StorageTek SL150 Modular Tape Library

Systems Assurance Guide

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StorageTek SL150 Modular Tape Library Systems Assurance Guide

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Preface

This guide is intended for anyone involved with installation planning or the ordering of Oracle's StorageTek SL150 Modular Tape Library.

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Product Overview

Oracle's StorageTek SL150 Modular Tape Library is a rack-mounted, automated tape library containing up to 300 tape cartridges (tapes) with one to 20 half-height LTO Ultrium 5 or 6 Fibre Channel (FC) or Serial Attached SCSI (SAS) tape drives (see "Tape Drives and Media" on page 1-4). The robot control is a SCSI Medium Changer device that appears as LUN 1 on a bridged tape drive.

The SL150 Library scales from one to ten modules. A module has two tape drive slots. Each module stores up to 30 tapes in two 15-slot magazines (one on the left side and the other on the right side). Additionally, a four slot mailslot is available in the base module for entering tapes into or removing tapes from the library (see Figure 1–1).

Figure 1–1 90 Cartridge Library (Front View)

Illustration Legend:

1 - Base module (Module 1)

2 - Expansion module (Module 2)

3 - Left cartridge magazines

4 - Right cartridge magazines

5 - Front control panel

6 - Mailslot

Bridging

Tape drive bridging provides the external interface for library control. The bridged drive is LUN 0 and the library is LUN 1.

Data, command, and control signals travel directly to the data interface of the SAS or FC tape drive. The designated bridged drive handles all control communications for the library or library partition and passes command and control signals to the library controller.

A library without partitions must have one bridged drive. A partitioned library must have a bridged drive for each partition.

Modules

The SL150 Library has two types of modules: the base module (designated Module 1) and the expansion module (designated as Modules 2 through 10).

Module 1 is the smallest fully functional library, and it contains:

- Front control panel
- Two 15-slot tape magazines (left and right)
- Standard Mailslot with four tape slots (see "Partitions" on page 1-8 for additional details)

> **Note:** Code version 2.25, and higher, supports a 19 slot Expanded Mailslot configuration.

- Robotics with one hand
- Power supply (with an option to add a second power supply)
- Tape drive (with an option to add a second drive)

Up to three tape slots in Module 1 can be designated as reserved slots to store diagnostic or cleaning tapes.

At the rear of Module 1, there is an Ethernet port for remote management and nine USB Type A ports for connection to expansion modules (see Figure 1–2).

Figure 1–2 Base Module and Expansion Modules - Rear View

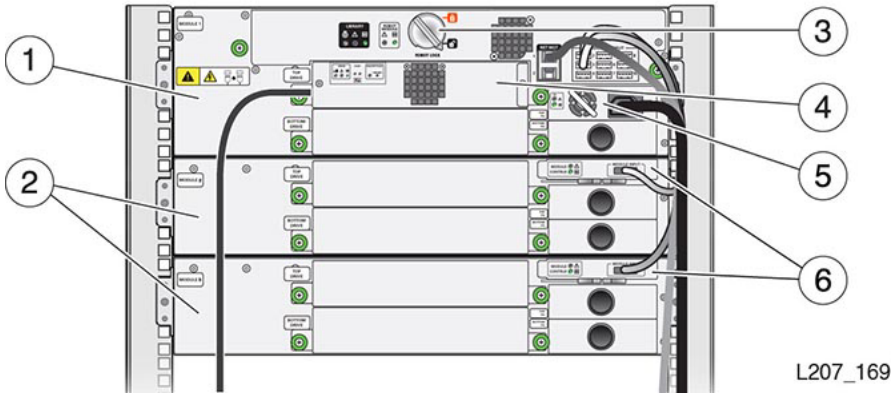

Illustration Legend:

1 - Base module (the Module 1 label is on the rear panel of the module)

2 - Expansion module (a label with the module number is on the rear panel)

3 - Robot lock (Improved Design)

4 - Tape drive tray

5 - Power supply

6 - Module controller (Module 2 and Module 3)

> **Note:** In addition to the components listed previously, Module 1 ships with an accessory kit containing rail components, attachment hardware, and identification labels.

An expansion module can be added to the bottom of the library to provide additional tape cartridge capacity and additional performance by adding tape drives (see Figure 1–2). An expansion module requires 2U of rack space. An expansion module ships with:

- Two 15-slot tape magazines (left and right)
- Module controller
- Expansion cable that has two USB Type A connectors
- Mounting hardware to secure the module to the rack
- Identification labels

The module controller is connected to the base module by an expansion cable that incorporates USB Type A connectors. The cable provides a communication path between the base and expansion modules and a power source for the module controller.

The expansion module has slots for two tape drives and two power supplies. There is *insufficient* power from the expansion cable to support a tape drive. Therefore, a power supply is required when the expansion module has a tape drive.

An SL150 Library can be divided into partitions (see "Partitions" on page 1-8).

Robot

The robotic mechanism resides in the base module. The bull wheel is located in the top of the base module. The Z platform cables go through pulleys and wind around the bull wheel (see Figure 1–3). As the bull wheel rotates, the cables lower or raise the Z platform depending on the direction of bull wheel rotation. A hand assembly moves along Z-platform rods to provide the track motion. The hand assembly contains a retractable reach mechanism, and the hand rotates to align with a left magazine slot, a right magazine slot, a slot in the mailslot, or a tape drive at the rear of the library. The reach mechanism has spring-loaded grippers to grip and release a tape cartridge.

Vision

The hand assembly uses two vertical cavity surface emitting laser (VCSEL) devices to scan barcodes and to target cells. One VCSEL is mounted on each end of the hand. Moving the VCSEL past a bar code or the edge of a tape cartridge slot generates a data stream which is decoded on the main processor to generate the bar code or to locate a target position.

Figure 1–3 Robot

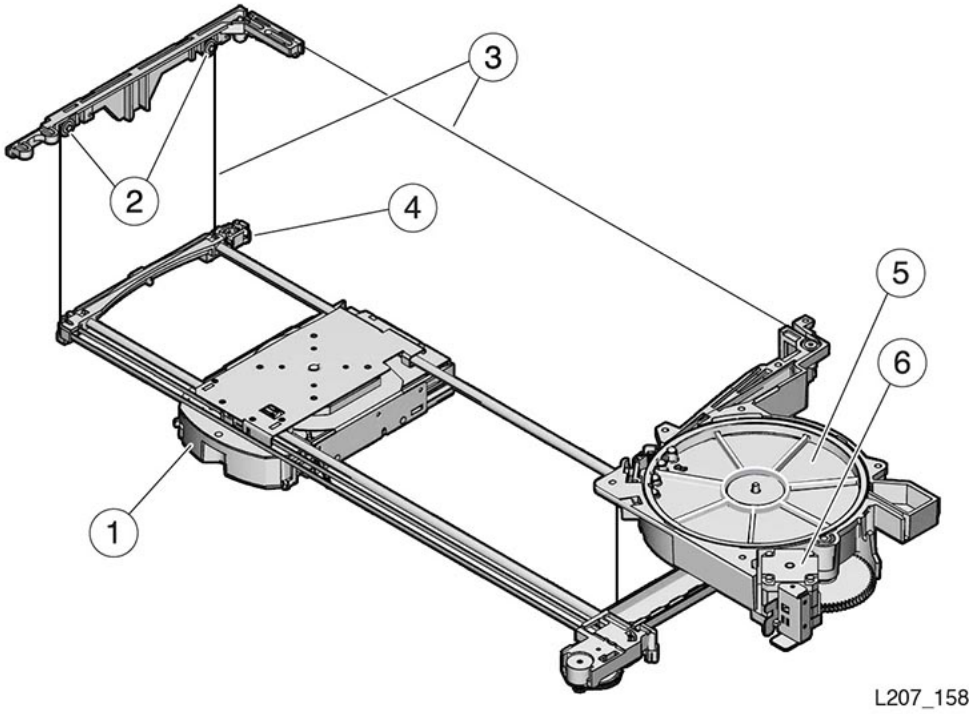

Illustration Legend:

1 - Hand

2 - Pulleys

3 - Suspension cables

4 - Z platform

5 - Bull wheel

6 - Z motor

Class 1 Laser Product Notice

The StorageTek SL150 Modular Tape Library contains a class-1 laser as defined by IEC 60825-1 Ed. 2 (2007).

Tape Drives and Media

The SL150 Library supports the following Linear Tape Open (LTO) half-height, tape drives manufactured by HP:

- Generation 5 Fibre Channel or SAS
- Generation 6 Fibre Channel or SAS

  The library supports simultaneous installation of Generation 5 and 6 tape drives as bridged tape drives and data drives.

Drive Firmware version required:

- Fibre Channel:

  - LTO-5: Y5BS, Y65S, or greater
  - LTO-6: 22GS, 239S, or greater
- SAS:
  - LTO-5: Z55S, Z65S, or greater
  - LTO-6: 32DS, 339S, or greater

Cartridges supported:

Standard LTO data cartridges are labeled with a unique, customer-assigned, volume ID, followed by a media ID field.

- Generation 6:
  - L6 media ID: read and write in LTO-6 format
  - LW media ID (WORM): read and write in LTO-6 format
- Generation 5:
  - L5 media ID: read and write in LTO-5 format
  - LV media ID (WORM): read and write in LTO-5 format
- Generation 4:
  - L4 media ID or LU media ID (WORM):
    * LTO-6 drive: read only
    * LTO-5 drive: read and write in LTO-4 format
- Generation 3:
  - L3 media ID or LT media ID (WORM): read only in an LTO-5 drive

> **Note:** The LTO-6 drive does not support generation 3 media.

- Universal Cleaning Cartridge

Figure 1–4 Tape Cartridge

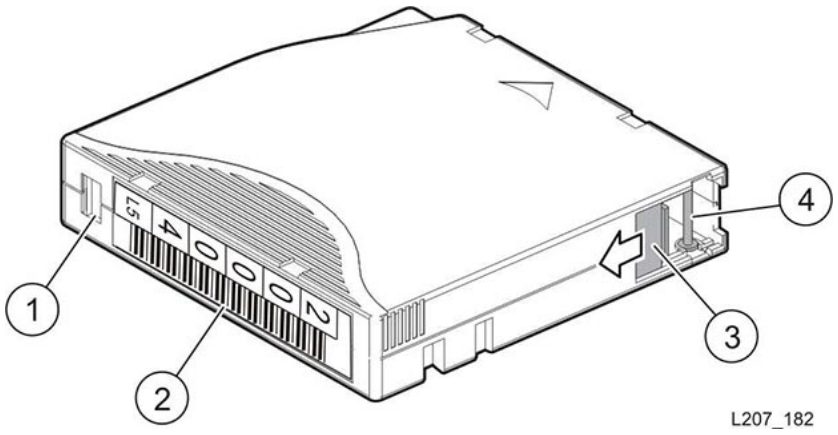

Illustration Legend:

1 - Write protect switch

2 - Volume ID label (barcode toward cartridge hub)

3 - Access door

4 - Leader pin

Cartridge Label Options

To accommodate the fullest range of possible labeling schemes, the SL150 Library supports labels eight to 14 characters long and provides a *label windowing* feature that lets you specify how labels should be interpreted when communicating with the host application.

The library user interface supports the following labeling options:

- **No type checking** passes all characters in the label without modification and without checking the media domain and type. Use this option if your labels do not identify the media; for example, `M123456789AB` does not contain a media descriptor (such as `L5`).
- **Prepend last two characters** passes all the characters after moving the last two characters in the label to the front: `KL10203012L5` is translated to `L5KL10203012`.
- **Full label** passes the first eight characters in the physical label: `KL10203012L5` is translated to `KL102030`.
- **Trim last character** passes the first seven characters in the physical label: `KL10203012L5` is translated to `KL10203`.
- **Trim last two characters** passes the first six characters in the physical label: `KL10203012L5` is translated to `KL1020`.
- **Trim first two characters** passes the third through eighth characters in the physical label: `KL10203012L5` is translated to `102030`.
- **Trim first character** passes the second through eighth characters in the physical label: `KL10203012L5` is translated to `L102030`.

See the *StorageTek SL150 Modular Tape Library User's Guide* for additional information on tape labels and use of the Configuration section of the SL150 remote GUI.

Human Interfaces

There are three ways to interact with the SL150 Library: the mailslot, operator panel, and remote interface.

- The four cartridge mailslot, located above the right magazine in the base module, is used for entering tapes into and removing tapes from the library without interfering with robot operations. It can be opened from the front control panel touch screen or from the remote interface depending on your user role.

  Note: Code version 2.25, and higher, supports a 19 slot Expanded Mailslot configuration.

- The front control panel contains an LCD touch screen operator panel designed for use as an information point rather than as a maintenance tool (see Figure 1–5).

  Information shown on the panel is primarily in tabular format and is available for: the library, modules, magazines, the mailslot, partitions (if enabled), drives, tapes, and settings. The masthead contains a home button to return from an information section, a button to present the copyright information, an activity icon, the library health (Operational in this example), and the library state.

Figure 1–5 Operator Panel Home Screen

- The remote GUI is the primary management interface for the SL150 Library, and you access it by entering the library host name or IP address into a web browser. The interface example (shown in Figure 1–6) is for a library with two partitions, and provides menus for the library, partitions, drives, tapes, configuration, firmware, SNMP, users, and service.

> **Note:** Library code versions lower than 2.0 had a Settings menu instead of the Configuration, Firmware, and SNMP menus in 2.0.

Figure 1–6 Remote Management Interface

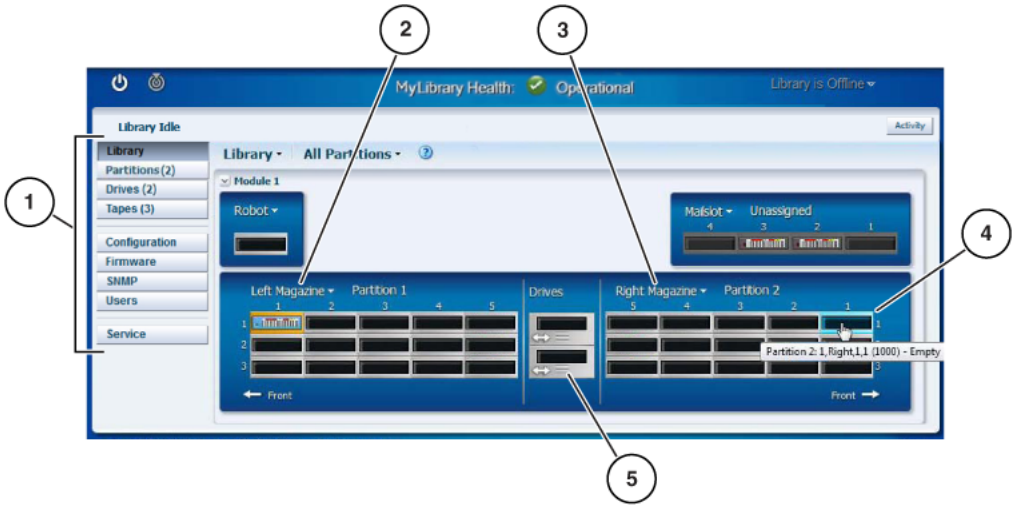

Illustration Legend:

1 - Section navigation

2 - Left magazine control

3 - Right magazine control

4 - Slot identification

5 - Tape drive (two-headed arrow indicates a bridged drive)

The library information is presented as a graphical representation of tape slots in the left and right magazines, mailslots, drives, the robot, and all installed modules (Module 1 is expanded in Figure 1–6 while Module 2 is collapsed). In addition, the slot identification information is shown for the right magazine, first row, and first column. For additional information on slot identification see Appendix A, "Locations" and Appendix B, "Partitioning Overview".

The Library list (above the label for Module 1) provides the capability to display library properties, audit the library, unlock magazines, lock and audit magazines, run a self test, expand all available modules, or collapse all modules.

The partitions, drives, tapes, configuration, firmware, SNMP, and service menus present information in a tabular format. Some of the menus have tabs to present information in distinct categories.

An administrator creates individual user accounts for the library and assigns a distinct user role to each account. The library recognizes four user roles: viewer, operator, service, and administrator. Each of these roles has limits on what screens are seen and what actions can be performed.

Refer to the *StorageTek SL150 Modular Tape Library User's Guide* or the Help system of the remote interface for specific information regarding the user interface.

Partitions

The SL150 Library supports a maximum of eight partitions with each partition having at least one tape drive and one magazine. Each partition behaves as an independent library, but all partitions share the use of the reserved cells, the single robot, and the four-cartridge mailslot. Each partition must have a tape drive to provide the host interface (bridging).

- When ejecting cartridges, the mailslot must be explicitly assigned to a partition before any cartridge movement takes place.
- When entering cartridges through the mailslot, the user must specify the destination partition.

> **Note:** The administrator enables partitions from the Configuration button. Refer to the user's guide or the remote interface online Help for specific information about setting configuration values.

Additional information on partitions is provided in Appendix B.

SNMP

The library's SNMP agent can automatically send *traps* to alert network management stations of faults and configuration changes. Both version 2c and version 3 of the SNMP standard are supported.

- Version 2c is backward compatible with earlier versions of the standard, but it is not secure because authentication credentials (community strings) and management data are exchanged in clear text.

- Version 3 is not backward compatible, but it supports a more secure authentication method and can encrypt management data.

The administrator defines SNMP users and recipients in the SNMP section of the remote management interface. The MIB can be downloaded using the management interface. Refer to the *StorageTek SL150 Modular Tape Library User's Guide* or the remote interface online Help for specific information.

StorageTek Tape Analytics

StorageTek Tape Analytics (STA) is an intelligent monitoring application, available exclusively for StorageTek modular tape libraries (including SL150, SL500, SL3000, and SL8500). It simplifies tape storage management and allows the customer to make informed decisions about future tape storage investments based on the current health of the tape storage environment.

Note: STA requires a dedicated server. Oracle recommends that you place the STA server on the same subnet as the library to improve SNMP UDP reliability.

To set up communications between the STA server and the libraries, you must perform some configuration procedures on the libraries and some on the STA server. STA uses both the v2c and v3 SNMP protocols to communicate with the library.

- The initial communication handshake between a library and the STA server is done through the v2c protocol.
- The traps and get functions are done through the v3 protocol. The authentication, encryption, and message integrity features in SNMP v3 provide a secure mechanism for sending library data.

STA allows the customer to monitor globally dispersed libraries from a single, browser-based user interface. The customer can manage open systems and mainframe, mixed-media, and mixed-drive environments across multiple library platforms.

STA allows the customer to increase the use and performance of tape investments by performing detailed performance trending analyses. These analyses are based on a regularly updated database of library operations. STA captures and retains data from your tape library environment and uses this data to calculate the health status of your library resources (drives and media). STA aggregates data according to a variety of criteria and displays it in tabular and graphical formats, allowing you to quickly assess environment activity, health, and capacity.

Refer to the STA documentation library on the Oracle Technology Network (OTN) for additional information regarding the STA product and the dedicated STA server. Select the **Tape Storage** link at the following URL:

http://www.oracle.com/technetwork/documentation/index.html#storage

Automated Cartridge System Library Software

Note: ACSLS is supported but not required for operation of the SL150 Library.

StorageTek Automated Cartridge System Library Software (ACSLS) functions as the central service provider for all library operations, efficiently sharing library resources with any ACSLS-enabled application on any system, and allowing centralized library control across multiple StorageTek libraries.

ACSLS version 8.2 or greater is required for interfacing with the SL150 Library.

ACSLS version 8.3 (second patch) is required for library code version 2.25 which supports new ASC and ASCQ reporting.

Refer to the ACSLS documentation library for additional information regarding support for the SL150 Library. Use the link listed in the STA section to access the Tape Storage section of OTN.

Note: ACSLS versions 8.2 and 8.3 do not support the Expanded Mailslot configuration (19 mailslots) available with library code version 2.25.

Library Specifications

Physical:

- Depth: 925 mm (36.4 inches including 2.25 inches of tape drive extension)
- Height:
  - 3U (130.8 mm, 5.15 inches): base module (Module 1)
  - 2U (88.9 mm, 3.5 inches): expansion module (Modules 2 through 10)
- Width: 481 mm (18.9 inches)
- Weight:
  - 21.3 kg (47 pounds [base module, two cartridge magazines, one tape drive, and one power supply])
  - 14.3 kg (31.5 pounds [expansion module, two cartridge magazines, no tape drive, and no power supply])

Power:

- AC voltage: 100-240 VAC
- Line frequency: 50-60 Hz single phase (auto-ranging)
- Library (operating maximum continuous—not peak) see the power calculator at the following URL

http://www.oracle.com/us/products/servers-storage/sun-power-calculators/index.html

The smallest SL150 Library consisting of a base module, one tape drive, and one power supply has a total idle power of 44 W (150 Btu/hr) and a steady state maximum of 67.5 W (230 Btu/hr).

Rack space requirements:

- Base module: 3U (131 mm, 5.15 inches)
- Expansion module: 2U (88.9 mm, 3.5 inches)
- Depth (minimum): 925 mm (36.4 inches)

Note: The SL150 Library can be installed in a rack with front to rear rail spacing from 457 mm (18 inches) to 902 mm (35.5 inches).

Environmental Information

Temperature:

- Operating: +10° to +40°C (+50° to +104°F)
- Non-operating –40° to +60°C (–40° to +140°F)

Relative Humidity:

- Operating: 20% to 80% non-condensing
- Non-operating: 10% to 95% non-condensing

The operating environment must meet the additional requirements listed in Appendix C, "Controlling Contaminants".

2

Planning

This chapter provides information for consideration when planning for the installation of the StorageTek SL150 Modular Tape Library.

Multiple LUN Support

The SL150 Library uses a single SCSI ID and two logical unit numbers (LUN). LUN 0 controls the tape drive and LUN 1 controls the robotics. The designated tape drive provides the bridging function and must be connected to an HBA supporting multiple LUNs (also referred to as LUN scanning).

A library without partitions must have one bridged drive. A partitioned library must have a bridged drive for each partition.

Tape Device Driver

Make sure that the proper device driver is installed, if applicable. Download the driver from the HP website, if needed.

For example, Oracle has qualified the HP LTO-5 and LTO-6 drives with Windows driver 3.5.0.0.

SAN Connection

The library can be connected to the host HBA through a storage area network (SAN). Configure zoning on the Fibre Channel switch so only the backup servers access the library.

The half-height FC tape drive has an 8 Gb per second data interface.

Zoning

Use zoning to partition a SAN into logical groupings of devices so that each group is isolated from the other and can only access the devices in its own group. Two types of zoning exist:

- Hardware zoning: based on physical fabric port number
- Software zoning: defined with the World Wide Node Name (WWNN) or World Wide Port Name (WWPN)

While zoning can be reconfigured without causing an outage, some zoning configurations can become complicated. The advantage of the library's WWNN implementation is that you can avoid the exposure of introducing zoning errors

because there is no need to change the zoning configuration when a drive needs service or replacement.

Note: The dynamic World Wide Name (dWWN) feature assigns world wide names to the library drive slots rather than the drives themselves which allows you to swap or replace a drive without bringing down the entire operating system.

Persistent Binding

When a server is started, it discovers attached devices and assigns SCSI target and LUN IDs. It is possible for these SCSI assignments to change between restarts. Some operating systems do not guarantee that devices will always be allocated the same SCSI target ID after restarting. Also, some software depends on this association, so you do not want it to change.

The issue of SCSI ID assignment is addressed by persistent binding. Persistent binding is a host bus adapter (HBA) function that allows a subset of discovered targets to be bound between a server and device.

Implemented by a WWNN or WWPN, persistent binding causes a tape drive's WWN to be bound to a specific SCSI target ID.

Serial Attached SCSI (SAS)

SAS uses serial connections, with a direct connection between the host server and each of the storage devices. SAS signal rates require clean connections and a minimum number of connections between the HBA and the SL150 Library. Oracle recommends a maximum SAS cable length of six meters.

The half-height SAS tape drive has a 6 Gb per second data interface.

Oracle SAS HBAs:

- 3Gb (SAS-1):
  - SG-XPCI8SAS-E-Z
  - SG-XPCIE8SAS-E-Z
  - SG-XPCIE8SAS-EB-Z
- 6Gb (SAS-2):
  - SGX-SAS6-EXT-Z
  - SGX-SAS6-EM-Z

SAS-2 Configuration Issues

Caution: The Solaris 10 (Update 8 and later) SAS driver disrupts communications between Oracle Solaris and common tape backup applications.

The SAS driver only allows one device driver to attach per device (sg, sgen, st, and so forth). Users must have every component in the following list to be affected:

- Oracle Solaris 10 (Update 8 or later) or Solaris 11

- Any SAS-2 HBA
- Tape drives or libraries using a SAS-2 connection
- A backup application that requires multiple SAS drivers. The most common backup applications that use multiple device drivers include:
  - CA ARCserve
  - EMC Networker
  - HP Data Protector
  - IBM Tivoli Storage Manager
  - Symantec NetBackup

A SAS tape drive attached through the SAS-2 HBA will work on the Solaris system using just the Solaris native commands such as `dd` or `tar`.

Power Over Ethernet (POE)

Network switches providing power over Ethernet (POE) must be IEEE certified.

Note: A switch that is not IEEE certified might provide too much current over the cable and overload the Ethernet connection on the library. Results of an overload appear as the Ethernet port being unresponsive and the remote management interface not working.

IPv6 Network Address

Code version 2.0, and higher, enables the SL150 Library to support a dual-stack network configuration that uses both IPv4 and IPv6. In dual-stack mode, the library continues to recognize the familiar, dot-delimited IPv4 addresses while adding the capability to use hexadecimal IPv6 addresses.

The library administrator enables dual-stack IPv4 and IPv6 from the Configuration section of the remote management interface. The available selections for IPv6 are DHCPv6, Stateless (SLAAC), or Static. If Static is selected, the administrator is prompted to enter the Prefix Length.

Always consult with the network administrator:

- Before configuring or changing IPv6 addressing
- To get the length of the network prefix for your location

Equipment Service Clearances

The front and rear service clearance must be at least 965 mm (38 inches).

Drives With Two Ports

When a tape drive has two ports, host applications can treat the second drive port as a failover port. The library may report a Check Condition to a command received on one port when the other port is busy with a library command. When a host application receives either of the following *new* Check Conditions, it should reissue the command:

- Not Ready, Logical Unit Offline (02/04/12h)

- Aborted Command, Logical Unit Communication Failure (OBh/08/00)

Notes: The half-height LTO-5 FC tape drive has one port while the other supported drives have two ports.

Only some host applications support this feature. Be sure to check the status of this feature with your application.

Tape Drive Cleaning

LTO drives send a cleaning request to both the SL150 Library and the host application managing the library (or partition). You can handle cleaning in either of two ways:

- Automatically manage cleaning by configuring the host application (for example, Symantec NetBackup or IBM Tivoli Storage Manager) for *Automatic*, *Tape Alert*, or *reactive cleaning* depending on the application.
- Monitor the library health for a Degraded state and initiate cleaning for the specific drive. Because this is not an automatic process, you must monitor drives regularly and respond quickly to cleaning requests.

Refer to the *StorageTek SL150 Modular Tape Library User's Guide* for details on implementing tape drive cleaning.

3

Ordering

This chapter provides the following information:

SL150 Modular Tape Library Part Numbers

When ordering a new SL150, use the following part numbers:

- 7101750: base module, 30 slots with one HP LTO-5 half-height FC tape drive
- 7101760: base module, 30 slots with one HP LTO-5 half-height SAS tape drive
- 7104475: base module, 30 slots with one HP LTO-6 half-height FC tape drive
- 7104476: base module, 30 slots with one HP LTO-6 half-height SAS tape drive
- 7101763: SL150 expansion module, 30 slots (contains neither a tape drive assembly nor a power supply)
- 7101761: SL150 drive, HP LTO-5, half-height SAS
- 7104474: SL150 drive, HP LTO-6, half-height SAS
- 7101762: SL150 drive, HP LTO-5, half-height FC
- 7104473: SL150 drive, HP LTO-6, half-height FC
- 7101769: SL150 power supply

For upgrades and other options to existing systems, use the following part numbers:

- 7101770: SL150 expansion module, 30 slots (contains neither a tape drive assembly nor a power supply)
- 7101772: SL150 drive, HP LTO-5, half-height SAS
- 7104450: SL150 drive, HP LTO-6, half-height SAS
- 7101773: SL150 drive, HP LTO-5, half-height FC
- 7104449: SL150 drive, HP LTO-6, half-height FC
- 7101771: SL150 power supply
- 7101774: SL150 magazine set (left and right)

Configuration and Ordering Examples

A few examples are provided to show the use of both new library part numbers and upgrade part numbers.

Example 1:

- **30 cartridge library** with an FC drive, a second FC drive, and a second power supply (redundant power):

  7101750: SL150 library, 30 slots with HP LTO-5 half-height FC tape drive

  7101762: SL150 drive, HP LTO-5, half-height FC

  7101769: SL150 power supply

Example 2:

- **60 cartridge library with two partitions**, a total of four drives (2 SAS and 2 FC), and four power supplies:

  7101760: SL150 library, 30 slots with one HP LTO-5 half-height SAS tape drive

  7101763: SL150 expansion module, 30 slots (contains neither a tape drive assembly nor a power supply)

  7101761: SL150 drive, HP LTO-5, half-height SAS

  7101762: SL150 drive, HP LTO-5, half-height FC

  7101762: SL150 drive, HP LTO-5, half-height FC

  7101769: SL150 power supply (**x3**)

> **Note:** For this example, partition 1 has SAS drives while partition 2 has FC drives. However, the SL150 Library does support mixed drives without partitioning.

Example 3:

- **90 cartridge library** with one FC drive

  7101750: SL150 library, 30 slots with one HP LTO-5 half-height FC tape drive

  7101763: SL150 expansion module, 30 slots [contains neither a tape drive assembly nor a power supply] (**x2**)

Example 4:

- **Upgrade** an existing nonpartitioned library from 30 to 120 cartridges with a SAS drive in each module (power is not redundant):

  7101770: SL150 expansion module, 30 slots [contains neither a tape drive assembly nor a power supply)] (**x3**)

  7101772: SL150 drive, HP LTO-5, half-height SAS (**x3**)

  7101771: SL150 power supply (**x3**)

> **Note:** Additional modules require a power supply when a tape drive is installed in the module.

Cable Part Numbers

This section provides part numbers for:

- "Ethernet Cables"
- "Multimode Fiber-optic Cables"
- "SAS Cables"

Ethernet Cables

The library uses Ethernet cables for network connections. Always use shielded Ethernet cables to connect to a drive installed in a library.

The following Ethernet cable part numbers can be ordered with the initial order or as upgrades.

- CABLE10187033-Z-A: CAT5E, 8 feet, shielded
- CABLE10187034-Z-A: CAT5E, 35 feet, shielded
- CABLE10187035-Z-A: CAT5E, 50 inches, shielded
- CABLE10187037-Z-A: CAT5E, 55 feet, shielded

Multimode Fiber-optic Cables

The following multimode (50-micron) fiber-optic cables connect Fibre Channel devices. These cables are orange with tan LC connectors. The tape drive only supports LC connectors.

The following fiber-optic cable part numbers can be ordered with the initial order or as upgrades.

Riser cable materials are not classified according to flammability.

- CABLE10800307-Z-A

  LC-LC, 50/125/ duplex, riser, 1 meter
- CABLE10800308-Z-A

  LC-LC, 50/125/ duplex, riser, 2 meter
- CABLE10800310-Z-A

  LC-LC, 50/125/ duplex, riser, 10 meter
- CABLE10800311-Z-A

  LC-LC, 50/125/ duplex, riser, 50 meter
- CABLE10800312-Z-A

  LC-LC, 50/125/ duplex, riser, 100 meter
- CABLE10800340-Z-A

  LC-LC, 50/125/ duplex, riser, 3 meter
- CABLE10800341-Z-A

  LC-LC, 50/125/ duplex, riser, 5 meter

Plenum cables meet UL standards for flammability.

- CABLE10800313-Z-A

LC-LC, 50/125/ duplex, plenum, 10 meter

- CABLE10800314-Z-A

  LC-LC, 50/125/ duplex, plenum, 50 meter

- CABLE10800315-Z-A

  LC-LC, 50/125/ duplex, plenum, 100 meter

SAS Cables

The following SAS cable part numbers can be ordered with the initial order or as upgrades:

- 7100274: 2x1 3M SAS cable
- 7100276: 1x1 3M 4X Mini SAS cable, SHLD

  Each SAS tape drive assembly has two SAS ports.

Power Cord Part Numbers

- PWRCORD10083243-A

  Power Cord: Japan, 2.5 meters, METI plug, IEC60320-1-C13 connector, 15 A (for factory installation)

- PWRCORD10083244-A

  Power Cord: Australia, 2.5 meters, SA3112 plug, IEC60320-1-C13 connector, 10 A (for factory installation)

- PWRCORD10083245-A

  Power Cord: Italy, 2.5 meters, CEI23 plug, IEC60320-1-C13 connector, 10 A (for factory installation)

- PWRCORD10083246-A

  Power Cord: Switzerland, 2.5 meters, SEV1011 plug, 10A, IEC60320-1-C13 connector, 10 A (for factory installation)

- PWRCORD10083247-A

  Power Cord: United Kingdom, 2.5 meters, BS1363A plug, 10A, IEC60320-1-C13 connector, 10 A (for factory installation)

- PWRCORD10083248-A

  Power Cord: Denmark, 2.5 meters, DEMKO107 plug, IEC60320-1-C13 connector, 10 A (for factory installation)

- PWRCORD10083636-A

  Power Cord: South Africa, 2.5 meters, BS546 plug, IEC60320-1-C13 connector, 16 A (for factory installation)

- PWRCORD10187018-A

  Power Cord: Europe, 2.5 meters, CEE 7/VII plug, IEC60320-1-C13 connector, 10 A (for factory installation)

- PWRCORD10187019-A

  Power Cord: North America and Asia, 2.3 meters, NEMA 5-15 plug, IEC60320-1-C13 connector, 10 A (for factory installation)

- PWRCORD10187061-A

  Power Cord: North America and Asia, 3.0 meters, NEMA 5-15 plug, IEC60320-1-C13 connector, 15 A (for factory installation)

- PWRCORD10187086-A

  Power Cord: Taiwan, 2.5 meters, CNS10917 plug, IEC60320-1-C13 connector, 10 A (for factory installation)

- 333U-10-10-C14

  Power cord: Jumper, 1.0 meter, straight IEC60320-2-2 Sheet E (C14) plug, right angle IEC60320-1-C13 connector, 10A. 250 VAC

Information on Ordering Media and Labels

- Call 1.877.STK.TAPE to order media from your local reseller or to obtain media pre-sales support.
- E-mail: tapemediaorders_ww@oracle.com

See the tape media area on the corporate website for additional information.

`http://www.oracle.com/us/products/storage/overview/index.html`

Click the **Tape Storage** tab and the **StorageTek LTO Data Cartridges** link.

A

Locations

This appendix describes the SL150 Modular Tape Library walls (sides), tape slots, and location scheme.

Library Walls

There are two types of walls in the library:

1. Left side wall, which consists of a 15-cartridge slot magazine array
2. Right side wall, which consists of 15-cartridge slot array magazine and 4-cartridge slot Mailslot magazine array

Tapes (cartridges) placed in slots lay flat, hub down, and parallel to the floor. To prevent slippage, tapes are held within their slots by molded-in internal retainer clips.

Tape Slot Locations

Figure A–1 through Figure A–3 show valid storage slot, mailslot, and drive locations.

Tape locations in previous StorageTek libraries were listed by a LIBRARY Physical addressing scheme involving Panel, Row, and Column values. SL150 uses the USER Physical addressing scheme which may change per the component being referenced.

Component	SCSI Element Address	USER Physical addressing
Slot (Data)	Yes	*module*,*side*,*row*,*column*
Slot (Reserved)	No	*module*,*side*,*row*,*column*
Drives	Yes	*module*,*top*|*bottom*
Mailslot	Yes	*slot number*
Expanded Mailslot	Yes	*module*,*side*,*row*,*column*
Power Supply	No	*module*,*top*|*bottom*
Hand (Robot)	Yes	n/a

Figure A–1 through Figure A–3 illustrate where these terms apply.

Element Mapping

Table A–1 shows the starting element address and the maximum number of each element type when the SL150 Library is installed with 10 modules.

Note: The mailslots allow an operator to insert or remove cartridges during library operations. The mailslots are also referred to as Import/Export elements or cartridge access ports (CAPs).

Table A–1 Starting Element Address and Maximum Number of Elements

Element Type	First Element Address	Maximum Number of Elements for an SL150 Library with 10 Modules and the Standard Mailslot Configuration	Maximum Number of Elements for an SL150 Library with 10 Modules and the Expanded Mailslot Configuration
Hand	0	1	1
Mailslot	10	4	19
Drives	500	20	20
Storage Slots	1000	300	285

Table A–2 shows the element type and the associated numbering key in the SL150 Library.

Table A–2 Numbering Key

Element Type	Numbering Key
Hand	Host Address: *SCSI Element Address*
Mailslot	Host Address: *SCSI Element Address* User Physical: *slot number*
Expanded Mailslot	Host Address: *SCSI Element Address* User Physical: *module*,*side*,*row*,*column*
Drives	Host Address: *SCSI Element Address* User Physical: *module*,*Top*|*Bottom*
Storage Slots	Host Address: *SCSI Element Address* User Physical: *module*,*side*,*row*,*column*
Reserved Slots	User Physical: *module*,*side*,*row*,*column*
Power Supply	User Physical: *module*,*Top*|*Bottom*

Library Configuration and Slot Maps

Figure A–1 shows a library with a base module, no reserved cells, and the standard mailslot configuration.

Figure A–2 shows a library with two modules, no reserved cells, and the expanded mailslot configuration.

Figure A–3 shows a library with ten modules, three reserved cells, and the standard mailslot configuration.

Figure A–1 Non-Partitioned One Module Library, Standard Mailslot, and No Reserved Cells

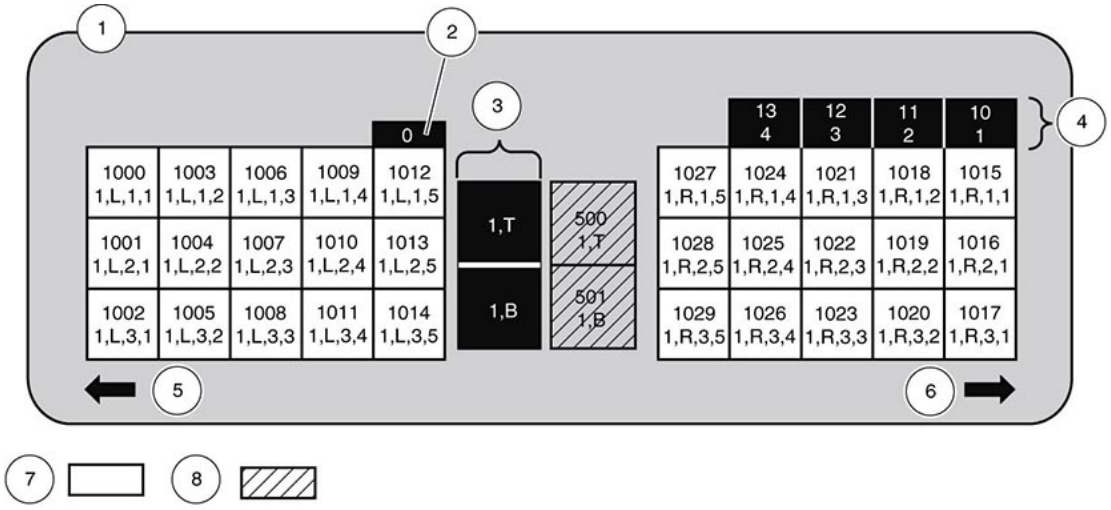

Illustration Legend:

1 - Module 1 (Base)

2 - Robot

3 - Power supplies

4 - Standard mailslots

5 - Left magazine front

6 - Right magazine front

7 - Storage slots

8 - Tape drives

Figure A–2 Non-Partitioned Two Module Library, Expanded Mailslot, and No Reserved Cells

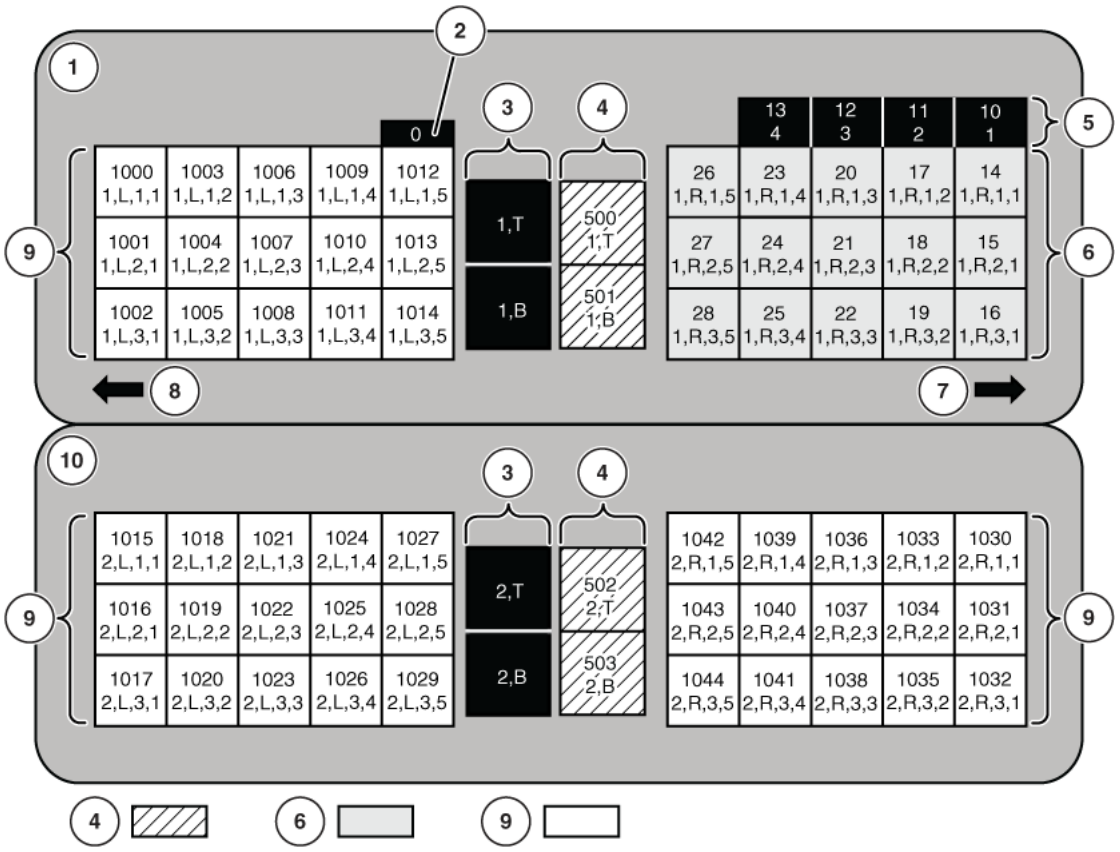

Illustration Legend:

1 - Module 1 (Base)

2 - Robot

3 - Power supplies

4 - Tape drives

5 - Standard mailslots

6 - Mailslot expansion

7 - Right magazine front

8 - Left magazine front

9 - Storage slots

10 - Module 2 (Expansion)

Figure A–3 Non-Partitioned Ten Module Library, Standard Mailslot, and Three Reserved Cells

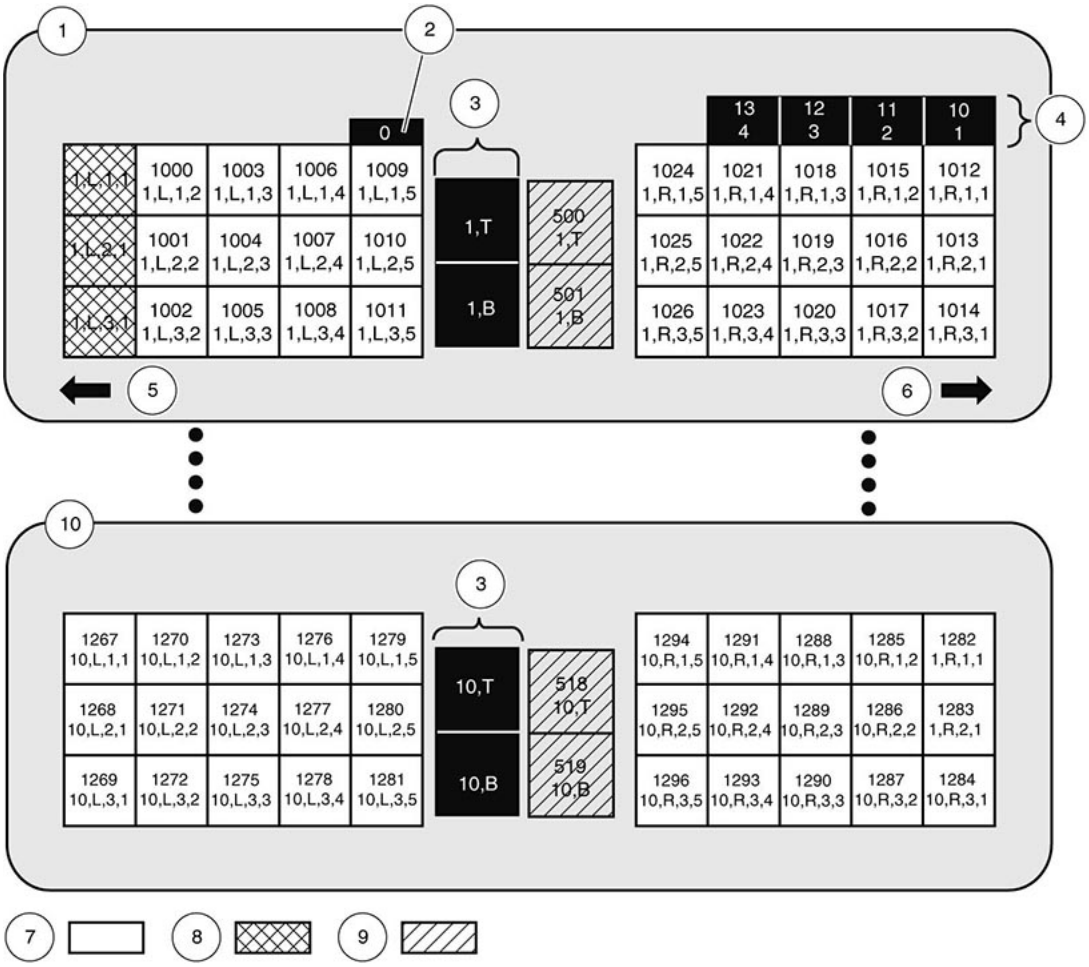

Illustration Legend:

1 - Module 1 (Base)

2 - Robot

3 - Power supplies

4 - Standard mailslots

5 - Left magazine front

6 - Right magazine front

7 - Storage slots

8 - Reserved slots (Configurable)

9 - Tape drives

10 - Module 10 (Expansion)

Capacity

Table A–3 shows the number of Storage, Mailslot, and Tape Drive slots as Expansion Modules are added to the library configuration.

Address numbering changes when a library is partitioned. Partition number is prefixed to the USER addressing indexes (see Appendix B, "Partitioning Overview").

Table A–3 Storage Slot, Mailslot, and Drive Counts for Different Configurations

Library Configuration	Standard Mailslot Configuration		Expanded Mailslot Configuration		Total
Modules	Total Storage Slots	Total Mailslots[1]	Total Storage Slots	Total Mailslots	Drive Slots
Base Module	30	4	15	19	2
Base Module plus one expansion module[2]	60	4	45	19	4
Base Module plus two expansion modules	90	4	75	19	6
Base Module plus three expansion modules	1200	4	105	19	8
Base Module plus four expansion modules	150	4	135	19	10
Base Module plus five expansion modules	180	4	165	19	12
Base Module plus six expansion modules	210	4	195	19	14
Base Module plus seven expansion modules	240	4	225	19	16
Base Module plus eight expansion modules	270	4	255	19	18
Base Module plus nine expansion modules	300	4	285	19	20

Notes:

1. All Mailslots (Standard Mailslots and Expanded Mailslots) are physically located in the base module.

2. Each expansion module has 30 Storage Slots and 2 Drive Slots.

Diagnostic and Cleaning Cartridge Locations

A total of up to three slots are allowed to be configured within the front left (Column 1) of the base module. The reserved slots may contain diagnostic and cleaning cartridges. The customer may not elect to configure any reserved slots, in which case these are used as normal storage slots.

The user may configure up to three of these reserved slots in the base module magazine beginning from row 1, column 1 and proceeding to row 3 of Column 1.

Reserved slots in a partitioned library must be configured before you enable partitioning.

B

Partitioning Overview

The SL150 Library can be partitioned into a maximum of eight distinct sections.

Briefly stated, instead of one library—with all its cartridge slots, tape drives, and mailslots—being a single entity, the library and these components can now be divided into sections or partitions. A library supports a maximum of eight partitions. Each partition can be accessed by one host or multiple hosts.

Partitioning—General

Partitioning has terms associated with it that must be understood to effectively use the feature. In certain cases, these terms redefine some concepts that are familiar to users of the traditional, nonpartitioned library configuration.

A *partition* is defined as the process of dividing portions of a library into discrete sections. The partitioning feature offers great flexibility for users.

Enabling the library to be partitioned requires some important considerations:

- Each partition designates tape drives and magazines solely to its partition, the other partitions cannot use these tape drives or magazine storage slots.
- Partition users must anticipate how much storage area is needed for their resident tape volumes and the amount of free slots required. Once storage needs are defined for the partitions within the library, sufficient modules need to be present within the library to accommodate this need.

Partitioning—Feature

The SL150 Library supports one to eight partitions.

The customer has the choice of a nonpartitioned library or a partitioned library with one to eight partitions.

When a partitioned library is desired, the administrator enables the Library Partitioning option and adds the desired number of partitions. The administrator configures each partition with the following:

- One or more magazines
- One or more tape drives
- A bridged drive

The mailslots are shared among all partitions. If the library is configured with the Standard Mailslots, then all partitions share the Standard Mailslots. If the library is

configured with the Expanded Mailslots, then all partitions share the Expanded Mailslots.

Refer to Figure B–1 as an example of how a customer might divide a library into two partitions. In this example:

- Partition one owns the magazines on the left side of the library.
- Partition two owns the magazines on the right side of the library.
- Partition one owns the top drive in every module.
- Partition two owns the bottom drive in every module.

SCSI Element Addresses are assigned from left to right and top to bottom for each partition. The example in Figure B–1 shows the SCSI Element Address for the elements in both partitions.

Figure B–1 Ten Module Library, Two Partitions, and the Standard Mailslot Configuration

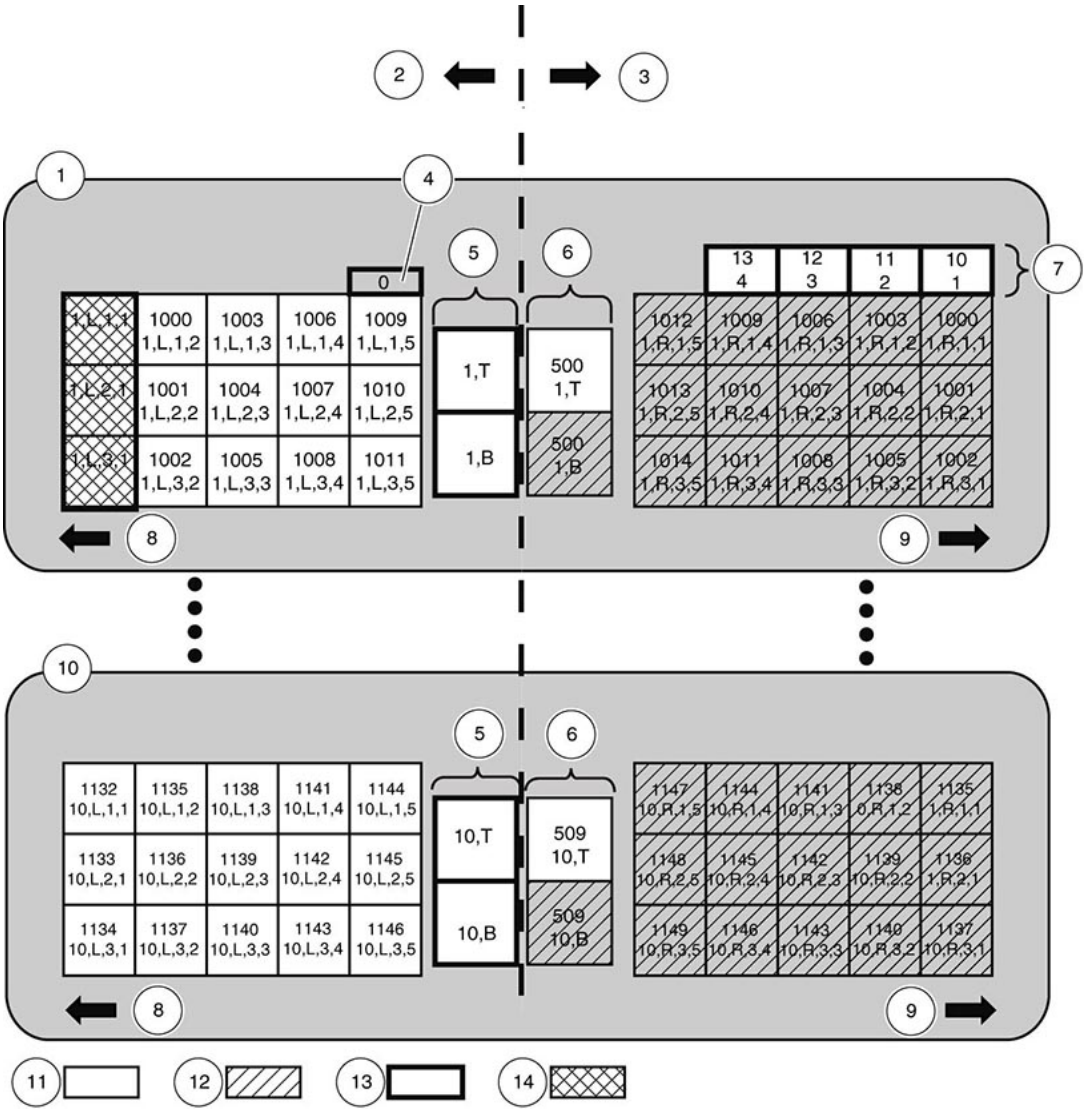

Illustration Legend:

1 - Module 1 (Base)

2 - Partition 1

3 - Partition 2

4 - Robot

5 - Power supplies

6 - Tape drives

7 - Standard Mailslots

8 - Left magazine front

9 - Right magazine front

10 - Module 10 (Expansion)

11 - Partition 1 resource

12 - Partition 2 resource

13 - Shared resource

14 - Reserved slots (configurable, shared resource)

When the library is partitioned, all partitions report the mailslots with a starting SCSI Element Address of 10. The Mailslot Element count depends on the mailslot configuration:

- The library reports four mailslot elements when the Standard Mailslot is configured.
- The library reports 19 mailslot elements when the Expanded Mailslots are configured.

Partitioning—Access Control

All hosts that issue commands to a bridged tape drive may also send commands to the library partition. Commands are processed by the partition in which the bridged drive resides. The host sends commands to the drive on LUN 0 and to the library on LUN 1.

Partitioning—Shared Mailslot Behavior

When the library is partitioned, the mailslots become a shared resource. When a partition needs access to the mailslots, the operator must use the ASSIGN action in the user interface to assign the partition to the mailslots before initiating an import or export operation. Refer to the *StorageTek SL150 Modular Tape Library User's Guide* for help.

A Partition-Mailslot assignment gives a partition exclusive ownership of the shared mailslot. This ensures that cartridges are always entered into the correct partition and prevents the other partition from taking ownership of a shared mailslot that is already in use.

If the mailslot is not assigned to the partition, a SCSI host application connected to the partition will receive a status indication from the library that shows the mailslot is open. When a SCSI host application receives status that the mailslot is open, the application will direct the operator to either close the mailslot or ASSIGN the mailslot to the partition. The SCSI host application cannot tell the difference between an open mailslot and a shared mailslot that has not been assigned to the partition.

The following SCSI commands will return mailslot open status when the mailslot is not assigned to the partition or when the mailslot is actually open:

- A SCSI MOVE command to or from a mailslot element. The command will end in Check Condition Status. The sense data will indicate Not Ready, Mailslot Open (Sense Key =2h, ASC =3Ah, ASCQ =02h).
- A SCSI READ ELEMENT STATUS command that includes the mailslot elements. The command will end in GOOD status. The Import/Export Element Descriptor data for the mailslot element will return an exception condition indicating that the mailslot is open; the Except Bit will be set to 1, the ASC field will be set to 3Ah, and the ASCQ field will be set to 02h.

Table B–1 shows how the SCSI Move and SCSI Read Element Status commands are affected by the shared mailslot assignment. For the purposes of this example, the library has been configured with two partitions. The library supports up to eight partitions. The behavior is the same for one or more partitions.

Table B–1 SCSI Commands Affected by the Shared Mailslot Assignment

Mailslot Assignment	Commands from Partition 1	Commands from Partition 2
Unassigned	Commands will be processed as though the mailslot door is open. The following commands will report exception status: ■ Read Element Status command that includes the mailslot element(s) ■ Move command with source or destination set to a mailslot	Commands will be processed as though the mailslot door is open. The following commands will report exception status: ■ Read Element Status command that includes the mailslot element(s) ■ Move command with source or destination set to a mailslot
Assigned to Partition 1	Commands will be processed normally. The SCSI Read Element Status and SCSI Move commands will only report that the Mailslot is open if it is physically opened and the request includes the mailslot.	Commands will be processed as though the mailslot door is open. The following commands will report exception status. ■ Read Element Status command that includes the mailslot element(s) ■ Move command with source or destination set to a mailslot
Assigned to Partition 2	Commands will be processed as though the mailslot door is open. The following commands will report exception status: ■ Read Element Status command that includes the mailslot element(s) ■ Move command with source or destination set to a mailslot	Commands will be processed normally. The SCSI Read Element Status and SCSI Move commands will only report that the Mailslot is open if it is physically opened and the request includes the mailslot.

Note: The operator *must* use the UNASSIGN action in the user interface to remove the partition ownership of the mailslots when the import or export operation is complete.

The operator can open the mailslot only if it is unlocked. The locked or unlocked state of the mailslot depends on the mailslot assignment and the SCSI Prevent/Allow Medium Removal state. The library keeps separate Prevent/Allow Medium Removal data for each partition. Refer to the SCSI Prevent/Allow Medium Removal Command in the *SL150 Modular Tape Library Interface Reference Manual* for more details.

Table B–2 shows the conditions under which the shared mailslot is either locked or unlocked. A value of *Ignored* indicates that the Prevent/Allow Media Removal state for the associated partition does not matter. For the purposes of this example, the library is configured with two partitions. The library supports up to eight partitions. The behavior is the same for one or more partitions.

Table B–2 Shared Mailslot Door Locked and Unlocked Conditions

Mailslot Assignment	Partition 1 Prevent/Allow Media Removal State	Partition 2 Prevent/Allow Media Removal State	Mailslot Locked State
Unassigned	Ignored	Ignored	Locked
Assigned to Partition 1	Allowed	Ignored	Unlocked
Assigned to Partition 1	Prevented	Ignored	Locked
Assigned to Partition 2	Ignored	Allowed	Unlocked
Assigned to Partition 2	Ignored	Prevented	Locked

Partitioning—Removing the Feature

The administrator for the SL150 Library can remove all partitions by turning the library partitioning OFF. The administrator must designate a bridged drive as part of the new configuration.

C

Controlling 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.

Environmental Contaminants

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 and 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 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 near 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 expand 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 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 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 about 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
Biennial 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, and so forth 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. Use specially treated dust wipes 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 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 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.

alphanumeric

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

arm

The robotic assembly that is lowered between the columns of tapes. The arm hangs on four wires from the Z mechanism. The arm includes the hand, the rails the hand rides on, the track motor that moves the hand along the rails, and the KLT card.

audit

The process of recording the location of all tapes in a library.

base chassis

The sheet metal and plastic chassis that makes up the framework of Module 1.

base module

The smallest, fully functional library consisting of the base chassis with the midplane, robot, front control panel, mailslot, one or two power supplies, up to two half-height LTO Ultrium tape drives, left magazine, and right magazine.

cartridge

A storage device that consists of magnetic tape on a supply reel in a protective housing. The spine of the cartridge usually contains a label listing the volume identification number. Also called tape, tape cartridge, tape volume, or cassette.

cell

See **slot**.

cleaning cartridge

A tape cartridge that contains special material to clean the tape path in a transport or drive. LTO Ultrium cleaning cartridge labels have a CLN prefix and a CU media identifier.

configuration

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

data cartridge

A term used to distinguish a cartridge onto which a tape drive may write data.

diagnostics

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

dismount

To remove a tape from a drive.

drive

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

drive cleaning

The device feature that uses a cleaning cartridge to clean a tape drive.

drive slot

The space in the library where the tape drive resides.

drive tray

See **tape drive**.

dynamic host configuration protocol (DHCP)

A network protocol that enables a server to automatically assign an IP address to devices on a network. DHCP assigns a number dynamically from a defined range of numbers for a given network.

encryption

The process of changing data into a form that cannot be read until it is deciphered, protecting the data from unauthorized access and use.

Ethernet

A local-area, packet-switched bus topology that enables the connection of several computer systems. The Ethernet architecture is similar to the IEEE 802.3 standard.

expanded mailsot

An optional library configuration to increase the capacity of the Mailslot from four to 19 cartridges. A logical entity containing four slots in the Standard Mailslot plus 15 slots in the Base Module right magazine (the Mailslot Expansion).

expansion cable

A cable used to connect modules 2–10 to Module 1. Each end of the cable has a USB A style connector.

expansion chassis

The sheet metal and plastic chassis that makes up the framework for Module 2–10.

expansion module

A module that can be added to the bottom of an existing library to increase its capacity for drives and tape cartridges (tapes). The module consists of the expansion chassis, a module controller, up to two power supplies, up to two half-height LTO Ultrium tape drives, a left magazine, and a right magazine. The expansion module connects to the base module by an expansion cable.

export

The action in which the device places a cartridge into the mailslot so that the operator can remove the cartridge. Also called eject.

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 ultra-thin 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 or fiber-optic physical media and provides the best characteristics of both networks and channels over diverse topologies.

front control panel

An assembly mounted on the front of the base chassis. It includes the touch screen operator panel, various LEDs and switches, and associated electronics.

get

An activity in which a robot obtains a cartridge from a slot or drive.

gripper

The portion of the hand assembly that grasps and holds a cartridge.

GUI

Graphical user interface. Software that allows the user to control the device through visual screens.

hand

The robotic mechanism that grabs tape cartridges and moves them between slots and the drive. It is a component of the arm. The hand has a reach mechanism that gets tape cartridges from slots or drives and puts them into slots or drives. The hand also has a wrist mechanism that rotates the hand to allow it to reach cartridges on either side or the drives at the back of the library.

hardware

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

HBA

See host bus adapter.

host bus adapter (HBA)

A circuit installed in a multi-platform host or device that interfaces between the device and the bus.

host computer

In a computer network, a computer that usually performs network control functions and provides end users with services such as computation and database access. (T)

host interface

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

import

The process of bringing a cartridge into the library from the mailslot. Also called enter.

indicator

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

initial program load (IPL)

A process that activates a device reset and loads system programs to prepare a computer system for operation. Processors having diagnostic programs activate these programs at initial program load execution. Devices running firmware usually reload the functional firmware from a diskette or disk drive at initial program load execution.

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)

interface

Hardware, software, or both, that links systems, programs, or devices. (IBM)

internet protocol (IP)

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

inventory

The process of reading and storing in memory the bar code identification and location of all tape cartridges in a library.

IP

See internet protocol.

IPL

See initial program load.

LC connector

A standard fiber-optic cable connector for Fibre Channel data transfer.

LED

Light emitting diode. An electronic device that lights up when electricity is passed through it.

left magazine

A plastic assembly containing 15 tape slots that can be inserted into the left side (as viewed from the front) of Modules 1–10. Left magazines and right magazines are not interchangeable.

library

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

LTO

An acronym for Linear Tape-Open technology which is set of data format standards created to enable data interchange among tape drive produced by a consortium of manufacturers. With LTO standards, the tape cartridges are interchangeable between tape drive brands.

LUN

Logical Unit Number. An address for a component of a SCSI device. In this device, the host computer sends the SCSI commands for the *library* to LUN 1 of the master *tape drive* and sends SCSI commands for the tape drive itself to LUN 0.

MAC address

The media access control address is a unique identifier assigned to devices for communication on a physical network.

magnetic tape

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

magnetic tape drive

A mechanism for controlling the movement of magnetic tape, commonly used to move magnetic tape past a read head or write head, or to allow automatic rewinding. (I) (A)

mailslot

The standard mailslot is a plastic and metal assembly located in the upper right corner of the base chassis used to enter tapes into the library and to remove tapes from the library. Previous StorageTek libraries called this a CAP (Cartridge Access Port).

mailslot expansion

A term describing the Base Module right magazine (the magazine immediately below the Standard Mailslot) when the library has the expanded mailslot configuration. The mailslot capacity expands from four cartridges (Standard Mailslot) to 19 cartridges.

management information base (MIB)

An ASCII text file organized hierarchically that describes the elements (configuration and statistical information) of a managed device. When a manager requests information, or a managed device generates a trap, the MIB translates the numeric strings into readable text that identifies each data object within the message.

midplane

A card mounted in the base chassis or expansion chassis that is behind the tape slots and in front of the tape drives. Other cards connect to it either by direct connection or by a cable.

Module 1

See **base module**.

module controller

A card inserted into the back of Modules 2–10 that controls the operation of the module. It is connected to the robot by an expansion cable.

Module X (2 through 10)

See **expansion module**.

mount

To place a tape in a drive and make it accessible to the host system.

multimode fiber

An optical fiber designed to carry multiple signals, distinguished by frequency or phase, at the same time.

net mask

A 32-bit, or 4-byte number, in dotted decimal format (typically written as four numbers separated by periods, such as 255.255.0.0 or 255.255.255.0) that is applied to an IP address to identify the network and node address of a host or router interface. (*Synonymous* with subnet mask.)

network

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

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 panel

A component of the front control panel consisting of a seven inch WVGA color touch screen.

port

A specific communications end point within a host. A port is identified by a port number. (IBM) (2) In Fibre Channel, an access point in a device where a link attaches.

power supply

An AC to DC power supply that mounts into the rear of a module Module (1–10). Referred to as top power supply or bottom power supply when referring to a power supply installed in a specific module.

power supply filler

A metal frame that slides into a power supply slot when a power supply will not be used in that slot.

put

An activity in which a robot places a cartridge into a slot or drive.

release

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

right magazine

A plastic assembly containing 15 tape slots that can be inserted into the right side (as viewed from the front) of Modules 1–10. Right magazines and left magazines are not interchangeable.

robot

An assembly that incorporates the bulk of the Module 1 electronics and the robotic components. This assembly is a combination of mechanical components, electronics, and a sheet metal housing. It is located at the top of the base chassis and incorporates the arm, Z mechanism, a CPU board, plus the KLC and KLZ cards.

SAS

Serial Attached SCSI. A computer bus technology and serial communication protocol for direct attached storage devices, including disk drives and high-performance tape drives.

SCSI

Small Computer System Interface. A standard interface and command set for transferring data between mass storage and other devices. The host computer uses SCSI commands to operate the device. Depending on the model, physical connection between the host computer and the tape drive will use a parallel SCSI, SAS, or Fibre Channel interface.

SLAAC

Stateless automatic address configuration. The process of a host generating its own address by using a combination of locally available information, such as a MAC address, and information that is advertised by routers.

slot

An empty location into which something else may be placed. Most commonly used when referring to the locations in the magazine or mailslot where tape cartridges are placed. Power supplies and drives are also placed in slots.

switch

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

tape

Also known as cartridge, tape cartridge, tape volume, volume, or cassette.

tape cartridge

A container holding magnetic tape that can be processed without separating the tape from the container. The device uses data and cleaning cartridges. These cartridges are not interchangeable. *See* cartridge.

tape drive

An electro-mechanical device that moves magnetic tape and includes mechanisms for writing and reading data to and from the tape. The drive is mounted into a proprietary tray (sometimes called a sled).

tape drive filler

A metal frame that slides into a tape drive slot when a tape drive will not be used in that slot.

Terabyte

A unit of storage, abbreviated T or TB, equal to 1,024 Gigabytes.

U

A measure of chassis height. 1U in rack measurement is 44.45 millimeters (1.75 inches).

Ultrium

An LTO tape format optimized for high capacity and performance. The Ultrium tape format uses a single reel cartridge to maximize capacity.

USB

Universal Serial Bus. A serial bus standard used to interface devices.

World Wide Name

A unique identifier in a Fibre Channel or SAS storage network. The first three bytes are derived from an IEEE Organizationally Unique Identifier (OUI), which defines the manufacturer or vendor. The remaining five bytes are assigned by the vendor.

WORM

An acronym for Write Once Read Many times, a class of recording systems that allow recording and adding data, but not altering recorded data.

wrist

A component of the hand assembly that rotates the hand horizontally.

Z mechanism

The robotic assembly mounted at the back of the robot that raises and lowers the arm. The Z mechanism includes a motor, gears, the bullwheel, and the wires and pulleys that hold the arm. As the motor turns, the bullwheel rotates and extends or retracts the wires to lower or raise the arm.

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