



M990 GCR
CacheTape®

**M990 GCR
CacheTape® Unit
Maintenance Manual**

Technical Manual
No. 744491-001
Ninth Edition

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Introduction

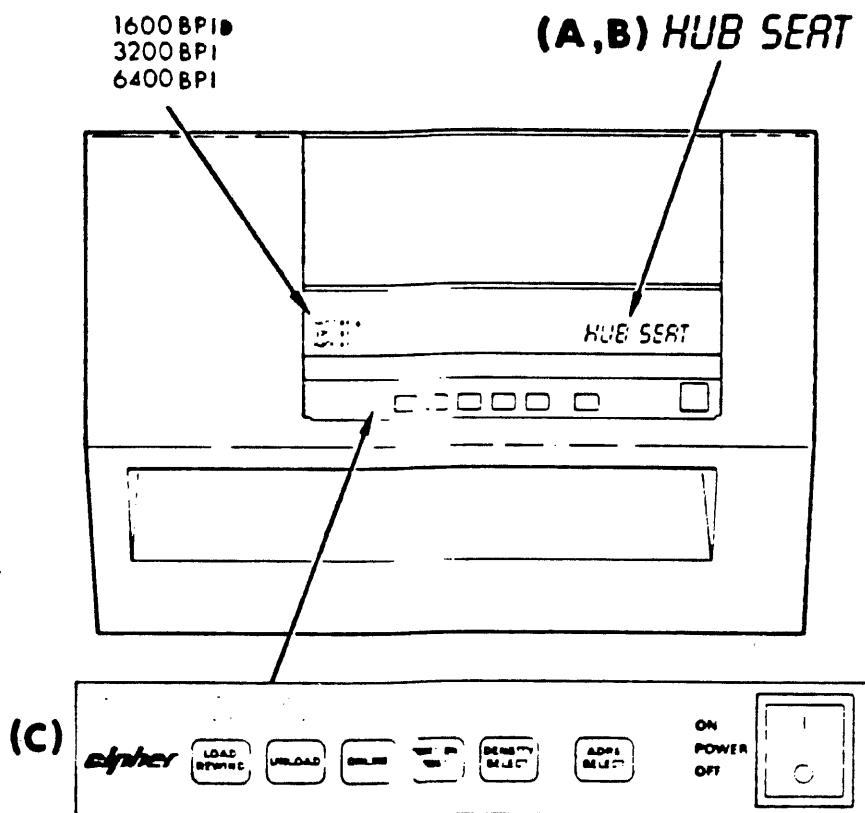
The Model M990 GCR CacheTape® unit is a nine-track, multi-density, tape transport manufactured by Cipher Data Products Inc., San Diego, California. The M990 simulates the performance characteristics of traditional start/stop tape drives while using the reliable Microstreamer® tape drive mechanical components. It incorporates a two connector, industry standard interface. The GCR CacheTape® Unit will operate on switch selectable voltage ranges of 85 to 264 Vac, single-phase, 49-61 Hz line power. Reels to 10.5 inches can be accommodated. Tape speed and data density capabilities are as follows:

1. Model M990
 - a. 50 ips at 3200 bpi
 - b. 70 ips at GCR 6250 bpi
 - c. 100 ips at PE 1600 bpi

Chapter 1

The Operator Display Panel

The operator display panel contains an 8-character alphanumeric display (A) that provides information to the operator during normal operation and diagnostic testing. Error messages (B) will give you more specific information about drive problems. Indicators on the front panel (C) of the drive will alert you to any problems in the loading or unloading operation.



1.1 The Alphanumeric Display

When the unit fails to operate properly, the indicators on the front panel of the unit flash patterns to alert the operator of an error condition. Error messages are also displayed by the alphanumeric display and describe the condition that must be corrected to allow normal operation. To reset the error press the Load/Rewind or Unload indicator/switches on the front panel. Press the Load/Rewind switch again to restart the load sequence.

Alphanumeric Display

Error Conditions

Three types of error conditions can be displayed:

1. Soft error conditions
2. Medium error conditions
3. Hard error conditions

Soft errors are usually caused by operator error or slightly damaged tape that prevents completion of the autoload sequence.

Medium and hard error messages are described in the GCR maintenance manual. The following alphanumeric display messages indicate soft error conditions that may usually be corrected by the operator.

HUB SEAT

If the HUB SEAT message is displayed on the alphanumeric display, check to see that the tape reel is positioned properly on the supply reel. After correcting the reel/supply hub alignment, press the Load/Rewind or Unload switches to reset the error.

LOAD FAILURE

If the LOAD FAILURE message is displayed, the unit failed to load tape. You should inspect the tape leader for damage. Refer to section 2.1 of this manual.

Once the tape leader has been repaired, press the Load/Rewind or Unload switches to reset error. If the unit still does not load tape properly, refer to section 2.4 of this manual.

TAPE STUCK

If the TAPE STUCK message is displayed, the unit failed to unwind tape from the supply reel into the tape path. Check the tape leader to make sure that it is properly crimped. Refer to section 2.1 of this manual. Press the Load/Rewind, Unload or Test switches to reset the error.

NO DOOR LOCK

If the NO DOOR LOCK message is displayed, you tried to load the tape reel while leaving the tape access door or the top cover open. You must close the tape access door and the top cover before you load or unload a reel of tape. After closing the tape access door and top cover, press the Load/Rewind or Unload switches to reset the error.

REEL UPSIDE DOWN

If the REEL UPSIDE DOWN message is displayed, the tape reel was inserted upside down. You must insert the tape with the write enable ring facing down. Press the Load/Rewind or Unload switches to reset the error.

NO BOT

If the NO BOT message is displayed, the unit could not locate the load-point marker within the first 35 feet of tape. Make sure that the marker is a least 16 feet from the leading end of the tape. Press the Load/Rewind or Unload switches to reset the error.

NOT ENOUGH TAPE ON TAKE-UP

If the NOT ENOUGH TAPE ON TAKE-UP message is displayed, then the unit doesn't have any tape in path while attempting to do a manual load.

1.2 The Switches And Indicators

Load-Rewind Switch/Indicator



Press the Load/Rewind switch to load or rewind the tape. The indicator flashes as the tape loads and remains lit when loading is complete.

Unload Switch/Indicator



Press the Unload switch to remove tape from the tape path. The indicator flashes as the tape clears the path and remains lit when the tape path is clear.

On-line Switch/Indicator



Press the On-line switch to place the M990 under system control. The On-line indicator will then light. Press the On-line switch a second time to remove the M990 from system control. The On-line indicator will then shut off. While on-line, the M990 will not respond to other front panel switch inputs.

Write Enable-Test Switch/Indicator



When this indicator is lit, a write-enable ring is installed on the tape reel and information can be written on or erased from the tape.

If the M990 is in the off-line mode and the Test switch is pressed, the indicator will flash to signal the operator that the unit is in the diagnostic mode. Refer to section 1.2 of the M990 maintenance manual for a description of the available tests. When the Test switch is pressed again, the M990 will exit the diagnostic mode.

Address Select Switch



Press the Address Select switch to determine the unit address for

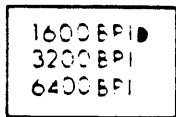
each M990 when more than one tape unit is connected to the same system. To change the unit address, continue to press the Address Select switch and press the On-line switch to reset the address to 0. Press the On-line switch again to increment the address until the desired number is reached. The address selected is displayed on the alphanumeric display as UNIT X, where X is 0 through 7. Each tape unit connected to the same system must have a unique address.

Density Select Switch/Indicator



Press the Density Select switch to select the operating density of the M990. The available densities are: PE 1600 bpi, GCR 6250 bpi, and optional 3200 bpi. The selected density is indicated by the density LED's. This switch can only be used when the tape is at load point.

Density LED Lights



FOUND DENSITY

This denotes the density that is currently recorded on the tape. Upon completion of the load sequence, the alpha display will reflect the found density with the message "ID 6250," "ID 3200," or "ID 1600." "NO ID" will be displayed if a blank tape or invalid format is detected. This found density message will continuously display until execution of an interface command or a front panel diagnostic. The message can be restored by cycling the on-line switch to the on-line state when the tape unit is idle.

COMMANDED DENSITY

This denotes the density that has been selected for recording. The density LED lights on the left side of the display panel denote the last commanded density (1600 BPI, 3200 BPI, or 6250 BPI). Density is commanded by one of four means.

1. Power-up default: Selected by the internal processor when

power is applied to the tape unit. The desired power-up density is stored as NOVRAM option 10. (See Maintenance Manual P/N 799891-001).

2. **Front Panel:** Selected by the operator using the density select switch when the unit is unloaded or with tape loaded, offline, and positioned at the beginning of tape.
3. **Interface:** Selected remotely by the host system using the five command lines (IREV, IWRT, IWFM, IEDIT, IERASE). This method is system dependent and also requires NOVRAM option 19 enabled (See Maintenance Manual P/N 799891-001).
4. **Internal:** The tape unit will internally command the recording density under one condition. A read operation from beginning of tape, followed immediately by a write operation, will switch to commanded density (if necessary) to match the density that was read. If a rewind precedes the first write operation, the commanded density will not be switched. This feature ensures that an operator/system error does not create a mixed density tape.

OPERATING DENSITY

This denotes the density that is read from or written to the tape. During a read operation from beginning of tape, if the commanded density does not agree with the found density, the density LED lights will automatically switch to reflect the found density. Using this approach, the LED lights will always indicate the current operating density of the tape drive when active. This allows the operator to identify procedural problems which could result in tape generation in an unspecified density.

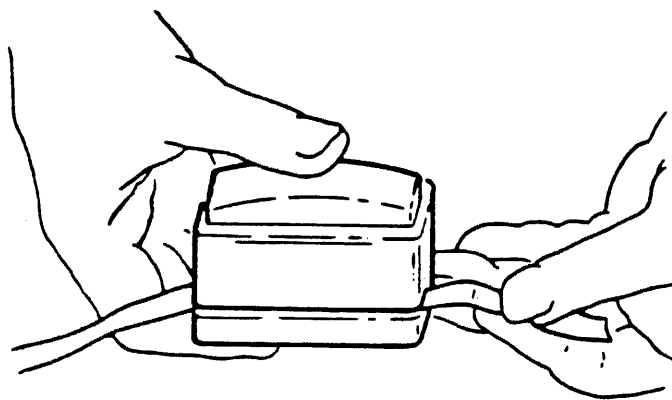
Chapter 2

Operating The Tape Drive

2.1 Preparing The Magnetic Tape

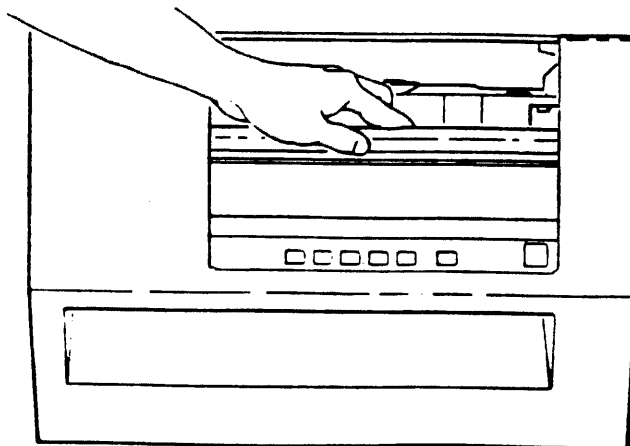
Prepare the leading end of the magnetic tape using the tape leader tool (Part No. 209990-500) shown below. This tool shapes the tape so that the unit can load the tape automatically.

Place the tape in the slot and squeeze the tool as shown.



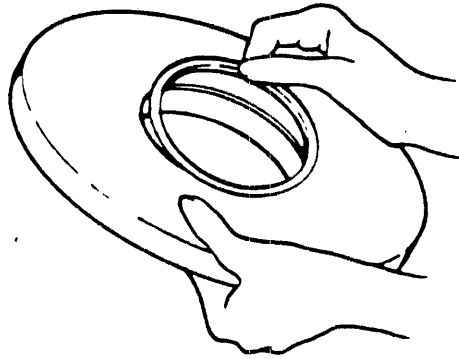
2.2 Loading The Tape

1. If the power is off, press the top of the Power switch/indicator to apply power to the unit.
2. Open the tape access door by gently pressing down on the top (center) of the door.

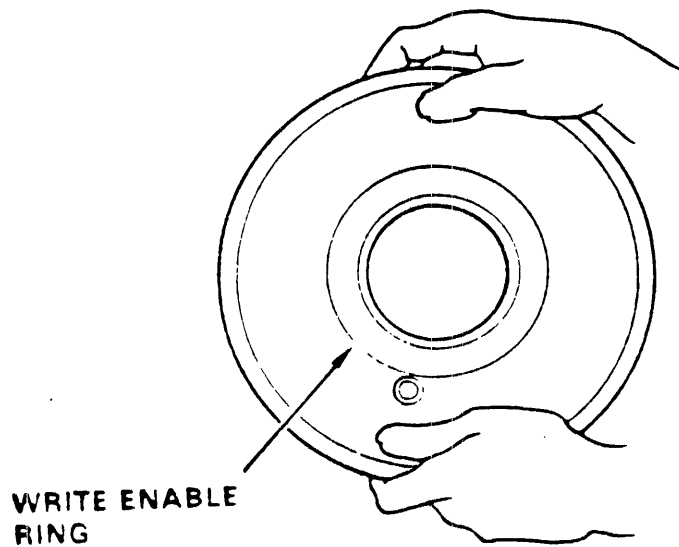


Loading Tape

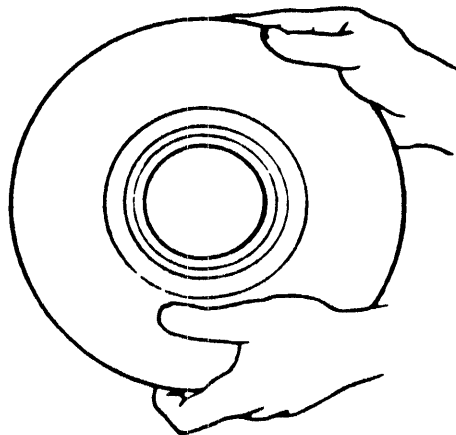
3. If you intend to write data on the tape, place a write-enable ring in the slot on the back of the tape reel.



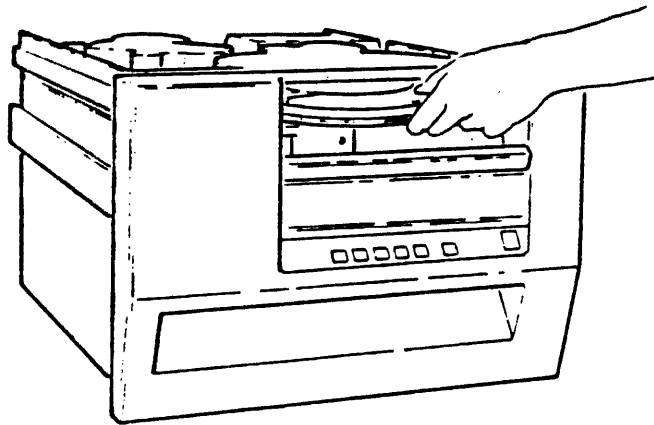
4. Make sure that the tape is wound completely onto the reel.



5. Hold the tape reel so that the write-enable ring faces down.



6. Insert the tape reel so that it lies flat inside the front opening. The reel should lie evenly on the hub.



7. Close the tape access door. The unit will not load the tape if you leave this door open.
8. Press the Load/Rewind switch. The load indicator flashes while the tape loads and remains lit when loading is complete. During the auto-load sequence, the alphanumeric display will present the word **LOADING**. When the sequence is complete, the Density will be displayed for 15 seconds.

CAUTION

The top cover and front panel door are locked while the tape is loading and during operation. If you try to open the cover or door while the tape is loading, you could damage the door or lock mechanism.

2.3 Unloading The Tape

To unload tape, use the following procedure.

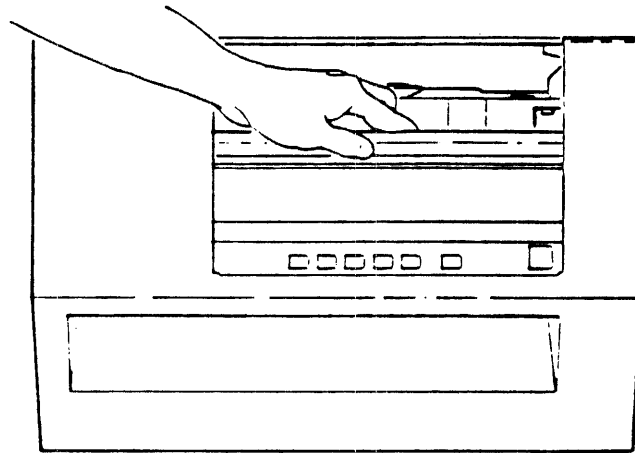
1. Make sure that the tape access door and the top cover are closed.
2. Press the Unload switch/indicator.

Unloading Tape

CAUTION

The top cover and tape access door are locked while the tape is unloading. If you try to open the cover or door while the tape is unloading, you could damage the door or lock mechanism.

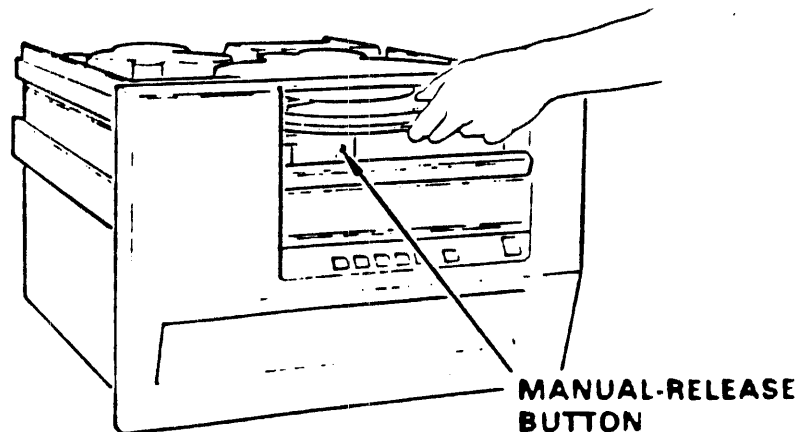
3. Open the tape access door when the Unload indicator remains lit.



NOTE

If an indicator other than the Unload indicator flashes at this time, refer to section 1.1 of this manual.

4. Remove the tape reel.



If the reel is locked to the hub, press and hold the manual release button, located behind the front panel door on bottom left-hand side of tape reel opening, while rotating the tape reel counterclockwise.

5. Close the tape access door.

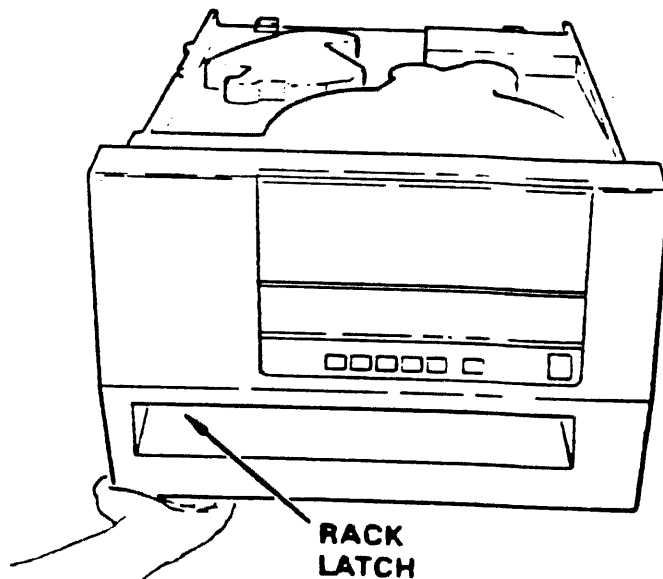
2.4 Loading The Tape Manually

If the tape fails to load, use the following procedures.

NOTE

You should not load tape manually if any of the indicators are flashing. Refer to section 1.1 of the manual, if any of the indicators are flashing.

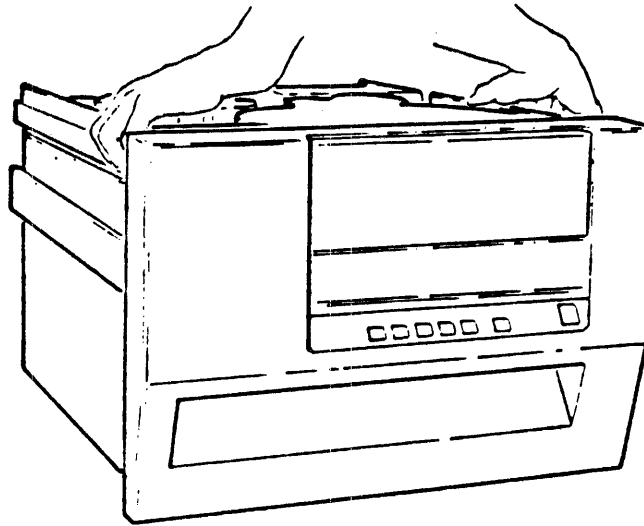
1. If the power is on, press the bottom of the Power switch/indicator to remove power from the unit
2. Release the rack latch just inside the lower left side at the front panel. Pull from behind the lower left-hand side of the front panel and slide the unit out of the rack.



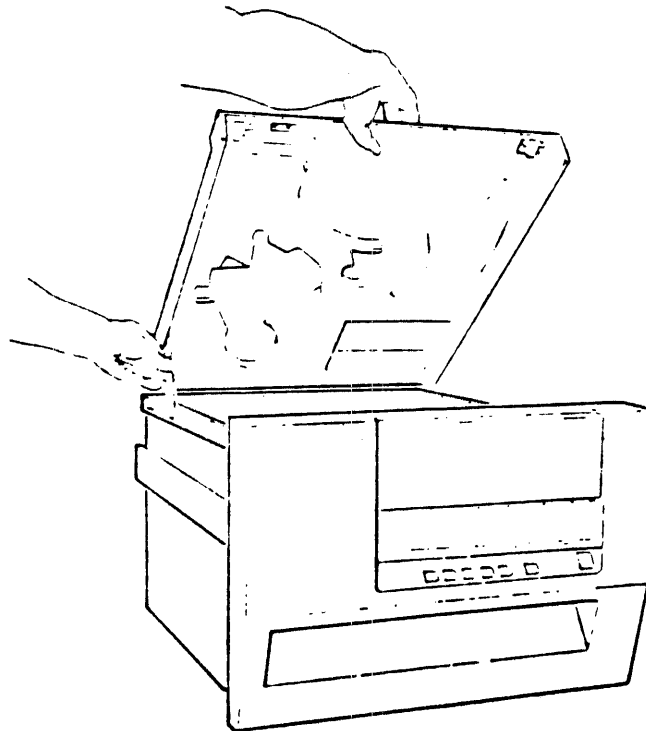
3. Slide the unit forward until it is fully extended from the rack.

Loading Tape Manually

4. Grasp the lower edges of the top cover and lift.

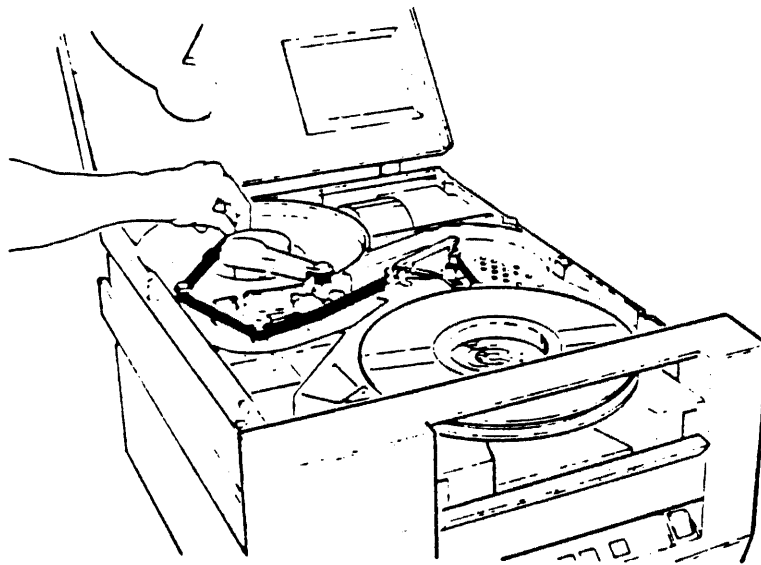


5. While holding the top cover in the raised position, place retainer bar in its slot.



6. If you intend to write data on the tape, place a write-enable ring in the slot on the back of the tape reel.

7. Hold the tape reel so that the write-enable ring faces down.
8. Open the tape access door and insert the tape reel so that it lies flat inside the front opening.
9. Depress and hold the manual unlock button, located behind the front-panel door on the bottom left hand side of the tape reel opening, and simultaneously rotate the supply hub clockwise until supply hub is locked in place.
10. Press the top of the Power switch/indicator to apply power to the unit.
11. Pull the tape around the first two roller guides.
12. Pull the tape around the third roller guide and across the read/write head.
13. Pull the tape around the next two roller guides.

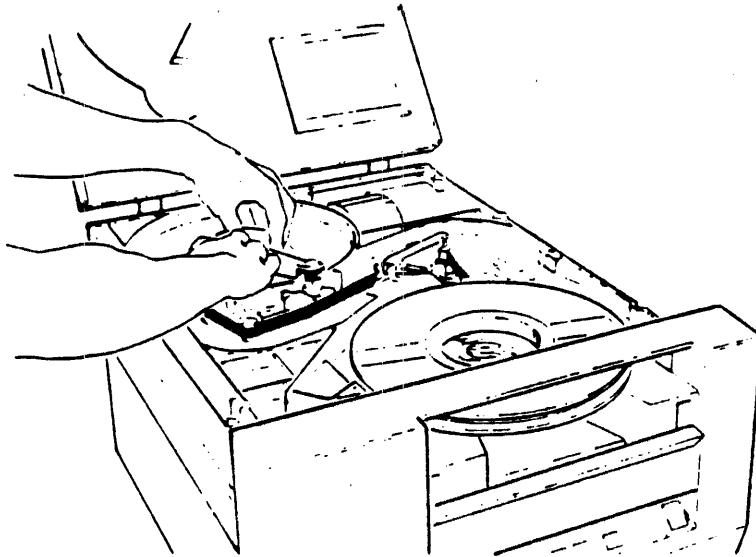


14. Move the tachometer away from the take-up hub.

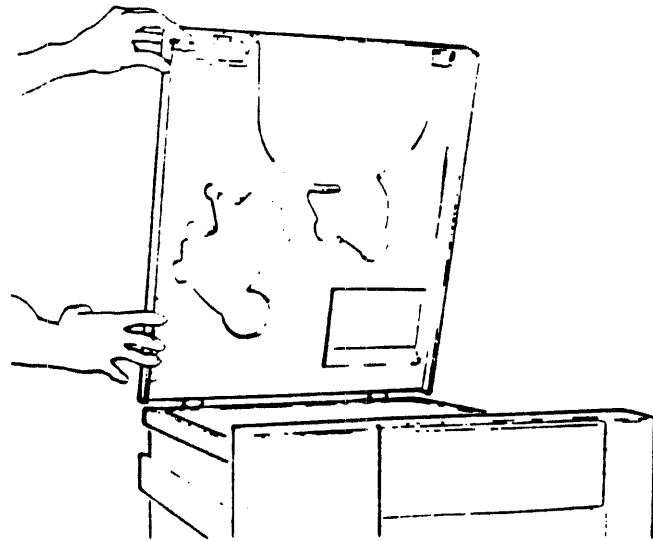
CAUTION

Do not release the tachometer while holding it away from the take-up hub. It will become damaged if it strikes sharply against the hub.

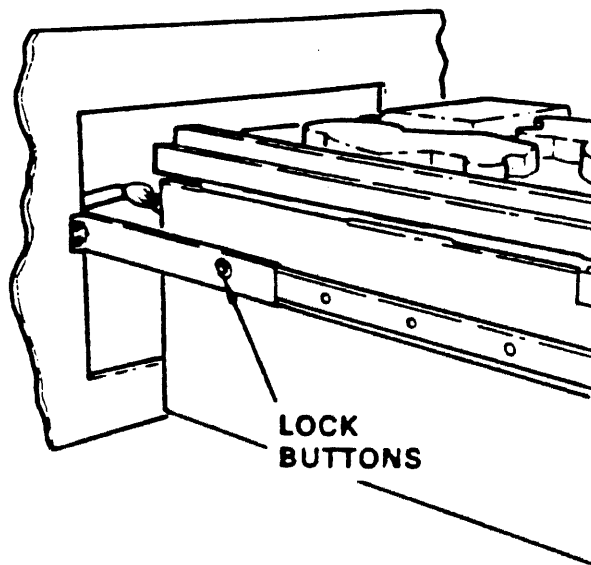
- 15. While holding the tachometer away from the hub, press the end of the tape against the hub and turn the hub clockwise until the end of the tape is held by the next layer of tape. Turn the hub six complete revolutions clockwise.**



- 16. Gently place the tachometer against the hub.**
- 17. Lift the top cover until the retainer bar is clear of its slot.**
- 18. While holding the top cover in the raised position, push the retainer bar back and up so that it lies flat against the underside of the top cover.**



19. Close the top cover.
20. Close the tape access door.
21. Press and hold the lock buttons on both slides and slide the unit carefully back into the rack.



22. While pressing the Density Select switch, press the Load/Rewind switch.

The Load indicator flashes while the tape loads and remains lit when loading is complete.

If the ARM FAULT DURING LOAD message is displayed, you did not wrap enough tape onto the take-hub. After threading the tape securely onto the take-up hub, press the Load/Rewind, Unload, or Test switches to reset the error.

CAUTION

If either the top cover or front tape loading door are forced open, moving mechanical parts may cause injury.

ACHTUNG

Wenn der Klappdeckel oder die vordere Bandladetüre mit Gewalt geöffnet werden, besteht Gefahr der Verletzung durch die beweglichen Teile.

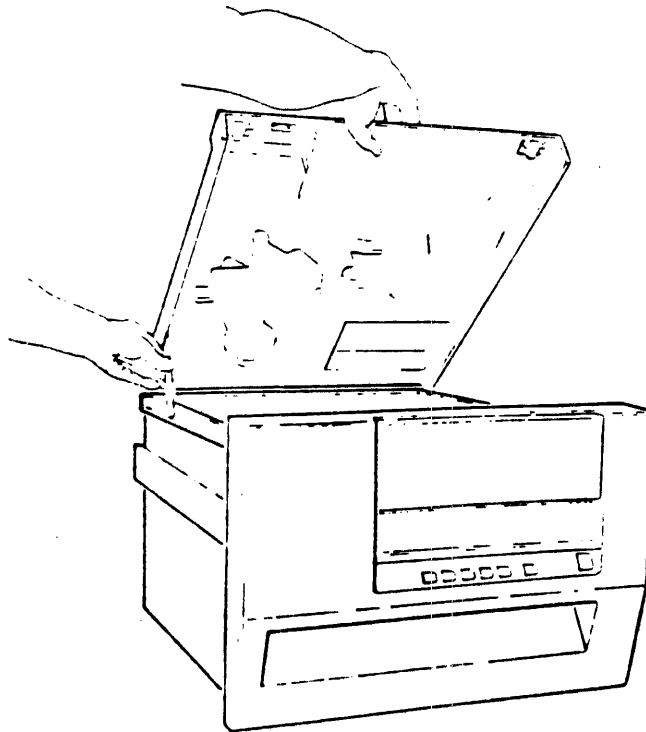
Chapter 3

Maintaining the Tape Drive

3.1 Cleaning The Tape Unit

To clean the tape unit, use the following procedure after every eight hours of operation.

1. If the power is on, press the bottom of the Power switch/indicator to remove power from the unit.
2. Pull from behind the lower left-hand side of the front panel and slide the unit out of the rack.
3. Slide the unit forward until it is fully extended from the rack.
4. Grasp the lower edges of the top cover and lift.
5. While holding the top cover in the raised position, place the retainer bar in its slot.

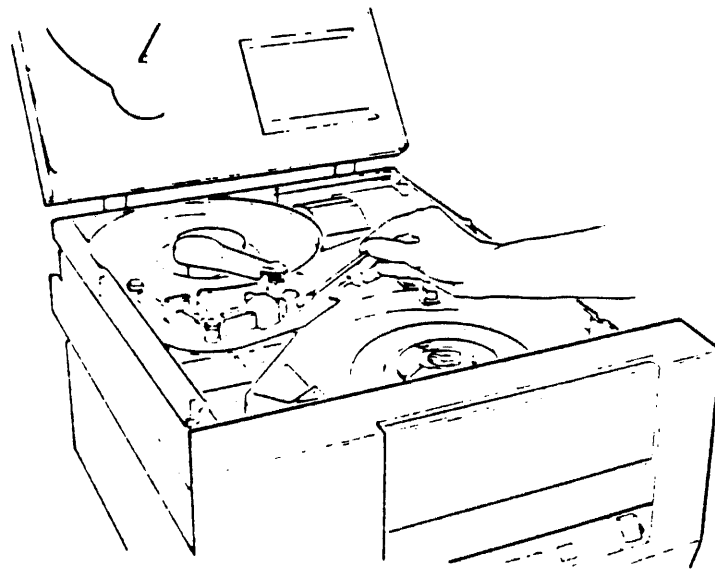


Cleaning Tape Unit

6. To clean the unit, use the Cipher tape drive cleaning kit (Part 960855-001). Moisten a swab applicator with tape drive cleaner and carefully swab the surface of the read/write head and tape cleaner.

CAUTION

Rough or abrasive materials can scratch sensitive surfaces of the head resulting in permanent damage. Other cleaners, such as alcohol based types, can cause read/write errors or load failures. **USE ONLY FREON TF** (Trichlorotrifluoroethane).



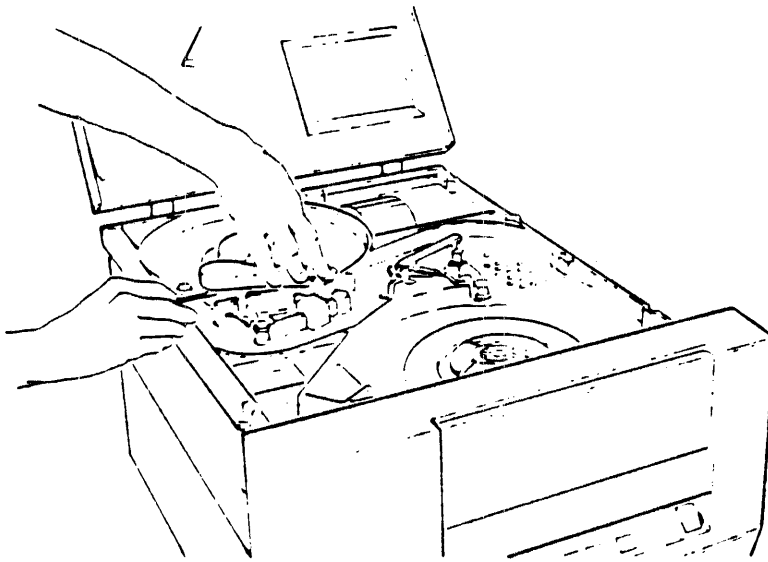
NOTE

If the surfaces are extremely dirty, you may have to use more than one swab.

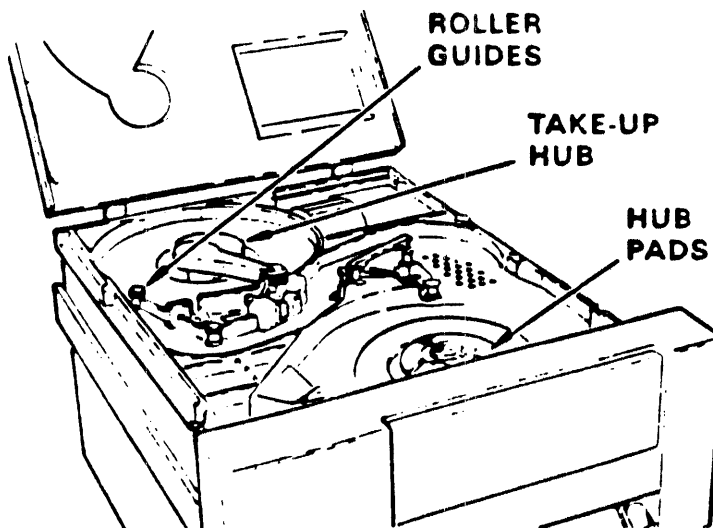
7. Clean the tachometer roller using the method described in step 6.

CAUTION

If the cleaning solvent seeps into the tachometer housing, it could damage the tachometer. Do not release the tachometer while holding it away from the take-up hub. It will become damaged if it strikes sharply against the hub.



8. Use the felt pads provided in the tape cleaning kit to clean the hub pads, takeup hub and roller guides.



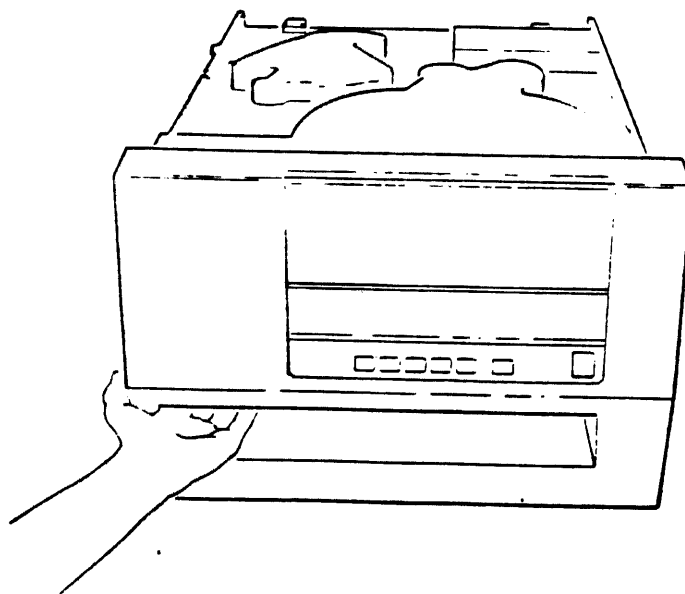
Cleaning Tape Unit / Cleaning Air Filter

9. Lift the top cover until the retainer bar is clear of its slot.
10. While holding the top cover in the raised position, push the retainer bar back and up so that it lies flat against the underside of the top cover.
11. Close the top cover.
12. Press and hold the lock buttons on both slides and slide the unit back into the rack.

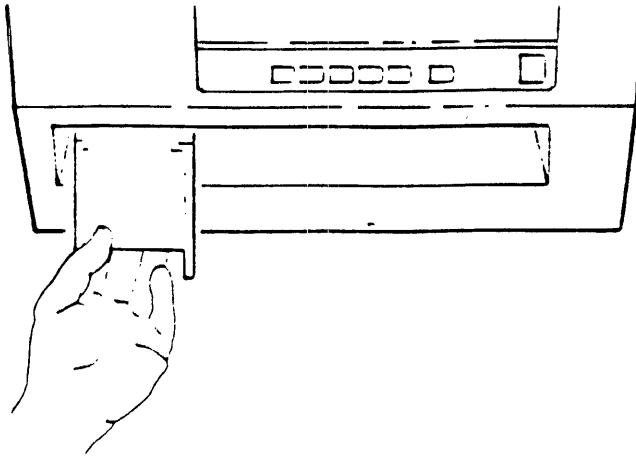
3.2 Cleaning The Air Filter

To clean the air filter, use the following procedure after every three months of operation.

1. If the power is on, press the bottom of the Power switch/indicator to remove power from the unit.
2. The filter is located just behind the Rack Latch at the lower left-hand side of the front panel. Feel for the filter tab and gently remove the filter.



3. Shake the filter clean.
4. Replace the filter.



CAUTION

This unit should be serviced by qualified maintenance personnel only.

ACHTUNG

Dieses Gerät darf nur von Fachpersonal gewartet werden.

Chapter 4. Diagnostic Tests and Troubleshooting

- CAUTION:** This unit should be serviced by qualified maintenance personnel only.
- ACHTUNG:** Dieses Gerät darf nur von Fachpersonal gewartet werden.
- CAUTION:** If either the top cover or front tape loading door are forced open, moving mechanical parts may cause injury.
- ACHTUNG:** Wenn der Klappdeckel oder die vordere Bandladetüre mit Gewalt geöffnet werden, besteht Gefahr der Verletzung durch die beweglichen Teile.

4.1 Diagnostic Test

The M990 tape unit has three separate types of built-in diagnostic tests.

1. Power-On Confidence Tests - Automatic power-on self diagnostic tests.
2. Series 100 Tests - Diagnostic tests **WITHOUT** a tape loaded.
3. Series 200 Tests - Diagnostic tests **WITH** a tape loaded.

The alphanumeric messages displayed during the diagnostic tests are shown below along with a brief description of each test.

4.1.1 Power-On Confidence Test

The power-on confidence test mode starts when the power is first switched on. During the power-on sequence, the number of the POC test that is being executed is displayed on the front panel.

The front panel indicators also illuminate with various patterns during the RAM test.

Note: Some tests run so fast that the test name i.e., POC 0, will not appear in the alphanumeric display unless that test fails. Normal operation will show, TESTING RAM, POC 1, POC 2, 88888,, ***** , and POC 5.

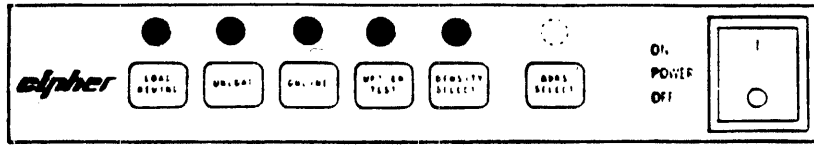
POC 0

This test checks both data and code RAM memory using a write/read and compare sequence of four patterns (FFFF, 5555, AAAA, 0000). The code RAM is checked first.

TESTING RAM

During the POC 0 test, the TESTING RAM message is displayed and the front panel indicators illuminate with various patterns.

RAM ERR



If the RAM ERR message is displayed and all of the front panel indicators remain lit, the unit failed to complete the RAM tests. Press any front panel switch to display a hex code (0000-FFFF) that indicates what area of RAM failed. The second activation of any front panel switch will display the reference designation of the faulty IC. Continue pressing the front panel switch until all faulty RAM IC reference designators are displayed. For example:

00FF

Press any switch. Indicates that the lower bank of RAM failed.

IC U21N

Press any switch again. Indicates that U21N is one of the faulty IC's.

POC 1

This test calculates the check sum for the four PROM memories U20K, U22K, U23K, and U25K.

CSE UXXK

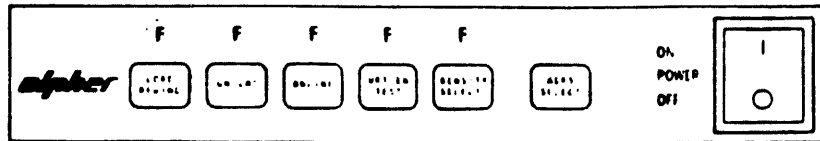
If the CSE UXXK message is displayed, POC 1 detected a check sum error on the indicated IC number. If more than PROM IC is faulty, its designator number will be displayed next.

POC 2

This test copies the data and code contained in the ROM's into the RAM memory, also resets the boot line.

88888888

.....



This test checks the alphanumeric display with three patterns; 88888888,, and, that alternate every 1/2 second. The front panel indicators also cycle continuously during this test.

POC 3

This test checks the contents of the Novram. It performs a recall cycle on the Novram, copies the information into RAM and performs an ecc check. If the ecc check fails completely, the Novram is uninitialized and the default values are copied into the Novram and the zero servo routine is called.

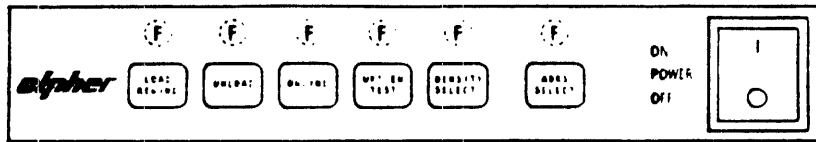
NVRM ERR

If the NVRM ERR message is displayed, the ecc routine corrected the erroneous bits. This message is displayed momentarily before the test continues.

POC 4

This test performs a fast check of the cache RAM by writing the patterns 1ff, 155, 099, and 000 in order into the first eight locations of each bank of cache RAM and then executing a read/compare operation.

CRAM ERR

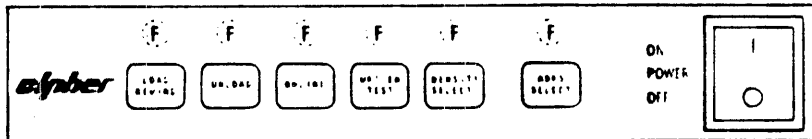


If the CRAM ERR message is displayed and all front panel indicators are flashing, the unit failed to complete the cache RAM test. Press the Load switch to display a hex code that indicates the section of cache RAM that failed. Press the Load switch again to display the reference designator of the faulty IC. Continue pressing the Load switch until all faulty IC reference designators are displayed. To exit the cache RAM test, press the Wrt En/Test switch.

POC 5

This test determines the phase quadrature of the tachometer and performs a pass/fail test by rotating the take-up hub in a clockwise direction for 200 milliseconds.

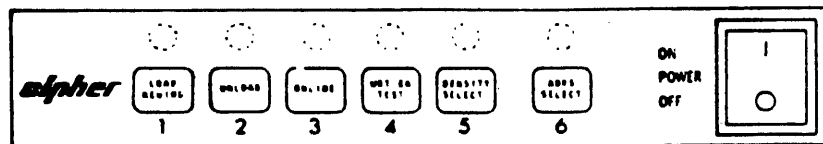
TACH ERR



If the TACH ERR message is displayed, the take-up hub moved less than .05 inch or 10 tachometer counts were not sensed.

4.1.2 Starting The Diagnostic Tests

Check to see that the On-Line indicator is off. If the indicator is on, press the On-Line switch to switch the unit to an off-line mode.



Note: Steps 2 through 5 must be accomplished within 3 seconds between keystrokes. If too much time is used, the GCR will automatically return to the normal operating mode.

1. Press the Wrt En/Test switch number 4.
2. Press the Density Select switch number 5.
3. Press the switch numbers that represent the test to be run.
4. Press the Density Select switch number 5 to **START** the diagnostic test.
5. Press the Wrt En/Test switch number 4 to **STOP** or cancel the diagnostic test.

Note: Some diagnostic tests require you to stop the test from running before you cancel the diagnostic.

When a diagnostic test is first entered, specific front panel indicators are lit to indicate the options available at this point. The diagnostic tests can operate in either the test execution mode or the parameter selection mode. The parameter selection mode allows you to select the operational parameters that are used when the test is run in the execution mode.

During the test, the alphanumeric display will display information about the drive's status.

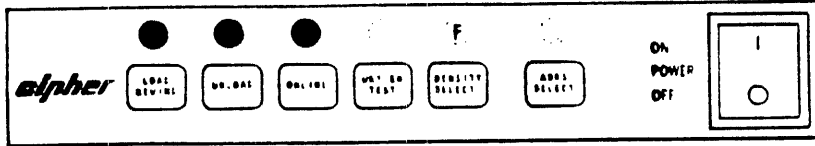
4.1.3 Diagnostic Tests WITHOUT Tape Loaded (Series 100)

CAUTION: Remove tape prior to running series 100 tests, failure to do so could cause damage to tape.

Test 111 (Oscillate Servos):

This test checks both the supply and take-up motors and their related servo circuits.

MODE ?



When entered, the test is in the parameter selection mode.

AUTO OSC

Press the Load switch to select the auto-oscillate option. The initial speed is about 25 ips.

MAN SPLY

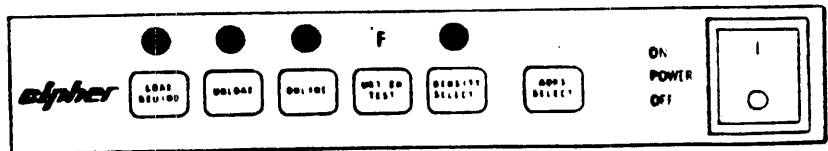
Press the Unload switch to select the manual supply option with initial speed of 0 ips.

MAN TKUP

Press the On-Line switch to select the manual take-up option. The initial speed is 0 ips.

Press the Density Select switch to access the execution mode.

Note: Press and hold the Load switch during MAN SPLY or MAN TKUP mode to steadily increase speed up to 115 ips. Press and hold the Unload switch to decrease the speed to 0 and reverse direction. A positive drive value corresponds to clockwise rotation of the hub and negative drive value corresponds to counterclockwise rotation. The sequence is identical but opposite indirection if the Unload switch is pressed first. Press the On-Line switch to reverse the direction of rotation in the MAN SPLY, MAN TKUP, or AUTO OSC mode.

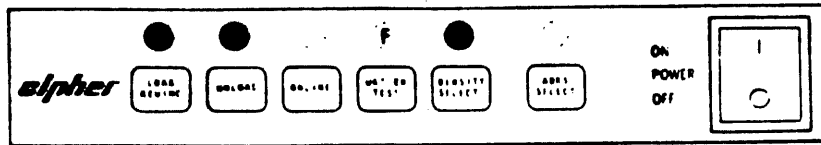


Test 124 (Voltage Display):

This test displays the analog voltage ($\pm 20\%$) of the following signal:

ARM Compliance arm output voltage

ARM + X.XX



The compliance arm voltage is displayed when the test is executed.

Test 125 (PROM Revision):

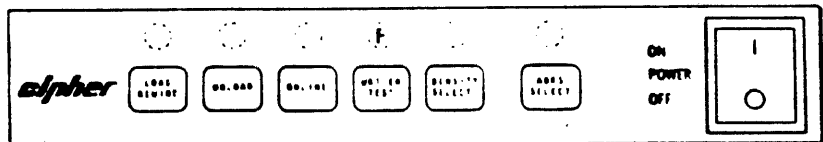
XXXXXX-XXX

This test displays the part number of the PROMs installed in the unit.

Test 131 (File Protect/Reel Seat, BOT, EOT, AND Tape-in-Path):

This test checks the status and operation of the file protect/reel seat, BOT, EOT, and Tape-in-Path sensor circuits.

The test begins by rotating the supply hub very slowly to allow the sensor to detect pulses reflected from the file protect and reel seat tabs. A reel of tape, with file protect ring inserted, must be placed on the supply hub (not loaded) and must be allowed to rotate freely. The display messages and corresponding actions are listed below:



This display occurs if there is no tape reel sensed on the supply hub. Exit the test and place the unit in the Operator Access Position (see para. 5.1). Place a tape reel on the supply hub and re-enter the test.

With a reel placed on the hub, as the reel seat tab passes the sensor the unload LED will flash twice. If the reel is write enabled, the LED will flash once as the write enabled tab passes the sensor, and twice for the reel seat sensor.

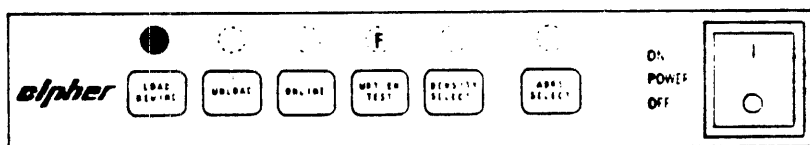
For BOT, EOT, and Tape-in-Path sensor, a strip of tape about three feet long with a BOT and EOT reflective strips placed on it. Remove the reel of tape from the supply hub and manually thread the piece of tape through the tape path.

B E T

Move the tape in front of the Tape-in-Path sensor, a "T" will be displayed on the alphanumeric display. As you move the BOT and EOT reflective strips past their respective sensors, a "B" or "E" will be displayed on the alphanumeric display.

Test 132 (Door and Hub Lock):

When entered, the test cycles both door lock and hub lock solenoids.



LOCKED

This display occurs when both front panel door and top cover are locked.

UNLOCKED

This display occurs if either the front panel door or top cover is open.

Press the Load switch to display the status of the door lock micro-switch.

SW OPEN

This message occurs when the solenoid is engaged.

SW CLOSED

This display indicates that the switch is in its normally closed (solenoid disengaged) position.

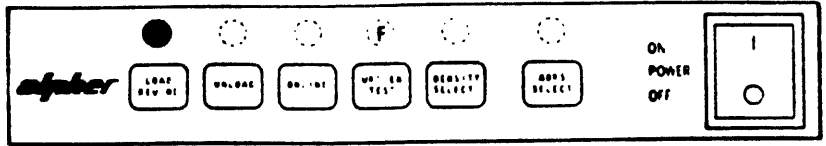
Test 133 (Door Open):

DR OPEN

This test deactivates the front panel and top cover lock solenoid so that the covers may be opened during the next load attempt. The DOOR OPEN message is displayed for 20 seconds.

Test 134 (Blower Motor):

BLWR ON



When entered, this test activates the blower motor.

BLWR OFF

Press the Load switch to turn the blower motor off.

BLWR ON

Press the Load switch again to turn the blower motor on.

To exit the test, press the Wrt En/Test switch.

Test 142 (Edit NOVRAM):

This test allows you to select the NOVRAM values to configure the M990 for efficient operation in your system. When first entered, the test will display the current value of the serial port baud rate parameter. The values of the configuration parameters can be displayed in the same order as the following list:

- | | |
|--|---|
| 1. Reserved | Option Deleted |
| 2. Host Supplied Parity - | Yes, No |
| 3. Echo Read Strobes -
on Write | Yes, No |
| 4. EOT Mode - | Normal, T.I. |
| 5. Forward Hitch Enabled - | Yes, No |
| 6. Echo 3200 bpi ID Burst - | Yes, No |
| 7. Reserved - | (Option Deleted) |
| 8. Abort Active Writes -
on Overwrites (Not
active at this time) | Yes, No |
| 9. Interface transfer Rate -
(kHz) | 70.3, 79.1, 90.4,
105.5, 126.6, 158.2
211.0, 316.5, 632.8 |

10. Default Density - on Power-Up	1600, 6250, 3200
11. Maximum Block - Size (k bytes)	9, 16, 32, 64
12. Interface Ramp Delay -	0 through 15
13. Write Sync Option -	DBLE FMK, SNGL FMK, NO W/S, ALL WRTS
14. Read Error Retries -	0, 3, 7, 11, 15
15. Write Error Retries -	0, 3, 7, 11, 15
16. Read Error Correction on -	Yes, No
17. Unit -	0 through 7
18. Lock Out 3200 bpi - Writes	Yes, No
19. Remote Density - Select Enabled	Yes, No
20. Report Corrected - Errors	Yes, No
21. Allow One Track Down - on Writes	Yes, No
22. 6250 Write Current - (read as XX.XX ma)	XXXX
23. 1600 Write Current -	XXXX
24. 3200 Write Current -	XXXX
25. 6250 RAW Threshold - (read as .XXX mv)	XXX
26. 1600 RAW Threshold -	XXX
27. 3200 RAW Threshold -	XXX
28. 3200/6250 BPI Select as 6250 BPI	Yes, No
29. Display ft. from EOT	Yes, No

Press the Load switch to display the next parameter. If you press and hold the Load switch, the display will increment through the parameter list.

Press the Unload switch to display the previous parameter. Press and hold the Unload switch to decrement through the parameter list.

Press the On-Line switch to redisplay the current parameter.

To exit the test without changing any of the parameters, press the Wrt En/Test switch.

If you want to change a parameter value, select the appropriate number, using the Load or Unload switch, and enter the edit mode by pressing the Density Select switch.

Note: Items 22 thru 27 are not alterable by test 142.

Press the Load switch to get a yes/no parameter value to yes, or increment a value parameter to its next higher value.

Press the Unload switch to set a yes/no parameter value to no, or decrement a value parameter to its next lower value.

To scroll the parameter name through the display, press the On-Line switch. The parameter value will remain in the display.

Press the Density Select switch to return to the test execution mode.

To save the new parameter values and exit the test, press the Wrt En/Test and Density Select switches together. These new values will be stored in the Novram when the unit is powered down.

(For more information see section 1.7.1)

4.1.4 Diagnostic Tests WITH Tape Loaded (Series 200)

When entered, the diagnostic tests that move tape will default to the density/speed combinations shown below if the tape is write enabled. If the tape is write protected, the test will determine the density/speed combination that is compatible with the data written on the tape. The density is displayed on the front panel LED's.

Model M990: 1600bpi/100ips

3200bpi/50ips

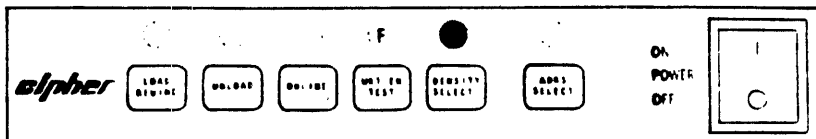
6250bpi/70ips

Test 212 (Read/Write Data):

This test writes 16 bytes of data per block incrementing from 01 to 0F on the tape, if write enabled, until EOT is detected, then reads reverse to BOT. No error correction attempts are made during this test. The data is written at the density indicated by the front panel LED's.

If the tape is write protected, the drive will read forward to EOT, then read reverse to BOT until the test is terminated.

TEST 212



WRITING

This message is displayed if the tape is write enabled.

RUN FWD

The RUN FWD message is displayed if the tape is not write enabled.

Press the Wrt En/Test switch to rewind to BOT and exit the test.

Press the Density Select switch once to stop tape movement, and a second time to cause a read reverse.

READ REV

The READ REV message is displayed if the tape is write enabled.

RUN REV

The RUN REV message is displayed if the tape is not write enabled.

Press the Wrt En/Test to rewind to BOT and exit the test.

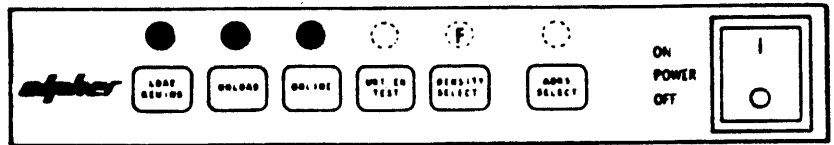
Press the Density Select switch once to stop tape movement, and a second time to cause a read forward.

Note: Tape must be moving to exit this test. If the tape is not moving, press the Density Select switch to start tape movement, then press the Wrt En/Test switch to exit the test.

Test 222 (Tape Shuttle):

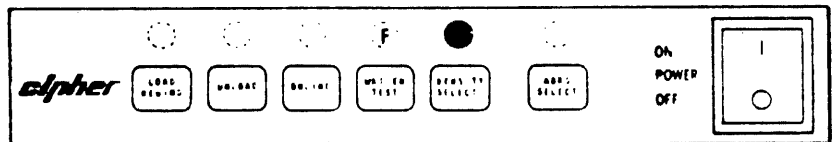
This test runs the tape forward and reverse for the amount of time selected in the parameter selection mode. There is no data transfer during this test.

SELECT FWD/REV TIME IN SECONDS



When entered, the test is in the parameter selection mode.

- .5/.2** Press the Load switch to run tape forward for .5 seconds and reverse for .2 seconds.
- 2/1** Press the Unload switch to run tape forward for 2 seconds and reverse for 1 second.
- 10/5** Press the On-Line switch to run tape forward for 10 seconds and reverse for 5 seconds.
- Press the Density Select switch to execute the test, if no time periods were selected, the tape will rewind to BOT and the test will terminate.



Test 223 (Read/Write Check):

This test cycles through the following sequence of operations until exited.

- WRITING** The unit writes blocks of data forward to EOT. Write retries are performed and the number of write errors are recorded.
- READ REV** The unit reads reverse to BOT and compares the read data with the write data of the previous operation. Read retries are performed as part of this test.

READ FWD

The unit next reads forward to EOT and performs a read/write data compare check with read retries.

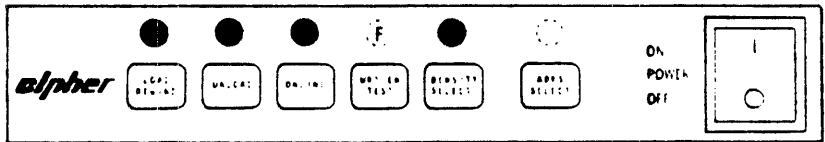
REWIND'G

The unit rewinds tape to BOT.

The unit increments the density to the next higher value, i.e., if the present density is 1600 bpi it increments to 3200 bpi.

The test increments the pass count by one and repeats the above loop.

**TAPE MUST BE
WRITE ENABLED**



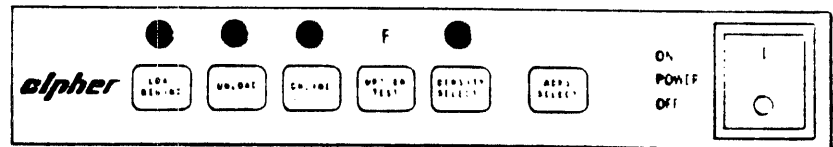
When entered, the tape loaded on the unit must be write enabled to allow test to continue.

Press the Load switch to increment to the next operation in the cycle, i.e., writing to Read Rev, Read Rev to Read Fwd, and Read Fwd to Rewind.

Press the Unload switch to abort the current operation, rewind and switch to the next density.

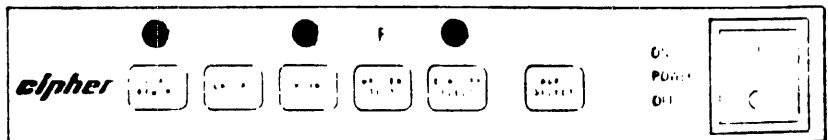
Press the On-line switch to lock or unlock the option to switch to the next density at the end of the read forward operation.

UNLOCKED



Default condition is Unlocked when entering the test. By pressing On-line once, 'LOCKED' will be displayed and you will continuously cycle in the current density until On-line is pressed again or the test is terminated.

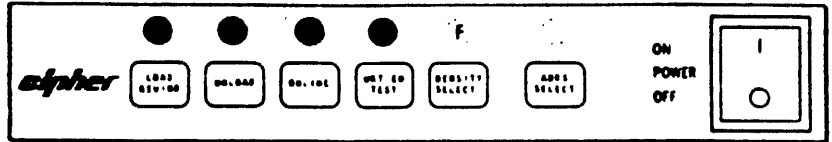
LOCKED



Press the Wrt En/Test switch to rewind the tape to BOT and enable the status mode.

Press the Density Select switch to enable the status mode at any point on the tape.

STATUS



This display occurs when the test is in the status mode.

TOTAL

Press the Load switch to display the total errors that occurred during this test in all three densities.

1600 BPI

Press the Unload switch to display the errors that occurred in the 1600 bpi mode.

3200 BPI

Press the On-line switch to display the errors that occurred in the 3200 bpi mode.

6250 BPI

Press the Wrt En/Test switch to display the errors that occurred in the 6250 bpi mode.

The errors are displayed in the following sequence:

P A S S

This message represents the number of passes the test has completed.

H D E N

This message represents the number of hard errors.

C R E N

This message represents the number of corrected errors.

W T T_n

This display indicates the number of write retries.

R D T_n

This display indicates the number of read retries.

TRK ERRS

TRK tn

This message represents the error history of each track (t) 0 through 7, P.N. indicates the number of errors for each track. Only tracks with errors are displayed.

TOT 1600

TOT 3200

TOT 6250

These messages represent the sum of the previous errors that occurred with the unit operating at the indicated density. These will be displayed only if the total error display mode is selected.

Press the Wrt En/Test switch to rewind tape and enter the status mode. Press the Density Select switch to exit the test.

Test 224 (Voltage Display):

Same as test 124, but with tape loaded.

Test 233 (Door Open):

DR OPEN

This test disengages the top-cover/front-panel lock. The DR OPEN message is displayed for 20 seconds.

Test 242 (Edit Novram):

Same as test 142 except that tape is loaded on unit during test.

Test 243 (No Write Retries):

WRT RETRIES OFF

This test disables the write retry circuit.

Note: To return the write retry circuit to normal operation, the ac power switch must be turned off then on, or perform test 241.

Test 244 (Infinite Read/Write Retries):

WRT/RD RTRYS = 64K

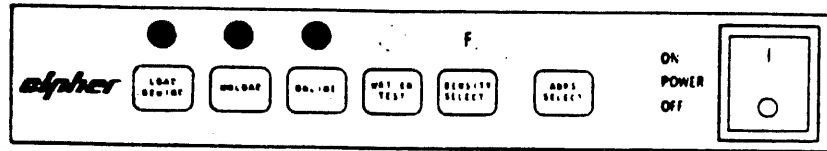
This test set both the write and read retries to 64K.

Note: To return the write retry circuit to normal operation, the ac power switch must be turned off then on, or perform test 241.

Test 255 (Display Status):

This test displays the following error history information. The error history can be compiled during on-line operation or diagnostic tests that read and write data.

STATUS



HRD ERRS
COR ERRS

Press the Load switch to display the number of hard errors and corrected errors.

WRT TRYS
RD TRYS

Press the Unload switch to display the number of write retries, then the number of read retries.

TRACK ERROR
HISTORY

Press the On-line switch to display the error history of each track as TRK (t) (n) where (t) is the track number 0 through 7, and (n) is the number of errors. (Tracks without errors are not displayed.) If no errors have occurred, the message 0 ERRORS is displayed. Press 'Test' to display clear error history, followed by Yes/No. Press Load select for Yes or Unload select for No. Pressing density will execute your selection.

Press the Density Select switch to exit the test.

4.2 Troubleshooting

The purpose of this section is to assist in repairing common faults through some simple tests designed to find the field replaceable subassembly that is causing the problem. The section is divided into three sub-sections: the Troubleshooting, Main Tests and Common Tests.

Troubleshooting

This section explains how to troubleshoot the M990 using this chapter and general information which is required to be known by the technician prior to troubleshooting.

Main Tests

This section contains all the tests used to find the source of the problem. It is divided into four areas: power up failures, load faults, operational faults, and data related errors.

Common Tests

Some subassemblies can cause more than one type of error, but the test is always the same. These tests are grouped together in this section. In the main tests section, a common test is shown by enclosing it inside parenthesis as "(common test)". Some of the common tests also refer to other common tests.

It is intended that this section be used by a technically skilled person who is familiar with the GCR tape unit and the diagnostics available on the machine. For more information on the GCR diagnostics, see section 4.1.

4.2.1 Using This Section -

1. Before doing anything, make a thorough visual inspection of the drive. Look for loose or damaged connectors and make sure that all the boards are seated properly. Also look for any damage to the backplane connectors or cables.
2. Find the type of problem the drive is having in the list below.

Problem type	Table
Power up failures	1
Load faults	2
Operational faults	3
Data related errors	4

3. Refer to the appropriate table (see pages 4-22 and 4-23) to further classify the problem.
4. Find the symptom or error message you are seeing in the table. Error messages are shown inside double quotes, e.g., "FRONT PANEL MESSAGE".
5. Go to the page listed in the "Page" column and follow the test procedure listed under "Test".

Example -

Suppose the drive won't load tape and the front panel display shows "LOAD FAILURE". In the table above we find "Load faults". The right hand column refers us to Table 2. In Table 2 we find "LOAD FAILURE" close to the bottom of the table. The right hand columns tells us to turn to page 4-32 and follow test B-9 to find the failing sub-assembly.

6. If you replace or repair anything, start the test over from the beginning unless told to do otherwise. (See the following section on changing boards.)
7. If after following the test procedure the problem continues, replace the backplane.

Recording NOVRAM values -

Record the values stored in the NOVRAM somewhere so you can check them and make sure someone has not changed them accidentally.

4.2.2 Changing boards

To change any of the four main boards, use the following procedures. Anytime you change a board, check the connector on the backplane before pulling the board out. If you notice the backplane is damaged, try fixing it before swapping out the board.

4.2.2.1 Sense Servo Board

1. Zero the servo offsets using procedure 5.34.4.
2. Run Test 513 to set the Read/Write threshold.

4.2.2.2 CPU Board

1. Record the current NOVRAM values.
2. Run Test 542 to set drive to Internal Mode.
3. Enter Test 525 to set the default values in the NOVRAM. The display will read "INITIALIZE NOVRAM TO". Press the UNLOAD switch and "FIELD" will be displayed. Press the HIDDEN switch to exit the test.
4. Run Test 542 to set the drive back to Field Mode.
5. Edit the NOVRAM using Test 142 and insert the values recorded in step 1.
6. Zero the servo offsets using procedure 5.34.4.
7. Run Test 513 to set Read/Write threshold.

4.2.2.3 Data board

1. Run Test 513 to set Read/Write threshold.

4.2.2.4 CIF Board

1. Run Test 513 to set Read/Write threshold.

4.2.3 Notes and Cautions

1. Using a digital voltmeter may give misleading readings when measuring voltages across the motors. Use Triplet model 630 NA, Fluke Model 77 or equivalent.
2. Be sure to turn the power off and wait for 10 seconds before removing or installing any boards.

<u>Symptom or Message</u>	<u>Test</u>
No alpha dsp, power light doesn't come on	A-1
No alpha dsp, power light on steady	A-2
All front panel LED'S on steady	A-3
"POC 0"	A-4
"TESTING RAM"	A-5
"POC 1"	A-6
"POC 2"	A-7
"POC 3"	A-8
"POC 3"	A-9
"NVRM ERR"	A-10
"POC 4"	A-11
"POC 5"	

Table 1. Power up failures.

<u>Symptom or Message</u>	<u>Test</u>
"ARM FAULT DURING LOAD"	B-1
"HUB SEAT"	B-2
"NOT ENOUGH TAPE ON TAKEUP" (Man. load)	B-3
"TAPE STUCK"	B-4
"NO DOOR LOCK"	B-5
"SERVO FAILURE"	B-6
"REEL UPSIDE DOWN"	B-7
"NO BOT"	B-8
"LOAD FAILURE"	B-9
During auto load, takeup doesn't turn	B-10
Pawls don't lock	B-11
Run away during auto load	B-12

Table 2. Load faults

<u>Symptom or Message</u>	<u>Test</u>
Interface timeout	C-1
Online but won't respond to commands	C-2
Blower won't come on.....	C-3
"ARM FAULT DURING RU"	C-4
"NO BOT" or Misses EOT or BOT	C-5
Doesn't sense write protected tape	C-6
Breaks tape	C-7
Destroys tape.....	C-8
"TAPE LENGTH 3700 FT"	C-9
"18 FT PAST EOT"	C-10
"ARM FAULT DURING LOAD"	C-11
"SPEED ERROR".....	C-12
"CACHE RAM PARITY ERR"	C-13
Problems with impending EOT	C-14
Won't knock pawls down.....	C-15
Buttons don't work	C-16
Display doesn't work.....	C-17
Can't sense open door.....	C-18

Table 3. Operation faults

<u>Symptom or Message</u>	<u>Test</u>
Mispositions	D-1
Excessive repositioning	D-2
Excessive write retries.....	D-3
Excessive read retries	D-4
"BLOCK SIZE ERROR"	D-5
"VRC ERR"	D-6
Record length errors.....	D-7
Can't interchange tapes	D-8
"WRITE EDIT ERR"	D-9
Data errors.....	D-10
Continuous hard errors at host	D-11
Host detected misposition	D-12
Unit selects incorrect density for read	D-13

Table 4. Data related errors

4.3 Main Tests

Note - See section 4.4 for tests that are shown inside parenthesis, "()".

As the GCR evolved, the Printed Wiring Boards were improved, resulting in several "sets" of boards being produced. The table below identifies which PWB Set a particular board belongs to based on the first six digits of its part number. Be sure to use the appropriate instructions for the board you are troubleshooting.

PWB	PWB Set A	PWB Set B	PWB Set C	PWB Set D
S/S-37V		962810-XXX		963491-XXX
S/S-57V	961344-XXX	962832-XXX		963490-XXX
CPU	961730-XXX	962112-XXX		963394-XXX
Data	961420-XXX	962789-XXX	963674-XXX	962981-XXX
CIF	961346-XXX	962357-XXX		

4.3.1 Tests for Power Up Failures

- A-1. No alpha display, power light does not turn on.
 - a. Check (Power supply).
- A-2. No alpha display, power light on steady. Same as A-3 below.
- A-3. All front panel LED's on steady.
 - a. Check (Harness) to front panel and all Sense Servo connectors.
 - b. Cycle power while monitoring the reset line on TP-14, PWB Set A, or U11C Pin 7, PWB Set B, on Sensor/Servo board. Does reset change from high to low and remain low?
 - Yes - Continue at step c.
 - No - Continue at step f.
 - c. Check (Power supply). Is it ok?
 - Yes - Continue at step d.
 - d. On the CPU board, monitor CPU clock TP-11, PWB Sets A, B, and D, with an oscilloscope. Is the clock toggling up and down?
 - Yes - Continue at step e.
 - No - Replace CPU board.
 - e. On the CPU board, check U25B pins 1 through 5, 8, 9, and 32 through 40, PWB Sets A and B; check U25C, same pins, for PWB Set D. Are the data lines going up and down?

Yes - Continue at step g.

No - Replace CPU board.

f. Check (Power supply). Is it ok?

Yes - Replace Sensor/Servo board.

g. On the CPU board, check the vectored interrupts on U25B pin 11, PWB Sets A and B; U25C Pin 11, PWB Set D. Is there a negative pulse approximately every 1 millisecond?

Yes - Continue at step h.

No - Replace CPU board.

h. Turn off power. Pull out the Data and CIF boards. Power up the drive. Does the drive power up normally now?

Yes - Continue at step i.

No - Replace Sensor/Servo board.

i. Turn off the power, and reinstall Data board. Does the drive power up normally now?

Yes - Replace the CIF board.

No - Replace the Data board.

A-4. POC 0.

a. Replace CPU board.

A-5. TESTING RAM.

a. Replace CPU board.

A-6. POC 1.

a. Replace CPU board.

A-7. POC 2.

a. Replace CPU board.

A-8. POC 3.

a. Replace CPU board.

A-9. NVRM ERR.

a. Replace CPU board.

- b. Recalibrate servo using Servo Offset adjustment procedure 5.34.4 of Maintenance Manual.
- c. Enter the recorded values in the NOVRAM.

A-10. POC 4.

- a. Replace CPU board.

A-11. POC 5.

- a. Check (Tach assembly). Is it ok?
Yes - Continue at step b.
- b. Check (Takeup motor).

4.3.2 Tests for Load Faults

B-1. Arm fault during autoload.

- a. Check (Arm assembly).
- b. Check (Supply motor).
- c. Check (NOVRAM offset).

B-2. Hub Seat Failure.

- a. Check (File protect / reel seat) sensor.
- b. Check (NOVRAM offset).

B-3. Not Enough Tape on Takeup (Manual load only)

- a. Check (Tach assembly).
- b. Check (NOVRAM offset).

B-4. Tape Stuck.

- a. Check (Tape in path) sensor.
- b. Check (NOVRAM offset).

B-5. No Door Lock.

- a. Check (Door lock).

B-6. Servo Failure.

- a. Check (Supply motor).
- b. Check (NOVRAM offset).

- B-7. Reel is upside down.**
 - a. Check (Tape in pat) sensor.
- B-8. No BOT.**
 - a. Check (EOT / BOT) sensor.
- B-9. Autoload failure after 4 tries.**
 - a. Check tape leader. Is it smooth and unwrinkled, and has the end been trimmed with the tape trimmer?
 - Yes - Continue at step b.
 - No - Repair tape leader.
 - b. Cycle power. Do you get a POC 5 error?
 - Yes - See A-11.
 - No - Continue at step c.
 - c. Check (Supply motor).
 - d. Check (Blower motor).
 - e. Check (NOVRAM offset).
- B-10. During autoload, Takeup Motor does not turn.**
 - a. Check (Takeup motor).
 - b. Check (NOVRAM offset).
- B-11. Pawls do not lock.**
 - a. Check (Supply motor).
 - b. Check (Hub lock).
 - c. Check (NOVRAM offsets).
- B-12. Run away during autoload.**
 - a. Check (Tach assembly). Is it ok?
 - Yes - Replace Sensor/Servo board.

4.3.3 Tests for Operational Faults

- C-1. Interface timeout.**
 - a. Replace CIF board.

- C-2.** Online but does not respond to commands.
 - a. Replace CIF board.
- C-3.** Blower does not come on.
 - a. Check (Blower motor).
- C-4.** Drops tape during rewind.
 - a. Cycle power. Do you get POC 5 error?
 - Yes - See A-11.
 - No - Continue at step b.
 - b. Check (Arm assembly).
 - Yes - Replace Sense/Servo board.
- C-5.** Misses EOT or BOT.
 - a. Check (EOT/BOT).
- C-6.** Does not sense write protected tape.
 - a. Check (File protect / reel seat) sensor.
- C-7.** Breaks tape.
 - a. Replace Sensor/Servo board.
- C-8.** Destroys Tape.
 - a. Check tape path (Hub height, roller guides, Tach Arm).
 - b. Clean Head and Rollers.
 - c. Check head for nicks or dings.
 - d. If problem is finning (uneven tape pack on the takeup reel), check tach roller or roller guide near the take-up reel for damage. If roller wear looks uneven, replace tach assembly.
- C-9.** Tape length greater than 3700 feet.
 - a. Check (Tach assembly).
- C-10.** 18 feet past EOT.
 - a. Check (EOT / BOT) sensor.
- C-11.** Arm fault during run.

- a. Check (Arm assembly).
- C-12. Speed error.**
- a. Check (Tach assembly).
 - b. Check (Takeup motor).
 - c. Run test 212 while monitoring on the Data board Pin 13 of U5B for PWB Set A; U12B Pin 13 for PWB Sets B and C. Is there a positive pulse approximately every 7 milliseconds?

No - Replace the Data board.

Yes - Replace Sensor/Servo board.
- C-13. Cache RAM parity error.**
- a. Replace CPU board.
- C-14. Problems with impending EOT.**
- a. Check (File protect / reel seat) sensor.
- C-15. Does not retract pawls.**
- a. Check (Hub lock).
 - b. Check (Supply motor).
- C-16. Front panel switches do not work.**
- a. Check (Harness). Is it ok?

Yes - Continue at step b.
 - b. Replace Sensor/Servo board. Problem fixed?

Yes - PASS.

No - Replace front panel switches.
- C-17. Display does not work.**
- a. Check (Harness).
 - b. On the Sensor/Servo board, measure +5 volts for the display board at R163 for PWB Set A; J1-37 for PWB Set B. Is it between 4.85 to 5.15 volts?

Yes - Continue at step c.

No - Replace Sensor/Servo board.

- c. Run test 143. On the Sensor/Servo board, PWB Set A, trigger the scope on the negative edge of the clock pulse on U16G pin 11. Check for data at U12G pins 3, 6, 8, 11 and U13G pins 3, 6, and 11. Are they toggling up and down? On the Sensor/Servo board, PWB Set B, trigger the scope on the negative edge of the clock pulse on U12F Pin 8. Check for data at U14E Pins 3, 6, 8, and 11, and U14F Pins 3, 8, and 11. Are they toggling?

Yes - Replace display board.

No - Replace Sensor/Servo board.

C-18. Does not sense open door.

- a. Check (Door lock).

4.3.4. Tests for Data Related Errors

D-1. Mispositions.

- a. Check (Read threshold).
- b. Replace Sensor/Servo board.

D-2. Excessive repositioning.

- a. Check (File protect / reel seat) sensor.
- b. Replace Sensor/Servo board. Does problem go away?

Yes - Pass.

No - Continue at step c.

- c. Unless the transfer rate in the NOVRAM is at its maximum value, step it to the next higher rate (refer to section 4.1.3.) When you move data through the interface, do you get VRC, record length errors, or some other type of data error?

Yes - Lower the transfer rate one step.

No - Repeat step b above.

D-3. Excessive write retries.

- a. Check (Common data problems).
- b. Clean the tape scraper. Repeat test with a new reel of tape.

D-4. Excessive read retries.

- a. Check (Common data problems).

D-5. Block size error.

- a. Are you sure that the block size on tape is less than 64K?
Yes - Replace CPU board.
No - Continue at step b.
- b. Check (Common data problems).

D-6. VRC error.

- a. Check (Common data problems).
- b. Replace the CIF board. Does problem go away?
Yes - PASS
No - Continue at step c.
- c. Replace the CIF board with the one you took out, then replace the Data board. Does this fix the problem?
Yes - PASS.
No - Continue at step d.
- d. Replace the Data board with the one you took out, then replace the CPU board.

D-7. Record length errors.

- a. Check (Common data problems).
- b. Replace the CPU board. Does problem go away?
Yes - PASS.
No - Continue at step c.
- c. Replace the CPU board with the one you took out. Replace the CIF board. Does this fix the problem?
Yes - PASS.
No - Continue at step d.
- d. Replace the CIF board with the one you took out. Replace the Data board.

D-8. Cannot Interchange tapes. There are two types of failures for this problem. See (1) and (2) below for the one that applies.

- (1) Does not read other drives tapes.
 - a. Check (Common data problems).
 - b. Replace Data board. Does this fix the problem?
Yes - PASS.
No - Continue at step c.
 - c. Replace the Data board with the one you took out. Replace the CIF board.
- (2) Other drives cannot read the tapes written on this drive.
 - a. Check (Common data problems).
 - b. Replace CIF board.
- D-9. Write edit error.
 - a. This problem is most often caused by the host command sequence not matching the GCR command sequence specifications. See the installation manual for more information.
 - b. Replace the CIF board.
- D-10. Data errors.
 - a. Check (Common data problems).
 - b. Replace the Data board. Does problem go away?
Yes - PASS
No - Continue at step c.
 - c. Replace the Data board with the one you took out, then replace the CPU board. Does problem go away?
Yes - PASS
No - Continue at step d.
 - d. Replace the CPU board with the one you took out, then replace the CIF board.
- D-11. Continuous hard errors at host.
 - a. Check (Common data problems).
 - b. Replace the CIF board.
- D-12. Host detected misposition or wrong record ID.

- a. Replace Sensor/Servo board. Does problem go away?
 Yes - PASS.
 No - Continue at step b.
- b. Replace the Sensor/Servo board with the one you removed, then replace the Data board.

D-13. Unit selects incorrect density for read.

- a. Check (Common data problems).
- b. Replace the Data board. Does problem go away?
 Yes - PASS
 No - Continue at step c.
- c. Replace the Data board with the one you took out, then replace the Sensor/Servo board.

4.4 Common Tests

The following table identifies the common tests listed in this section along with the page number of the test.

	Test	Page
4.4.1.	Arm assembly	4-32
4.4.2.	Blower motor	4-32
4.4.3.	Door lock	4-33
4.4.4.	EOT / BOT	4-33
4.4.5.	File protect / reel seat	4-34
4.4.6.	Harness	4-34
4.4.7.	Hub lock	4-34
4.4.8.	Novram offset	4-35
4.4.9.	Power supply	4-35
4.4.10.	Supply motor	4-36
4.4.11.	Tach assembly	4-38
4.4.12.	Takeup motor	4-38
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4.4.14.	Common data problems ...	4-40
4.4.15.	Read threshold	4-40
4.4.16.	Set Internal/Field	4-41
	Mode (test 542)	
4.4.17.	Automatic Write Current Calibration (test 513)	4-42

4.4.1 Arm assembly

Does the arm bind when you move it?

1. Yes - Perform visual inspection for anything interfering with arm movement.

No - Continue at step 2.

2. Enter test 124. Pull the arm back to its stop while watching voltage on front panel display. Does the voltage change?

Yes - Continue at step 3.

No - Continue at step 4.

3. Record the voltage at rest, record the voltage at full arm travel. Is the difference between the two at least 2 VDC, but no more than 12.5 VDC?

Yes - PASS.

No - Replace Sensor/Servo board.

4. Check (Harness). Is it ok?

Yes - Replace Sensor/Servo board.

4.4.2. Blower motor

1. Enter test 134. Can you hear the blower come on?

Yes - PASS.

No - Continue at step 2.

2. Check Sensor/Servo board for blower signal at R35 for PWB Set A; J1-5 for PWB Set B. The signal drops from +12V to +5V when the motor is activated with PWB Set A, and from +5V to 0 with PWB Set B.

Yes - Continue at step 3.

No - Replace Sensor/Servo board.

3. Turn off the power. Check voltage from power supply to blower by unplugging the P4 connector (a small, 3 position connector next to the blower motor). Place a AC voltmeter on pins 1 and 2 (female part of connector). Do you measure 110-140 Vac?

Yes - Replace blower motor.

No - Replace power supply.

4.4.3. Door lock

1. Open the front door and the top cover of the drive. Enter test 132. Looking through the opening between the front panel and the top plate on the left side of the drive, can you see the door lock solenoid pulling in then releasing, and does the display show "UNLOCKED"?

Yes - Continue step 3.

No - Continue at step 2.

2. Check (Harness). Is it ok?

Yes - Replace Sensor/Servo board.

3. Press load button. Display should show "SW CLSD". Close both top cover and front door. Press load. Does drive show "LOCKED"?

Yes - PASS.

No - Replace door lock assembly.

4.4.4. EOT/BOT

1. Enter test 131. Place a tape marker in front of the BOT sensor in approximately the same place as the tape would hold it. Does the LOAD LED come on?

Yes - Continue at step 2.

No - Continue at step 3.

2. Place tape marker in front of the EOT sensor. Does the UNLOAD led come on?

Yes - PASS.

No - Continue at step 3.

3. Check (Harness). Is it ok?

Yes - Continue at step 4.

4. On the Sensor/Servo board, check R122 on PWB Set A or R195 on PWB Set B for +5 to sensor. Is the voltage between 4.85 and 5.15 Vdc?

Yes - Replace EOT/BOT sensor.

No - Replace Sensor/Servo board.

4.4.5 File protect / reel seat

1. Place a write enabled reel of scratch tape in the drive. Enter test 131. Observe the "UNLOAD INDICATOR" comes on.

Yes - PASS.

No - Continue at step 2.

2. Is the (Harness) ok?

Yes - Continue at step 3.

3. Measure power to sensor on Sensor/Servo board at R118 for PWB Set A or R195 for PWB Set B. Is it between 4.85 to 5.15 Vdc?

Yes - Replace file protect / reel seat sensor.

No - Replace Sensor/Servo board.

4.4.6. Harness

1. Check the harness where it connects with the sub-assembly under test. Is the connection ok?

Yes - Continue at step 2.

No - Repair or replace harness.

2. Check the harness where it connects with the Sensor/Servo board. Is the connection ok?

Yes - PASS.

No - Repair or replace harness.

4.4.7. Hub lock

1. Open top cover of drive. Face the drive and turn the supply reel so that the reel seat tab is in the 10 o'clock position. Look through the hole in the top plate next to the supply reel at about 8 o'clock. Enter test 132. Does the hub lock move?

Yes - Continue at step 2.

No - Continue at step 3.

2. While the door lock is pulled in (Display shows "UNLOCKED"), turn the supply hub slowly by hand counterclockwise. Does the hub stop with the reel seat tab at about the 9 o'clock position?

Yes - PASS.

No - Remove the supply hub and repair or replace the hub or bellcrank as necessary.

3. Check (Harness). Is the connection ok?
Yes - Continue at step 4.
4. Check power to the hublock on Sensor/Servo board at CR39 cathode for PWB Set A or CR58 cathode for PWB Set B. Does the voltage toggle between -15 and +10 volts?
Yes - Replace the hublock.
No - Replace the Sensor/Servo board.

4.4.8. NOVRAM offset

1. From Unload state. Measure voltage across Supply and Takeup motors on the Sensor/Servo board at TP-7 and 8 PWB Set A; TP 34 and 35, PWB Set B; for the supply and TP-6 and 9, PWB Set A; and TP 32 and 33, PWB Set B; for the takeup. Are both measurements less than 50 millivolts?
Yes - PASS.
No - Adjust offset using procedure 5.34.4.

4.4.9. Power supply

1. Is this a TUV machine?
Yes - Continue at step 2.
No - Continue at step 3.
2. Is the +37 volts measured at TP-5 on PWB Set A and the positive side of C4 on PWB Set B between 31.5 and 41 volts?
Yes - Continue at step 4.
No - Continue at step 9.
3. Is the +57 volts measured at TP-5 on PWB Set A and the positive side of C4 on PWB Set B between 48.5 and 63 volts?
Yes - Continue at step 4.
No - Continue at step 9.
4. On the Sensor/Servo board for PWB Set A and the positive side of C258 for PWB Set B, is the +5 between 4.85 to 5.15 Vdc?
Yes - Continue at step 5.
No - Continue at step 13.
5. On the Sensor/Servo board TP-37 for PWB set A and TP-2 for PWB Set B, is the +6 between -5.64 to -6.36 Vdc?
Yes - Continue at step 6.
No - Continue at step 13.

6. On the Sensor/Servo board TP-38 for PWB Set A and TP-1 for PWB Set B, is the -6 between -6.36 to -5.64 Vdc?
Yes - Continue at step 7.
No - Continue at step 13.
7. On the Sensor/Servo board TP-39 for PWB Set A and TP-4 for PWB Set B, is the +12, between 11.28 to 12.72 Vdc?
Yes - Continue at step 5.
No - Continue at step 13.
8. On the Sensor/Servo board TP-40 for PWB Set A and TP-3 for PWB Set B, is the -12 between -12.72 to -11.28 Vdc?
Yes - PASS.
No - Continue at step 13.
9. Check the (Harness) where it plugs into the power supply.
10. Is the power cord ok?
Yes - Continue at step 11.
No - Replace power cord
11. Is the fuse at the rear of the drive ok?
Yes - Continue at step 12.
No - Replace fuse
12. Is the power switch ok?
Yes - Replace power supply
No - Replace power switch
13. Replace the Sensor/Servo board. Is the voltage ok now?
Yes - PASS.
No - Turn off the power and reinstall the original Sensor/Servo board. Pull out the other boards one at a time until voltage is ok. Replace the board that was causing the problem.

4.4.10. Supply motor

1. With power off, turn supply motor by hand. Does motor turn in both directions smoothly?
Yes - Continue at step 2.
No - Replace supply motor.

2. Enter test 111. Before selecting a test mode, does the motor spin?
Yes - Continue at step 6.
No - continue at step 3.
3. Select the manual supply mode in test 111. Run the supply motor up to approximately 50 counts. Does the motor move?
Yes - Continue at step 8.
No - Continue at step 4.
4. Check the (Harness). Is it ok?
Yes - Continue at step 5.
5. Is the drive on the Sensor/Servo board ok?
Yes - Replace motor.
No - Replace Sensor/Servo board.
6. Is the motor spinning fast or slow?
Fast - Continue at step 10.
Slow - Continue at step 7.
7. Check (NOVRAM) offsets. Are they ok?
Yes - Replace Sensor/Servo board.
No - Adjust the offset using procedure 5.34.4.
8. Is the speed of the motor fairly constant?
Yes - Continue at step 9.
No - Replace Sensor/Servo board.
9. Reverse direction of the motor. Is the speed about the same as in the opposite direction?
Yes - PASS.
No - Continue at step 7.
10. Replace Sensor/Servo board. Does motor still spin fast?
Yes - Reinstall first servo board and continue at step 7.
No - PASS.

4.4.11. Tach assembly

1. Enter 111 auto oscillate mode. Are both tach phases on the Sensor/Servo board ok? (Use O-scope and read at U11L Pin 13 and Pin 14 for PWB Set A, and at U16H pins 13 and 14 for PWB Set B.)

Yes - PASS.

No - Continue at step 2.

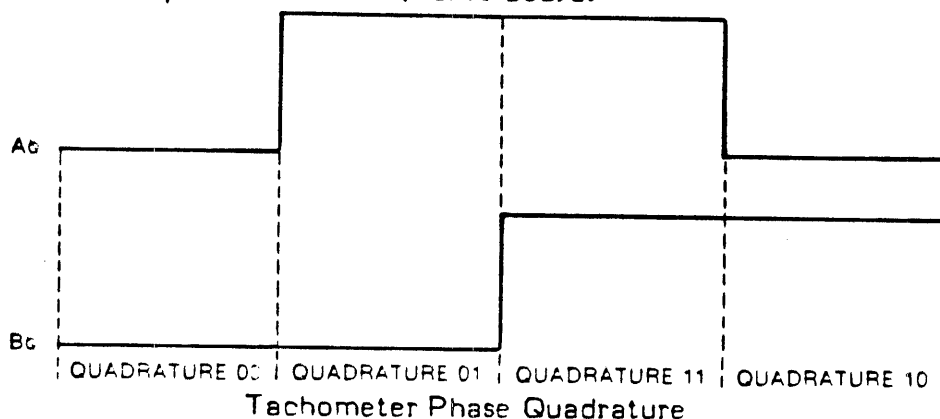
2. Check (Harness). Is it ok?

Yes - Continue at step 3.

3. Is the power from the Sensor/Servo board to the tach ok?

Yes - Replace the tach assembly.

No - Replace the Sensor/Servo board.



4.4.12. Takeup motor

1. With power off, turn takeup motor by hand. Does motor turn in both directions smoothly?

Yes - Continue at step 2.

No - Replace takeup motor.

2. Enter test 111. Before selecting a test mode, does the motor spin?

Yes - Continue at step 6.

No - continue at step 3.

3. Select the "MAN TAKE-UP" mode in test 111. Run the takeup motor up to approximately 50 counts. Does the motor move?

Yes - Continue at step 8.

No - Continue at step 4.

4. Check the (Harness). Is it ok?
Yes - Continue at step 5.
5. Is the drive on the Sensor/Servo board ok?
Yes - Replace motor.
No - Replace Sensor/Servo board.
6. Is the motor spinning fast or slow?
Fast - Continue at step 10.
Slow - Continue at step 7.
7. Check (NOVRAM) offsets. Are they ok?
Yes - Replace Sensor/Servo board.
No - Adjust the offset using procedure 5.34.4.
8. Is the speed of the motor fairly constant?
Yes - Continue at step 9.
No- Replace Sensor/Servo board.
9. Reverse direction of the motor. Is the speed about the same as in the opposite direction?
Yes - PASS.
No - Continue at step 7.
10. Replace Sensor/Servo board. Does motor still spin fast?
Yes - Reinstall first servo board and continue at step 7.
No - PASS.

4.4.13. Tape in path

1. Enter test 131. Place your hand between the tape in path transmitter and receiver. Does the "T" in the display come on?
Yes - PASS.
No - Continue at step 2.
2. Is the (Harness) ok?
Yes - Continue at step 3.

3. On the Sensor/Servo board, check R118 for PWB Set A and R270 for PWB Set B for power to the tape in path transmitter and receiver. Is the voltage between 4.85 to 5.15 Vdc?

Yes - Replace the transmitter, if that does not fix the problem, replace the receiver.

No - Replace the Sensor/Servo board.

4.4.14. Common data problems

1. Check (Read threshold).
2. Check head cables.
3. Clean head, tape scraper, and roller guides.
4. Check the NOVRAM configuration with the values that were recorded before the drive started having problems. Pay special attention to the Parity, ramp delay, and transfer rate.

4.4.15. Read threshold

1. Enter test 212. Measure and record read after write envelope on the data board at TP-60, TP-62, and TP-64 on PWB Set A; TP-93, TP-96, and TP-99 on PWB Sets B and C. Read the value from the zero point to the positive peak of the wave form. Average these three readings together for the other calculations. Measure and record Vcom at U15U Pin 7 on PWB Set A and U26U Pin 7 on PWB Sets B and C. This is Vcom1. Rewind and exit test. Measure and record Vcom once more. This is Vcom2. Is the average of the read after write envelope readings between the min and max values for Vcom1 in the read threshold table at the end of this test? (If the value you get isn't in the table, the average read after write envelope times 28% should be equal to Vcom1 plus or minus 5%.)

Yes - Continue at step 2.

No - Run (test 513) to set read threshold.

2. Is the average of the readings between the min and max values for Vcom2 in the read threshold table at the end of this test? (If the value you get isn't in the table, the average read after write envelope times 10% should be equal to Vcom1 plus or minus 3%.)

Yes - PASS.

No - Run (test 513) to set read threshold.

Read Threshold Table

Peak Average	VCOM1		VCOM2	
	min	max	min	max
0.500	0.133	0.147	0.049	0.052
0.600	0.160	0.176	0.058	0.062
0.700	0.186	0.206	0.068	0.072
0.800	0.213	0.235	0.078	0.082
0.900	0.239	0.265	0.087	0.093
1.000	0.266	0.294	0.097	0.103
1.100	0.293	0.323	0.107	0.113
1.200	0.319	0.353	0.116	0.124
1.300	0.346	0.382	0.126	0.134
1.400	0.372	0.412	0.136	0.144
1.500	0.399	0.441	0.146	0.155
1.600	0.426	0.470	0.155	0.165
1.700	0.452	0.500	0.165	0.175
1.800	0.479	0.529	0.175	0.185
1.900	0.505	0.559	0.184	0.196
2.000	0.532	0.588	0.194	0.206

4.4.16. Set Internal/Field Mode (Test 542)

CAUTION: Care must be taken when using 500 series tests. Follow instruction to the letter. Failure to do so could render the GCR unit inoperable.

(Internal Mode)

1. Enter test 542, does display scroll "SET FIELD MODE? YES NO".
Yes - Press the UNLOAD switch, then the HIDDEN switch to exit the test.
No - Continue to step 2.
2. "PASSWORD ?" is displayed, enter 54524. Display now reads "MODE ?", press the LOAD switch and now "INTERNAL" is displayed, press HIDDEN switch to exit the test.

You are now in the internal mode and can run test 513.

(Field Mode)

1. Enter test 542, does display show "SET FIELD MODE? YES NO".
Yes - Press LOAD switch and "YES" is now displayed. Press HIDDEN to exit the test.
No - "PASSWORD" is displayed. Press the WRT EN/TEST switch to cancel the test.

4.4.17. Automatic Write Current Calibration (Test 513)

1. This test requires that a write enabled tape be loaded before entering.
2. Enter test 513 as per instructions listed in 4.4.16.
3. Test will now run automatically. When test is done the display will either read "PASS" or "FAIL". Did the test pass?

Yes - PASS Go to step 4.

No - FAIL, Check the last component that was installed prior to running this test. Check all contacts and connections and the backplane.

4. Return unit back to Field Mode (test 542).

CHAPTER 5: INTERFACES & Error CONDITIONS

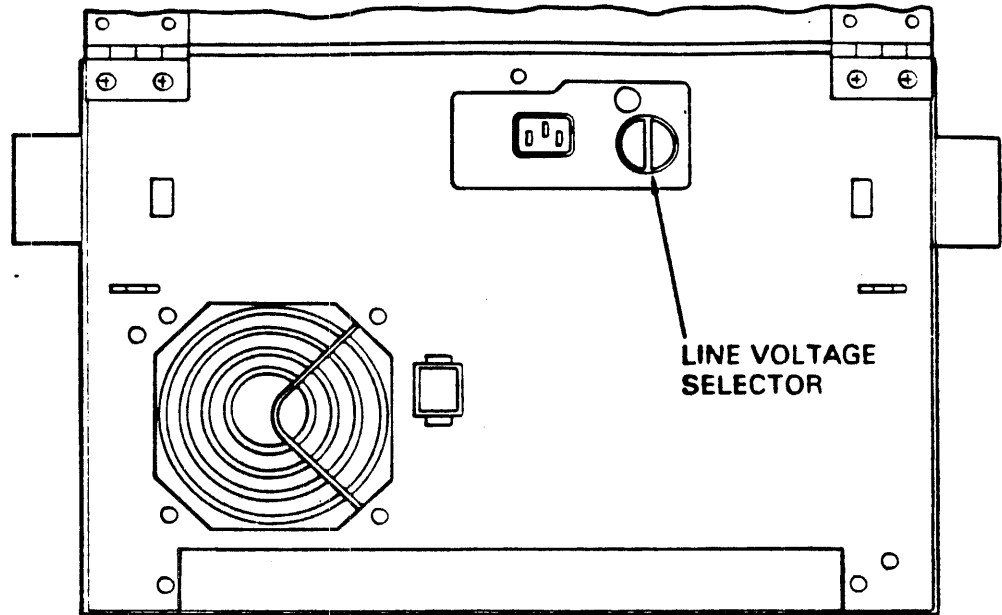
1.3 Power Connection

The a-c input voltage to the M990 is determined by a multi-position select switch located at the rear of the tape unit. The following voltages and frequencies may be selected:

NOMINAL VOLTAGE (Vac)	FREQUENCY (Hz)	AVAILABLE VOLTAGE (Vac)	OPERATING VOLTAGE RANGE (Vac)	AC SWITCH SELECTION (Hz)
127	59-61	111-137	102-158	120,60
200	49-61	190-220	170-220	200,50/60
208	59-61	180-220	170-220	200,50/60
110	49-61	96.5-119	96.5-120	120,50/60
120	49-61	104-127	102-132	120,50/60
240	49-51	210-259	204-264	240,50/60
240	59-61	208-254	204-264	240,50/60
100	49-61	85-110	85-110	100,50/60
104	49-61	88-110	88-114	100,50/60
220	49-61	193-238	187-242	220,50/60
230	49-51	202-249	187-249	220,50/60

CAUTION:

To prevent damage to the M990 and ensure proper operation, be sure the outlet voltage is correct before applying power to the tape unit.



A power cord is supplied only for the voltage range indicated on the manufacturer's label.

1.2.1 Plug Connector - Power cord preparation - 3 conductor, 1-phase, 16 Amp max.

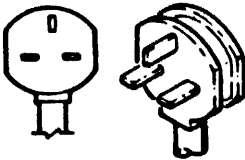
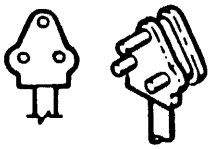

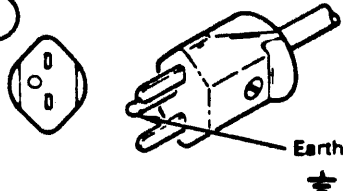
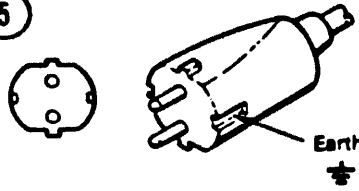

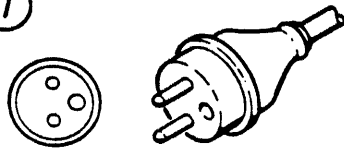
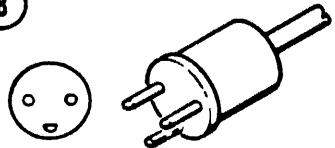
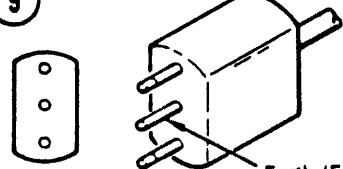
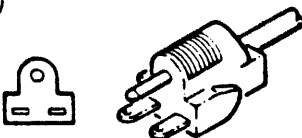
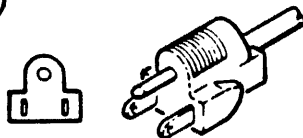

This unit may or may not have an electrically acceptable plug attached to the power cord. Select a plug from the chart (Figure 1) that corresponds to the country in which the machine is being installed. If more than one plug is acceptable for use in your country, you must select a plug with an electrical rating equal to or greater than the machine rating.

This plug shall comply with IEC Publication 83, and be marked with a safety agency mark acceptable to the country of installation.

The Power Cord wires must be prepared by stripping the outside jacket and wire insulation to make with the respective plug. Strain relief clamps on the plug must secure the outside jacket of the power/cable when finished.

1.2.2 Power Cord Connections to Plug

1. Connect the blue wire to the Neutral terminal or the plug.
2. Connect the brown wire to the line (Hot) terminal on the plug.
3. Connect the green/yellow wire to the Earth terminal on the plug.

<p>①</p>  <p>13 Amp. 250 Volt BS 1363</p>	<p>②</p>  <p>15 Amp. 250 Volt BSI 546</p>	<p>③</p>  <p>6/16 Amp. 250 Volt (Earth Pin may be round) S.I. 32</p>
<p>④</p>  <p>10 Amp. 250 Volt (Voltage Pins may be round) SNV 24509</p>	<p>⑤</p>  <p>16 Amp. 250 Volt CEE7</p>	<p>⑥</p>  <p>10 Amp. 250 Volt Approved as C112-1964</p>
<p>⑦</p>  <p>16 Amp. 250 Volt CEE7</p>	<p>⑧</p>  <p>6/10 Amp. 250 Volt Approved AFSNIT 107</p>	<p>⑨</p>  <p>16 Amp. 250 Volt</p>
<p>⑩</p>  <p>15 Amp. 250 Volt IEC 83 UL 498</p>	<p>⑪</p>  <p>15 Amp. 125 Volt IEC 83 UL 498</p>	<p>⑫</p>  <p>15 Amp. 125 Volt</p>

① United Kingdom
 Ireland
 Malaysia
 Singapore
 Argentina

② South Africa

③ Israel

④ Switzerland

⑤ Germany
 Austria
 Bulgaria
 Finland
 Iceland
 Indonesia
 Iran
 Netherlands
 Norway
 Poland
 Portugal
 Romania
 Spain
 Sweden
 Turkey
 Bolivia

⑥ Australia
 New Zealand
 Uruguay

⑦ France
 Belgium
 Greece
 Hungary
 Yugoslavia

⑧ Denmark

⑨ Chile
 Italy

⑩ United States
 Canada

⑪ Bahamas
 Barbados
 Bermuda
 Brazil
 Canada
 Colombia
 Costa Rica
 Dominican Rep.
 Ecuador
 Guatemala
 Honduras
 Jamaica

⑫ Mexico
 Antilles
 Nicaragua
 Panama
 Paraguay
 Peru
 Philippines
 Taiwan
 Trinidad
 Venezuela
 United States

⑬ Japan

Figure 7

1.4 Interface Connection

Note: If the M990 is to be connected with the SCSI Interface, please refer to the SCSI Addendum, part number 799893-002, at this time.

Interconnection to the M990 and system equipment should be made with a twisted-pair shielded cable with approximately 110 ohms of characteristic impedance. To ensure reliable performance, the cables should have:

1. A maximum length of 30 feet to include service loop. The length of cable from the host to the first tape unit must not exceed 15 feet.
2. The cable length between units connected in the daisy chain harness should not exceed 10 feet.
3. 22 or 24 AWG conductors with a 0.01 inch minimum insulation thickness and not less than one twist-per-inch for twisted-pair cables.

It is important that the ground wires of twisted-pair be grounded at each end of the cable.

Note: This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions included in this manual, may cause interference to radio communications. Verification of compliance with Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference, is the responsibility of the installer. Interface connectors provided on the GCR are shown in Fig. 8. Tables 1 and 2 list the pin locations for interface inputs and outputs.

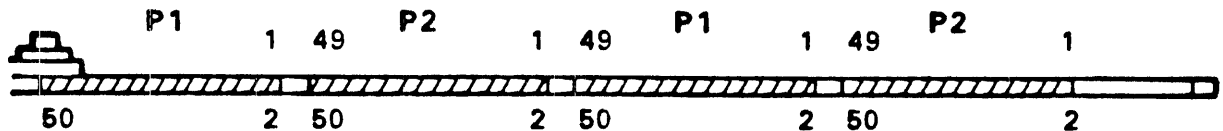


Figure 8. Interface Connectors

The M990 may be configured to allow of up to eight transports with a single controller. Use cables similar to those described above for interconnection of transports. Refer to Figures 9 and 10.

To configure the M990 to operate on a multiple transport system, proceed as follows:

1. Place M990 in service access position. (See Section 5.2.)
2. Remove the CIF/WRITE board. (See Section 5.37.)
3. Remove terminator resistor pack U1B and U3C (Figure 10) from each transport except last unit in the chain.
4. Install interconnection cables as shown in Figure 10.

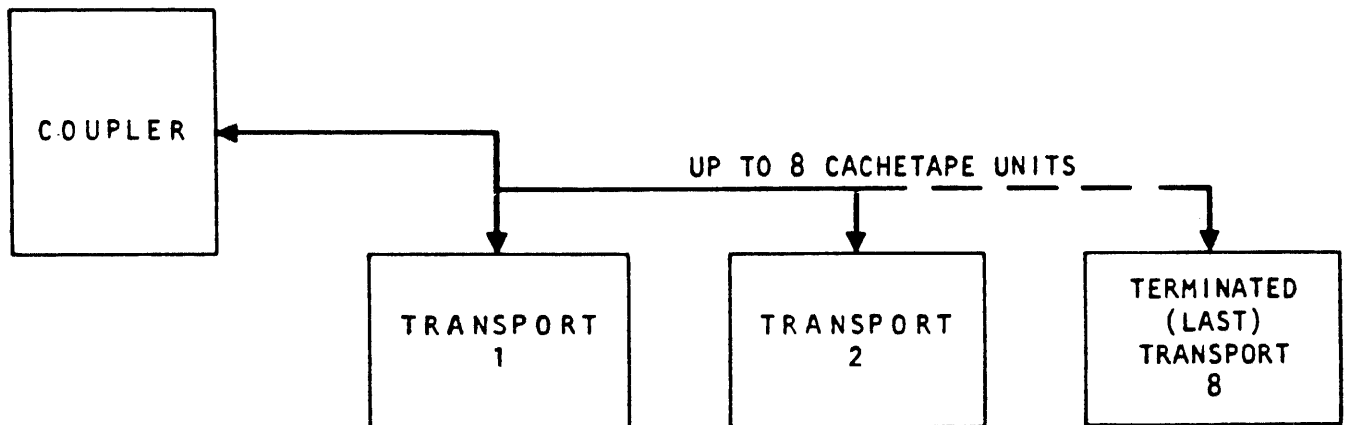


Figure 9. Daisy Chain Block Diagram

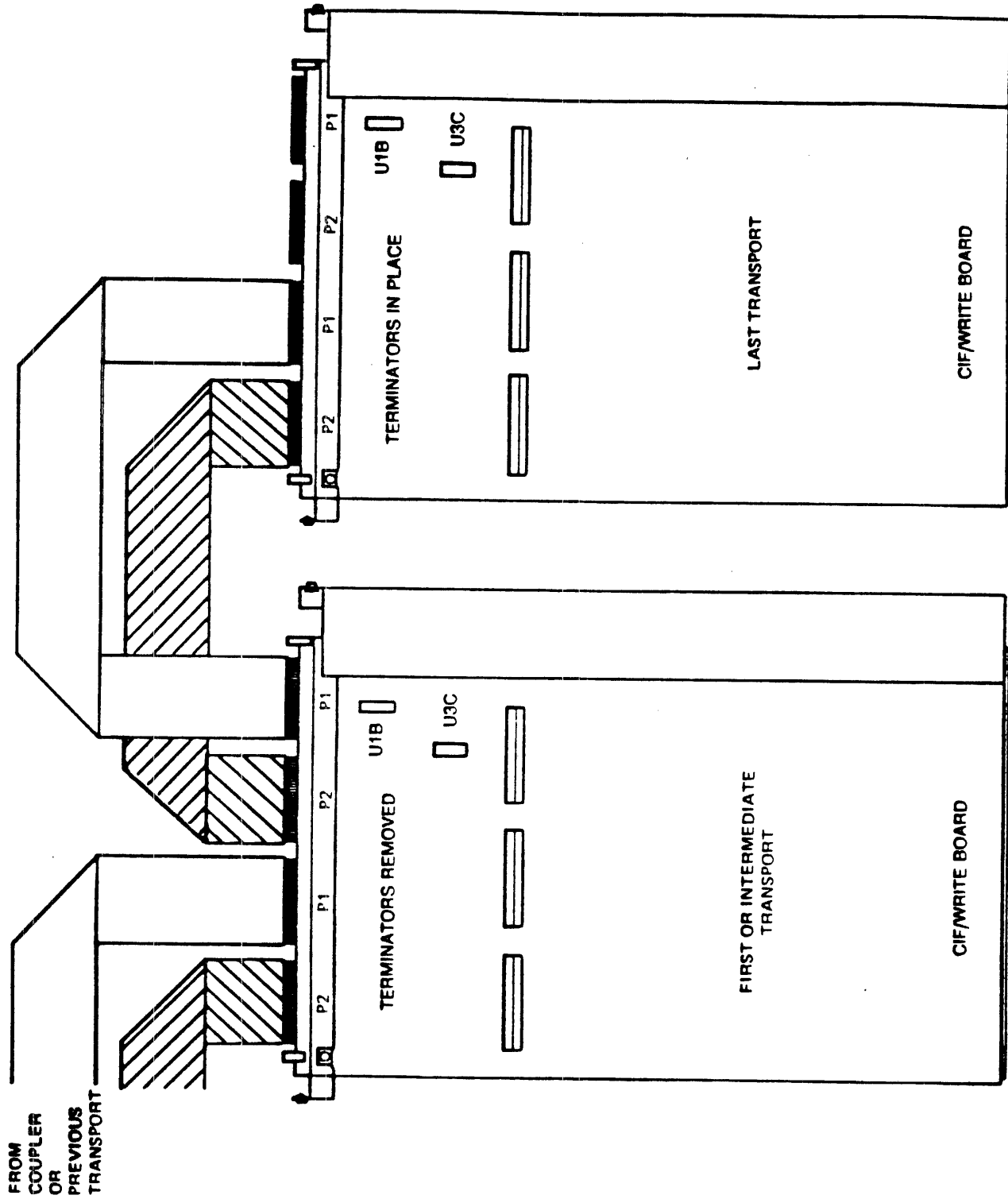


Figure 10. Daisy Chain Configuration

11 5.6

1.5 Interface Description

Commands, status, and data are exchanged between the host controller and the M990 GCR tape unit via the interface section. The interface signals are all active low.

Interface Input Signals

The following signals are received by the M990 from the host controller.

- IGO Initiate Command. Used to latch the command specified on the command lines into the selected ready GCR tape unit.
- IFEN Formatter Enable. Enables the GCR tape unit. With GCR tape unit on-line and IDBY true, pulse will reset a command "runaway" condition.
- IREW Rewind. Interface input signal. With GCR tape unit ready, on-line, and not at BOT, causes tape to rewind in reverse direction.
- IREWU Rewind/Unload. With GCR tape unit on-line, cause selected unit to go off-line, rewind to BOT marker, and then unload the tape.
- IREV Reverse.
- IWRT Write.
- IWFM Write File Mark.
- IEDIT Edit.
- IERASE Erase.
- ILWD Last Word. Used during a write operation to indicate that the character to be strobed into the formatter is the last character of the record.
- IW0-IW7 Write Data. Input lines that carry write data from the host controller to the GCR tape unit.
- IFAD- Address lines used to select a daisy-chained GCR tape unit.
(MSB)
- ITAD0, ITAD1-LSB

IFAD	TAPE DRIVE ADDRESS		Logical Address
	ITAD0	ITAD1	
0	0	0	0
0	0	1	1
0	1	0	2
0	1	1	3
1	0	0	4
1	0	1	5
1	1	0	6
1	1	1	7

1.6 Error Conditions

When the unit fails to operate properly, the indicators on the front panel of the unit flash patterns to alert the operator of an error condition. Error messages are also displayed by the alphanumeric display and describe the condition that must be corrected to allow normal operation. To reset soft or medium errors, press the flashing indicator switches on the front panel.

Three types of error conditions can be displayed:

1. Soft error conditions
2. Medium error conditions
3. Hard error conditions

Soft error messages are described in the M990 GCR Operator's Guide.

1.6.1 Medium Error Conditions

Medium errors are usually caused by interface command or format violations. Medium errors are reported to the host system via the interface and usually require a restart command from the host. An error message is displayed on the alphanumeric display to aid in identifying the problem. The indicated problem must be corrected in order to continue operation. To reset the medium error, press the Load/Rewind and Unload indicator/switches on the front panel. Press the Load/Rewind switch again to restart the load sequence.

READ ONLY TAPE

If the READ ONLY TAPE message is displayed, the unit received a write command with a write protected reel of tape loaded on the transport. Install the write protect ring or load the proper tape on the unit and press the Load/Rewind or Unload switches to reset the error.

ILLEGAL COMMAND

If the ILLEGAL COMMAND message is displayed on the alphanumeric display, an illegal or undefined command was received by the unit. Press the Load/Rewind or Unload switches to reset the error. Refer to the **Interface Commands** section of the M990 Theory of Operations manual. Receipt of a valid command will also reset the error.

WRITE RETRY EXCEEDED

If the WRITE RETRY EXCEEDED message is displayed, the unit exceeded the allowable number of write retries. Press the Load/Rewind or Unload switches to reset the error.

PAST EOT

If the PAST EOT message is displayed, tape travel beyond the EOT marker exceeded 18 feet. Once the controller error has been corrected, press the Load/Rewind or Unload switches to reset the error.

BLOCK SIZE ERROR

If the BLOCK SIZE ERROR message is displayed, the data block size exceeded the NOVRAM 64K value. Press the Load/Rewind or Unload switches to reset the error.

1.6.2 Hard Error Conditions

Hard errors are caused by severely damaged tape, or a serious deviation from the normal operating routine of the M990. Since these malfunctions could cause damage to the tape, the transport drive servos are disabled and tape tension is removed in a controlled manner. Hard errors are reported to the host via the interface and an error message is displayed on the alphanumeric display. To reset the hard error, switch the unit power off and on, reload the tape, and issue a restart from the host system. The hard error messages are described below.

ARM FAULT DURING LOAD

If the ARM FAULT DURING LOAD message is displayed, the tension arm swing exceeded the range of normal operation during the auto-load sequence. After correcting the problem, switch the unit power off then on and issue a restart from the host system.

ARM FAULT DURING RUN

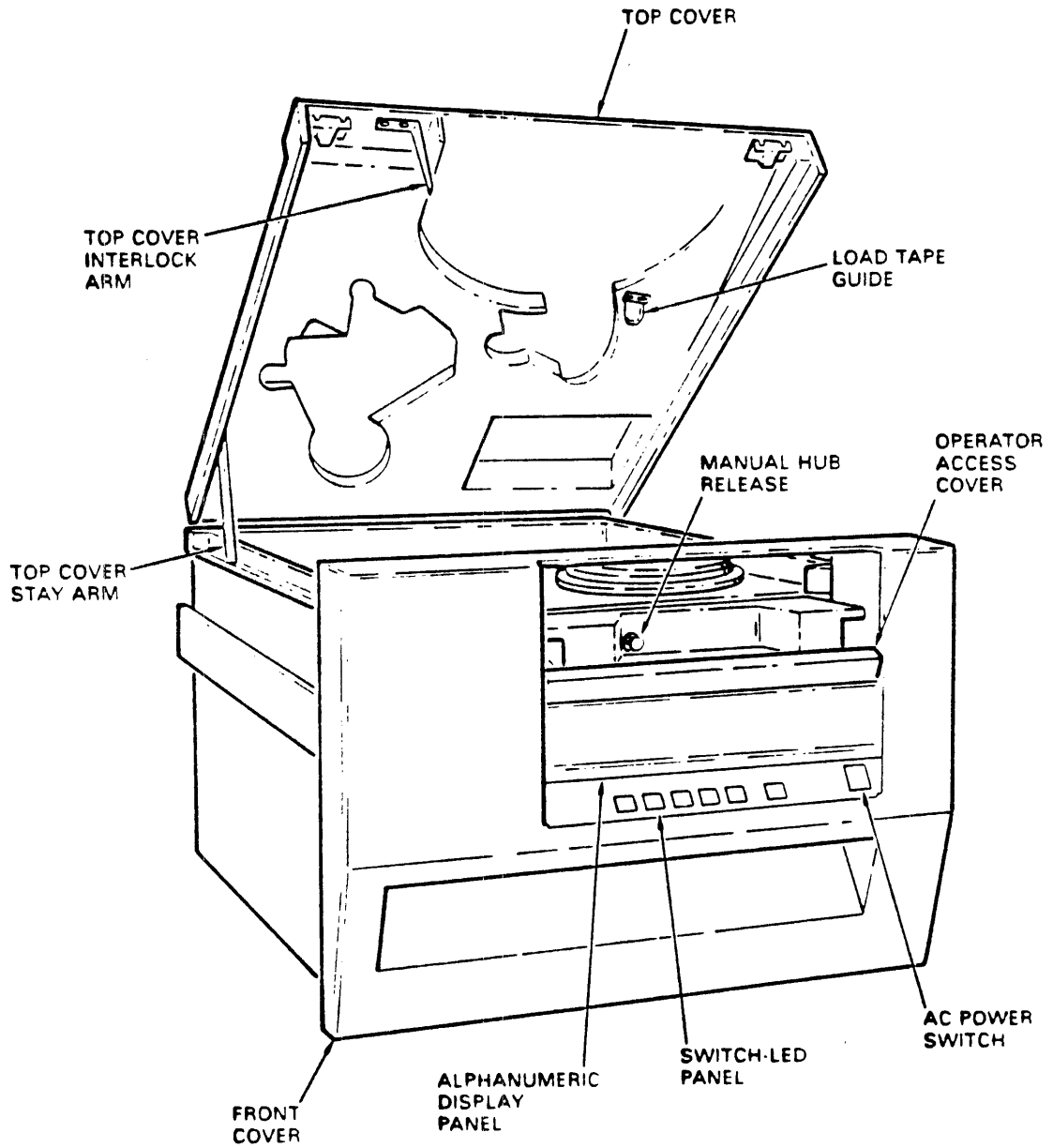
If the ARM FAULT DURING RUN message is displayed, the tension arm exceeded its free travel limits during any operation except those functions of the load and unload sequence when tape tension is not under arm control. After correcting the problem, switch the unit power off then on and issue a restart from the host system.

SPEED ERROR

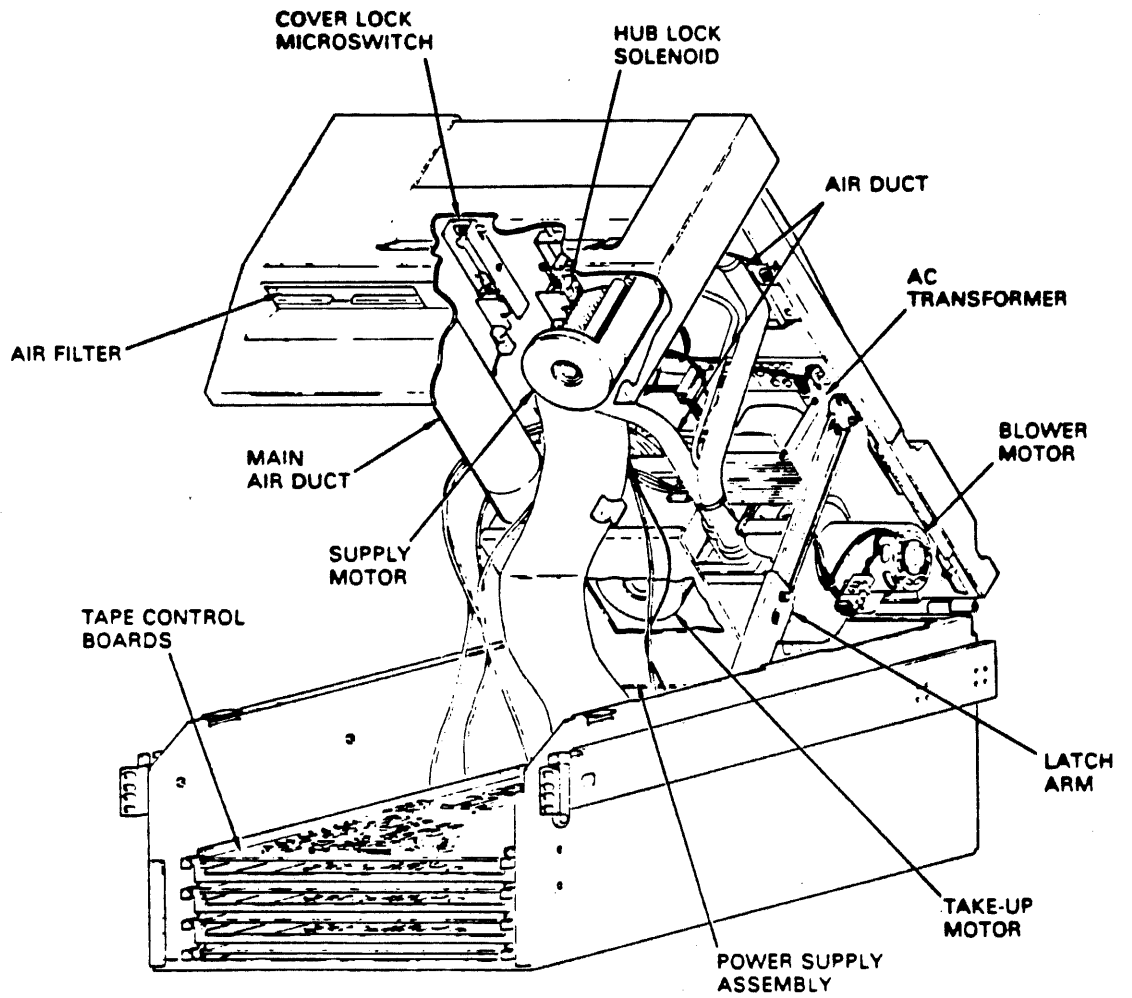
If the SPEED ERROR message is displayed, tape speed variations in excess of the ANSI maximum of $\pm 10\%$ deviation from normal operating speed occurred.

Chapter 2. Illustrations and Locations

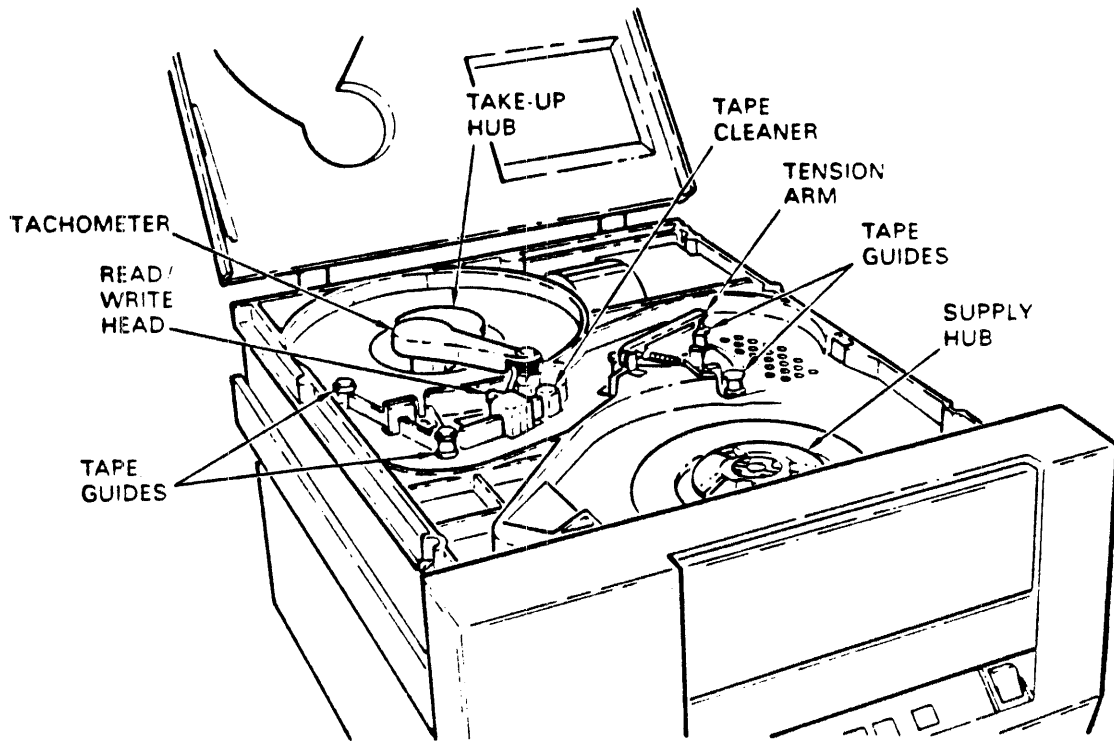
2.1 M990 GCR Tape Unit - Front View



2.2 M990 GCR Tape Unit - Front View
(Unit in Service Position)



2.3 M990 GCR Tape Unit - Top View



2.5 M990 GCR Tape Unit - Bottom View

