ADDENDUM TO CS348A

HALF INCH TAPE OPERATIONS

Some Atlas installations are equipped with half inch tape mechanisms as well as the standard one inch tape. The half inch tape operations are described in the following sections. At present there is an upper limit of 4096 characters in a record, if no information is to be lost during a transfer, and this is described herein; this limit may later be removed.

9.8 Atlas Half Inch Tape

Information on each magnetic tape is split up into sections or records, consisting of up to 4096 six bit characters each. Groups of records may be formed into a file, separated from other files by file marks - short, standard records recognised by hardware. When the tape is first mounted it is positioned ready move forward and use the first record. As the records are of variable length, and the tape is not pre-addressed, it is very difficult to use particular records, unless these occur sequentially on the tape. The file marks enable unwanted files to be neglected without having to examine every record within them.

Searching for file marks is a relatively slow process compared with the computing speed of Atlas, and the time taken is proportional to the length of tape traversed. Any search instructions should be given as early as possible in the program.

The characters stored on the tape each have a parity bit associated with them - the programmer can chose whether this should give odd or even parity. The character themselves may be in one of two forms: Binary Coded Decimal, (BCD) usually for input or output data, and normally with even parity, or pure Binary, usually with odd parity, when the tapes are used as an extension of the computer store. The characters may be packed with one of up to three densities on the tape.

9.9 Half Inch Tape Instructions

9.9.1 The Selection Instructions

The tape which is required for processing is initially selected by obeying a 1260 instruction, which also defines the maximum record length, and the mode of transfer. All succeeding half inch tape instructions apply to this tape, with the exception of the 1262 instruction. The tape number is that appearing in the job description, and is specified by the Ba digits of the instruction ($0 \leqslant Ba \leqslant 126$). The maximum record length is specified by bits 12-20 of the singly-modified operand n; hence the longest record allowable is 512 Atlas words, or 4096 characters. The octal fraction of n determines the mode of transfer as follows:-

bit 21 = 0 for odd parity
= 1 for even parity
bit 22 = 0 if no code conversion is required (binary)
= 1 if code conversion is required (BCD)
bit 23 must be zero

Thus, the instruction

1260 42 0 48

would select tape 42 to provide backing store, transfers being unconverted with odd parity, with a maximum of 384 characters in any record.

1260 2 0 4.6

would select tape 2 for B.C.D. even parity working, maximum record length 32 characters.

It may often be necessary to find which tape is being used, for instance on entering a subroutine. Extracode 1261 will find the selected tape, mode, and record length. The contents of Ba will be set to the tape selected, stored in the half word position, bits 15-21. ba will be set to J4 if no half inch tapes are selected. The record length and mode will be given in the same way as for the 1260 instruction, and will appear in the B-line specified in the half-word position (bits 15-21) of the singly modified operand n. Thus the instruction

1261 10 0 11D1

at the beginning of a routine, and

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121    121    10    0
1260   122    11    0
```

at the end would preserve the half inch tape selected on entry, together with the maximum record length and mode of transfer.

Before any transfers take place, the instruction 1256 must be obeyed to select the density of character packing on the currently chosen tape, using operand n as follows:-

n = 0 for low density, 200 characters per inch
n = 0.4 for medium density, 556 characters per inch
n = 1 for high density, 800 characters per inch

This density applies to the selected channel and should not be changed between tape transfers. If an attempt is made to read a tape in a higher density than it has been written in, the situation may be irretrievable. Hence if a tape's density is unknown, it should be read first with low density selected. If the wrong density is selected, there will be a read failure, which may be trapped (see sections 9.11 and 11.2).

9.9.2 The Transfer Instructions

Records are written to the selected tape using the 1270 extracode. The number of characters, specified by bits 12-23 of ba, must not exceed the number specified by the 1260 extracode. The first character transferred is taken from the address S.

The 1274 instruction will read the next record from the tape. Ba must be 1; S specifies the character position to which the first character will be transferred. Thus

1260 1 0 63.4

will transfer the next record from tape to store, starting at address location 63.4. If $S < 0$ there will be no storage of the record, providing a means of skipping records. If the number of words in the record is greater than the maximum specified by the 1260 instruction, the tape will continue to move to the end of the record, but the excess words will be lost.

The 1276 instruction sets ba to the number of characters transferred from the tape by the previous 1274 instruction reading from the currently selected half inch tape. This may be greater than the maximum length specified by the 1260 instruction, in which case characters will have been lost.

9.9.3 The Skip Instructions

Besides reading and writing records, it is also possible to move the tape along without either operation occurring. Skipping one record forward is achieved by 'reading' to a negative store address using 1274. The instruction

1275 1 0 S

where S is negative, will skip one record backwards.

The tape is moved more quickly when searching for a file mark than when simply scanning each record, and so the 1257 instruction allows this faster search either backward or forward along the tape; 1257 is also used to write a file mark at the current position of the selected tape. The operation performed depends on the value of Ba as follows:-

Ba = 0, write a file mark
Ba = 1, search forwards for a file mark, positioning the tape to read the record following it.
Ba = 2, search backwards for a file mark, positioning the tape to read the file mark. The short record forming the file mark must be skipped before reading the first record of the file; alternatively searching forward for a file mark will have the same effect.

The tape may be rewound and positioned ready to read the first record by obeying the instruction

1267 0 0 0

9.9.4 Other Instructions

When a program deals with data that may be either on one inch tape or on half inch tape it is necessary to know which is being used in a particular run. Obeying a 1262 instruction will set ba according to the type of device that is listed as number n (singly modified operand) in the job description. Thus

1262 10 0 6

will set b10' = 0 if device 6 in the job description is a one inch tape mechanism
= 0.4 if device 6 is a half inch tape mechanism
= J4 if no device 6 is defined.

The following instructions have a similar use for both one and half inch mechanisms.

1010 Mount tape. For half inch tape, although it will be called for by name, no check can be made that the correct tape is mounted.

1016 Unload and Store
1021 Release Mechanisms

9.9.5 Summary of Half Inch Tape Instructions

1256 Select density n on selected mechanism
n = 0 low density, 200ch/in
n = 0.4 medium density, 556ch/in
n = 1 high density, 800ch/in
Reading in a higher density than the tape is written in has an unpredictable effect. Once the correct density is found, no further changes should be made.

1257 Write file mark/Skip to file mark, using selected device.
Ba = 0, write a file mark
Ba = 1, position the tape to read the record following the next file mark, moving the tape forwards.
Ba = 2, move the tape backwards to the previous file mark, positioning the tape to read the file mark.

1260 Select deck Ba; define record length and mode of transfer n. ($0 \leq Ba \leq 126$)
Bits 12-20 of n define the maximum record length
Bit 21 of n = 0 for odd parity
= 1 otherwise
Bit 22 of n = 0 if no code conversion required
= 1 otherwise
Bit 23 of n = 0 always

1261 Set ba to selected device; set b(n) to record length and mode defined.
ba' = number of selected deck in the half word position
= J4 if no half inch tape mechamism selected.
The B-register given in bits 15-21 of n is set to the record length and mode as defined in 1260.

1262 Set ba to type of device n (bits 0-20)
ba' = 0 if device n is one inch tape
= 0.4 if device n is half inch tape
= J4 if no device n defined

1267 0 0 0 Rewind selected device. Position tape to read first record.

1270 Write a record of ba characters from core store starting at S to selected device
ba must not exceed the number of characters defined by 1260

1274 Read a record to core store starting at S/Skip forward one record, using selected device.
Ba must be 1.
If the record is longer than defined by 1260, the extra characters will be lost. If $S < 0$, there will be no transfer, only skipping.

1275 Skip backward one record on selected device. Ba must be 1, and S negative.

1276 Set ba to length of previous record read from selected device.
If ba' is greater than the record length defined in 1260, characters have been lost.

9.10 Specification of the Atlas Half Inch Tape System

9.10.1 Control

An Atlas installation may have up to 6 half inch magnetic tape mechanisms, all connected to the computer through one channel, which may be used by one inch mechanisms in the usual way. This channel controls a read, write or backspace operation on one deck at any one time. Rewind operations are autonomous, and need the channel only to initiate them. A search for a file mark is autonomous with any operations involving one inch mechanisms connected to the same channel.

9.10.2 The Tape Layout

The tape mechanism is the IBM 729 Mark IV or the Potter MTS 120X - 41306, using half inch wide magnetic tape. There are seven tracks across the tape; six are used for data, and one for parity. There is no clock track provided; characters are recognised by the presence of a bit in at least one of the tracks.

Information is stored on tape in blocks or records, which can be of any length, and are unaddressed. Because records are of variable length, selective overwriting is virtually impossible. At the end of each record is one character generated from the parities of each track in the record; these parity characters are used to check the accuracy of all reading and writing operations. Records may be grouped into files separated by file marks - short records recognised by the hardware.

Data is stored in two different character representations.

a) Binary Mode

When it is required to use the tape as a backing store to the computer, the data will be transferred to tape directly from the main store without any code conversion, i.e. in binary form. The parity track bits then ensure odd parity.

b) B.C.D. Mode

When it is required to use the tape as an input or output device, then alpha-numeric information will be required. The data is converted into Binary Coded Decimal (BCD) by the hardware; the parity track bits ensure even parity.

Three densities of recording are possible: 200, 556 and 800 characters per inch. Each record is separated from its neighbour by a 3/4" gap in which nothing is recorded. Tapes are up to 2400 feet long.

9.10.3 Performance

For the IBM deck, the normal tape speed is 112.5 inches per second, allowing instantaneous transfer rates of 22,500, 62,500 or 90,000 characters per second for the low, medium and high densities respectively. There is a fast wind and rewind speed of about 500 inches per second; this speed is also used on long searches for file marks. For the Potter decks the normal tape speed is 120 inches per second giving instantaneous transfer rates of 24,000, 66,600 and 96,000 characters per second. The fast wind speed is 240 inches per second.

There are independent read and write heads, separated by a gap of about 0.3 inches. It is possible to read or write when the tape is moving forwards only, although the tape may be backspaced a record at a time.

9.10.4 Safeguards

A program is held up if it attempts to read from or write to a block of store which is involved in a magnetic tape transfer. The Supervisor may then enter another program until the transfer is completed.

If a transfer cannot be initiated when it is requested, it is placed in queue; if this is already full, the program is held up.

A write permit ring must be fitted to a reel of tape before that reel can be written on. Tapes containing permanent information will not have such a ring.

Because the tape's title is not written on the tape itself, the operator must ensure that the correct tape is mounted on the deck allocated; the Supervisor will assume that any tape so mounted will be the one requested.

9.11 Half Inch Tape Faults

Trap entry 7 is now defined as

IBM TAPE ERROR

This message will be printed by the Supervisor if the fault is not trapped (see Chapter 11). If the fault is trapped, B119 contains a number giving the reason for monitoring; this number is printed in decimal after 'IBM TAPE ERROR', if not trapped.

b119	Reason for monitoring
0.0	Filemark read by 1274
0.4	Read failure
1.0	End of tape detected either following a 'skip backwards' or a 'write' instruction
1.4	Write failure
2.0	Failure to detect a filemark
(2.4	No IBM LAM within 2 minutes).

10.6.4 Half Inch Tapes

At those installations capable of handling half inch (IBM - compatible) magnetic tape, each tape required must be listed in the job description by means of a TAPE heading, followed on a new line by a description, consisting of the letters IBM, the programmer's number (in the range 0 to 126), or a tape reference letter, and the title of the tape:

```
TAPE
IBM     42      WINCHESTER SALES
TAPE
IBM     C       WINCHESTER PURCHASES
```

The tape reference letter and the deck allocation are treated in the same way as for one inch tape. Each tape used should have a different programmer's number.

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