StorageTek T9840 Tape Drive

User's Reference Manual

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E27291-02

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Preface

This book is for users and operators of Oracle's StorageTek T9840 tape drives. It also provides information about the various cartridges and their labels.

The term *T9840* is used in this publication to generically reflect all drive models. The specific model suffix is used whenever model differentiation is appropriate.

Access to Oracle Support

Oracle customers have access to electronic support through My Oracle Support. For information, visit http://www.oracle.com/support/contact.html or visit http://www.oracle.com/accessibility/support.html if you are hearing impaired.

What's New

- Modified the title page branding
- Added a note on the tape drive operating altitude specification
- Corrected a couple of typographical errors

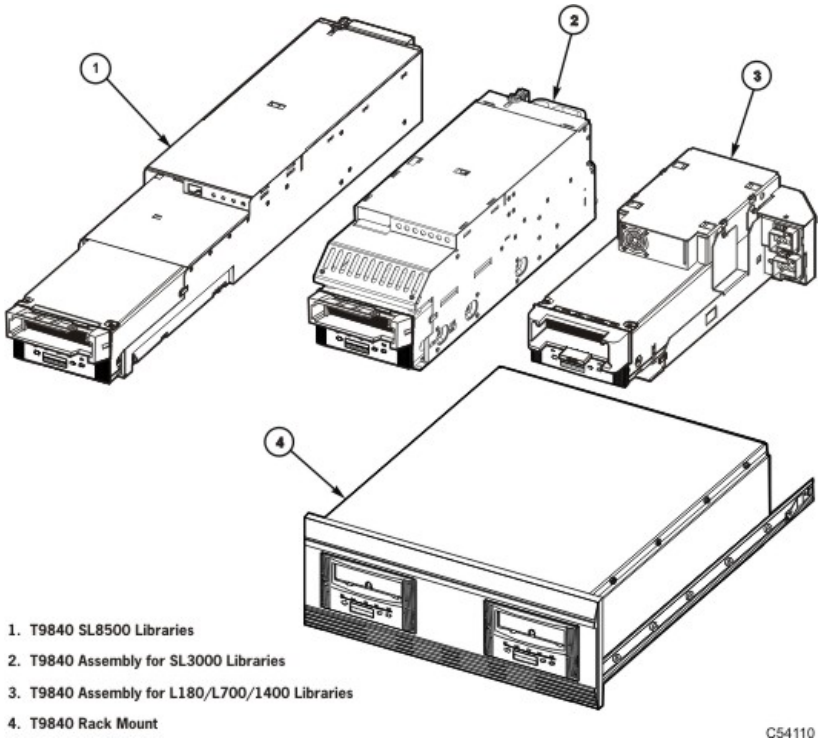
1

Overview

Oracle's StorageTek T9840 tape drive family provides a range of products designed for fast-access to data stored on a midpoint loading tape cartridge. The drive is either rack mounted or used in various StorageTek libraries (see FIGURE 1-1). This chapter provides an overview of the T9840 Tape Drive family.

There are four drive models for the enterprise and client-server environments. The T9840A and T9840B drives have a 20 GB uncompressed cartridge capacity. The T9840C drive has a cartridge capacity of 40 GB (uncompressed). The T9840D encryption-capable tape drive has a cartridge capacity of 75 GB (uncompressed). See "Cartridges" on page 23 for more tape cartridge information, and see TABLE 1-2 on page 24 for the cartridge read/write compatibility.

FIGURE 1-1 Example Drive Configurations

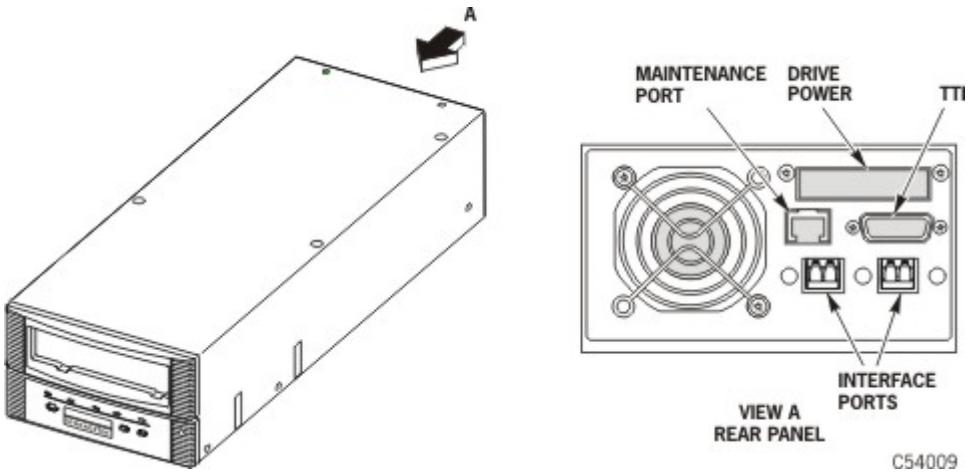


Tape Drive

The drive front panel (FIGURE 1-2) has a tape load/unload slot and an operator panel for manual control. See Chapter 2, "Operator Controls" for detailed information on operator panel controls and indicators.

The drive rear panel has connectors for power, library interface (TTI), host interface, and maintenance (not available on the T9840A). An encryption status LED is present between the TTI connector and maintenance port on the T9840D drive (see "Encryption Status LED" on page 18).

FIGURE 1-2 T9840 Tape Drive Front Panel



Maintenance Port

All service calls for tape drives under warranty, maintenance contract, or time-and-materials service require physical access and connection to the rear panel maintenance (Ethernet) port of the T9840B/C/D tape drive. In the event that a customer has an Ethernet cable physically connected to the drive requiring service, the service person must disconnect this cable to perform the required service action.

- T9840 non-encryption drives supported by the Service Delivery Platform (SDP) require 100% dedication of the drive's Ethernet port to the SDP site unit.
- T9840 encryption-enabled drives require 100% dedication of the drive's Ethernet port to the Encryption Service Network except during service activities performed by authorized personnel.

Where Encryption and SDP coexist, the Ethernet Port must be concurrently shared by using the Service Network.

> **Note –** Oracle neither supports nor assumes any responsibility for drive functional failures that occur during the unauthorized use of the drive's maintenance port.

Unauthorized use applies to any use of the drive's Ethernet port for other than the following items:

- Encryption 1.x or 2.x environments

- StorageTek Virtual Operator Panel (VOP) customer or service versions provide support for the T9840D tape drive
- Service Delivery Platform (SDP)
- Service's Tape Health Check Tool
- StorageTek Diagnostic System (STDS)

Starting with drive code 1.44.x04, you can use IPv6 addressing. An IPv6 address is a 128-bit value written as eight groups of four hexadecimal characters separated by colons (for example, 2001:0db8:85a3:0000:0000:8a2e:0370:7334).

Interfaces

Host interfaces for the T9840 Tape Drive include:

- Enterprise Systems Connection (ESCON) [single port connector]
- Fibre Channel (FC)
- Fibre Connection (FICON)
- Small computer system interface (SCSI) - T9840A/B only [single port connector]

> **Note –** Not all interfaces are available for all configurations.

The T9x40 tape drives support connection of both ports in accordance with ANSI Fibre Channel specifications. Refer to the InterNational Committee on Information Technology Standards [INCITS] documents:

- SCSI Primary Commands -3, Section 5.6
- Fibre Channel Protocol -3

> **Note –** The drive will support two hosts, provided that they honor the "reserve/release" or the "persistent reserve/release" specifications.

Encryption

Encryption is based on the science of cryptography and is one of today's most effective ways to achieve data security. To read an encrypted file, you must have access to the key that enables the drive to decipher the data.

The T9840D tape drive employs a device-based (or data-at-rest) encryption solution. The drive is shipped from the factory encryption-capable, but not encryption-enabled. You must explicitly enable the drive for encryption.

> **Note –** A tape drive that has not been enabled for encryption can neither read nor append to any encrypted data cartridge.

An encryption-enabled drive can:

- Write to the data cartridge in encrypted mode only (by using its assigned write key).
- Read an encrypted data cartridge, if it has the proper read key.
- Read non-encrypted data cartridges.

- Format tape cartridges.

An encryption-enabled drive cannot:

- Append (write) to a non-encrypted data cartridge.
- Mix encrypted and non-encrypted data on the same cartridge.

With drive code level 1.44.xxx and Key Management System (2.1), the T9840D Fibre Channel and FICON drives comply with FIPS Level 1 which is the lowest classification (production-grade requirements).

Encryption Resources

For additional information on the encryption capabilities and features of the T10000 Tape Drive, see:

- OKM 2.3 or higher
  - *Oracle Key Manager, Administration Guide*
  - *Oracle Key Manager, Systems Assurance Guide*
- KMS 2.x
  - *Crypto Key Management System, Administration Guide*
  - *Crypto Key Management System, Systems Assurance Guide*
- KMS 1.x
  - *Crypto Key Management Station, User's Guide*
  - *Crypto Key Management Station, Configuration and Startup Guide*
  - *Crypto Key Management Station and Data-at-Rest Encryption, Technical Brief*

For further information on the encryption option, see your sales representative.

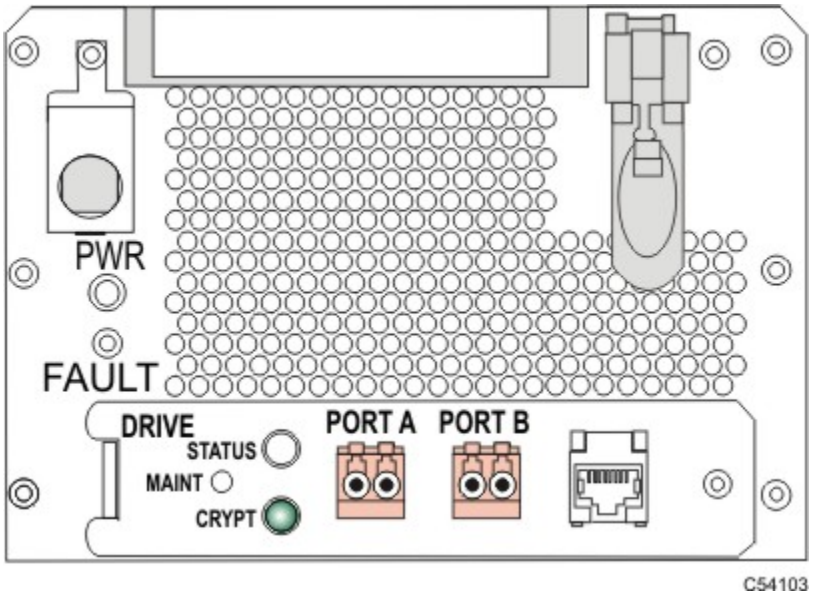
Encryption Status LED

Encryption-capable drives have a tricolor, encryption-status LED on the rear panel (status indication explanations are provided in TABLE 1-1 on page 19). Drive trays that fully enclose the drive use a light pipe to transfer the LED indication to the rear of the tray (see the **CRYPT** label in FIGURE 1-3 on page 19).

If the encryption status LED is green, it indicates that the drive is encryption capable, but not encryption enabled. In this state, the drive functions only in a non-encryption *safe* mode, and cannot read/write encrypted data cartridges. However, the drive can function normally for non-encryption tasks.

When the drive is encryption enabled, the LED turns red to indicate the drive is *armed* and functioning in the encryption mode. In this state, the drive can read/write encrypted data cartridges. The drive can also read non-encrypted data cartridges, but cannot write to non-encrypted data cartridges.

FIGURE 1-3 Encryption Status LED (SL8500 Library Drive Tray)



The following table interprets the various states of the encryption status LED. Refer to the Crypto Key Management documentation for additional information.

TABLE 1-1 Encryption Status LED State Descriptions

LED State	Mode	Description
Green	Safe	Encryption capable, but not enabled. Normal-unencrypted drive write/read cartridge operations.
Red	Armed	Encryption enabled/active. Ready to encrypt.
Slow flashing Green[1]	Reset[2]	Encryption previously enabled, but requires keys. Drive is capable read-only, unencrypted cartridge operations.
Slow flashing Red[1]		Encryption read/write cartridge operation in progress.
Amber		Requires media key.
Slow flashing Amber[1]		Requires device key.
Cycling[3]	Zeroed	Media, device, and enabling keys missing. The drive is unusable, and must be returned to manufacturing.

1. Slow flash (1 cycle per second).
2. Drive is no longer capable of unencrypted write operation once encryption has been enabled.
3. The LED continuously cycles through all three colors at the slow flash rate.

Configurations

T9840 Tape Drives are available in desktop, rack-mountable, and library-attached configurations.

Desktop and Rack-mountable Drive Units

Both the desktop and rack-mount configurations, shown in FIGURE 1-4, feature manual tape cartridge loading. The desktop version (T9840A/B *only*) comprises a single drive and a power supply mounted within a cabinet with rubber feet. The rack-mount version includes a single drive or dual drives plus power supplies in a chassis (tray).

Up to six single-drive and/or dual-drive trays may coexist in a single cabinet. The tray fits in a standard 483-mm (19 in.) rack with a depth of at least 780 mm (30.75 in).

Cartridge Scratch Loader Drive Units

The T9840A cartridge scratch loader (CSL) configuration has manual/automatic/system sequencing of up to six tape cartridges (see FIGURE 1-5 on page 21). The desktop version comprises a single drive, power supply, and loader mechanism contained in a cabinet with rubber feet. The rack-mountable version differs only in the cover, and the addition of rail assembles for rack mounting. A rack can hold up to six CSLs or combinations of CSLs and manual load drive units.

Library Attached Configurations

The drive is available in configurations for various libraries; several are shown in FIGURE 1-6 on page 22.

Refer to the appropriate library documentation for additional information.

FIGURE 1-4 T9840 Desktop and Rack-mount Units

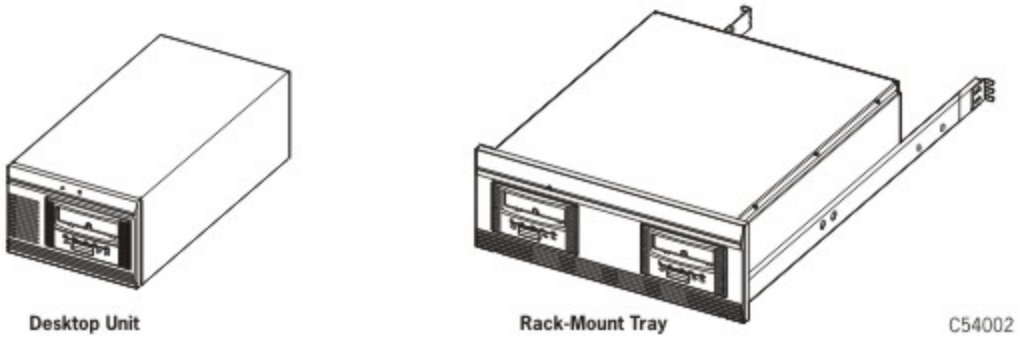


FIGURE 1-5 CSL Desktop and Rack-mount (T9840A)

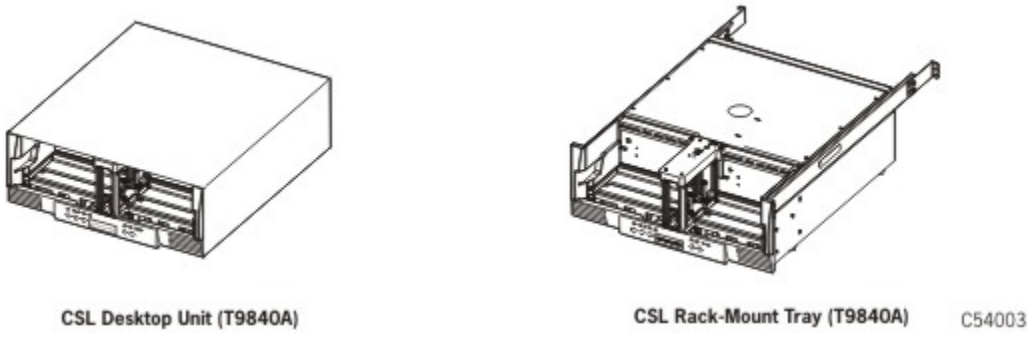
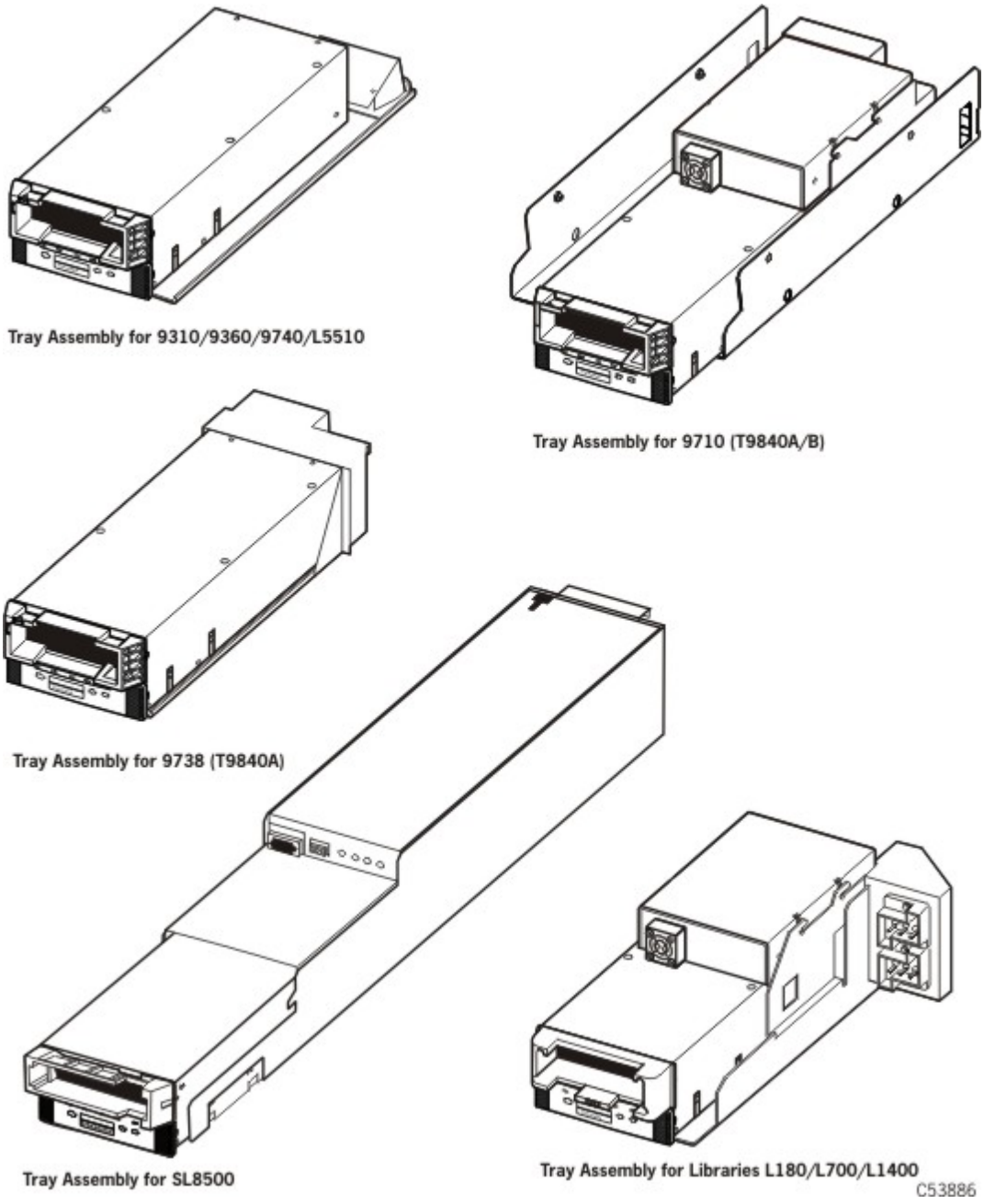


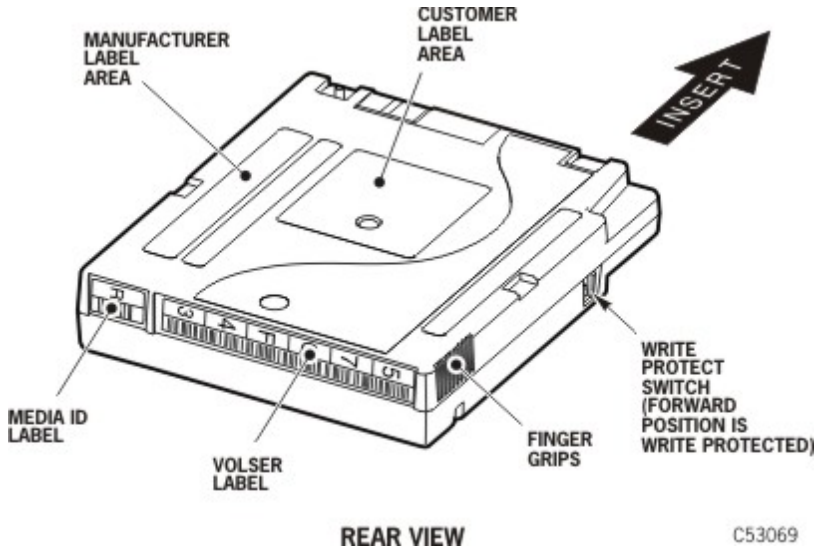
FIGURE 1-6 T9840 Tape Drive Library Attached Configurations



Cartridges

The StorageTek 9840 tape cartridge shown in the figure below has the supply and takeup reels inside the cartridge which permits midpoint loading and fast access to data files.

FIGURE 1-7 9840 Tape Cartridge



The 9840 data cartridge has a typical capacity of:

- 20 GB, uncompressed when written by a T9840A or T9840B drive
- 40 GB when written by a T9840C drive (PRML data format)
- 75 GB when written by a T9840D drive (PRML data format)

See TABLE 1-2 on page 24 for information regarding read and write compatibility.

The 9840 cleaning cartridge is capable of 100 cleaning operations. The media identification labels for 9840 Tape Cartridges have unique letters:

- R - 9840 standard and VolSafe data tape cartridges
- U - cleaning cartridge used with T9840A, T9840B, and T9840C drives
- Y - cleaning cartridge used with the StorageTek T9840D tape drive only

A variation of the data cartridge is available for VolSafe (append-only) use.

- The manufacturer and media identification labels are yellow (9840A/B), green (9840C), or purple (T9840D).
- The write-protect switch is yellow (9840A/B), green (9840C), or purple (T9840D).
- A model-unique dimple pattern exists on the bottom of the cartridge case.

To place orders electronically, send an e-mail to:

tapemediaorders_ww@oracle.com

TABLE 1-2 Cartridge Read/Write Compatibility

Compatibility	Drive Model			
	T9840A	T9840B	T9840C	T9840D
Read a cartridge formatted by:	T9840A and T9840B	T9840A and T9840B	T9840A, T9840B, and T9840C	T9840A, T9840B, T9840C, and T9840D
Write or append data to a cartridge formatted by:	T9840A and T9840B	T9840A and T9840B	T9840C	T9840D

Mixed Media Management

Because T9840A, T9840B, T9840C, and T9840D drives use the same 9840 standard data cartridge, you should take extra media management measures when:

- T9840C drives coexist in the same library system with T9840A/B drives.
- T9840D drives coexist in the same library system with T9840A/B/C drives.

The extra measures essentially involve creation and management of separate media pools/sub-pools for:

- T9840A/B formatted/written data cartridges
- T9840C formatted/written data cartridges
- T9840D formatted/written data cartridges

Guidelines for creation and maintenance of media pools/sub-pools are located in ACSLS, HSC, and independent software vender (ISV) documentation sets.

T9840A/B tape drives cannot read from a data cartridge written by either T9840C or T9840D tape drives because of the higher-density formats, and must have an appropriate drive firmware level to even identify the higher-density data cartridges:

- T9840A:
  - R1.33.103, or higher, to identify a T9840C written cartridge
  - R1.41.105, or higher, to identify a T9840D written cartridge
- T9840B:
  - R1.33.303, or higher, to identify a T9840C written cartridge
  - R1.41.305, or higher, to identify a T9840D written cartridge
- T9840C - R1.41.505, or higher, to identify a T9840D written cartridge

Without the appropriate drive firmware level, a T9840A/B drive would consider a higher-density formatted cartridge blank and available for scratch. T9840A/B drive attempts to read the data from an identified higher-density data cartridge will fail.

The T9840C or T9840D tape drive can read data from a tape cartridge written by a T9840A/B tape drive in the low-density format, but does not append data to that cartridge. An attempt to append a low-density data cartridge on a T9840C or T9840D drive will fail, and sense byte data indicates an error (similar to that of a file-protected data cartridge).

Note – For additional information about mixed-media management, see "Cross-Density MIR Processing".

Media Information Region

The T9840 tape drives use information recorded on each tape cartridge to access and manage that tape cartridge while it is loaded in the drive. This information is recorded at the beginning of the tape in an area known as the Media Information Region (MIR). The information contained in the MIR falls into two major categories:

- Statistical Counters

  Statistical counters include read/write activity, error activity, cumulative mounts, and other information that reflects tape cartridge usage.

- Data Pointers

  The data pointer information is basically a directory (map) used to locate the data on the physical tape media. Since user data is compressed and written in drive controlled blocks on the tape, a map is needed to efficiently locate the data after it is written. This map provides an index between user block ID's and the physical block on the tape media. Once the data is written, the drive accesses this map to optimize access to the user data.

  A read to a user block ID is translated to the physical location on the tape media, and the drive determines the quickest method to read the block. If the block is some physical distance from the current location, a calculation results in a high-speed locate to the block location and is followed by a normal speed read.

The existence of the MIR is usually transparent to the user unless the MIR has a problem. This could occur if the MIR update fails during a dismount. The impact of an invalid MIR occurs in several areas. Since the MIR enables high speed positioning, an invalid MIR forces all operations to a slow speed mode. This has no impact on a sequential read from the beginning of the tape. However, an operation that could use high-speed locate defaults to a sequential slow speed read to the requested block, which can result in a longer processing time.

An invalid MIR might be suspected if you observe poor performance on a specific tape cartridge. The T9x40 drive also posts a 36B2 informational FSC whenever a tape cartridge with an invalid MIR is loaded.

The following sections describe MIR processing and some potential implications of MIR problems.

Normal MIR Processing

Every time a tape cartridge is loaded, the MIR is read from the tape media and saved in the drive memory. When the MIR is loaded in drive memory, an invalid flag is written in the tape-resident MIR. The tape-resident MIR is marked invalid because it does not reflect results of activity in the current mount session. All subsequent MIR accesses during the current mount session are saved in the memory-resident MIR.

When the tape cartridge is unloaded, as part of the unload routine, the memory-resident MIR information is written to the tape-resident MIR and the MIR invalid flag is turned off. A copy of the memory-resident MIR is stored in the drive's persistent memory (EEPROM) and used should the MIR fail to be written because of a power failure or firmware problem (SNO or should not occur).

Cross-Density MIR Processing

Whenever a data cartridge is loaded that was written in a data density format that is different from the one used when the drive writes, model-specific MIR processing occurs. The following explanations cover:

- T9840D tape drive loaded with a lower-density cartridge
- T9840C tape drive loaded with aT9840D-written data cartridge
- T9840C tape drive loaded with a T9840A/B-written data cartridge
- T9840A/B drive loaded with a high-density tape cartridge

T9840D Tape Drive Loaded With a Lower-Density Cartridge

When the T9840D drive detects that a data cartridge is loaded, the drive first looks in the designated location for a T9840D MIR. If a T9840D MIR is not found, the drive then checks for a T9840C MIR and if its not found, it then checks for a T9840A/B MIR. The processing for these operations is described in the sections below. If the MIR cannot be read, the T9840D drive attempts to recover its contents using any portions of the MIR that can be read and the contents of the Format Identity Burst (FIB).

> **Note –** The FIB is written in a format that can be read by T9840C and T9840A/B drives if they have an appropriate level of firmware.

The T9840D drive uses a memory-resident copy of the MIR to access user data pointers for read-only functions. Statistical counters are continuously updated in the memory-resident MIR with any drive activity.

When the data cartridge is unloaded, the T9840D drives writes the FIB to the high-density MIR location.

Notes:

- When the T9840D drive identifies the data cartridge as a low-density data format, that is written by a T9840C or T9840A/B, **`Ready L`** appears on its operator panel.
- The T9840D tape drive cannot correct or cause an invalid MIR on a T9840C written data cartridge. A T9840C MIR can only become invalid during a mount on a T9840C drive.
- The T9840D tape drive cannot correct or cause an invalid MIR on a T9840A/B written data cartridge. A T9840A/B MIR can only become invalid during a mount on a T9840A/B drive.

- If a T9840C or T9840A/B written data cartridge has an invalid MIR, its contents cannot be read into the T9840D drive's memory and the user data pointer information will be unavailable. This causes a performance degradation.

T9840C tape Drive Loaded With a T9840D Data Cartridge

The T9840C drive will not be able to read the MIR written by a T9840D drive. Because it was written by a T9840D there will be no T9840A/B MIR. The T9840C drive will read the Format Identity Burst (FIB) written by the T9840D tape drive.

> **Note –** The T9840C drive identifies the tape cartridge as high-density data format, and **`Ready H`** (high-density) appears in the T9840C operator panel display.

Since the T9840D written data cannot be read by the T9840C tape drive, the only available drive actions are: 1) unload the data cartridge or 2) reclaim the data cartridge.

If the data cartridge is reclaimed, the T9840C drive will include the statistical information from the T9840D FIB when it writes the T9840C MIR and FIB.

T9840C Tape Drive Loaded With a T9840A/B Data Cartridge

When a data cartridge is loaded into a T9840C, the drive first looks for a MIR at the high-density MIR designated location, and will not find a MIR if the data cartridge is in low-density data format. The high-density MIR location will be blank if it is the first time the low-density data cartridge is loaded into a T9840C drive. This causes the drive to look at the low-density MIR designated location, where it finds a MIR and reads it into drive memory (invalid flag is not set).

The T9840C drive uses the memory-resident MIR for user data pointers for read-only functions. During the first mount session, the drive captures statistical counters from the MIR into a memory area called the Format Identity Burst (FIB), and continues to build it with drive activity.

> **Note –** The FIB is written in a special format which can also be read by T9840A/B drives with the appropriate drive firmware level.

During the unload routine, the T9840C drive writes the FIB to the high-density MIR designated tape location. The tape-resident, low density MIR remains intact and valid.

Notes:

- The T9840C drive identifies the tape cartridge as low-density data format, which results in the display of **`Ready L`** (low-density) on the T9840C operator panel.
- The T9840C tape drive cannot cause nor correct an invalid MIR on a low-density data cartridge. A low-density MIR can only become invalid during a mount on a T9840A/B tape drive.
- If a low-density data cartridge MIR is invalid, it is not read into the T9840C drive memory, and not available for user data pointer information. Therefore, T9840C performance for a low-density data cartridge with an invalid MIR is degraded.

- Since a T9840C tape drive cannot correct nor rebuild a low-density data cartridge invalid MIR, the only options for increasing performance are:
  - Migrate the data to a high-density format cartridge, using a copy utility with a second T9840C drive.
  - Rebuild the MIR with a T9840A/B tape drive.
  - Operate with degraded performance.

On subsequent mounts, the T9840C drive first sees the tape-resident FIB, identifies the tape cartridge as low-density, and reads the low-density MIR into drive memory. At dismount, the T9840C updates the tape-resident FIB with cumulative data, including newer statistical data from the MIR, if the cartridge had been loaded into a T9840A/B drive since the last mount in a T9840C drive.

T9840A/B Tape Drives

When a high-density data cartridge is loaded into a T9840A/B drive with appropriate level firmware, the drive looks for a low-density MIR at the default location but finds a Format Identity Burst (FIB), which identifies the cartridge as formatted in a high-density. Because the T9840A/B drive cannot read nor write higher-density data, subsequent normal read/write attempts will fail unless the cartridge is being reclaimed.

A T9840A/B drive cannot update statistical data, such as the mount/dismount count in the FIB. Therefore, cumulative statistical data will not include mounts into a T9840A/B drive as long as the tape cartridge is in high-density format.

The tape cartridge could be deliberately over-written in low-density data format from the beginning-of-tape point, or reformatted to low-density data format by the offline Drive Operation, Make Data Tape submenu. Either case over-writes the FIB with a low-density MIR, and erases the high-density MIR. Such a reformatted data cartridge is no longer identifiable as a high-density data cartridge, but does include the statistical data read from the FIB.

When a low-density data cartridge with a tape-resident FIB (created by a T9840C or T9840D drive) is loaded into a T9840A/B drive with appropriate level firmware, the MIR is read into drive memory and an invalid flag is written to the tape-resident MIR. During the unload routine, the T9840A/B drive compares statistical data in the tape-resident MIR with statistical data in the tape-resident FIB, and uses the latest data to calculate the statistical data update into the new tape-resident MIR.

Notes:

- The T9840A/B drive shows **`Ready H`** on the operator panel when a cartridge written by a T9840C or T9840D drive is loaded.
- If the last load was into a T9840A/B drive, the tape-resident MIR will contain the latest statistical data; whereas, if the last load was into a T9840C or T9840D drive, the tape-resident FIB contains the latest data.
- To recognize a high-density data cartridge written by a T9840C or T9840D drive, and to properly handle a low-density data cartridge that has been previously loaded into a T9840C or T9840D drive, T9840A/B drives must have the appropriate drive firmware level, see "Mixed Media Management" on page 24.

- If a T9840A/B drive has down level drive firmware, a high-density data cartridge would be considered as a blank tape cartridge. A low-density data cartridge would lose statistical data stored in the FIB during a previous mount into a T9840C drive.

Exceptional MIR Processing

There are instances when the MIR process departs from the normal.

- Write Protect

  When the tape cartridge is write protected, neither the MIR nor FIB is rewritten and statistical information for that mount is not captured. If the tape cartridge is in a library that logically write protects the tape cartridge, the MIR is updated as normal on each dismount.

- Major Error/Power Off

  If a tape cartridge is mounted and the drive SNO's (should not occur error) or loses power, the drive memory-resident MIR is not written to the tape media. Instead after IPL (initial program load), the drive will read the existing MIR on tape. Special data is saved in EEPROM that will allow the existing MIR to be updated and rewritten to the media with the valid flag set. Therefore, the MIR will contain all positioning information up to the last mount and this tape will operate with mixed performance until EOD is found. T9840A/B/C drives must have the appropriate drive firmware level to update the MIR after a SNO or power loss (see "Mixed Media Management" on page 24).

Invalid MIR Correction

Once a tape cartridge has an invalid MIR, some action is required to correct it. An invalid MIR can be corrected in several ways using the drive model that created the cartridge (for example: a T9840A/B formatted cartridge in a T9840A/B drive or a T9840C formatted cartridge in a T9840C drive).

1. Reading to the end of existing data (EOD) creates a complete and valid MIR. This is done at normal read speeds and could take up to 45 minutes, for a full 9840 tape cartridge.
2. Appending to the tape cartridge will also create a valid MIR, although a slow speed read must first be done to the end of existing user data.
3. The Drive Operation Menu (offline) "Rebuild MIR" utility will sequentially read from block ID 0 to the EOD. The MIR will be complete and valid when the tape cartridge is unloaded (see "Build the MIR" on page 68).
4. The Drive Operation Menu (offline) "Make Data Tape" utility will reformat the tape cartridge with a valid MIR. However, all previous data will be lost (see "Reformat a Cartridge" on page 67).

The memory-resident MIR is always rebuilt to the last block read, on-the-fly, during normal read/write functions. When the partially rebuilt memory-resident MIR is written to the tape during the download process, the invalid flag is reset because the MIR is now partially valid. This can result in seemingly conflicting performance from a single tape.

Notes:

- If a tape cartridge with a partially valid MIR is mounted for long periods of time with locates to different locations, locate times will be inconsistent depending on whether the locate is to a record already in the rebuilt MIR, or if some low speed locate is required.
- The longer the tape cartridge is mounted and the more activity occurs, the more rebuilt the memory-resident MIR becomes. Once the EOD is reached, the MIR is complete and valid.

2

Operator Controls

Several methods are available that enable you to determine the state of the tape drive, perform operator tasks, or view and alter drive configuration settings.

All T9840 drives have a physical operator panel. You can use this panel to access the drive menu system, to view drive indicators, to access front panel switches, and to load a tape cartridge. In the rack-mounted drive, you should always have clear access to the panel.

For a library attached drive, you must open the library door to access the drive operator panel. Several library models provide the capability to obtain information about the drive from the library or a software application. The library console for the SL8500 and SL3000 libraries is introduced in this chapter.

The T9840D tape drive is supported by the Virtual Operator Panel application (release 1.0.12 or higher). The VOP application is introduced in this chapter.

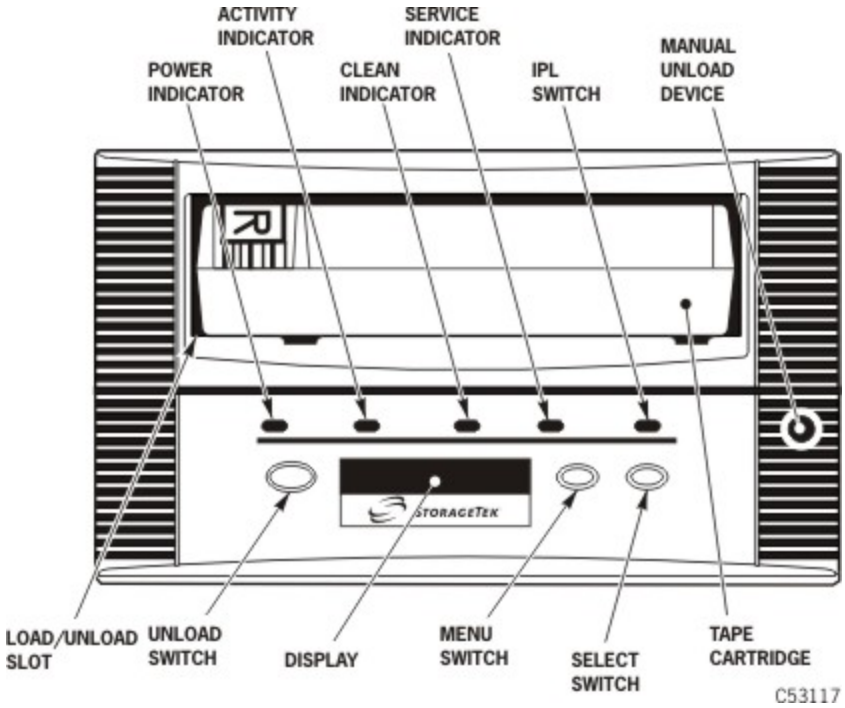
Information in chapters 3 and 4 of this document rely on use of the physical operator panel.

Front Panel

The T9840 tape drive front panel is the operator's interface with the drive. The panel features: a cartridge load/unload slot, four indicator lights, four switches, a manual unload device, and an alphanumeric display with an optional tape bar (FIGURE 2-1 on page 32).

Chapter 4, "Operator Tasks" describes how to use the switches to perform operations. Chapter 5, "Indicators and Messages" describes how to interpret the indicators and display messages.

FIGURE 2-1 T9840 Operator Panel



Load/Unload Slot

The load/unload slot is the opening in the front panel that accepts 9840 Tape Cartridges that you load by hand, that a T9840A CSL loads, or that a library robotic hand loads. After a tape cartridge is inserted, the loader mechanism raises to engage the tape cartridge and draw it into the loaded position. After an unload command, the loader mechanism rewinds the tape to the mid-point and ejects the cartridge into the slot for removal.

Indicators

TABLE 2-1 describes T9840 Tape Drive operator panel indicators.

TABLE 2-1 Operator Panel Indicators

Indicator	Indication	Explanation
power (green)	Off:	Power is not applied.
	Flashing:	Unit is powering up, performing IPL, or collecting dump data.
	Flashing does not stop:	IPL failed.
	On (steady):	Power applied and IPL complete.
activity (green)	Off:	Tape cartridge is not loaded.
	Flashing:	Tape cartridge is loaded and the tape is moving.
	On (steady):	Tape cartridge is loaded and the tape is stopped.
clean (amber)	On (steady):	Drive requires cleaning because: 1. A firmware-defined length of tape has passed over the R/W heads. 2. A read/write perm (permanent error) is detected, and at least one-half the firmware-defined length of tape has passed over the R/W heads. *See* "Use a Cleaning Cartridge" on page 63 for use of cleaning cartridges.
service (red)	Off:	Error(s) have not been detected.
	Flashing:	Error(s) detected and dump data has been saved to the EEPROM. The message **`DumpAgain?`** displays if the drive detects the same Fault Symptom Code (FSC) within one minute. Manually initiate IPL. If the IPL does not eliminate the problem, contact authorized service personnel.
	On (steady):	A hardware error is detected and the drive is not functional. If a manually initiated IPL does not eliminate the problem, contact authorized service personnel.

Manual Unload Device

Note – Only qualified service personnel should operate the MUD.

The manual unload device (MUD) is a mechanism to manually remove a tape cartridge from the drive when:

- The Unload switch action fails.
- Power is not available for the drive.

You use a screwdriver to engage the MUD and position the cartridge to be manually pulled out of the load/unload slot.

Switches

TABLE 2-2 describes T9840 operator panel switch functions.

TABLE 2-2 Operator Panel Switches

Switch	Description
Menu	Pressing the Menu switch accesses the menu system, steps through a series of submenus, or answers No to a displayed question. Pressing the Menu switch the first time causes the Online/Offline selection to display. See Chapter 3, "Menus" for information/guidance with the menu system.
Select	Pressing the Select switch accesses a displayed submenu, steps through possible options of a submenu, or answers Yes to a displayed question. When the drive is Online and in a view only submenu, pressing Select is the same as pressing Menu.
IPL	Pressing the IPL switch causes the drive to execute an initial program load (IPL) sequence. During IPL, the drive firmware loads from non-volatile memory in an EEPROM, to RAM. The same process occurs at power-on.
Unload	Pressing the Unload switch causes the tape cartridge to rewind, unthread, and unload; ending with the tape cartridge ejected and retrievable. If this switch is pressed during a write operation, the drive attempts to write the remaining data before it unloads. A display of UnWr xxxx (meaning Unwritten Data, where xxxx is a fault symptom code) means that the attempt failed and some data remains unwritten to tape. **Note –** Pressing Unload a second time causes the unwritten data to be lost. Before you press Unload again, *see* **`UnWr`** *xxxx* on page 75.

Front panel switches are color coded by drive model:

T9840A - Yellow

T9840B - Purple

T9840C - Green

T9840D - Deep Purple

Display

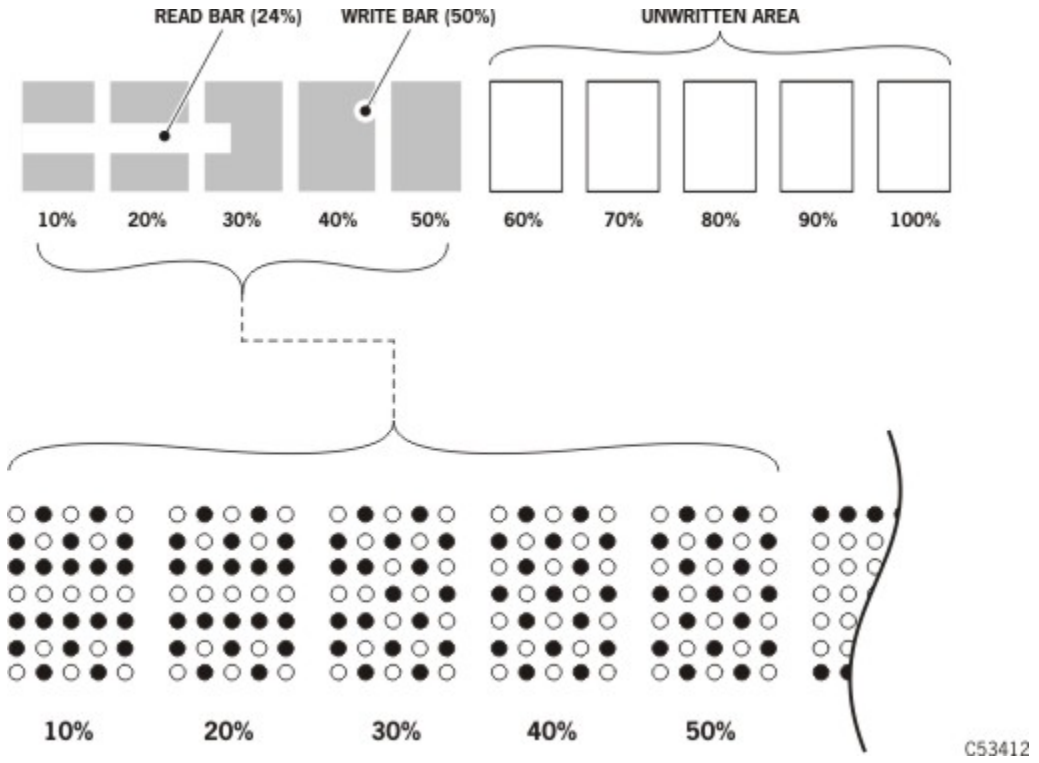
The operator panel has a 10 segment, alphanumeric display that indicates:

- Drive status
- Menu selections and configuration choices
- Error messages and fault symptom codes
- Host-generated messages
- Tape bar, if activated

The display is formed by a horizontal array of 10 segments. Each segment is formed by an array of 35 dots—five wide and seven high (FIGURE 2-2). Each array can form an uppercase or lowercase alpha character, a numerical digit, or a special character,

such as an asterisk (*). When the tape bar is not activated, the lighted segments and dots form text messages. The text messages may display steadily, flashing, or alternating with other messages.

FIGURE 2-2 Tape Bar



Tape Bar

The tape bar uses the operator panel display to show the amount of tape that has been written and read. The tape bar is a configuration option that must be activated by authorized service personnel. Once activated, it appears on the operator panel display when the drive is reading or writing.

When the tape bar is activated, the segments and dots simultaneously show the percentage of the total tape length that has been written and read. Each dot represents 2% of the tape length; each segment represents 10%.

> **Note –** The tape bar gets its information from the media information region (MIR) on the tape. The MIR is written to the tape when the tape is unloaded. If the MIR is bad, the tape bar does not display. To rewrite the MIR, see "Build the MIR" on page 68.

Write Bar

As data is written to tape, the lighted dots forming the write bar appear at the left side of the display and advance to the right. The write bar uses the full height of the display. As the dots fill the display, note that only every other dot is lighted. The point where the write bar ends is the percentage of tape written.

Read Bar

As data is read from the tape, the read bar appears in the center of the write bar as a single row of unlighted dots. This row is bordered above and below by single rows of lighted dots. The read bar also begins at the left side of the display and advances to the right. The point where the read bar ends is the percentage of tape that has been read.

FIGURE 2-2 on page 35 is a simplified and an actual view of a tape bar that shows a tape that is 50% written and 34% read.

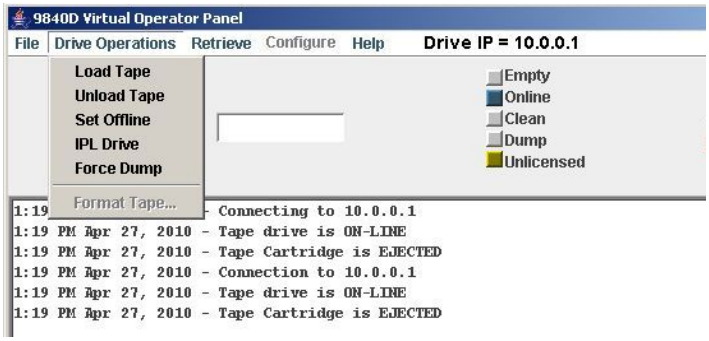
Virtual Operator Panel

The Virtual Operator Panel provides a graphical user interface to the T9840D tape drive. The interface contains several menus, a set of indicators, two small display areas, and a text pane (see FIGURE 2-3).

The Drive Operations menu provides commands to perform actions that are similar to the physical operator panel switches.

The Retrieve and Configure menus provide commands to allow you to access functions that are equivalent to the online and offline drive menu system.

FIGURE 2-3 Virtual Operator Panel



See the Virtual Operator Panel documentation for a description of the application.

> **Note –** VOP version 1.0.13 or higher in conjunction with the appropriate drive code level supports the use of an IPv6 address.

Library Controls/Indicators

When a T9840 Tape Drive is attached to the SL3000 or SL8500 Modular Library System, you cannot access the drive operator panel on the front of the drive without opening the library door. The drive tray rear panel does provide some indicators and an Ethernet port.

SL8500/T9x40 Drive Tray

FIGURE 2-4 illustrates the power switch and indicators on the rear panel of the SL8500/T9x40 drive tray.

- The power (PWR) switch is a momentary push-switch that manually changes the state of the internal power supply PWA.
- The green PWR LED indicates the power state of the tray:

  Not lit: Power is not on, nor is 48 Vdc input power applied to the tray.

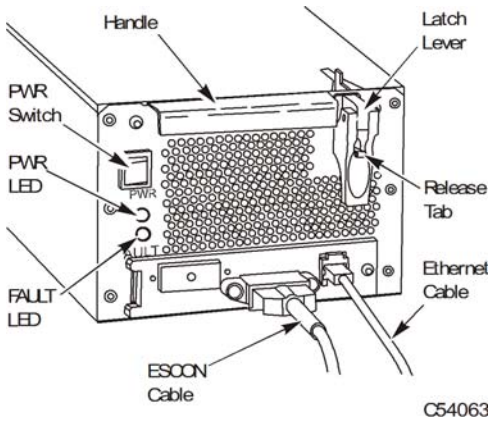
  Blinking: Power is not on, but 48 Vdc input power is applied to the tray.

  Steady: Power is on, and power supply output voltages are normal.
- The red FAULT LED indicates anomalies within either the internal power supply PWA or with the drive tray fan assembly.

Notes:

- Library firmware controls the drive tray power and indicators.
- The red FAULT LED *does not* indicate drive-related anomalies.
- Pressing the SL8500 drive tray PWR switch while the tray is powered *does not* cause an interrupt signal to the library firmware. Wait at least 10-seconds before you press the PWR switch to manually power-on the drive. Otherwise, the library's drive audit will be corrupted. When the red FAULT LED comes on (after power-off), it is safe to re-push the PWR switch to reapply power to the drive tray.

FIGURE 2-4 SL8500/T9840 Drive Tray Rear Panel



StorageTek Library Console

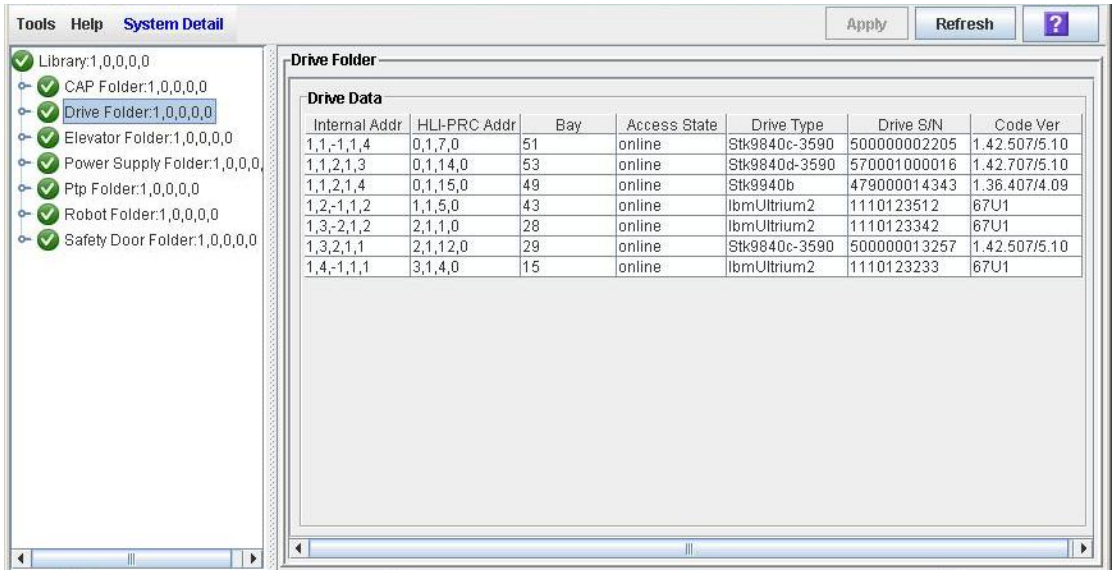
Although you cannot access the T9840 Tape Drive Operator Panel to view menu items, you can use the StorageTek Library Console (SLC), local or remote, to display data pertinent to the attached drives.

> **Note –** General guidance on using the SLC application is available within the SLC "Help" function (click the ? button).

Drive Folder Top Level Display

FIGURE 2-5 shows an overall summary of the Drive Folder. The left window pane displays library folders in a tree format, which you can expand or collapse.

FIGURE 2-5 SL8500 SLC Drive Folder Display



The right window pane summarizes drive data in a tabular format, whether you expand or collapse the drive folder tree view. You can customize how the data is displayed by sorting the rows relative to a selected column, and reordering or resizing the columns.

Notes:

- The HLI-PRC Addr column displays the host software logical address for the drive, relative to the specific host software.
- The Access State column is online/offline relative to the library drive controller, and not relative to the drive, menu-driven online/offline.
- The Code Ver column displays the drive's current firmware level, including the drive interface sub-module level. Interface level 4.06, or higher, is required for proper SL8500 operation.

Drive Specific Displays

When you select an individual drive in the tree pane, the right pane changes to display drive-specific data instead of the drive folder summary data.

You can view and use the SLC drive displays to develop reports to assist with the analysis of drive-related problems.

In SLC 4.10, the Status, Properties, and Display tabs are available.

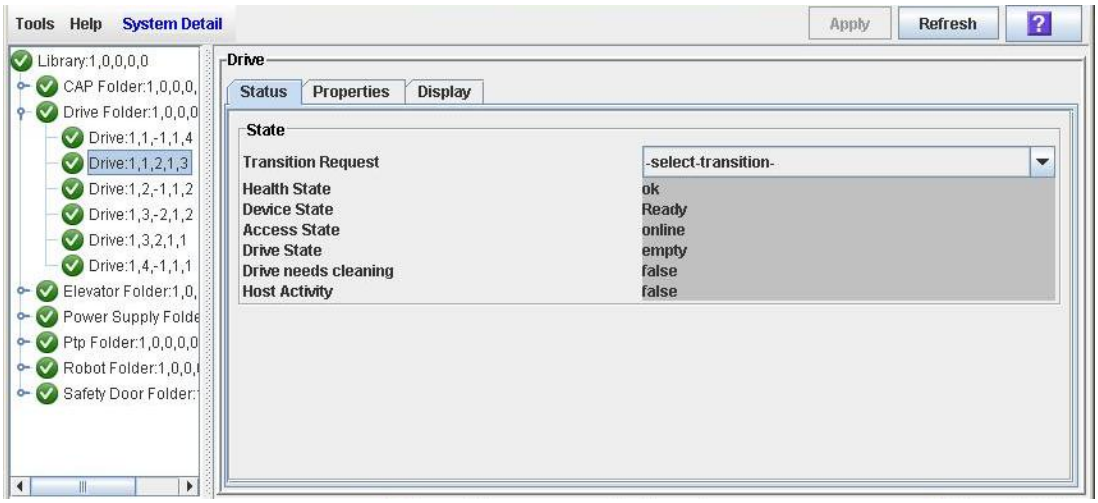
> **Note –** The drive displays are evolving. New releases might contain an additional tab or expanded information elements. Therefore, what is presented here is for illustrative purposes only. No attempt will be made to keep the examples current.

Status

The tab shown in FIGURE 2-6 displays key drive status data: Health State, Device State, Access State, Drive State, Drive needs cleaning, and Host activity.

> **Note –** The list of states is variable based upon the drive, library, and SLC firmware.

FIGURE 2-6 SL8500 SLC Drive Status Tab

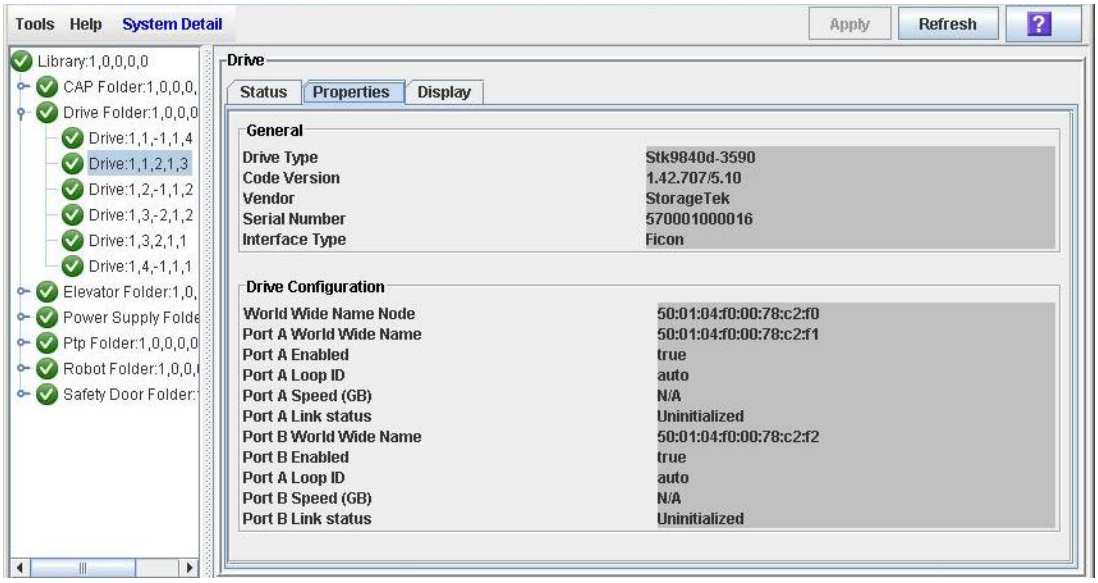


Properties

The General block in the Properties tab, FIGURE 2-7, displays some of the data from the drive folder summary plus the drive interface type (not displayed in the summary).

The Drive Configuration block displays selected configuration items, such as World-Wide-Name (this is a dynamic value, dWWN, that is auto-set by the library relative to the drive bay number).

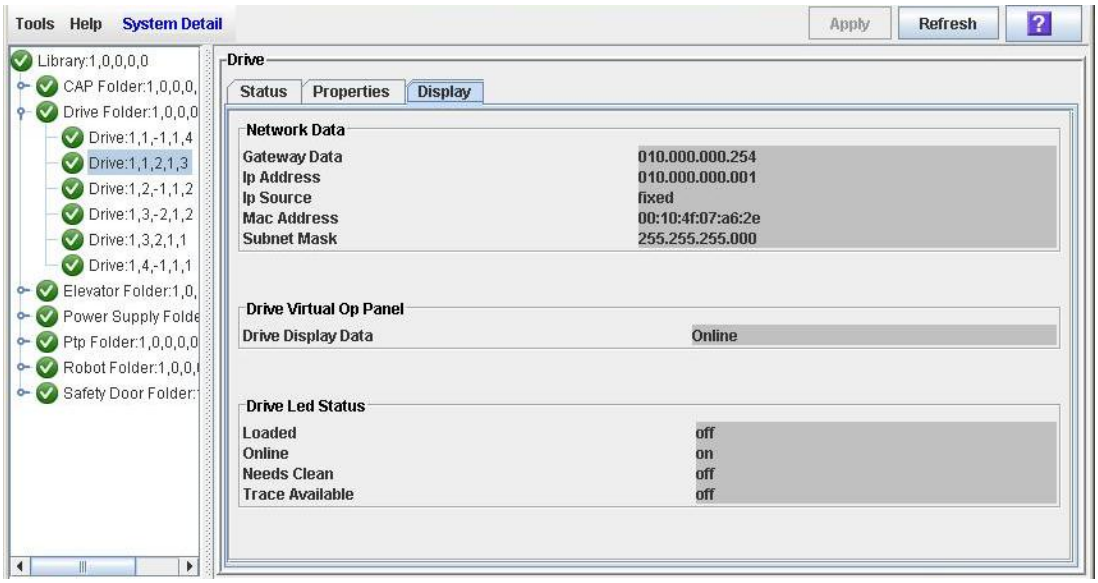
FIGURE 2-7 SL8500 SLC Drive Properties Tab



Display

The Display tab, FIGURE 2-8, contains three sections: Network Data, Drive Virtual Op Panel, and Drive LED Status.

FIGURE 2-8 SL8500 SLC Drive Display Tab



3

Menus

The menu system provides the operator and service representative a means to determine drive configuration settings, access drive utilities, and display the drive firmware level at the drive operator panel. The menu system consists of information or values, submenus, and options that appear in the display section of the operator panel (see "Display" on page 34). You navigate through the menu system by pressing the Menu and Select switches on the operator panel (*see* "Switches" on page 34).

The menu system information and guidelines are provided in the following order:

1. "Menu Structure Overview"
2. "Online Menu Operation"
3. "Offline Menus"

Menu Structure Overview

The drive has two main menus:

- When the drive is online, you will use the main menu primarily for viewing the drive configuration settings.
- When the drive is offline, you will use the main menu primarily for changing the drive configuration settings or for performing drive operations.

FIGURE 3-1 on page 44 is a high-level depiction of the common elements comprising the main menu system. The left column shows the first item in the menu while the right column shows the last item in the menu system.

The drive is available with several data path interfaces. The main menu items do have some variation based upon the particular interface, and those variations are presented in later sections of this chapter.

> **Note –** The Port Enable/Disable item does not appear as a main menu item for all drive interfaces.

Although the illustration menu titles contain full words, the actual presentation on the display is an abbreviation because the display is limited to ten characters. The Configuration, TCP/IP, and Drive main menu items contain a ? as the last character in the display. The ? signifies that a submenu is available.

Use the Menu and Select switches to navigate through the menu system.

- Press Menu (No) to bypass and advance to the next menu.
- Press Select (Yes) to enter the submenus.

When you press the Menu switch on the operator panel, the first menu provides selection of Online (default) or Offline menus.

- Press the Select switch to toggle between online mode and offline mode as desired, then press the Menu switch to advance to the second menu item.

> **Note –** If you press the Menu switch again, you will bypass the second menu item and advance to the third menu item.

View/Change Configuration menus display drive configuration settings (view only) when online, or allow drive configuration changes when offline. Press Menu to advance the display to the next menu. Press Select to enter the submenu.

View/Change TCP Configuration menus display the drive Transmission Control Protocol /Internet Protocol (TCP/IP) configuration settings (view only) when online, or allow TCP/IP configuration changes when offline. Press Menu to advance the display to the next menu. Press Select to enter the submenu.

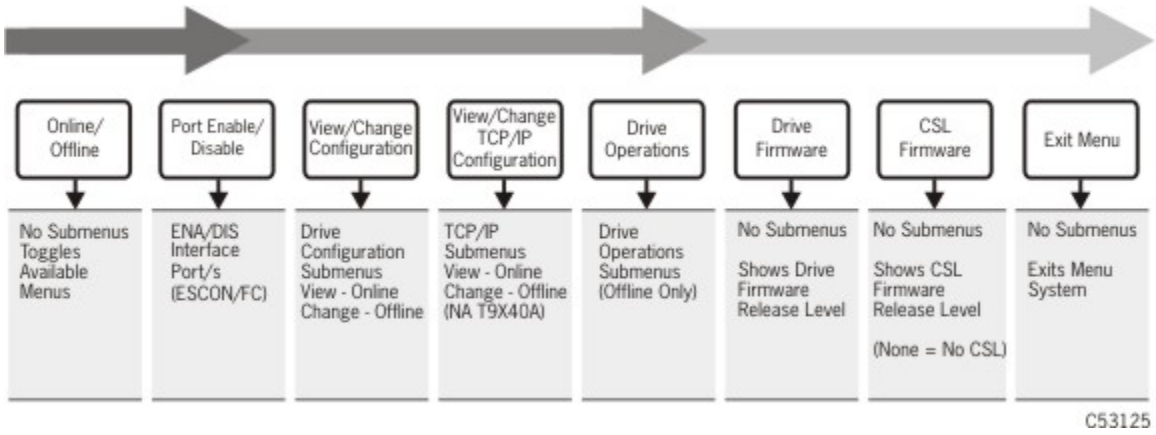
Drive Operations menus (*offline only*) provide drive utilities. Press Menu to advance the display to the next menu. Press Select to enter the submenu.

The Drive Firmware menu (*view only*) displays the current drive firmware release level.

The Exit Menu allows you the choice to either return to the Online/Offline selection menu or to exit the menu system. The last character in the Exit menu is a ? that signifies that you must make a choice. Press Select to exit the menu or press Menu to repeat the main menu.

> **Note –** The Virtual Operator Panel application provides the capability to view the configuration settings of a T9840D tape drive. You might prefer to use this method instead of the physical drive panel. See the *Virtual Operator Panel User's Guide* for pertinent information.

FIGURE 3-1 Menu System Overview



Online Menu Operation

When the drive is Online, the menus shown in FIGURE 3-2 on page 46 are available.

> **Note –** Individual submenu items in the illustration are based 1on the T9840A/B/C drives using a code level lower than 1.42.x07.
>
> The content of the figure was created before the T9840D tape drive was available. The note on the TCP/IP menu does not apply to the T9840D drive because the drive Ethernet port can be used with the Crypto Key Management System 2.0.

Press Menu to advance to the View Configuration menu.

- View the drive configuration.
- View the TCP/IP configuration (N/A for the T9840A).

  The online (view) TCP/IP menu is presented on page 54.
- View the drive firmware level.
- View the ASIC firmware level (FICON drives only).
- View the CSL firmware level.

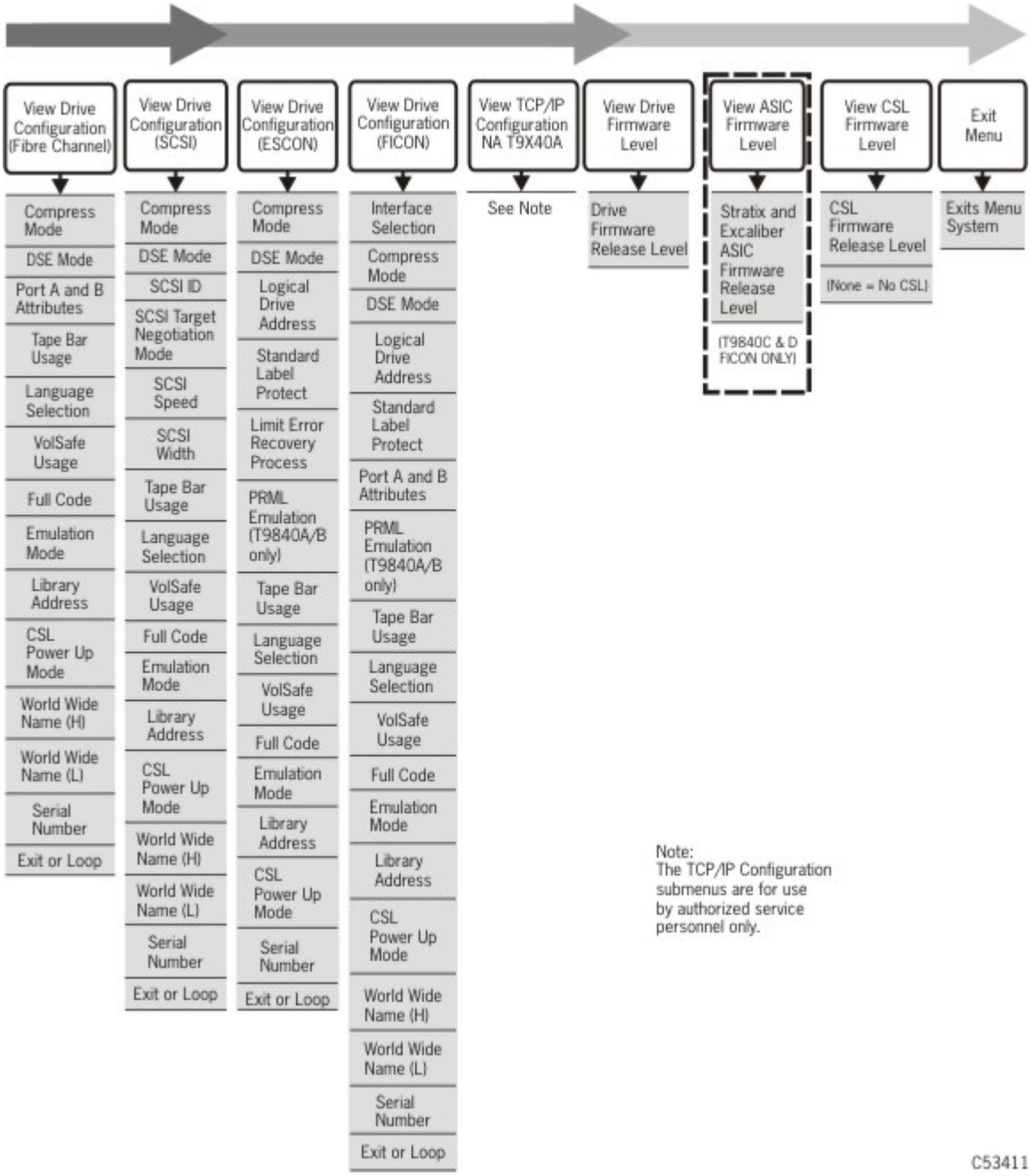
View Configuration Menu

The View Configuration menu is presented in more detail in the following sections:

The basic format is a text-based representation of the menu structure with indention levels to indicate second and third levels (submenus). There is also a listing of options and other pertinent information.

> **Note –** Code level 1.42.x07 was used as the basis for documenting the View Configuration menu. Specific menu item order and options might differ if your drive is using a different code level.

FIGURE 3-2 Online Menus



Fibre Channel View Configuration Menu Tree (T9840A/B/C)

Use the online view configuration menu tree as a brief guide.

Online/Offline [Press Select to toggle; then press Menu to set.]

Port X YYY {A/B and ENA/DIS}

View CFG ? (View Configuration) {Press Select to enter, press Menu to bypass.]

Cmprss xxx {Yes/Off/No} (compression mode)

Full DSE x {Y/N} (data security erase mode)

SL Prot x {Y/N} (standard label protection mode)

View PrtA? (view current port attributes)

Hard PA xx {Y/N} (Physical Address)

PA=xx,ddd {PA=hex, decimal index} (valid only when Hard PA is yes)

Soft PA xx {HI/LO} (only when Hard PA is no)

MaxSz xxxx {2112/2048/1280/1024/768} (maximum data frame size)

A_I=xxxxxx (24-bit address ID - when port login is complete)

H=xxxxxxxx (first half, 64-bit port node world-wide-name)

L=xxxxxxxx (second half, 64-bit port node world-wide-name)

WWN Custom (only when custom or dynamic WWN is set)

View PrtB? (current port B attributes) (same sub-menus as port A)

Tape Bar x {Y/N} (tape completion indication)

English/Espanol/Francais/Italiano/Deutsch (current language)

VolSafe X {Y/N} (determines the VolSafe capability of the drive)

FullCode X {Y/N} (determines whether a full code image is in drive memory)

Emul xxxxx {STD/3590/*/*/3490E/*/*/*/*/*/*/*/*/*} (displays the active emulation mode)

(*=special modes, used only when directed by Engineering or Tech Support)

Lib Adr xy {FF/00-13} (2-character hexidecimal library address) manufacturing setting is FF and it must be changed to a valid drive address when installed in a 9310 library.

CSL Xxxxxx {System/Auto/Manual} (CSL power up mode)

H=xxxxxxxx (first half, 64-bit drive node world-wide-name)

L=xxxxxxxx (second half, 64-bit drive node world-wide-name)

WWN Custom (only when custom/dynamic WWN is set)

S/N=xxxxxx {drive serial number} (last six-characters of drive DMOD)

Exit CFG ? (exit view configuration) [Press Select to exit or press Menu to return to the **View CFG ?** submenu.]

Fibre Channel View Configuration Menu Tree (T9840D)

Use the online view configuration menu tree as a brief guide.

Online/Offline [Press Select to toggle; then press Menu to set.]

View CFG ? (View Configuration) [Press Select to enter or press Menu to bypass.]

Intf XXXXX {FICON/**FCP**}

View PrtA? (view current port attributes)

A=xxxxxxay (24-bit address ID - when port login is complete)

B=xxxxxxay (when viewing port B)

SFP module parameters {2G MM0300m/2G SM10.0k}

Hard PA x {Y/N} (Physical Address)

PA=xx,ddd (PA=hex, decimal index) (*only when Hard PA is yes*)

Soft PA XX {HI/LO} (only when Hard PA is no)

MaxSz xxxx {2112/2048} (maximum data frame size)

H=xxxxxxxx (first half, 64-bit port node world-wide-name)

L=xxxxxxxx (second half, 64-bit port node world-wide-name)

WWN Custom (only when custom or dynamic WWN is set)

View PrtB? (current port B attributes) (same sub-menus as port A)

Emul xxxxx {STD/3590/*/*/3490E/*/*/*/*/*/*/*/9940A} (displays the active emulation mode) (*=special modes, used only when directed by Engineering/Tech Support)

Cmprss Xxx {Yes/Off/No} (compression mode)

Full DSE x {Y/N} (data security erase mode)

SL Prot x {Y/N} (standard label protection mode)

English/Espanol/Francais/Italiano/Deutsch (current language)

Tape Bar x {Y/N} (tape completion indication)

VolSafe x {Y/N} (enable VolSafe - write once read many)

Full Code x {Y/N} (drive memory contains full code load)

Lib Adr xy {FF/00-13} (2-character hexidecimal library address) manufacturing setting is FF and it must be changed to a valid drive address when installed in a 9310 library.

CSL Xxxxx {Y/N} (CSL operating mode - System/Auto/Manual)

H=xxxxxxxx (first half, 64-bit drive node world-wide-name)

L=xxxxxxxx (second half, 64-bit drive node world-wide-name)

WWN Custom (only when custom/dynamic WWN is set)

S/N=xxxxxx (drive serial number) (last six-characters of drive DMOD)

Exit CFG ? (exit view configuration) [Press Select to exit or press Menu to return to the **View CFG ?** submenu.]

SCSI View Configuration Menu Tree

Use the online view configuration menu tree as a brief guide.

Online/Offline [Press Select to toggle; then press Menu to set.]

View CFG? (View Configuration) [Press Select to enter or press Menu to bypass.]

Cmprss xxx {Yes/Off/No} (compression mode)

Full DSE x {Y/N} (data security erase mode)

SL Prot x (Y/N) (standard label protection mode)

SCSI ID x {0-7 or 0-F} (bus address of the drive for narrow or wide bus)

Tar Neg X {Y/N} (determines if the transmission speed is negotiable)

SCSI Xxxxx {Ultra/Slow/Fast} (sets the drive transmission speed)

SCSI xxBit {16/8} (selects the drive bus width)

Tape Bar x {Y/N} (tape completion indication)

English/Espanol/Francais/Italiano/Deutsch (current language)

VolSafe X {Y/N} (determines the VolSafe capability of the drive)

FullCode X {Y/N} (determines whether a full code image is in drive memory)

Emulation Mode: (displays current emulation, based on active interface)

Emul STD/* (standard/3590/*/*/*/*/*/3490E/*/*/*/*/*/*/*/*/*)
(*=special modes, used only when directed by Engineering/Tech Support)

Lib Adr xy (2-character hexidecimal library address)

CSL Xxxxxx {System/Auto/Manual} (CSL power up mode)

H=xxxxxxxx (first half, 64-bit drive node world-wide-name)

L=xxxxxxxx (second half, 64-bit drive node world-wide-name)

WWN Custom (only when custom/dynamic WWN is set)

S/N=Xxxxxx {Normal/Custom} [appears only when in 3590 or 3590s emulation mode]

S/N=xxxxxx {drive serial number} (last six-characters of drive DMOD)

Exit CFG ? (exit view configuration) [Press Select to exit or press Menu to return to the **View CFG ?** submenu.]

ESCON View Configuration Menu Tree

Use the online view configuration menu tree as a brief guide.

Online/Offline [Press Select to toggle; then press Menu to set.]

Port xxx {ENA/DIS} (enables or disables the ESCON port)

View CFG? (View Configuration) [Press Select to enter or press Menu to bypass.]

Cmprss Xxx {Yes/Off/No} (compression mode)

Full DSE X {Y/N} (data security erase mode)

Drv Adr xy (2-character hexidecimal logical drive address - usually 00)

SL Prot X {Y/N} (standard label protection mode)

Lmit ERP X {Y/N} (limit error recovery process to 10 minutes)

98x Yyyyyy {x/c} {Normal/Emul} (ID the drive as high-density during an MVS swap) [x=T9840A/B only in 3590 emulation modes]

Tape Bar X {Y/N} (tape completion indication)

English/Espanol/Francais/Italiano/Deutsch (current language)

VolSafe X {Y/N} (determines the VolSafe capability of the drive)

FullCode X {Y/N} (determines whether a full code image is in drive memory)

Emul xxxxx {3490/3590/*/*/*/*} (displays the active emulation mode)

(*=special modes, used only when directed by Engineering or Tech Support)

Lib Adr xy {FF/00-13} (2-character hexidecimal library address) manufacturing setting is FF and it must be changed to a valid drive address when installed in a 9310 library.

CSL Xxxxxx {System/Auto/Manual} (CSL power up mode)

S/N=xxxxxx {drive serial number} (last six-characters of drive DMOD)

Exit CFG ? (exit view configuration) [Press Select to exit or press Menu to return to the **View CFG ?** submenu.]

FICON View Configuration Menu Tree (T9840B/C)

Use the online view configuration menu tree as a brief guide.

Online/Offline [Press Select to toggle; then press Menu to set.]

View CFG ? (View Configuration) [Press Select to enter or press Menu to bypass.]

Intf FICON

View PrtA? (view current port attributes)

A=xxxxxxay (24-bit address identifier, connection type, and port speed - when port log in is complete)

B=xxxxxxay (when viewing port B)

SFP module parameters {2G MM0300m/2G SM10.0k}

Hard PA x {Y/N} (Physical Address)

PA=xx,ddd (PA=hex, decimal index) (only when Hard PA is yes)

Soft PA XX {HI/LO} (only when Hard PA is no)

Rate xxxx {Auto/fixed rate - 2Gb or 1Gb} (interface speed negotiation)

MaxSz xxxx {2112/2048} (maximum data frame size)

H=xxxxxxxx (first half, 64-bit port node world-wide-name)

L=xxxxxxxx (second half, 64-bit port node world-wide-name)

WWN Custom (only when custom or dynamic WWN is set)

View PrtB? (current port B attributes) (same sub-menus as port A)

Emul xxxxx {3490/3590/*/*/*/*} (displays current emulation mode)

(*=special modes, used only when directed by Engineering or Tech Support)

Cmprss Xxx {Yes/Off/No} (compression mode)

Full DSE x {Y/N} (data security erase mode)

Drv Adr xy (2-character hexidecimal logical drive address - usually 00)

SL Prot x {Y/N} (standard label protection mode)

English/Espanol/Francais/Italiano/Deutsch (current language)

Tape Bar x {Y/N} (tape completion indication)

VolSafe x {Y/N} (enable VolSafe - write once read many)

Full Code x {Y/N} (drive memory contains full code load)

CSL Xxxxx {Y/N} (CSL operating mode - System/Auto/Manual)

98x Yyyyyy {x/c} {Normal/Emul} (ID the drive as high-density during an MVS swap) [x=T9840B only in 3590 emulation modes]

Lib Adr xy {FF/00-13} (2-character hexidecimal library address) manufacturing setting is FF and it must be changed to a valid drive address when installed in a 9310 library.

H=xxxxxxxx (first half, 64-bit drive node world-wide-name)

L=xxxxxxxx (second half, 64-bit drive node world-wide-name)

WWN Custom (only when custom/dynamic WWN is set)

S/N=xxxxxx (drive serial number) (last six-characters of drive DMOD)

Exit CFG ? (exit view configuration) [Press Select to exit or press Menu to return to the **View CFG?** submenu.]

FICON View Configuration Menu Tree (T9840D)

Use the online view configuration menu tree as a brief guide.

Online/Offline [Press Select to toggle; then press Menu to set.]

View CFG ? (View Configuration) [Press Select to enter or press Menu to bypass.]

Intf XXXXX {**FICON**/FCP}

View PrtA? (view current port attributes)

A=xxxxxxay (24-bit address identifier, connection type, and port speed - when port log in is complete)

B=xxxxxxay (when viewing port B)

SFP module parameters {2G MM0300m/2G SM10.0k}

Hard PA x {Y/N} (Physical Address)

PA=xx,ddd (PA=hex, decimal index) (only when Hard PA is yes)

Soft PA XX {HI/LO} (only when Hard PA is no)

Rate xxxx {Auto/fixed rate - 2Gb or 1Gb} (interface speed negotiation)

MaxSz xxxx {2112/2048} (maximum data frame size)

H=xxxxxxxx (first half, 64-bit port node world-wide-name)

L=xxxxxxxx (second half, 64-bit port node world-wide-name)

WWN Custom (only when custom or dynamic WWN is set)

View PrtB? (current port B attributes) (same sub-menus as port A)

Emul xxxxx {3490/3590/*/*/*/*} (displays current emulation mode)

(*=special modes, used only when directed by Engineering or Tech Support)

Cmprss Xxx {Yes/Off/No} (compression mode)

Full DSE x {Y/N} (data security erase mode)

Drv Adr xy (2-character hexidecimal logical drive address - usually 00)

SL Prot x {Y/N} (standard label protection mode)

English/Espanol/Francais/Italiano/Deutsch (current language)

Tape Bar x {Y/N} (tape completion indication)

VolSafe x {Y/N} (enable VolSafe - write once read many)

Full Code x {Y/N} (drive memory contains full code load)

CSL Xxxxx {Y/N} (CSL operating mode - System/Auto/Manual)

Lib Adr xy {FF/00-13} (2-character hexidecimal library address) manufacturing setting is FF and it must be changed to a valid drive address when installed in a 9310 library.

H=xxxxxxxx (first half, 64-bit drive node world-wide-name)

L=xxxxxxxx (second half, 64-bit drive node world-wide-name)

WWN Custom (only when custom/dynamic WWN is set)

S/N=xxxxxx (drive serial number) (last six-characters of drive DMOD)

Exit CFG ? (exit view configuration) [Press Select to exit or press Menu to return to the **View CFG?** submenu.]

TCP/IP View Configuration Menu

Use the following menu tree as a brief guide to view the TCP/IP settings of the T9840D tape drive.

Online/Offline [Press Select to toggle, then press Menu to set.]

View CFG ? [Press Menu to bypass.]

View TCP ? [Press Select to enter or press Menu to bypass.]

DHCP x {Y/N} (must be set to "N" to view/change the static settings)

IPhaaa.bbb {IP Address, high} (first half of static IP address)

IPlccc.ddd {IP Address, low} (second half of static IP address)

NMhaaa.bbb {Net Mask, high} (first half of sub-net mask)

NMlccc.ddd {Net Mask, low} (second half of sub-net mask)

GWhaaa.bbb {Gateway, high} (first half of gateway address)

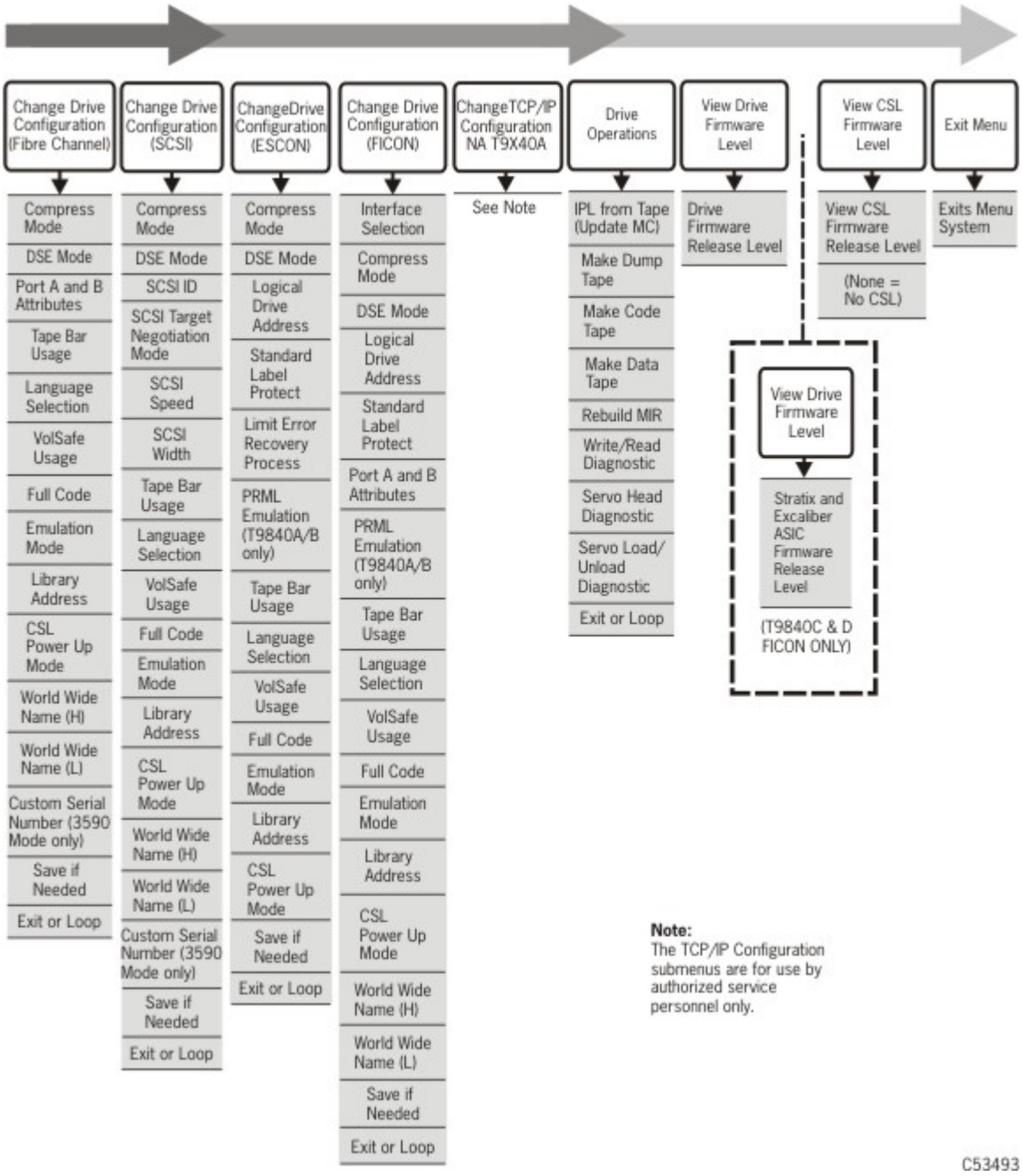
GWlccc.ddd {Gateway, low} (second half of gateway address)

Exit TCP ? [Press Select to exit or press Menu to return to the **View TCP ?** submenu.]

Offline Menus

With the offline menus, the operator can change configuration settings, reformat a data tape cartridge and build the media information region (MIR) on a tape cartridge.

FIGURE 3-3 Offline Menus/Interface Menu Tree



Configuration Changes

You can change configuration settings from the drive offline menu system by using the Menu and Select switches to navigate the offline menu system. You enter the configuration or TCP/IP submenu when you press the Select switch while the main menu item appears in the display. The first option in the submenu appears in the display to confirm your selection.

There are three basic types of change mechanisms: toggles, options, and values.

A **toggle** is a choice between two values. An example is the DSE mode option where you must choose between the choices of YES or NO. If *YES* appears in the display and you wish the selection to be *NO*:

1. **Press the** Select **switch.**

   No appears in the display.

2. **Press the** Menu **switch to advance to the next menu item.**

Options are similar to toggles, but you must choose among three or more values.

An example is the Compression mode option with choices of Yes, No, or OFF.

1. **Press the** Select **switch until the desired choice appears in the display.**
2. **Press the** Menu **switch to advance to the next menu item.**

A **value** is typically a numeral or a hexadecimal character.

Often you will change an address consisting of one or more characters.

1. **Press the** Select **switch.**

   The left-most character of the value flashes.

2. **Press the** Select **switch to increment the value.**
3. **Press the** Menu **switch when the desired value appears in the display.**

   The character stops flashing.

The adjacent character to the right flashes.

4. **Repeat steps 1 through 3 to set the proper value for the second or succeeding character. When you have set all characters, go to step 5.**
5. **Press the** Menu **switch to advance to the next menu item.**

   Note – If you press the Select switch, the first character in the value sequence flashes, and you can increment the value.

The last menu item after a change is typically Save/IPL ?. Press the Select switch to accept the change and start the drive IPL.

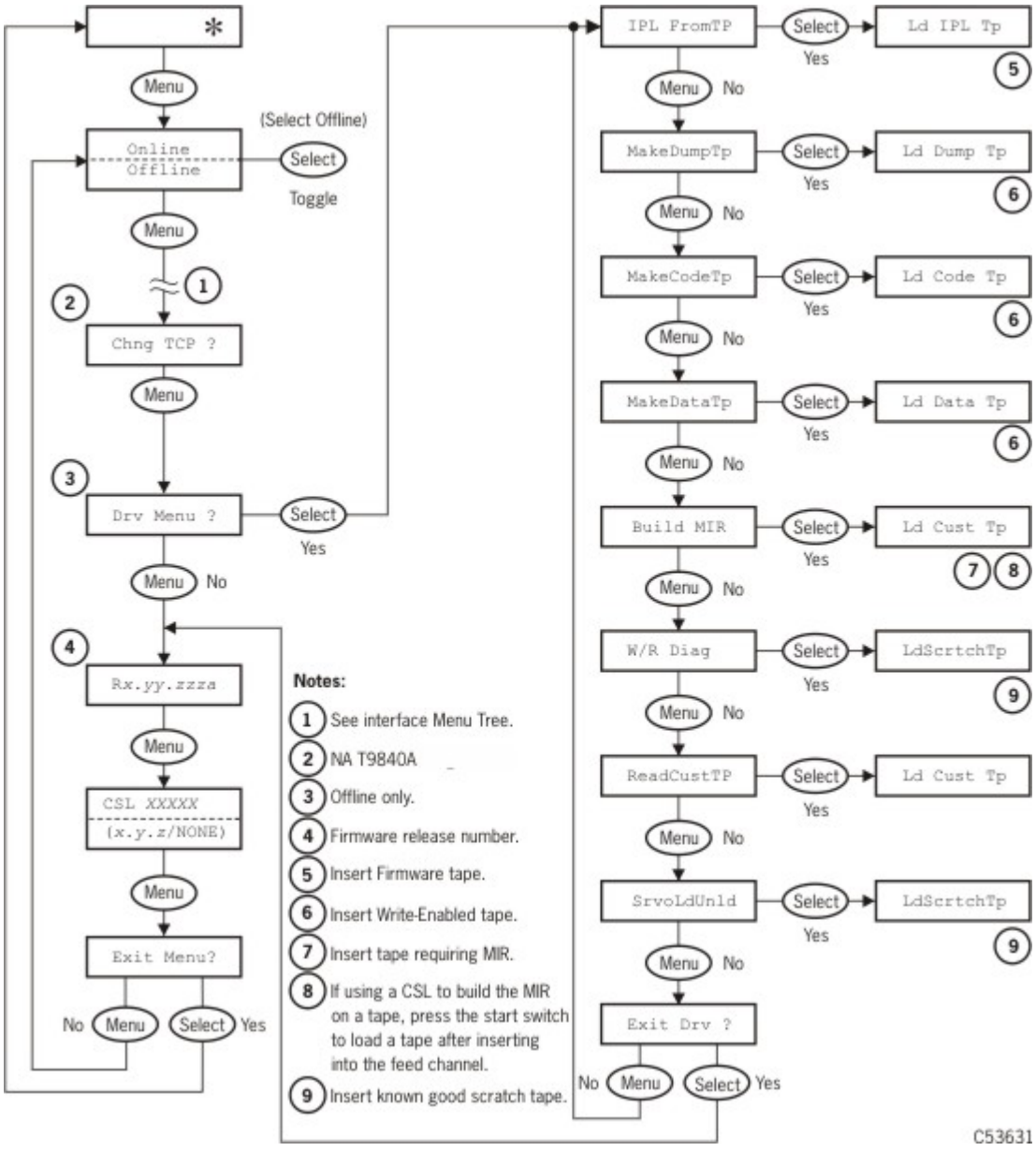
However, if you press the Menu switch, the display will typically advance to Exit Menu ? Press Select to exit or Menu to return to the first item in the submenu.

Drive Operations Menu

The Drv Menu ? branch of the main menu is the same for Fibre Channel, SCSI, ESCON, and FICON interfaces. FIGURE 3-4 shows an expansion of the drive operations sub-menus.

Note that the menu items both preceding and following the Drv Menu ? branch vary with the type of data path interface (see FIGURE 3-3 on page 55 for specific menu items).

FIGURE 3-4 Drive Operations Menu Tree



4

Operator Tasks

This chapter discusses operator tasks primarily for desktop and rack-mounted tape drives. Most of these tasks rely on the physical operator panel switches, alphanumeric display, and the drive menu system.

> **Note –** For operator tasks relating to drives within a library, consult the appropriate library operator guide. The scope of tasks documented depends on the functionality of the particular library. Library information might describe only drive cleaning or provide a broad range of tasks (using the drive operator panel, cleaning a drive, and manually mounting or dismounting a cartridge).

Basic Tasks

▼ Power-on a Drive

To apply power to the desktop or rack-mount configuration:

1. **Make sure the power cord is connected from the receptacle on the chassis rear panel to an AC power outlet or power strip.**
2. **Make sure that all interface cables are fully seated.**
3. **Set the power switch on the back of the drive or the rear panel to on (|).**

The drive(s) will power-on and perform an initial program load (IPL).

- The drive power indicator flashes.
- Various messages relative to the IPL sequence appear in the operator panel display window. These messages do not require any action from you.

  The drive successfully completes an IPL when:

  - The drive power indicator is steady.
  - An asterisk (*) appears in the operator panel display window.

▼ Power-off a Drive

To remove power from the desktop and rack-mount configuration:

1. **Make sure the tape drive is not in use.**

   Check for the following elements:

   a. **There are no active jobs, applications, or programs using this drive.**

   b. **The operator panel activity indicator is steady and *not* flashing.**

   c. **The display window does not indicate any activity relative to tape movement, such as reading, writing, or locating.**

2. **Make sure a data cartridge is *not loaded* in the tape drive (see "Unload a Data Cartridge" on page 63, as necessary).**

3. **Set the power switch on the rear panel to off (O).**

▼ IPL the Drive

To IPL (initial program load) a drive that is already powered on:

1. **Make sure the tape drive is not in use.**

   Checking for the following elements:

   a. **There are no active jobs, applications, or programs using this drive.**

   b. **The operator panel activity indicator is steady and *not* flashing.**

   c. **The display window does not indicate any activity relative to tape movement, such as reading, writing, or locating.**

2. **Make sure a data cartridge is *not loaded* in the tape drive (see "Unload a Data Cartridge" on page 63, as necessary).**

3. **Press the operator panel IPL switch.**

When the IPL starts, the following things happen:

- The drive power indicator flashes.
- Various messages relative to the IPL sequence appear in the operator panel display window. These messages do not require any action from you.

After the drive successfully completes an IPL:

- The drive power indicator is steady.
- An asterisk (*) appears in the operator panel display window.

  Note – If a dump is present, the operator panel display window alternates between the asterisk and the dump message. The dump present indication stops after you load a tape cartridge.

Cartridge Procedures

Cartridge Handling Precautions

Magnetic fields are present near disk drives and electric motors (the larger the electric motor, the stronger the magnetic field is which surrounds it). Items containing buzzers of any form product alternating current electrical fields strong enough to partly erase a magnetic tape.

Never store cartridges on a floor where moisture might be present or near air conditioners or air handlers. Air conditioners might leak water as a function of cooling the air, and air handlers might be adding moisture to the air as a function of con troll ling the environment in a computer room.

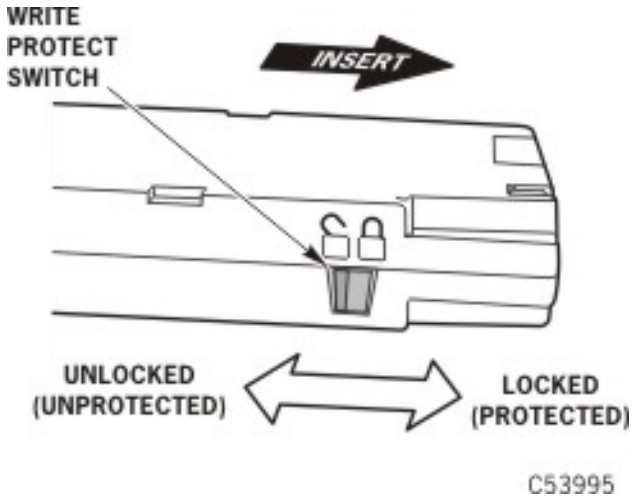
Rough handling of a data cartridge could cause its locking mechanism or brake to slip, resulting in a loose tape. Loose tapes are easily damaged by a tape drive.

▼ Write-protect/Enable a Data Cartridge

To write-protect or write-enable a data cartridge, move the write-protect switch on the cartridge to the desired setting.

The write-protect switch is located on the side of the cartridge as shown in FIGURE 4-1.

FIGURE 4-1 T9840 Data Cartridge Write Protect Switch



The switch points to a padlock symbol on the case to indicate a status:

Locked: Write protected. Data can only be read from the data cartridge.

Unlocked: Write enabled (unprotected). Data can be read from and written to the standard data cartridge. With a VolSafe cartridge, data can be read from the cartridge, and data can be appended if the drive VolSafe configuration option is enabled.

▼ Load a Data Cartridge

To load a cartridge into a T9840 tape drive:

> **Note –** A T9840 tape drive accepts only T9840 cartridges.

1. **Inspect the cartridge for damage (see "To Identify a Damaged Cartridge" on page 88).**
2. **Look into the drive load/unload slot to make sure there are no obstructions.**
3. **Hold the cartridge by the finger grips with the hub side down, and insert the cartridge, carefully, into the tape drive loading slot.**

   > **Note –** For scratch data cartridges and other data cartridges on which the tape is written, make sure the write protect switch on the data cartridge is in the unlocked position (see "Write-protect/ Enable a Data Cartridge" on page 61).

4. **Push the cartridge into the load slot.**

   > **Note –** For desktop or rack-mounted tape drives, when a cartridge is loaded, the operator panel display window indicates one of the values in the following table

Display	Meaning
`Ready U`	The cartridge is ready and not file protected (the drive can read, write, or append data).
`Ready F`	The cartridge is ready and file protected. A VolSafe cartridge is loaded, but the drive VolSafe option is disabled.
`Ready A`	The VolSafe cartridge with the proper density is ready.
`Ready H`	The data cartridge density is higher than the drive is capable of reading or writing.
`Ready L`	The data cartridge is loaded into a drive that is capable of writing at a higher density (the drive can read a lower density cartridge, but cannot append data).
`LOAD xxxx`	The cartridge load was not successful.

▼ Unload a Data Cartridge

> **Caution –** Possible data loss: Do not push the Unload switch while a data cartridge is in use.

To remove cartridges from the drive:

1. **Make sure the tape drive is not in use.**

   Check for the following elements:

   a. **There are no active jobs, applications, or programs using this drive.**

   b. **The operator panel activity indicator is steady and *not* flashing.**

   c. **The display window does not indicate any activity relative to tape movement, such as reading, writing, or locating.**

2. **Press the operator panel Unload switch.**

   An asterisk (*) should appear in the display when the cartridge is unloaded.

   > **Note –** If the drive is offline, the asterisk will alternate with Offline.

3. **Grasp the cartridge by the finger grips and extract it from the load/unload slot.**

4. **Set the write protect switch to the locked position, if applicable.**

▼ Use a Cleaning Cartridge

> **Caution –** Equipment damage: Do not wet-clean the tape drive. Do not clean the tape drive unless the Clean indicator lights.

After the tape drive transports a predetermined length of tape or records a predetermined number of errors, the Clean indicator lights. It is time to clean the tape drive.

> **Note –** Use the appropriate cleaning cartridge for the drive model (see "Cartridges" on page 23).

1. **Make sure the tape drive is not in use before proceeding to Step 2.**

   > **Note –** If there is a tape loaded in the tape drive, make sure the application or job that was using that tape drive is no longer running.

2. **Unload any data cartridge in the tape drive ("Unload a Data Cartridge" on page 63).**

3. **Insert a cleaning cartridge in the tape drive.**

   When loaded, the *activity* light flashes. Cleaning is complete when the *activity* and *clean* indicators turn off, and the tape drive unloads the cleaning cartridge.

> **Note –** The tape drive might immediately eject the cleaning cartridge and show the message **`Expo Clacker`** in the front panel display. This indicates that the cleaning cartridge has been used its maximum number of cleaning cycles. *Discard* the worn cleaning cartridge and insert a new cleaning cartridge into the tape drive.
>
> The cleaning cartridge can be used about 100 times before you must discard it.

If **`CHK sextets`** appears in the tape drive's front panel display, where sextets is the fault symptom code (FSC), a cleaning cartridge failure occurred.

Try the procedure again with a different cleaning cartridge. If the problem persists, contact your service representative.

4. **Remove the cleaning cartridge from the tape drive.**

   This completes the cleaning process and the tape drive is ready to resume normal operations.

Menu System Tasks

The remaining operator tasks are accomplished by using the drive menu system. Some tasks can be performed from the offline menu system only.

- "Place the Drive Online" on page 65
- "View the Drive Configuration" on page 65
- "View the Firmware Release Level" on page 66
- "Place the Drive Offline" on page 66
- "Reformat a Cartridge" on page 67
- "Build the MIR" on page 68
- "Exit the Menu System" on page 69

You can use the Virtual Operator Panel, version 1.0.12 (or higher), with Oracle's StorageTek T9840D tape drive to perform many of the operator tasks listed above (see "Virtual Operator Panel" on page 36). The Virtual Operator Panel provides a graphical user interface to accomplish task functions. See the *StorageTek Virtual Operator Panel Customer User's Guide* for specific information.

> **Note –** VOP version 1.0.13 (or higher) in conjunction with the appropriate drive code level supports the use of an IPv6 address.

▼ Place the Drive Online

To change the tape drive state from offline to online:

1. **Press the operator panel** Menu **switch until** `Offline` **appears in the display window.**

   Note – If you are within a submenu, press the Menu switch until `Exit XXX ?` appears in the display window and press the Select switch to enter the main menu.

2. **Press the operator panel** Select **switch to toggle the drive state.**

   `Online` appears in the display window.

3. **Press the** Menu **switch until** `Exit Menu?` **appears in the display window.**

4. **Press the** Select **switch to exit the menu system.**

5. **Bring the tape drive back online to the host by using one of the following methods:**

   - Enterprise: Set the tape drive online for all host paths to the tape drive by using one of the following `Vary` commands:

     MVS: V <address> online

     VM: Vary on, <address>

   - Open Systems: if there is a switch unit installed and the port to this tape drive is blocked, unblock (enable) that switch port.

▼ View the Drive Configuration

To view the current drive configuration settings:

1. **Press the operator panel** Menu **switch to enter the menu system:**

   - If `Online` appears in the tape drive's front panel, go to Step 2.
   - If `Offline` appears in the tape drive's front panel shows, press the Select switch to toggle the drive state.

     Note – It is important that you view configuration settings in the *online* state, because you cannot accidently change online settings. To change settings, you must first set the drive to the offline state.

2. **Press the** Menu **switch until** `View CFG ?` **appears in the display window.**

3. **Press the operator panel** Select **switch (Yes) to enter the view configuration submenus.**

   The first configuration setting appears in the operator panel display window.

4. **Press either the** Menu **or the** Select **switch to step through the configuration settings.**

   Note – In the drive online state, the Select switch has the same function as the Menu switch, except when answering a displayed question.

5. **Press either the** Menu **or** Select **switch until `Exit CFG ?` appears in the display window.**
6. **Press either the** Select **switch (Yes) to exit the submenu or the** Menu **switch (No) to repeat the view configuration sequence.**
7. **Press the** Menu **switch until `Exit Menu?` appears in the display window.**
8. **Press either the** Select **switch (Yes) to exit the menu system or the** Menu **switch (No) to return to the online/offline selection menu.**

▼ View the Firmware Release Level

1. **Press the** Menu **switch to enter the menu system.**
2. **Press the** Menu **switch until a number in the form of Rx.yy.zzzc appears in the display.**

   Where:

   `x`: the major revision level

   `yy`: the minor revision level

   `zzz`: the integration level

   `c`: the channel type with the following values for various channel types:

   `f`: Fibre Channel

   `s`: SCSI

   `e`: ESCON/FICON (3490 image)

   `m`: ESCON/FICON (3590 image)
3. **Press the** Menu **switch repeatedly until `Exit Menu?` appears in the display window.**
4. **Press either the** Select **switch to exit the menu system or press the** Menu **switch to repeat the Online/Offline selection.**

▼ Place the Drive Offline

To change the drive state to offline:

1. **Stop all I/O activity from the host.**

   In *mainframe* environments, set the tape drive offline for all host paths to the tape drive by using one of the following **`Vary`** commands:

   - MVS: V <address> offline
   - VM: Vary off, <address>

   In *open systems* environments, do one of the following:

   - Stop the job that is using that tape drive.
   - In a multi-host setting, stop any job that is using the tape drive and then, if there is a switch unit in use, block (disable) the port in that switch to that tape drive.

2. **Press the operator panel** Menu **switch.**

   `Online` appears in the display window.

3. **Press the operator panel** Select **switch to toggle the drive state.**

   `Offline` appears in the display window to indicate a successful transition to the offline state.

4. **Press the** Menu **switch until `Exit Menu?` appears in the display window.**

5. **Press either the** Select **switch to exit the menu system or the** Menu **switch to return to the first main menu item.**

   Use the offline main menu as appropriate, see "Offline Menus" on page 55.

   Note – If you select **`Exit Menu?`** the display alternates between **`Offline`** and the normal message after a cartridge has been loaded as a reminder that the drive is still in the offline state.

▼ Reformat a Cartridge

You can reformat a data cartridge for new data recording using the offline drive operations menu. Once a data cartridge is reformatted, old data is no longer accessible because the reformatting and new data recording overwrites previous data areas.

Note – You cannot reformat a VolSafe data cartridge with the offline drive operations submenu.

1. **Press the** Menu **switch to access the menu system.**

   a. **If the display shows `Offline`, go to step 2.**

   b. **If the display shows `Online`, press the Select switch to place the drive offline.**

2. **Press the** Menu **switch until `Drv Menu ?` appears in the display.**

3. **Press the** Select **switch to enter the submenu.**

4. **Press the** Menu **switch until `MakeDataTp` appears in the display.**

5. **Press the** Select **switch (`Ld Data Tp` appears in the display).**

6. **Inspect the cartridge for damage (see "To Identify a Damaged Cartridge" on page 88).**

7. **Load a write-enabled data cartridge in the drive load slot (see "Load a Data Cartridge" on page 62).**

   The drive reformats and ejects the data cartridge.

8. **Remove the cartridge.**

9. **Press the** Menu **switch until `Exit Drv ?` appears in the display.**

10. **Press either the** Select **switch to enter the main menu or the** Menu **switch to repeat the drive operations menu.**

11. **Press the** Menu **switch until `Exit Menu?` appears in the display**

12. **Press either the** Select **switch to exit the menu system or the** Menu **switch to repeat the Online/Offline selection.**

    Note – It is a best practice to return the drive to the online state. See "Place the Drive Online" on page 65.

▼ Build the MIR

This process rebuilds an MIR from the operator panel.

1. **Set the drive to the offline state.**
2. **Press the** Menu **switch until** `Drv Menu?` **appears in the display window.**
3. **Press the** Select **switch (Yes) once.**

   The first drive utilities submenu appears in the display window.
4. **Press the** Menu **switch until** `Build MIR` **appears in the display window.**
5. **Press the** Select **switch to begin the MIR rebuilding process.**

   `Ld Cust Tp` appears in the display window.

   Note – Any loaded cartridge unloads at this time. Remove any cartridge that may be present.
6. **Inspect the cartridge for damage (see "To Identify a Damaged Cartridge" on page 88).**
7. **Insert a write-enabled cartridge with a defective MIR (see "Load a Data Cartridge" on page 62).**

   The drive rebuilds the MIR and ejects the data cartridge.

   Note – Rebuilding the MIR could take up to 40 minutes for a full data cartridge.
8. **Remove the cartridge from the drive load/unload slot.**

   If there are other cartridges for MIR rebuilding, repeat Step 6 and Step 7 for each cartridge. When the drive has rebuilt all cartridges with defective MIRs, continue with Step 9.
9. **Press the** Menu **switch once.**

   `Exit Drv?` appears in the display window.
10. **Press either the** Select **switch (Yes) to exit the drive utilities submenus or the** Menu **switch (No) to repeat the utilities submenu sequence.**
11. **Press the** Menu **switch until** `Exit Drv ?` **appears in the display.**
12. **Press either the** Select **switch to enter the main menu or the** Menu **switch to repeat the drive operations menu.**
13. **Press the** Menu **switch until** `Exit Menu?` **appears in the display**
14. **Press either the** Select **switch to exit the menu system or the** Menu **switch to repeat the Online/Offline selection.**

    Note – It is a best practice to return the drive to the online state. See "Place the Drive Online" on page 65.

▼ Exit the Menu System

1. **Press the** Menu **switch repeatedly until** `Exit Menu?` **appears in the display window.**

   Note – If you are within a submenu, press the Menu switch until `Exit XXX ?` appears in the display window and press the Select switch to enter the main menu.

2. **Press the** Menu **switch to determine the current drive state (**`Offline` **or** `Online` **appears in the display).**
3. **If the present state is** `offline`**, press the** Select **switch (**`Online` **appears in the display)**
4. **Press the** Menu **switch repeatedly until** `Exit Menu?` **appears in the display.**
5. **Press the** Select **switch (an** `*` **or** `Online` **appears in the display).**

5

Indicators and Messages

This chapter summarizes the operator panel indicator lights and display messages.

Indicators

TABLE 5-1 shows the meaning of the indicators located on the front panel and the recommended action.

TABLE 5-1 Operator Panel Indicators

Indicator				Meaning	Recommended Action
power	activity	clean	service		
Off				The drive is powered off.	Power on the drive as required.
Flashing			Off	The drive is in initial program load (IPL).	None
Persistent Flashing			Off	The drive failed IPL and cannot exit the sequence.	Power the drive off and on again. If the problem persists, place a service call.
On			Off	Normal operation.	None
On	Off			No tape cartridge is loaded.	Load a tape cartridge as needed.
On	On			A tape cartridge is loaded.	None
On	Flashing			The tape is moving.	None
On		Off		No cleaning is required.	None
On		On		Cleaning is required.	Load the appropriate cleaning cartridge in the drive.
On	Flashing	On		Cleaning is proceeding.	None.
On			On	A drive error occurred.	Perform an IPL on the drive. If the problem persists, place a service call.
On			Flashing	An error occurred and dump data was collected.	Observe the display message. See TABLE 5-2 for more information about the message.

Messages

TABLE 5-2 lists operator panel display messages, meanings, and recommended actions.

TABLE 5-2 Operator Panel Display Messages

Display	Meaning	Recommended Action
* (asterisk)	The tape drive is online but a cartridge tape is not loaded.	Load a cartridge tape as required.
`ASIA Diags`	IPL diagnostics are running.	None
`Bank n Bad`	During boot, a section of memory was found bad.	IPL the tape drive. If the problem persists, place a service call.
`BldMIRFail`	Rebuild of Media Information Region (MIR) unsuccessful. **Note:** Code level 1.30.109 and higher displays CHK XXXX.	
`Boot Fail`	The IPL failed.	IPL the tape drive again. If the problem persists, place a service call.
`BT Monitor`	A sequence of switches accessed an engineering area.	IPL the tape drive. If the problem persists, place a service call.
`CC Diags`	IPL diagnostics are running.	None
`CHK xxxx,` where **`xxxx`** is an FSC	An operational failure occurred; the tape drive might automatically perform an IPL depending on the operational mode of the drive and the specific failure.	Wait for the IPL to complete and retry the operation. If the problem persists, place a service call. See TABLE 5-3 on page 76 for a list of codes that are most often caused by an operator error.
`Cleaning` (*Cleaning*)	A cleaning cartridge is in the tape drive and is now cleaning.	None
cnhndnsn (Hardware revision level supported by the firmware in this drive)	The tape drive firmware level is insufficient to control the tape drive hardware.	Place a service call.
`CodCrFail1`	The tape drive cannot write code onto the data cartridge tape, or the tape drive cannot position the data cartridge tape.	Ensure that the tape is write-enabled, or try another cartridge tape.
`CodCrFail2`	The tape drive cannot read code from the data cartridge tape.	Retry the operation, or try another cartridge tape. If the problem persists, place a service call.
`CodeUpDate`	The firmware in the tape drive is being updated from the host; the operator panel switches are locked.	None

TABLE 5-2 Operator Panel Display Messages (Continued)

Display	Meaning	Recommended Action
CodUpFail1	The tape drive cannot read the data cartridge tape, or the tape drive cannot position the data cartridge tape.	Try another cartridge tape.
CodUpFail2	The EEPROM failed.	Contact authorized service personnel.
CodUpFail3	The tape drive cannot read code from the data cartridge tape.	Retry the operation, or try another cartridge tape. If the problem persists, contact authorized service personnel.
CodUpFail4	The data cartridge tape is not a code update cartridge tape.	Try another code update cartridge tape. If the problem persists, place a service call.
DatCrFail1	The tape drive cannot create (reformat or reclaim) a cartridge tape.	Ensure that the data cartridge tape is write-enabled, or try to reformat the tape on another drive. If the problem persists, place a service call.
DmpCrFail1	The tape drive cannot create (reformat or reclaim) a diagnostic dump tape.	Ensure that the data cartridge tape is write-enabled. If the problem persists, place a service call.
DmpCrFail2	The tape drive cannot read the format of the data cartridge tape.	Retry the operation, or try another cartridge tape. If the problem persists, place a service call.
DmpWrFail1	The tape drive cannot write diagnostic data onto the data cartridge tape, or the tape drive cannot position the data cartridge tape.	Contact authorized service personnel.
DmpWrFail2	There is no diagnostic dump data to process.	Contact authorized service personnel.
xxxx:**Dmp y**	Alternates with * (an asterisk) after completion of IPL, where *xxxx*=the FSC of last dump data collected and *Y*=number of uncollected dumps in non-volatile memory.	Contact authorized service personnel who accesses the diagnostic data and collects it to tape or to the host.
DumpAgain? alternating with CHK xxxx, where xxxx is an FSC.	The tape drive detected the same error within a minute. **Note:** The Service indicator is flashing.	IPL the tape drive. If the problem persists, contact authorized service personnel.
DumpToHost	The dump or event log is being transferred to the host; operator panel switches are locked.	None
Exp ClCart	The cleaning cartridge is used up.	Replace the cleaning cartridge.
Fix CfgErr	The checksum does not match after an IPL.	Contact authorized service personnel.

TABLE 5-2 Operator Panel Display Messages (Continued)

Display	Meaning	Recommended Action
Init xxxx. where xxxx is an FSC	An initialization error occurred.	Contact authorized service personnel.
IPL Pend	The IPL switch has been pressed.	None
LOAD CC	The common controller code is loading; IPL is proceeding.	None
LOAD ESCON	ESCON firmware is loading; IPL is proceeding.	None
LOAD FIBRE	Fibre Channel firmware is loading; IPL is proceeding.	None
LOAD FICON	FICON firmware is loading; IPL is proceeding.	None
LOAD SERVO	The servo code is loading; IPL is proceeding.	None
LOAD SCSI	SCSI firmware is loading; IPL is proceeding.	None
LOAD *xxxx*, where *xxxx* is an FSC	The load or unload operation failed.	If the load failed, insert another cartridge tape. If it loads successfully, suspect the original tape. If another tape fails to load, IPL the tape drive. If the problem persists, contact your service representative.
Loading	A cartridge tape is loading.	None
Locating	The tape drive is doing a high-speed seek.	None
Memory Err	The IPL failed.	IPL the tape drive again. If the problem persists, contact authorized service personnel.
NTReady A	A write-enabled VolSafe data cartridge is in the process of a manual unload.	None
NTReady F	A write-protected tape is in the process of a manual unload.	None
NTReady U	A write-enabled tape is in the process of a manual unload.	None
Offline, alternating with *****	The tape drive is offline.	Perform offline menu operations or exit the menu system.
Online	The tape drive is online.	None
OnLn Pend	The online state is pending completion of IPL diagnostics.	None
Power Fail	The power supply failed.	Contact authorized service personnel.
Reading	The tape drive is reading data.	None

TABLE 5-2 Operator Panel Display Messages (Continued)

Display	Meaning	Recommended Action
`Ready A`	The loaded cartridge tape is a VolSafe cartridge.	None
`Ready F`	The loaded cartridge tape is write-protected.	None
Ready H	A loaded high-density data cartridge is write-enabled by the cartridge write-protect switch in the unlocked position.	Reload with low-density cartridge or intentionally over-write from BOT.
Ready L	A loaded low-density data cartridge is write-enabled by the cartridge write-protect switch in the unlocked position.	Use for read-only jobs or intentionally over-write from BOT. **Note:** Low-density data files can be read, but not revised by a higher density drive.
`Ready U`	The loaded cartridge tape is write-enabled (write-unprotected).	None
`Rewinding`	The tape drive is rewinding.	None
`Save Fails`	The new configuration cannot be saved because the read-access memory (RAM) may be defective.	This message is associated with changing the tape drive configuration, a task for authorized service personnel only.
`SavingDump`	A dump is being saved to non-volatile memory.	None
`Start Init`	Initialization has started.	None
`Trapped`	The IPL process is trapped in a loop.	IPL the tape drive again. If the problem persists, place a service call.
`Unloading`	A cartridge tape is unloading.	None
`UnWr` *xxxx*, where *xxxx* is an FSC	The Unload switch was pressed during a write operation. Some data remains unwritten.	To write the unwritten data, issue the command: **ESCON Swap** in the VM/MVS environment Alternatively, Press the Unload switch again; unwritten data is lost.
`Write Prot`	The tape drive attempted to write to a write-protected cartridge tape.	Change the switch on the data cartridge tape to enable writing.
`Writing`	The tape drive is writing data.	None

Potential Operator Recovery Scenarios

The following table contains Fault Symptom Codes (FSCs) that commonly result from an operator error. The first column in the table lists an operator panel message at the time of the error event. The description column provides insight into the error condition from which you should be able to determine a recovery action.

TABLE 5-3 Selected Check Message Meanings

Message	Description
CHK 6109	This drive does not contain the key needed to decrypt this tape. The ID of the missing key can be viewed from this drive using the VOP program. The ID has also been written to the Operational Key Token (OKT). Connect the OKT to the Key Management Station (KMS) and view the error log for error 6109
CHK A33A	The user requested a motion operation that requires a tape to be installed, however, a tape has not been loaded.
CHK A34C	The user requested a write operation that requires a tape to be installed; however, a tape has not been loaded.
CHK A3FB	A format override tape write operation failed. The failure may not be serious. Error recovery was not invoked for the failure. Re-attempting the test may resolve this issue.
CHK A733	The operator or library inserted a write protected tape into the drive while in a menu selected create tape mode. If the write protect switch on the cartridge is moved to the unlocked position, operation will work.
CHK A749	A high density tape was attempted to be read on a drive only capable of reading lower density tapes. Retry with a low density tape.
CHK A74E	A high density tape was loaded on a low density drive, or a low density tape was loaded on a high density drive. In either case, the drive cannot write to the tape. The MIR cannot be written on the tape during the unload process so there is no point in running the build MIR function. If it is a high density tape, rebuild the MIR on a high density drive. If it is a low density tape, rebuild the MIR on a low density drive.

Translated Messages

TABLE 5-4 lists operator panel display messages that are translated when the drive configuration Language option is set to something other than English.

TABLE 5-4 Translated Display Messages

English	Espanol	Francais	Italiano	Deutsch
CLEANING	*LIMPIEZA*	*NETTOYAGE	*PULIZIA*	*REINIGEN*
CHK XXXX	ERR XXXX	ERR XXXX	ERR XXXX	PRUEF XXXX
ERASING	*BORRANDO*	EFFACEMENT	*CANCELLA*	*LOESCHEN*
Locating	Localizar	Recherche	Ricerca	Suchen
LOAD XXXX	CARGA XXXX	CHARG XXXX	CARIC XXXX	LADEN XXXX
Loading	Cargando	Chargement	Carico	Laden
NT Ready A	No Listo A	NPret A	No Prnt A	N Bereit A
NT Ready F	No Listo F	NPret F	No Prnt F	N Bereit F
NT Ready U	No Listo U	NPret U	No Prnt U	N Bereit U
Overtemp	*Caliente*	*Overtemp*	*Temperat*	* Heiss *
Processing	Procesar	Traitement	Processo	Verarbeitn
Reading	Leer	Lecture	Lettura	Lesen
Ready A	Listo A	Pret A	Pronto A	Bereit A
Ready F	Listo F	Pret F	Pronto F	Bereit F
Ready H	Listo H	Pret H	Pronto H	Bereit H
Ready L	Listo L	Pret L	Pronto L	Bereit L
Ready U	Listo U	Pret U	Pronto U	Bereit U
Rewinding	Rebobinar	Rebobinage	Riavvolgi	Spulen
Unloading	Descarga	Dechargemt	Scarico	Entladen
Writing	Excritura	Ecriture	Scrittura	Schreiben

A

Specifications

This appendix lists the physical, power, and performance specifications for the T9840 tape drive plus the environmental requirements for the drive and data cartridges.

Physical Specifications

This section lists the physical specifications for T9840 tape drives in three configurations: desktop, rack mount, and library attached.

Tape Drive Only

TABLE A-1 lists the T9840 tape drive physical specifications.

TABLE A-1 T9840 Tape Drive Physical Specifications

Measurement	Specification
Width	146 mm (5.75 in.)
Depth	381 mm (15 in.)
Height	82.5 mm (3.25 in.)

Desktop Configuration

The T9840 desktop configuration is a single enclosed assembly.

TABLE A-2 T9840 Tape Drive Desktop Physical Specifications

Drive Type	Chassis Dimensions	Weight
Manual-Load Drive	230 mm (9.1 in.) wide 160 mm (6.5 in.) high 483 mm (19 in.) deep[1]	9.3 kg (20.5 lb)
Cartridge Scratch Loader	483 mm (19 in.) wide 197 mm (7.7 in.) high 630 mm (24.8 in.) deep[1]	23 kg (50 lb)

1. Plus 76 mm (3 in.) for cables

Rack-Mount Configuration

Chassis dimensions:

483 mm (19 in.) wide

177 mm (7.0 in.) high

630 mm (24.8 in.) deep plus 76 mm (3 in.) for cables

Weight:

Single drive 14.1 kg (32 lb), dual drive 20.4 kg (45 lb), and Cartridge Scratch Loader 18 kg (39 lb)

Library-attached Configuration

TABLE A-3 lists the weights of the library tape drives and accessories (including trays, power supplies, and cables).

TABLE A-3 T9840 Tape Drive Weights (Library-attached)

Library	Drive and Accessory Weights
9310/9740/L5500	7.30 kg (16.1 lb)
L180/L700/L1400	7.39 kg (16.3 lb)
SL3000	9.53 kg (21 lb)
SL8500	8.85 kg (19.5 lb)

The T9840 Tape Drive library-attached configuration trays fit inside the:

- StorageTek L180/L700/L1400 libraries
- StorageTek SL3000 Modular Library System
- StorageTek SL8500 Modular Library System
- 9741 drive cabinet that attaches to StorageTek 9310 and 9740 libraries
- 9741E drive cabinet that attaches to StorageTek 9310, 9740, and L5500 libraries

Refer to the appropriate library Systems Assurance Guide for the physical dimensions and weights of the library and frame.

Power Specifications

The power specifications for the T9840 tape drive are listed in the following table.

TABLE A-4 T9840 Tape Drive Power Specifications

Characteristic	Value
Input voltage	100 to 240 VAC
Input frequency	50 to 60 Hz
Power consumption	T9840D
	61.7 W - write
	43 W - Idle with tape loaded
	35 W - Idle no tape loaded
	T9840C
	65 W - write
	45 W - Idle with tape loaded
	38 W - Idle no tape loaded
SL8500 Power dissipation	345 Btu/hr

Environmental Requirements

This section lists the environmental requirements for the tape drive, power supply, and tape cartridge.

Airborne Contamination

Tape drives and media are subject to damage from airborne particles. The operating environment must adhere to the ISO 14644-1 Class 8 requirements (see Appendix C, “Controlling Contaminants”).

Tape Drive and Power Supply

TABLE A-6 on page 83 lists the environmental requirements for the tape drive and the power supply.

TABLE A-5 T9840 Drive and Power Supply Environmental Requirements

Description	Range
Temperature	
Operating	15° to 32°C (59° to 90°F)
Shipping	-40° to 60°C (-40° to 140°F)
Storing	10° to 40°C (50° to 104°F)
Relative Humidity, (*non-condensing*)	
Operating	20% to 80%
Shipping	10% to 95%
Storing	10% to 95%
Wet Bulb Maximum	
Operating	29°C (84°F)
Shipping	35°C (95°F)
Storing	35°C (95°F)
Altitude	
Operating	26°C (79°F) 3.05 km (10,000 feet) **Note –** Except in China markets where regulations may limit installations to a maximum altitude of 2 km (6,562 ft).
Shipping	26°C (79°F) 15.2 km (50,000 feet)
Storing	26°C (79°F) 3.05 km (10,000 feet)
Air Flow Requirement (Operating Heat Output)	
Drive and power supply operating	73.2 Calories/hr (290.2 Btu/hr)

Tape Cartridge

TABLE A-6 lists the T9840 tape cartridge environmental requirements.

TABLE A-6 T9840 Tape Cartridge Environmental Requirements

Characteristic	Value
Temperature	
Operating[1]	15° to 32°C (59° to 90°F)
Storage (up to four weeks)	5° to 32°C (41° to 90°F)
Storage (archival)	18° to 26°C (65° to 79°F)
Shipping (unrecorded)[2]	-23° to 49°C (-10° to 120°F)
Shipping (recorded)[2]	4° to 40°C (40° to 104°F)
Relative Humidity (*non-condensing*)	
Operating[1]	20% to 80%
Storage (up to four weeks)	5% to 80%
Storage (archival)	40% to 60%
Shipping (unrecorded)[2]	5% to 80%
Shipping (recorded)[2]	5% to 80%
Wet Bulb Maximum	
Operating[1]	26°C (79°F)
Storage (nonarchive)	26°C (79°F)
Storage (archival)	26°C (79°F)
Shipping (unrecorded)[2]	26°C (79°F)
Shipping (recorded)[2]	26°C (79°F)

1. The acclimation time before use is 24 hours.
2. The shipping environment must not exceed the limit of the storage environment, archive or nonarchive, for longer than 10 days.

Performance Specifications

This section describes the T9840 Tape Drive and Tape Cartridge performance.

Tape Drive

TABLE A-7 on page 84 lists the performance specifications of the T9840 tape drive.

TABLE A-7 T9840 Tape Drive Performance Specifications

Characteristic	Value			
	T9840A	T9840B	T9840C	T9840D
Capacity and Performance				
Capacity, native	20 GB	20 GB	40 GB[1]	75 GB[1]
Data buffer size	8 MB	32 MB	64 MB	64 MB
tape speed, read/write	2 m/s	4 m/s	3.295 m/s	3.4 m/s
Performance, native (head-to-tape)				
uncompressed	10 MB/s	19 MB/s	30 MB/s	30 MB/s
compressed (maximum)	35 MB/s	60 MB/s	60 MB/s	60 MB/s[2]
Burst (FC & FICON)	100 MB/s	200 MB/s	200 MB/s	200 MB/s
Burst (ESCON)	17 MB/s	17 MB/s	17 MB/s	17 MB/s
Interface data				
Fibre Channel	1 Gb	2 Gb	2 Gb	2 Gb
Ultra SCSI (HVD)	40 MB/s	40 MB/s	N/A	N/A
ESCON	17 MB/s	17 MB/s	17 MB/s	17 MB/s
FICON	N/A	2 Gb	2 Gb	2 Gb
Access times				
Tape load and thread to ready	7 sec	7 sec	6.5 sec	8.5 sec
File access, first (average)	8 sec	8 sec	8 sec	8 sec
Rewind (maximum/average)	16/8 sec	16/8 sec	16/8 sec	16/8 sec
Unload	8 sec	8 sec	11.5 sec	12.5 sec
Reliability				
Mean time between failure (MTBF)				
Power on @ 100% duty cycle	290,000 hr	290,000 hr	290,000 hr	290,000 hr
Tape load @ 10/day (100k loads)	240,000 hr	240,000 hr	240,000 hr	240,000 hr
Tape path motion (TPM) @ 70% duty cycle	216,000 hr	216,000 hr	216,000 hr	216,000 hr
Head life @ 70% TPM duty cycle	5 years	5 years	5 years	5 years
Uncorrected bit error rate	1×10^{-18}	1×10^{-18}	1×10^{-18}	1×10^{-18}
Undetected bit error rate	1×10^{-33}	1×10^{-33}	1×10^{-33}	1×10^{-33}

1. VR^2 is a trademark of Overland Storage.
   VR^2 technology is used to achieve T9840C and T9840D capacity.
2. Fibre Channel (FC) write and 55 MB/s FICON write

Tape Cartridge

TABLE A-8 lists the physical and performance specifications for the StorageTek 9840 data cartridge. The cleaning cartridges have the same physical specifications.

TABLE A-8 StorageTek 9840 Data Cartridge Physical and Performance Specifications

Characteristic	Value
Cartridge physical data	
Drive compatibility	T9840A, T9840B, T9840C, T9840D
Form factor	1/2 in. cartridge, 3490/3490E
Width	10.9 cm (4.29 in.)
Length	12.5 cm (4.92 in.)
Height	2.54 cm (1.0 in.)
Weight	262 g (9.17 oz)
Drop strength Drop strength	1.0 m (39.4 in.)
Tape media data	
Capacity, native (uncompressed)	20 GB (T9840A, T9840B) 40 GB[1] (T9840C)) VR² 75 GB[1] (T9840D)
Tracks	288 (T9840A, T9840B, T9840C) 576 (T9840D)
Track following servo	Factory pre-recorded
Formulation	Advanced metal particle (AMP)
Physical thickness	9 microns
Physical length	271 m (889 ft)
Recordable length (including MIR)	251 m (823 ft)
Reliability	
Archival life	15-30 years
Short-length durability	80,000 write/read passes minimum
Long-life durability	6,500 write/read passes minimum
Load/unloads	10,000 minimum
Uncorrected bit error rate	1×10^{-18}
Permanent errors	Zero

1. VR² is a trademark of Overland Storage.
VR² technology is used to achieve T9840C and T9840D capacity.

B

Cartridge Care

StorageTek 9840 tape cartridges require care to ensure proper operation and longevity.

▼ To Handle a Tape Cartridge

> **Caution –** *Tape cartridge damage or data loss:* Handle tape cartridges properly.

- **Follow accepted tape cartridge handling practices.**

  Consider the following guidelines:

  - Never open a data cartridge or touch the tape.
  - Never carry data cartridges loosely in a container.
  - Never expose the tape or cartridges to direct sunlight or moisture.
  - Never expose a recorded data cartridge to magnetic fields.
  - Always maintain a clean operating, working, and storage environment.

▼ To Store a Tape Cartridge

- **Follow accepted practices to store tape cartridges.**

  > **Note –** Always store tape cartridges in an environment with the specified range of temperature and humidity found in "Tape Cartridge" on page 83.

  Consider the following guidelines:

  - Never take data cartridges out of their protective wrapping until they are needed. Always use the tear string, not a sharp instrument, to remove the wrapping.
  - Store data cartridges in a dirt-free environment that, if possible, duplicates the conditions of the data processing center.
  - Before using data cartridges that have been in tape storage, *acclimate* the cartridges to the operating environment for at least 24 hours.

▼ To Identify a Damaged Cartridge

Caution – *Equipment damage:* Do not load a damaged cartridge.

- **Inspect the cartridge for problems before loading it into a drive.**

  Look for the following problems:

  - A cracked or broken case
  - A dirty case (see "To Clean a Cartridge")
  - A missing or broken access door
  - A damaged file-protect switch
  - Liquid in the cartridge
  - A loose label (replace or remove the label)
  - Any other obvious damage

▼ To Clean a Cartridge

- **Wipe all dust, dirt, and moisture from the cartridge case with a lint-free cloth.**

▼ To Ship a Cartridge

Caution – *Data cartridge damage:* Ship data cartridges properly.

If you must ship tape cartridges, especially if they are for remote system backup, remote database duplication, or disaster recovery, follow these guidelines:

1. **Save the original factory packaging. Use it, or the equivalent, to package tape cartridges.**
2. **Wrap the tape cartridges in plastic to block moisture and contamination from entering the tape cartridges.**
3. **Pad the tape cartridges on all sides.**
4. **Fill voids in the packaging with padding equivalent to the original padding, if you are using factory packaging to ship fewer tape cartridges than the packaging originally held, or if you are using other packaging.**
5. **Label the outside of the shipping carton clearly with text or accepted symbols that indicate:**

   - Do not expose to magnetic fields
   - Do not expose to moisture
   - This end up
   - Fragile

C

Controlling Contaminants

Environmental Contaminants

Control over contaminant levels in a computer room is extremely important because tape libraries, tape drives, and tape media are subject to damage from airborne particulates. Most particles smaller than ten microns are not visible to the naked eye under most conditions, but these particles can be the most damaging. As a result, the operating environment must adhere to the following requirements:

- ISO 14644-1 Class 8 Environment.
- The total mass of airborne particulates must be less than or equal to 200 micrograms per cubic meter.
- Severity level G1 per ANSI/ISA 71.04-1985.

Oracle currently requires the ISO 14644-1 standard approved in 1999, but will require any updated standards for ISO 14644-1 as they are approved by the ISO governing body. The ISO 14644-1 standard primarily focuses on the quantity and size of particulates as well as the proper measurement methodology, but does not address the overall mass of the particulates. As a result, the requirement for total mass limitations is also necessary as a computer room or data center could meet the ISO 14644-1 specification, but still damage equipment because of the specific type of particulates in the room. In addition, the ANSI/ISA 71.04-1985 specification addresses gaseous contaminations as some airborne chemicals are more hazardous. All three requirements are consistent with the requirements set by other major tape storage vendors.

Required Air Quality Levels

Particles, gasses and other contaminants may impact the sustained operations of computer hardware. Effects can range from intermittent interference to actual component failures. The computer room must be designed to achieve a high level of cleanliness. Airborne dusts, gasses and vapors must be maintained within defined limits to help minimize their potential impact on the hardware.

Airborne particulate levels must be maintained within the limits of *ISO 14644-1 Class 8 Environment*. This standard defines air quality classes for clean zones based on airborne particulate concentrations. This standard has an order of magnitude less particles than standard air in an office environment. Particles ten microns or smaller are harmful to most data processing hardware because they tend to exist in large

numbers, and can easily circumvent many sensitive components' internal air filtration systems. When computer hardware is exposed to these submicron particles in great numbers they endanger system reliability by posing a threat to moving parts, sensitive contacts and component corrosion.

Excessive concentrations of certain gasses can also accelerate corrosion and cause failure in electronic components. Gaseous contaminants are a particular concern in a computer room both because of the sensitivity of the hardware, and because a proper computer room environment is almost entirely recirculating. Any contaminant threat in the room is compounded by the cyclical nature of the airflow patterns. Levels of exposure that might not be concerning in a well ventilated site repeatedly attack the hardware in a room with recirculating air. The isolation that prevents exposure of the computer room environment to outside influences can also multiply any detrimental influences left unaddressed in the room.

Gasses that are particularly dangerous to electronic components include chlorine compounds, ammonia and its derivatives, oxides of sulfur and petrol hydrocarbons. In the absence of appropriate hardware exposure limits, health exposure limits must be used.

While the following sections will describe some best practices for maintaining an ISO 14644-1 Class 8 Environment in detail, there are some basic precautions that must be adhered to:

- Do not allow food or drink into the area.
- Cardboard, wood, or packing materials must not be stored in the data center clean area.
- Identify a separate area for unpacking new equipment from crates and boxes.
- Do not allow construction or drilling in the data center without first isolating sensitive equipment and any air targeted specifically for the equipment. Construction generates a high level of particulates that exceed ISO 14644-1 Class 8 criteria in a localized area. Dry wall and gypsum are especially damaging to storage equipment.

Contaminant Properties and Sources

Contaminants in the room can take many forms, and can come from numerous sources. Any mechanical process in the room can produce dangerous contaminants or agitate settled contaminants. A particle must meet two basic criteria to be considered a contaminant:

- It must have the physical properties that could potentially cause damage to the hardware.
- It must be able to migrate to areas where it can cause the physical damage.

The only differences between a potential contaminant and an actual contaminant are time and location. Particulate matter is most likely to migrate to areas where it can do damage if it is airborne. For this reason, airborne particulate concentration is a useful measurement in determining the quality of the computer room environment. Depending on local conditions, particles as big as 1,000 microns can become airborne, but their active life is very short, and they are arrested by most filtration devices.

Submicron particulates are much more dangerous to sensitive computer hardware, because they remain airborne for a much longer period of time, and they are more apt to bypass filters.

Operator Activity

Human movement within the computer space is probably the single greatest source of contamination in an otherwise clean computer room. Normal movement can dislodge tissue fragments, such as dander or hair, or fabric fibers from clothing. The opening and closing of drawers or hardware panels or any metal-on-metal activity can produce metal filings. Simply walking across the floor can agitate settled contamination making it airborne and potentially dangerous.

Hardware Movement

Hardware installation or reconfiguration involves a great deal of subfloor activity, and settled contaminants can very easily be disturbed, forcing them to become airborne in the supply air stream to the room's hardware. This is particularly dangerous if the subfloor deck is unsealed. Unsealed concrete sheds fine dust particles into the airstream, and is susceptible to efflorescence -- mineral salts brought to the surface of the deck through evaporation or hydrostatic pressure.

Outside Air

Inadequately filtered air from outside the controlled environment can introduce innumerable contaminants. Post-filtration contamination in duct work can be dislodged by air flow, and introduced into the hardware environment. This is particularly important in a downward-flow air conditioning system in which the sub-floor void is used as a supply air duct. If the structural deck is contaminated, or if the concrete slab is not sealed, fine particulate matter (such as concrete dust or efflorescence) can be carried directly to the room's hardware.

Stored Items

Storage and handling of unused hardware or supplies can also be a source of contamination. Corrugated cardboard boxes or wooden skids shed fibers when moved or handled. Stored items are not only contamination sources; their handling in the computer room controlled areas can agitate settled contamination already in the room.

Outside Influences

A negatively pressurized environment can allow contaminants from adjoining office areas or the exterior of the building to infiltrate the computer room environment through gaps in the doors or penetrations in the walls. Ammonia and phosphates are often associated with agricultural processes, and numerous chemical agents can be produced in manufacturing areas. If such industries are present in the vicinity of the data center facility, chemical filtration may be necessary. Potential impact from automobile emissions, dusts from local quarries or masonry fabrication facilities or sea mists should also be assessed if relevant.

Cleaning Activity

Inappropriate cleaning practices can also degrade the environment. Many chemicals used in normal or “office” cleaning applications can damage sensitive computer equipment. Potentially hazardous chemicals outlined in the “Cleaning Procedures and Equipment” section should be avoided. Out-gassing from these products or direct contact with hardware components can cause failure. Certain biocide treatments used in building air handlers are also inappropriate for use in computer rooms either because they contain chemicals, that can degrade components, or because they are not designed to be used in the airstream of a re-circulating air system. The use of push mops or inadequately filtered vacuums can also stimulate contamination.

It is essential that steps be taken to prevent air contaminants, such as metal particles, atmospheric dust, solvent vapors, corrosive gasses, soot, airborne fibers or salts from entering or being generated within the computer room environment. In the absence of hardware exposure limits, applicable human exposure limits from OSHA, NIOSH or the ACGIH should be used.

Contaminant Effects

Destructive interactions between airborne particulate and electronic instrumentation can occur in numerous ways. The means of interference depends on the time and location of the critical incident, the physical properties of the contaminant and the environment in which the component is placed.

Physical Interference

Hard particles with a tensile strength at least 10% greater than that of the component material can remove material from the surface of the component by grinding action or embedding. Soft particles will not damage the surface of the component, but can collect in patches that can interfere with proper functioning. If these particles are tacky they can collect other particulate matter. Even very small particles can have an impact if they collect on a tacky surface, or agglomerate as the result of electrostatic charge build-up.

Corrosive Failure

Corrosive failure or contact intermittence due to the intrinsic composition of the particles or due to absorption of water vapor and gaseous contaminants by the particles can also cause failures. The chemical composition of the contaminant can be very important. Salts, for instance, can grow in size by absorbing water vapor from the air (nucleating). If a mineral salts deposit exists in a sensitive location, and the environment is sufficiently moist, it can grow to a size where it can physically interfere with a mechanism, or can cause damage by forming salt solutions.

Shorts

Conductive pathways can arise through the accumulation of particles on circuit boards or other components. Many types of particulate are not inherently conductive, but can absorb significant quantities of water in high-moisture environments. Problems caused by electrically conductive particles can range from intermittent malfunctioning to actual damage to components and operational failures.

Thermal Failure

Premature clogging of filtered devices will cause a restriction in air flow that could induce internal overheating and head crashes. Heavy layers of accumulated dust on hardware components can also form an insulative layer that can lead to heat-related failures.

Room Conditions

All surfaces within the controlled zone of the data center should be maintained at a high level of cleanliness. All surfaces should be periodically cleaned by trained professionals on a regular basis, as outlined in the "Cleaning Procedures and Equipment" section. Particular attention should be paid to the areas beneath the hardware, and the access floor grid. Contaminants near the air intakes of the hardware can more easily be transferred to areas where they can do damage. Particulate accumulations on the access floor grid can be forced airborne when floor tiles are lifted to gain access to the sub-floor.

The subfloor void in a downward-flow air conditioning system acts as the supply air plenum. This area is pressurized by the air conditioners, and the conditioned air is then introduced into the hardware spaces through perforated floor panels. Thus, all air traveling from the air conditioners to the hardware must first pass through the subfloor void. Inappropriate conditions in the supply air plenum can have a dramatic effect on conditions in the hardware areas.

The subfloor void in a data center is often viewed solely as a convenient place to run cables and pipes. It is important to remember that this is also a duct, and that conditions below the false floor must be maintained at a high level of cleanliness. Contaminant sources can include degrading building materials, operator activity or infiltration from outside the controlled zone. Often particulate deposits are formed where cables or other subfloor items form air dams that allow particulate to settle and accumulate. When these items are moved, the particulate is re-introduced into the supply airstream, where it can be carried directly to hardware.

Damaged or inappropriately protected building materials are often sources of subfloor contamination. Unprotected concrete, masonry block, plaster or gypsum wall-board will deteriorate over time, shedding fine particulate into the air. Corrosion on post-filtration air conditioner surfaces or subfloor items can also be a concern. The subfloor void must be thoroughly and appropriately decontaminated on a regular basis to address these contaminants. Only vacuums equipped with High Efficiency Particulate Air (HEPA) filtration should be used in any decontamination procedure. Inadequately filtered vacuums will not arrest fine particles, passing them through the unit at high speeds, and forcing them airborne.

Unsealed concrete, masonry or other similar materials are subject to continued degradation. The sealants and hardeners normally used during construction are often designed to protect the deck against heavy traffic, or to prepare the deck for the application of flooring materials, and are not meant for the interior surfaces of a supply air plenum. While regular decontaminations will help address loose particulate, the surfaces will still be subject to deterioration over time, or as subfloor activity causes wear. Ideally all of the subfloor surfaces will be appropriately sealed at the time of construction. If this is not the case, special precautions will be necessary to address the surfaces in an on-line room.

It is extremely important that only appropriate materials and methodology are used in the encapsulation process. Inappropriate sealants or procedures can actually degrade the conditions they are meant to improve, impacting hardware operations and reliability. The following precautions should be taken when encapsulating the supply air plenum in an on-line room:

- Manually apply the encapsulant. Spray applications are totally inappropriate in an on-line data center. The spraying process forces the sealant airborne in the supply airstream, and is more likely to encapsulate cables to the deck.
- Use a pigmented encapsulant. The pigmentation makes the encapsulant visible in application, ensuring thorough coverage, and helps in identifying areas that are damaged or exposed over time.
- It must have a high flexibility and low porosity to effectively cover the irregular textures of the subject area, and to minimize moisture migration and water damage.
- The encapsulant must not out-gas any harmful contaminants. Many encapsulants commonly used in industry are highly ammoniated or contain other chemicals that can be harmful to hardware. It is very unlikely that this out-gassing could cause immediate, catastrophic failure, but these chemicals will often contribute to corrosion of contacts, heads or other components.

Effectively encapsulating a subfloor deck in an on-line computer room is a very sensitive and difficult task, but it can be conducted safely if appropriate procedures and materials are used. Avoid using the ceiling void as an open supply or return for the building air system. This area is typically very dirty and difficult to clean. Often the structural surfaces are coated with fibrous fire-proofing, and the ceiling tiles and insulation are also subject to shedding. Even before filtration, this is an unnecessary exposure that can adversely affect environmental conditions in the room. It is also important that the ceiling void does not become pressurized, as this will force dirty air into the computer room. Columns or cable chases with penetrations in both the subfloor and ceiling void can lead to ceiling void pressurization.

Exposure Points

All potential exposure points in the data center should be addressed to minimize potential influences from outside the controlled zone. Positive pressurization of the computer rooms will help limit contaminant infiltration, but it is also important to minimize any breaches in the room perimeter. To ensure the environment is maintained correctly, the following should be considered:

- All doors should fit snugly in their frames.
- Gaskets and sweeps can be used to address any gaps.

- Automatic doors should be avoided in areas where they can be accidentally triggered. An alternate means of control would be to remotely locate a door trigger so that personnel pushing carts can open the doors easily. In highly sensitive areas, or where the data center is exposed to undesirable conditions, it may be advisable to design and install personnel traps. Double sets of doors with a buffer between can help limit direct exposure to outside conditions.
- Seal all penetrations between the data center and adjacent areas.
- Avoid sharing a computer room ceiling or subfloor plenum with loosely controlled adjacent areas.

Filtration

Filtration is an effective means of addressing airborne particulate in a controlled environment. It is important that all air handlers serving the data center are adequately filtered to ensure appropriate conditions are maintained within the room. In-room process cooling is the recommended method of controlling the room environment. The in-room process coolers re-circulate room air. Air from the hardware areas is passed through the units where it is filtered and cooled, and then introduced into the subfloor plenum. The plenum is pressurized, and the conditioned air is forced into the room, through perforated tiles, which then travels back to the air conditioner for reconditioning. The airflow patterns and design associated with a typical computer room air handler have a much higher rate of air change than typical comfort cooling air conditioners so air is filtered much more often than in an office environment. Proper filtration can capture a great deal of particulates. The filters installed in the in-room, re-circulating air conditioners should have a minimum efficiency of 40% (Atmospheric Dust-Spot Efficiency, ASHRAE Standard 52.1). Low-grade pre-filters should be installed to help prolong the life of the more expensive primary filters.

Any air being introduced into the computer room controlled zone, for ventilation or positive pressurization, should first pass through high efficiency filtration. Ideally, air from sources outside the building should be filtered using High Efficiency Particulate Air (HEPA) filtration rated at 99.97% efficiency (DOP Efficiency MILSTD-282) or greater. The expensive high efficiency filters should be protected by multiple layers of pre-filters that are changed on a more frequent basis. Low-grade pre-filters, 20% ASHRAE atmospheric dust-spot efficiency, should be the primary line of defense. The next filter bank should consist of pleated or bag type filters with efficiencies between 60% and 80% ASHRAE atmospheric dust-spot efficiency.

ASHRAE 52-76	**Fractional Efficiencies %**		
Dust spot efficiency %	**3.0 micron**	**1.0 micron**	**0.3 micron**
25-30	80	20	<5
60-65	93	50	20
80-85	99	90	50
90	>99	92	60
DOP 95	--	>99	95

Low efficiency filters are almost totally ineffective at removing sub-micron particulates from the air. It is also important that the filters used are properly sized for the air handlers. Gaps around the filter panels can allow air to bypass the filter as it passes through the air conditioner. Any gaps or openings should be filled using appropriate materials, such as stainless steel panels or custom filter assemblies.

Positive Pressurization and Ventilation

A designed introduction of air from outside the computer room system will be necessary to accommodate positive pressurization and ventilation requirements. The data center should be designed to achieve positive pressurization in relation to more loosely controlled surrounding areas. Positive pressurization of the more sensitive areas is an effective means of controlling contaminant infiltration through any minor breaches in the room perimeter. Positive pressure systems are designed to apply outward air forces to doorways and other access points within the data processing center to minimize contaminant infiltration of the computer room. Only a minimal amount of air should be introduced into the controlled environment. In data centers with multiple rooms, the most sensitive areas should be the most highly pressurized. It is, however, extremely important that the air being used to positively pressurize the room does not adversely affect the environmental conditions in the room. It is essential that any air introduction from outside the computer room is adequately filtered and conditioned to ensure that it is within acceptable parameters. These parameters can be looser than the goal conditions for the room since the air introduction should be minimal. A precise determination of acceptable limits should be based on the amount of air being introduced and the potential impact on the environment of the data center.

Because a closed-loop, re-circulating air conditioning system is used in most data centers, it will be necessary to introduce a minimal amount of air to meet the ventilation requirements of the room occupants. Data center areas normally have a very low human population density; thus the air required for ventilation will be minimal. In most cases, the air needed to achieve positive pressurization will likely exceed that needed to accommodate the room occupants. Normally, outside air quantities of less than 5% make-up air should be sufficient (ASHRAE Handbook: Applications, Chapter 17). A volume of 15 CFM outside air per occupant or workstation should sufficiently accommodate the ventilation needs of the room.

Cleaning Procedures and Equipment

Even a perfectly designed data center requires continued maintenance. Data centers containing design flaws or compromises may require extensive efforts to maintain conditions within desired limits. Hardware performance is an important factor contributing to the need for a high level of cleanliness in the data center.

Operator awareness is another consideration. Maintaining a fairly high level of cleanliness will raise the level of occupant awareness with respect to special requirements and restrictions while in the data center. Occupants or visitors to the data center will hold the controlled environment in high regard and are more likely to act appropriately. Any environment that is maintained to a fairly high level of cleanliness and is kept in a neat and well organized fashion will also command respect from the room's inhabitants and visitors. When potential clients visit the room they will interpret the overall appearance of the room as a reflection of an

overall commitment to excellence and quality. An effective cleaning schedule must consist of specially designed short-term and long-term actions. These can be summarized as follows:

Frequency	Task
Daily Actions	Rubbish removal
Weekly Actions	Access floor maintenance (vacuum and damp mop)
Quarterly Actions	Hardware decontamination
	Room surface decontamination
Bi-Annual Actions	Subfloor void decontamination
	Air conditioner decontamination (as necessary)

Daily Tasks

This statement of work focuses on the removal of each day's discarded trash and rubbish from the room. In addition, daily floor vacuuming may be required in Print Rooms or rooms with a considerable amount of operator activity.

Weekly Tasks

This statement of work focuses on the maintenance of the access floor system. During the week, the access floor becomes soiled with dust accumulations and blemishes. The entire access floor should be vacuumed and damp mopped. All vacuums used in the data center, for any purpose, should be equipped with High Efficiency Particulate Air (HEPA) filtration. Inadequately filtered equipment cannot arrest smaller particles, but rather simply agitates them, degrading the environment they were meant to improve. It is also important that mop-heads and dust wipes are of appropriate non-shedding designs.

Cleaning solutions used within the data center must not pose a threat to the hardware. Solutions that could potentially damage hardware include products that are:

- Ammoniated
- Chlorine-based
- Phosphate-based
- Bleach enriched
- Petro-chemical based
- Floor strippers or re-conditioners

It is also important that the recommended concentrations are used, as even an appropriate agent in an inappropriate concentration can be potentially damaging. The solution should be maintained in good condition throughout the project, and excessive applications should be avoided.

Quarterly Tasks

The quarterly statement of work involves a much more detailed and comprehensive decontamination schedule and should only be conducted by experienced computer room contamination-control professionals. These actions should be performed three to four times per year, based on the levels of activity and contamination present. All room surfaces should be thoroughly decontaminated including cupboards, ledges, racks, shelves and support equipment. High ledges and light fixtures and generally accessible areas should be treated or vacuumed as appropriate. Vertical surfaces including windows, glass partitions, doors, etc. should be thoroughly treated. Special dust cloths that are impregnated with a particle absorbent material are to be used in the surface decontamination process. Do not use generic dust rags or fabric cloths to perform these activities. Do not use any chemicals, waxes or solvents during these activities.

Settled contamination should be removed from all exterior hardware surfaces including horizontal and vertical surfaces. The unit's air inlet and outlet grilles should be treated as well. Do not wipe the unit's control surfaces as these areas can be decontaminated by the use of lightly compressed air. Special care should also be taken when cleaning keyboards and life-safety controls. Specially treated dust wipes should be used to treat all hardware surfaces. Monitors should be treated with optical cleansers and static-free cloths. No Electro-Static Discharge (ESD) dissipative chemicals should be used on the computer hardware, since these agents are caustic and harmful to most sensitive hardware. The computer hardware is sufficiently designed to permit electrostatic dissipation thus no further treatments are required. After all of the hardware and room surfaces have been thoroughly decontaminated, the access floor should be HEPA vacuumed and damp mopped as detailed in the Weekly Actions.

Biennial Tasks

The subfloor void should be decontaminated every 18 months to 24 months based on the conditions of the plenum surfaces and the degree of contaminant accumulation. Over the course of the year, the subfloor void undergoes a considerable amount of activity that creates new contamination accumulations. Although the weekly above floor cleaning activities will greatly reduce the subfloor dust accumulations, a certain amount of surface dirt will migrate into the subfloor void. It is important to maintain the subfloor to a high degree of cleanliness since this area acts as the hardware's supply air plenum. It is best to perform the subfloor decontamination treatment in a short time frame to reduce cross contamination. The personnel performing this operation should be fully trained to assess cable connectivity and priority. Each exposed area of the subfloor void should be individually inspected and assessed for possible cable handling and movement. All twist-in and plug-in connections should be checked and fully engaged before cable movement. All subfloor activities must be conducted with proper consideration for air distribution and floor loading. In an effort to maintain access floor integrity and proper psychrometric conditions, the number of floor tiles removed from the floor system should be carefully managed. In most cases, each work crew should have no more than 24 square feet (six tiles) of open access flooring at any one time. The access floor's supporting grid system should also be thoroughly decontaminated, first by vacuuming the loose debris and then by damp-sponging the accumulated residue. Rubber gaskets, if present, as the metal framework that makes up the grid system should be removed from the grid

work and cleaned with a damp sponge as well. Any unusual conditions, such as damaged floor suspension, floor tiles, cables and surfaces, within the floor void should be noted and reported.

Activity and Processes

Isolation of the data center is an integral factor in maintaining appropriate conditions. All unnecessary activity should be avoided in the data center, and access should be limited to necessary personnel only. Periodic activity, such as tours, should be limited, and traffic should be restricted to away from the hardware so as to avoid accidental contact. All personnel working in the room, including temporary employees and janitorial personnel, should be trained in the most basic sensitivities of the hardware so as to avoid unnecessary exposure. The controlled areas of the data center should be thoroughly isolated from contaminant producing activities. Ideally, print rooms, check sorting rooms, command centers or other areas with high levels of mechanical or human activity should have no direct exposure to the data center. Paths to and from these areas should not necessitate traffic through the main data center areas.

Glossary

This glossary defines terms and abbreviations in this publication.

Some of the definitions are taken from other glossaries. The letters in the parentheses that follow some definitions indicate the source of the definition:

(A) *The American National Standard Dictionary for Information Systems*, ANSI X3.172-1990, copyright 1990 by the American National Standards Institute (ANSI).

(E) The ANSI/Electronic Industries Association (EIA) Standard-440-A, *Fiber Optic Terminology*.

(I) The *Information Technology Vocabulary*, developed by Subcommittee 1, Joint Technical Committee 1, of the International Organization for Standardization and International Electro-technical Commission (ISO/IEC/JTC1/SC1).

(IBM**)** *The IBM Dictionary of Computing*, copyright 1994 by IBM.

(T) Draft international standards committee drafts, and working papers being developed by the ISO/IEC/JTC1/SC1.

A

access time
The time interval between the instant at which a call for data is initialized and the instant at which the delivery of data is completed. (T)

address
A character or group of characters that identifies a register, a particular part of storage, or some other data source or destination. (A)

alphanumeric
Pertaining to data that consist of letters, digits, and usually other characters, such as punctuation marks. (T), (A).

B

beginning-of-tape (BOT)
The location on a tape where written data begins.

block
A collection of contiguous records recorded as a unit. Interblock gaps separate blocks, and each block can contain one or more records.

buffer
A routine or storage that compensates for a difference in the rate of data flow, or the time of occurrence of events when transferring data from one device to another.

burst
In data communication, a sequence of signals counted as one unit in accordance with a specific criterion or measure. (A)

C

capacity
Total amount of User Data stored on one data cartridge in 8-bit bytes. *Synonymous with* "User Capacity" or "Native Capacity". This is the capacity that the user sees after the ECC/Format/ERP and other overhead has been assessed (no compression).

capacity, raw
Total amount of data stored on one data cartridge in 8-bit bytes before any ECC/Format/ERP and other overhead has been assessed (no compression).

capacity, user
Total amount of data stored on one data cartridge in 8-bit bytes that is sent by the host computer. This is the capacity that the user sees after the ECC/Format/ERP and other overhead has been assessed (no compression).

cartridge
A storage device that consists of magnetic tape on a supply reel in a protective housing.

cartridge scratch loader
A device that attaches to a tape drive to automatically load and unload tape cartridges into and out of the drive.

cleaning cartridge
A data cartridge that contains special material to clean the tape path in a transport or drive.

compress
To save space by eliminating gaps, empty fields, redundancy, or unnecessary data to shorten the length of records or files. (IBM)

condition
One of a set of specified values that a data item can assume. (IBM)

conditioning time
The amount of time to prepare a tape cartridge for use in a T9840 Tape Drive.

configuration
The manner in which the hardware and software of an information processing system is organized and interconnected. (T)

connector
An electrical or optical part that joins two or more other parts.

D

data error rate
The number of errors that occur per a measurable amount of data on a tape.

data rate
The speed of a data transfer process, usually expressed in bits per second or bytes per second. (IBM)

Data Security Erase (DSE)
A random binary pattern, over-writing existing data, from the point of an “Erase” command to the End of Tape point.

data tape
A data cartridge formatted for use as a regular data tape for the system in which it is used.

data tracks
The regions of recorded tape containing user data formed as discreet longitudinal “tracks” (similar to railroad tracks).

diagnostics
Pertaining to the detection and isolation of errors in programs and faults in equipment.

drive
A drive controls the movement of the tape and records or reads the data on the tape as desired by the customer.

dump
To copy the contents of all or part of storage to collect error information.

dynamic host configuration protocol (DHCP)
An IP protocol that a host uses to obtain all necessary configuration information, including an IP address.

E

emulation
The use of programming techniques and special machine features to permit a computing system to execute programs written for another system. (IBM)

encryption
The translation of data into a secret code. Encryption is one of the most effective ways to achieve data security. To read an encrypted file, you must have access to a special key or password that enables you to decipher it.

enterprise
A representation of the goals, organizational structure, business processes, and information resources and requirements of an enterprise. (IBM)

Enterprise Systems Connection (ESCON)
A set of IBM products and services that provide a dynamically-connected environment within an enterprise. (IBM)

environmental requirement
Any of the physical conditions required for the protection and proper operation of a functional unit; the requirement is usually specified as a nominal value and a tolerance range. For a device, there may be more than one set of environmental requirements; for example, one set for transport, another for storage, and another for operation. (T) (A)

EOT
End of tape.

error
A discrepancy between a computed, observed, or measured value or condition and the true, specified, or theoretically correct value or condition. (I) (A)

ESCON
See Enterprise Systems Connection.

ESCON channel
A channel having an Enterprise Systems Connection channel-to- control-unit I/O interface that uses optical cables as a transmission medium.

ESD
Electrostatic Discharge.

F

fault symptom code (FSC)
A four-character hexadecimal code generated in response to an error to help isolate failures within the device. Some FSCs are for information purposes only.

FC
See Fibre Channel.

fiber optics
The branch of optical technology concerned with the transmission of radiant power through fibers made of transparent materials such as glass, fused silica, and plastic. (E)

fiber-optic cable
A cable made of ultrathin glass or silica fibers which can transmit data using pulses of laser light. Fiber-optic cables have several advantages over copper cables: they have much less signal loss; they allow information to be transmitted at higher speeds and over longer distances; they are not affected by external electrical noise; and they are better for transmissions which require security.

Fibre Channel
The National Committee for Information Technology Standards standard that defines an ultrahigh-speed, content-independent, multilevel data transmission interface that supports multiple protocols simultaneously. Fibre Channel supports connectivity to millions of devices over copper and/or fiber-optic physical media and provides the best characteristics of both networks and channels over diverse topologies.

fibre connection (FICON)
An ESA/390 and zSeries computer peripheral interface. The I/O interface uses ESA/390 and zSeries FICON protocols (FC-FS and FC-SB-2) over a Fibre Channel serial interface that configures units attached to a FICON-supported Fibre Channel communications fabric.

FICON channel
A channel having a Fibre Channel connection (FICON) channel-to-control-unit I/O interface that uses optical cables as a transmission medium. May operate in either FC or FCV mode.

file-protect
To prevent the erasure or overwriting of data stored on data cartridges. *See also* write-protect switch.

firmware
An ordered set of instructions and data stored in a way that is functionally independent of main storage; for example, microprograms stored in ROM. (T)

FRU
Field replaceable unit.

FSC
Fault symptom code.

FTP
File Transfer Protocol.

G

Gb
Gigabit, equal to 10^9 bits.

Gbps
Gigabits per second.

gigabyte (GB)
One X 2^{30} bytes (binary) or 1 X 10^9 (decimal).

H

hardware
All or part of the physical components of an information processing system, such as computers or peripheral devices. (T) (A)

host
The primary computer on a network, with which other computers interact.

host interface
An interface between a network and host computer. (T)

hub
A Fibre Channel Arbitrated Loop switching device that allows multiple servers and targets, such as storage systems, to connect at a central point. A single hub configuration appears as a single loop.

I

indicator
A device that provides a visual or other indication of the existence of a defined state. (T)

Initial Program Load (IPL)
The initialization procedure that causes an operating system to commence operation.

initialization
The operations required for setting a device to a starting state, before the use of a data medium, or before implementation of a process. (T)

input/output (I/O)
Pertaining to a device, process, or channel involved in data input, data output, or both. (IBM)

internet protocol (IP)
A protocol used to route data from its source to its destination in an Internet environment. (IBM)

internet protocol (IP) v4 address
A four-byte value that identifies a device and makes it accessible through a network. The format of an IP address is a 32-bit numeric address written as four numbers separated by periods. Each number can be from 0 to 255. For example, 129.80.145.23 could be an IP address.

internet protocol (IP) v6 address
The next generation internet protocol. It provides a much larger address space than IPv4. This is based upon the definition of a 128-bit address - IPv4 used a 32-bit address. The IPv6 address format is eight fields of four hexadecimal characters separated by colons (such as, 2001:0db8:85a3:0000:0000:8a2e:0370:7334).

IP
See internet protocol.

L

library
A robotic system that stores, moves, mounts, and dismounts data cartridges that are used in data read or write operations.

link
A physical connection (electrical or optical) between two nodes of a network.

loader
The device that physically loads data cartridges for use.

M

magnetic tape
A tape with a magnetizable layer on which data can be stored. (T)

manual operation
Processing of data in a system by direct manual techniques. (IBM)

MB
Megabytes, or 1,048,576 bytes.

menu
A list of options displayed to the user by a data processing system, from which the user can select an action to be initiated. (T)

Multiple Virtual Storage (MVS)
IBM's Multiple Virtual Storage, consisting of MVS/System Product Version 1 and the MVS/370 Data Facility Product operating on a System/370 processor. (IBM).

Multiple Virtual Storage/Enterprise Systems Architecture (MVS/ESA)
An extended version of IBM's MVS.

MVS
See Multiple Virtual Storage

MVS/ESA
See Multiple Virtual Storage/Enterprise Systems Architecture

N

network
An arrangement of nodes and branches that connects data processing devices to one another through software and hardware links to facilitate information interchange.

O

offline
Neither controlled by, nor communicating with, a computer. (IBM)

online
Pertaining to the operation of a functional unit when under the direct control of the computer. (T)

operator control panel
A functional unit that contains switches used to control all or part of a computer and possibly the indicators giving information about its functioning. (T)

P

performance
One of two major factors on which the total productivity of a system depends. Performance is largely determined by a combination of throughput, response time, and availability. (IBM)

port
A specific communications end point within a host. A port is identified by a port number. (IBM)

R

R/W
Read/write

read/write head
The data sensing and recording unit of a tape drive. (IBM)

reclaim
The act of overwriting a 9840 legacy data cartridge by a newer generation drive. For example, a cartridge written by a T9840A drive can be overwritten (reclaimed) by either a T9840C or T9840D drive while a cartridge written by a T9840C drive can be reclaimed by a T9840D drive.

release
A distribution of a new product or new function and fixes for an existing product. (IBM)

rewind
To move tape from the take-up hub to the supply hub. (IBM)

ROM
Read-only memory.

S

SCSI
See small computer system interface.

SLC
See StorageTek Library Console.

small computer system interface (SCSI)
An input and output bus that provides a standard interface between devices.

StorageTek Library Console
The operator panel software application used for the SL8500 Modular Library System.

submenu
A menu related to and reached from a main menu. (IBM)

subsystem
A system that is part of some larger system.

switch
In Fibre Channel technology, a device that connects Fibre Channel devices together in a fabric.

system
A combination of functionally interrelated interacting mechanical and electrical elements designed to work as a coherent entity.

T

tape
See magnetic tape.

tape drive
A device for moving magnetic tape and controlling its movement. (T)

TCP/IP
Transmission Control Protocol/Internet Protocol.

transmission control protocol/internet protocol (TCP/IP)
A set of communication protocols that support peer-to-peer connectivity functions for both local and wide area networks. (IBM)

V

vary offline
To change the status of a device from online to offline. When a device is offline, no data set may be opened on that device. (IBM)

vary online
To restore a device to a state where it is available for use by the system. (IBM)

VolSafe
VolSafe (volume safe) is a special StorageTek feature that provides write once, read many (WORM) technology to VolSafe-designated tape cartridges. VolSafe permits new data to only append the tape media, while it prevents erasure or overwrite of previously written data.

VOLSER
1. VOLume SERial Number. It is usually six characters long and is both the paper label stuck on the back edge of the cartridge and in the VOLID label that is recorded, particularly by MVS systems, at the beginning of the media.
2. An alphanumeric label that the host software uses to identify a volume. It attaches to the spine of a cartridge and is both human- and machine-readable.

W

wrap
A single pass of tape from either BOT to EOT or EOT to BOT with the heads in a fixed transverse location.

write-enabled
A setting on a data cartridge that allows data to be written on the tape.

write operation
An output operation that sends a processed record to an output device or output file. (IBM)

write-protected
A setting on a data cartridge that prevents data from being written on the tape. Reading data is still possible.

Index

Symbols

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