

**StorageTek SL150 Modular Tape Library**  
Systems Assurance Guide

**22579-04**

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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.

## Access to Oracle Support

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



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## What's New

Added LTO-6 FC information in Chapter 1.

Added LTO-6 FC information in Chapter 3.

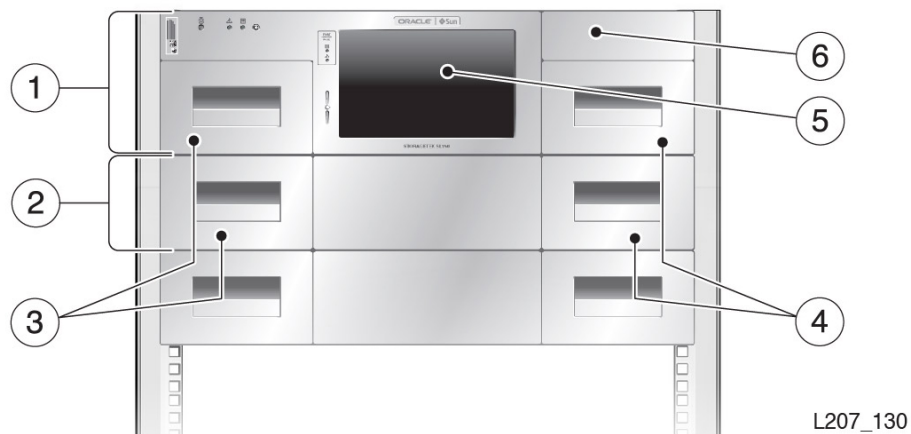


## Product Overview

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 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)**



L207\_130

**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 bridge drive is LUN0 and the library is LUN1.

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

The drive providing the bridge interface must reside in Module 1. An unpartitioned bridged library must have one bridge drive. A partitioned bridged library must have a bridge drive for each partition.

## Modules

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

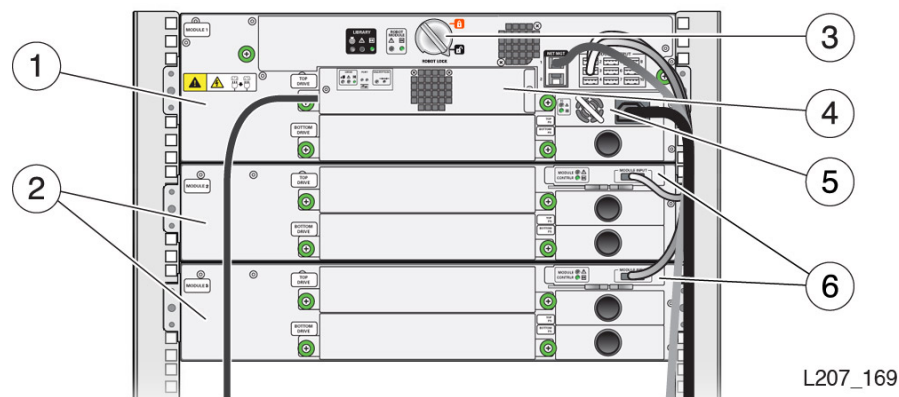
Module 1 is the smallest fully functional library, and it contains:

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



L207\_169

### Illustration Legend:

**1 - Base Module (Module 1)**

**2 - Expansion Module (Module 2 and Module 3)**

**3 - Robot Lock (Improved Design)****4 - Tape Drive Tray****5 - Power Supply****6 - Module Controller (Module 2 and Module 3)**


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

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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 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 and raise the Z platform. 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.

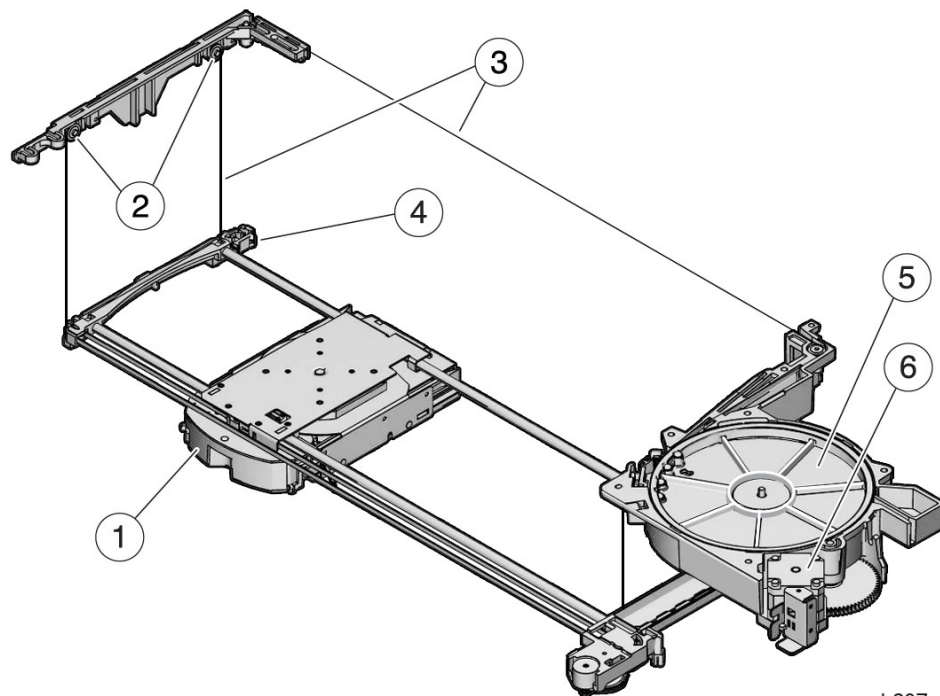
## Vision

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.

## 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).

**Figure 1-3 Robot**



L207\_158

### Illustration Legend:

- 1 - Hand
- 2 - Pulleys
- 3 - Suspension Cables
- 4 - Z Platform
- 5 - Bull Wheel
- 6 - Z Motor

## Tape Drives and Media

The SL150 Modular Tape Library supports the following Linear Tape Open (LTO) half-height, tape drive manufactured by the Hewlett-Packard Company (HP):

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

### Drive Firmware version required:

- Fibre Channel:
  - LTO-5: Y5BS or greater
  - LTO-6: 22GS or greater



- SAS:
  - LTO-5: Z55S or greater
  - LTO-6: 32DS or greater

#### Cartridges supported:

Standard LTO data cartridges are labeled with a unique, customer-assigned, six-character 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

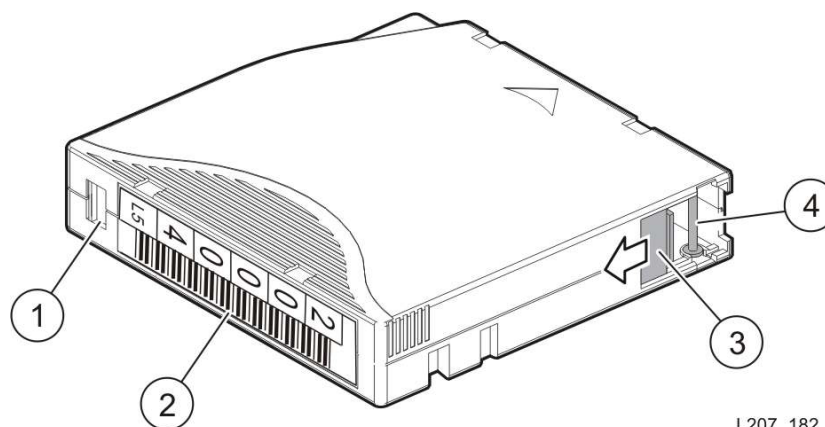
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**Note:** The LTO6 drive does not support generation 3 media.

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- Universal Cleaning Cartridge

**Figure 1–4 Tape Cartridge**



L207\_182

#### 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 8 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 SL150 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: M123456789AB does not, for example, 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 Settings section of the SL150 GUI.

## Human Interfaces

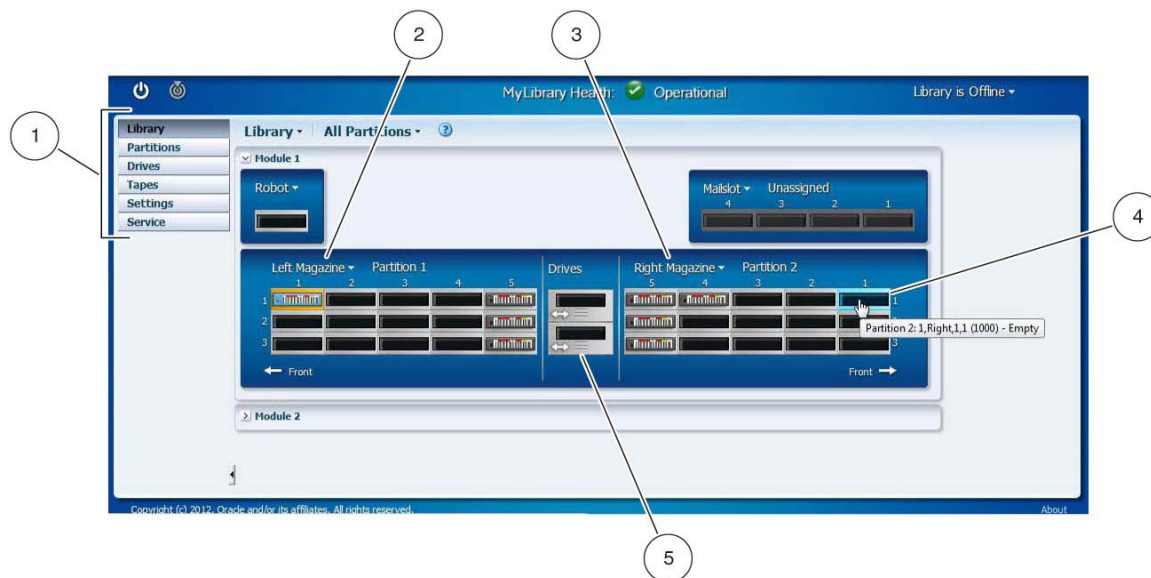
There are three ways to interact with the SL150 Modular Tape Library: the operator panel, mailslot, and remote interface.

- 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.
- The front control panel (see [Figure 1-1](#)) 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, 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, and it is accessed by entering the library hostname or IP address into a web browser (such as Firefox, Google Chrome, or Safari). The interface example (shown in Figure 1–6) is for a partitioned library, and provides menus for the library, partitions, drives, tapes, settings, and service.

**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 control (above the label for Module 1) provides the capability to display library properties, audit the library, run a self test, expand all available modules, or collapse all modules.

The partitions, drives, tapes, settings, and service menus present information in a tabular format. Some of the menus have tabs to present information in distinct categories. For example, the Settings menu for the administrator role contains the following tabs: Library, Partitions, Drive Port Settings, Network, SNMP, and User.

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 Modular Tape Library can be divided into a maximum of two partitions with each having at least one tape drive and one magazine. The drive providing the interface (bridging) for the specific partition must reside in the base module. 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.

- 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.

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**Note:** The administrator can enable partitions from the Settings section of the remote management interface. Additional information is available in the user's guide or the online Help for the remote GUI.

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Additional information on partitions is provided in [Appendix B](#).

## SNMP

The library's SNMP agent can automatically send *traps* that 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.
- SNMP version 3 is not backwards compatible, but it supports a more secure authentication method and can encrypt management data.

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

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**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.

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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 utilization 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 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

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

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StorageTek Automated Cartridge System Library Software (ACSL) 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.

ACSL version 8.2 or greater is required for interfacing with the SL150 library.

## 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): 614 BTU/hour, 1.42 A at 120V or 0.75 A at 240V

### 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)

## 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 adhere to the additional requirements listed in [Appendix C, "Controlling Contaminants"](#).

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

## **Multiple LUN Support**

The SL150 Modular Tape 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 tape drives in the base module provide the bridging function and must be connected to an HBA supporting multiple LUNs (also referred to as LUN scanning).

## **Tape Device Driver**

Make sure that the proper device driver is installed, if applicable. Download the driver from the HP web site, 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/s data interface.

## **Persistent Binding**

When a server is booted, devices are discovered and assigned SCSI target and LUN IDs. It is possible for these SCSI assignments to change between boots. Some operating systems do not guarantee that devices will always be allocated the same SCSI target ID after rebooting. 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 World Wide Node Name (WWNN) or World Wide Port Name (WWPN), persistent binding causes a tape drive's World Wide Name to be bound to a specific SCSI target ID.

## Zoning

Zoning allows you to partition your 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 or World Wide Port Name

While zoning can be re-configured 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 if a drive needs service or replacement.

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**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.

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## 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/s 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

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

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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
  - 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`.

## 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)

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**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.

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## Tape Drive Cleaning

LTO drives send a cleaning request to the SL150 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.



This chapter provides the following information:

- ["SL150 Modular Tape Library Part Numbers"](#)
- ["Configuration/Ordering Examples"](#)
- ["Cable Part Numbers"](#)
- ["Power Cord Part Numbers"](#)
- ["Information on Ordering Media and Labels"](#)

## **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 LTO6- 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/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, partitioned library** with 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)

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**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.

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### 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 non-partitioned 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)

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

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## 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: [tapemediorders\\_ww@oracle.com](mailto:tapemediorders_ww@oracle.com)

See the tape media area on the corporate web site 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.





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## Locations

This appendix describes the SL150 Modular Library System 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

[Figure A-1](#) and [Figure A-2](#) show valid slot and drive locations.

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

Tape locations in previous StorageTek libraries were listed by a LIBRARY Physical addressing scheme involving "Panel, Row, and Column" indices. 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	<i>module,side,row,column</i>
Slot (Reserved)	No	<i>module,side,row,column</i>
Drives	Yes	<i>module,top bottom</i>
Mailslot	Yes	<i>slot number</i>
Power Supply	No	<i>module,top bottom</i>
Hand (Robot)	Yes	n/a

[Figure A-1](#) and [Figure A-2](#) illustrate where these terms apply; [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.

### Slot Maps

[Figure A-1](#) and [Figure A-2](#) show valid storage slot, mailslot, and drive locations.

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.

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**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).

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## Default Element Mapping

The following table shows the default first element and maximum number of elements in the SL150 library.

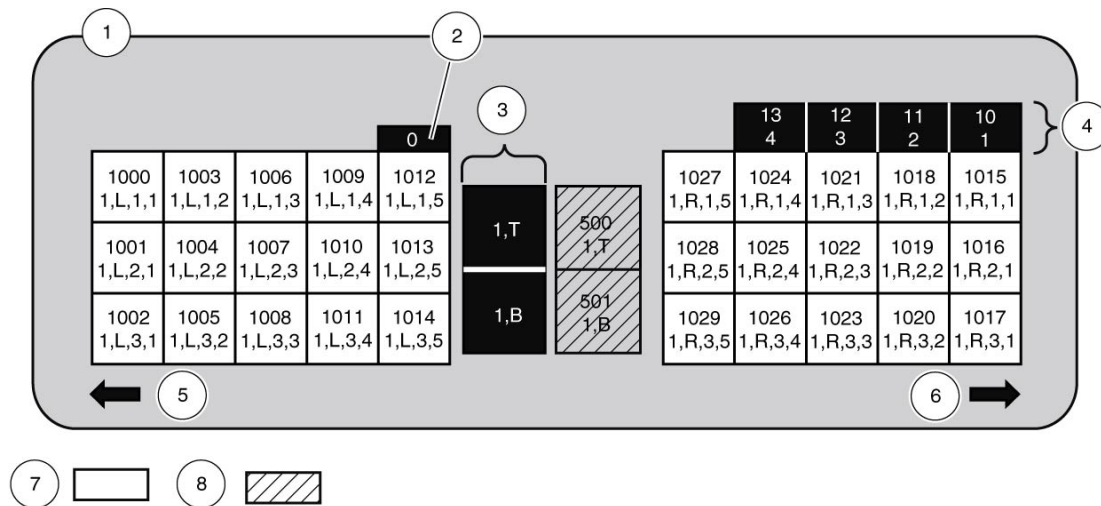
**Table A–1 Default Starting Element Address and Maximum Number of Elements**

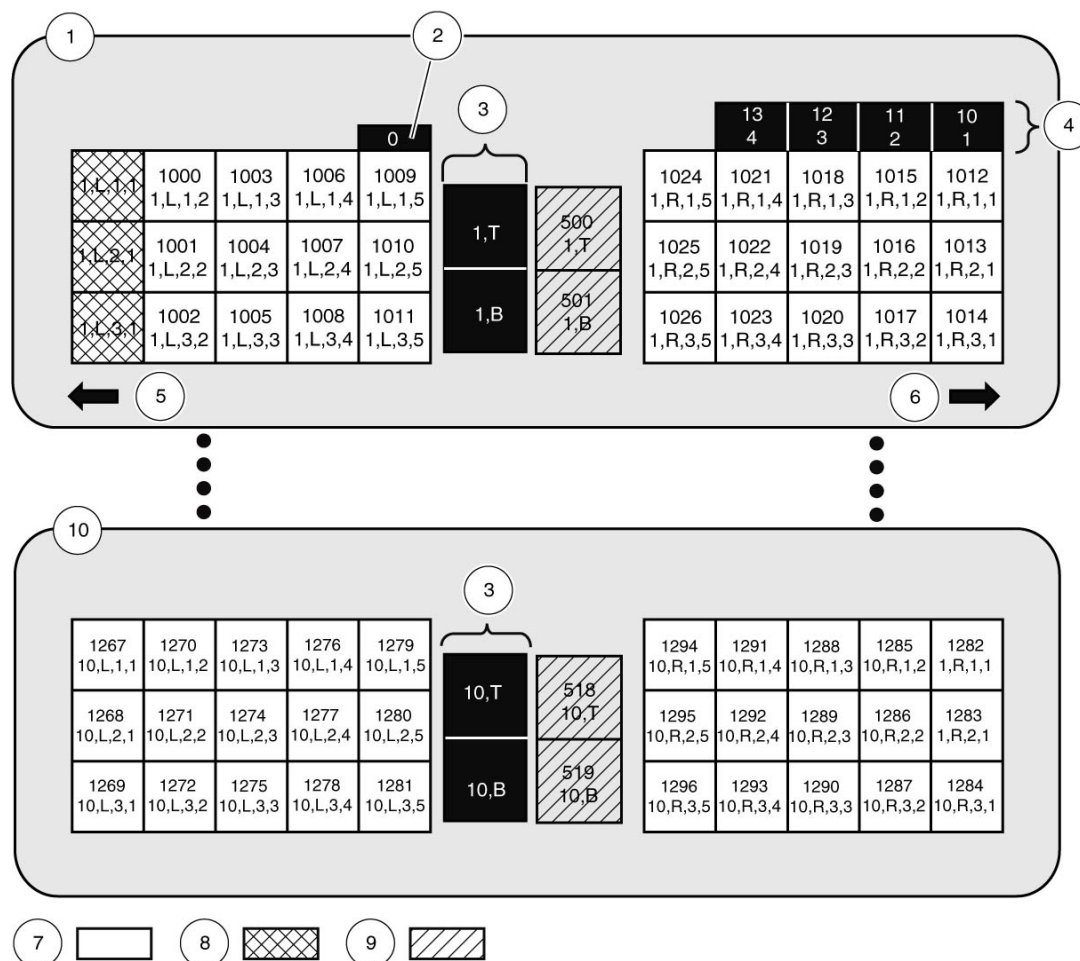
Element Type	First Default Element Address	Maximum Number of Elements for an SL150 Library with 10 Modules
Hand	0	1
Mailslot	10	4
Drives	500	20
Storage Slots	1000	300

The following table 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: <i>SCSI Element Address</i>
Mailslot	Host Address: <i>SCSI Element Address</i> User Physical: <i>slot number</i>
Drives	Host Address: <i>SCSI Element Address</i> User Physical: <i>module,Top/Bottom</i>
Storage Slots	Host Address: <i>SCSI Element Address</i> User Physical: <i>module,side,row,column</i>
Reserved Slots	User Physical: <i>module,side,row,column</i>
Power Supply	User Physical: <i>module,Top/Bottom</i>

**Figure A-1 Base Module Slots of Non-Partitioned SL150 Modular Tape Library****Illustration Legend:****1 - Module 1 (Base)****2 - Robot****3 - Power supplies****4 - Mailslots****5 - Left magazine front****6 - Right magazine front****7 - Slots available for customer data tape****8 - Tape drives**

**Figure A-2 Base Module and Drive Expansion Module Slots (After Configuring Reserved Slots)****Illustration Legend:****1 - Module 1 (Base)****2 - Robot****3 - Power supplies****4 - Mailslots****5 - Left magazine front****6 - Right magazine front****7 - Slots available for customer data cartridges****8 - Reserved slots (Configurable)****9 - Tape drives****10 - Module 10 (Expansion)**

The library supports only HP LTO Ultrium Linear Tape-Open (LTO) Generation 5 or Generation 6 tape drives. The following table shows how many LTO cartridges can be placed in the library, depending on the modules installed.

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

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

<b>Configuration</b>	<b>Module 1</b>	<b>Expansion Module</b>	<b>Total Slots</b>	<b>Mailslots</b>	<b>Maximum Drives</b>
Module 1	30	N/A	30	4	2
Module 1 +1 drive expansion module	30	30	60	4	4
Module 1 +2 drive expansion modules	30	60	90	4	6
Module 1 +3 drive expansion modules	30	90	120	4	8
Module 1 +4 drive expansion modules	30	120	150	4	10
Module 1 +5 drive expansion modules	30	150	180	4	12
Module 1 +6 drive expansion modules	30	180	210	4	14
Module 1 +7 drive expansion modules	30	210	240	4	16
Module 1 +8 drive expansion modules	30	240	270	4	18
Module 1 +9 drive expansion modules	30	270	300	4	20

**Notes:**

1. Expansion modules have 30 slots and 2 drives each (no mailslots)
2. When the mailslots are used for storage slots, add the mailslots count number in that column to the number in the total slots column.

## Diagnostic and Cleaning Cartridge Locations

A total of up to 3 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 3 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 prior to enabling partitioning.



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## Partitioning Overview

The SL150 library can be partitioned into two distinct sections.

Briefly stated, this means that 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 two sections or partitions. Each partition can be accessed by one host or multiple hosts.

### Partitioning—General

Partitioning has terms associated with it that you and your customer must understand to effectively use the feature. In certain cases, these terms redefine some concepts that are familiar with users of the traditional, non-partitioned 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 solely to its partition, the other partition cannot use these tape drives.
- 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.

The SCSI element numbering within partitioned libraries is continuous for each partition.

### Partitioning—Feature

The SL150 library supports two partitions.

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**Important:** You must enable the partitioning feature through the administrator role within the Settings Screen under the Partitions tab. Online help within the library explains the partitioning configuration presented when partitions are enabled. Only the administrator can enable or disable the partitioning feature.

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The customer has the choice of a non-partitioned library or a partitioned library with 2 partitions. When a partitioned library is desired, the library uses the following simple method for dividing the resources in 2 partitions:

- **Storage Slots**

Partition 1 owns all storage slots on the left side of the library.

Partition 2 owns all storage slots on the right side of the library.

- **Tape Drives**

Partition 1 owns the top tape drive in the base module and the top tape drive in each additional expansion module.

Partition 2 owns the bottom tape drive in the base module and the bottom drive in additional expansion module.

- **Mailslot Elements**

The mailslot elements are shared by both partitions.

Using [Figure B-1](#) as an example, partition one owns the left side of the base and the expansion modules, SCSI element numbering begins at the first available slot in Module 1 and continues through the expansion module slots. The first drive in the top module will begin the element numbering for partition 1 and continue to each top drive slot in all expansion modules that are installed.

The library will discover the current number of modules at each boot up. If you shut down the library and then boot up, the partitions will redefine to the current number of modules.

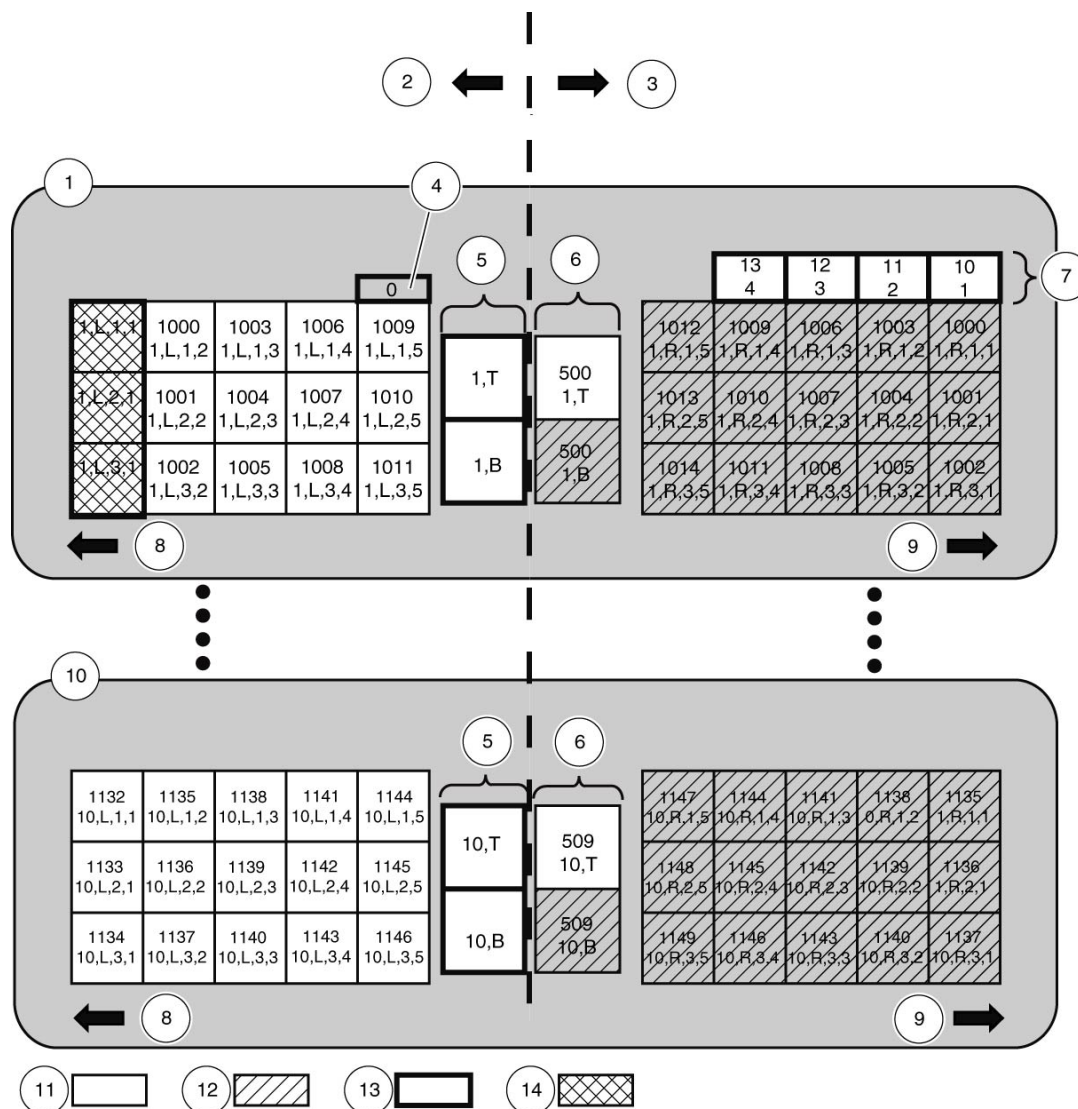
After ENABLING partitioning, the library sets the bridged drive for each partition:

- The bridged drive for partition 1 is the top drive in Module 1. Partition 1 owns all tape drives in the top slot of each module.
- The bridged drive for partition 2 is the bottom drive in Module 1. Partition 2 owns all tape drives in the bottom slot of each module.

## **Partitioning—Access Control**

All hosts that issue commands to a bridged HP LTO-5 or LTO-6 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.



**Figure B-1 Partitioned SL150 Modular Tape Library****Illustration Legend:**

- 1 - Module 1 (Base)
- 2 - Partition 1
- 3 - Partition 2
- 4 - Robot
- 5 - Power supplies
- 6 - Tape drives
- 7 - 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)**

## **Partitioning—Shared Mailslot Behavior**

When the library is partitioned, the mailslots are shared between the two partitions. 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 SL150 Users 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 connected to the partition will receive a status indication from the library that the mailslot is open. When a SCSI host receives status that the mailslot is open, the application will let the operator close the mailslot or ASSIGN the mailslot 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.

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

Mailslot Assignment	Commands from Partition 1	Commands from Partition 2
Unassigned	<p>Commands will be processed as though the mailslot door is open. The following commands will report exception status:</p> <ul style="list-style-type: none"> <li>Read Element Status command that includes the mailslot element(s)</li> <li>Move command with source or destination set to a mailslot</li> </ul>	<p>Commands will be processed as though the mailslot door is open. The following commands will report exception status:</p> <ul style="list-style-type: none"> <li>Read Element Status command that includes the mailslot element(s)</li> <li>Move command with source or destination set to a mailslot</li> </ul>
Assigned to Partition 1	<p>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.</p>	<p>Commands will be processed as though the mailslot door is open. The following commands will report exception status:</p> <ul style="list-style-type: none"> <li>Read Element Status command that includes the mailslot element(s)</li> <li>Move command with source or destination set to a mailslot</li> </ul>
Assigned to Partition 2	<p>Commands will be processed as though the mailslot door is open. The following commands will report exception status:</p> <ul style="list-style-type: none"> <li>Read Element Status command that includes the mailslot element(s)</li> <li>Move command with source or destination set to a mailslot</li> </ul>	<p>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.</p>

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**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.

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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.

**Table B–2** *Shared Mailslot Door Locked/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

To disable the partitioning feature, simply disable partitioning on the SETTINGS screen under the Partition tab and it will revert to a non-partitioned library configuration. Only the administrator can enable or disable the partitioning feature.

After the partitions are removed, the top drive in Module 1 is configured to be the bridged drive for the non-partitioned library.

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## 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 as well as the proper measurement methodology, but does not address the overall mass of the particulates. As a result, the requirement for total mass limitations is also necessary as a computer room or data center could meet the ISO 14644-1 specification, but still damage equipment because of the specific type of particulates in the room. In addition, the ANSI/ISA 71.04-1985 specification addresses gaseous contaminations as some airborne chemicals are more hazardous. All three requirements are consistent with the requirements set by other major tape storage vendors.

### Required Air Quality Levels

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

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

systems. When computer hardware is exposed to these submicron particles in great numbers they endanger system reliability by posing a threat to moving parts, sensitive contacts and component corrosion.

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

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

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

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

## Contaminant Properties and Sources

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

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

The only differences between a potential contaminant and an actual contaminant are time and location. Particulate matter is most likely to migrate to areas where it can do damage if it is airborne. For this reason, airborne particulate concentration is a useful measurement in determining the quality of the computer room environment.

Depending on local conditions, particles as big as 1,000 microns can become airborne, but their active life is very short, and they are arrested by most filtration devices.

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

## Operator Activity

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

## Hardware Movement

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

## Outside Air

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

## Stored Items

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

## Outside Influences

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

## Cleaning Activity

Inappropriate cleaning practices can also degrade the environment. Many chemicals used in normal or “office” cleaning applications can damage sensitive computer equipment. Potentially hazardous chemicals outlined in the ["Cleaning Procedures and Equipment"](#) on page C-8 section should be avoided. Out-gassing from these products or direct contact with hardware components can cause failure. Certain biocide treatments used in building air handlers are also inappropriate for use in computer rooms either because they contain chemicals, that can degrade components, or because

they are not designed to be used in the airstream of a re-circulating air system. The use of push mops or inadequately filtered vacuums can also stimulate contamination.

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

## Contaminant Effects

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

### Physical Interference

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

### Corrosive Failure

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

### Shorts

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

### Thermal Failure

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

## Room Conditions

All surfaces within the controlled zone of the data center should be maintained at a high level of cleanliness. All surfaces should be periodically cleaned by trained



professionals on a regular basis, as outlined in the "[Cleaning Procedures and Equipment](#)" on page C-8 section. Particular attention should be paid to the areas beneath the hardware, and the access floor grid. Contaminants near the air intakes of the hardware can more easily be transferred to areas where they can do damage. Particulate accumulations on the access floor grid can be forced airborne when floor tiles are lifted to gain access to the sub-floor.

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

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

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

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

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

- Manually apply the encapsulant. Spray applications are totally inappropriate in an on-line data center. The spraying process forces the sealant airborne in the supply airstream, and is more likely to encapsulate cables to the deck.
- Use a pigmented encapsulant. The pigmentation makes the encapsulant visible in application, ensuring thorough coverage, and helps in identifying areas that are damaged or exposed over time.

- It must have a high flexibility and low porosity to effectively cover the irregular textures of the subject area, and to minimize moisture migration and water damage.
- The encapsulant must not out-gas any harmful contaminants. Many encapsulants commonly used in industry are highly ammoniated or contain other chemicals that can be harmful to hardware. It is very unlikely that this out-gassing could cause immediate, catastrophic failure, but these chemicals will often contribute to corrosion of contacts, heads or other components.

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

## Exposure Points

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

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

## Filtration

Filtration is an effective means of addressing airborne particulate in a controlled environment. It is important that all air handlers serving the data center are adequately filtered to ensure appropriate conditions are maintained within the room. In-room process cooling is the recommended method of controlling the room environment. The in-room process coolers re-circulate room air. Air from the hardware areas is passed through the units where it is filtered and cooled, and then introduced into the subfloor plenum. The plenum is pressurized, and the conditioned air is forced into the room, through perforated tiles, which then travels back to the air conditioner for reconditioning. The airflow patterns and design associated with a typical computer room air handler have a much higher rate of air change than typical comfort cooling air conditioners so air is filtered much more often than in an office environment.

Proper filtration can capture a great deal of particulates. The filters installed in the in-room, re-circulating air conditioners should have a minimum efficiency of 40% (Atmospheric Dust-Spot Efficiency, ASHRAE Standard 52.1). Low-grade pre-filters should be installed to help prolong the life of the more expensive primary filters.

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

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

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

## Positive Pressurization and Ventilation

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

Because a closed-loop, re-circulating air conditioning system is used in most data centers, it will be necessary to introduce a minimal amount of air to meet the ventilation requirements of the room occupants. Data center areas normally have a very low human population density; thus the air required for ventilation will be

minimal. In most cases, the air needed to achieve positive pressurization will likely exceed that needed to accommodate the room occupants. Normally, outside air quantities of less than 5% make-up air should be sufficient (ASHRAE Handbook: Applications, Chapter 17). A volume of 15 CFM outside air per occupant or workstation should sufficiently accommodate the ventilation needs of the room.

## Cleaning Procedures and Equipment

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

Operator awareness is another consideration. Maintaining a fairly high level of cleanliness will raise the level of occupant awareness with respect to special requirements and restrictions while in the data center. Occupants or visitors to the data center will hold the controlled environment in high regard and are more likely to act appropriately. Any environment that is maintained to a fairly high level of cleanliness and is kept in a neat and well organized fashion will also command respect from the room's inhabitants and visitors. When potential clients visit the room they will interpret the overall appearance of the room as a reflection of an overall commitment to excellence and quality. An effective cleaning schedule must consist of specially designed short-term and long-term actions. These can be summarized as follows:

Frequency	Task
Daily Actions	Rubbish removal
Weekly Actions	Access floor maintenance (vacuum and damp mop)
Quarterly Actions	Hardware decontamination
	Room surface decontamination
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, etc. should be thoroughly treated. Special dust cloths that are impregnated with a particle absorbent material are to be used in the surface decontamination process. Do not use generic dust rags or fabric cloths to perform these activities. Do not use any chemicals, waxes or solvents during these activities.

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

## Biennial Tasks

The subfloor void should be decontaminated every 18 months to 24 months based on the conditions of the plenum surfaces and the degree of contaminant accumulation. Over the course of the year, the subfloor void undergoes a considerable amount of activity that creates new contamination accumulations. Although the weekly above floor cleaning activities will greatly reduce the subfloor dust accumulations, a certain amount of surface dirt will migrate into the subfloor void. It is important to maintain the subfloor to a high degree of cleanliness since this area acts as the hardware's supply air plenum. It is best to perform the subfloor decontamination treatment in a short time frame to reduce cross contamination. The personnel performing this operation should be fully trained to assess cable connectivity and priority. Each exposed area of the subfloor void should be individually inspected and assessed for possible cable handling and movement. All twist-in and plug-in connections should be

checked and fully engaged before cable movement. All subfloor activities must be conducted with proper consideration for air distribution and floor loading. In an effort to maintain access floor integrity and proper psychrometric conditions, the number of floor tiles removed from the floor system should be carefully managed. In most cases, each work crew should have no more than 24 square feet (six tiles) of open access flooring at any one time. The access floor's supporting grid system should also be thoroughly decontaminated, first by vacuuming the loose debris and then by damp-sponging the accumulated residue. Rubber gaskets, if present, as the metal framework that makes up the grid system should be removed from the grid work and cleaned with a damp sponge as well. Any unusual conditions, such as damaged floor suspension, floor tiles, cables and surfaces, within the floor void should be noted and reported.

## Activity and Processes

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

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# 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.

## **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.

## **alphanumeric**

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

## **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 a number of computer systems. The Ethernet architecture is similar to the IEEE 802.3 standard.

**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 and/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 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 bus adapter (HBA)**

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

**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 machine 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 to for the *library* to LUN 1 of the master *tape drive* and sends SCSI commands for the tape drive itself to LUN 0.

**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**

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).

**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.

### **put**

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

### **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.

### **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.

**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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