



**The HP 7978A
Magnetic Tape Subsystem
Operator's Manual**

Warranty and Service

Hewlett-Packard products are warranted against defects in materials and workmanship. For Hewlett-Packard 1/2" Tape products sold in the U.S.A. and Canada, this warranty applies for ninety (90) days from date of installation.* Hewlett-Packard will, at its option, repair or replace equipment which proves to be defective during the warranty period. A copy of the complete warranty statement is available upon request.

HP offers complete service and maintenance worldwide. Maintenance agreements are available for all HP peripheral products. Advantages of these agreements to the customer include a fixed annual cost, individualized cost-effective contracts and a choice of response time. Current U.S.A rates can be determined by contacting your local HP Sales Office.

The selection and use of media, supplies, and consumables is the customer's responsibility. Hewlett-Packard reserves the right to exclude from the warranty or service agreement any repairs for damage to HP products which HP reasonably determines or believes were caused by use of non-HP media or cleaning supplies. Hewlett-Packard will, upon request, repair such damage on a time and material basis.

Repairs necessitated by misuse of the equipment, or by hardware, software, or interfacing not provided by Hewlett-Packard are not covered by this warranty.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OR MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. HEWLETT-PACKARD SHALL NOT BE LIABLE FOR CONSEQUENTIAL DAMAGES.

* For other countries, contact your local Sales and Support Office to determine warranty terms.

Federal Communications Commission Radio Frequency Interference Statement

Warning: This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

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SAFETY CONSIDERATIONS

GENERAL – This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation.

SAFETY SYMBOLS



Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect the product or tape medium against damage.



Indicates hazardous voltages.



Indicates earth (ground) terminal.

WARNING

WARNING calls attention to a procedure or practice which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a **WARNING** sign until the indicated conditions are fully understood and met.

CAUTION

CAUTION calls attention to an operating procedure or practice which, if not correctly performed or adhered to, could result in damage to the product or tape medium. Do not proceed beyond a **CAUTION** sign until the indicated conditions are fully understood and met.

SAFETY EARTH GROUND – This is a safety class I product and is provided with a protective earthing terminal. An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, the product must be made inoperative and be secured against any unintended operation.

BEFORE APPLYING POWER – Verify that the product is configured to match the available main power source. If this product is to be operated with an autotransformer make sure that the common terminal is connected to the earth terminal of the main power source.

SERVICING

WARNING

Any servicing, adjustment, maintenance, or repair of this product, other than that described within this document, must be performed only by service personnel trained by Hewlett-Packard.

INTRODUCTION

SECTION

I

1.1 GENERAL INFORMATION

The HP 7978A tape drive is designed to provide low-cost, high-speed backup and data interchange. This drive supports 6250 cpi Group-Coded Recording (GCR) and 1600 cpi Phase-Encoded Recording (PE). Nominal read/write tape speed is 75 ips and the rewind speed is 250 ips. Interface to the Host is through the Hewlett-Packard Interface Bus (HP-IB).

For systems with greater than 400 Mbytes of storage and where backup is the primary concern, the HP 7978A provides an ideal solution.

Reliability is designed into the drive by use of HP-designed Large Scale Integration circuitry and a simplified hardware design. These features, plus an extensive set of internal diagnostics, result in fewer and faster repairs. System operational time is increased and maintenance costs are significantly reduced. There is no preventive maintenance required except for tape path cleaning done by the operator.

1.2 ORDERING OPTIONS

HP 7978A Standard Product

- 6250/1600 cpi magnetic tape drive
- upright cabinet
- power configuration and power cord option taken from country code on the order.

Option 132

- 6250/1600 cpi magnetic tape drive
- installation hardware to mount the tape drive into an existing HP 7978A cabinet.

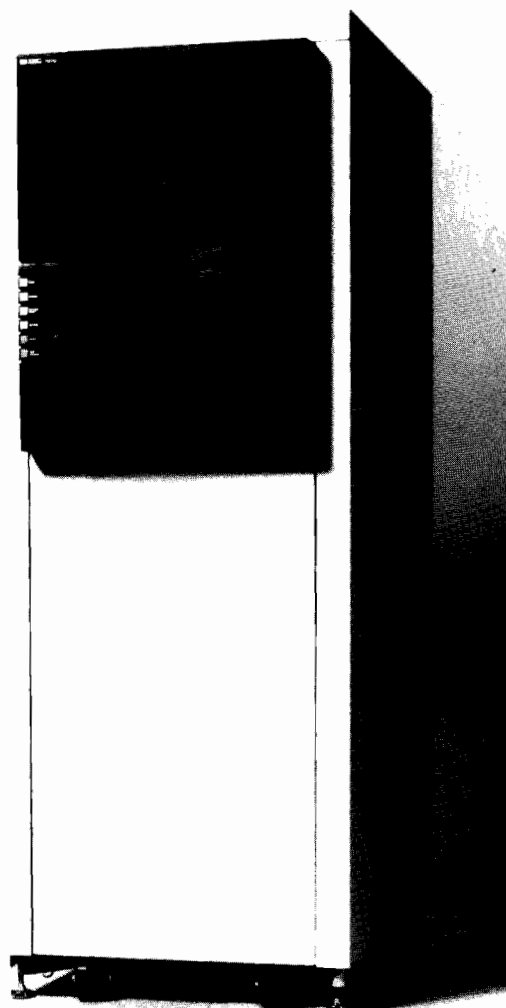


Figure 1-1 The HP 7978A

1.3 SUPPLIES AND ACCESSORIES

A supply of cleaning and other high-usage materials should be kept in stock at all times. The following HP products are recommended for use with the HP 7978A:

- Magnetic Tape, 2400 ft (box of 10)	92150F
- Tape Head Cleaner, 6 - 4 oz bottles	92193X
- Foam Swabs (50 per package)	9300-0767
- Lint-Free Wipes (100 per bag)	92193W
- Magnetic Head Cleaning Kit	92193H
2 - 4 oz bottles of Tape Head Cleaner	
50 - Lint-Free Wipes	
10 - Foam Swabs with plastic shaft	
1 - easy-pour dispensing cap	
- Magnetic Tape Sense Markers (250 per card)	92150M

Supplies and accessories may be ordered from the Computer Users Catalog through Hewlett-Packard Sales and Support Offices. To find the office nearest you, refer to the list at the end of this manual.

1.4 SPECIFICATIONS

PERFORMANCE

TRANSFER RATE*

Channel Burst Rate	1 Mbyte/second, nominal
6250 GCR Burst Recording Transfer	461 Kbytes/second, nominal
1600 PE Burst Recording Transfer	120 Kbytes/second, nominal
*see Subsection 1.5	

DATA CAPACITY (2400 ft tape)*

6250 GCR	140 to 150 Mbytes (typical)
1600 PE	40-41 MBytes (typical)
*see Subsection 1.5	

READ HARD ERROR RATE*

6250 GCR	$\leq 10^{-11}$ bytes
1600 PE	$\leq 10^{-10}$ bytes
*see Subsection 1.5	

SPEEDS

Read/Write/Search Speed	75 ips, nominal
Rewind Speed	250 ips

REPOSITION TIME

6250 GCR	738 ms
1600 PE	712 ms

TENSION AND BRAKING

Tape Tension	283.5 gmf (10 oz) nominal
Reel Motor Braking	Active for normal tape operations; passive in power failure.

INTERFACE

IEEE 488-1978 (HP-IB)

MAGNETIC HEAD ASSEMBLY	Nine-track, long-life ceramic coating; factory preset for skew and azimuth. No adjustment required.
BOT/EOT SENSING	Reflective; LED/phototransistor
MAGNETIC TAPE	
Width	12.7 mm (0.5 inch)
Thickness	0.38 mm (1.5 mils) Use of 1 mil tape not supported
Reel Size	178 mm (7.0 in.) 216 mm (8.5 in.) 267 mm (10.5 in.)

PHYSICAL CHARACTERISTICS

	Standard Option (tape drive with cabinet)	
	In shipping container (incl. pallet and carton)	No shipping container
Height	1725 mm (68 in.)	1600 mm (63 in.)
Width	925 mm (36 in.) (viewed from pallet front)	600 mm (24 in.) (viewed from drive front)
Depth	775 mm (31 in.) (pallet front to pallet rear)	780 mm (31 in.) (drive front to drive rear)
Weight	214 kg (472 lbs)	190 kg (419 lbs)* *(excludes accessory pack)
	Option 132 (tape drive less cabinet, with mounting hardware)	
	In shipping container (incl. pallet and carton)	Drive Module Only
Height	895 mm (35 in.)	635 mm (25 in.)
Width	785 mm (31 in.) (viewed from pallet front)	484 mm (19 in.) (viewed from drive front)
Depth	635 mm (25 in.) (pallet front to pallet rear)	685 mm (27 in.) (drive front to drive rear)
Net Weight	84 kg (185 lbs)	64 kg (141 lbs) (excludes mounting hardware)

**Drive Module on Pallet
(with accessory pack
and lower padding)**

Weight	81 kg (179 lbs)
Height	820 mm (32 in.)
Width	785 mm (31 in.)
Depth	635 mm (25 in.)

OPERATING ENVIRONMENT

TEMPERATURE

Operating Temperature	Range is media limited: 15 to 32°C (60 to 90°F)
Storage Temperature	-40 to 75°C (-40 to 167°F)
Shipment Temperature	-40 to 75°C (-40 to 167°F)
Rate of Change	8°C (36°F) / hour (non-condensing)

RELATIVE HUMIDITY (Non-Condensing)

Operating	media limited to 20% to 80% at <22°C (78°F) maximum wetbulb temp.
Standby	media limited to 20% to 80% at <22°C (78°F) maximum wetbulb temp.
Storage or Shipment	90% at 65°C (149°F)

ALTITUDE (Above Sea Level)

Operating	3.0 km (10,000 ft)
Non-Operating	15.3 km (50,000 ft)

SHOCK and VIBRATION

Non-Operating Shock	2-inch edge drop
Non-operating Vibration	0.5 G for 5 to 55 Hz

POWER

LINE VOLTAGE	Factory configured to 90 to 125V or 198 to 250V	
LINE FREQUENCY	48-66 Hz	
POWER CONSUMPTION (Watts)	90-125 VAC	198-250 Vac
Standby (tape not loaded)	162	147
Standby (tape loaded)	229	186
Operating (any motion)	367	397

HEAT DISSIPATION	2,074 Btu/Hr
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LINE CURRENT

(Amperes-max. average)	90-125 VAC	198-250 VAC
Standby (tape not loaded)	2.4	1.0
Standby (tape loaded)	3.5	1.3
Operating (any motion)	7.1	3.3

REGULATORY AGENCY COMPLIANCE

Agency	Standard
SAFETY	
Underwriters Laboratories	UL 114,478 (UL listed)
Canadian Standards Association	C22.2 No. 154-M1983 (CSA certified)
International Electrotechnical Commission	IEC 380,435 (complies)
EMISSIONS	
Federal Communication Commission	FCC-A
FTZ	VDE-B

**AUDIBLE NOISE**

60 dBA Sound Power

APPLICABLE STANDARDS

ANSI X3.39-1973	Recorded Magnetic Tape for Information Interchange (1600 cpi, PE)
ANSI X3.54-1976	Recorded Magnetic Tape for Information Interchange (6250 cpi, Group-coded Recording)
ANSI X3.40-1976	Unrecorded Magnetic Tape for Information Interchange (9-track 200 and 800 cpi, NRZI 1600 cpi, PE)
ECMA-36	Data Interchange on 9-track Phase-encoded Magnetic Tape at 63 bits/mm (1600 cpi)
ECMA-62	Data Interchange on 12.7 mm 9-track Magnetic Tape

1.5 HP 7978A TAPE DRIVE PERFORMANCE

The following brief explanation points out some factors which must be considered when evaluating the performance of the HP 7978A tape drive.

The most important concept underlying these performance figures is that SYSTEM usage must be included as a dominant factor. "Burst" or theoretical maximum limits do not reflect the performance of a tape drive in a specific system doing real operations.

If you desire more information about performance factors, and how they might apply to your system, contact your nearest Hewlett-Packard Sales and Support Office.

TRANSFER RATE

Transfer rate, in real terms, is determined by three general factors as follows:

FILE SET	number of files sizes of the files location of the files on the system discs
COMPUTER/TAPE DRIVE	the capabilities of the Host hardware and software, the capabilities of interfaces, the hardware and software capabilities of the tape drive
WORKLOAD	competition for system resources

The following table, using HP equipment as examples, illustrates the range of performance factors.

	PERFORMANCE		
	HIGH	MEDIUM	LOW
FILE SET	-large files close together	<---->	-small files far apart -or medium, fragmented files
COMPUTER/TAPE DRIVE	-HP 3000, Series 64 or 68 with HP 7978A or HP 7976 tape drives, multiple HP 7933 disc drives - each on a separate GIC	<---->	-HP 3000 Series 39,40 42,44,48 w/HP 7978A tape drive and a single HP 7933 disc drive on the same GIC.
WORKLOAD	-single user -tasks are mainly offline dumps (very fast w/ no CPU contention)	<---->	-many users -disc traffic greater than 30 disc I/O's per second -heavy sharing of CPU resources (e.g. simultaneous simulations).

Using the performance matrix as a framework, three general categories of backup operations are usually encountered.

TYPICAL OFFLINE BACKUP	Highest performance Host, 2 discs, backing up after hours. Medium fileset. No one else online. (The system delivers data faster than the tape drive can record it).
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TYPICAL ONLINE BACKUP

Highest performance Host, 2 discs, backing up after hours. Medium fileset. Medium workload imposed by users.

WORST CASE BACKUP

Lower performance Host with disc space nearly full. Disc and tape on a single interface. Reload has not occurred recently so files are extensively fragmented. A system "store" operation attempted at peak use time.

The transfer rate for the HP 7978A is as shown in Figure 1-2.

A = Burst recording rate (density * tape speed).

B = theoretical transfer rate. Includes streaming gap overhead. Bytes-per-record is 16,384 bytes for GCR and 8,192 for PE.

C = typical offline – approximately 90% down to 70% of B for GCR and from 90% down to 80% of B for PE.

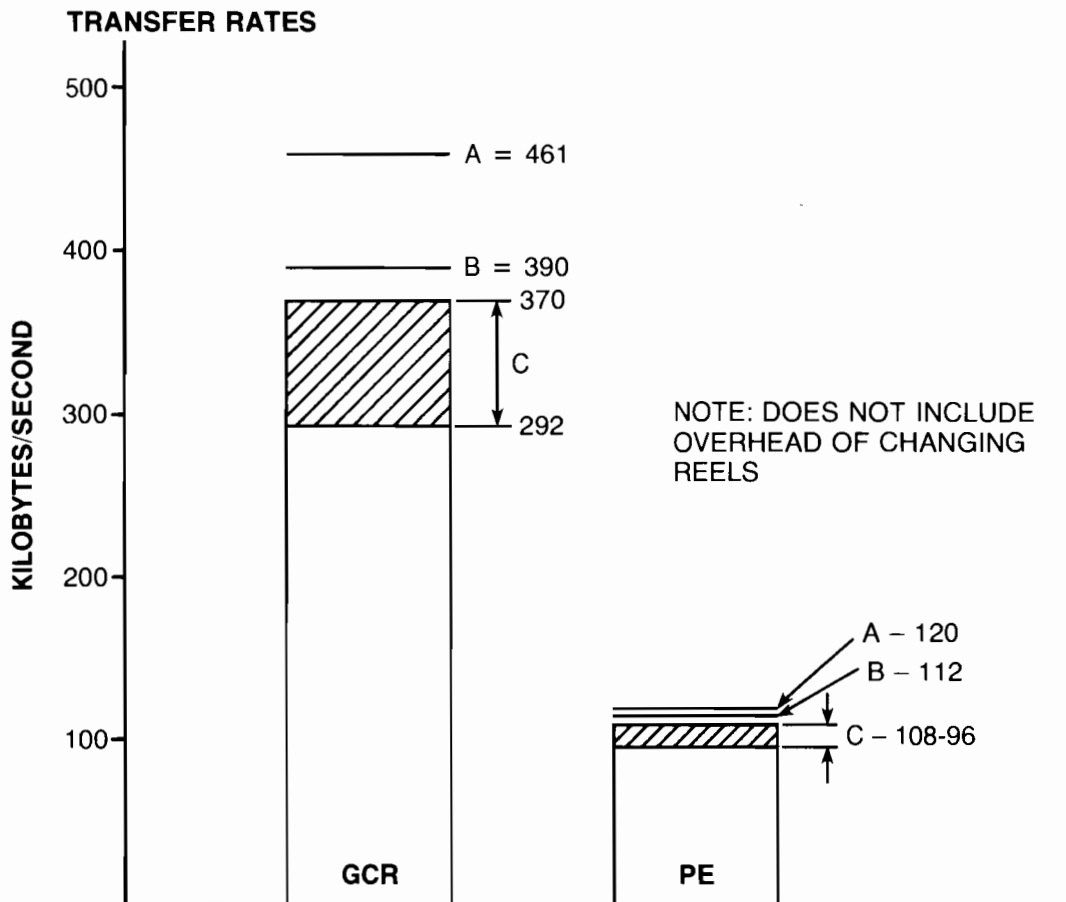


Figure 1-2. HP 7978A Transfer Rates

DATA CAPACITY

The amount of data which can be placed on a reel of tape depends on the following:

- (1) size of the records being written
- (2) the size of the interrecord gap (minimal gap and typical streaming gap)
- (3) gap extensions due to speed matching factors in the transfer
- (4) number of file marks written (to a lesser degree).

Figure 1-3 shows the range of densities, from theoretical maximum to worst case.

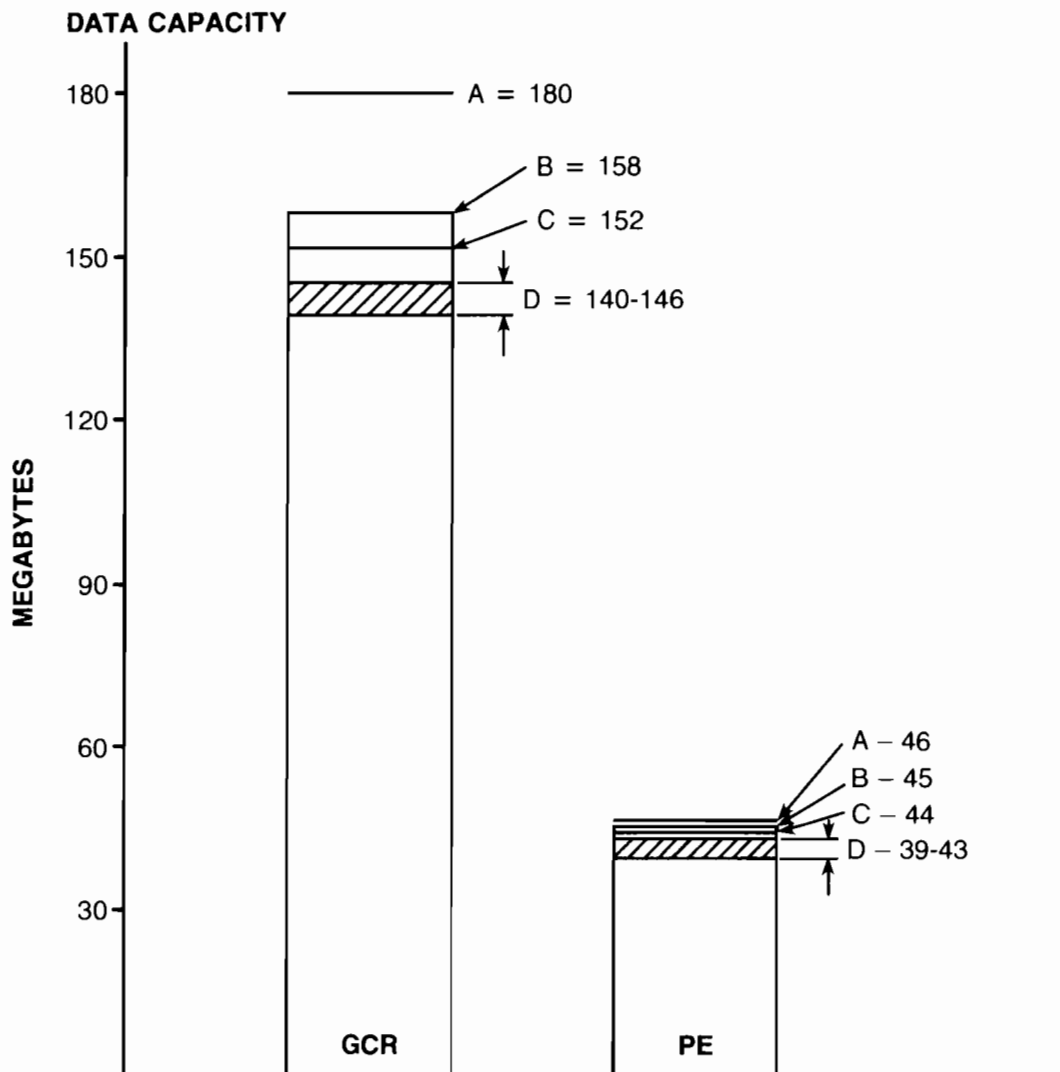


Figure 1-3. HP 7978A Data Capacity

A = unformatted data [theoretical] – 2400 ft * 12 in./ft * 6250 cpi for GCR
 2400 ft * 12 in./ft * 1600 cpi for PE

B = maximum formatted data- minimum gap as written by an HP 7978A, no file marks
 – for GCR, maximum block size is 16,384 bytes per block, approximate minimum gap is 0.365 in.
 – for PE, maximum block size is 8,192, approximate minimum gap is 0.6 in.

C = formatted, typical streaming gap, no file marks
 – GCR typical streaming gap is approximately 0.48 in.
 – PE typical streaming gap is approximately 0.6 in.

D = typical -- GCR assumes – approximately 1500 files/tape
 – approximately 10,000-12,000 records written
 – approximate average record size – 14,000 bytes
 – streaming gap length of 0.48 in.
 – minimal amount of gap extensions

PE assumes – approximately 500 files/tape
 – 2,500-3,500 records written
 – approximate average record size – 7,000 bytes
 – gap length is approximately 0.6 in.
 – minimal amount of gap extensions.

ERROR RATES

Error rates for the HP 7978A were measured using 6250 cpi certified tape with less than 200 passes under normal operating conditions. Multiple-bit errors within a block were counted as a single error. Error rates were taken with 16,384 characters per block. Error rates indicated are statistically valid to 90% confidence.

The following rates were gathered under these general conditions –

Permanent Read Error – any data error not recoverable after seven retries.

GCR – less than 1 in 1×10^{11} bytes

PE – less than 1 in 1×10^{10} bytes

Temporary Read Error – any data error recoverable within seven retries.
 Measured during 10 read passes after write.

GCR – less than 1 in 5×10^8 bytes

PE – less than 1 in 1×10^8 bytes

Write Error – any data error encountered during a write operation, including corrected data.

GCR – less than 1 in 1×10^7 bytes

PE – less than 1 in 1×10^7 bytes

Permanent Write Error – any write error which cannot be corrected with 18 retries including write skips.

GCR – less than 1 in 1×10^{10} bytes

PE – less than 1 in 1×10^9 bytes.



INSTALLATION

SECTION

II

2.1 SITE SELECTION

Performance may be kept to a maximum by maintaining a clean, climate-controlled operating area. The HP 7978A is designed to function within a wide range of temperature and humidity conditions; however the actual operating range is limited by the magnetic tape. Sections V, Transport Care, and VI, Tape Library Management, give a detailed description of the problems which can occur. Most problems occur because of the susceptibility of the magnetic oxide coating of a tape to contamination and the sensitivity of the tape to changes in temperature and humidity. Position the drive away from sources of particulate contamination such as frequently-used doors and walkways, stacks of supplies that collect dust, and smoke-filled rooms. The area does not have to be air-conditioned but an operating room temperature between 18° C to 24° C (65° F to 75° F, non-condensing) is recommended.

Ventilation and door clearance requirements also need to be considered when choosing an appropriate operating site. Figure 2-1 is provided to help you determine the space needed. A minimum of 70-80 mm (3 in.) is required behind the rear door to allow air circulation. Maintain a clearance of at least 1 metre (approximately 39 in.) in front of the unit to provide adequate space for opening the front door (490 mm / 19.3 in.) and for pulling the cabinet out during servicing.

For detailed site environmental information, refer to the publication entitled "Site Environmental Requirements for Tape Drives" HP # 5955-3456.

NOTE

Environmental specifications listed in this manual apply when this tape drive is not connected to a Hewlett-Packard system. When the tape drive is connected to Hewlett-Packard systems, the most stringent environmental specifications listed for any single Hewlett-Packard device within the system are applicable and supersede these specifications.

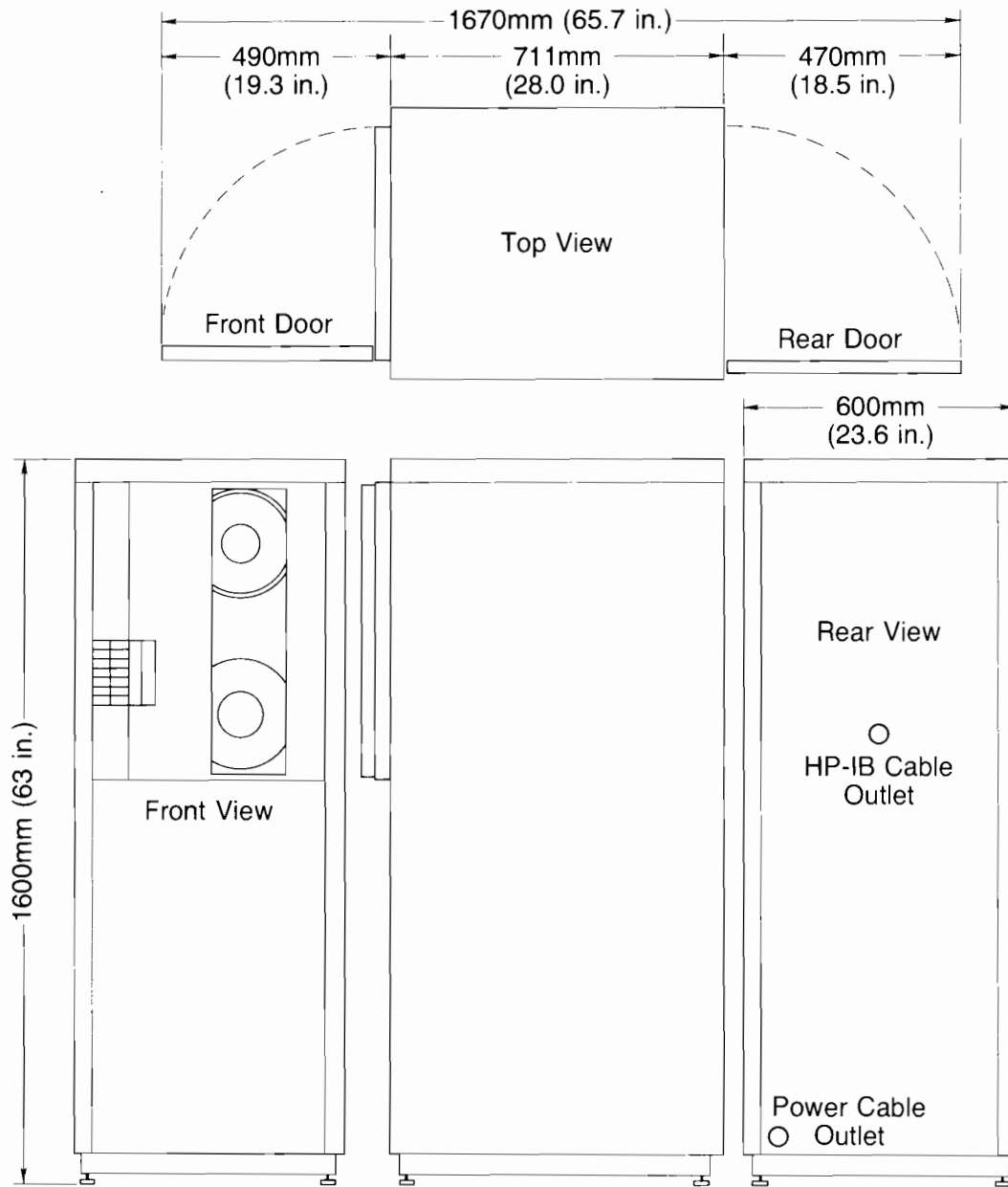


Figure 2-1. HP 7978A Dimensions



2.2 UNPACKING INSTRUCTIONS

2.2.1 BEFORE UNPACKING THE TAPE DRIVE

Inspect the shipping container before unpacking the unit. If the shipping carton is damaged, refer to CLAIMS PROCEDURE (Subsection 2.5). If no damage is seen on the carton, remove the carton (Steps a to c in the next Subsection) and inspect the tape drive unit. If there is no damage, continue unpacking and move the tape drive to its operating site (Steps d to m).

The parts and accessories inventory is listed in Subsection 2.4.

2.2.2 UNPACKING THE TAPE DRIVE

This procedure requires a sharp knife or scissors for cutting the plastic banding material and the cardboard carton, an adjustable wrench for raising the levelers and removing the wheel stops on the pallet, and at least two people to unload the unit.

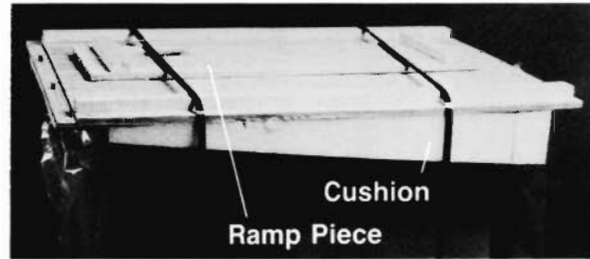
WARNING

Protective glasses should be worn while cutting the strapping bands around the drive cabinet. These straps are under tension. When cut, they may spring back and cause serious eye injury or other injuries.

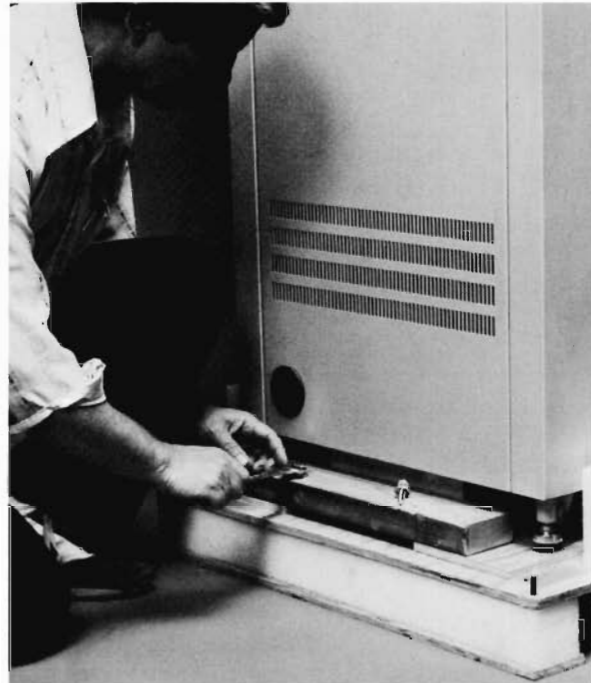
- a) Cut the strapping bands surrounding the carton.
- b) Cut the shipping carton along one of the vertical edges and across one adjoining upper horizontal edge.
- c) Fold back the edge that has been cut and remove the carton from the opposite side.
- d) Cut the strapping bands surrounding the tape drive cabinet.



- e) Remove the cushion, ramp piece, and plastic bag from the top of the unit. The cushion and ramp piece will be used in Steps g and h to form a ramp for rolling the tape drive down to the floor.



- f) One end of the pallet has steel pins sticking up through the corners. Use the wrench to remove the wheel stop from that end of the pallet.



- g) Build the ramp by placing the cushion behind the pallet so that the pins protrude through the holes in the deck of the cushion.

- h) Place the ramp piece at the lower end of the cushion. Make sure the pins on the lower end of the cushion protrude through the holes in the ramp piece.



HP Computer Museum
www.hpmuseum.net

For research and education purposes only.

WARNING

Ensure that the tape drive casting is properly secured before moving the unit. Severe injuries could result if the casting swings open while the cabinet is being pushed, especially on inclines.

The access panel for the screw that secures the casting is directly below the front panel buttons. Grasp the edges of this portion of the panel and pull. The panel is a snap fit and should come off easily. Use a screwdriver to verify that the casting release screw is tight. Replace the access panel.

**WARNING**

The leveler feet must be raised when the drive is rolled down the ramp. If not, they could catch on the ramp and cause the unit to tip over.

- i) Check that the leveler feet are raised at least 1/2" above the pallet. Use the wrench to adjust them if necessary.



Front View



Rear View

WARNING

The tape drive is heavy and difficult to move. Use considerable care during unloading. Use a minimum of two people; one pushing and one guiding it down the ramp.

- j) Carefully roll the unit down the ramp.
- k) Before placing the drive into its operating site, lower the rear levelers until they are .3 - .6 cm (1/8 - 1/4 in.) above the floor.

CAUTION

Do not push the drive unit when the levelers are touching the floor. The levelers may bend or break.

- l) Push the drive into place and lower the front levelers to the floor.



WARNING

Do not attempt to operate the unit until an HP Customer Engineer has installed and thoroughly checked its operation. If the system is configured incorrectly or there are any signs of physical damage, you could injure yourself or damage the unit when applying power. Repairs necessitated by the misuse or improper operation of the equipment are not covered under warranty.

m) Call your HP Customer Engineer to complete the installation.

2.3 RELOCATING THE TAPE DRIVE

Two people should be present when moving a unit to a new site; one to push and the other to guide it safely. Follow all the safety precautions of Subsection 2.22 during the move. In particular, pay attention to the position of the levelers. Ensure that the levelers are not touching the floor. If a leveler catches on the floor while moving the drive, the drive may accidentally tip over. Once the HP 7978A has been relocated, we recommend that an HP Customer Engineer inspect the unit and verify its operation before applying power.

2.4 ACCESSORIES SUPPLIED

The equipment packed with the tape drive is as follows:

Qty.	Item	HP Part No.
1	– HP 7978A Operator and Installation Manual	07978-90000
1	– 2-metre HP-IB Cable	5060-3446
1	– Reel of Magnetic Tape (2400 ft)	9164-0158
1 pkg	– Foam-tipped Swabs	9300-0468
1 can	– Head Cleaner	8500-1251

2.5 CLAIMS PROCEDURE

If the tape drive appears to have been damaged in shipment, notify the carrier and the nearest Hewlett-Packard Sales and Support Office immediately. Sales and Support Offices are listed at the back of this manual.

The tape drive model number and serial number are on an identification label inside the front access panel, directly beneath the front panel buttons.

Be sure to include the model number and full serial number in any correspondence with Hewlett-Packard concerning the tape drive.

OPERATION

SECTION

III

3.1 OPERATOR CONTROLS AND INDICATORS

The operator control panel is located on the left side of the tape path door. This panel contains 6 buttons and 12 indicator lights to control and monitor all operations of the drive. Refer to Figure 3-1.

The buttons, from top to bottom, are labeled LOAD, ONLINE, OFFLINE/RESET, REWIND, ENTER, and TEST/ADDRESS. Indicator lights, across the top and down the right side, backlight the words WRITE ENABLE, 1600, 6250, DOOR OPEN, BUSY, BOT, ONLINE, OFFLINE, REWIND, TEST, and ADDRESS.

A STATUS light and two-digit alphanumeric display are located to the right of the ENTER Button.

3.11 CONTROL BUTTONS

NOTE

The following paragraphs describe both the operation of the operator control buttons and normal responses of the tape drive to the use of the each button. Refer to Figure 3-1 for the location of the control buttons.

LOAD BUTTON (1)

Purpose:

Pressing the LOAD button when the drive is offline initiates a tape load operation.

Conditions and Responses:

The tape drive must be offline. While the the load operation is in progress the BOT light flashes. When the load operation completes, the BOT light comes on steady and the prerecorded density of the tape is shown in the density lights.

Any errors in establishing tension or finding the BOT marker are reported to the front panel display. A load operation can be aborted by pressing the OFFLINE/RESET button. The LOAD button is inactive when the drive is online, or while an error message is shown in the display.

ONLINE BUTTON (2)

Purpose:

Pressing the ONLINE button places the drive online.

Conditions and Responses:

A tape must be currently loaded. If a load operation is in progress, the Online command is held in waiting until the load operation completes successfully. During this wait, the ONLINE light flashes. The ONLINE button is inactive while an error message is in the display, or the drive is already online.

OFFLINE/RESET BUTTON (3)*Purpose:*

Places the drive offline if it is online. Resets the drive if pressed when the drive is offline.

Conditions and Responses:

If the drive is online and Host commands are being processed when this button is pressed, a warning message is placed in the display indicating that any further Host commands will be rejected because the drive has gone offline. This warning message remains until all pending Host commands have been executed and reported back to the Host.

Pressing this button while the drive is offline terminates a load, rewind, or unload operation. All diagnostic tests approved for use by an operator (explained in Section IV) are aborted by use of this button. If the drive was placed offline by pressing the OFFLINE/RESET button as described in the previous paragraph, all pending commands from the Host are purged if the button is pressed again while offline.

This button also aborts the selection of an HP-IB address or diagnostic test number (see TEST/ADDRESS button description).

REWIND BUTTON (4)*Purpose:*

Initiates a rewind or unload operation.

Conditions and Responses:

If the drive is offline and positioned beyond the start point on the tape, a rewind to the start point is initiated. If the tape is positioned prior to the start point, or if the start point is not found, the tape unloads. Rewind and unload operations both cause the REWIND light to be on steadily and the BOT light to flash until the operation is complete.

When in test mode (see TEST/ADDRESS BUTTON), the button may be used to increment the test number by 10.

This button is inactive when the drive is online, or while an error message is in the display.

ENTER BUTTON (5)*Purpose:*

Enters the selected test number or HP-IB address into the drive.

Conditions and Responses:

See the next description, TEST/ADDRESS BUTTON.

TEST/ADDRESS BUTTON (6)*Purpose:*

A two-function button: 1) pre-selects the diagnostic test mode or the HP-IB address-setting mode and 2) increments the test or address number.

Conditions and Responses:

Active only while the drive is offline. If this button is pressed while the two-digit display is off, the TEST light illuminates. Pressing this button a second time causes the TEST light to go out and the address light to be lit. Successive presses toggle between the TEST and ADDRESS modes. When the desired mode (TEST or ADDRESS) is lit, pressing the ENTER button selects that mode.

The operation of the TEST/ADDRESS button then changes to that of incrementing the test number or address number.

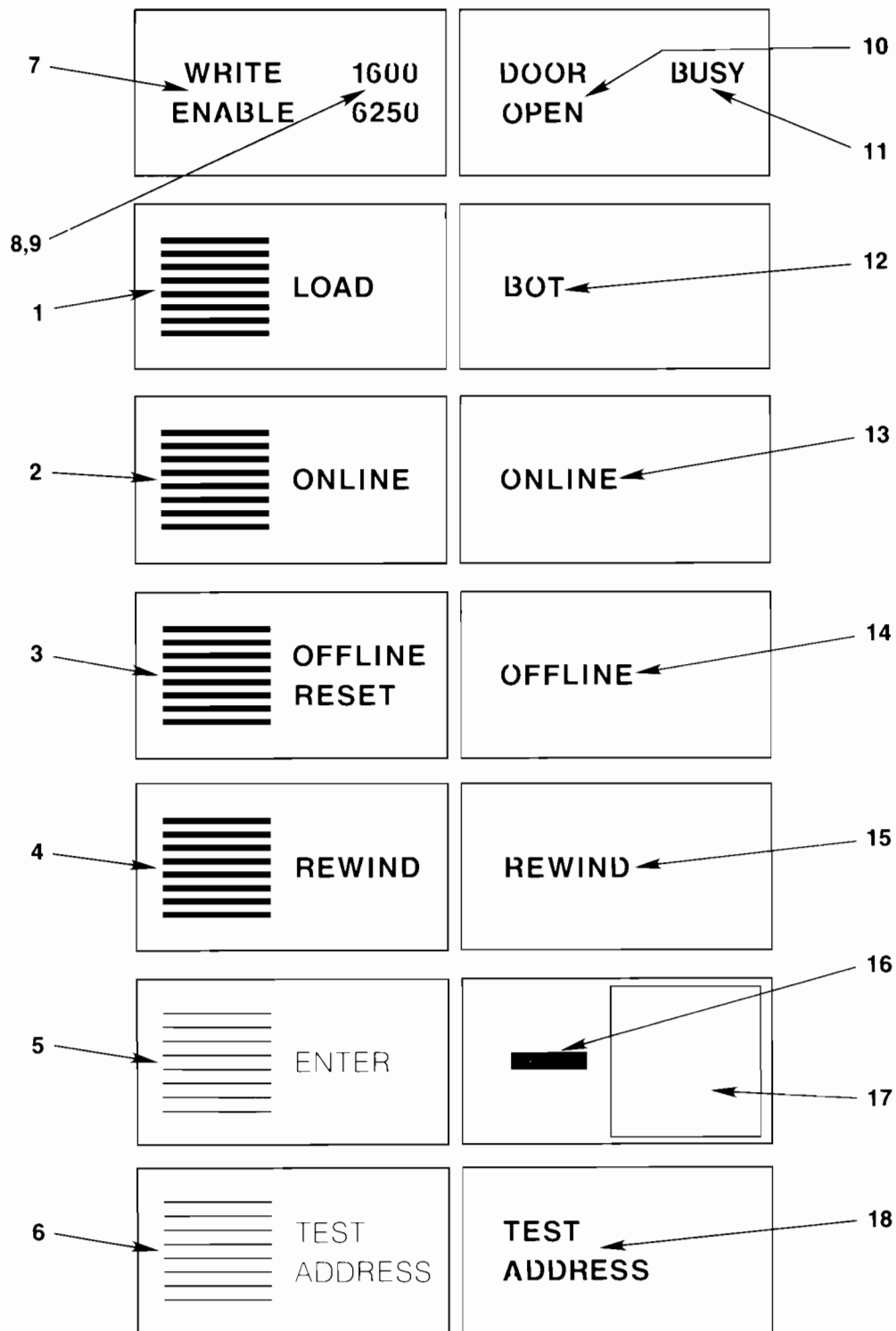


Figure 3-1. Front Panel Controls and Indicators

If the ADDRESS mode is selected, the current HP-IB address is shown in the two-digit display. The range of possible addresses is from 0 through 7. Each press of the TEST/ADDRESS button increments the displayed HP-IB address by one. Holding the TEST/ADDRESS button down causes the displayed address to be incremented twice per second.

If, after incrementing to an address, the ENTER button is pressed within 10 seconds, the drive interface initializes to the number shown in the display. If neither the ENTER button nor TEST/ADDRESS button is pressed within 10 seconds the HP-IB address selection process is aborted. Address selection is also aborted if the RESET button is pressed.

Entering TEST mode causes Test Number 00 to be shown in the display. Each press of the TEST/ADDRESS button increments the displayed test number by one. Holding the TEST/ADDRESS button down increments the displayed test number four times per second. In this mode, pressing the REWIND button increments the test number by ten. Test numbers range from 0 through 79.

If, after incrementing to a test, the ENTER button is pressed within 10 seconds, the diagnostic test number shown in the display is initiated. If neither the ENTER button nor TEST/ADDRESS button is pressed within 10 seconds the test selection process is aborted. Test selection is also aborted if the RESET button is pressed.

If the selected diagnostic test passes, the display is cleared, otherwise the display shows a diagnostic error message.

POWER SWITCH (on back electronics panel inside rear cabinet door, see Figure 3-4)

Purpose:

Control application of power to the tape drive.

3.12 INDICATOR LIGHTS

WRITE ENABLE LIGHT (7)

Purpose:

Indicates when a write enable ring is present on the tape reel.

Conditions and Responses:

The light comes on if a write enable ring is detected during a load operation and remains on until the tape is unloaded.

DENSITY LIGHTS (8) and (9)

Purpose:

These two lights, 1600 (PE) and 6250 (GCR) indicate the current density of a loaded tape.

Conditions and Responses:

The lights are set by the Host and show the density of the tape after a load operation completes. If no tape is tensioned or if the tape is blank, both lights stay off. Tapes of unknown densities (including 800 cpi NRZI) are indicated by both lights coming on.

After a valid processing of any write density operation the density lights will be updated to reflect the current recording density. When the tape is unloaded, the density lights go off.

DOOR OPEN LIGHT (10)*Purpose:*

Indicates that the tape path door is open.

Conditions and Responses:

Rather than always lighting when the door is opened, this indicator comes on only when the door is open and the drive needs the door closed to complete a tape operation.

BUSY LIGHT (11)*Purpose:*

Lights whenever the drive is executing a command.

Conditions and Responses:

The command being executed may be either from the Host or the front panel.

The light also comes on during execution of diagnostics.

BOT LIGHT (12)*Purpose:*

Indicates that the tape is currently positioned at the start point.

Conditions and Responses:

This light stays on continuously after the completion of a load or rewind operation. While performing these operations, the light flashes.

ONLINE LIGHT (13)*Purpose:*

Indicates that the drive is online and able to process tape motion commands.

Conditions and Responses:

A tape must be loaded. If the ONLINE button is pressed during a load operation, the command to go online is stored until the load operation is completed. The ONLINE light flashes until the load operation completes, then the online command is executed and the ONLINE light comes on steadily.

When the drive is placed offline this light goes out.

OFFLINE LIGHT (14)*Purpose:*

Indicates that the drive is offline.

REWIND LIGHT (15)*Purpose:*

Illuminates whenever a rewind command is being executed.

Conditions and Responses:

Rewind operations may be commanded by the Host or through the front panel REWIND button. When the rewind operation completes, the REWIND light goes off.

STATUS LIGHT (16)*Purpose:*

Indicates the status of the drive.

Conditions and Responses:

The STATUS light shows green when a power-on selftest passes and red when the power-on test fails or an error message is in the display. The light shows amber whenever a warning message is in the display.

When an error condition is cleared or warning condition is corrected the light reverts to the indication appropriate to the power-on selftest status (green – passed, red – failed).

DISPLAY (17)*Purpose:*

Used by the operator to set test numbers and the HP-IB addresses. Used by the drive to send messages to the operator.

Conditions and Responses:

The two-digit display is used for five categories of messages: runtime warning messages, runtime error messages, HP-IB address numbers, diagnostic test numbers, and diagnostic error messages.

An explanation of how the HP-IB address numbers appear in the display is in the TEST/ADDRESS button and ENTER button descriptions in the previous subsection. Warning messages, error messages, and diagnostic test number displays are explained in Section IV, "DIAGNOSTICS AND BASIC TROUBLESHOOTING".

TEST/ADDRESS LIGHTS (18)*Purpose:*

Indicate whether test mode or address mode is selected.

Conditions and Responses:

The first press of the TEST/ADDRESS button activates the selection process. The TEST light comes on. Each subsequent press of the TEST/ADDRESS button changes the mode available for execution from test selection mode to address selection mode and back again.

When the ENTER button is pressed, the mode currently shown (TEST light or ADDRESS light on) becomes the active mode in the drive.

If no test number or address is supplied by the operator within 5 seconds of selecting the test mode or address mode, the selection is canceled, the indicator light goes out, and the STATUS light comes on.

3.2 BOT AND EOT TABS

The Beginning-of-Tape (BOT) and End-of-Tape (EOT) light-reflecting tabs enable the tape drive to sense the limits of the working portion of the tape.

If a tab comes off or if the section on which the tab is mounted is cut off, replace as shown in Figure 3-2. When replacing a BOT tab, ensure that this tab is located within approximately 30 feet of the physical beginning of the tape. During a load operation, the tape drive searches in the forward direction for a BOT marker only this amount.

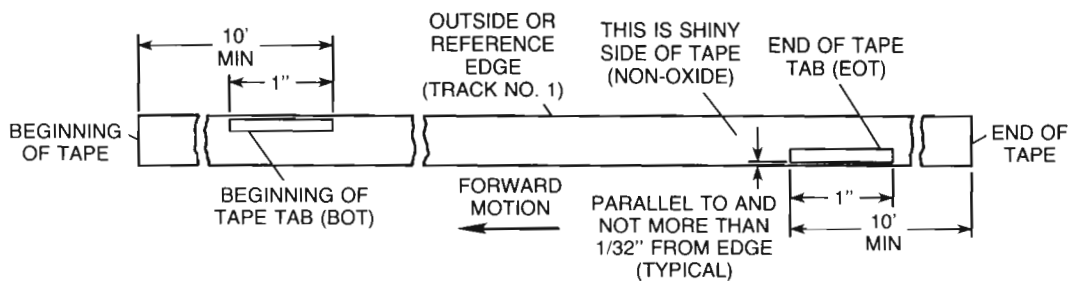


Figure 3-2. BOT/EOT Tab Location

These adhesive-backed tabs, along with other supplies, are available from Hewlett-Packard. The part numbers are shown in Subsection 1.3.

3.3 WRITE ENABLE RING

New reels of tape have a write enable ring installed on the back of the reel as shown in Figure 3-3. When in place, recording operations are allowed on the tape. To protect data on the tape from being written over, remove the ring. You may then read from the tape, but not write on it.

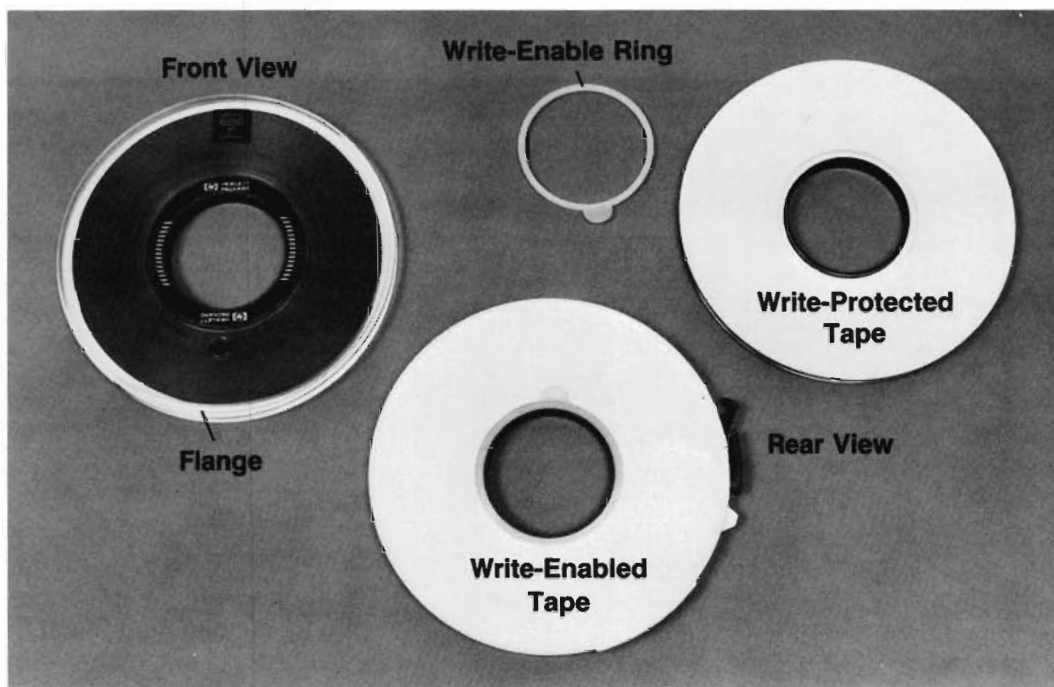


Figure 3-3. Reel Anatomy

3.4 BRINGING THE TAPE DRIVE ONLINE

3.4.1 POWER-ON PROCEDURE

Plug the tape drive into the appropriate power receptacle.

The power switch is a rocker switch located on the back panel of the drive electronics. To apply power, open the back door of the tape drive and rock the switch to the left (towards the '1'). See Figure 3-4.

When you turn power ON, the drive immediately executes a power-on test sequence. The tape drive checks its own operating system, the digital data path, control functions, and partially checks its BOT/EOT sensing capability. No checks which involve tape movement are made at this time.

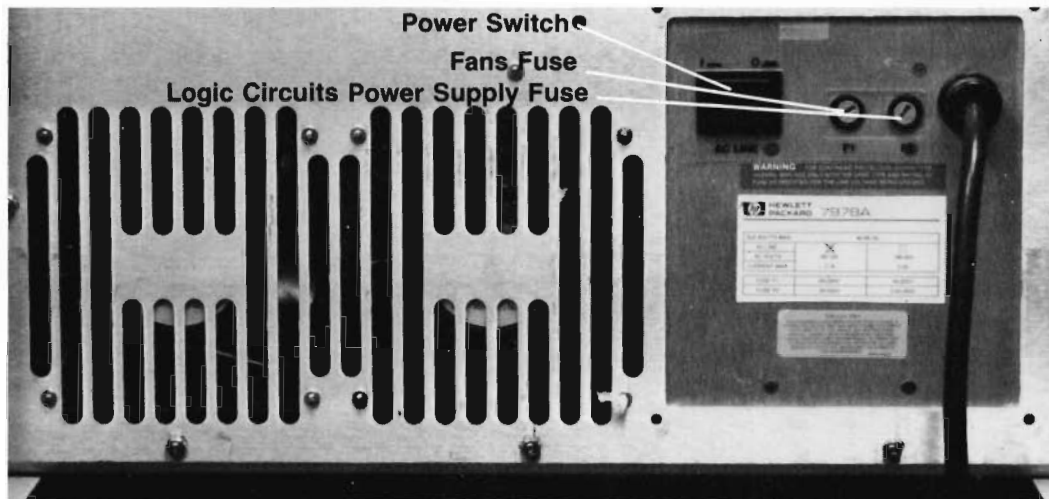


Figure 3-4. Power Switch

As each internal test is called, its number is shown in the display on the front panel. Many tests, however, pass by too quickly for a person to see the number.

The most noticeable test is when the drive exercises the front panel. Each light, starting from the top, will be lit and then extinguished in order. The display will cycle through the digits from 00 to 99 and the letters from AA to FF.

Even though the HP 7978A extensively checks itself during power-on, the complete sequence should take no more than one minute.

If all subsystems pass, the STATUS light comes on green. The BUSY light goes out and the OFFLINE light comes on.

If any of the power-on tests fail the STATUS light comes on red. Also, the code F0 appears in the display. F0 is the failure code for the power-on selftest and is explained, with other messages, in Section IV.

After showing a failure code, the drive would place itself in a halt state, preventing any further actions until the cause of the failure is found and corrected. Again, Section IV outlines what to do.

NOTE

To prolong the life of the tape drive, Hewlett-Packard recommends that the power remain on continuously.

3.42 SETTING THE HP-IB ADDRESS

The HP-IB address is set using the buttons on the front panel. To set the address, perform the following steps:

Go offline –

If not offline, press the OFFLINE/RESET button to place the drive offline. The OFFLINE light should be lit.

Set display to addressing –

If the ADDRESS light is not illuminated, press the TEST/ADDRESS button to toggle the ADDRESS light on.

Select addressing mode –

Press the ENTER button to select the addressing mode.

Select address –

Each press of the TEST/ADDRESS button increments the number shown in the display. Holding the button down causes the display to increment about twice per second. Release the button when the desired address is shown.

Enter address into drive –

Press the ENTER button within 5 seconds after the address you want is shown in the display. The tape drive initializes to that address.

If neither the ENTER button nor the TEST/ADDRESS button is pressed within 5 seconds, the drive aborts the addressing mode. The ADDRESS light goes out and the display goes blank. The addressing mode may also be aborted by pressing the OFFLINE/RESET button.

3.43 MOUNTING AND THREADING THE TAPE

Open the tape path door.

Release the hub locking lever on the supply hub by catching your thumb or fingers under the lip of the level and pulling away from the hub.

Grasp the reel of tape by hooking your thumb into the hub hole and place your fingers lightly on the outside rim. Let approximately three feet of tape dangle from the right side of the reel to give you an ample amount to lay in the tape path.

CAUTION

Do not hold the reel by the rims. Pressure on the outside edges of the tape may cause the tape to wrinkle and its edges could be damaged. Edge damage may result in hard errors that prevent reading data on the tape.

Place the reel over the hub using both hands. Press near the center of the tape reel and push the reel flat against the tape drive casting. See Figure 3-5.



Figure 3-5. Mounting the Supply Reel

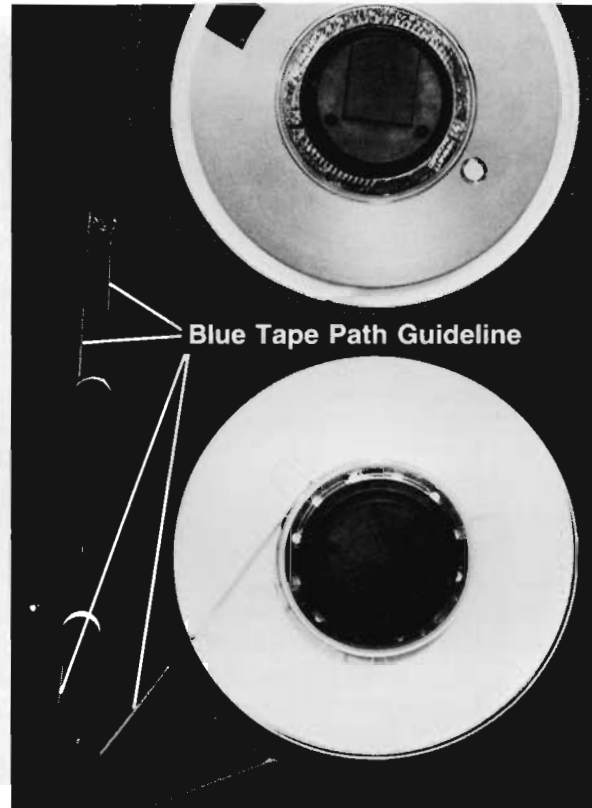


Figure 3-6. Threading Diagram

Hold the reel in place and lock it onto the drive hub by rotating the hub locking lever forward and down until the lever is flat with the reel hub. Ensure that the tape is flat against the casting.

CAUTION

If the tape is not squarely mounted on the drive, it may wobble during tape operations and damage the edges of the tape. Edge damage may cause hard errors that prevent accessing data on the tape.

Thread the tape along the path of the blue line on the casting. See Figure 3-6.

Place the end of the tape on the top of the takeup reel in a position where you can stick a finger between the spokes of the takeup reel and press the end of the tape to the hub. Slowly rotate the supply reel clockwise with one hand (to keep tension off) as you rotate the takeup reel (also clockwise) with the other hand, keeping the end of the tape on the hub with your finger.

After a full clockwise turn of the takeup reel, the tape coming on to the reel should overlap the tape held down by your finger. Rotate the takeup reel a little more until the tape is capable of holding itself onto the reel. Withdraw your finger and, using both hands, feed tape onto the takeup reel for 2-3 more turns. Keep a small amount of tension on the tape as you rotate the takeup reel to ensure that the tape is forming a good hold on the hub.

After the tape is started on the takeup reel, check the tape where it passes over the tape guides. The tape should be centered on each guide and not riding up on the edges of the guides. If the tape is not centered on a guide, the edge may wrinkle and be damaged as the tape passes along the path.

CAUTION

Edge damage may cause hard errors and prevent accessing data on a tape.



Turn the top or bottom reels gently to take all the slack from the tape.

3.44 LOADING THE TAPE

NOTE

Trying to execute a Load command with a slack tape may cause the load operation to fail.

First, close the tape path door.

Press the LOAD button. The drive will search forward for the BOT marker. During the search the BOT light blinks. If the marker is not found within 30 feet of the point at which you gave it the Load command, the drive reverses direction and searches backwards (toward the beginning of the tape). If the BOT is not found in the reverse direction, the drive eventually rewinds the tape off the takeup reel, thereby unloading the tape drive. The error message F2 (cannot find BOT) appears in the two-digit display.

If the BOT is found, the BOT light stops blinking and remains on. The tape drive is at the start point.

Press the ONLINE button to place the drive online.

NOTE

The ONLINE button may be pressed immediately after pressing the LOAD button. The command to go online will be held until the load operation is completed and the Online command can be executed.

3.5 REWINDING AND UNLOADING TAPE

Tape may either be rewound online through Host commands, or offline by use of the REWIND button on the front panel.

When the Host commands a rewind operation, and the tape is somewhere between the BOT and EOT markers, the tape rewinds to the start point. The drive remains online.

To unload the tape, the operator must press the OFFLINE button to gain control of the drive, and then press the REWIND button. The tape will unload.

The Host may also command a combination rewind and go offline command. In that case, the tape drive is placed offline at the completion of the rewind command. The OFFline light comes on.

To unload the tape, the operator need only press the REWIND button.

Two situations may come up when manually unloading a tape, depending on whether the drive currently holds a valid start point in its memory or not.

If the tape drive has been placed offline (through normal commands) with the tape located between the BOT and EOT marks, and the drive has established a start point, pressing the REWIND button causes the tape to return to the start point at rewind speed. Pressing the REWIND button a second time unloads the tape.

If a load was aborted in mid tape, the start point information is lost. Pressing the REWIND button causes the tape to rewind at 75 ips and continue until the tape is unloaded.

3.6 RESTART AFTER POWER FAILURE

A long-term power failure (longer than 20 ms) causes the tape drive to revert to a power-on situation. The drive automatically executes a power-on selftest when power returns. When the sequence of tests completes, the drive will be in an offline state.

If power failed when the tape was somewhere between the start point and EOT marker, first manually remove all slack in the tape and then press the LOAD button. The drive will establish tension on the tape, search forward (about 30 feet) for the BOT and, if not finding it there, search backwards until that marker is found. Press the ONLINE button when ready to resume online operations.

If the tape was at start point (which is actually a small distance short of the BOT to allow ramping up to read/write speed), the sequence is the same as just explained. However, when the drive begins its forward search for the BOT, it immediately finds the mark. The drive re-initializes itself at start point. Press the ONLINE button when ready to continue online operations.

3.7 RECOVERY FROM TAPE SPOOLING OFF SUPPLY REEL

Using the blue line as a guide, thread the tape backwards through the tape path and wind it onto the supply reel in a *counterclockwise* direction. Continue winding the tape onto the reel until the EOT marker appears on the top of the reel. The marker may be up to approximately 30 feet from the physical end of the tape.

Close the tape path door.

Press the LOAD button. The drive will establish tension and then search forward until it finds a marker. In this case the marker is an EOT marker which causes the drive to reverse direction and rewind the tape at 250 ips until it reaches the BOT.

DIAGNOSTICS AND BASIC TROUBLESHOOTING

SECTION

IV

4.1 INTRODUCTION

The HP 7978A Tape Drive is equipped with an extensive set of built-in diagnostics. A number of these diagnostics are useful to an operator, but most of them are useful only to service personnel trained by Hewlett-Packard.

The information in this Section is meant to give an operator an overall idea of what types of diagnostics are built into the drive, what functions are tested, and what diagnostics may be of use to the operator. Instructions about how to run specific diagnostics are given in Subsection 4.4, "BASIC TROUBLESHOOTING".

There are two levels of diagnostics as far as the operator is concerned. One level is the runtime diagnostics which result in error and warning messages displayed on the front panel. The other level is what might be termed 'drive verification and confidence checks' which are individually called and executed. The results of these checks are also shown in the display.

4.2 RUNTIME DIAGNOSTIC MESSAGES

This subsection describes the warning and error messages an operator might see during operation of the tape drive. A shortened version of these descriptions, and corrective actions, are printed on a sticker inside the tape path door.

Warning Messages

A1 – RESETTING THE DEVICE PROGRAM

Every time a RESET command is accepted from the front panel or from the Host, the STATUS light flashes orange and the A1 message briefly appears in the display. There is no action required from the operator.

A2 – DRIVE IS ACTIVE AND IS OFFLINE

This is a notification that the Host attempted to use the tape drive and the tape drive was offline. Pressing the ONLINE button makes the drive available to the Host. Pressing the RESET button aborts the Host operation.

A3 – DIRTY TAPE PATH

This is an excessive soft error rate warning. When the acceptable soft error rate is exceeded this message is displayed. The threshold used for computation is 1 retry per 255 commands given to the drive.

The warning message is cleared from the front panel when the error rate declines below the error threshold or when a Load command is executed. The error message may also be cleared by pressing the RESET button.

The error rate is computed using a combination of hard and soft errors and 32 is the maximum number of occurrences allowed for a 2400-foot tape. If the error rate equals or exceeds this maximum number during a pass of the tape, the A3 error message will remain on, even after the tape is unloaded.

Causes for a high error rate, in order of probability, are

- 1) dirty tape path
- 2) worn out or dirty tape
- 3) hardware failure.

This warning is displayed until another tape is loaded or the RESET button is pressed.

Error Messages

F0 – SELFTTEST FAILURE

When power is applied to the drive an automatic power-on selftest is initiated. The power-on selftest covers the Master Controller assembly, HP-IB assembly, tape drive digital data path, Servo Controller assembly, a partial testing of the BOT/EOT sensor and the speed encoder loop. Approximately 75% of the tape drive is tested. Tests requiring tension on the tape are not done.

If any one of this series of tests fails the STATUS light illuminates red and the **F0** code is placed in the display. This error notifies the operator of a failure in the electronics hardware of the drive.

F1 – TAPE NOT AT LOAD POINT OR TAPE NOT TENSIONED

Tape position information and proper tape tension are both necessary for tape movement control. Loss of either results in this error.

Tape positioning information may be lost, for example, if the drive is reset while the Host is reading the tape ID during a rewind operation.

Improper mounting and/or threading of the tape may cause tension loss. Also, excess slack may be left after a load operation or could be introduced when power is interrupted.

Whether caused by loss of positioning information error or loss of tension, a reload operation should correct the error.

F2 – BOT NOT POSITIONED CORRECTLY OR BOT NOT FOUND

The tape drive cannot find the BOT marker. Check that the BOT (and EOT) markers are on the tape and are mounted correctly. If markers are correct, this message may indicate an electronics hardware failure.

F3 – HARDWARE FAILURE

A hardware failure was detected. The hardware failure was such that operator control is still allowed – the error message may be removed by pressing the RESET button and other operations can be attempted – however, the drive should be considered inoperable.

F4 – FIRMWARE ERROR

The firmware of the drive has failed an internal runtime check. The drive should be considered inoperable.

F5 – HOST PROTOCOL ERROR

A protocol error in the communications with the Host was detected.

Two other types of runtime error messages may be seen in the display: timing errors on the internal bus and unexpected errors.

If any of a number of selected internal subsystem response times exceed allowable limits, the HP 7978A responds by showing bus error exception codes in the display. Codes describing a number of other possible error conditions may also be shown.

Because runtime errors may occur in the middle of an instruction and the processor in the tape drive may have no way to return to the point in the program where the error occurred, any further operations would be unpredictable. Therefore, to prevent unpredictable and perhaps hazardous operations, the drive is placed in a HALT condition. Tape motion is stopped and no operations are possible either from the front panel or from the Host. All front panel lights, except for the error code in the display, will be off. The power must be recycled to restart the drive.

NOTE

As stated in the beginning of the Section, most diagnostics in the HP 7978A are oriented toward service. Information in this Section is meant to give an operator a functional knowledge of the origin of messages that may appear in the front panel display as a result of the built-in diagnostics.

This Section does not give enough information for extensive troubleshooting. Operator actions should be limited to those contained in Subsection 4.4, "BASIC TROUBLESHOOTING".

4.3 TEST AND UTILITY DIAGNOSTICS

Diagnostics available to an operator or Host are grouped into test diagnostics and utility diagnostics. In addition to the built-in test and utility diagnostics, the Host may also request some special diagnostics through secondary protocol commands.

A test diagnostic performs a set of tasks using the hardware of the tape drive and attempts to detect and isolate a failure. The diagnostics should detect nearly all failures and correctly isolate the failure to, at most, three Field Replaceable Units (FRU).

A utility diagnostic returns status of a requested subsection of the drive or changes the environment in which a diagnostic test is executed. Some utility diagnostics perform service functions such as setting gain values and updating Electrically Erasable Programmable Read Only Memory (these functions are service functions and are not discussed in this manual).

An error message is displayed on the front panel if an error exists on completion of a test diagnostic. This error message is displayed until the operator presses the RESET button. After the RESET button is pressed, the front panel display reflects the status of the drive prior to execution of the diagnostic.

4.31 DIAGNOSTIC LOGS

The built-in diagnostics use two logs: the diagnostic error message log and the data error log.

The diagnostic error message log contains the ten most recent diagnostic test error messages and the time, relative to power-on initialization, that the error message was logged.

The data error log is used by diagnostics to compute the excessive error rate warning message, A3. A new entry is made whenever a Load command is executed. This is a cyclic log, twenty entries deep, and contains the following:

- time the current tape was loaded referenced to the power-on initialization
- hard error count

- soft error count
- number of reportable commands since the tape was loaded.

This log is only available to the Host via an image dump.

4.32 TAPE USAGE ODOMETER

The amount of tape that passes over the head is recorded in memory. The total, in 20,000-foot increments, may be viewed on the front panel (see next subsection, Test 28).

4.33 INDIVIDUAL DIAGNOSTIC DESCRIPTIONS

The following list contains descriptions of only the tests that are executed, either automatically by the drive, or manually by an operator, during normal operations.

NOTE

The tests are listed in the order that they would normally be used.

The first group of tests (Group 1) is automatically performed by the drive when power is applied. Test 5 calls other tests, as noted in the descriptions, until Test 16 completes.

When the test sequence (starting with Test 5) is called as part of the power-on sequence, testing is automatically continued; the drive continues into Group 2 and calls Test 57. Test 57 calls other tests, as seen in the list, and the series ends with Test 44.

If Test 5 is being executed from the front panel, the series of tests stop after completing Test 16. If desired, Test 57 could then be executed from the front panel and the drive would be tested the same as it is at power-on.

Tests 28, 20, 29, 0, and 1 are placed at the end of the list. These are four utility tests the operator may want to use for information and one test to confirm proper operation of the front panel.

NOTE

Test numbers range from 0 to 59, however the tests not mentioned in the following lists are only of use to a service person trained by Hewlett-Packard.

We do not recommend executing tests other than the two power-on test groups initiated by Test 5 and Test 57, and Tests 20, 29, 0 and 1. See the following CAUTION note.

CAUTION

Execution of Test 24 changes the characteristics of the tape drive. This test should only be used by service personnel trained by Hewlett-Packard.

Tests 21, 22, 35, 36, and 37 write data, or an erase signal, to tape. Data currently on a tape is overwritten.

Other tests could cause loss of tape position information.

Group 1**Test 5 -- POWER-ON SELFTEST**

Power-on selftest. Always performed at power-on. Calls Tests 6, 2, 7, 10, 11, 13, 14, 12, 15 and 16.

Test 6 -- KERNAL MASTER CONTROLLER TESTS

Checks major components of the Master Controller board. Calls Tests 8 and 9. This test does not affect current drive status.

Test 2 -- CLEAR ERROR LOG

The diagnostic error log is cleared and the diagnostic environment is set to default values.

Test 7 -- FRONT PANEL DISPLAY TEST

The front panel lights are lit and extinguished one at a time, followed by rotating 00, 11, ..., FF on the two-digit display. This utility leaves all lights off except for OFFLINE and STATUS.

Test 10 -- MASTER CONTROLLER EEPROM READ TEST

The Electrically Erasable Programmable Read Only Memory (EEPROM) chips on the Master Controller are verified to be correct by reading some predefined addresses containing constant values, and performing a checksum.

Test 11 -- DATA BUFFER TEST

This test checks the data buffer's functionality by writing and then reading a set of data bytes from each buffer address.

Test 12 -- WRITE CLOCK TEST

The write clock is run at PE and GCR frequencies and verified. At the completion of this test the write clock is returned to the data rate required by the density of the currently loaded tape.

Test 13 -- HP-IB INTERNAL LOOPBACK TEST

Checks the HP-IB board functions. Host commands are ignored during testing.

Test 15 -- DIGITAL LOOPBACK TEST

Tests the Master Controller, Formatter, Phase-Locked Loop and the Write Electronic assemblies. Several tests are run to verify each density and to confirm that track errors and Data Buffer error conditions can be detected.

Whenever a failure is detected, a loopback is performed without the Phase-Locked Loop assembly. If this test passes, the Phase-Locked Loop is reported to be the failure.

Test 16 -- WRITE ELECTRONICS BOARD PRESENT TEST

Checks for the presence of the write electronics board.

Group 2**Test 57 -- SERVO CONTROLLER POWER-ON TESTS**

This is the Servo Controller power-on self test called by the Channel Program. Tests 41, 42, 43, and 44 are called by this driver.

Test 41 -- SERVO CONTROLLER/MASTER CONTROLLER HANDSHAKE

The Servo Controller interface with the Master Controller is tested.

Test 42 -- SERVO CONTROLLER POWER-ON TEST

Checks the Servo Controller processor. This test is always performed at power-on or after a RESET command from the Master Controller.

Test 43 -- SERVO CONTROLLER BOARD TEST

The Servo Controller performs a board test by sequencing through tests 49 – 55. The door must be closed for this test to execute.

Test 49 -- SERVO CONTROLLER SENSOR TEST

Tests the BOT, EOT, and Write Enable circuitry.

Test 50 -- SERVO CONTROLLER CONNECTOR TEST

The Servo Controller checks to make sure that all the connectors on the Servo Controller Board are connected.

Test 51 -- SERVO CONTROLLER SHUTDOWN TEST

Verifies that the Servo Controller can open the hard shutdown line that controls the relay on the Motor Drive Board.

Test 52 -- SERVO CONTROLLER COMPARATOR TEST

Tests the zero-crossing detector by writing minimum and maximum values to the Servo Controller digital-to-analog converter.

Test 53 -- SERVO CONTROLLER DAC TEST

Tests Servo Controller digital-to-analog converter.

Test 54 -- SERVO CONTROLLER STATE MACHINE TEST

Tests the Servo Controller speed encoder state machine.

Test 55 -- SERVO CONTROLLER INTERRUPT TEST

Tests the Servo Controller in-position interrupt circuitry.

Test 44 -- SERVO CONTROLLER GAP

Servo Controller gap handling is verified. This test will not move tape. Data Detect and Deskew is put into an idle state on completion of this test and the Servo Controller is reset.

The operator may find the following tests helpful.

Test 28 -- DISPLAY TAPE ODOMETER

Displays (in hexadecimal format) the current total of tape usage as stored in tape drive memory. The most significant word is displayed first by alternating the two bytes in the display. The least significant word can be viewed by pressing the Test button. The two bytes of this word are then alternated in the display.

This total is updated in 20,000-foot increments. When the total is viewed, it may not include the last amount of tape length being accumulated (up to 20,000 feet).

Test 20 -- FRONT PANEL CONFIDENCE TEST

This test allows the user to press any button and have a code from 1-6 returned to the front panel

display. Pressing the uppermost button displays a '1'; pressing the lowest button displays a '6'. When the door is opened a '7' is displayed. Exit this test by pressing two or more buttons at once.

Test 29 -- DISPLAY DENSITIES SUPPORTED

Illuminates the density lights corresponding to the densities supported in the tape drive. The lights remain lit for five seconds.

Test 0 -- DISPLAY ERROR

Display the most recent diagnostic error message. If this test is executed a second time, there will be no error shown. This test would then be considered as the last test executed – and this test always passes.

Test 1 -- DISPLAY ERROR LOG

The diagnostic error message log is displayed starting with the most recently logged error. Previous entries will be displayed each time the ENTER button is pressed until all errors in the log have been displayed. The display order is from most recent to least recent.

4.4 BASIC TROUBLESHOOTING

4.41 EXECUTING A DIAGNOSTIC TEST FROM THE FRONT PANEL

The following procedures describe the entering and execution of diagnostic tests from the front panel. As explained in the previous subsection, only a few tests may be useful to an operator (specifically, Tests 5,57,20,28,29,0 and 1). Tests not described in Subsection 4.3 under "INDIVIDUAL DIAGNOSTIC DESCRIPTIONS" should not be executed.

Also, individually executing the 'sub' tests called by Tests 5 and 57 will not provide any helpful information.

CAUTION

Execution of Test 24 changes the characteristics of the tape drive. This test should only be used by service personnel trained by Hewlett-Packard.

Tests 21, 22, 35, 36, and 37 write data, or an erase signal, to tape. Data currently on a tape is overwritten.

Other tests could cause loss of tape position information.

NOTE

A diagnostic test may not be executed when the drive is displaying a warning or error message. To clear a warning or error condition, press the RESET button. The display will clear and the status light will change to green.

If the error condition was caused by a failure in the power-on sequence, pressing the RESET button will clear the F0 message from the display but the STATUS light remains red. This is the only situation where a diagnostic test may be initiated with a red STATUS light on.

Procedure:

1. Go offline
2. Press the TEST/ADDRESS button. The TEST light will come on and the STATUS light will go out.
3. Press the ENTER button to select the test mode. If the ENTER button is not pressed within 10 seconds, the selection process is aborted. When the process is aborted, the TEST light goes out and the STATUS light will come on green (the STATUS light comes on red if this process was initiated from a power-on failure condition).
4. The function of the TEST/ADDRESS button changes when the ENTER button is pressed. Pressing the button now increments the number in the display by one. If the button is held down, the display increments twice per second. The REWIND button may be used while in this mode to increment the display by 10. Use any of these methods to increment the display to the desired test number.
5. Press the ENTER button within 10 seconds of completing Step 4. The STATUS light briefly flashes amber as the execution command is accepted and the test called by the number in the display is executed.

The BUSY light remains on continuously during the execution of the test. When the test completes, the BUSY light goes off. If the test passed, the STATUS light will be green. If the test failed, the STATUS light will be red and there will be an alphanumeric service code in the display.

If the test passed, but the diagnostic test was executed after a power-on fail condition (see previous NOTE), the STATUS light will come on red but there will be no service code in the display.

4.42 PROBLEMS**Cannot Find BOT During Load Sequence**

1. Unload the tape.
2. Check for presence of a reflective BOT marker tape within approximately 30 feet of the physical beginning of the tape. If marker is absent, replace marker.
3. If marker is present, check that nothing is covering BOT/EOT sensor windows.
4. Execute Test 5. If no error results from Test 5, execute Test 57 (see Executing Diagnostic Tests From The Front Panel). Record any error code that may appear. Contact your nearest Hewlett-Packard Sales and Support Office.

No Front Panel Lights

1. Check that the tape drive is plugged into the power receptacle.
2. Check that the power switch is on. The switch is located on the back panel of the drive electronics enclosure inside the cabinet.
3. If the power switch is on, press it again to remove power. Check the condition of the right-hand fuse (F2). This fuse is in the power supply to the logic circuits. Replace if necessary. Press the power switch again to apply power.

CAUTION

Replace the fuse with with one of the same rating.

4. If the problem has not been found, call the nearest Hewlett-Packard Sales and Support Office.

Tape Loses Tension

1. Check your mounting procedure. The tape should be wound around the takeup reel hub approximately three times to provide proper grip. All slack should be taken out before a Load command is given.
2. If this problem persists during normal operations, contact the nearest Hewlett-Packard Sales and Support Office.

Error Message When Power Is Applied

F0 is the only error code you should receive as a first display after power is applied to the tape drive. This error means that a test in the power-on sequence has failed.

1. Recycle power using the power switch located on the back panel of the drive electronics enclosure inside the cabinet.
2. If the same error appears, call the nearest Hewlett-Packard Sales and Support Office.

Warning Message A3 Remains In Display After Tape Is Unloaded

The A3 warning indicates a soft error rate above an allowable threshold (see Subsection 4.2). The usual cause for this message is a dirty tape path. Next in probable causes is a worn out or dirty tape. Finally, there is the possibility of a hardware failure.

1. Read Section V, "TRANSPORT CARE".
2. Clean tape path as explained in Subsection 5.3, "CLEANING PROCEDURE".
3. Ensure that the tape you are using is of high quality and has not deteriorated.
4. If, after cleaning the tape path and using known good tape, the A3 message still appears frequently or remains on, a hardware problem might exist. Call the nearest Hewlett-Packard Sales and Support Office.

NOTE

The selection and use of media, supplies and consumables is the customer's responsibility. Hewlett-Packard reserves the right to exclude from the warranty or service agreement any repairs for damage to HP products which HP reasonably determines or believes was caused by use of non-HP media or cleaning supplies. Hewlett-Packard will, upon request, repair such damage on a time and material basis.





TRANSPORT CARE

SECTION

V

5.1 CLEANING THE TRANSPORT

Many transport problems can be traced to either improper cleaning or the use of poor quality tapes that leave oxide and binder on the tape path. Without frequent cleaning, collected particles contaminate tapes, cause transport failure, and, in extreme cases, ruin the tape head. Replacing the head is costly.

Clean the tape path regularly. When you clean, inspect the path carefully and watch out for any of the following problems:

BROWN STAINING: Low humidity levels cause brown deposits of oxide to accumulate on the head. As the stain grows, tape-to-head separation increases until the head becomes useless. Once ruined, the head must be replaced.

CLEAR FILMING: Every time a tape is used it sheds oxide and binder which forms a clear film upon the head. If not removed with cleaning solvents at frequent intervals, tape-to-head separation errors occur.

CAUTION

Clear films can build up until cleaning with solvent is no longer effective and replacement of the head becomes necessary.

Regular cleaning improves performance and cuts maintenance costs. A clean tape path (and clean tapes) reduces read/write errors and lengthens tape life. Frequent cleanings also require fewer cleaning materials and are relatively quick. How often you need to clean your system depends upon three factors: usage, operating environment, and tape quality. The following definitions should be used as guidelines for developing an appropriate cleaning schedule.

MINIMUM: A thorough cleaning of the tape path every shift (eight hours). Minimum cleaning is appropriate under the following conditions:

- less than 10 reels are used per shift (eight hours)
- there is no visible debris on tape head after each reel of tape
- there is no reason to suspect a high level of dust in the computer center from vacuuming, delivery of supplies, etc.

NORMAL: A thorough cleaning of the tape path after every 10 reels of tape (roughly every 1.5 hours of continuous running). Normal cleaning is appropriate under the following conditions:

- more than 10 reels are used per shift
- there is no visible debris on the tape head after each reel of tape
- there is no reason to suspect a high level of dust in the computer center.

HEAVY: A thorough cleaning of the tape path after each reel of tape under the following conditions:

- visible debris appears on the tape head after each reel of tape
- uncleaned interchange tapes from outside your computer center are being read
- uncleaned new tapes which have been used only once or twice are being used (new tapes usually contain additional debris from the slitting process during manufacture).

SPECIAL: A thorough cleaning of the tape path under the following conditions:

- abnormal dust level in the computer center because of custodial activity, equipment moves, supply delivery, etc.
- extended periods (days) of tape drive inactivity prior to use.

Most users find that they need to clean the transport once after every eight-hour work shift. However, if you develop any of the problems listed previously or the excessive soft-error rate message A3 begins to occur regularly, you should try cleaning the transport more frequently. If an increased cleaning schedule does not improve reliability, check your tapes. Are the tapes old, worn, or kept in a dirty environment? All old and worn tapes should be copied immediately and then discarded.

Refer to Section VI for general guidelines on tape storage and use to determine whether or not environmental problems may exist in the area the tape drive is used. High quality tapes may be obtained from Hewlett-Packard through the Computer Users Catalog.

If error problems persist after taking all the steps outlined above, call your nearest HP Sales and Support Office. The drive hardware may possibly have a problem.

5.2 CLEANING SUPPLIES

CLEANING SOLVENT

HP supports ONLY the use of LIQUID Freon TF (trichlorotrifluoroethane) as a tape path cleaning solvent. Freon TF cuts oil and grease, evaporates quickly, leaves no residue, and will not damage the transport. If using a vendor other than HP, make sure that the cleaning fluid is a high quality solution of 80% Freon TF and 20% isopropyl alcohol. Avoid solutions of Freon TF and other solvents.

CAUTION

- Do not use cleaner solutions which contain lubricants. Lubricant deposited on the tape head degrades performance.
- Do not use soap and water on the tape path. Soap leaves a thick film and water may damage electronic parts.
- Do not use standard hub cleaners or strong alcohol solutions (>20%). These solutions will damage the guides and rollers in the tape path.
- Do not use aerosol cleaners, even if they are freon TF. The spray is difficult to control and often contains metallic particles which damage the tape head.

WIPING MATERIALS

Use non-abrasive lint-free cloth and swabs. Discard these materials after use; even if they appear clean, they contain contamination.

CAUTION

Do not use facial tissues or cotton-tipped swabs. Although seemingly effective, they introduce highly abrasive lint into the tape path.

ORDERING

See Section 1.3 .

5.3 CLEANING PROCEDURE

- a) Pour a small amount of solvent into a clean container, such as a small UNWAXED paper cup.

CAUTION

Freon TF dissolves wax. If a waxed cup is used, the wax will be transferred to the tape path.

- b) Dab all cloths and swabs into the container, as needed.

NOTE

To prevent debris from being redeposited on clean surfaces, clean the tape path from top to bottom.

- c) While applying gentle pressure in the direction of tape path, clean the following surfaces. Give attention to the inner edges of rollers and guides. (Refer to Figure 5-1 for locations).
- (1) supply roller
 - (2) buffer arm roller
 - (3) top fixed guide
 - (4) top horizontal surfaces on the head assembly enclosure
 - (5) tape cleaner; clean scraping surfaces and inside debris traps
 - (6) read/write/erase heads
 - (7) bottom edge guide
 - (8) speed sensor roller

- d) Use a damp, lint-free cloth to wipe the
 (9) lower left corner of the casting
 (10) inside surfaces of the takeup reel
 (carefully draw cloth through).

CAUTION

Be careful with the takeup reel. If it is bent or broken, damage to tapes may result.

- (11) Periodically you may also want to wipe off the rubber gripping surface on the supply reel with a dampened cloth. Hold the write ring sensor (shiny ring) back towards the casting as you wipe.

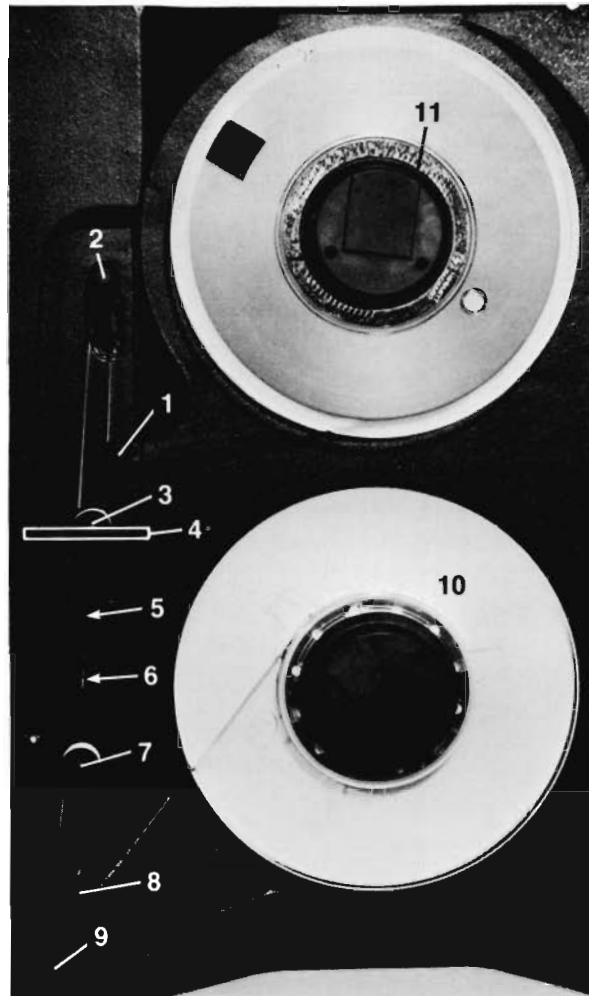


Figure 5-1. Cleaning Points

TAPE LIBRARY MANAGEMENT

SECTION

VI

6.1 COMMON PROBLEMS

Most tape failures are caused by physical abuse or poor storage methods. Accidental erasure rarely occurs because the tape packaging provides substantial protection in most office type of environments. The following list describes the most serious problems and their normal causes.

DROPOUT ERRORS -- The read signal is too low. These errors are caused by excess particles on the tape head or the tape which cause an increase in tape-to-head distance.

NOISE ERRORS -- The read signal exceeds the threshold in an area where a signal should not be present; for example, an interblock gap. This error could be caused by a lack of oxide, perhaps from a cut or scratch. Noise may also be introduced (in an interblock gap) if a piece of oxide covered a portion of the recorded signal on a tape during erasing. If the particle was moved away later (friction, cleaning, etc.), the unerased portion of the signal would then be exposed and appear as noise.

LEVEL ERRORS -- The read signal may be either too high or too low and is caused by variations in the thickness of the oxide coating. These variations may be introduced during manufacturing or they may develop as the tape wears.

OXIDE SHEDDING -- Oxide coatings tend to become brittle or soft at temperature and humidity extremes.

TAPE STICK -- High temperatures and humidity cause tape binder to soften and stick to the drive head. Large areas of oxide are usually lost in the process.

BLOCKING -- High temperature causes layers of tape to stick together. The sticking disturbs tension and may remove oxide coating.

EDGE DAMAGE -- High pressures on the edge of the tape damage the outer tracks. Once deformed, the damage worsens with use.

CINCHING -- When a spinning reel is suddenly stopped, the outer layers of tape continue to spin momentarily and cause loose windings within the pack to bunch up.

PACK SLIP -- It appears as "steps" in an otherwise smooth winding. If a tape is wound at low tension, sections will shift when subjected to rough handling, impact, vibration, or thermal stress. Pack slip causes uneven winding and rewinding. As a result, edge damage frequently occurs when the tape is caught by the reel flange or transport guide edges.

6.2 GUIDELINES

The suggestions in this section are mainly common sense. By following them whenever possible, you'll reduce recording errors and lengthen tape life.

Storage

Keep tapes in a clean environment at all times. Exposure to dust and other particles, such as food and cigarette smoke, degrades tape performance. Choose storage areas away from office activity to reduce sources of contamination.

A constant temperature of between 16° C and 32° C (60° F to 90° F) and a relative humidity of 50% is recommended in the storage area. Tapes subjected to extremes in temperature or humidity are frequently ruined as a result of sticking problems or brittleness.

The end of the tape should always be secured either by a vinyl strip or a foam pad to prevent the pack from losing its tension.

All tape reels should be hung vertically in protective casings or canisters.

Horizontal stacking is not recommended because bottom tapes may be crushed. If absolutely necessary, metal canisters can be used for stacking but care must be taken to prevent damage.

During long-term storage, dust contamination is easily reduced by sealing canisters in plastic bags. *CLEAN THE BAGS BEFORE REMOVING THE TAPES.*

Transportation

When transporting tapes from one location to another, pack tapes in water-resistant containers. To maintain proper tensioning, the end of the tapes should be secured. Avoid physical shock and extreme changes in temperature.

Handling

Hold the reel by the outer edges.

Do not pick up the reel by the flanges; they are easily bent. Once bent, the tape cannot unwind evenly. Uneven winding interferes with tensioning and eventually causes edge damage.

Do not shake the tape. This causes pack slip.

Prevent sharp blows to the reels. The reel could fracture and damage the tape.

Winding

Proper tensioning is necessary to insure smooth movement by the transport and accurate data transfer. Excessive tension permanently distorts the polyester backing. Loose tension causes cinching. A properly maintained tape drive will hold the correct tension.

To prevent the pack from losing its tension, secure the end of the tape with either a vinyl strip or a foam pad when you remove it from the transport.

Adopt a program of regular inspection, winding, rewinding, and relaxing of stored tapes every six to nine months to insure wind quality.

Tapes can be contaminated if they are wound onto dirty reels. Clean empty reels before using them.

Tape Reliability Labels

To run a well managed tape library, you must keep accurate records on each tape's condition and adopt a regular schedule of evaluation. This will help you preserve reliability, lengthen tape life and spot problems quickly.

We recommend the use of reliability labels, similar to the one in Figure 6-1, to reduce paper work and increase operator efficiency. The labels eliminate many files by allowing you to record a tape's history on the reel itself. Operators need only glance at the label to identify the condition of the tape and determine when maintenance action is required.

SERIAL No. _____	DATE _____	OPERATOR _____
FILE No. _____	CREATED _____	PURGED _____
NOTES:		
DENSITY = 800 1600 6250		RETENTION PERIOD

Figure 6-1. Tape Reliability Label



6.3 RESOURCE MATERIAL

The following publication is available for those who wish to learn more about tape library management and operator training plans.

“Handling and Storage of Computer Tape” (DR-2082(791))

Contact:

Technical Service
Data Recording Products Division
3M Corporation
3M Center
St. Paul, MN 55101

