.	Tape Position (within Record)									Card Col.	Tape Position (within Record)								Card Col.	Tape Position (within Record)								Card Col.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40

Field No. 8										Field No. 9										Field No. 10										Field No. 11									
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Card No.	First (High-Order) Character Location		No. of Chars.							Card No.	First (High-Order) Character Location		No. of Chars.							Card No.	First (High-Order) Character Location		No. of Chars.						Card No.	First (High-Order) Character Location		No. of Chars.							
	Card Col.	Tape Position (within Record)									Card Col.	Tape Position (within Record)									Card Col.	Tape Position (within Record)								Card Col.	Tape Position (within Record)								Card Col.
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

Figure 6. Control Card 2 — Card-to-Tape

or *stacker-selected*, both exception character locations must be in the first card of each record. If exception records are to be *bypassed*, the exception character locations can be anywhere in the input record. If no records are to be excepted, columns 12-25 of the control cards should be left blank. Only one exception procedure can be used for a single job.

**Column 12:** This is punched with the exception procedure code. This code specifies the special procedure to be taken when a record that is to be excepted is recognized. The possible exception procedures and their codes are:

- 0-punch Bypass excepted records.
  - 2-punch Select excepted records into stacker 8/2.
  - 3-punch Print excepted records.
  - 4-punch Punch excepted records.
- Only one exception procedure may be specified in column 12.

**Column 13:** This column is punched with the logical comparison option. This specifies the logical relationship between the first and second exception characters (columns 14 and 20 respectively, of the control card) that determines whether a record is to be excepted.

a) A 1-punch in column 13 specifies an *and* comparison. This means an exception record is recognized when the character in the first exception-character location in the record matches the exception character punched in column 14 of the control card, and the character in the second exception-character location in the record matches the exception character punched in column 20 of the control card.

b) A 2-punch in column 13 specifies an *or* comparison. This means an exception record is recognized when either or both of the two exception characters punched in columns 14 and 20 of the control card matches the character in the corresponding exception location in the card record.

When only one exception-character location is used, column 13 is left blank.

Field No. 12										Field No. 13						Field No. 14						Field No. 15																	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Card No.		First (High-Order) Character Location		Card Col.		Tape Position (within Record)		No. of Chars.		Card No.		First (High-Order) Character Location		Card Col.		Tape Position (within Record)		No. of Chars.		Card No.		First (High-Order) Character Location		Card Col.		Tape Position (within Record)		No. of Chars.		Card No.		First (High-Order) Character Location		Card Col.		Tape Position (within Record)		No. of Chars.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40

Field No. 16										
41	42	43	44	45	46	47	48	49	50	51
Card No.		First (High-Order) Character Location		Card Col.		Tape Position (within Record)		No. of Chars.		Unused Columns
41	42	43	44	45	46	47	48	49	50	51

Figure 7. Control Card 3 — Card-to-Tape

**Column 14:** This is punched with the first exception character. Any valid character or symbol can be used. The program compares it with the character in the first exception-character location in the card record. (This location is punched in columns 16-19 of the control card.) The exception character can contain both a numerical and a zone portion, or it can contain a zone portion alone or a numerical portion alone. A zero-punch is a numerical punch. The extent to which the program compares these characters is governed by the punch in column 15.

**Column 15:** This is punched with the first exception-character code. This code governs the extent to which the character in the first exception-character location of the record is compared to the character in column 14 of the control card. The six valid codes are:

1-punch — The program tests for the presence of both the zone and numerical portions of the first exception-character location in the input record.

2-punch — The program tests for the absence of both the zone and numerical portions of the first exception character in the first exception-character location in the input record.

(Note: The word “absence” in connection with control columns 15 and 21 means that the exception-character location contains any configuration other than the configuration of the exception character punched in the control card.)

A-punch — The program tests for the presence of the zone portion of the first exception character in the first exception-character location in the input record.

B-punch — The program tests for the absence of the zone portion of the first exception character in the first exception-character location in the input record.

J-punch — The program tests for the presence of the numerical portion of the first exception character in the first exception-character location in the input record.

K-punch — The program tests for the absence of the numerical portion of the first exception character in the first exception-character location in the input record.

The punches required in column 15 of the control card to specify each of the six possible conditions outlined above are summarized in Figure 8.

First Exception Character	Presence in Record	Absence from Record
Full Character	1	2
Zone Portion Only	A	B
Numerical Portion Only	J	K

Figure 8. Punch in Column 15

**Columns 16-19:** These are punched with the first exception-character location in the card records. The card number within each record in which this character is located is punched in columns 16 and 17; the column number is punched in columns 18 and 19. Exception records that are to be punched, printed, or stacker-selected, require both exception-character locations in the first card of each record.

**Column 20:** This column is punched with the second exception character. Any valid character or symbol may be used. The program compares it with the character in the second exception-character location in the card record. (This location is punched in columns 22-25 of the control card.) The extent to which the program compares these characters is governed by the punch in column 21.

**Column 21:** This is punched with the second exception-character code. This code governs the extent to which the character in the second exception-character location of the record is compared with the character in column 20 of the control card. The six punches used in column 15 are also applicable in column 21. Column 21 controls the test for the second exception character in the same manner that column 15 controls the test for the first exception character.

**Columns 22-25:** These are punched with the second exception-character location in the card records. The position of the card within each record in which this character is located is punched in columns 22 and 23; the column number is punched in columns 24 and 25.

**Example:** Here is an example of exception identification and action. In this case, all card records that contain the number 6 as the full character in the first exception-character location, but do not contain an 11-punch as the zone portion in the second exception-character location, are to be printed out instead of being written on tape. The first exception-character location is column 40 of the first card in each record. The second exception-character location is column 72 of the first card in each record. In this example, columns 12-25 of the first control card are punched as shown in Figure 9.

#### INTRA-RECORD SEQUENCE CHECKING (COLUMNS 26 AND 27)

This program enables the user to check sequencing of cards within multiple-card records before they are written on tape. Columns 26 and 27 of the first control card are used for this function. If card sequence checking is performed, a program stop results when an out-of-sequence card is encountered. If sequence checking of cards is not desired, columns 26 and 27 are blank.

Column 12	3	Exception records are to be printed.
Column 13	1	An <i>and</i> comparison — the two exception characters in columns 14 and 20 of the control card must both agree with the characters in the exception-character locations in the record in accordance with the codes in columns 15 and 21.
Column 14	6	The first exception character is a 6.
Column 15	1	The program tests for the presence of the full character in the first exception-character location.
Columns 16 and 17	01	The card in which the first exception character is located.
Columns 18 and 19	40	The column in which the first exception character is punched.
Column 20	11-punch	The second exception character.
Column 21	B	The program tests for the absence of the zone portion in the second exception-character location.
Columns 22 and 23	01	The card in which the second exception character is located.
Columns 24 and 25	72	The column in which the second exception character is punched.

Figure 9. Example of Exception Identification and Action

Columns 26 and 27 are punched with the location of the field in which sequence numbers appear within each input record. If there are ten or more cards per record, two columns are sequence-checked. If there are fewer than ten cards per record, one column is sequence-checked. If the sequence number occupies two columns (indicating ten or more cards per record), columns 26 and 27 of the control card are punched with the high-order position of the sequence number field. (Example: If each input record contains twenty cards, and the sequence numbers are punched in columns 79 and 80 of each card, then columns 26 and 27 of the control card are punched with a 79.) No more than two columns can be used for intra-record sequence checking.

#### UNUSED COLUMNS (COLUMNS 28 AND 29)

Columns 28 and 29 of the first control card are unused and should be left blank.

#### COLUMN BINARY CARD CONTROL (COLUMN 30)

A 0- or a 1-punch in column 30 enables the program to process input files containing column binary records. A 1 should be punched in column 30 when the input file contains intermixed column binary and BCD records. If the input file contains only column binary records, a zero should be punched in column 30, unless the look-ahead feature is desired, in which case a 1 is punched in column 30. In the latter case, column binary records will be written on tape in 168-character-per-record format. If column 30 contains a 1-punch, all column binary cards must have 7- and 9-punches in column 1. If there are no column binary cards, column 30 is left blank, unless the user wants to write BCD cards in the 84-character record format associated with the column-binary mode. The IBM 1401 system must be equipped with the column binary device if column binary cards are to be processed. The presence of a 0-punch or a 1-punch in column 30 creates several limitations on the operation of the card-to-tape program:

1. Only single card input records are acceptable.
2. Field selection is not possible.
3. No records may be excepted from normal card-to-tape procedure.

#### TAPE LABELS (COLUMNS 31-38)

Columns 31-38 contain the specifications of all header and trailer labels to be written on tape. A header label can be written at the beginning of a job; a trailer label can be written at the end of a job. If a job contains more than one file, the user can, if he prefers, write a header label or a trailer label or both, for each file.

The contents of header and trailer labels, when used, must be punched into cards just as they will appear on tape. Header labels can contain a maximum of 160 characters and must be contained in one or two cards. Trailer labels can have maximum length of 80 characters. They are punched in one card.

If one header and one trailer label per job is desired, the header label card (s) and the trailer label card must be inserted between the end card and the first card of the data deck. If labels are desired for each file on a reel, the label cards must precede each file as it is fed into the machine.

*Columns 31-33:* These are punched with the length of the header label used. If more than one header label is written and these labels vary in length, the length of the longest is punched in columns 31-33.

**Column 34:** This is punched with the header-label location code. If a header label is written only at the beginning of a job, leave this column blank. If a header label is desired for each file, punch N.

**Columns 35 and 36:** These are punched with the length of the trailer label. If more than one trailer label is written and these labels vary in length, the length of the longest is punched in columns 35 and 36.

**Column 37:** This is punched with the trailer-label location code. If a trailer label is to be written only at the end of a job, leave this column blank. If a trailer label is desired for each file, punch N.

**Column 38:** If this column is blank, tape marks are automatically written after each header label. If a tape mark is not desired after header labels, a 1 is punched in this column. Note that a tape mark is always written after each trailer label.

#### PADDING OF SHORT BLOCKS (COLUMN 39)

If the last block of a file contains fewer than the number of records specified in columns 7 and 8 of the first control card, the block will be *padded*, or filled out, to its proper length with whatever character is punched in column 39. If column 39 is blank, short blocks are filled with blanks.

#### RECORD MARK OPTION (COLUMN 40)

If a record mark is desired at the end of a padded block, punch an R in this column.

#### TAPE UNIT NUMBER (COLUMN 41)

Column 41 is punched with the number of the magnetic tape unit that is used for output. Valid numbers are 1-6. The tape unit must have its address selection switch set to the number punched in column 41. If column 41 is left blank, the program automatically directs output to tape unit 1.

#### SEQUENCE CHECKING OF RECORDS (COLUMNS 42-48)

Columns 42-48 of the first control card are used in sequence checking of records within the card file before output. This operation is based on the program's ability to sequence-check from record to record, using information in as many as three different fields. These three fields can be located anywhere within an individual card record. They must, however, be located in the same place in every record.

**Column 42:** This is punched with the number of input record fields used in sequence checking. They must be one, two, or three of the maximum of 16 fields selected for output. If sequence checking of records is not desired, column 42 is left blank.

**Columns 43-48:** These are punched with the field numbers of the three fields used in sequence checking. The field specified in columns 43 and 44 can be referred to as the major field; it is checked first. The field specified in columns 45 and 46 can be referred to as the intermediate field; it is checked second. The field specified in columns 47 and 48 can be referred to as the minor field; it is checked last.

The numbers punched in columns 43-48 are derived from the numbers assigned to fields selected for output. Thus field 1 is the field defined in columns 51-60 of the first control card, field 2 is the field defined in columns 61-70 of the first control card, etc.

**Example:** Here is an example of record sequence checking. In this example, 16 fields from each card record are selected and written on tape. The first two selected fields are used for sequence checking. (Any of the 16 fields selected for output can be used. In this example fields 1 and 2 are used.) The first field used in sequence checking is columns 76-80 of the first card in each record. The second field used in sequence checking is columns 11-20 of the third card in each record. In this example, Figure 10 shows the punching for columns 42-70 of the first control card.

In the example in Figure 10, the program inspects column 42 of the control card to determine how many fields are used in sequence checking. (If this column is blank, sequence checking of records does not take place.) Because in this example column 42 contains a 2-punch, the program next inspects columns 43-44 and 45-46 to determine which fields are used in sequence checking. In this case field 1 and field 2 are used for sequence checking; the program next inspects columns 51-60 and 61-70 to learn the specifications of these fields.

The program checks the two major fields first. If the value of the second is greater than the first, the program ignores the intermediate and minor sequence checks and goes on to check the next record. If the two major fields are equal, the program checks the intermediate fields. If the second intermediate field is greater than the first, the program ignores the minor sequence check and goes on to check the next record. If the two intermediate fields are equal, the program checks the minor fields. If the second minor field is greater than or equal to the first, the program checks the next record. Thus equal minor fields are a valid condition in this program. An out-of-sequence condition (second field smaller than the first) always causes an error indication to be printed and the program is not interrupted.

Sequence checking of records is based on the value of the entire field being checked. It may be

Column 42	2	Number of fields used in sequence checking.
Columns 43 and 44	01	Number of first field used in sequence checking.
Columns 45 and 46	02	Number of second field used in sequence checking.
Columns 47 and 48	blank	Only two fields used in sequence checking.
Columns 49 and 50	16	Number of fields written on tape.
These ten columns define field 1.		
Columns 51 and 52	01	Number of card within record in which field 1 appears.
Columns 53 and 54	76	Location of high-order position of field 1 in input card.
Columns 55-58	0001	Location of high-order position of field 1 in tape record. (Assume that first character position in each tape record is numbered 0001.)
Columns 59 and 60	05	Number of characters in field 1.
These ten columns define field 2.		
Columns 61 and 62	03	Number of card within record in which field 2 appears.
Columns 63 and 64	11	Location of high-order position of field 2 in input card.
Columns 65-68	0006	Location of high-order position of field 2 in tape record.
Columns 69 and 70	10	Number of characters in field 2.

(Note: Fields 3-16 must also be defined, using the remainder of the first control card, plus control cards 2 and 3. In this example of sequence checking, however, only field 1 and field 2 have been defined.)

Figure 10. Example of Record Sequence Checking

numerical or alphabetic. The 1401 system considers numbers to be of higher value than letters. If an input record is identified as an exception record, it is not sequence checked. Sequence checking can only be performed by using fields that have been selected for output. Inter-record sequence checking and intra-record sequence checking may be performed simultaneously. An out-of-sequence condition in either case causes an error indication to be

printed and the program is not interrupted. (Note: The three fields used in record sequence checking can contain a total of no more than eighty characters.)

#### SELECTIVE FIELD OUTPUT (COLUMNS 49-80)

This program makes it possible to select fields from the input card record for output on tape. Up to 16 fields can be selected. It is also possible to write fields of blanks or fields of any specified character on tape. Columns 49-80 of the first control card, plus all of control card 2 and columns 1-50 of control card 3, are used for these operations. The number of fields selected determines whether cards 2 and 3 must be included.

Numbers are assigned to selected fields according to where they are defined on the control cards. Thus the field defined in columns 51-60 is known as field 1, the field defined in columns 61-70 is field 2, the field defined in columns 71-80 is field 3, etc. (see Figures 5, 6, and 7).

Columns 49 and 50 are punched with the number of input fields selected for output. This total includes fields of blanks and specified characters to be written. The maximum combined total is 16. If selective field output is not desired, columns 49-80 of control card 1 are left blank, and control cards 2 and 3 are not used.

Ten columns in the control card are devoted to each field selected for output. The first two of these columns (columns 51 and 52 of the first control card for field 1) are punched with the number of the card within the record in which the field is located. If a field of blanks or a field of any specified character is selected, these columns are punch II. The second two control columns (columns 53 and 54 for field 1) are punched with the number of the column in which the high-order character of the field is located. If a field of blanks is selected, these columns are left blank. If a single repeated character is selected, that character is punched in each of these columns. Fields of group marks cannot be selected for output. The next four control columns (columns 55-58 for field 1) are punched with the position in the tape record in which the high-order character of the field will be written. The first character location of every tape record is 0001. The final two control columns (columns 59 and 60 for field 1) are punched with the number of characters in the field selected.

In the example in Figure 10, the punches in columns 51-60 indicate that field 1 is located in the first card of each input record, that it is five characters long, that its high-order character is in column 76, and that it is written with its high-order character in position 0001 of each tape record.

The program's ability to write selectively offers the user a great deal of flexibility in card-to-tape operation:

1. Fields can vary in length from 1 to 80 columns. The only stipulation is that they appear in the same place in every input record.
2. Fields do not have to be written on tape in the same order as they appear in the input records. Thus field 1 can appear on tape after field 2 and field 3. However, the field specified as field 1 in the control card must precede in the input record the field specified as field 2 in the control card, etc.
3. More than one field from each card can be selected for output. Conversely, the input record can contain cards from which no output occurs.

As noted previously, sequence checking of records can be performed only by checking fields that have been defined for selective output. If the user wants to write from the entire card record, rather than to write only selected fields, he must define the entire record in terms of fields if inter-record sequence checking is to take place. This is done by using the *selective field output* section of the control cards.

For example, the user may wish to write on tape the entire contents of input records containing five cards each. Sequence checking of these records is performed by using columns 51-53 of the first card in each record. This can be done by breaking the input records into seven fields:

- Field 1 Columns 1-50 of first card
- Field 2 Columns 51-53 of the first card
- Field 3 Columns 54-80 of the first card
- Field 4 Columns 1-80 of second card
- Field 5 Columns 1-80 of third card
- Field 6 Columns 1-80 of fourth card
- Field 7 Columns 1-80 of fifth card.

Sequence checking can now be performed, using field 2. Although the entire input record is written on tape, it appears to the program to be in the field mode. Columns 42-48 of the first control card, the area reserved for defining sequence checking of fields, contain the information shown in Figure 11.

Column 42	1	Number of fields to be sequence-checked.
Columns 43 and 44	02	Field number of first field to be sequence-checked.
Columns 45 and 46	blank	Only one field is being sequence-checked.
Columns 47 and 48	blank	Only one field is being sequence-checked.

Figure 11. Example of Record Sequence Checking without Field Selection

The selective field output area of the control cards defines the seven fields. Columns 49 and 50 are punched 07 (the number of input fields selected for output). Columns 51-60 define field 1, columns 61-70 define field 2, etc.

#### CONTROL CARDS 2 AND 3

Control card 2 is used when 4-11 fields are selected for output. Control cards 2 and 3 are used when 12-16 fields are selected for output. (See Figures 6 and 7.)

#### SENSE SWITCHES

Sense switches A, B, and F perform functions that increase the flexibility of this program.

*Sense Switch A:* This switch must be ON in order to test for a last-card condition.

*Sense Switch B:* If an output file requires more than one tape reel, the position of SENSE SWITCH B determines whether or not a trailer label will be written at the end of the first reel. If the switch is ON, a trailer label exactly matching the contents of the trailer label card will be written at the end of the reel. If the switch is OFF, no trailer label will be written. In either case, when an end-of-reel occurs before a file is completed, new header and trailer cards must be inserted before processing is continued.

*Sense Switch F:* When turned ON, this switch causes the read-release feature to become inoperable for the remainder of the run. Read release should not be used when using the sequence-check option.

### Tape-to-Card Program

This program punches information from magnetic tape into cards; it performs 1401 tape-to-card operations formerly performed as auxiliary or off-line operations. Output operations that were performed on the IBM 722 Card Punch and IBM 758 Card Punch Control can now be performed on the IBM 1402 Card Read-Punch.

In addition to tape-record-to-card-record output, this program provides the following options, which increase the flexibility of tape-to-card operations:

- The program accepts fixed-length multi-record input blocks.
- Output records can be composed of one card or a number of cards.
- Variable-length records can be accommodated but they cannot be blocked on tape.
- Selection of input fields for output in selected card fields is possible.
- Sequence checking of tape records prior to output is possible.
- An exception procedure provides that certain input records can be bypassed, printed, stacker-selected, or printed and punched.

- Intra-record and intra-file sequence-numbering of cards is possible.
- A limited amount of additional information can be punched into each output record.
- One or more files can be punched during one operation.
- Limited selective file punching is possible.
- A header label, if present, can be checked, punched, or printed. A trailer label, if present, can be used only to test for an end-of-reel condition.
- Output can be printed as well as punched into cards.
- An IBM 1401 group mark (12-7-8) on tape can be converted to an IBM 705 group mark (12-5-8) when it is punched into cards.
- Data on tape in binary form can be accommodated. It is punched into cards in column binary form. The 1401 system being used must have the Column Binary Device for this operation.
- A count of the number of tape records read and the number of data cards punched is printed out after each file is processed.

### General Description

This program performs various tape-to-card operations in accordance with the users' specifications punched in a maximum of three control cards.

Any number of files contained on one or more tape reels can be processed by this program without reloading. The only limitations are that all input files must have identical specifications, and no file can overlap two reels.

### INPUT RECORDS

In usual tape-to-card operation, a single input record is punched column-for-column into as many cards as it requires. The series of cards produced from one input record is called a card record. For example, if an input record contains 200 characters, the resultant card record consists of three cards: the first two are punched in all eighty columns, and the third is punched in columns 1-40. This program can accommodate either fixed- or variable-length input records. For convenience, fixed-length input records are often blocked on tape. Variable-length records cannot be blocked. A block consists of two or more data records not separated by inter-record gaps. The number of data records in one block is called the *blocking factor*. For this program, blocks can contain no more than 1197 characters.

### FILES CONTROL AND SELECTION

If the exact number of input files to be processed is specified, the machine will halt after this number has been processed. If the exact number is unknown, the machine can be made to stop when it senses a double tape-mark, or a specified trailer label, or after each

file. All files can thus be processed without having to reload the program. Also, it is possible to bypass files by using a sense switch, and it is possible to select up to three files for output. During processing, files are fed into alternate stackers to facilitate card handling.

### EXCEPTION RECORDS

Certain input records, identifiable to the program, can be treated in a manner differing from ordinary procedure. A code in the first control card enables the program to recognize records to be excepted from the usual tape-to-card operation. These excepted records can be bypassed, printed out, or punched and then selected into a specified stacker.

### CARD SEQUENCE NUMBERING

Two types of card sequence numbering are possible, either separately or simultaneously. Cards within each output record can be numbered, and cards within each output file can be numbered. In both cases, input data that would ordinarily appear in the columns devoted to numbering is lost.

### ADDITIONAL INFORMATION

A maximum of eighty columns of information not contained in the input tape can be punched into output cards. This information can be punched into every output card, or into only one card per record. The additional information enters the machine via a card that accompanies the control cards. Input data that would ordinarily appear in the columns devoted to additional information is lost. The additional information can be varied for each file processed in a single run.

### BINARY RECORDS

(*Note:* This section is applicable only when the 1401 system being used is equipped with the optional Column Binary Device.)

Although the 1401's language is binary-coded-decimal (BCD), the machine can be used to process tapes containing binary records. This program can, within limitations, accommodate binary tape records. The resulting cards are in column binary form. When the input tape contains a mixture of binary and BCD records, each binary record must contain 168 characters and each BCD record must contain 84 characters. The last eight characters of each binary record and the last four characters of each BCD record provide a *look-ahead* feature, which enables the machine to determine whether the record following is binary or BCD. The *look-ahead* characters are not punched.

### HEADER AND TRAILER LABELS

Header labels appearing at the beginning of reels may be printed, punched into cards, or bypassed. They may also be compared to header label cards accompanying

the control cards. Header labels preceding all files except the first file on a reel can be printed, punched, or bypassed, but they cannot be compared. If header labels are present, a header must precede the first file, and can precede every other file on the reel. The maximum header label length that can be accommodated by this program is 160 characters.

Trailer labels can follow every file in a reel, or they can follow only the last file in a reel, or they can be omitted. Their maximum length is eighty characters. If each file is followed by a trailer label, these trailers will be treated in the same fashion as the first header label in the reel. If a reel contains no header labels, trailer labels are printed out, and the only function of a trailer label is to halt processing when it matches the contents of a trailer label card provided by the user.

**SEQUENCE CHECKING**

The sequence of records within a file can be checked by comparing one, two, or three fields from record to record. These fields can have a maximum composite length of eighty characters.

**SELECTIVE OUTPUT**

Punching into cards of only certain selected fields is possible. It is also possible to punch fields filled with a certain specified character. The maximum number of fields that can be selected is 16.

**Control Cards**

One, two, or three control cards, depending on the application, are required by this program. These control cards must be punched with information pertaining to the magnetic tape to be read and the cards to be punched. Figures 12, 13, and 14 show the formats of control cards 1, 2, and 3 respectively.

When preparing the control cards, leading zeros are punched in fields containing information. For example, in control card 1, the record length (columns 1-4) should be punched 0300 if there are 300 characters per record in the input files being processed. Unused fields should always be blank. Control cards must be punched according to the formats shown. The card columns of the first control card are shown in Figure 12.

Record Blocking							Files Control							Exception Identification and Action										Card Sequence Numbering					Additional Information															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40					
Characters per Record				Blocking Factor			No. of Files		No. of 1st Sel. File		No. of 2nd Sel. File		No. of 3rd Sel. File			Exception Procedure Code		First Exception Character		Logical Comparison Option		1st Exception Character Code		First Exception Character Location		Second Exception Character		2nd Exception Char. Code		Second Exception Character Location		Location of Intra-Record Seq. Numbering (High-Or)			Location of Intra-File Seq. Numbering (High-Or)		Size of Intra-File No. Fld.		Card Number Within Record		Pos. in Data Card (High-Order)		No. of Cols. of Add'l Info. (Tens Position)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40					

Add'l Inf.		Header Labels					Inter-Record Sequence Checking										Field Selection																									
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80			
No. of Cols of Add'l Info. (Units Position)		Tape Unit Number		Binary Record Control			Header Label Procedure		No. of Fields to be Seq. Chkd		No. of 1st Field to be Seq. Chkd		No. of 2nd Field to be Seq. Chkd		No. of 3rd Field to be Seq. Chkd		Group Mark Conversion		Varying Add'l. Information		Add'l. Headers and Trailers		Tape Redundancy Correction		No. of Sel. Fields		No. of Characters		First (High-Order) Character Location			Card No.		No. of Characters		First (High-Order) Character Location			Card No.			
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80			

Figure 12. Control Card 1 — Tape-to-Card

RECORD BLOCKING (COLUMNS 1-7)

*Columns 1-4:* These are punched with the number of characters per fixed-length input record. If the input file contains intermixed BCD and binary records, these columns must be punched 0168. Because this program accommodates either variable- or fixed-length input records, VVVV should be punched for variable-length records. Note that if fixed-length records are specified in columns 1-4, the presence of a short record in the input file causes incorrect processing but will not necessarily cause an error halt.

*Columns 5-7:* These are punched with the blocking factor. This is the number of records per block on tape. It must be a fixed number. Since variable-length records cannot be blocked, a 1 must be punched if the input tape contains variable-length

records. When establishing the blocking factor, remember that this program does not accommodate input blocks greater than 1197 characters in length.

FILES CONTROL (COLUMNS 8-16)

More than one file can be accommodated without reloading the program, provided all files have the same specifications. Control card columns 8-16 provide some flexibility in file processing. The user may want to punch the contents of every file on a single tape reel, or he may want to punch only the first few files on a tape. He may also want to select certain files from the reel for punching. A maximum of three files can be selected in this manner. Furthermore, the user may want to stop operation of the machine after each file is punched. In this way it is possible to process more than one tape reel without having to reload the program after each reel.

Field No. 3							Field No. 4						Field No. 5						Field No. 6																				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
No. of Chars.		First (High-Order) Character Location				Card No.	No. of Chars.		First (High-Order) Character Location				Card No.	No. of Chars.		First (High-Order) Character Location				Card No.	No. of Chars.		First (High-Order) Character Location				Card No.												
		Tape Position (within Record)				Card Col.			Tape Position (within Record)				Card Col.			Tape Position (within Record)				Card Col.			Tape Position (within Record)				Card Col.												
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40

Field No. 7							Field No. 8						Field No. 9						Field No. 10																				
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
No. of Chars.		First (High-Order) Character Location				Card No.	No. of Chars.		First (High-Order) Character Location				Card No.	No. of Chars.		First (High-Order) Character Location				Card No.	No. of Chars.		First (High-Order) Character Location				Card No.												
		Tape Position (within Record)				Card Col.			Tape Position (within Record)				Card Col.			Tape Position (within Record)				Card Col.			Tape Position (within Record)				Card Col.												
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

Figure 13. Control Card 2 — Tape-to-Card

**Columns 8 and 9:** These are punched with the number of input files to be processed by the program. The program will cause an automatic stop after the specified number of files has been processed. Thus, if columns 8 and 9 are punched 05 and there are five files on the reel, the entire tape will be processed. If there are more than five files on the reel, only the first five will be punched into cards. If there are less than five files on the tape, the program will attempt to process five files nonetheless, and the tape will run off the reel. If columns 8 and 9 are left blank, and there is no file selection, the program will cause every input file on the reel to be punched. If columns 8 and 9 are left blank, column 10 should be punched with an end-of-reel test code. If the user wants to stop the machine at the end of each file, columns 8 and 9 should be punched 01. (Turning on SENSE SWITCH B causes the machine to stop after each file, regardless of

control card specifications.) This option can be used if the exact number of files on the reel is unknown and there is neither a trailer label nor two successive tape marks to signify end-of-reel. This feature is also useful when a particular job requires more than one tape reel. By stopping after each file, it is possible to change reels at the end of the last file on a reel without reloading the program.

Files can be bypassed by turning on SENSE SWITCH C. If this switch is turned on during processing, and if SENSE SWITCH B is also on, the tape file being acted upon is bypassed immediately and the machine stops. To bypass succeeding files, leave SENSE SWITCH C on and press the start key. To process files, turn SENSE SWITCH C off and press START. Bypassed files are included in the count of files processed.

**Column 10:** This is punched with the end-of-reel test code. This code tells the program what to look for to determine when the end of the tape reel is reached.

Field No. 11										Field No. 12										Field No. 13										Field No. 14									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
No. of Chars.		First (High-Order) Character Location					Card No.			No. of Chars.		First (High-Order) Character Location					Card No.			No. of Chars.		First (High-Order) Character Location					Card No.			No. of Chars.		First (High-Order) Character Location					Card No.		
		Tape Position (within Record)					Card Col.					Tape Position (within Record)					Card Col.					Tape Position (within Record)					Card Col.					Tape Position (within Record)					Card Col.		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40

Field No. 15										Field No. 16										Unused Columns																						
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61																				80		
No. of Chars.		First (High-Order) Character Location					Card No.			No. of Chars.		First (High-Order) Character Location					Card No.																									
		Tape Position (within Record)					Card Col.					Tape Position (within Record)					Card Col.																									
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61																				80		

Figure 14. Control Card 3 — Tape-to-Card

If column 10 contains a 1-punch, the program tests for a trailer label as an end-of-reel condition. If the correct trailer label is present, the machine stops when it is sensed. If this test is made, a card containing the exact configuration of the trailer label must be fed into the read hopper after the control card(s), additional information card, and header label card(s). The program tests no more than the first 80 characters, including blanks, of the trailer label. If there is no trailer label, or if up to the first 80 columns of the trailer label do not match the punches in the trailer label card, an end-of-reel condition is not recognized and the tape runs off the reel. If column 10 is blank, the program tests for two successive tape marks to signify end-of-reel. (An end-of-reel test is made only when columns 8 and 9 are blank and no file selection has been performed. When the number of files to be punched is specified, or if selective file punching is called for, the machine stops automatically when the indicated number of files has been processed.)

*Columns 11-16:* These are used only when selected files are processed. A maximum of three files can be selected. When file selection is performed, the first file on a tape reel, exclusive of header label, is considered file 01, the second is file 02, and so forth. The number of the first selected file is punched in columns 11 and 12; the number of the second selected file is punched in columns 13 and 14; the number of the third is punched in columns 15 and 16. For example, when only the fifth, seventh, and eighth files on a particular tape reel are to be processed, columns 11-12, 13-14, and 15-16 should be punched 05, 07, and 08 respectively. When selective file punching is performed, the files must be processed in the same order in which they appear on tape. If selective file punching is not desired, columns 11-16 must be left blank.

EXCEPTION IDENTIFICATION AND ACTION  
(COLUMNS 17-30)

Columns 17-30 allow the user the option of excepting entire records from usual tape-to-card procedure. These exception records can be bypassed, printed out, or punched, and then selected into a specified stacker. The program causes the machine to inspect one or two locations in each input record to determine whether the record is to be excepted from the usual procedure. The characters in these locations are compared with constant exception characters punched in the control card to define an exception record. Exception characters can be any alphanumerical character or special symbol. The exception character locations must be the same in each record. If no records are to be excepted, columns 17-30 are left blank.

*Column 17:* This is punched with the exception procedure code. This code specifies the special procedure to be followed when a record that is to be excepted is recognized. The possible exception procedures and their codes are:

- 1-punch Bypass excepted records.
- 2-punch Print excepted records.
- 3-punch Print and punch excepted records.
- 4-punch Select excepted records into stacker 8 after punching.

*Column 18:* This is punched with the first exception character. Any valid character or symbol can be used. The program compares it with the character in the first exception-character location in the input record (this location is specified in columns 21-24 of the control card). The exception character may contain both a numerical and a zone portion, or it may contain a zone portion alone, or a numerical portion alone. The extent to which the program compares these characters is governed by the punch in column 20.

*Column 19:* This is punched with the logical comparison option. This specifies the logical relationship between the first- and second-exception characters (columns 18 and 25, respectively, of the control card) that determines whether a record is to be excepted.

1. A 1-punch in column 19 specifies an *and* comparison. This means that an exception record is recognized when the character in the first exception-character location in the input data record matches the exception character punched in column 18 of the control card, and the character in the second exception-character location in the input record matches the exception character punched in column 25 of the control card.

2. A 2-punch in column 19 specifies an *or* comparison. This means that an exception record will be recognized when either one of the two exception characters punched in columns 18 and 25 of the control card matches the character in the corresponding exception-character location in the input record.

If only one exception-character location is used, column 19 is blank and columns 25-30 are blank.

*Column 20:* This is punched with the first exception-character code. This code governs the extent to which the character in the first exception-character location in the record is compared with the character in column 18 of the control card. Six codes are valid:

1-punch — The program tests for the presence of both the zone and numerical portions of the first

exception character (column 18) in the first exception-character location in the input record.

2-punch — The program tests for the absence of both the zone and numerical portions of the first exception character in the first exception-character location in the input record. (*Note:* the word *absence* in connection with the control columns 20 and 26 means that the exception character location contains any configuration other than the configuration punched in the control card.)

A-punch — The program tests for the presence of the zone portion of the first exception character in the first exception-character location in the input record.

B-punch — The program tests for the absence of the zone portion of the first exception character in the first exception-character location in the input record.

J-punch — The program tests for the presence of the numerical portion of the first exception character in the first exception-character location in the input record.

K-punch — The program tests for the absence of the numerical portion of the first exception character in the first exception-character location in the input record.

The punches required in column 20 of the control card to specify each of the six possible conditions outlined above are summarized in Figure 15.

First Exception Character	Presence in Record	Absence from Record
Full Character	1	2
Zone Portion Only	A	B
Numerical Portion Only	J	K

Figure 15. Punch in Column 20

*Columns 21-24:* These are punched with the first exception-character location in the input record. The first character location of each input record on tape is addressed as 0001, the second as 0002, etc. Thus if the first exception-character location in the input record is the tenth character, columns 21-24 are punched 0010.

*Column 25:* This is punched with the second exception character. Any valid character or symbol can be used. The program compares it with the character in the second exception-character location in the input record. (This location is specified in columns 27-30 of the control card.) The extent to which the

program compares these characters is governed by the punch in column 26.

*Column 26:* This is punched with the second exception-character code. This code governs the extent to which the character in the second exception-character location of the record is compared with the character in column 25 of the control card. The six punches used in column 20 can be used in column 26 also. Column 26 controls the test for the second exception character in the same manner that column 20 controls the test for the first exception character.

*Columns 27-30:* These are punched with the second exception-character location in the input record.

*Example:* In the example of exception identification and action in Figure 16, each record on tape pertains to an employee of a firm. These records are to be punched into cards, bypassing records pertaining to temporary employees (identified by a 12-punch in the 35th character location) and employees earning less than \$5,000 per year (identified by the absence of an M in the 80th character location). Figure 16 shows the punching of columns 17-30 of the first control card.

Column 17	1	Exception records are to be bypassed.
Column 18	12-punch	First exception character.
Column 19	2	An or comparison. If either one of the two exception characters in columns 19 and 25 of the control card matches the character in the corresponding exception character location in the record in accordance with the codes in columns 20 and 26, the record is treated as an exception.
Column 20	A	The presence of the zone portion in first exception-character location is tested for.
Columns 21-24	0035	The first exception-character location in input record.
Column 25	M	Second exception character.
Column 26	2	Absence of full character in second exception-character location is tested for.
Columns 27-30	0080	Second exception-character location in input record.

Figure 16. Example of Exception Identification and Action

#### CARD SEQUENCE NUMBERING (COLUMNS 31-35)

Two types of sequence numbering are possible on output data cards. Cards within each record can be numbered, and cards within a file can be numbered. Columns 31-35 of the first control card are used for this. The two types of numbering can be performed simultaneously.

Intra-record sequence numbering can occupy either one or two columns of the output card. Intra-file numbering can occupy up to four columns. When output card columns are devoted to sequence numbering, the tape data ordinarily punched in these columns is lost. This limitation can be circumvented, however, by using field selection. This is discussed in a later section.

*Columns 31 and 32:* These columns of the control card are devoted to intra-record sequence numbering. They are punched with the high-order position of the field in the data card in which intra-record sequence numbering is desired. When there are nine or less cards per record, only one column is used for numbering. For records containing ten or more cards, two numbering columns are needed and the high-order address must be punched in columns 31 and 32. Intra-record sequence numbering cannot exceed 99.

*Columns 33 and 34:* These are punched with the high-order position of the field in the data card in which intra-file sequence numbering is desired.

*Column 35:* This is punched with the number of columns contained in the intra-file sequence numbering field. The maximum is four.

#### ADDITIONAL INFORMATION (COLUMNS 36-41, 56)

While performing a tape-to-card operation, it is possible to punch into the card-records information not contained on the input tape. This additional information enters the machine as a separate card accompanying the control card. The maximum additional information that can be used is eighty columns. The user has the option of punching this information into every data card, or of punching it in only one card per record. Columns 36-41 and column 56 of the first control card govern punching additional information. Input data that would ordinarily appear where the additional information is punched is lost.

Additional information can be varied for each file in a single run. The additional information must be the same length for each file, however, and it must be punched in the same place in each output file. The additional information for each file after the first file must be punched into separate cards that follow the program deck.

*Columns 36 and 37:* These are punched with the number of the card within each record in which the

additional information is to be punched. If it is desired to punch the additional information in every data card, punch AA.

*Columns 38 and 39:* These are punched with the first, or high-order, position of the field in the data card that will receive the additional information.

*Columns 40 and 41:* These are punched with the number of columns of additional information. The maximum, including blanks, is eighty.

*Column 56:* This column governs punching additional information into more than one output file. If the additional information is the same for all files, this column is left blank. If the additional information is to vary for each file, this column must contain a 1.

#### TAPE UNIT NUMBER (COLUMN 42)

Column 42 of the first control card is punched with the number of the IBM Magnetic Tape Unit Model II or IV to be used for input. Valid numbers are 1-6. The tape unit used must have its address selection switch set to the number punched in column 42. If column 42 is blank, the program automatically assumes that tape unit 1 is to be used for input.

#### BINARY RECORDS (COLUMN 43)

(*Note:* This section is applicable only if the 1401 system being used is equipped with the Column Binary Device.)

This program accommodates fixed-length records that appear on the input tape in binary form. When the input binary records contain 168 characters, the output is in column binary form with data appearing in card columns 1-80. When the binary input record contains 144 characters, the resulting column binary cards are punched in columns 1-72. The program also accommodates binary records intermixed on tape with records in the usual *binary-coded-decimal* format (BCD). *Column 43* of the first control card regulates the punching of binary records.

If the input tape contains only binary records, column 43 should contain a 1-punch. If the input tape contains binary records intermixed with BCD records, column 43 should contain a 2-punch. If the input tape is devoid of binary records, column 43 should be blank.

If the input tape contains both binary and BCD records, the flexibility of the tape-to-card program is limited. The only operation possible is single tape-record to single data-card. When the input tape contains only binary records, blocking is possible.

Mixed binary and BCD records on tape must contain 168 and 84 characters, respectively. The last eight characters of binary records and the last four characters of BCD records make up the *look-ahead* feature that enables the program to tell whether a

binary or a BCD record is following. The program inspects these *look-ahead* characters internally, but does not punch them into cards during tape-to-card operation. When processing mixed binary and BCD input records, the *look-ahead* characters must be present.

#### HEADER LABELS (COLUMNS 44-47, 57)

Header labels can be printed, punched, or bypassed. Also, the first header label on a reel can be compared to header label cards that accompany the control card(s). Columns 44-47 of the first control card govern the action taken on header labels. Column 57 pertains to header labels and/or trailer labels between files.

*Columns 44-46:* These are punched with the number of characters contained in the first header label. This total must include blanks. The maximum header label length is 160 characters.

*Column 47:* This is punched with the header label procedure. A 1-punch in this column causes the label(s) to be printed. A 2-punch causes the label(s) to be punched into one or two cards, depending on their length. A 3-punch causes the label(s) to be bypassed. When a label is bypassed, it is not compared or processed in any way. When column 47 contains a 4-punch, the first header label on tape is compared with one or two cards, depending on length, following the control card(s). This first header label must match the configuration of the header label card(s) fed into the machine. When it does not, an error indication prints out and the machine halts. Processing can be resumed, however, by pressing the start key.

*Column 57:* If header labels and/or trailer labels appear between files, they are treated in the same fashion as the first header label is treated, unless the first header label is compared, in which case all headers and trailers between files are bypassed. If a header label precedes every file on a reel, a 1 is punched in column 57. If a trailer label follows every file on a reel, a 2 is punched in column 57. If every file on a reel is preceded by a header label and followed by a trailer label, a 3 is punched in column 57.

Header label cards need be fed into the machine only when a comparison is desired and column 47 contains a 4-punch. When the header label(s) are to be printed, punched, or bypassed, the additional card or cards are not needed and must be omitted.

#### TRAILER LABELS

If a trailer label is used for an end-of-reel test, it must be punched into an additional card that accompanies

the control card(s). When the trailer label on tape does not match the trailer label card, an end-of-reel is not recognized.

When a multi-file reel contains more than one trailer label, the program treats each trailer in the same fashion it treats the first header label. However, if the trailer labels are compared to a trailer label card, the program will not halt if the comparison is unequal. If the comparison is equal, an end-of-reel condition is assumed and the program halts. If a reel contains no header labels, all trailer labels are printed. They can be used only to indicate an end-of-reel condition.

#### SEQUENCE CHECKING OF RECORDS (COLUMNS 48-54)

Sequence checking of data records within the tape file prior to output can be performed by using columns 48-54 of the first control card. This operation is based on the program's ability to sequence check from record to record using information in a maximum of three different fields. These three fields must be located in the same place in each input record. The composite total of the fields used in sequence checking cannot exceed eighty columns.

The fields used in sequence checking are assigned numbers according to where they are defined in the control-card columns devoted to field selection. Thus field 1 is the field defined in columns 61-70 of the first control card, field 2 is the field defined in columns 71-80 of the first control card, etc. (See Figures 12, 13, and 14.) If an input field is to be used in sequence checking, it must be defined in one of the control-card fields devoted to field selection. However, an input field used in sequence checking does not necessarily have to be a field selected for output.

If a field used for sequence checking is not a field selected for output, the portion of the control card devoted to that field in Field Selection must have 9999 in its last four columns (see Figure 17B).

When an out-of-sequence record is detected, it is printed out in addition to being punched and the processing continues.

*Column 48:* This is punched with the number of unselected input fields to be used in sequence checking. When all fields used in sequence checking are selected fields, column 48 should be punched with a zero. If no sequence checking is to be performed, column 48 should be blank. If field selection is not to be performed, column 48 contains the number of fields being sequence checked. For example, if 3 fields are used in sequence checking and none are selected for output, column 48 should contain a 3-punch. If 3 fields are used in sequence checking and one of these is selected for output, column 48 should contain a 2-punch. If all fields used in sequence

A		
Column 48	3	Number of fields used for sequence checking not selected for output.
Columns 49 and 50	01	Number of first field used in sequence checking.
Columns 51 and 52	02	Number of second field used in sequence checking.
Columns 53 and 54	03	Number of third field used in sequence checking.
B		
These ten columns define field 1.		
Columns 61 and 62	05	Number of characters in field.
Columns 63-66	0001	High-order position of field in input record.
Columns 67-70	9999	
These ten columns define field 2.		
Columns 71 and 72	05	Number of characters in field.
Columns 73-76	0041	High-order position of field in input record.
Columns 77-80	9999	
These ten columns define field 3. They appear in the second control card.		
Columns 1 and 2	02	Number of characters in field.
Columns 3-6	0029	High-order position of field in input record.
Columns 7-10	9999	

Figure 17. Example of Record Sequence Checking

checking have been selected for output, column 48 should contain a zero-punch. The maximum number that can be punched in column 48 is 3.

*Columns 49-54:* These are punched with the field numbers of the three fields used in sequence checking. The field specified in columns 49 and 50 can be referred to as the *major field*. It is sequence-checked first. The field specified in columns 51 and 52 can be referred to as the *intermediate field*. It is sequence-checked second. The field specified in columns 53 and 54 can be referred to as the *minor field*. It is sequence-checked last.

As noted previously, the numbers punched in columns 49-54 are derived from the positions in the control cards where these fields are defined.

*Example:* In the example of sequence checking (Figure 17), three fields from each input record are used for sequence checking and the entire input record is punched (i e., field selection does not take place). The first field used in sequence checking is location 1-5 of the input record. The second field used in sequence checking is location 41-45 of the input record. The third field used in sequence checking is location 29-30 of the input record. As this example shows, fields need not appear on tape in the order in which they are sequence-checked. In this example, columns 48-54 of the first control card contain the information shown in Figure 17a.

The numbers of the three fields in Figure 17a are derived from the numbers assigned to fields selected for output. Therefore, the specifications of these three fields must be punched in the appropriate control card columns even though field selection is not to take place. In this case, columns 59 and 60 of the first control card must be left blank. This indicates that field selection will not occur. Columns 61-80 of the first control card, plus columns 1-10 of the second control card, have the information shown in Figure 17b.

Sequence checking of records is based on the value of the entire field being checked. It may be numerical or alphabetic. The 1401 system considers numbers to be higher in value than letters. When an input record is identified as an exception record, it is not sequence checked.

#### GROUP-MARK CONVERSION (COLUMN 55)

An IBM 1401 group mark (12-7-8) on tape will be converted to an IBM 705 group mark (12-5-8) when it is punched into cards, if a 1 is punched in column 55. If the conversion is not desired, column 55 is left blank.

#### TAPE-REDUNDANCY CORRECTION (COLUMN 58)

When a tape redundancy occurs, the program attempts to read the redundant tape record ten times. If these re-readings prove unsuccessful, the tape record is considered permanently redundant. If column 58 of the control card is blank, the machine will accept the redundant record and attempt to process it. A 1-punch in column 58 causes the program to halt when a redundancy occurs, thus enabling the user to scan for and manually correct the redundancy.

#### FIELD SELECTION (COLUMNS 59-80)

From the input record, it is possible to select a maximum of 16 variable-length fields for punching in cards. No selected field can have more than eighty columns.

It is also possible to punch fields of any repeated single character. Columns 59-80 of the first control card, plus all of control cards 2 and 3, if needed, are used for these operations. The number of fields selected determines whether cards 2 and 3 must be included.

The program assigns numbers to selected fields according to where they are defined on the control cards. Thus the field defined in columns 61-70 of the first control card is known as field 1, the field defined in columns 71-80 of the first control card is known as field 2, the field defined in columns 1-10 of the second control card is field 3, etc. (see Figures 12, 13 and 14).

The punches in columns 59 and 60 indicate the number of fields to be selected for output. The maximum, including fields of single characters, is 16. If selective field output is not to take place, columns 59 and 60 must be left blank.

Ten control card columns are devoted to each field selected for output. The first two of these columns (columns 61 and 62 of the first control card for field 1) are punched with the number of characters in the selected field. For a field of repeated single characters, punch the length desired. The next four columns (columns 63-66 for field 1) are punched with the high-order position in the input record of the selected field. If a field of single characters is to be inserted, punch that character in each of columns 63-66. For example, if a field of X's is desired, columns 63-66 are punched XXXX.

The next two columns (columns 67 and 68 for field 1) contain the number of the high-order column of the field in the card in which the record is to be punched. The final two columns (columns 69 and 70 for field 1) contain the number of the card within the record in which the selected field is to be punched.

Field selection can be performed:

1. by itself
2. with sequence checking
3. with the punching of additional information
4. with sequence numbering
5. or in any combination of these four.

*Example 1:* Five fields are selected for output, and three of these are used for sequence checking. Column 48 must contain a zero-punch, because all the fields used in sequence checking have been selected. Columns 49-54 must be punched with the numbers of the three fields to be used in sequence checking. Columns 59 and 60 must be punched 05, indicating that five fields have been selected for output. Columns 61-80 of the first control card and columns 1-30 of the second control card must contain the complete specifications of the five selected fields.

*Example 2:* Five fields are selected for output, and three fields that will *not* be punched are to be used for sequence checking. Column 48 should contain a 3-punch, and columns 59 and 60 should be punched 05. When the program detects 05 in columns 59 and 60, it assumes that the five selected fields are fields 1-5. The three fields to be used in sequence checking should therefore be assigned numbers 6, 7, and 8. Columns 61-80 of the first control card and columns 1-30 of the second control card must contain the complete specifications of the five selected fields. In addition, the control card columns pertaining to fields 6-8 (columns 31-60 of the second control card) must be punched with the length and location on tape of the fields to be used in sequence checking.

*Example 3:* The entire input record is to be punched into cards, yet 15 columns in each card are to be reserved for additional information and sequence numbering. Assume that each input record has 120 characters and that columns 66-80 of each output card are reserved for additional information and numbering.

This operation is accomplished by placing the input record in the field selection mode. The input record is broken down into two fields. Field 1 contains locations 1-65. Field 2 contains locations 66-120. Columns 59-80 of the first control card are punched as shown in Figure 18.

#### CONTROL CARDS 2 AND 3

The second control card is used when 3-10 fields are selected for output. The second and third control cards are used when 11-16 fields are selected for output (see Figures 13 and 14).

#### SENSE SWITCHES

Sense switches B, C, D, E, and F, when turned on, perform functions that increase the flexibility of this program.

*Sense Switch B* — Used to cause a stop after each file, regardless of control card specifications.

*Sense Switch C* — Used to bypass input files. If this switch is turned on while a file is being processed, the remainder of the file will be bypassed immediately and the program will stop if SENSE SWITCH B is also on. To process the next file, turn SENSE SWITCH C off and press the start key. To bypass more than one file, keep SENSE SWITCH C on and press START.

*Sense Switch D* — When turned on, the contents of the file being punched will also be printed. If it is turned on while a file is being processed, the remainder of that file will be printed as well as punched.

Columns 59 and 60	02	Two fields are selected for output.
These ten columns define field 1.		
Columns 61 and 62	65	Number of characters in field.
Columns 63-66	0001	High-order position of field in input record.
Columns 67 and 68	01	High-order position of field in output card.
Columns 69 and 70	01	Number of card within output record in which field will be punched.
These ten columns define field 2.		
Columns 71 and 72	55	Number of characters in field.
Columns 73-76	0066	High-order position of field in input record.
Columns 77 and 78	0001	High-order position of field in output card.
Columns 79 and 80	02	Number of card within output record in which field will be punched.
For this example, columns 31-41 of the first control card, pertaining to card sequence numbering and additional information, must also be punched.		

Figure 18. Example of Field Selection

*Sense Switch E* — When turned ON, this switch prevents the program from rewinding a tape reel after that reel has been processed. When control card columns 8 and 9 contain 01, indicating that the machine halts after each file, SENSE SWITCH E must be turned ON to prevent the tape from rewinding after the file is processed.

*Sense Switch F* — When turned ON, this switch causes the punch-release feature to become inoperable for the remainder of the job run.

### **Tape-to-Printer Program**

This program provides for printing information contained on magnetic tape. Its purpose is to perform, on the 1401 system, tape-to-printer operations that were previously performed as off-line or auxiliary operations. Output operations that were previously performed on the IBM 717 or 720A Printer can now be performed on the IBM 1403 Printer.

Although intended for use on a 1401 Model C system, which includes the IBM 1402 Card Read-Punch, it is possible to run this program on the Model D, which does not have a card input-output, provided a tape is obtained on which the program is written. This program includes a feature for producing such a system tape.

This program increases the flexibility of tape-to-printer operations by providing these options:

- Input files can contain fixed-length records with fixed blocking, or variable-length records with variable blocking.
- Multiple file printing and selective file printing is provided.
- Heading information, read in from cards, can be printed.
- Header labels on tape reels can be punched into cards, printed, or compared with header label information read in from cards.
- An exception procedure permits records to be bypassed or treated in a manner differing from ordinary routine.
- A maximum of 16 fields per input record can be selected for printing. Editing and zero suppression of these fields is possible.
- Fields of zeros can be printed.
- Printing of only the first line of variable length records can be specified.
- Forms-control spacing, in addition to that provided by first-character control, provides for controlling spacing between printed lines of a record, between records, and between blocks of records.
- Input records can be sequence checked prior to printing.
- Consecutive page numbers can be printed at the top of every page.
- After each file, a count of the number of input records processed is printed.

Figure 19 summarizes the characteristics and capabilities of the 1401 tape-to-printer program and the off-line 700-7000 series equipment.

### **General Description**

This program performs various tape-to-printer operations in accordance with specifications punched by the user in a maximum of three control cards.

The length of a printed line (132 maximum) is specified in advance by the user. When an input record has more characters than can be contained on one printed line, it occupies as many lines as are necessary, with each line left-justified. For example, when an input record contains 200 characters and the printed line length is specified as 120 characters, characters 1-120

CHARACTERISTICS OF OPERATION	700-7000 SERIES SYSTEMS		1401 SYSTEM TAPE-TO-PRINTER PROGRAM
	Tape-to-717 Printer	Tape-to-720A Printer	
1. Characters per line (max.)	120	120	132
2. Print speed — lines per minute (max.)	150	500 (or 1000)	600
3. Contents of each printed line	one block	one block	one block, one record, one or more fields, or part of a record
Unblocked records			same as above
Blocked records	does not apply	one record	same as above
4. Spacing/skipping control			
(a) First character of Unblocked records	block	block	block
Blocked records	does not apply	record	record
(b) Fixed, set by	printer carriage control switch	printer program switch	punch in control card
5. Overflow or ejection, page-to-page	carriage tape channels 12 and 1	carriage tape channels 12 and 1	carriage tape channels 12 and 1
6. Print suppression of individual print positions	not possible	accomplished by manually setting suppression levers	accomplished by field selection; high-order zeros may be print suppressed

Figure 19. Comparison of Tape-to-Printer Program to Off-Line Operation

of the record appear on the first line, and characters 121-200 of the record appear on the second line in print positions 1-80.

Variable-length records can be printed in their entirety, or the user can specify that only the first line of variable-length records is to be printed.

If record length for fixed-length records without field selection is less than the specified number of characters per print line, the following functions of this program cannot be performed: first character space/skip control; record forms control; exception record procedure; sequence checking.

The magnetic tape unit used for this program must have its address selector switch set to 3.

#### BLOCKING

Information on tape may be in the form of single fixed- or variable-length records, blocked fixed-length records, or blocked variable-length records. Blocked variable-length records must have a record mark as the final character of each record in the block except the last record. In this case, blocks need not contain a fixed number of records. Blocks (data on tape between two successive inter-record gaps) can contain

up to about 1400 characters; when editing is performed, the maximum block length is about 1200 characters.

#### FILES CONTROL

A maximum of 99 adjacent files on one or more tape reels can be printed without reloading the program, or any three files on a single reel can be selected for output. If multiple files are to be processed in a single run, they must have the same specifications. In addition, files can be bypassed during the running of the program under sense switch control. If the number of files on a reel is unknown, it is possible to cause a stop after each file to prevent the tape from running off the reel.

#### FORMS CONTROL

Spacing or skipping between records may be controlled either by the first character of each record or by a code punched in the first control card. Additional spacing or skipping between blocks can be specified. When a record requires more than one line for printing, the lines for that record are single-spaced.

#### HEADINGS

A maximum of three lines of report heading information can be printed at the top of the first page or at the top of a separate page immediately preceding the report. A maximum of two lines of page heading information can be printed at the top of each page of the report. Pages can be numbered consecutively within each file. After each file is printed, the number of records processed is printed.

#### EXCEPTION RECORDS

Certain input records can be excepted from the usual tape-to-printer operation. These exception records can be punched, punched and printed, or bypassed. A code punched in the first control card enables the program to recognize records to be excepted.

#### SEQUENCE CHECKING

A single field of up to thirty characters can be used to sequence check records within a file before printing.

#### FIELD SELECTION

For fixed-length records, a maximum of 16 fields can be selected for printing. All selected fields must be printed in nine lines or fewer, and each field must be contained in one line or less. Zero suppression of these fields is possible, in addition to printing fields of zeros. Selected fields can be edited by placing special editing cards in the machine together with the control card(s).

Note that in all cases except field selection, a record mark is blanked out before printing when it is the last character of a record.

#### HEADER LABELS

A header label at the beginning of the first tape reel of each job may be bypassed, printed, punched into cards, or compared with one or two header label cards provided by the user. Maximum header label length is 160 characters. When a multi-file job includes more than one header label, the program acts only on the label preceding the first file. Any other labels are treated as individual files, provided they are preceded and followed by tape marks.

#### END-OF-REEL TEST

The program automatically recognizes an end-of-reel condition when it senses double tape marks. At this point, the machine stops and the tape rewinds. End-of-reel can also be indicated by a trailer label matching the configuration of a trailer label card supplied by the user. Trailer labels must be preceded and followed by tape marks. If the trailer label is more than eighty characters long, only the first eighty characters must match the card. The tape runs off the reel if the label does not match the card and no double tape mark

is present. (This happens unless the number of files to be processed is specified in the control card, or unless file selection is performed.) When this number has been processed, the program stops.

#### Control Cards

This program requires one, two, or three control cards, depending on the application, to specify the necessary information pertaining to the tape records to be read and the information to be printed. Figures 20, 21, and 22 show the formats for control cards 1, 2, and 3 respectively.

When preparing the control cards, leading zeros are punched in fields containing information. For example, in control card 1, the record length field (columns 1-4) is punched 0300 if there are 300 characters per record in the file's being processed. Unused fields should always be blank. Control cards must be punched in accordance with the formats shown (Figure 20).

#### RECORD BLOCKING (COLUMNS 1-7)

*Columns 1-4:* These are punched with the input record length, in number of characters per record (including forms control characters and record marks, if present). For variable-length records, punch VVVV.

*Columns 5-7:* These are punched with the number of records per block. For variable-length records these columns must be left blank. In variable-length blocks, each record except the last in the block must end in a record mark.

#### CHARACTERS PER LINE (COLUMNS 8-10)

Columns 8-10 are punched with the number of characters per line of the printed report. The maximum is 132. By varying the line length, it is possible to vary the configuration of a printed record. For example, when the line length is 100 characters, a 100-character record occupies one printed line. When line length is 25 characters, the same record will occupy four print lines.

#### FILES CONTROL (COLUMNS 11 AND 12, 14-20)

This program can process a maximum of 99 contiguous input files without reloading, provided all files have identical specifications. The program can also cause processing to stop after each file. This feature is used when the exact number of input files is unknown, or when the files are contained on more than one tape reel. In this manner it is possible to change reels and continue operation by pressing the start key. Stopping after each file can be accomplished by a control card punch or by manipulation of a sense switch. In addition, files may be bypassed under sense switch control. It is also possible to select up to three files on a single reel for processing.

**Columns 11 and 12:** These are punched with the number of files to be processed by the program. If the number of files to be processed is unknown, these columns should be blank. When a number is punched in these columns, the program will attempt to process that many files and then stop. For example, if columns 11 and 12 are punched 05 and the reel contains five files, the entire reel will be processed and the machine will stop. If the reel contains more than five files, only the first five will be processed. If the reel contains less than five files, the program will attempt to process five nonetheless and the tape will run off the reel. If file selection is to be performed, columns 11 and 12 must be blank. When columns 11 and 12 are left blank, and file selection is not specified, the program processes every file on the reel and the tape runs off the reel

unless an end-of-reel indication is detected. If columns 11 and 12 are blank, provision should be made for halting after each file.

**Columns 14-20:** A 1-punch in column 14 causes the machine to halt after each file is processed. Turning on SENSE SWITCH B has the same effect as a 1-punch in column 14.

Columns 15-20 regulate selective file processing. Up to three files on a single reel can be selected for processing. When referring to files numerically, the first file on a reel is 01, the second is 02, etc. Header and trailer labels, when preceded and followed by tape marks, are counted as files on an input reel. The first header label on a reel is not counted, however, if the user has specified its presence in columns 49-52 of the control card.

Record Blocking							Files Control							Forms Control			Exception Identification and Action																					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
Characters per Record			Records per Block				Characters per Line			No. of Files		System Tape Option Halt Option	No. of 1st Sel. File	No. of 2nd Sel. File	No. of 3rd Sel. File	Page Number Option	1st Character Space/Skip Ctrl.	Suppress Option	Record Form Control Character	Block Form Control Character	Exception Procedure Code	Logical Comparison Option	First Exception Character	1st Exception Character Code	First Exception Character Location			Second Exception Character Code	Second Exception Character Location									
1	2	3	4	5	6	7	8	9	10	11	12														15	16	17		18	19	20	21	22	23	24	25	26	27

Inter-Record Sequence Checking				Headings			Header Labels		Field Selection																															
40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Sequence Check Field Location			No. of Chars.		No. of Lines of Report Heading	Report Heading Option	No. of Lines of Page Heading	Header Label Length	Header Label Option Code	Variable Length Record Option	No. of Selec. Fields	Tape Location (High-Order)	No. of Chars.	Print Position (High Order)	Line Number	Tape Location (High-Order)	Field No. 1			Field No. 2						No. of Chars.	Print Position (High Order)	Line Number	Editing Option	Trailer Label Option	Triple Space Suppression									
40	41	42	43	44													45	46	47	48	49	50	51	52	53							54	55	56	57	58	59	60	61	62

Figure 20. Control Card 1 — Tape-to-Printer

Columns 15 and 16 are punched with the number of the first file to be printed when file selection is used. Columns 17 and 18 are punched with the number of the second selected file to be printed. Columns 19 and 20 are punched with the number of the third selected file to be printed. Files must be selected in the order in which they appear in the input reel.

Files may be bypassed by using SENSE SWITCH C. If this switch is turned on while a file is being processed, the remainder of the file will be immediately bypassed. To prevent bypassing the next file, sense switches B and C should be turned on simultaneously. This will stop the machine after the file is bypassed. Succeeding files can then be bypassed by leaving switches B and C on and pressing the start key once for each file. If the machine has already

been instructed to stop after each file (Column 14 or SENSE SWITCH B), the position of SENSE SWITCH C when the start key is pressed determines whether a file will be printed or bypassed. A bypassed file is counted as a processed file.

SYSTEM TAPE PREPARATION (COLUMN 13)

A feature of this program enables the user to transcribe the program (as modified by the information contained in the control cards, heading cards, etc.) onto tape. It is thus possible to utilize the program on a 1401 Model D system that does not include an IBM 1402 Card Read-Punch. This feature is also useful on the Model C system when the same tape and print configurations are used repetitively. The system tape must, of course, be prepared on a 1401 Model C system.

Field No. 3											Field No. 4					Field No. 5					Field																		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Tape Location (High-Order)				No. of Chars.			Print Position (High Order)				Line Number	Tape Location (High-Order)			No. of Chars.		Print Position (High Order)			Line Number	Tape Location (High-Order)			No. of Chars.		Line Number	Tape Location (High-Order)			No. of Chars.									
1	2	3	4	5	6	7	8	9	10	11		12	13	14	15	16	17	18	19		20	21	22	23	24		25	26	27	28	29	30	31	32	33	34	35	36	37

No. 6				Field No. 7					Field No. 8					Field No. 9																									
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Print Position (High Order)			Line Number	Tape Location (High-Order)			No. of Chars.		Print Position (High Order)			Line Number	Tape Location (High-Order)			No. of Chars.		Print Position (High Order)			Line Number	Tape Location (High-Order)			No. of Chars.		Print Position (High Order)			Line Number	(Not Used) Blank								
41	42	43		44	45	46	47	48	49	50	51		52	53	54	55	56	57	58	59		60	61	62	63	64	65	66	67		68	69	70	71	72	73	74	75	76

Figure 21. Control Card 2 — Tape-to-Printer

Column 13 must contain a D-punch if a system tape is to be prepared. The user loads the program deck, together with control cards, heading cards, header label cards, trailer label cards, and editing cards, into the read hopper of the IBM 1402 Card Read-Punch. A tape is readied on tape unit 1. After the system tape is produced, the tape unit rewinds and the program halts. If the user wants to process a tape containing data at the same time, the data tape should be readied on tape unit 3. The IBM 1403 Printer is then readied and the start key is pressed. If a system tape is not to be prepared, column 13 must be left blank.

PAGE NUMBER OPTION (COLUMN 21)

Pages within the report printed from a single file are numbered consecutively by the program. A 1-punch in column 21 prevents page numbering. If page numbering is desired, column 21 should be left blank.

FORMS CONTROL (COLUMNS 22-25, 80)

Spacing or skipping between records in the printed report may be regulated by punches in the control card or by the first character in each record. This enables the 1401 to conform to the IBM 717 and 720 Printers. The only exception to first-character control is the case of the ampersand (&). This character usually indicates space suppression. Because space suppression is not provided by this program, it is possible to bypass a record beginning with an ampersand or to indicate its presence. Additional spacing between blocks is also possible. When a record occupies more than one printed line, its lines are always single-spaced.

An additional triple space automatically precedes the first line of a report (after the heading). The user can suppress this additional spacing.

Column 22: This is punched with the first character space/skip control code. If the first character of

Field No. 10					Field No. 11					Field No. 12					Field No. 13																								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Tape Location (High-Order)				No. of Chars.		Print Position (High Order)		Line Number			Tape Location (High Order)				No. of Chars.		Print Position (High Order)		Line Number			Tape Location (High-Order)					No. of Chars.												
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40

Field No. 13				Field No. 14				Field No. 15				Field No. 16				Unused Columns																							
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Print Position (High Order)			Line Number	Tape Location (High-Order)		No. of Chars.		Print Position (High Order)		Line Number			Tape Location (High Order)		No. of Chars.		Print Position (High Order)		Line Number			Tape Location (High-Order)		No. of Chars.		Print Position (High Order)		Line Number			Unused Columns								
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

Figure 22. Control Card 3 — Tape-to-Printer

each record is to control spacing and skipping between records, punch a 1. If the first character is not to be used to control spacing and skipping, leave column 22 blank. If columns 22 and 24 are left blank, records will be single-spaced. Figure 23 contains a list of characters, and their meanings, that can be used in first-character control.

FIRST CHARACTER OF RECORD	SPACE OR SKIP ACTION
&	suppress spacing (not applicable for this program; see explanation of control card 1, column 23)
Blank	single space
Zero	double space
- (Minus)	triple space
1-9 or J-R	skip to channel 1-9 (that is, 1 or J = skip to channel 1, 2 or K = skip to channel 2, etc.)

Figure 23. 1st Character Space/Skip Control

**Column 23:** This is punched with the suppress-option code. This punch determines the action to be taken when column 22 contains a 1-punch and the first character of a record is an ampersand (&). A 1-punch in column 23 prevents printing of a record beginning with an ampersand. When column 23 contains a 2-punch, the line preceding the record beginning with an ampersand is a series of three asterisks to identify the line following.

**Column 24:** This is punched with the record-form control character. This character controls spacing or skipping between records according to the list in Figure 24. If column 22 is blank, column 24 should be punched. When both are blank, single spacing between records is maintained.

**Column 25:** This column should be punched with a character to indicate the additional spacing desired between blocks. Figure 25 contains a list of legal characters. When column 25 is blank, the spacing that occurs between records also prevails between blocks.

**Example:** As an example of forms control, when records are to be double spaced and blocks are to be triple spaced, column 24 contains an s and column 25 contains a j. The s in column 24 indicates two spaces between records. The j in column 25 indicates an additional space (triple spacing) between blocks.

CHARACTER PUNCHED IN COLUMN 24 OF CONTROL CARD 1	SPACE OR SKIP ACTION
Blank	single space
S	double space
T	triple space
A-I	skip to channel 1-9 (that is, A = skip to channel 1, B = skip to channel 2, etc.)
? 12- and 0-punches	skip to channel 10
.	skip to channel 11
□	skip to channel 12

(NOTE: These characters are also punched in column 80 of second card for each heading line.)

Figure 24. Record Space / Skip Control

CHARACTER PUNCHED IN COLUMN 25 OF CONTROL CARD 1	SPACE OR SKIP ACTION
J	single space
K	double space
L	triple space
1-9	Skip to channel 1-9 (that is, 1 = skip to channel 1, 2 = skip to channel 2, etc.)
0	skip to channel 10
#	skip to channel 11
@	skip to channel 12

Figure 25. Block Space/Skip Control

**Column 80:** The additional triple space preceding the first line of a report is suppressed by punching a 1 in column 80. If the additional spacing is desired, column 80 is left blank.

#### EXCEPTION IDENTIFICATION AND ACTION (COLUMNS 26-39)

These columns allow the user the option of excepting entire records from the usual tape-to-printer procedure. Exception records can be bypassed, punched into cards, or printed out and punched into cards simultaneously. The program causes the machine to inspect

one or two locations in each input record to determine whether the record is to be excepted from the usual procedure. The characters in these locations are compared to constant exception characters punched in the control card to define an exception record. Exception characters can be any alphanumerical character or special symbol. The exception character locations must be the same in each record. If no records are to be excepted, columns 26-39 should be left blank.

**Column 26:** This is punched with the exception procedure code. This code specifies the special procedure to be followed when an exception record is recognized. The possible exception procedures and their codes are:

- 1-punch bypass excepted records
- 2-punch punch excepted records
- 3-punch punch and print excepted records.

**Column 27:** This is punched with the logical comparison option. This specifies the logical relationship between the first and second exception characters (columns 28 and 34, respectively, of the control card) that determines whether a record is to be excepted:

1. A 1-punch in column 27 specifies an *and* comparison. This means an exception record is recognized when the character in the first exception-character location in the input data record matches the exception character in column 28 of the control card, *and* the character in the second exception-character location in the input record matches the exception character in column 34 of the control card.
2. A 2-punch in column 27 specifies an *or* comparison. This means an exception record is recognized when either of the two exception characters punched in columns 28 and 34 of the control card matches the character in the corresponding exception-character location in the input record.

If only one exception character location is used, column 27 should be blank.

**Column 28:** This is punched with the first exception character. Any valid character or symbol may be used. The program compares it to the character in the first exception-character location in the input record. (This location is specified in columns 30-33 of the control card.) The exception character can contain both a numerical and a zone portion, or it can contain a zone portion alone or a numerical portion alone. The extent to which the program compares these characters is governed by the punch in column 29.

**Column 29:** This is punched with the first exception-character code. This code governs the extent to

which the character in the first exception-character location in the record is compared with the character in column 28 of the control card. There are six valid codes:

**1-punch** – The program tests for the presence of both the zone and numerical portions of the first exception character (column 28) in the first exception-character location in the input record.

**2-punch** – The program tests for the absence of both the zone and numerical portions of the first exception character in the first exception-character location in the input record. (*Note:* The word “absence” in connection with control columns 29 and 35 means that the exception-character location contains any configuration other than the configuration of the exception character punched in the control card.)

**A-punch** – The program tests for the presence of the zone portion of the first exception character in the first exception-character location in the input record.

**B-punch** – The program tests for the absence of the zone portion of the first exception character in the first exception-character location in the input record.

**J-punch** – The program tests for the presence of the numerical portion of the first exception character in the first exception-character location in the input record.

**K-punch** – The program tests for the absence of the numerical portion of the first exception character in the first exception-character location in the input record.

The punches required in column 29 of the control card to specify each of the six possible conditions above are summarized in Figure 26.

First Exception Character	Presence in Record	Absence from Record
Full Character	1	2
Zone Portion Only	A	B
Numerical Portion Only	J	K

Figure 26. Punch in Column 29

**Columns 30-33:** These are punched with the first exception-character location in the input record. The first character location of each input record on tape is addressed as 0001, the second as 0002, etc. Thus

when the first exception-character location in the input record is the tenth character, columns 30-33 are punched 0010.

*Column 34:* This is punched with the second exception character. Any valid character or symbol can be used. The program compares it with the character in the second exception-character location in the input record. (This location is specified in columns 36-39 of the control card.) The extent to which the program compares these characters is governed by the punch in column 35.

*Column 35:* This is punched with the second exception-character code. This code governs the extent to which the character in the second exception-character location of the record is compared with the character in column 34 of the control card. The six punches used in column 29 are also applicable in column 35. Column 35 controls the test for the second exception character in the same manner that column 29 controls the test for the first exception character.

*Columns 36-39:* These are punched with the second exception-character location in the input record.

*Example:* In the example of exception identification and action in Figure 27, all input records are to be printed; in addition, all records that do not contain an 11-punch in the 50th character location but do contain a z in the 72nd character location are to be punched into cards. In this example, Figure 27 shows the punching for columns 26-39.

#### SEQUENCE CHECKING (COLUMNS 40-45)

Input records can be sequence-checked before printing. Up to thirty contiguous columns of each input record can be used for this purpose. When an out-of-sequence record is detected, the program stops. Operation can be resumed by pressing the start key. Sequence checking is based on the value of the entire field used for this purpose. Standard 1401 collating sequence must be followed.

*Columns 40-43:* These are punched with the high-order position in the input record of the field used for sequence checking. (The first position of the input record is 0001.)

*Columns 44 and 45:* These are punched with the number of contiguous characters in the input record to be used for sequence checking. The maximum is thirty.

#### HEADINGS (COLUMNS 46-48)

A maximum of three lines of heading information can be printed on the first page of the report or on the

Column 26	3	Exception records are to be printed and punched.
Column 27	1	An <i>and</i> comparison — the two exception characters in columns 28 and 34 of the control card must both agree with the characters in the exception character locations in the record in accordance with the codes in columns 29 and 35.
Column 28	11-punch	First exception character.
Column 29	B	Absence of zone portion in first exception-character location is to be tested for.
Columns 30-33	0050	First exception-character location in input record.
Column 34	Z	Second exception character.
Column 35	1	Presence of full character in second exception-character location is to be tested for.
Columns 36-39	0072	Second exception-character location in input record.

Figure 27. Example of Exception Identification and Action

page immediately preceding the first page of the report. Two additional lines of heading can be printed near the top of each page of the report. This page heading appears on every page, including the first. If more than one file is processed without reloading, the same headings are printed for each report. Two cards must be punched for each line of heading. The first of the cards is punched with the first eighty characters of the line. The second card is punched in columns 1-52 with the remainder of the heading. Two cards must be used for each line, even if the line contains less than eighty characters. A code punched in column 80 of the second card can be used to control spacing between heading lines. (See Figure 24 for valid characters.) These heading cards are fed into the read hopper following the control card(s).

*Column 46:* This is punched with the number of lines of report heading — one, two, or three — to be printed at the beginning of the report. If no report heading is desired, column 46 is left blank. The information to be printed must be punched in report

heading cards (two per line). Spacing between report heading lines can be controlled by a punch in column 80 of the second report heading card for each line. If column 80 is not punched, single spacing will prevail.

*Column 47:* This is punched with the report-heading print option. Usually the report heading is printed on the first page of the report. A 1-punch in column 47, however, causes the report heading to be printed instead on the page preceding the first page of the report.

*Column 48:* This is punched with the number of lines of page heading — one or two — to be printed near the top of each page of the report. If no page heading is desired, column 48 is left blank. The information to be printed must be punched in page heading cards (two per line). Spacing between these lines is controlled by a punch in column 80 of the second card.

**HEADER LABELS (COLUMNS 49-52)**

If the first record on the tape being processed is a header label, columns 49-52 must be punched. The maximum number of characters that can be processed in a header label is 160. If the label contains more than 160 characters, only the first 160 are considered by this program. The user has the option of printing the label, punching it into cards, bypassing it, or comparing it to header label cards included with the control card(s). Header label cards are included only if the header label is to be compared. If a comparison is performed and the first 160 characters of the label do not exactly match the punches in the cards, the program will stop. Operation may be continued by pressing the start key.

*Columns 49-51:* These are punched with the number of characters in the header label. If the tape being processed does not include a header label, these columns are left blank. If the header label contains more than 160 characters, columns 49-51 are punched 160.

*Column 52:* This is punched with the header label option code. This code specifies the action to be taken on the header label. The options are:

- 1-punch print label
- 2-punch punch label into card(s)
- 3-punch bypass label
- 4-punch compare label with header label card(s)

**VARIABLE-LENGTH RECORD OPTION (COLUMN 53)**

If the input file contains variable-length records, some records may exceed the length of a single print line. In order to give the printed report a uniform appearance, the user has the option of printing only the first

line of variable-length records. A 1-punch in column 53 causes the program to print only the first line of each record. If column 53 is blank, records are printed in their entirety. (*Note:* This option is applicable only to variable-length records and can be used only when columns 1-4 are punched VVVV.)

**FIELD SELECTION (COLUMNS 54-78 PLUS CONTROL CARDS 2 AND 3)**

A maximum of 16 fields from each record can be selected for printing. A selected field can contain up to 132 characters, but the total number of fields selected cannot exceed nine printed lines. Any or all of the selected fields can be zero-suppressed (high-order zeros replaced by blanks) or edited before printing. Each selected field to be edited must have a separate edit word punched in a card included with the control card(s). The total length of all edit words cannot exceed 160 characters.

Selected fields are numbered according to where they are defined in the control card. Field 1, for example, is defined in columns 56-66 of the first control card; field 7 is defined in columns 45-55 of the second control card, etc. (See Figures 20, 21, and 22.) Selected fields must be printed on lines in the same order in which they are numbered in the control cards; the field or fields printed on the first line of the printed record must numerically precede the fields printed on the second line, etc.

Another feature of field selection is the program's ability to print fields of zeros. The combined total of selected fields and fields of zeros cannot exceed 16.

*Columns 54 and 55:* These are punched with the number of fields selected for printing. This total must include fields of zeros to be printed. The maximum combined total is 16.

*Column 78:* This column must contain a 1-punch if any selected field is to be edited. In addition, a card containing a single edit word must be included with the control card(s) for each selected field to be edited. These edit word cards must be in the same order as the fields defined in the control cards. The edit word card format is shown in Figure 28.

Column 1	□ (Lozenge)	This identifies the card as an edit word card.
Columns 2 and 3	XX	Number of characters in edit word.
Columns 4-n		Edit word is punched beginning in column 4.

Figure 28. Edit Word Card Format

Each of the fields (a maximum of 16) selected for output is defined in 11 control card columns. Following is a description of the 11 columns devoted to field 1. The format is the same for all selected fields.

**Columns 56-59:** These are punched with the location in the input record of field 1. The high-order position is punched in these columns. The first character of a record is considered 0001. If a field of zeros is to be printed, punch columns 56-59 ZZZZ.

Columns 54 and 55	03	Three fields selected.
These 11 columns pertain to field 1.		
Columns 56-59	0005	High-order position in input record of the selected field.
Columns 60-62	012	Number of characters in the selected field.
Columns 63-65	001	High-order print position of the selected field.
Column 66	1	Line in which the selected field is to be printed.
-----		
These 11 columns pertain to field 2.		
Columns 67-70	0050	High-order position in input record of selected field.
Columns 71-73	010	Number of characters in the selected field.
Columns 74-76	001	High-order print position of the selected field.
Column 77	2	Line in which the selected field is to be printed.
	12-punch	Zero suppression is to be performed.
Column 78	1	Editing is to be performed in this job.
-----		
These 11 columns in second control card pertain to field 3.		
Columns 1-4	0016	High-order position in input record of the selected field.
Columns 5-7	010	Number of characters in the selected field.
Columns 8-10	028*	High-order print position of the selected field.
Column 11	2	Line in which the selected field is to be printed.
	11-punch	Editing is to be performed.

Figure 29. Field Selection with Zero Suppression and Editing

Column 1	□ (Lozenge)	Identifies card as edit word card.
Columns 2 and 3	17	Length of edit word.
Columns 4-20	&bb,bbb,bb0.bb&CR	Edit word.

Figure 30. Edit Word Card Used in Example

**Columns 60-62:** These are punched with the number of characters in the selected field. If a field of zeros is being printed, the length of the field is punched here. The maximum field length in either case is 132.

**Columns 63-65:** These are punched with the high-order print position of field 1. The leftmost print position of the IBM 1403 Printer is 001.

**Column 66:** This is punched with the line number in which field 1 is to be printed. The first line of each record is counted as line 1. The maximum number of lines for each record is nine.

If the selected field is to be zero suppressed, column 66 contains a 12-punch in addition to the line number.

If the selected field is to be edited, column 66 contains an 11-punch in addition to the line number.

Here is an example of field selection incorporating zero-suppression and editing. Three fields from each input record are to be selected for printing. Field 1 is contained in location 5-16 of the input record. It prints in print positions 1-12 of the first line. Field 2 is contained in location 50-59 of the input record. It prints in positions 1-10 of the second line and suppression of high-order zeros is performed. Field 3 is contained in location 16-25 of the input record. It is edited and printed in positions 21-37 of the second line.\* The edit control word is

\$bb,bbb,bb0.bb&CR.

The specifications required in the control cards for this example are shown in Figure 29.

For this example an edit word card must be included with the two control cards. The edit card has the punches shown in Figure 30.

#### TRAILER LABELS (COLUMN 79)

Trailer labels can be used only to test for an end-of-reel condition. They cannot be printed out or punched into cards by this program. A trailer label should contain no more than eighty characters. If it does, only the first eighty characters will be used for comparison.

\* When the edit word is longer than the field to be edited, subtract the length of the field from the length of the edit word and add the difference to the high-order position of the print field. Punch this number in the control card columns devoted to print position.



## Technical Newsletter

File Number 1401 - 32

Re:Form No. J24-1411-2

This Newsletter No. N21-0030-0

Date 15 March 1965

Previous Newsletter Nos. None

This Technical Newsletter is issued as a supplement to the SRL publication, Utility Programs for IBM 1401 Tape Systems - Specifications, Form J24-1411-2, and revises certain information in this publication.

Each revision is related to the base publication by page number, column, and paragraph or line.

Inside Front Cover. Change line 2 of Publishing Source:

Address comments concerning the contents of this publication to: IBM Corporation, Product Publications, Dept. 245, Rochester, Minn. 55901.

Page 4, Column 2, Line 9. Add this paragraph:

While it is building blocked tape records and bypassing exception records, the program cannot check sequencing. An attempt to check sequencing at this time would cause false sequence errors after an exception record is bypassed. If sequencing must be checked, a separate run should be made.

*International Business Machines Corp., Product Publications Dept., Rochester, Minn. 55901*

Page 7, Column 2. Replace all lines of "Column 13":

Column 13: This column is punched with a logical comparison option specifying the relationship of the two exception characters that determine whether a record is to be excepted. If only one exception-character location is used per record, column 13 must be left blank.

1. A 1-punch specifies an and comparison. An exception record is recognized in each of the following cases:
  - a. When presence tests are used, if both exception characters in the control card are present in their respective exception positions of the record.
  - b. When absence tests are used, if both exception characters in the control card are absent from their respective exception positions of the record. (Absent, in this case, means not equal to the character in the exception position.)
2. A 2-punch specifies an or comparison. An exception record is recognized in each of the following cases:
  - a. When presence tests are used, if one or both of the exception characters in the control card are present in their respective exception positions of the record.
  - b. When absence tests are used, if one or both of the exception characters in the control card are absent from their respective exception positions of the record. (Absent, in this case, means not equal to the character in the exception position.)

Note: The exception characters are specified in columns 14 and 20 of the of the control card; the type of tests (presence or absence), involving the characters in columns 14 and 20, are specified in columns 15 and 21 respectively; and the exception positions in the record, related to columns 14 and 20, are indicated in columns 16 - 19 and 22 - 25 respectively.

Page 12, Column 2. Replace all lines of "Sense Switch F":

Sense Switch F: When turned on, this switch makes the read-release feature inoperable for the remainder of the run. The read-release feature should not be used in the following cases:

1. When using the sequence-check option.
2. When the program requires more than the available 21 milliseconds of read-start time to write out a record block. (This can occur in cases involving the larger block sizes allowed by the program.)

Page 17, Column 2. Replace all lines of "Column 19":

Column 19: This column is punched with the logical comparison option, specifying the relationship between the two exception characters that determine whether a record is to be excepted. If only one exception character location is used per record, column 19 must be left blank, as well as columns 25 - 30.

1. A 1-punch specifies an and comparison. An exception character is recognized in each of the following cases:
  - a. When presence tests are used, if both exception characters in the control card are present in their respective exception positions of the record.
  - b. When absence tests are used, if both exception characters in the control card are absent from their respective exception positions of the record. (Absent, in this case, means not equal to the character in the exception position.)
2. A 2-punch specifies an or comparison. An exception record is recognized in each of the following cases:
  - a. When presence tests are used, if one or both of the exception characters in the control card are present in their respective exception positions of the record.
  - b. When absence tests are used, if one or both of the exception characters in the control card are absent from their respective exception positions of the record. (Absent, in this case, means not equal to the character in the exception position.)

Note: The exception characters are specified in columns 18 and 25 of the control card; the type of tests (presence or absence), involving the characters in columns 18 and 25, are specified in columns 20 and 26 respectively; and the exception positions in the record, related to columns 18 and 25, are indicated in columns 21 - 24 and 27 - 30 respectively.

Page 23, Column 1. Replace all lines of "Sense Switch F":

Sense Switch F: When turned on, this switch makes the punch-release feature inoperable for the remainder of the job run. The punch-release feature should not be used if the program requires more than the available 37 milliseconds of punch-start time to read-in a record block. (This can occur in cases involving the larger block sizes allowed by the program.)

Page 30, Column 1. Replace all lines of "Column 27":

Column 27: This column is punched with the logical comparison option specifying the relationship between the two exception characters that determine whether a record is to be excepted. If only one exception character location is used per record, column 27 must be left blank.

1. A 1-punch specifies an and comparison. An exception character is recognized in each of the following cases:

- a. When presence tests are used, if both exception characters in the control card are present in their respective exception positions of the record.
  - b. When absence tests are used, if both exception characters in the control card are absent from their respective exception positions of the record. (Absent, in this case, means not equal to the character in the exception position.)
2. A 2-punch specifies an or comparison. An exception record is recognized in each of the following cases:
- a. When presence tests are used, if one or both of the exception characters in the control card are present in their respective exception positions in the record.
  - b. When absence tests are used, if one or both of the exception characters in the control card are absent from their respective exception positions in the record. (Absent, in this case, means not equal to the character in the exception position.)

Note: The exception characters are specified in columns 28 and 34 of the control card; the type of tests (presence or absence), involving the characters in columns 28 and 34, are specified in columns 29 and 35 respectively; and the exception positions in the record, related to columns 28 and 34, are indicated in columns 30 - 33 and 36 - 39 respectively.

A 1-punch in column 79 indicates that the program is to compare the trailer label with a single trailer label card included with the control card(s). When the trailer label is greater than eighty columns, only the first eighty characters are compared. When the first eighty columns of the trailer label match the configuration of the trailer label card, the program stops because an end-of-reel condition has been detected. When the trailer label does not match the configuration of the card, the tape runs off the reel unless a double tape mark is present. When columns 11 and 12 are punched with the number of files to be processed, or when columns 15-20 are punched for selective file printing, the program stops automatically after the proper files have been processed.

#### SPACE SUPPRESS (COLUMN 80)

Column 80 of the first control card is used to suppress the additional triple space preceding the first line of a report, as specified under *Forms Control* (columns 22-25, 80).

#### CONTROL CARDS 2 AND 3

The second control card is used only when 3-9 fields are selected for printing. The second and third control cards are used only when 10-16 fields are selected for printing. If less than three fields are selected, or if field selection is not performed at all, the second and third control cards must be omitted.

#### Simulation of the IBM 720 Printer

If it is desired to use the tape-to-printer program to simulate the output of the IBM 720 Printer, columns 21 and 80 of the first control card should both be punched with a 1. This prevents page numbering and the additional triple space at the top of a page.

Also, if the first character of each fixed-length input record is used for carriage control, print-line length (control card columns 8-10) should include the first position as a print position. The first character is then blanked and printed in print position one. For example, if record length is 121, including the carriage-control character, line length should be specified as 121, rather than 120. The last 120 positions of the record will print in positions 2-121. If it is desired to print in positions 1-120 instead, the field selection mode should be used.

