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L5500 Automated Cartridge System

Operator's Guide

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Operator's Guide

First Edition (April 2002)

This edition contains 124 pages. See “Summary of Changes” on page xx for the revision history and summary of changes made to this publication.

Information contained in this publication is subject to change without notice. Comments concerning the contents of this publication should be directed to:

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Preface

This guide describes how to operate the Storage Technology Corporation L5510/11/20/30 Automated Cartridge System (ACS). Most of the information is hardware-oriented.

For specific software commands and console messages, refer to your software operator's guide. For specific cartridge subsystem information, refer to your cartridge subsystem publications.

This guide is intended primarily for data center operators. System programmers and administrators also might find information contained in this guide useful. This guide can be read entirely; however, it is more important that you familiarize yourself with the overall organization and location of various information for reference purposes.

Organization

This guide is divided into four chapters and one appendix:

Chapter 1	"General Information" provides a basic overview of the ACS, including descriptions of system hardware components, discussions of operating modes, and safety features.
Chapter 2	"Controls and Indicators" shows the location of control panels and indicators in the ACS and the functions associated with them.
Chapter 3	"Operating an ACS" describes the basic procedures to operate the ACS.
Chapter 4	"Obtaining Maintenance Support" describes how to contact Customer Support for assistance if the LSM has a hardware or software problem.
Appendix A	"Cartridge Tape Information" lists the basic requirements for cartridges and describes how to prepare and maintain cartridges.
Glossary	The Glossary defines new or special terms and abbreviations used in this publication.
Index	The Index assists in locating information in this publication.

Alert Messages

Alert messages call the reader's attention to information that is especially important or that has a unique relationship to the main text or graphic.

Note: A note provides additional information that is of special interest. A note might point out exceptions to rules or procedures. A note usually, but not always, follows the information to which it pertains.

CAUTION:
A caution informs the reader of conditions that might result in damage to hardware, corruption of data, corruption of application software, or long-term health problems in people. A caution always precedes the information to which it pertains.

WARNING:
A warning alerts the reader to conditions that might result in injury or death. A warning always precedes the information to which it pertains.

Conventions

Typographical conventions highlight special words, phrases, and actions used in this publication

Item	Example	Description of Convention
Buttons	MENU	Font and capitalization follows label on product
Commands	Mode Select	Initial cap
Document titles	*System Assurance Guide*	Italic font
Emphasis	*not* or *must*	Italic font
File names	`fsc.txt`	Monospace font
Hypertext links	Figure 2-1 on page 2-5	Blue (prints black in hardcopy publications)
Indicators	*Open*	Font and capitalization follows label on product
Jumper names	TERMPWR	All uppercase
Keyboard keys	<Y> <Enter> or <Ctrl+Alt+Delete>	Font and capitalization follows label on product; enclosed within angle brackets
Menu names	Configuration Menu	Capitalization follows label on product
Parameters and variables	Device = *xx*	Italic font
Path names	`c:/mydirectory`	Monospace font
Port or connector names	SER1	Font and capitalization follows label on product; otherwise, all uppercase
Positions for circuit breakers, jumpers, and switches	ON	Font and capitalization follows label on product; otherwise, all uppercase
Screen text (including screen captures, screen messages, and user input)	`downloading`	Monospace font
Switch names	Power	Font and capitalization follows label on product
URLs	http://www.storagetek.com	Blue (prints black in hardcopy publications)

Related Publications

The following list contains the names and order numbers of publications that provide additional information about the LSM, the cartridge subsystems, cartridge tapes.

Hardware Publications	
9840/T9840/T9940 Tape Drive Planning and Migration Guide	MT6004
9840/T9840/T9940 Tape Drive System Assurance Guide	MT5003
9840/T9840 Tape Drive User's Reference Manual	95739
L5500 System Assurance Guide	MT9142
T9940 Tape Drive Operator's Guide	95989
Software Publications	
Automated Cartridge System Library Software (ACSLS) System Administrator's Guide	3134648
ACSLS Messages	3134649
ACSLS Quick Reference	3134650
LTO Publications	
IBM Ultrium Tape Drive Models T200 and T200F Setup, Operator, and Service Guide, GA32-0435	CD-ROM
Seagate Viper 200 LTO Ultrium Tape Drive Installation Manual, PN 100125716	CD-ROM
Seagate Viper 200 LTO Tape Drive Product Manual, PN 100125702	CD-ROM
Miscellaneous Publication	
American National Standard Magnetic Tape and Cartridge for Information Interchange	ACS X3B5

Additional Information

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The URL for the StorageTek external Web site is:

http://www.storagetek.com

Customer Resource Center

StorageTek's Customer Resource Center (CRC) is a Web site that enables members to resolve technical issues by searching code fixes and technical documentation. CRC membership entitles you to other proactive services, such as HIPER subscriptions, technical tips, answers to frequently asked questions, and online product support contact information. Customers who have a current warranty or a current maintenance service agreement may apply for membership by clicking on the Request Password button on the CRC home page.

The URL for the CRC is:

http://www.support.storagetek.com

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StorageTek's e-Partners site, formerly known as the Partners Page or the Channels Site, is a Web site that provides information about products, services, customer support, upcoming events, training programs, and sales tools to support StorageTek's e-Partners. Access to this site, beyond the e-Partners Login page, is restricted. On the e-Partners Login page, current partners who do not have access can request a login ID and password and prospective partners can apply to become StorageTek resellers.

The URL for the e-Partners site is:

http://channels.stortek.com

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http://sts.stortek.com/sts/tis/tisrcf.htm

Safety

The following information relates to topics essential to your safety when operating the LSM. Please read these instructions carefully.

Electrostatic Discharge Damage Prevention

Before you touch any internal components in the library, including drives, you must take precautions against electrostatic discharge (ESD).

CAUTION:
COMPONENTS ARE SENSITIVE TO STATIC ELECTRICITY. Even a small electrostatic discharge can damage an electrical component that is inside the library. A damaged component might not fail immediately, but over time, it will become worse and might eventually cause an "intermittent" problem. Be sure that you touch an *unpainted* metal surface of the library before you reach inside the library or touch the drives or optional interface equipment.

Before you touch any internal components:

1. With your finger, touch an *unpainted* metal surface of the library. In some libraries, you can touch the library's frame. In other libraries, you might have to touch a bolt on the wall or on the door frame.
2. Keep your body movement to a minimum as you touch the drives or the library components.

Antistatic wrist straps that have clip-on ends are commercially available.

Notices

Please read the following compliance and warning statements for this product.

CAUTION:
Cables that connect peripherals must be shielded and grounded; refer to cable descriptions in the instruction manual. Operation of this equipment with cables that are not shielded and correctly grounded might result in interference to radio and TV reception.

Changes or modifications to this equipment that are not expressly approved in advance by StorageTek will void the warranty. In addition, changes or modifications to this equipment might cause it to create harmful interference.

FCC Compliance Statement

The following compliance statement pertains to Federal Communications Commission Rules 47 CFR 15.105:

Note: This equipment has been tested and found to comply to the limits for Class A digital devices pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his or her own expense.

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The following compliance statement in Japanese pertains to VCCI EMI regulations:

この装置は、情報処理装置等電波障害自主規制協議会（ＶＣＣＩ）の基準に基づくクラスＡ情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。

English translation: This is a Class A product based on the standard of the Voluntary Control Council for Interference by Information Technology Equipment (VCCI). If this equipment is used in a domestic environment, radio disturbance may occur, in which case, the user may be required to take corrective actions.

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English translation: This is a Class A product. In a domestic environment, this product may cause radio interference, in which case, the user may be required to take adequate measures.

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NOTICE

INTERNAL CODE LICENSE

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   b. "Internal Code" is Microcode that (i) is an integral part of Equipment, (ii) is required by such Equipment to perform its data storage and retrieval functions, and (iii) executes below the user interface of such Equipment. Internal code does not include other Microcode or software, including data files, which may reside or execute in or be used by or in connection with such Equipment, including, without limitation, Maintenance Code.

   c. "Maintenance Code" is defined as Microcode and other software, including data files, which may reside or execute in or be used by or in connection with Equipment, and which detects, records, displays, and/or analyzes malfunctions in the Equipment.

   d. "Microcode" is defined as a set of instructions (software) that is either imbedded into or is to be loaded into the Equipment and executes below the external user interface of such Equipment. Microcode includes both Internal Code and Maintenance Code, and may be in magnetic or other storage media, integrated circuitry, or other media.

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   (ii) reverse assemble, decode, translate, decompile, or otherwise reverse engineer the Internal Code (except as decompilation may be expressly permitted under applicable European law solely for the purpose of gaining information that will allow interoperability when such information is not otherwise readily available); or

   (iii) sublicense, assign, or lease the Internal Code or permit another person to use such Internal Code, or any copy of it.

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6. You, the end user, agree to take all appropriate steps to ensure that all of your obligations set forth in this Notice, particularly in paragraphs 4 and 5, are extended to any third party having access to the Equipment.

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Summary of Changes

EC Number	Date	Edition	Description
111735	April 2002	First	Initial Release

General Information

1

This chapter provides a general description of the StorageTek L5500 automated cartridge system (ACS) components and features, and presents a high-level explanation of how the ACS interacts with the operating system.

The following topics are discussed:

- System components
- Controlling software modes
- Library storage module (LSM) operating modes
- LSM safety features

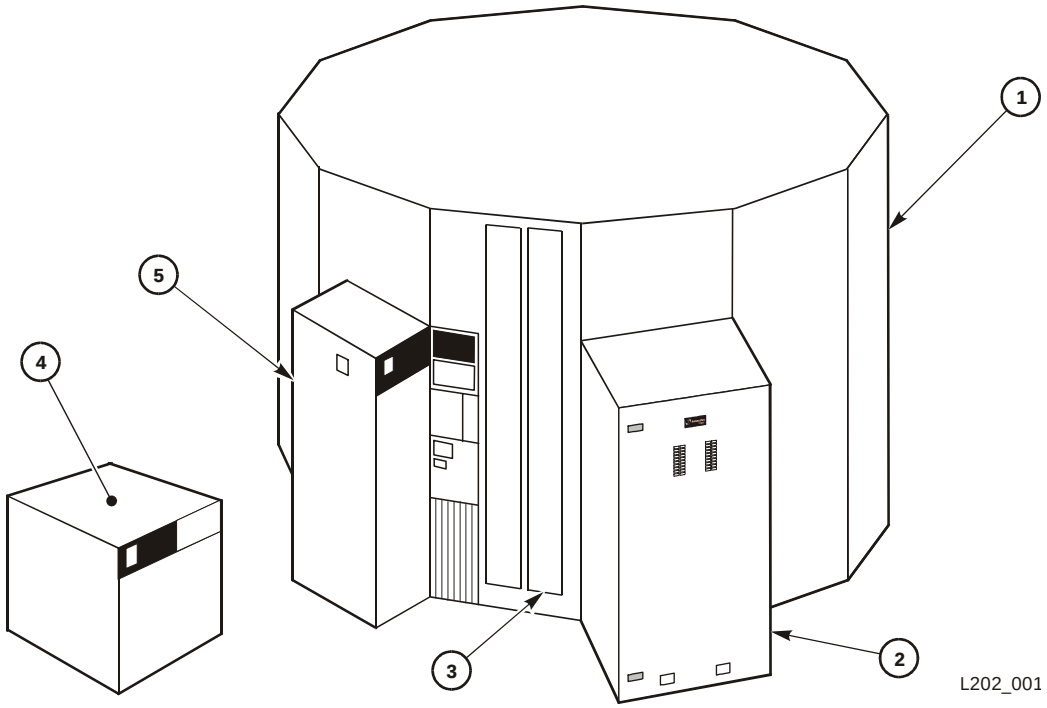
WARNING:
PHYSICAL INJURY. Under no circumstances should anyone other than an authorized service representative remove any covers from any component of an ACS.

By doing so, you might injure yourself, damage a component, and void any warranty on the unit.

System Components

The StorageTek L5500 ACS, also called the library, is a fully automated storage and retrieval system for cartridge tapes. The following pages describe the system components. Figure 1-1 on page 1-2 shows an L5500 ACS, which includes the L5510 library storage module (LSM), L5511 library control unit (LCU), L5530 library management unit (LMU), and a 9741E drive cabinet.

Figure 1-1. ACS Hardware with 80-Cell Cartridge Access Port (L202_001)



1. L5510 library storage module (LSM)
2. 9741E primary drive cabinet
3. Cartridge access port (CAP)
4. L5530 library management unit (LMU)
5. L5511 library control unit (LCU)

Controlling Software

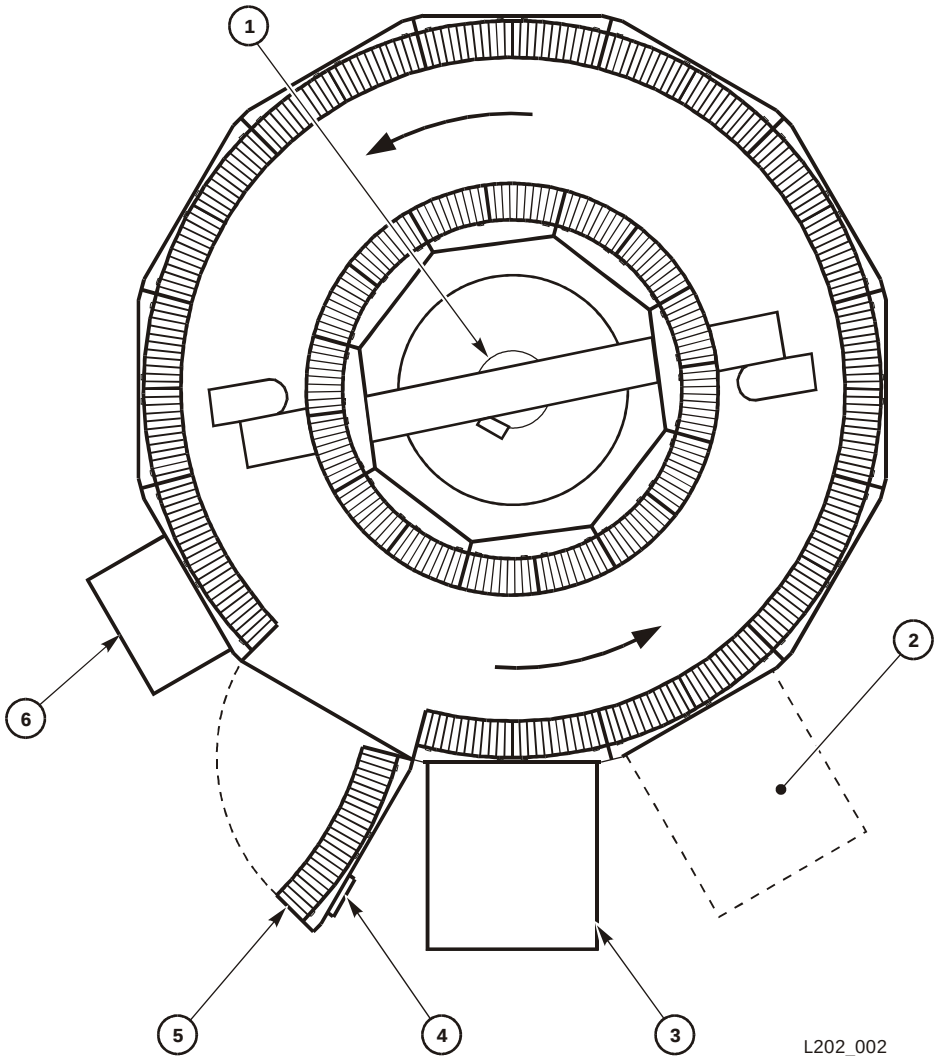
The controlling software is the overall manager of the library, the interface between the operating system and each ACS. It intercepts or receives mount/dismount messages, translates them into move requests, and routes them to the library management unit (LMU).

Library Storage Module (LSM)

The LSM is a 12-sided structure containing a free-standing, vision-assisted robot, and storage for up to 5,500 cartridges. From one to four drive cabinets can be attached to the exterior of an LSM, allowing the robot to insert cartridges into the tape drives. Each drive cabinet can hold up to 20 tape drives—with up to 20 LTO Ultrium tape drives, a combination of Ultrium and 9x40 tape drives, or up to seventeen 9x40 tape drives—for a maximum of 80 tape drives. Figure 1-2 on page 1-3 shows a top view of the L5510 LSM.

Note: Up to twenty 9x40 drives can be put in a drive cabinet that has no LTO Ultrium drives.

Figure 1-2. L5510 Library Module—Top View (L202_002)



1. Robot
2. Additional drive cabinet
3. Primary drive cabinet
4. Cartridge access port (CAP)
5. LSM access door
6. Library control unit (LCU)

When a mount is requested:

1. The servo system moves the robot fingers to within 0.65 cm (0.25 in.) of the center of the cell location.
2. A solid-state camera vision system fine-positions the robot fingers.
3. The camera makes sure that the volume serial ID (vol_id) label on the cartridge is correct.

4. The robot retrieves the cartridge from the cell.
5. The robot moves to the specified tape drive and mounts the cartridge.

When a dismount is requested, the robot removes the cartridge from the tape drive and either:

- Returns the cartridge to the source cell if pass-through operations were not required to mount the volume.
- Places the cartridge in an available cell in the robot LSM if pass-through operations were required to mount the volume. (Normally, pass-through operations are not performed to place a cartridge in a storage cell after it has been dismounted, as long as an available cell exists in the LSM.)
- If specifically directed to return the cartridge to its original home cell location, places the cartridge into the PTP cell to begin passing it back to the original LSM.

Each LSM has an access door in the outer wall for human access to the interior. The access door contains an 80-cell cartridge access port (CAP) and a priority CAP (PCAP).

Cartridge Access Port (CAP)

The CAP and PCAP allow you to enter and eject cartridges without interrupting automated operations in the LSM. The 80-cell CAP allows up to 80 cartridges to be loaded into or removed from the LSM without your entering the LSM. This CAP consists of two doors, each holding 40 cartridges, and a PCAP. The cartridges can be placed into magazines that hold 10 cartridges each, and the entire magazine can be placed into the CAP. The PCAP allows one cartridge to be entered or ejected at a time.

Library Control Unit (LCU)

An LCU is attached to each LSM. When the LCU receives a request from the LMU, the LCU microprocessor commands the LSM robot to:

1. Move to the location of the cartridge.
2. Make sure that the cartridge is correct by reading the volume serial ID (vol_id) label.
3. Retrieve the cartridge from the cell location.
4. Move the cartridge to the specified destination cell.
5. Place the cartridge into the tape drive, pass-through port (PTP), cartridge access port (CAP), or priority access port (PCAP).

Library Management Unit (LMU)

The LMU is the interface between the controlling software and the library control unit (LCU). A single LMU manages from 1 to 24 library storage modules (LSMs). It can receive mount and dismount requests from as many as 16 hosts. When a mount request is received, the LMU sends commands to the LCU attached to the correct LSM.

Controlling Software Modes

The terms “connected mode” and “disconnected mode” refer to the relationship between the controlling software and an ACS. An ACS may be connected to one host while being disconnected from another. A single host may be attached to several ACSs, some of which are connected to the controlling software, and some of which are disconnected from it.

If your system supports a dual LMU configuration, the ACS can be in a condition referred to as “standby mode.” Two LMUs exist in a dual LMU configuration: one master and one standby. If the master LMU stops functioning, the standby LMU becomes the master and takes over the LMU functions.

Connected Mode

Controlling software is connected to an ACS when both of the following conditions are true:

- The controlling software is executing on that particular host.
- The host and the ACS are communicating with a minimum of one station online to the ACS (a station is the connection between the host and the LMU).

While the controlling software is connected to the ACS, messages from the host are routed to the ACS, which automates the mounts and dismounts.

Disconnected Mode

Controlling software is disconnected from an ACS when both of the following conditions are true:

- The controlling software is executing on that particular host.
- The host and the ACS are not communicating (no stations are online to the ACS from that particular host).

In disconnected mode, no automated tape activity can occur for this host using this ACS.

In a multiple-host environment, however, because the ACS is still capable of automated operations, you can semi-automate mounts and dismounts by issuing software commands from a connected host’s console. As the mount and dismount messages are displayed on the disconnected host’s console, you can issue software mount and dismount commands from the connected host's console to direct the LSM robots to perform the mounts and dismounts.

Standby Mode

The controlling software is connected to an ACS in standby mode when the following conditions are true:

- The dual LMU feature has been installed.
- No stations are online to the master LMU.
- At least one station is online to the standby LMU.

In standby mode, the controlling software intercepts mount and dismount messages and accepts operator cartridge movement commands. The controlling software cannot send requests to the master LMU, because no stations are online. You can resolve this situation by issuing the switch command, causing the standby LMU to become the master LMU. When the standby LMU has assumed master LMU functionality, the controlling software sends all the pending (or saved) LMU requests to the new master LMU.

LSM Operating Modes

An LSM operating mode is the way in which an LSM and all the controlling software attached to it interact. The two operating modes are automatic and manual. Automatic mode is the normal operating mode of an LSM. An LSM is either in automatic mode to all hosts or in manual mode to all hosts.

Automatic Mode

An LSM operating in automatic mode does not require your intervention to mount, dismount, move, or pass a cartridge to another LSM. When the LSM is in automatic mode, you can use console commands or batch utility processing to enter or eject cartridges through the CAP.

Manual Mode

An LSM operating in manual mode cannot perform any automated operations. You must manually move, mount, and dismount cartridges.

LSM Safety Features

Unless otherwise noted, the following items are standard safety features on the LSM.

- **LSM Safety Interlocks** If the access door to the LSM is opened, electrical interlocks remove power from the robot to prevent injury to a person.
- **LSM Entrance Safety Sign** Just inside the access door to the LSM, a lit panel mounted on the ceiling directs you to enter when the electrical interlocks remove power to the robot and all safety procedures have been followed.
- **Prevention of LSM Access Door Closing** By following simple safety procedures (refer to "Entering the LSM" in Chapter 3, "Operating an ACS"), someone inside the LSM can prevent anyone outside the LSM from closing the LSM access door.
- **LSM Emergency Power Off (EPO) Switch** Pressing a large, bright red knob on the inside of the LSM access door activates an EPO switch that turns off AC power to the LCU/LSM. This extra safety feature is provided in case anyone outside the LSM locks the access door when someone is inside.
- **LSM Fire Detection** In the rare case of fire in the LSM, sensors start an immediate subsystem shutdown (EPO).
- **Internal Fire Suppression System Ports** The LSM contains ports to which the user may connect a fire suppression system. This system, as well as its controls and sensors, is supplied by a third party vendor at the customer's request. Additional information can be supplied by a StorageTek Marketing Representative.
- **Theta Obstruction Search** During initialization, the robot theta arm moves slowly through its full range of motion. In this mode, current is limited and the mechanism can be stopped by hand. If any physical obstruction prevents the arm from moving for more than a few seconds, the arm shuts down and an error is posted. If motion is disturbed only for a moment, the mechanism continues to sweep, but posts an error at the end of initialization, without going into normal move mode.

Controls and Indicators

2

LMU Status Panel

The Library Management Unit (LMU) status panel contains indicators that report the operation and status of the LMU. You can view this panel without opening the LMU door. Figure 2-1 shows the LMU status panel, and Table 2-1 on page 2-2 describes each numbered item.

Figure 2-1. LMU Status Panel (L202_028)

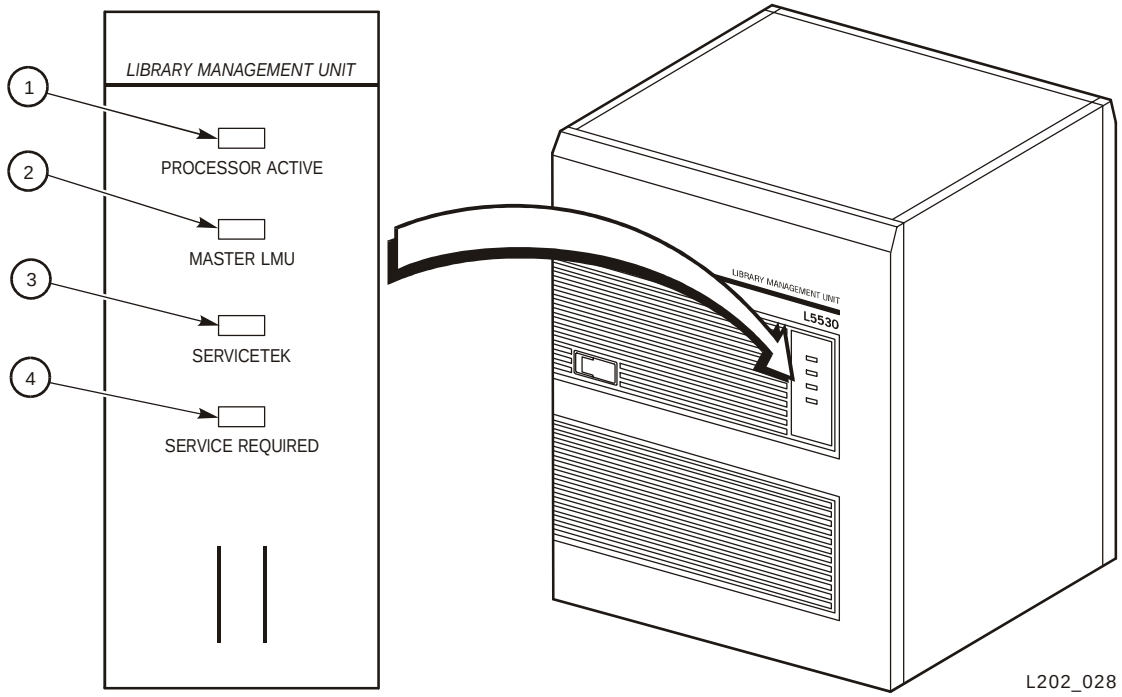


Table 2-1. LMU Status Panel

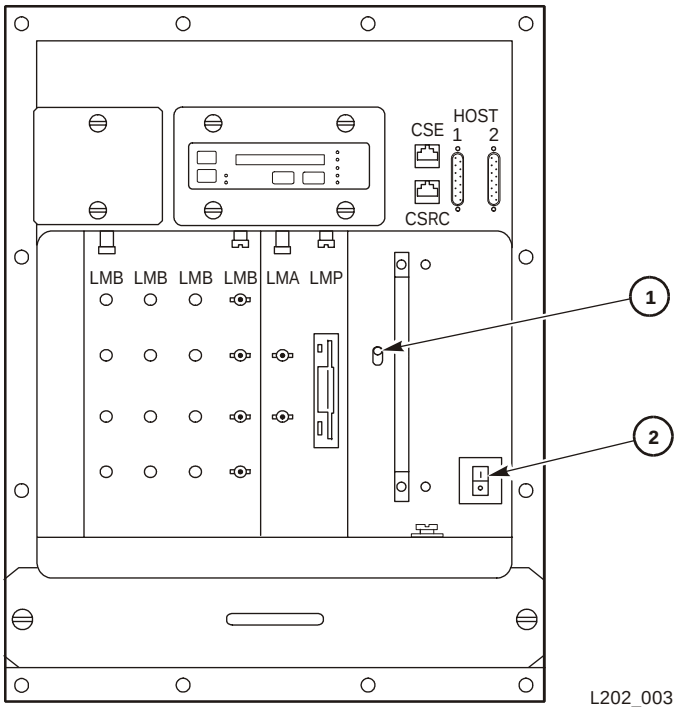
Item*	Label	Type	Function
1	PROCESSOR ACTIVE	Indicator	Indicates the processor is operating.
2	MASTER LMU	Indicator	In dual LMU configuration, lights when this LMU is the master LMU. Blinks briefly when this is the standby LMU. Not available in all operating environments.
3	SERVICETEK	Indicator	Lights when a problem has been detected in the ACS and an alert message and error code have been sent to Central Support Remote Center (CSRC) or the operator console.
4	SERVICE REQ	Indicator	Lights when the processor has detected an error in the LMU. The LMU does not operate under this condition.

Note: *Numbers correspond to item numbers in Figure 2-1 on page 2-1.

LMU Power Switch

To switch power off to the LMU in an emergency, press the power switch on the LMU (Figure 2-2).

Figure 2-2. LMU Power Switch (L202_003)



1. Power fault indicator light
2. Power switch

LCU/LSM Operator Panel

The LCU/LSM operator panel is on the LCU. Figure 2-3 shows this panel and Table 2-2 on page 2-5 lists and describes each numbered item.

Figure 2-3. LCU/LSM Operator Panel (L202_004)

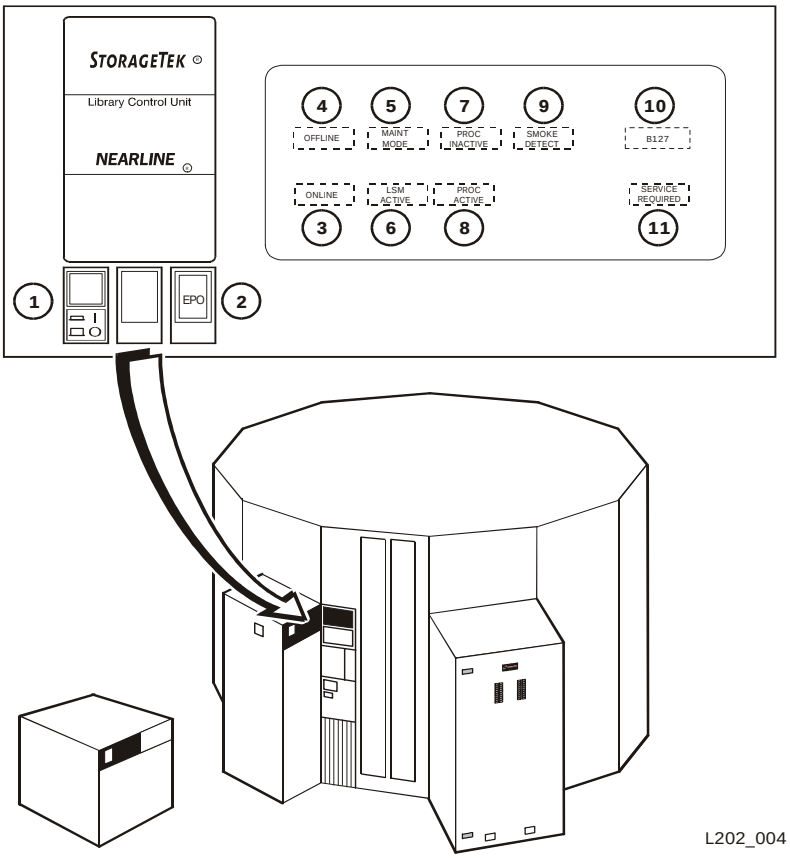


Table 2-2. LCU/LSM Operator Panel

Item*	Label	Type	Function
1	POWER	Push-button switch	**Switch:** Set the switch to "1" to turn on DC power and start wake up procedures. Set it to "0" to turn off DC power to the LSM after all in-process commands are completed.
2	EPO	Momentary switch	Emergency power off. Press this momentary switch to immediately remove all power from the LCU and LSM and end all activity in progress within the LSM. **Use this switch only in an emergency; the EPO switch can be reset only by a service representative.** Another EPO switch is inside the LSM.
3	ONLINE	Indicator	On if LSM is online.
4	OFFLINE	Indicator	On if LSM is offline.
5	MAINT MODE	Indicator	On in maintenance mode. Maintenance mode is an LSM state in which diagnostic routines can run. The only way to put an LSM into maintenance mode is with a software switch turned on from either a 392X diagnostic device or the Central Support Remote Center (CSRC), or during power on for wake-up diagnostics.

Table 2-2. LCU/LSM Operator Panel (Continued)

Item*	Label	Type	Function
			On when the robot is moving. **WARNING:** **Do not assume the LSM is safe to enter even if this indicator is not on. To prevent any possibility of being injured by the robot, follow the safety procedures discussed in "Entering the LSM" in Chapter 3, "Operating an ACS."**
6	LSM ACTIVE	Indicator	
7	PROC INACTIVE	Indicator	On if processor failure is detected.
8	PROC ACTIVE	Indicator	On if processor is functioning.
9	SMOKE DETECT	Indicator	Indicates that the overhead smoke detectors have been tripped (causing emergency power off).
10		Alphanumeric display	Displays status error codes. During initialization, it displays interim status codes for initialization, calibration, CEM/ pass-thru ports, and playgrounds. During normal operation, this display is blank. When the SERVICE REQUIRED indicator is on, this display shows an error code that points to the cause of the problem. If a failure generates more than one error code, only the first error code is displayed. If possible, the software saves any error codes not displayed for a service representative to retrieve.
11	*Service Required*	Indicator	On when LSM needs service. The alphanumeric display indicates the error code.

Note: * Numbers match item numbers in Figure 2-3 on page 2-4.

Cartridge Access Port (CAP) Display Panel

The CAP contains 81 cells, allowing you to enter or eject up to 81 cartridges from the library without anyone your having to enter the LSM.

The CAP consists of a one-cell priority CAP (PCAP) and two doors containing 40 cells each.

The display panel located above the PCAP on the LSM access door displays CAP and PCAP status, number, and location of cartridges in the CAPs, and error messages (Figure 2-4 on page 2-8).

The panel is divided into three sections–PCAP on the left, CAP 1 in the middle, and CAP 0 on the right.

The upper portion of each section shows requests for operator intervention and error messages. Data messages, such as `Load Cartridges` and `Remove Cartridges`, are displayed in reverse screen color. During the idle state of the PCAP, the StorageTek logo and model number appear.

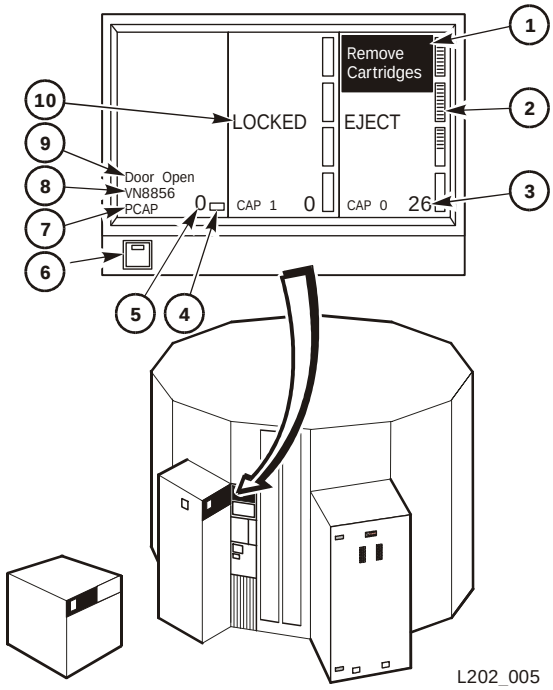
The middle portion of each section shows CAP status, such as *Locked*, *Enter,* or *Eject*.

The lower portion of each section shows CAP access interrupt status, such as *Door Open*, and number of cartridges in the device.

The LED push-button switch, on the left-hand side below the PCAP display, allows you to restore the display if it has gone blank. When the CAP or PCAP has been inactive for 10 minutes, the display goes blank and the green LED in the switch lights. The display remains blank until the switch is depressed, a host request for CAP interaction occurs, or a CAP/PCAP door open or close is sensed.

The following figure shows and describes each numbered item.

Figure 2-4. CAP Display Panel (L202_005)



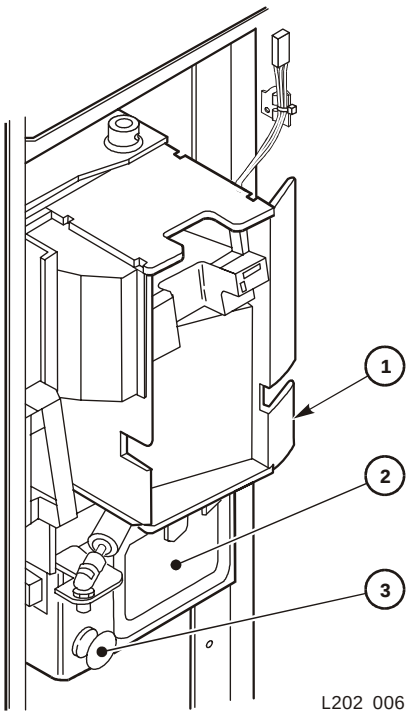
1. Message – Operator intervention required, error messages
2. Rectangular boxes with horizontal lines – The boxes show the number and location of magazines. The lines show cartridges being ejected or entered. If the magazines are not placed correctly within the CAP, an error message appears at the top of the CAP selected.
3. Number – Number of cartridges within the CAP
4. Box – Horizontal line indicates that a cartridge is in the PCAP
5. Number – “1” denotes a cartridge in the PCAP; “0” denotes the PCAP is empty.
6. Switch/Indicator:
   a. Switch – Restores display when blanked
   b. Indicator – Lights when display is blanked
7. Device – PCAP, CAP 0, or CAP1
8. Volume ID – with certain software, vol_id of cartridge in CAP
9. Status – CAP access interrupt (Door Open)
10. Status – *Locked, Enter, Eject*

Emergency Power Off Switch–Inside LSM

WARNING:
PHYSICAL INJURY. The LSM safety system is not foolproof. Use extreme caution before you close the access door to make sure that no one is inside. Make a visual inspection for people or other obstructions just before you close the access door.

It is remotely possible that someone could become trapped inside the LSM. For this reason, there is a large red EPO push-button switch on the inside of the LSM access door to immediately shut down the LSM. Pressing this switch turns off power from all moving parts of the robot. Figure 2-5 shows the location of this switch on the PCAP, next to the access door latch.

Figure 2-5. Emergency Power Off (EPO) Switch—Inside LSM (L202_006)



1. PCAP
2. Access door latch
3. EPO switch (red)

Tape Drive Operator Panel

The operator display panel on the 9840, T9840, and T9940 (9x40) tape drives is the same, but the Ultrium operator panels vary by manufacturer, with fewer indicators and switches than the 9x40 drives.

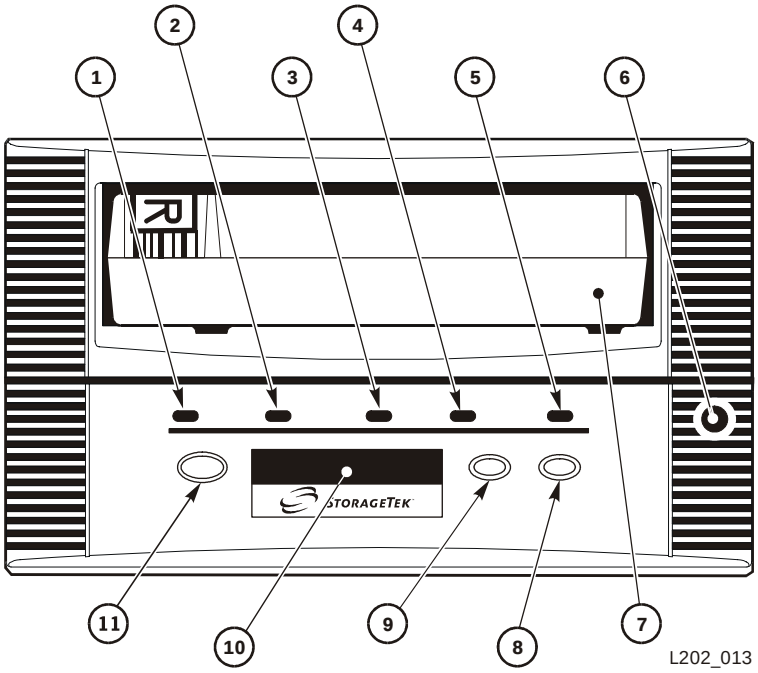
9x40 Operator Panel

9x40 drives have an operator panel below the cartridge slot. This panel contains the display, four indicators, and four switches (Figure 2-6 on page 2-11). Table 2-3 explains the 9x40 operator panel switches and indicators.

Table 2-3. 9x40 Operator Panel Indicators and Switches

Item	Description
power	When on constantly, indicates power on and IPL completed successfully.
activity	When on constantly, indicates tape is loaded and the drive is ready. When flashing, tape is moving in the drive.
clean	Indicates when the drive needs to be cleaned. A cleaning cartridge should be loaded at the next opportunity.
service	When on constantly, indicates a hardware error was detected and the drive is not functional.
IPL	Pressing this switch causes an IPL and resets the drive.
Unload	Pressing this switch rewinds tape in the cartridge and ejects the cartridge from the drive.
Select	Pressing this switch while in the Main Menu selects the displayed choice or advances to a sub-menu.
Menu	Pressing this switch accesses the menu system, the menus, and submenus.

Figure 2-6. 9x40 Operator Panel (L202_013)



1. Power indicator
2. Activity indicator
3. Clean indicator
4. Service indicator
5. IPL switch
6. Manual unload device
7. Data cartridge
8. Select switch
9. Menu switch
10. Operator display
11. Unload switch

Refer to the *9840/T9840 Tape Drive User's Reference Manual*, PN 95739, or the *T9940 Tape Drive Operator's Guide*, PN 95989, for additional information.

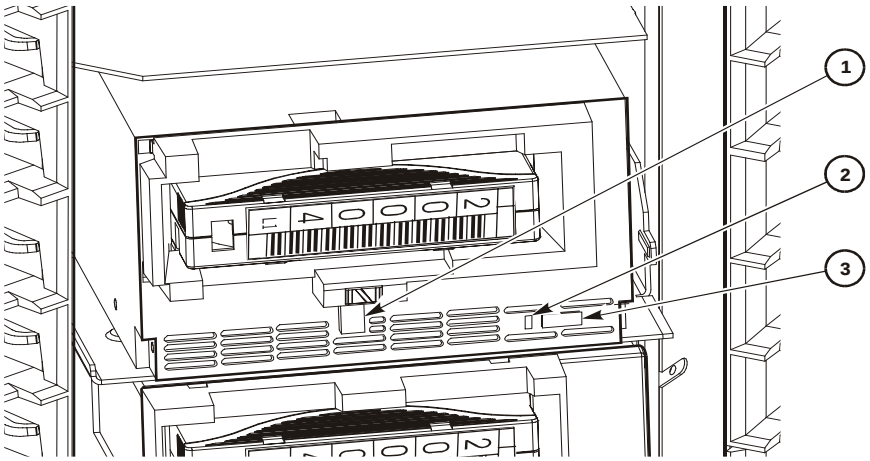
LTO Ultrium Drives Operator Panels

Each model of the LTO Ultrium tape drive has a slightly different operator panel.

IBM LTO Ultrium Operator Panel

The LTO IBM Ultrium drive has a single-character display, a status light, and a unload button.

Figure 2-7. IBM LTO Ultrium Drive Operator Panel (L202_043)



1. Single-character display
2. Status light
3. Unload button

The status light can be green or amber (yellow) and either solid or flashing.

The Unload button allows you to perform several functions, depending on the number of times you press the button and the length of time you press it.

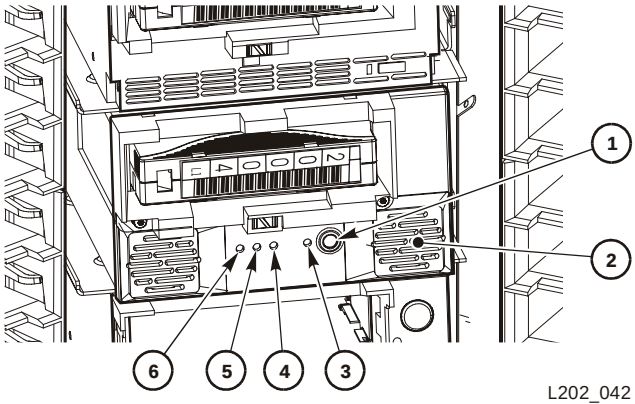
The single-character display presents diagnostic or maintenance functions, error conditions, and informational messages. If multiple errors occur, the code with the highest priority (represented by the lowest number) appears first. When each error is corrected, the next error in descending order appears.

For more information, refer to *IBM Ultrium Internal Tape Drive Models T200 and T200F Setup, Operator, and Service Guide*, GA32-0435-02, on the "IBM LTO Ultrium Tape Drive T200 Product Manuals" CD-ROM.

Seagate LTO Ultrium Operator Panel

The Seagate LTO Ultrium drive has an unload button and three status lights.

Figure 2-8. Seagate LTO Ultrium Drive Operator Panel (L202_042)



1. Unload button
2. Fan grate (2x)
3. Power light
4. Status light - Active
5. Status light - Warning
6. Status light - Error

The status lights work in various combinations of one, two or three lights to indicate normal operation, warnings, or operational errors. The lights can be on solid or flashing at different intervals.

For more information, refer to the *Viper 200 Product Manual* on the StorageTek Seagate CD-ROM.

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Operating an ACS

3

This chapter describes the procedures for operating an ACS:

WARNING:
PHYSICAL INJURY. Under no circumstances should anyone other than an authorized service representative remove any covers from any component of an ACS. By doing so, you might injure yourself, damage a component, and void any warranty on the unit.

LSM Automatic Mode

When an library storage module (LSM) is online, it is in automatic mode. This means that the robot can mount and dismount cartridges in the cartridge drive, retrieve cartridges and store them in the wall cells of the LSM, and retrieve and eject cartridges through the cartridge access port (CAP) and priority cartridge access port (PCAP). In other words, the robot can perform all operations that take place inside the LSM, without your intervention.

The most common functions that you must perform when an LSM is in automatic mode are:

- Inserting cartridges into the LSM through a CAP or PCAP
- Retrieving cartridges from the LSM through a CAP or PCAP
- Entering a cartridge when the eject routine is in progress

CAP and PCAP Modes

When an LSM is in automatic mode, the CAPs and PCAP can be in either auto-mode or manual mode.

When a CAP is in auto-mode, it is unlocked unless it is currently being used to enter cartridges. You can enter cartridges into an auto-mode CAP without using commands.

When the CAP is in manual mode, it is locked and must be unlocked by the host or by your command to enter or eject cartridges. When the host wants to use the CAP, a message on the console instructs you to place a cartridge into the CAP or remove one. If you want to use the CAP, you must issue the appropriate command to start the entering or the ejecting activity.

Entering Cartridges into the CAP in Auto-mode

To enter an LTO Ultrium or 9x40 cartridge into the CAP:

1. Look at the indicator or display to make sure that the CAP is not locked.
2. Unlatch and open the CAP; insert the cartridge into the proper slot (Figure 3-2 on page 3-4).
3. Close the CAP door. Make sure that the latch catches.

Entering Cartridges into the CAP in Manual Mode

Use the enter command to enter cartridges into an automatic mode LSM when a CAP is in manual mode. Each enter command lets you specify one CAP in one LSM. Refer to your software manual for the command syntax and console messages.

1. Type the enter command at the console. Refer to the *ACSLS System Administrator's Guide,* PN 3134648, for more information.

   `Enter` and `Load Cartridges` appear on the CAP panel display.

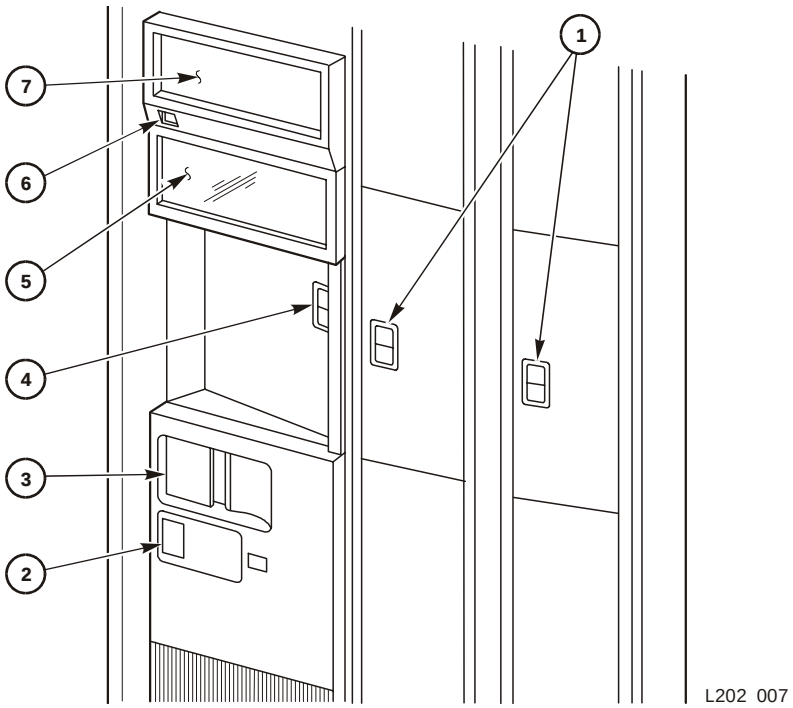
   A message appears on the console. The CAP door unlocks.

CAUTION:
ROBOT/MEDIA DAMAGE. Make sure that `Enter` appears on the CAP panel display before you open the CAP.

PHYSICAL INJURY. To prevent contact with the robot, do not try to reach beyond the CAP into the LSM.

2. Open the CAP door by pulling down on the paddle handle CAP latch (Figure 3-1 on page 3-3).

Figure 3-1. Cartridge Access Port—Closed (L202_007)

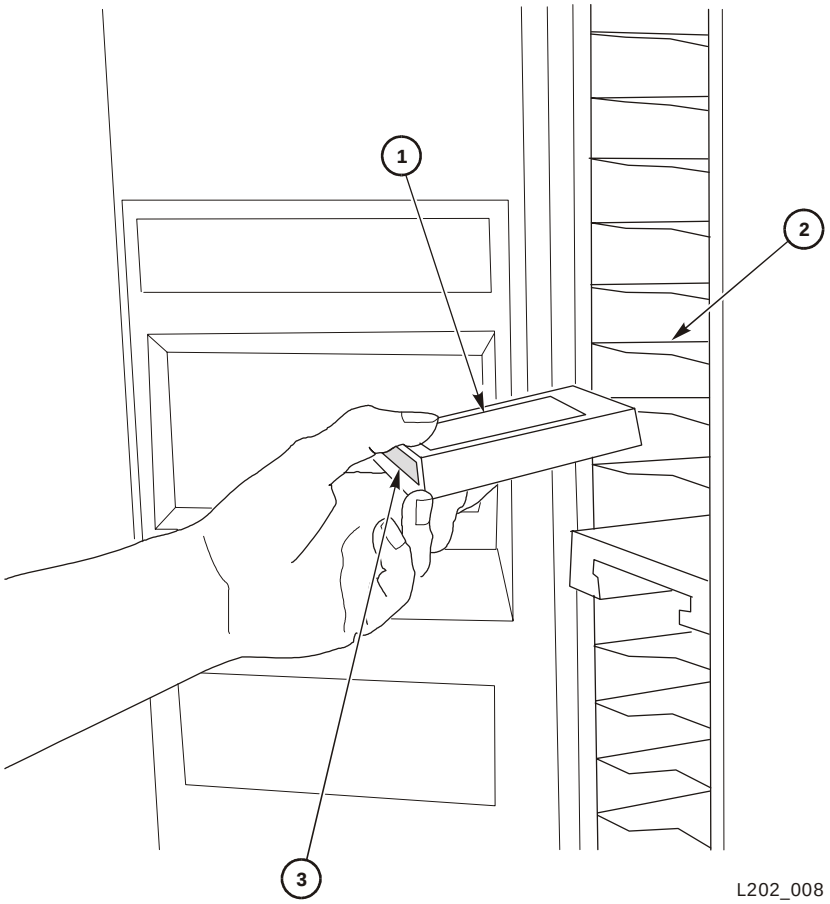


1. CAP latches
2. Lock access door (LAD) latch
3. LSM access door latch
4. PCAP latch
5. View window
6. CAP display switch
7. CAP display

CAUTION:
LOSS OF DATA. LTO Ultrium drives do not recognize a 'mount *vol_id drive_id* readonly' command from ACSLS. SET THE CARTRIDGE WRITE PROTECT SWITCH TO THE WRITE PROTECT POSITION TO PREVENT DATA FROM BEING OVERWRITTEN (see "Setting the LTO Ultrium Write Protect Switch to Read-Only" on page A-13 for more information).

3. Place the LTO Ultrium or 9x40 cartridges into the magazine cells as in Figure 3-2 on page 3-4. Insert the cartridges so that the customer label (if present) is facing up, the hub gear is facing down, and the volume serial ID (vol_id) label is facing you.

Figure 3-2. Cartridge Access Port—Opened (L202_008)



1. Customer label (9x40 only)
2. CAP magazine cells
3. Volume serial ID (vol_id) label

You may put cartridges into the magazines while the magazines are in the CAP; or you may remove the magazines from the CAP, insert cartridges into the magazines, and then replace the cartridge-filled magazines into the CAP.

Regardless of which method you use, you must make sure that two conditions are met before you close the CAP door:

- All magazine positions in both CAPs *must* be occupied by magazines. If a magazine from either CAP is missing, the robot will not service the CAP.
- The top cartridge slot in the top magazine of the open CAP must be occupied, and there must be no empty slots between the top and bottom cartridges. The robot scans down, starting at the topmost slot, and stops scanning at the first empty slot it encounters.

CAUTION:
MEDIA DAMAGE. Do not slam the door. The robot cannot retrieve cartridges if they fall out of the CAP onto the floor.

4. Close the CAP door. `Locked` appears on the CAP panel display.

   Note: If the LSM is operating in Paired CAP mode, you must open and close *both* CAP doors every time a CAP is unlocked.

5. The robot scans the CAP and stores all cartridges with readable labels inside the LSM.

CAUTION:
ROBOT/MEDIA DAMAGE. Make sure that `Enter` appears on the CAP panel display before you open the CAP.

6. The CAP unlocks when the robot has removed all readable cartridges from the CAP.

   Open the CAP.

7. If `Remove Cartridges` appears on the display, remove any cartridges that were not accepted by the robot.

8. If more cartridges must be placed in the CAP, repeat steps 3 through 7, as many times as necessary.

9. Close the empty CAP. The CAP returns to an empty state.

To discontinue this operation:

10. At the console, type the command to drain the CAP and make it available for other work.

11. Remove any cartridges left in the CAP.

12. Close the CAP door. `Locked` appears on the display.

Entering Cartridges into the LSM through the PCAP

The PCAP is on the access door. The following pages describe how to enter cartridges into the LSM through the PCAP.

When the PCAP is in Auto-mode

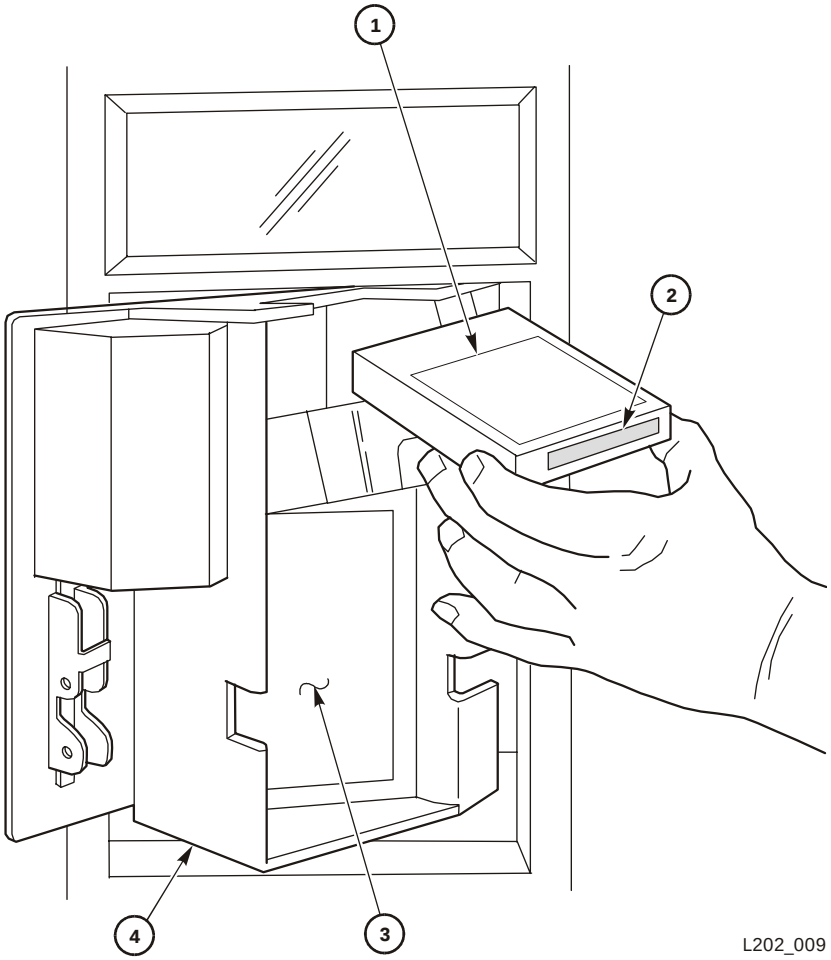
To load a cartridge in the PCAP:

1. Look at the indicator or display to make sure that the PCAP is not locked.
2. Unlatch and open the PCAP door (Figure 3-1 on page 3-3).

CAUTION:
LOSS OF DATA. LTO Ultrium drives do not recognize a 'mount *vol_id drive_id* readonly' command from ACSLS. SET THE CARTRIDGE WRITE PROTECT SWITCH TO THE WRITE PROTECT POSITION TO PREVENT DATA FROM BEING OVERWRITTEN (see "Setting the LTO Ultrium Write Protect Switch to Read-Only" on page A-13 for more information).

3. Insert a cartridge into the PCAP slot with the customer label (if present) on top, the hub gear facing down, and the vol_id label facing you. (Figure 3-3 on page 3-7).

Figure 3-3. Priority Cartridge Access Port—Opened (L202_009)



1. Customer label (9x40 only)
2. Volume serial ID (vol_id) label
3. Tape cartridge insertion directions
4. Priority cartridge access port (PCAP)

4. Close the PCAP door.

When the PCAP is in Manual Mode

Use the enter command to enter cartridges into a PCAP when it is in manual mode.

1. Type the enter command at the console. Refer to the *ACSLS System Administrator's Guide*, PN 3134648, for more information.

   `Enter` and `Load Cartridges` appear on the CAP panel display. A message appears on the console and the PCAP door unlocks.

CAUTION:
ROBOT/MEDIA DAMAGE. Make sure that `Enter` appears on the CAP panel display before you open the PCAP.

PHYSICAL INJURY. To prevent contact with the robot and possible injury to yourself, do not try to reach beyond the PCAP into the LSM.

2. Open the PCAP door by pulling down on the paddle handle PCAP latch (Figure 3-1 on page 3-3).

CAUTION:
LOSS OF DATA. LTO Ultrium drives do not recognize a 'mount *vol_id drive_id* readonly' command from ACSLS. SET THE CARTRIDGE WRITE PROTECT SWITCH TO THE WRITE PROTECT POSITION TO PREVENT DATA FROM BEING OVERWRITTEN (see "Setting the LTO Ultrium Write Protect Switch to Read-Only" on page A-13 for more information).

3. Place a cartridge into the PCAP cell (Figure 3-2 on page 3-4).

   Insert the cartridge so that the customer label (if present) is on top and the volume serial ID (vol_id) label is facing you.

CAUTION:
MEDIA DAMAGE. Do not slam the door. The robot cannot retrieve a cartridge if it falls out of the PCAP onto the floor.

4. Close the PCAP door. `Locked` appears on the CAP panel display.

   The robot scans the PCAP and stores the cartridge if its label is readable.

Ejecting Cartridges through a CAP

Use the eject command to eject cartridges from an LSM through the CAP.

1. Type the eject command at the console. Refer to the *ACSLS System Administrator's Guide*, PN 3134648, for more information.

   `Locked` appears on the CAP panel display, if it is not already there.

2. The robot places cartridges into the CAP until all specified cartridges are in the CAP or all CAP cells are filled. The rectangular boxes on the display represent the magazines, and the horizontal lines within the boxes represent the cartridges in the magazine slots (Figure 2-4 on page 2-8). The number at the bottom of the display increments as cartridges are added to the CAP.

   `Remove Cartridges` appears on the console and `Eject` replaces `Locked` on the CAP panel display.

CAUTION:
ROBOT/MEDIA DAMAGE. Make sure that `Eject` appears on the CAP panel display before you open the CAP.

3. Open the CAP door.

4. Remove all the cartridges, either by removing the cartridges from the magazines inside the CAP, or by removing the magazines from the CAP and taking the cartridges from the magazines outside of the CAP. Do not leave cartridges in the CAP, or `Remove Cartridges` will appear on the display.

   If you remove the magazines, replace them with empty magazines. Make sure that at least one magazine (the bottom one) is in the CAP.

5. Close the CAP door. `Locked` replaces `Eject` and `Remove Cartridges` on the CAP panel display.

   If the CAPs are operating in Paired CAP mode, you must open and close *both* CAP doors every time a CAP is unlocked.

6. If more cartridges need to be ejected, the robot continues filling the CAP. Wait until the CAP door is unlocked and repeat steps 3 through 5.

The eject operation ends automatically when all specified cartridges have been ejected.

Ejecting Cartridges through the PCAP

The priority CAP (PCAP) is on the access door. A cartridge is ejected from the PCAP when a message appears on the console to eject the cartridge. Use the eject command to eject cartridges from an LSM.

1. Type the eject command at the console. Refer to the *ACSLS System Administrator's Guide*, PN 3134648, for more information.

   `Locked` appears on the CAP panel display, if it is not already there.

2. The robot places a cartridge into the PCAP.

   `Remove Cartridge` appears on the console and `Eject` replaces `Locked` on the CAP panel display.

CAUTION:
ROBOT/MEDIA DAMAGE. Make sure that `Eject` appears on the CAP panel display before you open the CAP.

3. Open the PCAP door.
4. Remove the cartridge from the PCAP slot.
5. Close the PCAP door. `Locked` replaces `Eject` and `Remove Cartridge` on the CAP panel display.
6. If more cartridges need to be ejected, the robot continues filling the PCAP. Wait until the PCAP door is unlocked and repeat steps 3 through 5.

The eject operation ends automatically when all specified cartridges have been ejected.

LSM Manual Mode

When the LSM is in manual mode, the robot is disabled, and you must enter the LSM to mount and dismount cartridges in the cartridge drives. Manual operations include:

Determining the LSM Is Not in Automatic Mode

The following conditions indicate when an LSM is not functioning in automatic mode:

- The LSM access door is open.
- The robot does not automatically mount and dismount cartridges.
- A console message informs you that an LSM is not ready, indicating a problem has been detected in the LSM. The message identifies the LSM and provides a code for the failure.

Displaying LSM Status

If you suspect that the LSM is not functioning in automatic mode, type the command at the system console to display the status of the LSM. Refer to the *ACSLS System Administrator's Guide*, PN 3134648, for the command syntax and console messages. The status display indicates if the LSM is not functioning in automatic mode.

Dual LMU Environment

ACS requests cannot effectively be automated if all stations are offline to the LMU, or if all online station paths are not working. In a dual LMU environment, if all online station paths to the master LMU are not working, use the switch command to move the work load to the standby LMU.

Placing the LSM in Manual Mode

Refer to the *ACSLS System Administrator's Guide*, PN 3134648, for the command syntax and console messages to place the LSM in manual mode. The LSM remains in manual mode until a command is given to place the LSM online.

Making Sure the LSM is Offline

If you do not see a console message indicating that the LSM is offline, type the command to display the LSM status.

Note: Placing the LSM offline does not cause the drives in the affected LSM to become offline.

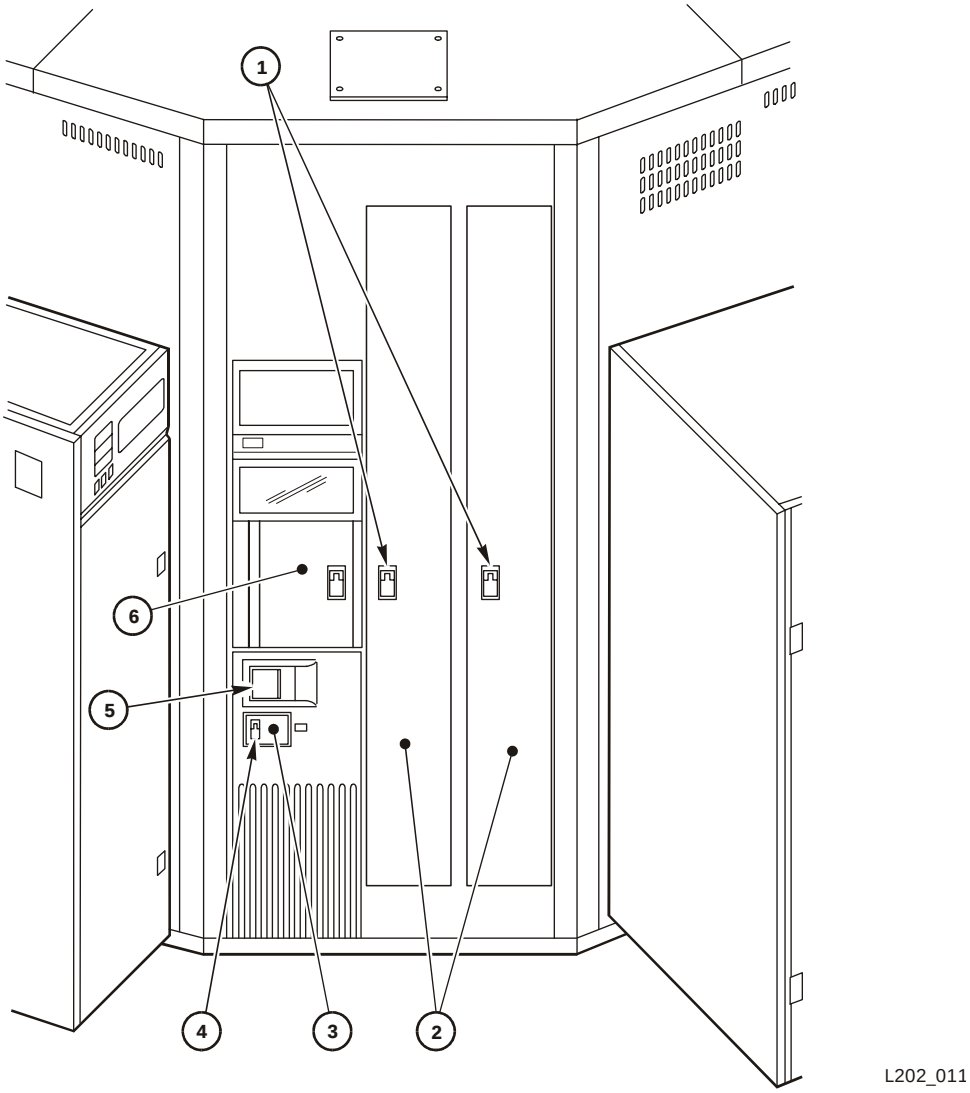
Entering the LSM

WARNING:
PHYSICAL INJURY. You can be injured if you do not follow the correct procedure to enter the LSM.

Note: To prevent personal injury, follow these precautions:

1. Do not enter the LSM until you are thoroughly familiar with this procedure.
2. Refer to Figure 3-4 on page 3-13 and familiarize yourself with the access door and its components.
3. Do not attempt to override any of the electrical or mechanical safety devices in this machine.
4. Do not enter the LSM without informing someone in the immediate area.
5. *Never* shut the LSM door when you leave without first making sure the LSM is unoccupied. Look around the inside of the LSM, and then ask in a loud voice if anyone is inside.

Figure 3-4. LSM Access Door—Outside View (L202_011)



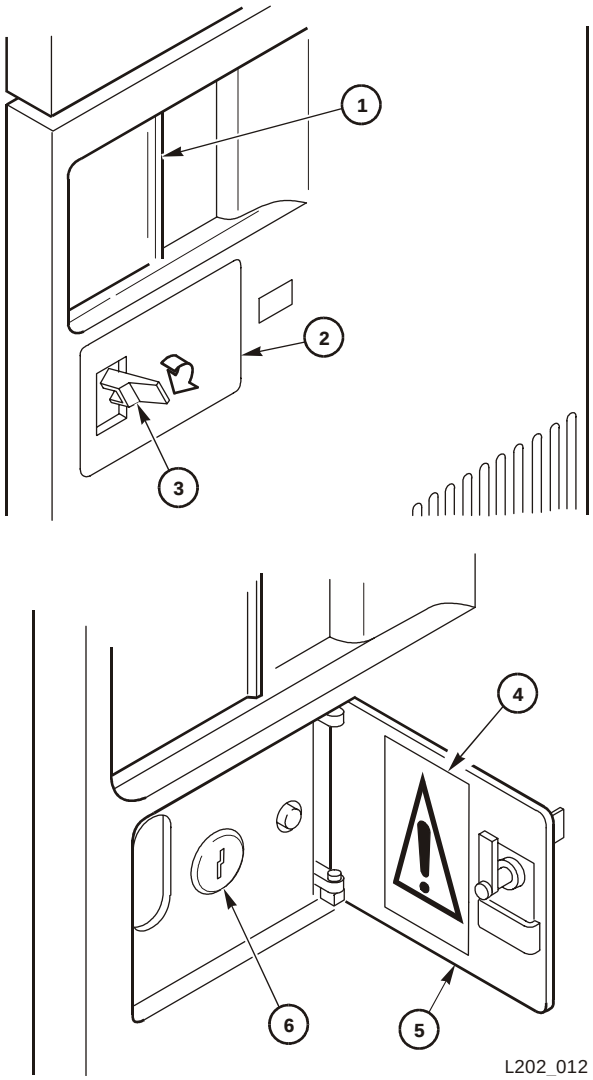
1. Cartridge access port (CAP) door latches
2. CAPs
3. Lock access door (LAD)
4. LAD latch
5. Access door latch
6. Priority cartridge access port (PCAP)

When you begin the procedure to enter the LSM, the LED warning sign next to the lock access door (LAD) displays the words `DO NOT OPEN`.

Refer to the *ACSLS System Administrator's Guide*, PN 3134648, for the command syntax and console messages and do the following:

1. If the LSM is online, place the LSM offline to all hosts. The `DO NOT OPEN` warning display turns off and the robot stops. This finishes all outstanding library requests.
2. Wait for the message confirming the LSM is offline. If the LSM does not come offline, enter the command to display the status of the ACS.
3. Wait for the outstanding processes to complete or type the command to force the LSM offline to all hosts.
4. Open the LAD and expose the door lock (Figure 3-5 on page 3-15). Opening the LAD activates a switch, which automatically causes a software interrupt and stops the robot.

Figure 3-5. LSM Access Door Latch and Door Lock Cover (L202_012)



1. Access door latch
2. Lock access door (LAD)
3. LAD latch
4. Warning label
5. LAD (inside)
6. Door lock

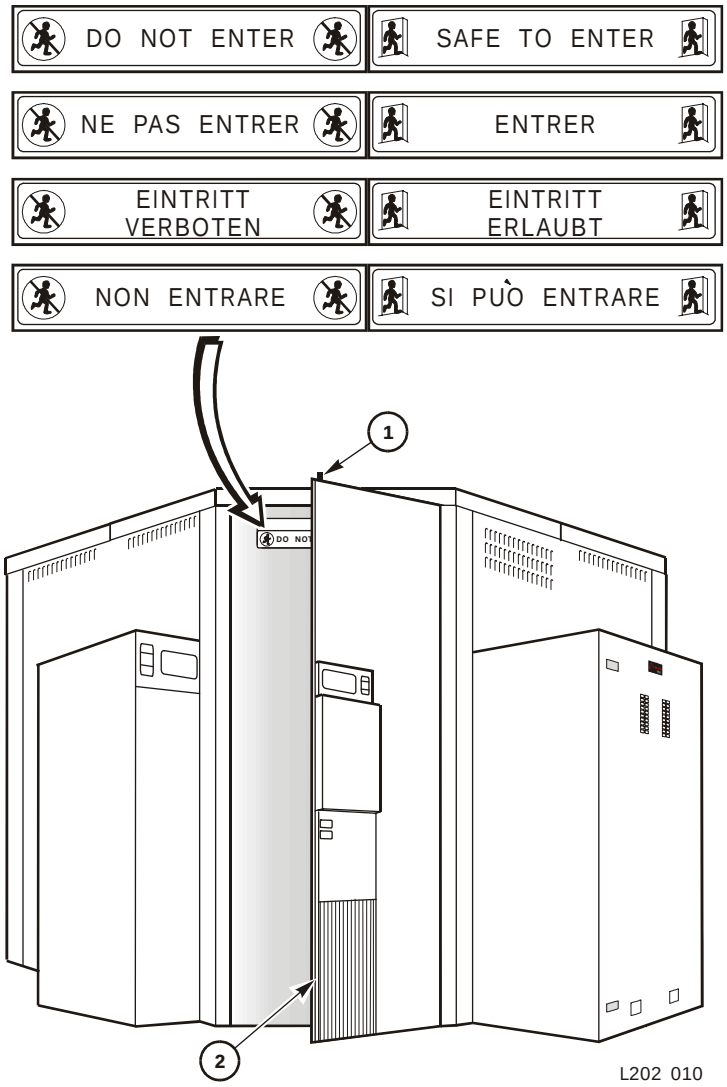
5. Insert the key and unlock the access door.
6. Pull the paddle handle to activate the opening mechanism and open the access door. At this time, several things happen:
   a. The locking pins activate the Door-Seated (ajar) switch.
   b. After 2 degrees of door rotation, power to the robot is turned off.

c. Two serial interlock switches are deactivated in the circuit that powers the robot rotation.

d. The Door Has-Been-Opened (HBO) switch is activated, causing an interrupt to software.

e. The Safety Sign switch activates the DO NOT ENTER sign inside the library (Figure 3-6).

Figure 3-6. LSM Warning Light (L202_010)

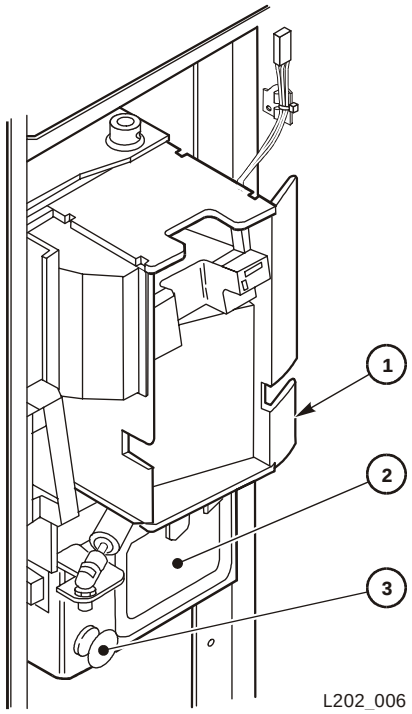


1. Door rod
2. Access door

7. Return the key lock to the locked position, remove the key, and close the LAD. This causes:
   a. The sign inside the LSM to display SAFE TO ENTER
   b. The lights to turn on inside the LSM
   c. The locking pins to move outward to prevent anyone from closing the door
   d. The safety switches to activate
8. Put the key in your pocket so that no one can close the door while you are inside, and enter the LSM.

In the unlikely event that someone becomes locked inside and the system begins to start up, lights flash for 30 seconds before the robot starts to move. This provides enough time and light to find the door and open it using the interior latch, or to push the emergency power off (EPO) switch located next to the interior latch (Figure 3-7). Either of these actions stops any further power up.

Figure 3-7. EPO Switch Inside the LSM (L202_006)



1. PCAP
2. Access door latch
3. EPO switch (red)

The inside door latch always allows someone to exit, regardless of the position of the exterior key.

WARNING:
This system is not foolproof and cannot detect all obstructions.

In addition, when the robot is powered on, the theta (robot) arm slowly sweeps the interior of the LSM, searching for any obstruction (such as a tool box or oscilloscope). In this mode, current is limited and the theta arm can be stopped by hand.

If any physical obstruction prevents the theta arm from moving for more than a few seconds, the theta arm shuts down and an error is posted. If motion is disturbed only for a moment, the theta arm continues to sweep, but posts an error at the end of initialization, without going into normal move mode.

Note: You may make as many LSM keys as you wish. Record the key number and store it in a safe place. Order copies from Illinois Lock Company (refer to the key package located inside the access door or call 312.537.1800). An experienced locksmith can open the lock.

Moving the Robot

You might need to move the robot to make it easier to retrieve cartridges from the LSM and manually load or unload those cartridges into the cartridge drives. The amount of movement is dictated by the location of the cartridge in the LSM and the location of the cartridge drive into which it is to be loaded or unloaded.

The following pages describe how to rotate, raise, and lower the robot, and how to remove a cartridge from the robot fingers.

WARNING:
PHYSICAL INJURY. To prevent physical injury and damage to components, follow the instructions carefully.

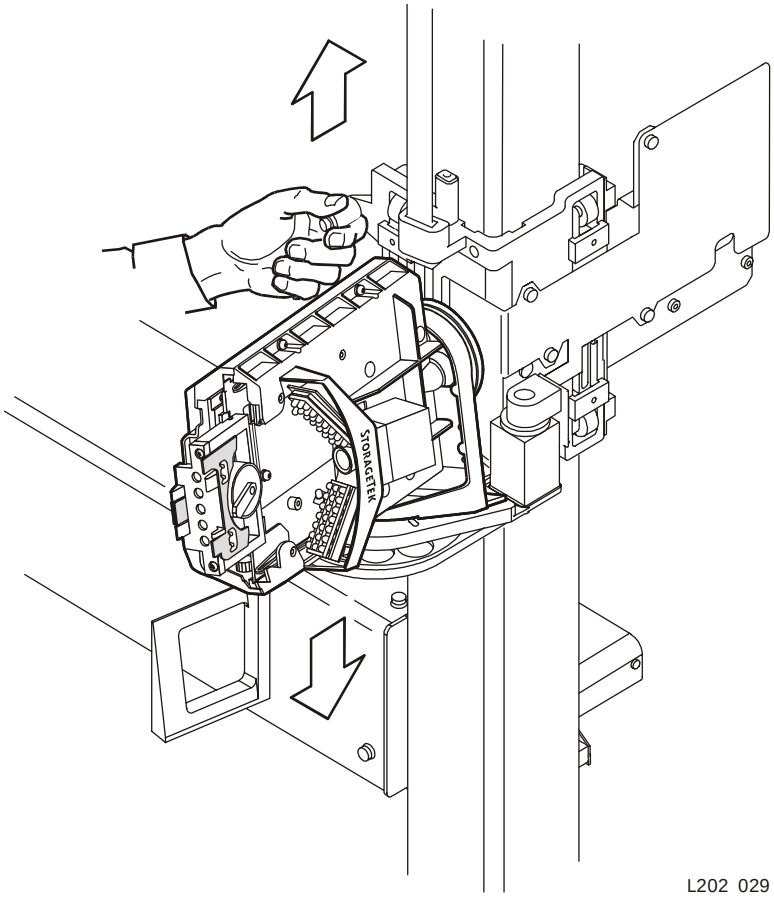
1. Do not enter the LSM until you are familiar with the procedure described in "Entering the LSM" on page 3-12.
2. Do not enter the LSM or move any of its robotics mechanisms if you have any reason to suspect they are enabled.
3. Do not touch any shiny polished surfaces. Body oils can destroy the lubrication on these surfaces.
4. Do not touch any lubricated parts.
5. Push or pull the robotics carriage only as shown in the following figures.
6. The robot should move freely. Do not force the robot if movement is restricted.

Raising and Lowering the Robot

WARNING:
ELECTRICAL SHOCK. Use extreme caution and make sure that your hand is placed at a point where no electrical parts are exposed.

If you need to raise or lower the robot, *gently* pull down or push up by placing your hand under the Z arm as shown in Figure 3-8.

Figure 3-8. Raising and Lowering the Robot (L202_029)



Rotating the Robot

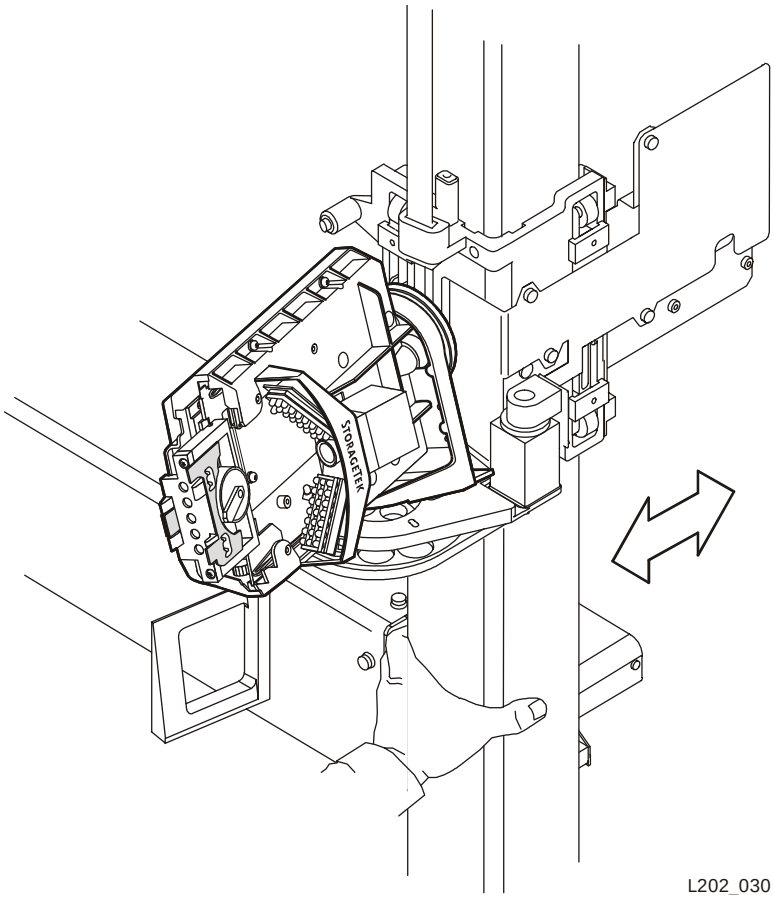
CAUTION:
DAMAGE TO ROBOT. Do not force the robot to move further if you meet resistance while you rotate the robot.

1. If you meet resistance when you push or pull the robot, do not force the robot; the arm probably has touched a stopping mechanism.

   Move the robot in the opposite direction.

2. If you need to rotate the robot, *gently* push or pull by placing your hand above the calibration assembly and at the point where the theta arm joins the Z channel, as shown in Figure 3-9.

Figure 3-9. Rotating the Robot (L202_030)



WARNING:
Before you close the LSM access door, look inside the LSM and ask in a loud voice if anyone is inside the LSM.

CAUTION:
DAMAGE TO ROBOT. Make sure that the robot is not resting against the mechanical stop.

Make certain no extra material (manuals, eyeglasses, tools) are left inside. These objects would cause the robot to stop and could damage the robot.

3. Leave the LSM only when you are certain that the robot can move freely in all directions.

Removing a Cartridge from the Robot Fingers

WARNING:
Do not enter the LSM until you are familiar with the procedure described in "Entering the LSM" on page 3-12. Do not enter the LSM or move any of its robotics mechanism if you have any reason to suspect it is enabled.

To prevent damage to robotic components:

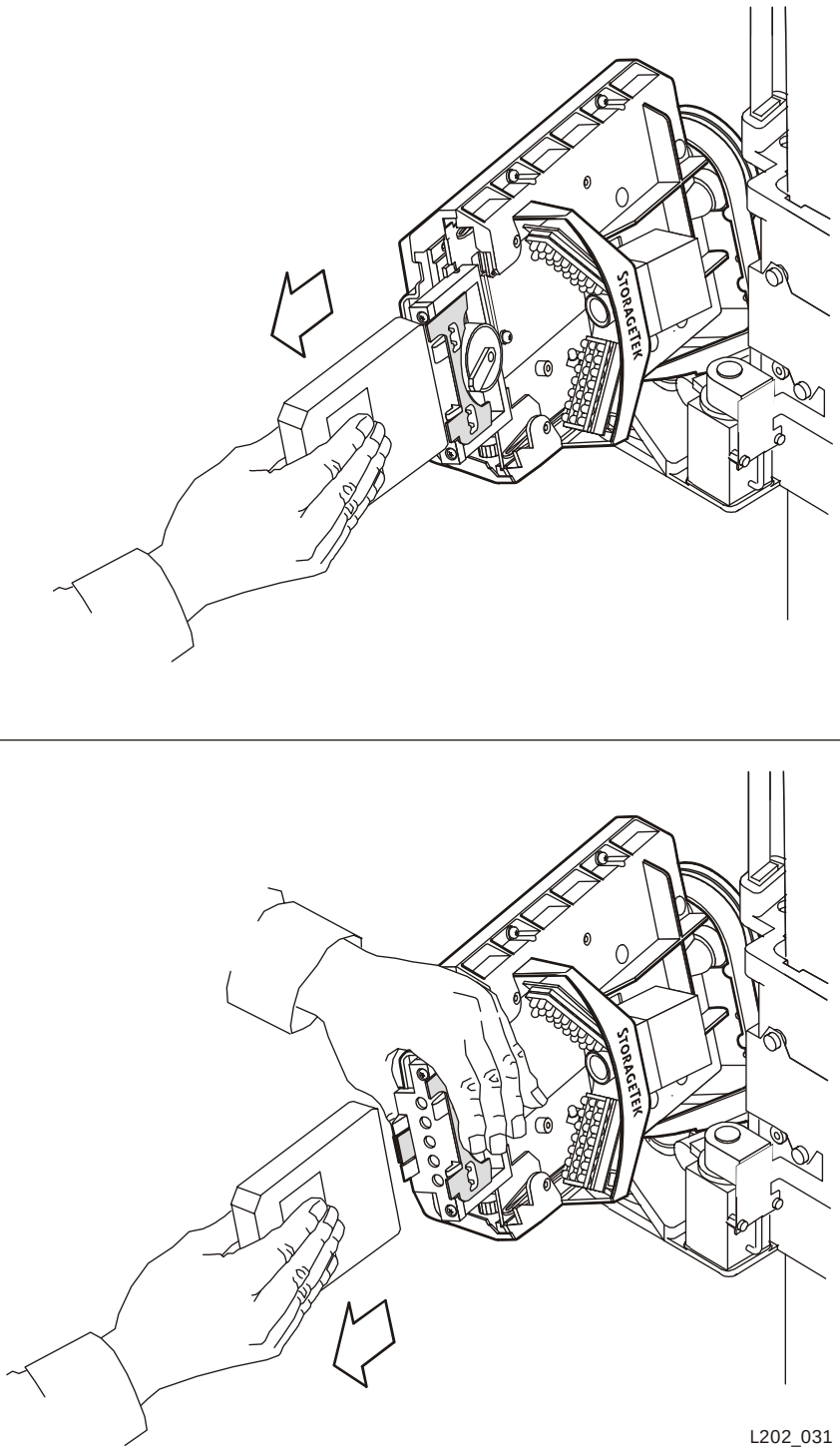
1. Be extremely careful when you remove a cartridge from the robot fingers (gripper assembly). Perform the following procedure exactly. In particular, do not bend the fingers; use the knob on the stepper motor to release the grip. Failure to do so causes mechanical damage to the finger mechanism.
2. Do not touch any shiny polished surfaces. Body oils can destroy the lubrication on these surfaces.
3. Do not touch any lubricated parts.
4. Do not push or pull the cartridge, fingers, plunger, camera or any other part of the reach function mechanism except as shown in the following figures.

CAUTION:
EQUIPMENT DAMAGE. Be extremely careful when you remove a cartridge from the robot fingers (gripper assembly). Perform the following procedure exactly to avoid damaging the equipment.

To remove a cartridge from the robot fingers:

1. Raise or lower the robot by using the wrist stop as shown in Figure 3-8 on page 3-20 until the robot is waist high.
2. Extend the gripper by grasping the cartridge and gently pulling until the gripper is fully extended as shown in Figure 3-10 on page 3-24.
3. Gently squeeze the back of the top and bottom fingers until the tension on the cartridge is removed.
4. Remove the cartridge and release the pressure applied to the fingers.

Figure 3-10. Removing a Cartridge from the Robot Fingers (L202_031)



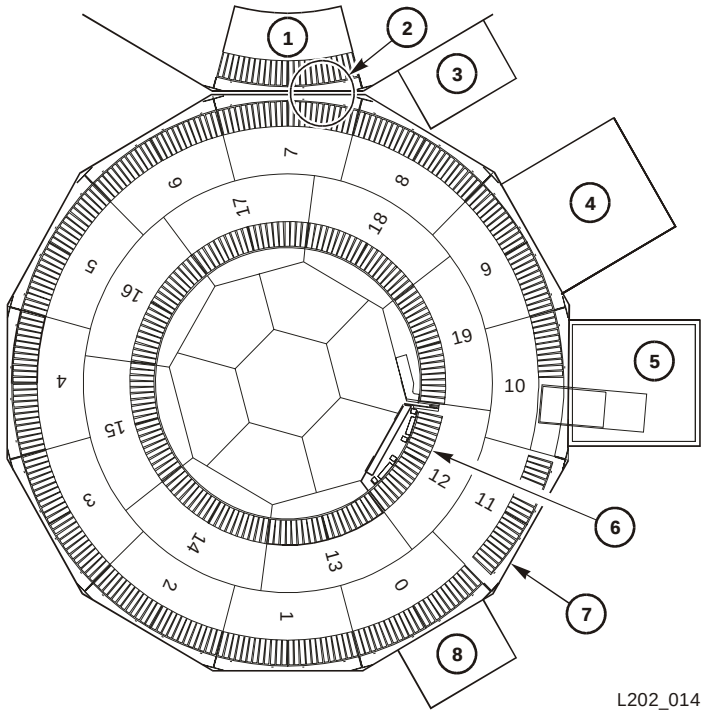
Locating a Cartridge in the LSM

Cartridges are “addressed” by which LSM (in an ACS with more than one LSM), panel (wall), row, and column they are stored.

Wall numbering in the L5510 LSM is done *clockwise*, as seen from above, with the outer walls numbered from 0 (zero) through 11 and the inner walls numbered 12 through 19 (Figure 3-11).

The library control unit (LCU) is always attached to wall 0, and the access door is always on wall 11. The primary (first) drive cabinet is always attached to wall 10. Additional drive cabinets can be attached to any of the other walls of the LSM, depending on the configuration of other LSMs that might be attached with a pass-through port (PTP).

Figure 3-11. LSM Wall Numbering (L202_014)



1. Attached LSM
2. Pass-through port (PTP)
3. LCU (attached LSM)
4. Additional drive cabinet
5. Primary drive cabinet
6. Inner door
7. Cartridge access port (CAP)
8. Library control unit (LCU)

Each wall must hold only one type of cartridge; that is, all the cartridges stored on a wall must be either LTO Ultrium cartridges or 9x40 cartridges. Most walls can store either all LTO Ultrium or all 9x40 cartridges, but the drive cabinet walls and the LCU wall must store only Ultrium cartridges.

Note: On the LCU wall, the first four cells in row six are universal cells, which can hold Ultrium or 9x40 cartridges. This is the only exception.

Any wall that is not assigned to store cartridges has just one special cell that indicates to the LCU that this is an “empty” wall.

Each type of wall holds a different number of cartridges in cells, with some cells reserved for specific types of cartridges or tasks, such as diagnostic cartridges or wall calibration (Figure 3-12 on page 3-27 through Figure 3-16 on page 3-31).

Each row of an outer wall has two arrays of 12 cells each; each row of an inner wall has two arrays of ten cells each. Each array is designed to hold only LTO Ultrium cartridges or 9x40 cartridges. (See the note on the previous page about the four universal cells on the LCU wall.)

The cartridge vol_id and cell location are provided in a console message and on the drive display panel (9x40 drives only). The cell location appears in this format:

	l	l	p	p	r	r	c	c	

where:

ll identifies the LSM
pp identifies the LSM panel
rr identifies the row in the panel
cc identifies the column in the row

A typical cartridge location would be:

	0	1	0	7	1	1	1	5	

This tells you that the cartridge is in LSM 01, panel 07, row 11, column 15.

The ACSLS command to locate a cartridge (volume) is:

query volume *vol_id*

For more information on this command, refer to Chapter 7. “Command References” in the *ACSLS System Administrator’s Guide*, PN 3134648.

Figure 3-12. Cartridge Locations—Standard Wall and Window Wall (L202_038)

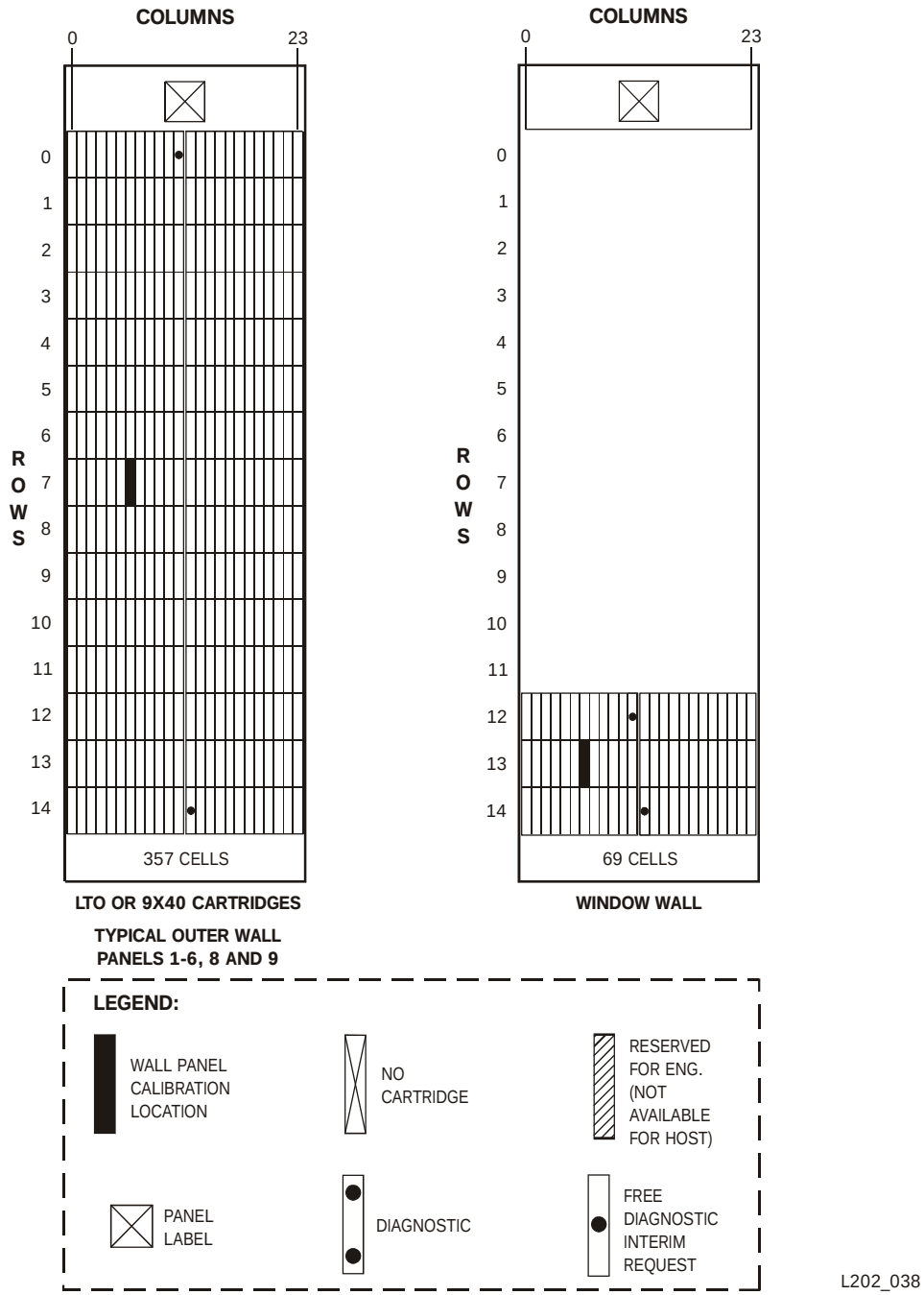


Figure 3-13. Cartridge Locations—Standard Door and LCU Wall (L202_024)

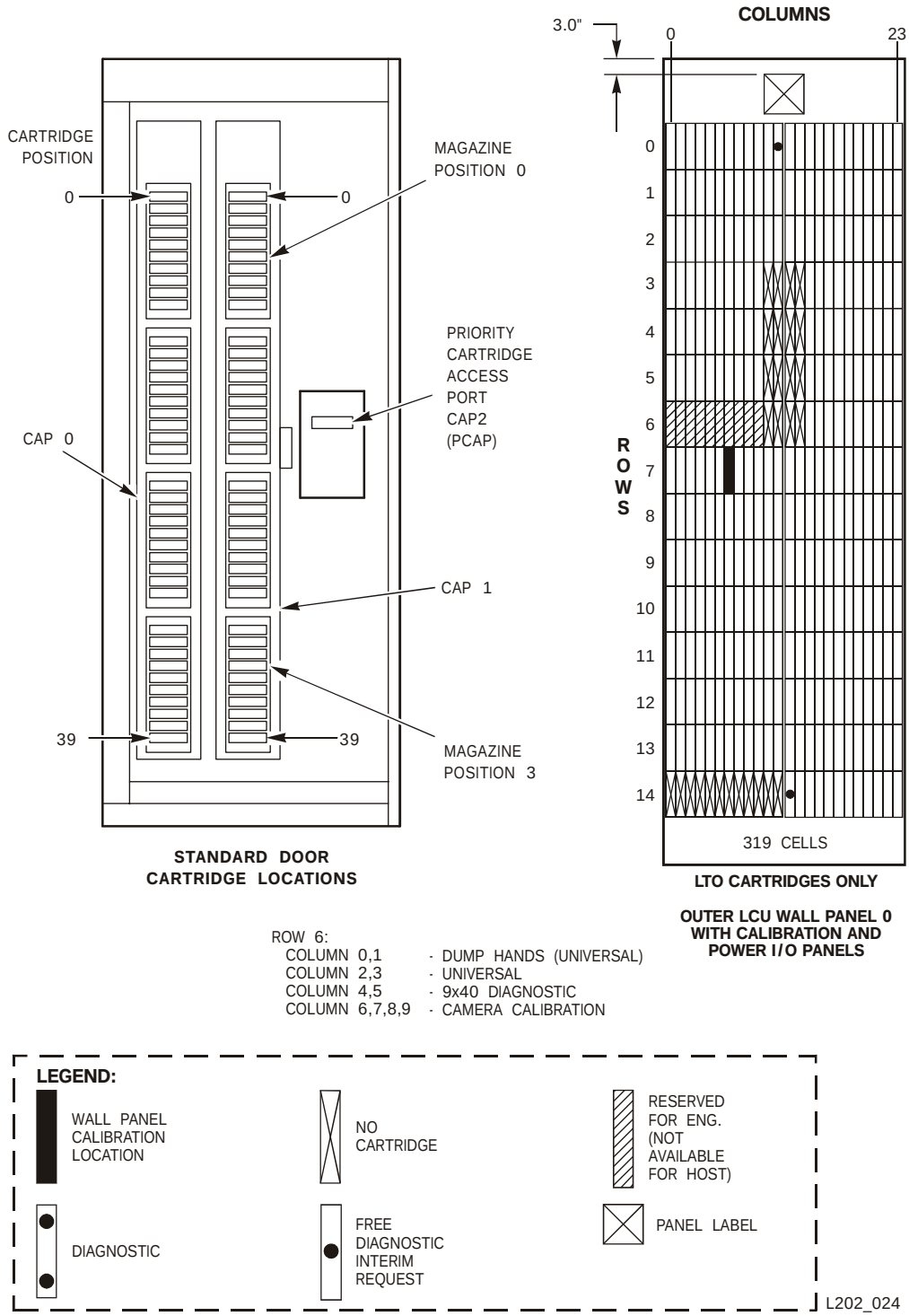


Figure 3-14. Cartridge Locations—20-Drive Wall (L202_027)

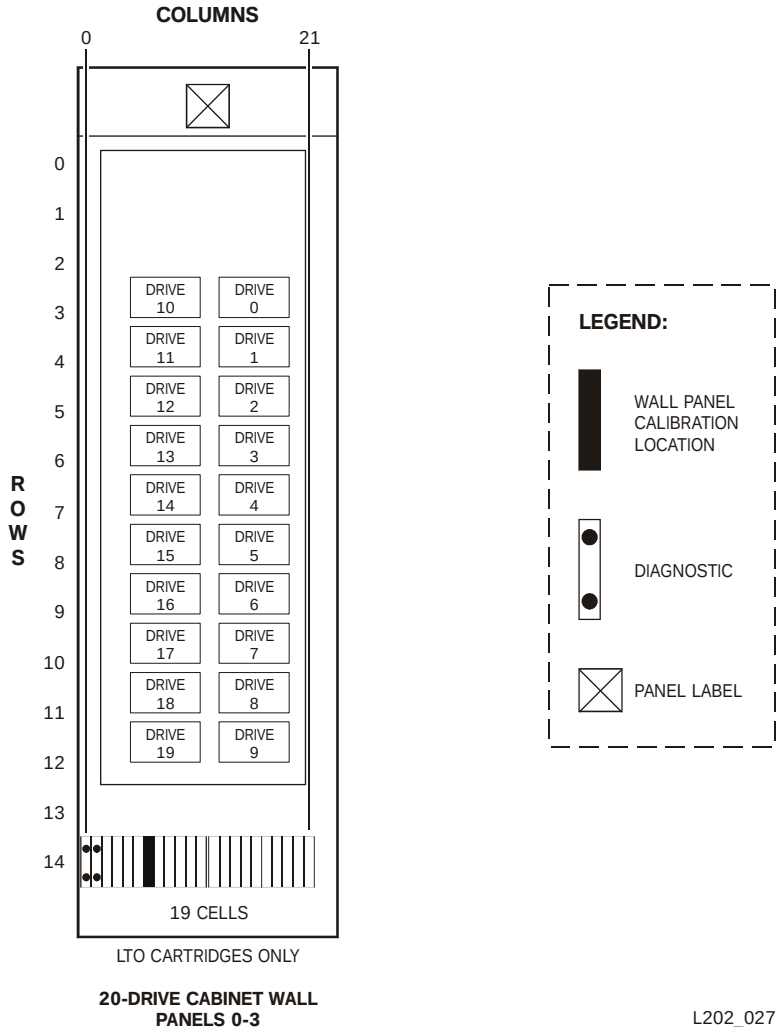


Figure 3-15. Cartridge Locations—PTP Walls (L202_025)

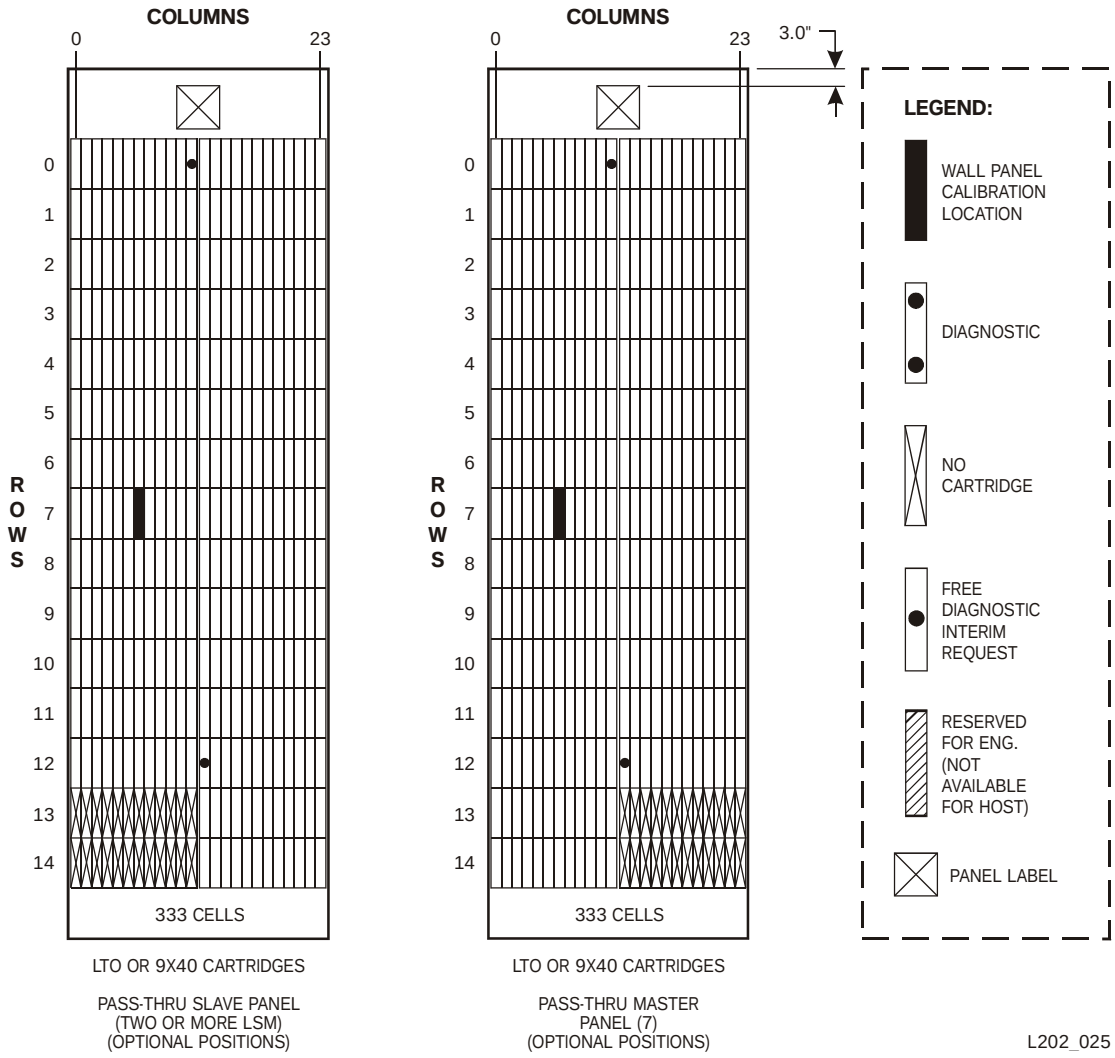
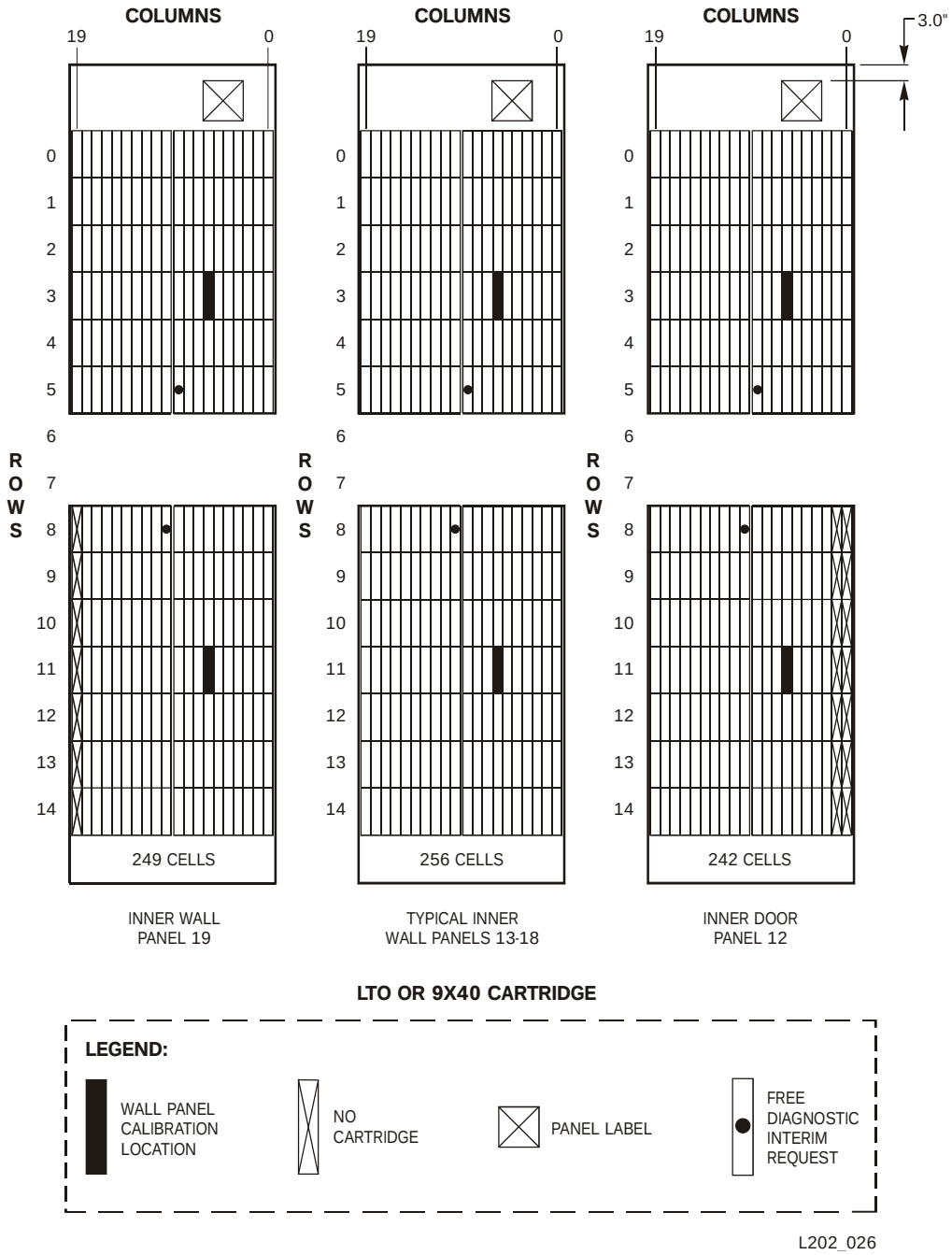


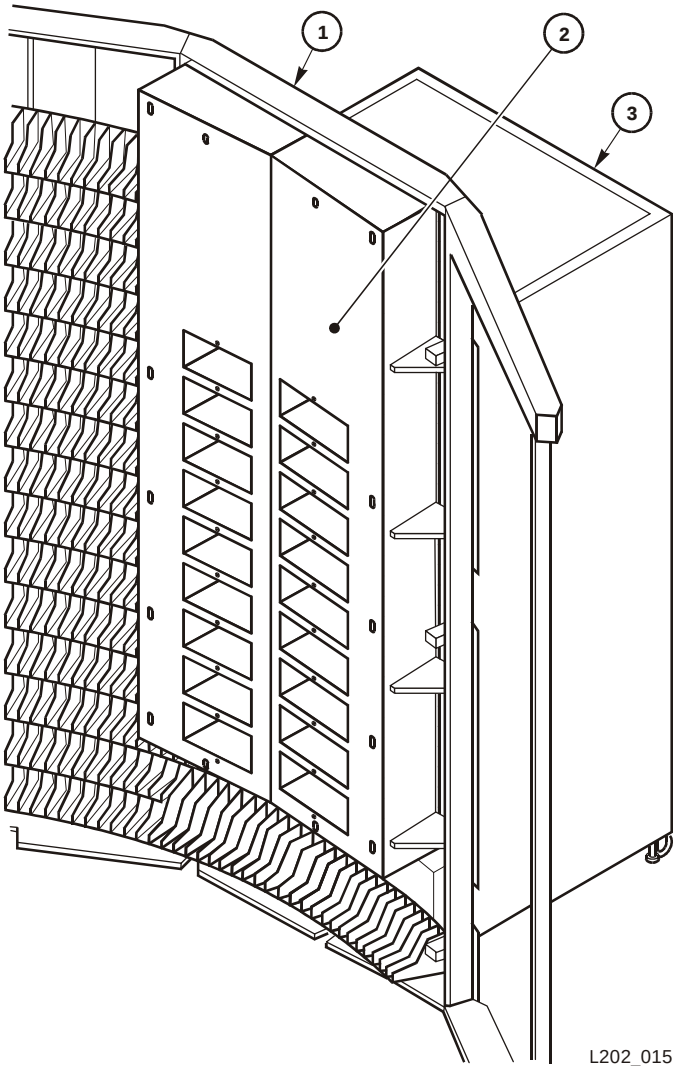
Figure 3-16. Cartridge Locations—Inner Walls (L202_026)



Mounting a Cartridge

WARNING:
Do not enter the LSM until you are familiar with the procedure described in “Entering the LSM” on page 3-12.

Figure 3-17. 9741/9741E Drive Cabinet (L202_015)



1. Cartridge drive wall panel
2. Transport airbox cover
3. Drive cabinet

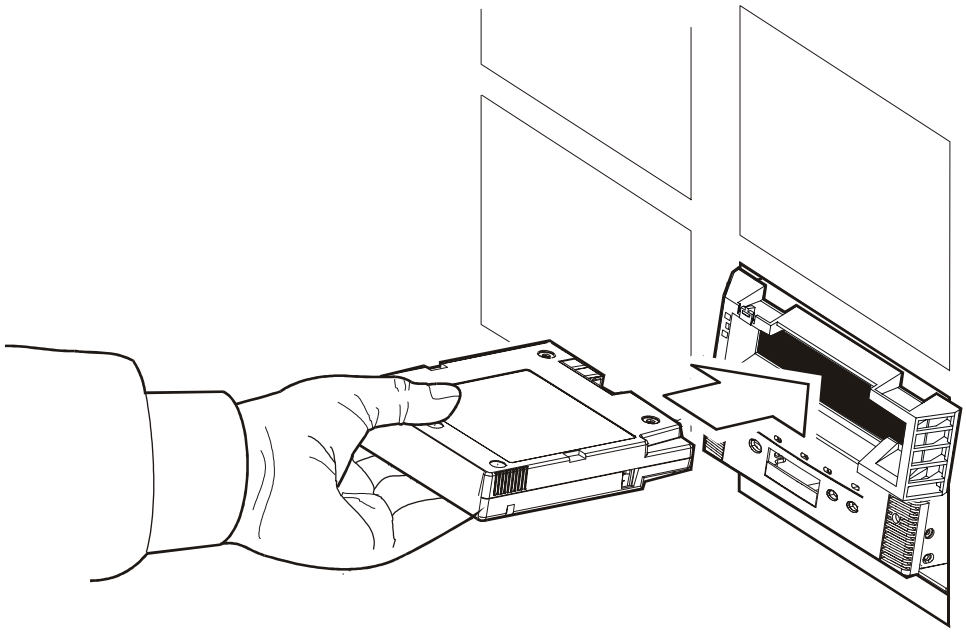
WARNING:
POSSIBLE PHYSICAL INJURY. Keep your fingers out of the transport when you mount a cartridge; the elevator lowers automatically.

1. Whether you manually insert a 9x40 cartridge or an LTO Ultrium cartridge, the volume serial ID (vol_id) label should be facing you, with the numeric characters above the bar code.
2. Do not force the cartridge into the tape drive. If you feel some resistance as you insert the cartridge, make sure you are installing the cartridge into the appropriate tape drive.
3. 9840, T9840, and T9940 tape drives look very similar, but you cannot put 9840/T9840 cartridges in a T9940 tape drive nor put T9940 cartridges in a 9840/T9840 tape drive.

   Never attempt to insert an LTO Ultrium cartridge in a 9x40 tape drive. However, you can insert Ultrium cartridges in either an IBM or Seagate LTO Ultrium tape drive.

Figure 3-18 show manual insertion of a 9840 cartridge.

Figure 3-18. Manually Inserting a Tape Cartridge (L202_039)



L202_039

Dismounting a Cartridge

WARNING:
Do not enter the LSM until you are familiar with the procedure described in "Entering the LSM" on page 3-12.

All 9x40 and LTO Ultrium tape drives have a dismount button on the operator panel.

1. Make sure that the tape drive is not in use by the system.
2. Press the UNLOAD switch. One of the following conditions occurs:
   - After the tape rewinds, the cartridge is ejected from the drive. Remove the cartridge from the drive.
   - The cartridge is not ejected after the tape rewinds. Refer to the appropriate document to resolve this situation:

     IBM Ultrium Internal Tape Drive Models T200 and T200F Setup, Operator, and Service Guide, GA32-0435

     *Seagate Viper 200 LTO Tape Drive Product Manua*l, PN 100125702

     9840/T9840 Tape Drive User's Reference Manual, PN 95739

     T9940 Tape Drive Operator's Guide, PN 95989

Returning to Automatic Mode

The following pages describe how to return the LSM to automatic mode:

9840/T9840/T9940 Drive Display

To verify that the 9840/T9840/T9940 drives are ready and online, press the MENU switch—the display should now read `Online`.

If the drive displays `Offline`, press the SELECT switch once to place it online.

- If the drive message indicates `Online`, the transition to online completed.
- If the `Onl Pend` message appears, the online state is pending due to completion of diagnostic tests.
- If other messages appear, refer to either the *9840/T9840 Tape Drive User's Reference Manual*, PN 95739, or *T9940 Tape Drive Operator's Guide*, PN 95989.

LTO Ultrium Drives

LTO Ultrium drives are automatically reset when you reset the LSM online (see "Placing the LSM in Automatic Mode" on page 3-36).

Exiting the LSM

Before you leave the LSM, make sure that no tools or foreign objects are left, and no cartridges are outside the cartridge cells. Make sure that nothing is lying on the top portion (the ledge) of the bottom inner wall. Then:

1. Step outside the LSM.

WARNING:
PHYSICAL INJURY. Before you close the LSM access door, look inside the LSM and ask in a loud voice if anyone is inside the LSM.

2. If necessary, close the CAP door.
3. Remove all cartridges from the CAP and store them outside the LSM.
4. Open the LAD, insert the key in the lock, and turn the key to the unlocked position.

CAUTION:
EQUIPMENT/MEDIA DAMAGE. Do not slam the door. You could damage the door or cause cartridges to fall onto the floor. The robot cannot recover cartridges that fall onto the floor.

5. Pull the latch handle and *gently* close the door, pushing on both top and bottom until it clicks shut.
6. Turn the key to the locked position.
7. Remove the key from the lock and close the LAD. The LSM automatically performs a quick initialization procedure.

Placing the LSM in Automatic Mode

Type the command at the console to place the LSM online to all hosts. Refer to the *ACSLS System Administrator's Guide*, PN 3134648, for the command syntax and console messages.

Entering Cartridges Removed During Manual Mode

To return the cartridges to the LSM that you removed while the LSM was in manual mode, do one of the following:

- After you place the LSM online to all hosts, enter the cartridges through the CAP, as described in "Entering Cartridges into the CAP in Manual Mode" on page 3-2.
- Before you leave the LSM, place all similar cartridges (Ultrium or 9x40) into the storage cells of *one panel* that holds that type of cartridge and audit that panel.

  Note: You *must* not put Ultrium cartridges in cells of a 9x40 wall. Also, 9x40 cartridges will not fit into Ultrium cells; do *not* force them.

- Before you leave the LSM, place the cartridges in empty cells at random on several different panels that hold that type of cartridge (Ultrium or 9x40), and audit the entire LSM (or at least all panels to which you added cartridges).

LMU Operation

The LMU responds to mount and dismount requests from the host through the library software and passes each request to the desired LSM, which performs the physical action requested. The following pages describe your procedures for stand-alone LMU and dual LMU configurations. Emergency power off procedures are the same for both configurations.

Refer to Chapter 2, "Controls and Indicators," for an explanation of the LMU control panel. Refer to *the ACSLS System Administrator's Guide*, PN 3134648, for the command syntax and console messages.

Operating an LMU–Stand-alone Configuration

The following sections describe how to operate a stand-alone LMU.

Powering On/IPLing an LMU

To power on a stand-alone LMU:

- Press the power switch on the LMU operator panel.

Displaying LMU Status

Type the command to display LMU status. The command lists:

- Current status of the ACS
- Current status of the LMU
- On-line, offline, or standby status of each LMU station

Powering Off an LMU

To power off a stand-alone LMU:

1. Place all stations offline to all software.

   Note: Leaving stations online when you power off an LMU causes I/O error messages to appear on the console.

2. Press the power switch on the LMU operator panel.

   Note: In a dual LMU environment, powering off the master LMU starts an LMU switch that causes the standby LMU to become the master LMU. See "Operating an LMU–Dual LMU Configuration" on page 3-38 for more information.

Operating an LMU–Dual LMU Configuration

The following sections describe how to operate dual LMUs.

Dual LMU Operation Overview

Dual LMU configurations provide a backup (standby) LMU that can take over if the active (master) LMU fails. Both LMUs are capable of being the master but only one can be the master at a given moment. The LMUs regularly check the status of each other over the local area network (LAN).

The software directs all input/output to the master LMU. All stations may be placed online to both LMUs when you start the software. The stations to the current master LMU come fully online, and the stations to the current standby LMU come up as standby.

Note: It is recommended that you place two stations online to each LMU from each host. An automatic LMU switch occurs only in response to a failure in the master LMU. Path failures do not start an LMU switch.

The requirements for a fully functional dual LMU configuration are:

- LMU firmware level 2.3 or higher
- Correct operating software level (refer to your software manual)
- Both LMUs powered on (one serves as the master, and the other as the standby)
- At least one station online to each LMU from each host. Online stations to a standby LMU are called standby stations.

If the above conditions are met, an automatic LMU switch can occur if a failure is detected in the master LMU.

You can use the switch command to manually switch the master LMU functionality to the standby LMU. You may give the switch command even if no LMU internal errors are present.

Note: When you type the switch command, remember that all hosts connected to the dual LMU ACS are affected by a switch of the master LMU functionality. You must restart Enter operations after an LMU switch.

Powering On/IPLing an LMU–Dual LMU Configuration

When an LMU is powered on in a dual LMU environment, it places itself in a standby status and then checks for an active master LMU. If an active master LMU exists, the LMU remains available as the standby LMU. If an active master LMU does not exist, the LMU becomes the master LMU.

If both LMUs are powered on at about the same time, the first to complete the initial program load (IPL) assumes the role of master. If you prefer to call out one LMU as the master, power it on first and wait for it to complete IPL before you power on the second LMU.

Note:

- Both LMUs must be loaded with the same version of LMU firmware.
- The correct hardware configuration must be on each LMU diskette.

The following procedure describes this type of dual LMU power on:

1. Press the power switch on the operator panel of one LMU. Upon IPL completion, the *Master* indicator turns on.
2. Power on the second LMU by repeating the above step on the operator panel of the second LMU. The *Master* indicator light blinks briefly on the standby LMU as it polls the master LMU to make sure that it is working.

If both LMUs power on successfully, the console message shows that the dual LMU is configured, which LMU is master, and that the standby is ready.

Note: If a series of highlighted messages appears, indicating first one LMU, then the other is master, refer to the software manual for dual LMU recovery procedures.

Displaying Dual LMU Status

To determine the status of the dual LMU, enter the command to display the ACS status. The command response lists:

- Current status of the ACS
- Current status of the dual LMU configuration
- Master LMU
- Standby LMU
- Online, offline, or standby status of each dual LMU station
- Software/LMU compatibility levels

LMU Switch Overview

The master LMU functionality can be switched in the following ways:

- The switch is automatic due to a self-detected failure or power supply problem in the master LMU.
- You start the switch operation with an ACSLS switch command.
- You press the IPL switch on the master LMU.
- The master LMU is powered off.

Consequences of an LMU Switch

When an LMU switch occurs, console messages track the changing status of the master and standby LMUs.

When a switch occurs in a dual LMU environment, the software questions the LMUs to determine the current status of each station. The status of each station is kept as online, offline, standby, pending online, pending offline, or pending force offline. Use the command to display the ACS status to determine the status of each station, as well as the status of each LMU.

Performing an Automatic LMU Switch

LMU firmware detects, reports, and reacts to LMU failures as necessary to keep the ACS working. You have no control over the timing of an automatic LMU switch; therefore, some work might be in process within the LMU.

When the standby LMU takes over as master, it notifies the software of its status and sends the LMU ready signal. The software reads the recovery information provided by the new master LMU concerning in-transit cartridges within the various LSMs in the ACS.

The firmware:

1. Marks completed the queued requests, reflecting the current locations of in-transit cartridges
2. Sends all incomplete requests to the new master LMU
3. Marks cartridges as errant when requests cannot be completed successfully

Note: You might need to restart Enter and Eject operations after an LMU switch.

Performing an Operator-Started LMU Switch

Before you start an LMU switch, while some stations are communicating, decide if the need to switch LMUs is immediate, or if processing can be completed before you make the switch. If the need to switch LMUs is not critical, wait until the LSMs are relatively idle.

Note: The switch operation causes all the attached LSMs to re initialize (the short init process).

Start an LMU switch by typing the switch command. The command is routed through the standby LMU to the disconnected master LMU, causing it to IPL.

The following sequence of events occurs:

1. The software sends the switch message.
2. The standby LMU becomes the master LMU and the *Master* indicator turns on.
3. Online LSMs perform a quick initialization.
4. As each LSM becomes ready, the firmware sends a message.
5. If the old master LMU completes IPL successfully, it becomes the standby LMU.

   If the switch command is given while processing is active, cartridges might be in-transit in various LSMs. Recovery procedures occur automatically as described in "Performing an Automatic LMU Switch" on page 3-40. Upon receiving the LMU ready signal, the software waits for the LSMs to complete a quick initialization and then re-drives the requests building up in the queue.

Powering Off an LMU–Dual LMU Configuration

To power off the master LMU:

1. Place at least one station online to the standby LMU. The station is on standby.
2. Press the power switch on the operator panel of the master LMU. This starts an LMU switch. Messages appear on your consoles indicating the changing status of the LMUs.
3. Make sure that the *Master* indicator turns on as the standby LMU becomes the new master LMU.

A message appears if the standby LMU successfully assumes the role of master LMU.

All LSMs go through quick-init and recovery procedures.

All LMU requests except Enter requests are re-driven. Enter operations must be restarted.

Note: Enter operations end when a master LMU is powered off. Other LMU and robotics operations recover and complete once the standby LMU becomes the new master LMU.

No special precautions are necessary to power off the standby LMU; just press the DC power switch on the standby LMU operator panel. Messages appear on your console that indicate which LMU is the master LMU and the changing status of the standby LMU.

Powering Off an LMU–Emergency

To power off the LMU in an emergency, press the EPO switch on the LMU operator panel. Call a service representative to restore power to an LMU that has been powered down by the EPO switch.

In a dual LMU environment, powering off the master LMU starts an LMU switch. If the standby LMU is powered on and at least one station is online to the standby LMU, the standby LMU becomes the master LMU.

LCU/LSM Operation

Redundant LANs provide the communication link between the LMU and the LCU. The LCU provides power to the LSM and interprets message commands to the LSM from the LMU. The following sections describe your procedures for the LCU/LSM.

Refer to Chapter 2, "Controls and Indicators," for explanations of all control panels. Refer to your software manual for console messages.

Powering On an LCU/LSM

To power on an LCU/LSM, press the power switch on the LCU operator panel.

Loading Functional Code–LCU/LSM

The functional code for the LCU is downloaded from the LMU. This code download can occur only when the following conditions are met:

- The LMU is powered up.
- The LMU is communicating with the LCU/LSM.
- The LCU/LSM has responded to initial startup commands from the LMU.

After the LCU is powered on, the functional code can be downloaded from the LMU by powering the LCU/LSM off and then on again. Code download and LCU/LSM initialization can take 10 to 25 minutes.

Powering Off an LCU/LSM

To power off an LCU/LSM:

1. Take the LSM offline from all hosts.

   Note: Error messages are given if the LCU/LSM are powered off while the LSM is online.

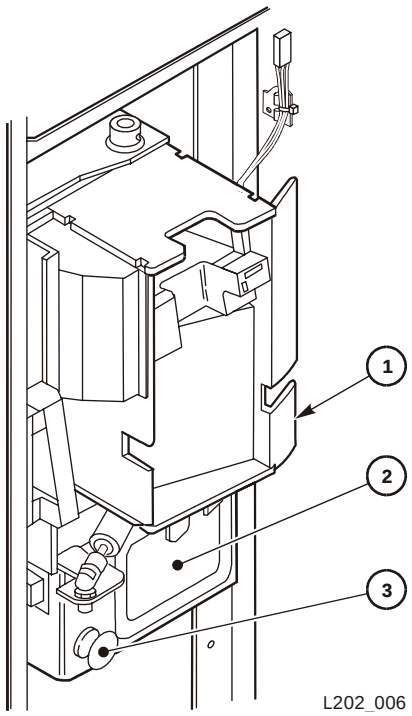
2. Press the power switch on the LCU operator panel.

Powering Off an LCU/LSM–Emergency

To power off the LCU/LSM in an emergency, press the EPO switch on the LCU operator panel. This immediately removes power to the robot and to the LCU.

An EPO switch is also inside the LSM. It is a large red button below the PCAP on the panel inside the LSM access door (Figure 3-19).

Figure 3-19. EPO Switch Inside the LSM (L202_006)



1. PCAP
2. Access door latch
3. EPO switch (red)

Call a service representative to restore power to an LCU/LSM that has been powered down by either EPO switch.

Cartridge Drives Operation

The procedure for cleaning a cartridge drive tape path with a cleaning cartridge is described in "Cleaning the Drive Tape Path."

Cleaning the Drive Tape Path

When a library drive has passed a certain amount of tape media across the read/write heads, it informs the LMU, which broadcasts a "drive needs cleaning" notification to all connected hosts. The software responds to this by either scheduling an automatic cleaning for the drive, or by notifying you with a console message.

Refer to the *ACSLS System Administrator's Guide,* PN 3134648, for command syntax and console messages.

Note: Cleaning the tape head causes wear to the head. Clean a tape head only when you receive a "drive needs cleaning" message.

Cleaning Cartridges

9840/T9840 cleaning cartridges have a **U** label in the media ID area instead of an **R** (data) media label and T9940 cleaning cartridges have a **W** label instead of a **P** (data) label.

IBM LTO Ultrium cleaning cartridges have a media ID of $\mathbf{C_2}$ and Seagate LTO Ultrium cleaning cartridges have a media ID of $\mathbf{C_3}$. LTO universal cleaning cartridges have a media ID of $\mathbf{C_u}$. IBM and Seagate LTO cleaning cartridges are not interchangeable. However, universal LTO cleaning cartridges can be used in any LTO Ultrium tape drive.

Cleaning cartridges also have a volume serial ID (vol_id) label with the prefix **CLN**. In addition, LTO Ultrium cleaning cartridges have a gray write-protect switch (data cartridges have a red switch) and a 4-character alphabetic prefix.

- CLNIxxx– IBM
- CLNSxxx – Seagate
- CLNUxxx – Universal

Cartridges with a cleaning prefix make up pools of cleaning cartridges in each LSM. Cleaning cartridges cannot be used as scratch cartridges or initialized by software utilities.

CAUTION:
READ/WRITE PERFORMANCE DEGRADATION. Do not re-enter a cleaning cartridge that has been ejected from the library. WHEN YOU ENTER A CLEANING CARTRIDGE, THE SOFTWARE CONSIDERS IT TO BE NEW AND SETS THE USAGE COUNTER TO ZERO.

When a tape drive requires cleaning, the software selects a cartridge from the pool of cleaning cartridges in the LSM that contains the tape drive (or from the closest LSM that has cleaning cartridges). If no cleaning cartridges exist in the ACS, you are prompted to mount a cleaning cartridge. It is recommended to have one cleaning cartridge in the ACS for each drive wall and drive type (9x40 or LTO).

When a cleaning cartridge is used a defined number of times, it is automatically ejected from the library, and you are notified by a console message. Open the specified CAP, remove the ejected cleaning cartridge, and dispose of it.

Obtaining Maintenance Support 4

This chapter describes what to do if problems occur with the Automated Cartridge System (ACS).

In some cases, you might be able to correct the problem.

- When the problem is caused by cartridge tapes, refer to Appendix A, "Cartridge Tape Information."
- When the problem is caused by tape drives, refer to the documentation for that product.

In other cases, you must contact your service representative or the Call Center.

- Most of the time, a fault symptom code (FSC) will appear on the LSM operator panel display. Write down the information on the display and give it to either your service representative or the staff at the Call Center.

Customer Support Services

The Call Center for Customer Support Services (CSS) is available 24 hours a day, seven days a week, to customers with StorageTek maintenance contracts and to StorageTek employees. You can find additional information about the CSS on StorageTek's external web site at:

http://www.support.storagetek.com/globalnavigation/support

Customer Initiated Maintenance

Customer Initiated Maintenance begins with a telephone call from you to the StorageTek CSS. You receive immediate attention from qualified StorageTek personnel, who record problem information and respond with the appropriate level of support.

To contact the CSS about a problem:

1. Use the telephone to call the StorageTek Customer Support Services at:

   1–800–525-0369 (from within the United States)

   303-673-4056 (from outside the United States)

2. Describe the problem to the call taker. The call taker will ask several questions and will either route your call to or dispatch a service representative.

If you have the following information when you place a service call, the process will be much easier:

Account name	
Site location number	
Contact name	
Telephone number	
Equipment model number	
Device address	
Device serial number (if known)	
Urgency of problem	
Fault Symptom Code (FSC)	
Problem description	

StorageTek's Worldwide Offices

You may contact any of the StorageTek worldwide offices to discuss complete storage, service, and support solutions for your organization. You can find address and telephone number information on StorageTek's external web site at:

http://www.support.storagetek.com/globalnavigation/support

Cartridge Tape Information

A

This appendix lists basic specifications and requirements for cartridges and describes how to prepare and maintain cartridges.

9840/T9840 Cartridge Specifications

Table A-1 shows the specifications for 9840/T9840 cartridge tapes.

CAUTION:
POSSIBLE TAPE DAMAGE. Servo tracks are written on the tape at the factory. When these tracks are mistakenly erased, the cartridge tape must be discarded. Do not degauss 9840/T9840 Tape Drive cartridges.

Table A-1. 9840/T9840 Cartridge Tape Performance Specifications

Characteristics	Values
Cartridge shell form factor	1/2 in. cartridge, 3490/3490E
Cartridge Shell Dimensions	125 x 109 x 25.88 mm (4.92 x 4.29 x 1.00 in.)
Cartridge weight	0.26 kg (9.17 oz)
Media	Advanced metal particle
Substrate	Polyethylene naphthalate (PEN)
Tape length overall (LOA) Tape written data length	271 m (889 ft) 251 m (823 ft)
Tape thickness	9 microns (µm)
Number of tracks	288
Archival life	15–30 years
Media Durability: Short length Long length	 80,000 write/read passes minimum 6,500 write/read passes minimum
Load/unload	10,000 minimum
Data capacity, uncompressed	20 GB
Coercivity	130 ±16.0 KA/m (1625 ±75 Oersteds)

Table A-1. 9840/T9840 Cartridge Tape Performance Specifications

Characteristics	Values
Flux-transition cell length for a density of 2,545 flux transitions/mm (66,648 flux transitions/in.)	0.196 µm (7.58 µin.)
Uncorrected bit error rate (BER), including those caused by media defects	1 in 10^{18} bits
Permanent errors	Zero
Track-following servo	Factory pre-recorded

T9940 Cartridge Specifications

Table A-2 shows the specifications for T9940 cartridge tapes.

CAUTION:
POSSIBLE TAPE DAMAGE. Servo tracks are written on the tape at the factory. When these tracks are mistakenly erased, the cartridge tape must be discarded. Do not degauss T9940 Tape Drive cartridges.

Table A-2. T9940 Cartridge Tape Specifications

Characteristics	Values
Cartridge shell form factor	1/2 in. cartridge, 3490/3490E
Cartridge Shell Dimensions	125 x 109 x 25.88 mm (4.92 x 4.29 x 1.00 in.)
Media length Recordable length, including MIR	700 m (2,296 ft) 650 m (2,134 ft)
Tape thickness	9 microns (µm)
Number of tracks	288
Media life	10 years
Media Durability	10,000 loads 6,500 full-length passes
Data capacity, uncompressed	60 GB
Uncorrected bit error rate (BER)	1 in 10^{18} bits
Undetected BER	1 in 10^{33} bits
Hard error rates	Read: 1 in 10^{14} bytes Write: 1 in 10^{13} bytes
Trac-following servo	Factory pre-recorded

LTO Ultrium Cartridge Specifications

Table A-3 shows the specifications for the LTO Ultrium cartridge tapes.

CAUTION:
POSSIBLE TAPE DAMAGE. Servo tracks are written on the tape at the factory. When these tracks are mistakenly erased, the cartridge tape must be discarded. Do not degauss LTO Ultrium Tape Drive cartridges.

Table A-3. LTO Ultrium Cartridge Tape Performance Specifications

Characteristics	Values
Cartridge Shell Dimensions	105.4 x 102.0 x 21.5 mm (4.1 x 4.0 x 0.8 in.)
Cartridge Shell Form Factor	1/2 in. cartridge
Media Length	609 m (1,198 ft)
Number of Tracks	384
Media Durability	5,000 loads
Data Capacity, Uncompressed	100 GB
Uncorrected Bit Error Rate (BER)	1 in 10^{17} bits
Undetected Bit Error Rate	1 in 10^{27} bits

Using and Maintaining Cartridges

The following sections describe how to handle and inspect a cartridge, apply labels, and set the file protect selector or write protect switch. These descriptions apply to 9x40 and LTO Ultrium cartridges unless otherwise noted.

Handling a Cartridge

Improper handling of cartridges can result in a loss of data or damage to a machine component.

To handle a cartridge correctly:

- Do not carry several cartridges loosely in a container. The leader blocks can snag on other cartridges and become unlatched.

  Note: T9940 and LTO Ultrium cartridges have leader blocks. 9840 and T9840 cartridges do not.

- Make sure that the leader block is latched every time you pick up a cartridge.
- Keep cartridges *clean*.
- Inspect a cartridge before each use and *never* put a damaged cartridge into a drive or LSM.
- Never release a leader block and pull tape from a cartridge.
- Never open a cartridge.
- Do not handle tape that is outside the cartridge; the tape edge might be damaged.
- Do not expose the tape or cartridge to direct sunlight or moisture.
- Do not expose a recorded cartridge to magnetic fields; this might destroy data on the tape.

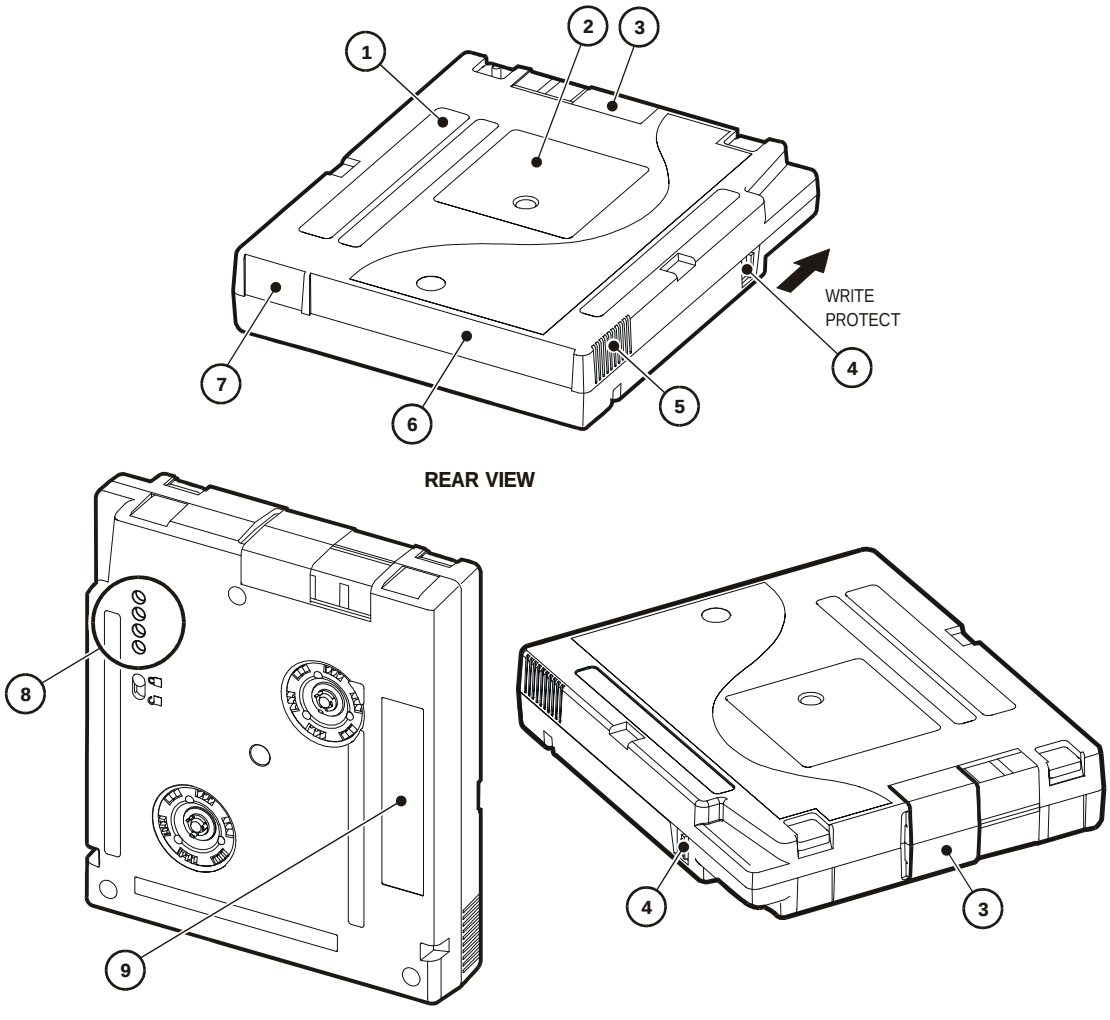
Identifying and Inspecting a Cartridge

All the cartridges you use in an L5510 are similar, but they have significant differences.

9840/T9840 Cartridge

The 9840/T9840 tape cartridge has two reels between which the tape travels (Figure A-1). It does not have a leader block. It cannot be used in a T9940 or LTO Ultrium tape drive.

Figure A-1. A 9840/T9840 Cartridge (L202_044)

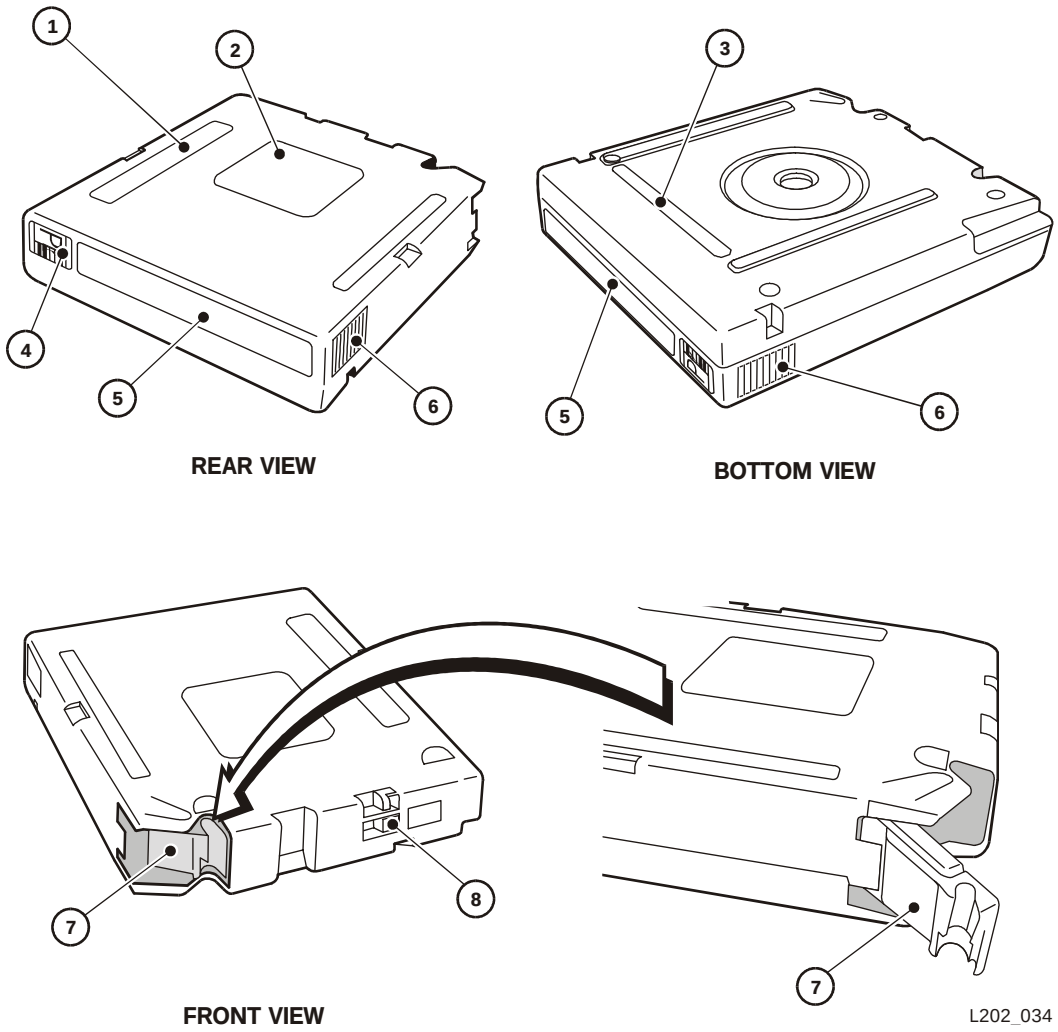


1. Manufacturer's label
2. Customer's label
3. Tape access door
4. Write-protect switch
5. Finger grips
6. Volume serial ID (vol_id) label
7. Media ID label (R=data, U=cleaning)
8. Media ID (machine identifiable)
9. Manufacturer Part ID

T9940 Cartridge

The T9940 cartridge has a single reel and a leader block that the T9940 tape drive uses to move the tape across the tape drive head (Figure A-2). A T9940 cartridge cannot be used in a 9840/T9840 or LTO Ultrium tape drive.

Figure A-2. A T9940 Cartridge (L202_034)

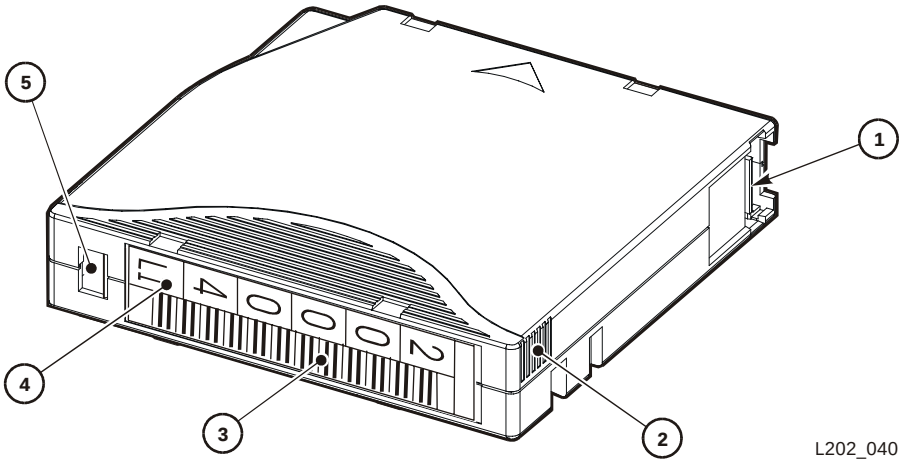


1. Manufacturer's label
2. Customer's label
3. Manufacturer's part ID
4. Media ID label (P=data, W=cleaning)
5. Volume serial ID (vol_id) label
6. Finger grips
7. Tape leader block
8. Write-protect switch

LTO Ultrium Cartridge

An LTO Ultrium cartridge has a single reel and a leader block (Figure A-3), which makes it similar to a T9940 cartridge, but it cannot be used in place of a T9940 cartridge. Ultrium cartridges follow the linear tape open (LTO) format that allows them to be used in Ultrium tape drives made by any manufacturer, such as Hewlett-Packard, IBM, or Seagate. In the past, cartridges could be used only in tape drives from the same manufacturer as the tape.

Figure A-3. An LTO Ultrium Cartridge (L202_040)



1. Tape access door
2. Finger grips
3. Volume serial ID (vol_id) label
4. Media ID label
5. Write protect switch

Inspecting a Cartridge

A defective or dirty cartridge can damage a tape drive. Always inspect a cartridge before you enter it into an LSM. Look for:

- Cracked or broken cartridge
- Broken leader block
- Broken leader block latch
- Damaged file-protect selector
- Liquid in the cartridge
- Labels not firmly attached or extending over the cartridge edge
- Any other obvious damage

Applying Labels to Cartridges

Cartridge labels reflect the cartridge media and usage. Cleaning cartridges have CLN in the volume serial ID (vol_id); diagnostic cartridges have DG in the vol_id. The media ID label correlates to the tape drive or transport capable of using the cartridge:

9840/T9840 cartridges media ID:

- R labeled cartridges are used for recording.
- U labeled cartridges are used for cleaning.

T9940 cartridges media ID:

- P labeled cartridges are used for recording.
- W labeled cartridges are used for cleaning.

LTO Ultrium cartridges media ID:

- C_2 labeled cartridges are used for cleaning IBM (CLNI – vol_id prefix).
- C_3 labeled cartridges are used for cleaning Seagate (CLNS – vol_id prefix).

  Note: IBM and Seagate LTO Ultrium cleaning cartridges are not interchangeable.

- C_u labeled cartridges are used for cleaning IBM or Seagate (CLNU - vol_id prefix)
- L_1 labeled cartridges are used for data recording.

The kinds of cartridge labels you might need to apply are:

- Customer (9x40 cartridges only)
- Volume serial ID (vol_id)
- Media ID
- Extended media (enhanced tape)

Place the labels on the recessed areas provided on each cartridge:

1. Make sure that the cartridge has been at room temperature for at least 24 hours.
2. Clean the surface where the labels will be placed using a cleaning solution made for this purpose. See “Cleaning the Cartridge Exterior” on page A-14.
3. Peel the backing from the vol_id label.
4. Lay the cartridge flat, in the position you would use to insert the cartridge in a tape drive.

5. Position the vol_id label with the barcode characters below the alphanumeric characters. Press into place.

   Note: On LTO Ultrium vol_id labels, the alpha numeric characters can be either vertical or horizontal.

6. If the cartridge has no customer label, place the label in the area and press it into place.

7. Repeat Steps 3 through 5 for the media ID label.

The labels must be within the indented area of the cartridge so that the edges of the label are parallel to the edges of the cartridge. The label should be close to the inside edge of the indented area but must *never* overlap the edge of this area.

Notes:

1. Make sure that the labels are not placed elsewhere on the cartridge surface.
2. Make sure that the edges of the labels do not curl up; curling causes the cartridge to stick in the drive loader.
3. Use labels that do not leave a residue when they are removed.
4. Make sure that the label contains a volume serial ID (vol_id).

Storing Cartridges

The following sections list environmental specifications, describe how to store and clean cartridges, use cleaning cartridges, and repair a detached leader block.

9840/T9840/T9940 Cartridge Environmental Specifications

The following specifications refer to the operating and storage environments for 9840/T9840/T9940 cartridges:

Operating environment:

Temperature	15.6º- 32.2ºC (60º- 90ºF)
Relative humidity	20% - 80%
Wet bulb temperature	26ºC (78.8ºF) maximum

Cartridge storage (non-archive) environment:

Temperature	5º- 32.2ºC (41º- 90ºF)
Relative humidity	5% - 80%
Wet bulb temperature	26ºC (78ºF) maximum

Cartridge storage (archive) environment:

Temperature	5º- 25.5ºC (41º- 78ºF)
Relative humidity	40% - 60%
Wet bulb temperature	26ºC (78ºF) maximum

LTO Ultrium Cartridge Environmental Specifications

The following specifications refer to the operating and storage environments for LTO Ultrium cartridges:

Operating Environment:

Temperature	10º- 45ºC (50º- 113ºF)
Relative humidity	20% - 80%
Wet bulb temperature	26ºC (78.8ºF) maximum

Cartridge storage (non-archive) environment:

Temperature	16º- 32ºC (61º- 90ºF)
Relative humidity	20% - 80%
Wet bulb temperature	26ºC (78.8ºF) maximum

Cartridge storage (archive) environment:

Temperature	16º- 25°C (61º- 77ºF)
Relative humidity	20% - 50%
Wet bulb temperature	26ºC (78.8ºF) maximum

When you store a cartridge:

- Do not take a cartridge out of its protective wrapping until you are ready to use it. Use the tear string, not a sharp instrument, to remove the wrapping.
- Store cartridges in a clean environment that duplicates the conditions of the room in which they are used.
- Before using a cartridge, make sure that it has been in its operating environment for at least 24 hours.
- Archival storage is 1 to 10 years for 9x40 cartridge tapes and 15 to 30 years for LTO Ultrium cartridge tapes.

Setting the Write Protect Switch

The following sections provide information about setting the write protect switch on the tape cartridges. The switch location and design varies slightly between cartridge types.

Setting 9840/T9840 Write Protect Switch to Read-Only

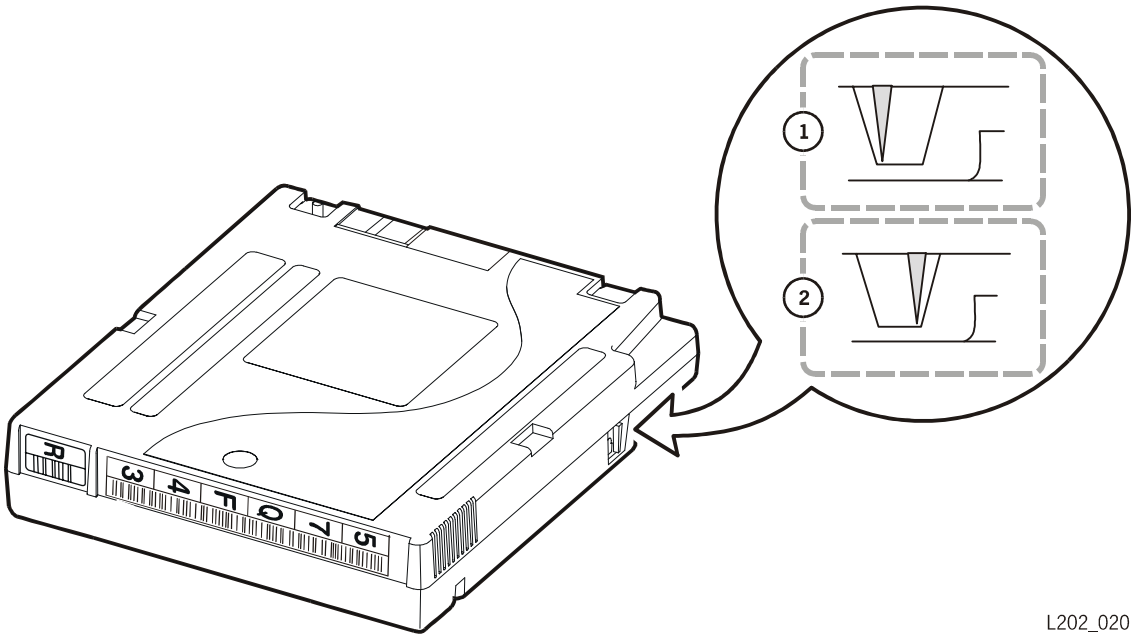
You can set the 9840/T9840 write protect switch so that the cartridge is read-only (nothing can be written on the tape). Slide the switch (Figure A-4) to the front of the cartridge. In this position, the drive can only read data from the tape and can not write data.

Setting 9840/T9840 Write Protect Switch to Read/Write

You can set the 9840/T9840 write protect switch so that the cartridge is write-enabled. Slide the switch (Figure A-4) to the rear of the cartridge. In this position, the drive can write as well as read data. This setting is recommended when you enter cartridges into the LSM.

Note: Some software has a feature called virtual thumb wheel, allowing read-only access to a cartridge that is not physically write protected.

Figure A-4. Setting the 9840/T9840 Cartridge Write Protect Switch (L202_020



1. Write enable position
2. Write protect position

Setting T9940 Write Protect Switch to Read-Only

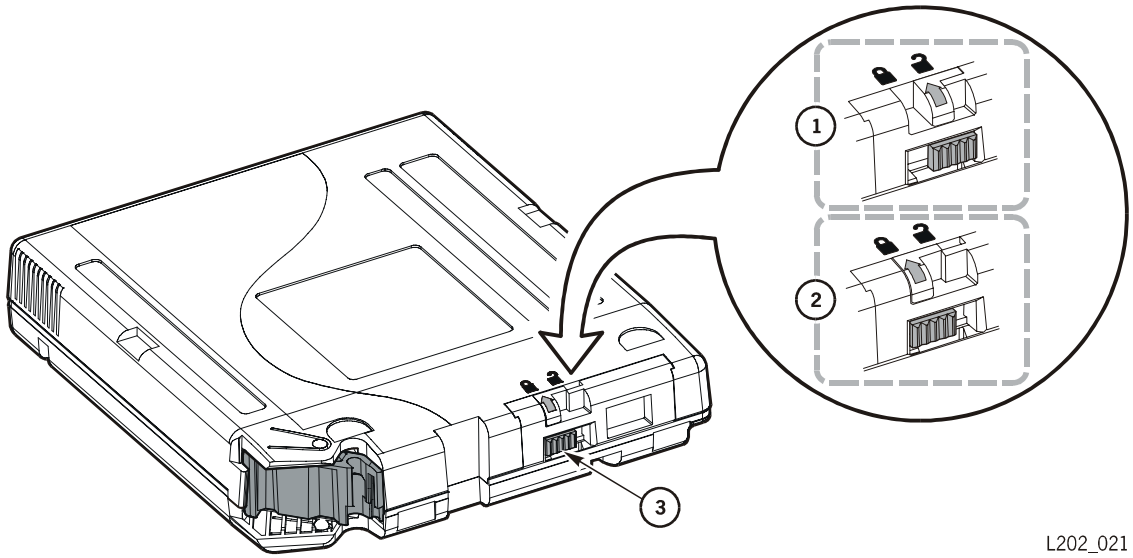
You can set the T9940 write protect switch so that the cartridge is read-only (nothing can be written on the tape). Slide the switch (Figure A-5) to the write protect position. In this position, the drive can only read data from the tape and can not write data.

Setting T9940 Write Protect Switch to Read/Write

You can set the T9940 write protect switch so that the cartridge is write-enabled. Slide the switch (Figure A-5) to the write enabled position. In this position, the drive can write as well as read data. This setting is recommended when you enter cartridges into the LSM.

Note: Some software has a feature called virtual thumb wheel, allowing read-only access to a cartridge that is not physically write-protected.

Figure A-5. Setting the T9940 Cartridge Write Protect Switch (L202_021)



1. Write enabled position
2. Write protect position
3. Write protect switch

Setting the LTO Ultrium Write Protect Switch to Read-Only

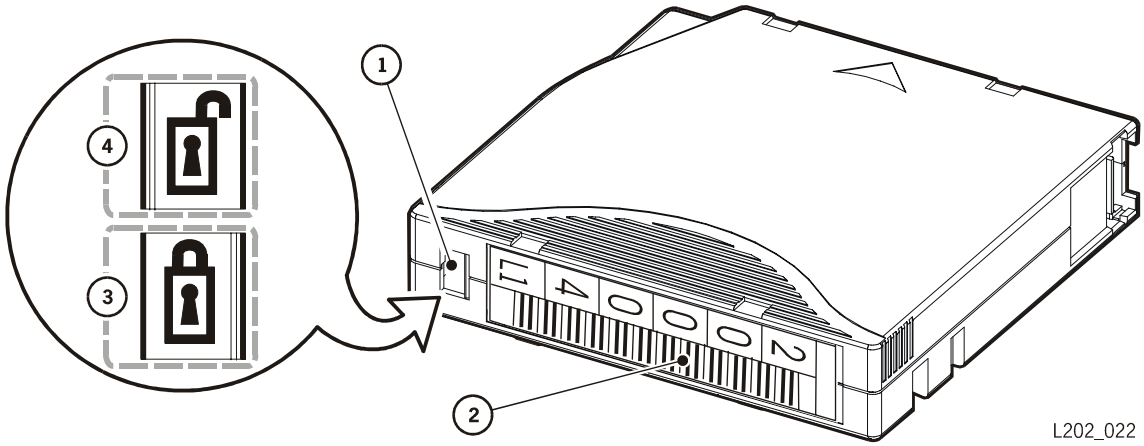
You can set the LTO Ultrium write protect switch so that the cartridge is read-only (nothing can be written on the tape). Slide the switch (Figure A-6) so that the “closed lock” is revealed. In this position, the drive can only read data from the tape and can not write data to it.

CAUTION:
LOSS OF DATA. LTO Ultrium drives do not recognize a ‘mount *vol_id drive_id* readonly’ command from ACSLS. SET THE CARTRIDGE WRITE PROTECT SWITCH TO THE WRITE PROTECT POSITION TO PREVENT DATA FROM BEING OVERWRITTEN.

Setting the LTO Ultrium Write Protect Switch to Read/Write

You can set the LTO Ultrium write protect switch so that the cartridge is write-enabled. Slide the switch (Figure A-6) so that the “open lock” is revealed. In this position, the drive can write as well as read data. This setting is recommended when you enter cartridges into the LSM.

Figure A-6. Setting the LTO Ultrium Cartridge Write-Protect Switch (L202_022)



1. Write protect switch (data=red, cleaning=gray
2. Volume serial ID (vol_id) label
3. Write protect position
4. Write enable position

Cleaning the Cartridge Exterior

CAUTION:
CARTRIDGE DAMAGE: Certain solvents can damage the cartridges. DO NOT USE ACETONE, TRICHLOROETHANE, TOLUENE, XYLENE, BENZENE, KETONE, METHYL ETHYL KETONE, METHYLENE CHLORIDE, ETHYLDICHLORIDE, ESTERS, ETHYL ACETATE, OR SIMILAR CHEMICALS TO REMOVE LABELS OR TO CLEAN CARTRIDGES.

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

Use StorageTek Tape Cleaner Wipes, PN 4046289-01 to clean the cartridges. These wipes are saturated with isopropyl alcohol. Do not let any solution touch the tape or get inside the cartridge.

Using Cleaning Cartridges

Cleaning cartridges have a media ID label that identifies the type of tape drive in which it can be used:

- U – 9840/T9840
- W – T9940
- C_2 – IBM LTO Ultrium
- C_3 – Seagate LTO Ultrium
- C_u – Universal LTO Ultrium

These tapes can also have a volume serial ID (vol_id) label with a CLN prefix. (IBM LTO Ultrium cleaning tapes have CLNI; Seagate LTO Ultrium cleaning tapes have CLNS.)

These cartridges can not be used as scratch cartridges or initialized by software utilities.

Note: IBM and Seagate LTO Ultrium cleaning tapes are *not* interchangeable. The universal Ultrium cleaning tape can be used in any LTO Ultrium drive.

CAUTION:
PROCEDURE ERROR: When you enter a cleaning cartridge, the software considers it to be new, and sets the usage counter to zero. DO NOT RE-ENTER A CLEANING CARTRIDGE THAT AN LSM HAS EJECTED.

Repairing a Detached Leader Block

When a T9940 or LTO Ultrium cartridge tape is damaged, use a backup tape if possible. If a cartridge leader block is detached, there is no backup tape, and the cartridge or tape has no obvious damage, you may repair the leader block using a repair kit provided by the tape supplier. You can use the tape one time to copy the data onto another tape.

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Glossary

Numerics

9741 A 20-drive cabinet that holds up to 20 9840/T9840/T9940 tape drives.

9741E A 20-drive cabinet that holds up to 17 9x40 or 20 LTO Ultrium tape drives.

9840 A cartridge drive that reads/writes to tapes; the housing for the tape contains supply and take-up reels.

9x40 Refers to 9840, T9840, or T9940 cartridges when a specific cartridge type is not required.

A

ac Alternating current.

ACS *See* automated cartridge system.

ACSLS *See* Automated Cartridge System Library Software.

automated cartridge system (ACS) A system that consists of five components: host software, a library management unit, a library control unit, library storage modules, and cartridge subsystems. These components provide automatic mounting and dismounting of cartridge tapes into a transport, cartridge access port, or pass-through port.

Automated Cartridge System Library Software (ACSLS) The software within a UNIX-based server that interfaces the server and hosts; it also maintains a list of all tapes within a library storage module (LSM).

automatic mode A relationship between a library and the client. In automated mode, the robot moves the cartridges among the storage cells, CAP, and drives in response to client commands. This is the normal operating mode of a library that is communicating with the client.

B

bar code label A barcoded external label that is both human- and machine-readable. The format of this label is unique and must be supplied by a StorageTek-approved vendor.

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

C

CAP *See* cartridge access port.

cartridge The plastic housing around the tape. The housing contains the tape and one or two reels for automatic threading when loaded in a transport. The spine of the cartridge contains a label listing the vol_id (tape volume serial number).

cartridge access port (CAP) In a StorageTek library, a mail slot through which an operator feeds tape cartridges into and retrieves tape cartridges from a library.

CD *See* cartridge drive.

cell A slot in the library in which a cartridge is stored.

Central Support Remote Center (CSRC) The remote diagnostic center at StorageTek. CSRC operators can access and test StorageTek systems and software, through telecommunications lines, from remote customer installations. Previously referred to as the Remote Diagnostic Center (RDC). *See also* Hardware Support Services.

CIM *See* customer-initiated maintenance.

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

connected mode A relationship between a host and an automated cartridge system (ACS). In this mode, the host and an ACS can communicate (at least one station to this ACS is online).

controlling software An automated cartridge system component that interfaces between the operating system and the rest of the automated library.

cross-host recovery The ability for one host to perform recovery for another host that has failed.

CSE Customer services engineer.

CSRC *See* Central Support Remote Center.

customer-initiated maintenance (CIM) A StorageTek maintenance agreement for maintenance support when the customer initiates a maintenance request. The customer calls Hardware Support Services to report the problem.

D

dc Direct current.

device number A four-digit hexadecimal number that uniquely identifies a device attached to a processor.

disconnected mode A relationship between a host and a library. In this mode, the host and a library cannot communicate (online stations do not exist to this library).

dual LMU A hardware/software feature that provides a redundant library management unit capability. *See also* master LMU and standby LMU.

E

eject The library robot places a cartridge in a cartridge access port so that the operator can remove it.

electrostatic discharge (ESD) An undesirable discharge of an accumulated electrical charge (static) that can severely damage delicate equipment and degrade electrical circuitry.

emergency power-off (EPO) A safety scheme that allows a “power down” of a subsystem or a system as a whole instead of powering it down component-by-component.

enabled (1) Active. (2) On.

end-of-tape (EOT) The location on a tape where written data ends.

EPO *See* emergency power off.

ESD *See* electrostatic discharge.

F

file-protect To prevent the destruction or overwriting of data stored on cartridge tape. *See also* write-protect.

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

G

GB *See* gigabyte.

gigabyte (GB) One billion (10^9) bytes. When referring to memory capacity, 1,073,741,824 in decimal notation. (IBM)

H

hand assembly The robotic element that includes a motor, a gripper for grasping cartridges, and a camera for reading volume serial number labels and targets.

Hardware Support Services (HSS) The remote diagnostic center at StorageTek. Hardware support services engineers (HSSEs) can access and test StorageTek equipment and software, through telecommunications lines, from certain remote customer installations. Previously referred to as the remote diagnostic center (RDC) or the Customer Support Remote Center (CSRC).

home location The cell in a library storage module in which a cartridge is stored. A cartridge returns to this location when it dismounts from a drive or cartridge tape unit.

I

ID (1)Identification. (2) Identifier.

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 microcode software usually reload the functional firmware from a diskette or disk drive at initial program load execution.

input/output (I/0) Pertaining to a device, process, or channel involved with data input, data output, or both. (IBM)

insert (1) The action of placing a cartridge into the cartridge access port magazine. (2) The action of placing a cartridge into a storage cell.

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

interlock switch A switch that disconnects power to the library when the front door is opened.

intervention required Operator action is required (such as removing a tape from the transport).

I/O *See* input/output.

IPL *See* initial program load.

L

LAD *See* lock access door.

LAN *See* local area network.

LCU *See* library control unit.

leader block The mechanism that loads the tape through the tape path of a transport.

LED *See* light emitting diode.

library An installation of one or more ACSs, attached cartridge drives, cartridges placed into the ACSs, host software that controls and manages the ACSs and associated cartridges, and the library control data set that describes the state of the ACSs.

library control unit (LCU) The portion of an automated library that controls the choosing, mounting, dismounting, and replacing of cartridges.

library management unit (LMU) The portion of an automated cartridge system that control the library storage module and communicates with the host.

library storage module (LSM) A housing that contains cartridge tapes and a robot that moves the tapes between storage cells and the attached transports. *Synonymous with* tape library.

light emitting diode (LED) A light-emitting electronic device that uses little energy and is used mainly on status panels to indicate an on or off condition.

linear tape open (LTO) A set of data format standards created to enable data interchange among tape drives produced by

a consortium of manufacturers, currently Hewlett-Packard (HP), IBM, and Seagate. With LTO standards, the tape cartridges are interchangeable between tape drive brands.

LMU *See* library management unit.

load a cartridge The process by which a drive prepares a cartridge tape for read and write operations.

local area network (LAN) A computer network in which devices within the network can access each other for data transmission purposes. The LMU and attached LCUs are connected with a local area network.

lock access door (LAD) A door mounted on the access door for safety reasons. The procedure to open and close the LAD prevents a person from being in the library storage module when the robot is moving.

LSM *See* library storage module.

LSM number A method used to identify an LSM. The first LSM listed in this parameter is 0 (hexadecimal), the second LSM listed is 1, and so forth, until all LSMs are identified (maximum number of 15 or hexadecimal F).

LTO *See* linear tape open.

M

maintenance facility Hardware that enables service personnel to run diagnostics, retrieve status, and communicate with these units through their respective control panels.

manual mode A relationship between a library and the client. A library operating in manual mode does not communicate with the client and requires human assistance to perform cartridge operations. Manual mode occurs when the robot is unavailable to the client.

master LMU The library management unit (LMU) currently controlling the functional work of the automated cartridge system in a dual LMU configuration. *See also* standby LMU.

microcode A code, representing the instruction of an instruction set, that is implemented in a part of storage that is not program-addressable. (IBM) *See also* firmware.

monitor A device that observes, records, and verifies the operations of a system to indicate andy significant departure from normal operation.

mount a cartridge To insert a cartridge into a drive.

N

Nearline A registered trademark of StorageTek, this term is used in association with StorageTek's family of tape-library information storage and retrieval products. ‘

not ready The library is not available to perform operator-requested actions. Some status information might be available through the network interfaces.

O

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

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

operating system (OS) Software that controls the execution of programs and that may provide services such as resource allocation, scheduling, input/output control, and data management. Although operating systems are predominately software, partial hardware implementations are possible.

P

pass-through port (PTP) A mechanism that enables a cartridge to be passed through from one library storage module (LSM) to another in a multiple LSM automated cartridge system.

PCAP *See* priority cartridge access port.

priority cartridge access port An assembly allowing an operator to enter/eject one cartridge during automated operations. The PCAP is located on the 80-cell CAP access door of an LSM.

PTP *See* pass-through port.

R

ready The library has been powered on and has completed its initialization and initial program load (IPL). It is ready to accept user requests.

reset the library To cause the library to reload its operating software (firmware) into working memory and reset some configuration values.

robot An electromechanical device that moves cartridges among cartridge access ports, the storage cells and the drives.

S

safety interlock switch A switch that disconnects power to the library when the front door is opened.

SCSI *See* small computer systems interface.

server A specific processor that runs an operating system and uses the library for data storage and retrieval. An example is the IBM RS/6000.

ServiceTek A StorageTek maintenance system, Maintenance Initiated Maintenance, that provides field machines to connect to a special call handling machine at a centralized location. The connection allows for automatic (and unattended) data transfer, problem determination, or diagnostic operations.

small computer systems interface (SCSI) A local interface operating over a wide range of transfer rates using a common command set for all devices attached to the interface. It connects host computer systems to a variety of peripheral devices.

software All or part of the programs, procedures, rules, and associated documentation of a data processing system. Software is the intellectual creation that is independent of the medium on which it is recorded. (T) *Contrast with* hardware.

standby The status of a station that has been placed online but is connected to the standby LMU of a dual LMU ACS.

standby LMU The redundant library management unit in a dual LMU configuration that is ready to take over functions if a master LMU fails or when the operator issues the switch command. *See also* master LMU.

station A hardware path between the host computer and a library management unit (LMU) over which the controlling software and LMU send control information.

storage cells The slots where cartridge tapes are kept in a library.

switchover The action of the standby library management unit (LMU) becoming the master LMU.

T

T9840 A cartridge drive that reads/writes to tapes; the housing for the tape contains supply and take-up reels.

T9940 A cartridge drive that reads/writes to tapes; the housing for the tape contains a single reel.

tape A medium with a magnetized layer on which data is stored by magnetic recording. Tape is the medium that is inside of a cartridge.

tape drive An electromechanical devices that moves magnetic tap and includes the mechanisms for writing and reading data to and from the tape.

tape library *Synonym for* library storage module.

transport *Synonym for* tape drive.

U

Ultrium The product name given to IBM and Seagate LTO-type single-reel tape drives and cartridges. *See* linear tape open (LTO).

utilities Utility programs. The programs that allow an operator to manage the resources of the library and to monitor overall library performance.

V

vol_id ACSLS term for volume serial number.

volume serial number A six-character alphanumeric label used to identify a tape cartridge. It attaches to the spine of a cartridge and is both human- and machine-readable.

volume A data carrier that mounts and dismounts as a unit; for example a reel of magnetic tape. *See* cartridge.

W

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

write-protect To set the switch on a cartridge to prevent data from being written on the tape. *See also* file-protect.

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

Z

Z carriage The assembly that moves the hand vertically up and down the Z-column to the storage cells, the drives, and the cartridge access port in a library storage module or library.

Z-column assembly The assembly that enables the hand mechanism in the library storage module or library to move vertically.

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