IBM System Storage TS3500 Tape Library

# Introduction and Planning Guide

*IBM 3584 Tape Library*

GA32-0559-04

IBM System Storage TS3500 Tape Library

# Introduction and Planning Guide

*IBM 3584 Tape Library*

GA32-0559-04

**Note!**

Before using this guide and the product it supports, read the information in "Safety and Environmental Notices" on page xiii and Appendix B, "Notices," on page 199.

**Fifth Edition (November 2007)**

This edition applies to the *IBM System Storage TS3500 Tape Library Introduction and Planning Guide* and to all subsequent releases and modifications until otherwise indicated in new editions. This edition replaces GA32-0559-03.

# Read This First

This is the fifth edition of the *IBM System Storage TS3500 Tape Library Introduction and Planning Guide* (November 2007).

## What's New in this Edition (November 2007)

Revision bars (|) appear next to all of the information that has been added or changed since the previous edition (GA32-0559-03).

Changes include:

- Additional information about remote support security.
- Addition of Secure Socket Layer (SSL) for Ethernet network security.
- An embedded SMI-S agent which works with the IBM TotalStorage Productivity Center (TPC) 3.3.1 and later.
- Addition of Internet Protocol, version 6 (IPv6) functionality, allowing the 3584 library to operate under the following configurations:
  - IPv4 network only
  - IPv6 network only
  - Both IPv4 and IPv6 networks

## Previous Edition (May 2007)

- LTO Ultrium 4 (TS1040) encryption capable drives and cartridges with enhanced data gathering (IBM® feature code 1604)
- Four I/O stations for new D23 or D53 frames add up to 64 additional I/O slots (IBM feature codes 1655 and 1656)
- Rack mountable TS3000 System Console (TSSC) ( IBM feature code 2730)
- Single feed bifurcated AC line cord (IBM feature code 1909)

## Send Us Your Feedback

Send us your comments by e-mail to *starpubs@us.ibm.com* or use the Readers' Comments form at the back of this publication. Be sure to include the following:

- Exact publication title
- Form number (for example, GA32-1234-02), part number, or EC level (located on the back cover)
- Page numbers to which you are referring

# Contents

# Figures

# Tables

# Safety and Environmental Notices

When using this product, observe the danger, caution, and attention notices that are contained in this guide. The notices are accompanied by symbols that represent the severity of the safety condition.

Most danger or caution notices contain a reference number (Dxxx or Cxxx). Use the reference number to check the translation in the @server *Safety Notices*, G229-9054.

The sections that follow define each type of safety notice and give examples.

## Danger Notice

A danger notice calls attention to a situation that is potentially lethal or extremely hazardous to people. A lightning bolt symbol always accompanies a danger notice to represent a dangerous electrical condition. A sample danger notice follows:

**DANGER**

**An electrical outlet that is not correctly wired could place hazardous voltage on metal parts of the system or the devices that attach to the system. It is the responsibility of the customer to ensure that the outlet is correctly wired and grounded to prevent an electrical shock.** *(D004)*

## Caution Notice

A caution notice calls attention to a situation that is potentially hazardous to people because of some existing condition, or to a potentially dangerous situation that might develop because of some unsafe practice. A caution notice can be accompanied by one of several symbols:

| If the symbol is... | It means... |
|---|---|
|  | A hazardous electrical condition with less severity than electrical danger. |
|  | A generally hazardous condition not represented by other safety symbols. |

| If the symbol is... | It means... |
|---|---|
|  | A hazardous condition due to the use of a laser in the product. Laser symbols are always accompanied by the classification of the laser as defined by the U. S. Department of Health and Human Services (for example, Class I, Class II, and so forth). |
|  | A hazardous condition due to mechanical movement in or around the product. |
|  | A hazardous condition due to the weight of the unit. Weight symbols are accompanied by an approximation of the product's weight. |

Sample caution notices follow:

**CAUTION:**
**The battery is a lithium ion battery. To avoid possible explosion, do not burn. Exchange only with the IBM-approved part. Recycle or discard the battery as instructed by local regulations. In the United States, IBM has a process for the collection of this battery. For information, call 1-800-426-4333. Have the IBM part number for the battery unit available when you call.***(C007)*

**CAUTION:**
**Energy hazard present. Shorting may result in system outage and possible physical injury. Remove all metallic jewelry before servicing.**
*(C001)*


**CAUTION:**
**This product contains a Class II laser. Do not stare into the beam.**
*(C029)*


**CAUTION:**
**The weight of this part or unit is between 18 and 32 kilograms (39.7 and 70.5 pounds). It takes two persons to safely lift this part or unit.**
*(C009)*

**CAUTION:**
**This assembly contains mechanical moving parts. Use care when servicing this assembly.** *(C025)*

## Attention Notice

An attention notice indicates the possibility of damage to a program, device, or system, or to data. An exclamation point symbol may accompany an attention notice, but is not required. Sample attention notices follow:

**Attention:** If you use a power screwdriver to perform this procedure it could destroy the tape.

**Attention:** Do not connect an IBM control unit directly to a public optical network. The customer must use an additional connectivity device between an IBM control unit optical adapter (that is, fibre, ESCON®, or FICON®) and an external public network . Use a device such as a patch panel, a router, or a switch. You do not need an additional connectivity device for optical fibre connectivity that does not pass through a public network.

**Attention:** Do not operate the 3584 Tape Library in a poor air-quality environment.

## Possible Safety Hazards

Possible safety hazards to the operation of this product are:

**Electrical** An electrically charged frame can cause serious electrical shock.

**Mechanical** Hazards, such as a safety cover missing, are potentially harmful to people.

**Chemical** Do not use solvents, cleaners, or other chemicals not approved for use on this product.

Repair any of the preceding problems before you use the 3584 Tape Library.

## Laser Safety and Compliance

Before using the 3584 Tape Library, review the following laser safety information.

### Class II Laser Product

The 3584 Tape Library is a Class II laser product. It is important for you to be aware of the laser caution label. See Figure 1 on page xvi for an example of the label.

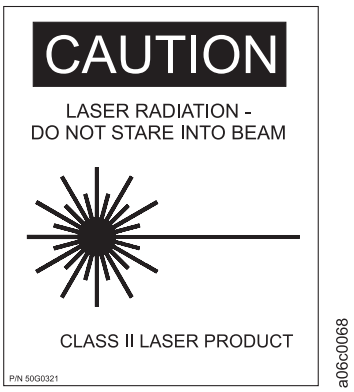



*Figure 1. Laser safety caution label*

This product complies with the performance standards set by the U.S. Food and Drug Administration for a Class II Laser product. This product belongs to a class of laser products that requires precautions be taken to avoid prolonged viewing of the laser beam. Under normal working conditions, you must not come in direct contact with the laser beam. This classification was accomplished by providing the necessary protective housings and scanning safeguards to ensure that laser radiation is inaccessible during operation or is within Class II limits. These products have been reviewed by external safety agencies and have obtained approvals to the latest standards as they apply to this product type.

### Class I Laser Product

The 3584 Tape Library contains a laser assembly that complies with the performance standards set by the U.S. Food and Drug Administration for a Class I laser product. Class I laser products do not emit hazardous laser radiation. Protective housing and scanning safeguards ensure that laser radiation is inaccessible during operation or is within Class I limits. External safety agencies have reviewed the library and have obtained approvals to the latest standards as they apply.

## End of Life (EOL) Plan

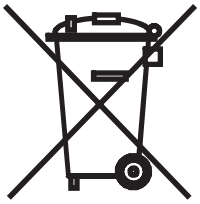
This box is a purchased unit. Therefore, it is the sole responsibility of the purchaser to dispose of it in accordance with local laws and regulations at the time of disposal.

This unit contains recyclable materials. The materials should be recycled where facilities are available and according to local regulations. In some areas, IBM may provide a product take-back program that ensures proper handling of the product. Contact your IBM representative for more information.

## Product Recycling and Disposal

This unit must be recycled or discarded according to applicable local and national regulations. IBM encourages owners of information technology (IT) equipment to responsibly recycle their equipment when it is no longer needed. IBM offers a variety of product return programs and services in several countries to assist equipment owners in recycling their IT products. Information on IBM product recycling offerings can be found on IBM's Internet site at `http://www.ibm.com/ibm/environment/products/prp.shtml`.

Esta unidad debe reciclarse o desecharse de acuerdo con lo establecido en la normativa nacional o local aplicable. IBM recomienda a los propietarios de equipos de tecnología de la información (TI) que reciclen responsablemente sus equipos cuando éstos ya no les sean útiles. IBM dispone de una serie de programas y servicios de devolución de productos en varios países, a fin de ayudar a los propietarios de equipos a reciclar sus productos de TI. Se puede encontrar información sobre las ofertas de reciclado de productos de IBM en el sitio web de IBM http://www.ibm.com/ibm/environment/products/prp.shtml.



**Notice:** This mark applies only to countries within the European Union (EU) and Norway.

Appliances are labeled in accordance with European Directive 2002/96/EC concerning waste electrical and electronic equipment (WEEE). The Directive determines the framework for the return and recycling of used appliances as applicable throughout the European Union. This label is applied to various products to indicate that the product is not to be thrown away, but rather reclaimed upon end of life per this Directive.

In accordance with the European WEEE Directive, electrical and electronic equipment (EEE) is to be collected separately and to be reused, recycled, or recovered at end of life. Users of EEE with the WEEE marking per Annex IV of the WEEE Directive, as shown above, must not dispose of end of life EEE as unsorted municipal waste, but use the collection framework available to customers for the return, recycling and recovery of WEEE. Customer participation is important to minimize any potential effects of EEE on the environment and human health due to the potential presence of hazardous substances in EEE. For proper collection and treatment, contact your local IBM representative.

## Battery Return Program

This product may contain sealed lead acid, nickel cadmium, nickel metal hydride, lithium, or a lithium ion battery. Consult your user manual or service manual for specific battery information. The battery must be recycled or disposed of properly. Recycling facilities may not be available in your area. For information on disposal of batteries outside the United States, go to http://www.ibm.com/ibm/environment/products/batteryrecycle.shtml or contact your local waste disposal facility.

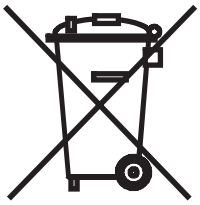
In the United States, IBM has established a return process for reuse, recycling, or proper disposal of used IBM sealed lead acid, nickel cadmium, nickel metal hydride, and other battery packs from IBM Equipment. For information on proper disposal of these batteries, contact IBM at 1-800-426-4333. Please have the IBM part number listed on the battery available prior to your call.

For Taiwan:

Please recycle batteries

廢電池請回收

For the European Union:



Batteries or packaging for batteries are labeled in accordance with European Directive 2006/66/EC concerning batteries and accumulators and waste batteries and accumulators. The Directive determines the framework for the return and recycling of used batteries and accumulators as applicable throughout the European Union. This label is applied to various batteries to indicate that the battery is not to be thrown away, but rather reclaimed upon end of life per this Directive.

In accordance with the European Directive 2006/66/EC, batteries and accumulators are labeled to indicate that they are to be collected separately and recycled at end of life. The label on the battery may also include a chemical symbol for the metal concerned in the battery (Pb for lead, Hg for mercury and Cd for cadmium). Users of batteries and accumulators must not dispose of batteries and accumulators as unsorted municipal waste, but use the collection framework available to customers for the return, recycling and treatment of batteries and accumulators. Customer participation is important to minimize any potential effects of batteries and accumulators on the environment and human health due to the potential presence of hazardous substances. For proper collection and treatment, contact your local IBM representative.

For California:

Perchlorate Material - special handling may apply. See `www.dtsc.ca.gov/hazardouswaste/perchlorate`.

The foregoing notice is provided in accordance with California Code of Regulations Title 22, Division 4.5 Chapter 33. Best Management Practices for Perchlorate Materials. This product/part may include a lithium manganese dioxide battery which contains a perchlorate substance.

## Flat Panel Display

The fluorescent lamp or lamps in the liquid crystal display contain mercury. Dispose of it as required by local ordinances and regulations.

# Preface

This guide contains information about how to plan for the IBM® System Storage™™ TS3500 Tape Library, formerly known as the IBM TotalStorage®® 3584 Tape Library. It includes the following chapters:

Chapter 1, “Introduction,” provides an overview of the 3584 Tape Library, tells how it can interact in both mainframe and Open Systems environments, describes how it can process both Linear Tape-Open (LTO) Ultrium Tape Cartridges and IBM TotalStorage 3592 Enterprise Tape Cartridges, summarizes its primary components, addresses its Multi-Path architecture capabilities, describes the method for determining supported servers and operating systems, describes methods for cleaning its tape drives, and outlines performance considerations.

Chapter 2, “Physical Planning Specifications,” lists dimensions of the 3584 Tape Library. It describes clearance requirements, sets forth fire-suppression provisions, and defines specifications for the library and the media. In addition, the requirements for the power cord, power plug, and power receptacle are addressed.

Chapter 3, “Standard Features,” gives the codes that you need when ordering features for all models of the 3584 Tape Library.

Chapter 4, “Using Ultrium Media,” describes the data and cleaning cartridges to use in Ultrium Tape Drives. It defines the information that appears on a bar code label, gives requirements for a bar code label, tells how to set the write-protect switch on a tape cartridge, provides tips about storing, shipping, and handling cartridges, and offers information about where to order cartridges and supplies.

Chapter 5, “Using 3592 Tape Drive Media,” describes the data and cleaning cartridges to use in the 3592 J1A Tape Drive and the TS1120 Tape Drive. It defines the information that appears on a bar code, gives requirements for a bar code label, tells how to set the write-protect switch on a tape cartridge, provides tips on storing, shipping, and handling cartridges, tells how to clean a tape drive, describes how to inspect a cartridge leader, and offers information about where to order cartridges and supplies.

Chapter 6, “Using the Fibre Channel Interface,” describes the requirements of the Fibre Channel interface, lists the types of topologies that the 3584 Tape Library supports, discusses the address scheme for the Fibre Channel tape drives, discusses the role of World Wide Names, and provides information about connectors and adapters.

Chapter 7, “Frame Capacity,” provides tables that show the quantity of storage slots that are available in library frames, depending on whether the whether the Capacity On Demand or Capacity Expansion Features are installed, the upper and lower I/O stations are used, and a specified quantity of drives are installed.

Chapter 8, “TS1120 Encryption Overview,” explains how encryption-enabled tape drives, encryption key management, and encryption policy configuration are the three elements that comprise the TS1120 Tape Drive solution. It describes the Encryption Key Manager (EKM) software that generates and stores the encryption keys which encrypt and decrypt information on the tape cartridges. It also gives

information about supported servers and operating systems, methods of encryption, and encryption keys. A checklist for installing and configuring encryption is provided.

Appendix A, "Statement of Limited Warranty," contains the warranty statement for the 3584 Tape Library.

Appendix B, "Notices," tells where and how to send your comments about this book. It also gives information about the electronic emission regulations that pertain to the 3584 Tape Library in the United States and other countries or regions.

## Related Information

Refer to the following sources for additional information about the 3584 Tape Library and its associated products. To ensure that you have the latest publications, visit the web at:

`http://www.ibm.com/storage/lto`

To view the IBM System Storage TS3500 Tape Library Information Center, go to:

`http://publib.boulder.ibm.com/infocenter/ts3500tl/v1r0/index.jsp`

### Publications about the 3584 Tape Library

- *IBM System Storage TS3500 Tape Library Operator Guide*, GA32-0560
- *IBM System Storage TS3500 Tape Library 3584 Maintenance Information* (part number 95P5559; provided with the 3584 Tape Library)
- *IBM System Storage TS3500 Tape Library SCSI Reference*, GA32-0561

### IBM System i5 and AS/400 Source

For information about the IBM System i5™™ and the AS/400®® servers, visit the web at `http://publib.boulder.ibm.com/iseries/`. The IBM System i5 is the follow-on product line to the IBM eServer™™ i5 and iSeries™™ Systems.

### IBM System p5 and RS/6000 Source

For information about the IBM System p5™™ and the RS/6000®® servers, visit the web at `http://www.ibm.com/servers/eserver/pseries`. The IBM System p5 is the follow-on product line to the IBM eServer p5, OpenPower™™, and pSeries®® servers.

### IBM System z9 Source

For information about the IBM System z9™ server, visit the web at `http://www.ibm.com/servers/eserver/zseries`. The IBM System z9 is the follow-on product line to the IBM eServer zSeries®® servers.

### Other Sources

- For a list of compatible software, operating systems, and servers for Ultrium Tape Drives, visit the web at `http://www.ibm.com/storage/lto`. Under `IBM System Storage TS3500 Tape Library`, select `Product details`. Under `Learn more`, select `Interoperability matrix` or select `Independent Software Vendor (ISV) matrix for LTO`.

- For a list of compatible software, operating systems, and servers for TS1120 Tape Drives, visit the web at http://www.ibm.com/servers/storage/tape/drives. Under IBM System Storage TS1120 Tape Drive, select Product details. Under Learn more, select Interoperability matrix or Independent Software Vendor (ISV) matrix.
- For a list of compatible software, operating systems, and servers for 3592 Tape Drives, visit the web at http://www.ibm.com/servers/storage/tape/drives. Under IBM TotalStorage 3592 Tape Drive, select Product details. Select Resource library. Select Interoperability, then 3592 Tape Drive. Or select Compatibility information, then Independent Software Vendor (ISV) Matrix for 3592 Tape Drive.
- *IBM Encryption Key Manager component for the Java™ platform Introduction, Planning, and User's Guide*, GA76-0148
- *IBM 3953 Tape System Introduction and Planning Guide*, GA32-0557
- *IBM 3953 Library Manager Model L05 Operator Guide*, GA32-0558
- *IBM 3953 Tape Frame Model F05 Maintenance Information* (part number 23R6439; provided with the 3953 Tape System)
- *IBM TotalStorage Enterprise Silo Compatible Tape Frame 3592 Introduction, Planning, and User's Guide Model C20*, GA32-0463
- *IBM System Storage TS1120 Tape Drive and Controller Operator Guide*, GA32-0556
- *IBM System Storage TS1120 Tape Drive and Controller Introduction and Planning Guide*, GA32-0555
- *IBM System Storage TS1120 Tape Drive Maintenance Information*, part number 23R9281
- *IBM System Storage TS1120 Tape Drive SCSI Reference*, GA32-0466
- *IBM System Storage TS3000 System Console (TSSC) Maintenance Information*, part number 23R6513
- *IBM Virtualization Engine TS7510 Introduction and Planning Guide*, GC26-7767.
- *IBM TotalStorage SMI-S Agent for Tape on Linux Systems Installation Guide*, GC35-0512. This book is available through the IBM Publications Center on the web at http://www.elink.ibmlink.ibm.com/public/applications/publications/cgibin/pbi.cgi.
- *IBM TotalStorage LTO Ultrium Tape Drive SCSI Reference*, GA32-0450
- *Systems Safety Notices*, G229-9054. This publication is available at http://www.ibm.com/servers/resourcelink. To access, register for a userid and password, then select Library in the navigation area.
- *IBM Tape Device Drivers Installation and User's Guide*, GC27-2130
- *IBM Tape Device Drivers Programming Reference*, GA32-0566
- *Implementing IBM Tape in Linux and Windows*, SG24-6268. This book is available on the web at http://www.redbooks.ibm.com/redpieces/pdfs/sg246268.pdf.
- *Implementing IBM Tape in Unix Systems*, SG24-6502. This book is available on the web at http://www.redbooks.ibm.com/redbooks/pdfs/sg246502.pdf.
- *The IBM TotalStorage Tape Libraries Guide for Open Systems*, SG24-5946
- *The LTO Ultrium Primer for IBM eServer iSeries Customers*, REDP-3580. This book is available on the web at www.redbooks.ibm.com. Search on REDP-3580.
- *IBM System Storage TS3500 Tape Library Data Gathering - Introduction to Library Statistics*, a white paper that is available from your IBM Representative
- *IBM TotalStorage 3584 Tape Library Performance*, a white paper that is available from your IBM Representative.

- To access installation instructions for customer-setup units (CSUs) from the web, go to http://www-03.ibm.com/servers/storage/tape/resource-library.html#publications. Under the Publications category, select 3584 Tape Library.
- *IBM LTO Ultrium Cartridge Label Specification (Revision 2)*. This document is available on the web at http://www.ibm.com/servers/storage/support/lto/3584/. Under Additional resources, select LTO Ultrium media. Under Learn more, select LTO label specifications. Under Abstract, select the .pdf file to access the document.
- *Label Specification for IBM 3592 Cartridges when used in IBM Libraries*. This document is available on the web at www.storage.ibm.com/media/tapecartridges/index.html. Under Enterprise storage media, select 3592 tape cartridges. Under Learn more, select Barcode Label Specification for use with 3592 Tape Media. Under Content, select the .pdf file to access the document. You can also contact your IBM Marketing Representative for this specification.

## Authorized Suppliers of Bar Code Labels

You can order bar code labels directly from the authorized label suppliers listed in Table 1.

**Attention:** The IBM System Storage TS3500 Tape Library is designed to work with bar code labels that meet the specifications and requirements set forth in the *IBM LTO Ultrium Cartridge Label Specification (Revision 2)* and the *Label Specification for IBM 3592 Cartridges when used in IBM Libraries*. The following label providers have demonstrated the ability to produce finished bar code labels that meet the foregoing specifications and requirements. This information is provided for the convenience of 3584 Tape Library users only, and is not an endorsement or recommendation of such providers. IBM is not responsible for the quality of bar code labels procured from sources other than IBM. This information is applicable to bar code labels actually printed by the listed companies. IBM has not reviewed the quality of any labels produced by software or services offered by such companies which allow end users to print labels on their own printing equipment.

*Table 1. Authorized suppliers of custom bar code labels*

| In the Americas | In Europe and Asia |
|---|---|
| Dataware<br>7570 Renwick<br>Houston, TX 77081<br>U. S. A.<br>Telephone: 800-426-4844<br>http://www.datawarelabels.com/ | Not applicable |
| Tri-Optic<br>6800 West 117th Avenue<br>Broomfield, CO 80020<br>U.S.A.<br>Telephone: 888-438-8362 or 303.464.3508<br>Fax: 888-438-8363 or 303-666-2166http://www.tri-optic.com | EDP Europe Limited<br>43 Redhills Road<br>South Woodham Ferrers<br>Chelmsford, Essex CM3 5UL<br>U. K.<br>Telephone: 44 (0) 1245 322380<br>Fax: 44 (0)1245 323484<br>http://www.edpeurope.com/media-labels.html |
| Netc, L. L. C.<br>100 Corporate Drive<br>Trumbull, CT® 06611<br>U. S. A.<br>Telephone: 203-372-6382<br>http://www.NetcLabels.com | Netc Europe Ltd<br>Town Farm Bungalow<br>North Curry<br>Taunton<br>Somerset U. K. TA3 6LX<br>Telephone: 44 (0) 1823 491439<br>http://www.NetcLabels.co.uk |
| | Netc Asia Pacific Pty Ltd<br>Locked Bag 14<br>Kenthurst<br>NSW Australia 2156<br>Telephone: 61 (0) 2 4563 6556<br>http://www.NetcLabels.com.au |

# Chapter 1. Introduction

This section introduces the IBM System Storage TS3500 Tape Library (TS3500 Tape Library), machine type 3584, referred to hereafter as the 3584 Tape Library.

## Overview

This section describes the 3584 Tape Library. It gives the maximum quantity of frames and drives, describes the data rate and capacity for the IBM LTO Ultrium Tape Drives and the IBM 3592 Tape Drives, describes the library's cartridge capacity, and gives the supported interfaces for each type of drive.

The 3584 Tape Library is a stand-alone device that provides reliable, automated tape handling and storage for both mainframe and Open Systems environments.

Figure 2 shows a 6-frame version of the 3584 Tape Library. The library can expand to 16 frames and can include 192 drives.

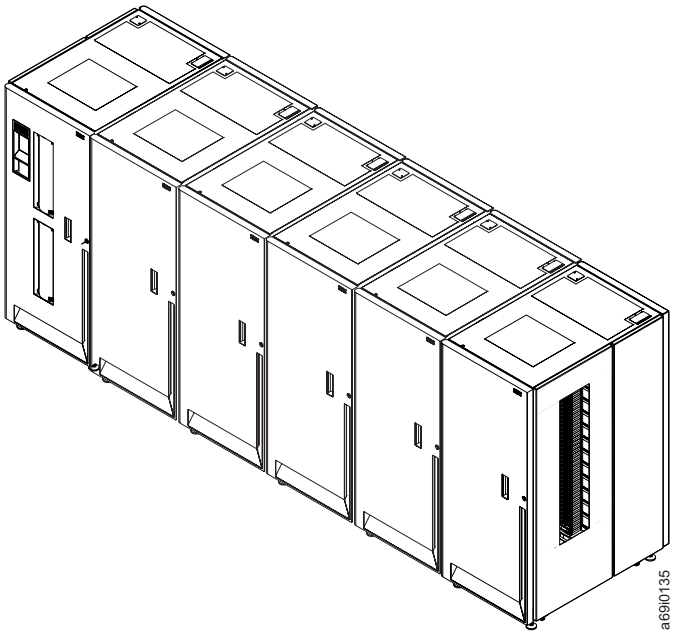



*Figure 2. The 3584 Tape Library.* The library can contain up to 16 frames.

The 3584 Tape Library comes with several tape drive and frame options to meet your needs. Table 2 on page 2 provides an overview of supported tape drives. Table 3 on page 2 gives the capacities of the supported frames.

*Table 2. Tape drives that are supported by the 3584 Tape Library*

| Supported Tape Drives | | | | |
|---|---|---|---|---|
| **Type of Drive** | **Speed of Connectivity** | **Native Data Rate** | **Native Capacity** | **Other Information** |
| IBM System Storage TS1040 Tape Drive Model F4A | 4 Gbps Fibre | 120 MB/s | 800 GB | Known as the Ultrium 4 Tape Drive |
| IBM System Storage TS1030 Tape Drive Model F3B | 4 Gbps Fibre | 80 MB/s | 400 GB | Both of these drives are known as the Ultrium 3 Tape Drive |
| IBM System Storage 3588 Tape Drive Model F3A | 2 Gbps Fibre | 80 MB/s | 400 GB | |
| IBM TotalStorage LTO Ultrium 2 Tape Drive | 2 Gbps Fibre<br>160 MB/s (LVD SCSI)<br>40 MB/s (HVD SCSI) | 35 MB/s | 200 GB | Known as the Ultrium 2 Tape Drive |
| IBM TotalStorage LTO Ultrium 1 Tape Drive | 1 Gbps<br>80 MB/s (LVD SCSI)<br>40 MB/s (HVD SCSI) | 15 MB/s | 100 GB | Known as the Ultrium 1 Tape Drive |
| IBM System Storage TS1120 Tape Drive | 4 Gbps Fibre | 100 MB/s | 500 GB | Formerly known as the IBM TotalStorage 3592 Tape Drive Model E05 |
| IBM TotalStorage 3592 Tape Drive Model J1A | 2 Gbps Fibre | 40 MB/s | 300 GB | |

*Table 3. Frames that are supported by the 3584 Tape Library*

| Supported Frames | | | |
|---|---|---|---|
| **A library of these models...** | **Containing these drives...** | **Can contain this many cartridges...** | **And has this maximum capacity...** |
| L52, D52, L53, and D53 | Ultrium Tape Drives | 6887 | 5509 TB |
| L32 and D32 | Ultrium Tape Drives | 6881 | 5509 TB |
| L22, D22, L23, and D23 | IBM System Storage TS1120 Tape Drive and IBM TotalStorage 3592 Tape Drive Model J1A | 6260 | 3130 TB (TS1120)<br>1878 TB (J1A) |

Ultrium 1 and Ultrium 2 Tape Drives use Fibre Channel and SCSI attachment. Each model of the Ultrium 4 Tape Drive, Ultrium 3 Tape Drive, and 3592 Tape Drive uses only Fibre Channel attachment. For more information, go to "Attachment Interfaces" on page 27.

To promote interoperability, the 3584 Tape Library also uses the Ethernet 10/100 interface, and supports two types of transmission control protocol/Internet protocol (TCP/IP): the Simple Network Management Protocol (SNMP) and the Hyper Text Transfer Protocol (HTTP) web user interface for library management. For more information, go to "SNMP Messaging" on page 32 and "Web Interface" on page 53.

In addition to moving cartridges to various locations, the library's optimized dual-gripper transport mechanism promotes failover protection by housing two grippers. If one gripper fails, the other gripper provides failover by taking control and continuing to process the cartridge. For libraries that mix drive types, the optimized dual gripper can house both Ultrium and 3592 Tape Cartridges.

The 3584 Tape Library offers an optional second cartridge accessor. When a library is installed with a second accessor, cartridge mount performance is optimized and the library's availability is enhanced because it can operate without disruption should any component of an accessor fail. The second accessor includes a D23, D22, D52, or D53 frame as service bay B and requires that you order a 3584 Tape Library high-availability (HA1) frame, known as service bay A. To use dual accessors and service bays, the 3584 Tape Library must be installed with the Advanced Library Management System (ALMS). For more information, go to "Dual Accessors and Service Bays" on page 7 and "Advanced Library Management System" on page 42.

Except for D42 frames that contain Digital Linear Tape (DLT) drives, the library's firmware is downward compatible with existing frames of the 3584 Tape Library.

**Related concepts**

"Attachment Interfaces" on page 27
This section describes the types of interfaces that are available with the 3584 Tape Library.

"SNMP Messaging" on page 32
This section describes the Simple Network Management Protocol (SNMP), which allows the 3584 Tape Library to send alerts about problems over a LAN network to a monitoring server.

"Web Interface" on page 53
This section gives basic information about the IBM System Storage Tape Library Specialist, the web interface for the 3584 Tape Library.

"Advanced Library Management System" on page 42
This section gives an overview of the Advanced Library Management System (ALMS), which virtualizes the locations of cartridges in the 3584 Tape Library. Logical libraries can then consist of unique drives and ranges of volume serial numbers instead of fixed locations.

"Dual Accessors and Service Bays" on page 7

"LTO Ultrium Tape Drives" on page 12

"3592 Tape Drives" on page 15

"Supported Tape Cartridges" on page 21
This section gives information about the tape cartridges that you can use in the 3584 Tape Library.

"Fibre Channel Interface" on page 28

"SCSI Interface" on page 28

## Structure of Library

This section defines base and expansion frames, and describes the models of the 3584 Tape Library.

The basic 3584 Tape Library is a single storage unit known as the *base frame* (Models L32, L52, or L53 for LTO Ultrium Tape Drives, or Models L22 or L23 for 3592 Tape Drives). The library's scalability allows you to increase capacity by adding up to fifteen additional storage units, called *expansion frames*. The frames

join end to end, with the base frame on the left and the expansion frame on the right. The additional expansion frames are supported by a common cartridge accessor that requires no pass-through mechanism. Each frame may contain up to twelve Ultrium Tape Drives or 3592 Tape Drives, but may not contain a mix of both.

The 3584 Tape Library features an optional second cartridge accessor. If you order dual accessors, two frames that are used as *service bays* are required. Service bay A is known as Model HA1 and service bay B is a Model D23, D22, D52, or D53 frame. For more information, see "Dual Accessors and Service Bays" on page 7

For bulk media handling, the TS3500 Tape Library supports four I/O stations in newly purchased Models D23 and D53 frames. The D-frame with I/O installed is comprised of four independently accessible I/O station doors with a total of 64 slots (16 in each I/O station door). Additionally, two LED indicators are provided for each I/O Station in a D-frame in order to indicate if the I/O Station is empty or full and if the I/O Station door is locked or unlocked. This plant feature reduces the frame storage slot capacity by 160 for a Model D23 and by 176 for a Model D53. The I/O stations increase the maximum library I/O slot capacity from 32 to 224. The multiple I/O stations can double the maximum insert/eject throughput since both accessors can be used. The D23 and D53 Models remain compatible with existing Models L22, L32, L52, D22, D32, and D52.

The models of the 3584 Tape Library vary, depending on the type of drives that they contain and whether the frame is a service bay, base frame, or expansion frame. The following is a description of each frame:

**Model L22 or L23**
: A base frame that uses up to twelve 3592 Tape Drives and up to 260 IBM TotalStorage 3592 Enterprise Tape Cartridges. Models L22 and L23 are approximately 307 mm (12 in.) shorter in depth than Model L32. Model L23 is equipped with the enhanced frame control assembly power structure.

**Model D22**
: An expansion frame that uses up to twelve 3592 Tape Drives and up to 400 IBM TotalStorage 3592 Enterprise Tape Cartridges. These frames can optionally be configured as service bay B. Models D22 is approximately 307 mm (12 in.) shorter in depth than Model D32.

**Model D23**
: An expansion frame that optionally includes the Enhanced Frame Control Assembly and optionally offers four I/O stations. The Model D23 uses up to twelve 3592 Tape Drives and up to 400 IBM TotalStorage 3592 Enterprise Tape Cartridges. If not equipped with four I/O stations, this frame can optionally be configured as service bay B. The Model D23 is approximately 307 mm (12 in.) shorter in depth than Model D32. It is optionally equipped with the enhanced frame control assembly power structure.

**Model L32**
: A base frame that uses up to twelve Ultrium Tape Drives and up to 281 IBM LTO Ultrium Tape Cartridges. The Model L32 is approximately 307 mm (12 in.) longer in depth than Model L52.

**Model D32**
: An expansion frame that uses up to twelve Ultrium Tape Drives and up to 440 IBM LTO Ultrium Tape Cartridges. The Model D32 is approximately 307 mm (12 in.) longer in depth than Model D52.

**Model L52 or L53**

A base frame that uses up to twelve Ultrium Tape Drives and up to 287 IBM LTO Ultrium Tape Cartridges. Models L52 and L53 are approximately 307 mm (12 in.) shorter in depth than Model L32. Model L53 is equipped with the enhanced frame control assembly power structure.

**Model D52**

An expansion frame that uses up to twelve Ultrium Tape Drives and up to 440 IBM LTO Ultrium Tape Cartridges. These frames can optionally be configured as service bay B. Model D52 is approximately 307 mm (12 in.) shorter in depth than Model D32.

**Model D53**

An expansion frame that uses up to twelve Ultrium Tape Drives and up to 440 IBM LTO Ultrium Tape Cartridges. Model D53 optionally offers four I/O stations. If not equipped with four I/O stations, this frame can optionally be configured as service bay B. Model D53 is approximately 307 mm (12 in.) shorter in depth than Model D32. Model D53 is optionally equipped with the enhanced frame control assembly power structure.

**Model HA1**

Required when you order the optional second accessor, a frame that is used as a service bay and that contains no tape drives or data cartridge capacity. Model HA1 contains only slots for diagnostic cartridges. This frame is always configured as service bay A. The Model HA1 is approximately 307 mm (12 in.) shorter in depth than Models L32 and D32.

Models L22, D22, L23, D23, L52, D52, L53, and D53 are compatible with Models L32 and D32, but will require additional features because they use different side and rear covers. If you change from a Model L32 or D32 to a Model D22, D23, D52, or D53 (or from a Model D22, D23, D52, or D53 to a Model L32 or D32) within the same library you may also need the appropriate side covers. If you have a Model D42, it must be removed or converted to a Model D32 before you can add a Model D22, D23, D52, or D53.

The IBM System Storage Tape Library Specialist web interface and 10/100 Ethernet support are included with Models L22, L23, L52, and L53. For Model L32, they are available as feature codes 1662 and 1660, respectively.

Figure 3 on page 6 shows examples of a base and an expansion frame.

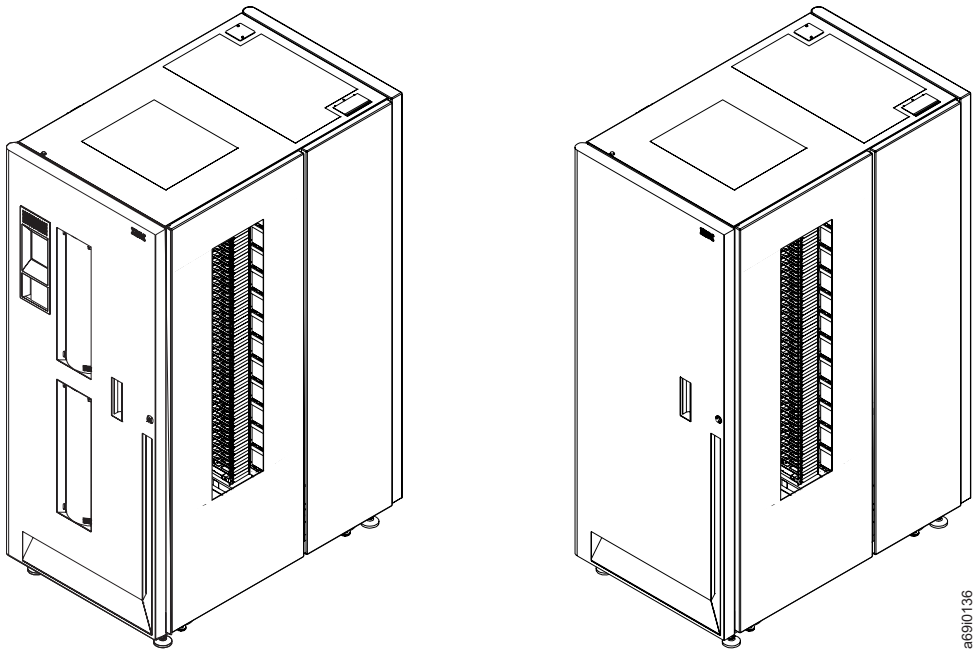



*Figure 3. Frames in the IBM System Storage TS3500 Tape Library.* A Model L22 or L52 (the base frame) is on the left. A Model D22 or D52 (the expansion frame) is on the right and attaches to the base frame. Models L23, D23, L32, D32, L53, and D53 are not shown. Models L22, D22, L23, and D23 house 3592 Tape Cartridges; Models L32, D32, L52, D52, L53, and D53 house LTO Ultrium Tape Cartridges.

**Related concepts**

"Supported Tape Drives" on page 12
This section introduces the types of drives that can be installed in the 3584 Tape Library.

"Web Interface" on page 53
This section gives basic information about the IBM System Storage Tape Library Specialist, the web interface for the 3584 Tape Library.

"Dual Accessors and Service Bays" on page 7

**Related reference**

"Mixing Drives in Frames" on page 33
This section contains a matrix of the drives that are compatible in a physical frame (model) of the 3584 Tape Library.

"Mixing Drives in a Logical Library" on page 34
This section contains information about drives that are compatible in a logical library of the 3584 Tape Library.

"Mixing Media in Drives" on page 35
This section contains information about compatible media and drives in the 3584 Tape Library.

## Dual Accessors and Service Bays

When an optional second accessor is installed, the 3584 Tape Library features enhanced availability through its ability to use that accessor and to operate without disruption when any component of the working accessor fails.

**Note:** To use dual accessors and service bays, the 3584 Tape Library must be installed with the Advanced Library Management System (ALMS). For additional information, see "Advanced Library Management System" on page 42.

If the library is installed with the optional second accessor, cartridge mount performance is also optimized. (A *mount* occurs when the accessor removes a cartridge from a drive, returns it to its storage slot, collects another cartridge from a random storage slot, moves it to and loads it into the drive.) The second accessor is part of feature code 1440 (Service Bay B Configuration), which also includes a D23, D22, D52, or D53 frame as service bay B. If you order a second accessor you must also order a 3584 high availability (HA1) frame, which is also known as service bay A. For information about library availability and performance, see "Library Performance" on page 68.

As you view the library from the front, service bay A is on the far left and service bay B is on the far right. Figure 4 shows the location of service bays in the 3584 Tape Library.

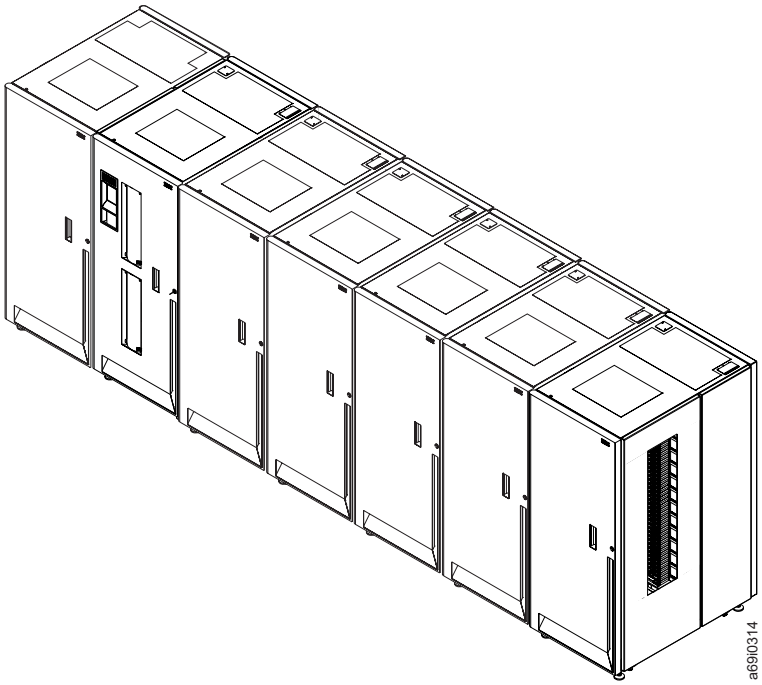



*Figure 4. Location of service bays in the 3584 Tape Library.* Service bay A (the HA1 frame) is on the far left. Service bay B (the D23, D22, D52, or D53 frame) is on the far right and contains the second accessor.

When dual accessors are installed and an attached host issues a command for cartridge movement, the library automatically determines which accessor can perform the mount in the most timely manner. If the library's primary accessor fails, the second accessor assumes control and eliminates system outage or the need for operator intervention.

Although the library uses defaults to specify the zones (areas) in which the accessors operate, you can specify particular zones by using the Tape Library Specialist web interface. This process is called setting the preferred zone. For details, see the section about setting the preferred zone in the *IBM System Storage TS3500 Tape Library Operator Guide*.

Service bay A (the HA1 frame) contains only gripper test slots ( **1** in Figure 5) for diagnostic cartridges. Service bay B contains gripper test slots **2** for diagnostic cartridges, and also contains unusable storage slots **3** . The storage slots in service bay B are not used if the frame is configured as a service bay.

Each service bay contains gripper test slots for three Ultrium diagnostic cartridges and three 3592 diagnostic cartridges. Place only diagnostic cartridges in the gripper test slots; do not place data or cleaning cartridges in them. Figure 5 shows the location of slots in the service bays.

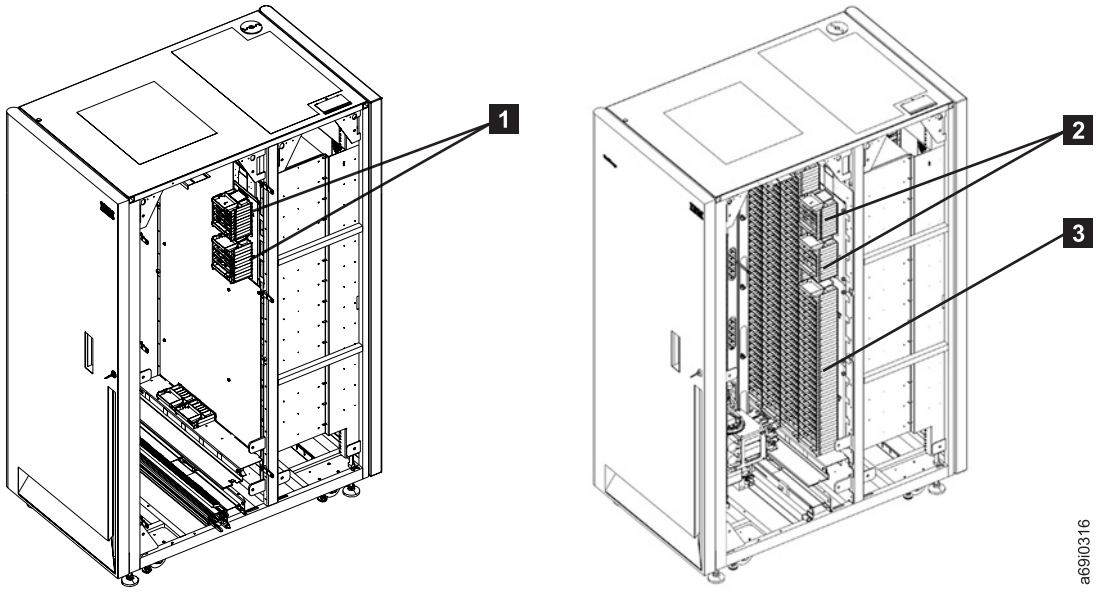



*Figure 5. Cartridge slots in the service bays of the 3584 Tape Library.* Service bay A (the HA1 frame) is on the left and contains only gripper test slots for diagnostic cartridges. Service bay B (the D23, D22, D52, or D53 frame) is on the right and contains both gripper test slots for diagnostic cartridges and unusable storage slots.

If you already have an installed 3584 Tape Library and you want to add a second accessor, your IBM Service Representative can add the accessor and its service bays. Converting from a single accessor to a dual accessor library requires that the Service Representative take down the entire library.

Should your library already contain the service bays and you decide to add one or more D23, D22, D52, or D53 expansion frames, your IBM Service Representative can convert service bay B to an expansion frame, add the new frame or frames to the right, and convert the last frame on the right to service bay B. This process requires no scheduled downtime (*downtime* is designed to be less than one hour). To convert the existing service bay to an expansion frame, the Service Representative will remove the test slots and replace them with storage slots. Similarly, to convert a D23, D22, D52, or D53 frame to a service bay, the Service Representative removes specific storage slots and replaces them with the test slots.

For more information, contact your IBM Service Representative.

**Related concepts**

"Advanced Library Management System" on page 42
This section gives an overview of the Advanced Library Management System (ALMS), which virtualizes the locations of cartridges in the 3584 Tape Library. Logical libraries can then consist of unique drives and ranges of volume serial numbers instead of fixed locations.

"Library Performance" on page 68
This section explains how performance values such as cartridge inventory times, mount performance, and cartridge move time were obtained for the 3584 Tape Library.

## Components of the Library

This section shows and describes the major parts of the 3584 Tape Library.

The 3584 Tape Library consists of the major components shown in Figure 6 on page 11 (the figure depicts Model L52). For a more complete description of each component, see the appropriate sections in the *IBM System Storage TS3500 Tape Library Operator Guide*.

**1 Library frames**
The base frame (Models L53, L52, or L32 for Ultrium Tape Drives, and Models L23 or L22 for 3592 Tape Drives) and the expansion frame (Models D53, D52, or Model D32 for Ultrium Tape Drives, and Models D23 or D22 for 3592 Tape Drives). Each frame contains a rail system, cartridge storage slots, and up to 12 tape drives.

**2 Rail system**
The assembly on which the cartridge accessor moves through the library. The system includes the top and bottom rails.

**3 Cartridge accessor with optimized dual-gripper transport mechanism**
The assembly that moves tape cartridges between storage slots, tape drives, and the I/O stations. An optional second accessor is available with two service bays.

**4 Accessor controller**
A circuit board that facilitates all accessor motion requests (such as calibrations, moves, and inventory updates). If your library includes a second accessor, it will also have a second accessor controller.

**5 Cartridge storage slots**
Cells that are mounted in the 3584 Tape Library and used to store tape cartridges.

**6 IBM LTO Ultrium Tape Drives or 3592 Tape Drives**
Mounted in the 3584 Tape Library, one or more units that read and write data that is stored on tape cartridges. IBM LTO Ultrium Tape Drives and 3592 Tape Drives may not be mixed in the same frame. IBM Ultrium Tape Drives use LTO Ultrium Tape Cartridges; 3592 Tape Drives use IBM TotalStorage 3592 Enterprise Tape Cartridges.

**7 Front door**
The front door of any frame. When you order the Capacity Expansion Feature for the Model L22, L32, or L52, the storage slots inside the front door become enabled and can increase the tape library's capacity.

**8 Door safety switch**
A device in each frame that shuts down the motion power to the cartridge accessor whenever the front door is opened.

**9 I/O stations**
Up to two cartridge compartments on the front door of the 3584 Tape Library that allow you to insert or remove tape cartridges without the library performing a reinventory of the frame.

**10 Operator panel and operator panel controller**
Located on the front of the base frame, the operator panel is the set of indicators and controls that lets you perform operations and determine the status of the library. The panel consists of the library power switch, a power-on indicator, a touchscreen liquid crystal display (LCD), and the controller for the I/O stations. The operator panel controller is a circuit board that facilitates communication between the operator panel and the accessor controller.

**11 Frame control assembly (FCA)**
An assembly of components that facilitates RS-422 communication between the set of drives within the frame and the accessor controller and operator panel controller. The FCA includes separate power supplies for the library and each tape drive in a frame.

**12 Enhanced frame control assembly**
Like the FCA, components that facilitate RS-422 communication between the drives in a frame and the accessor controller and operator panel controller. Only Models L23, D23, L53, and D53 are equipped with the enhanced frame control assembly, which includes two power supplies, both of which can provide power to the library and all drives in a frame.

**13 Patch panel**
A panel that houses the cable connections for the drives that use Fibre Channel interfaces.

**14 Power cable hole**
An optional, capped opening for a library whose power cable attaches to an outlet mounted above the library.

**15 Fibre Channel cable hole**
An optional, capped opening for a library whose Fibre Channel cables are routed above the library.

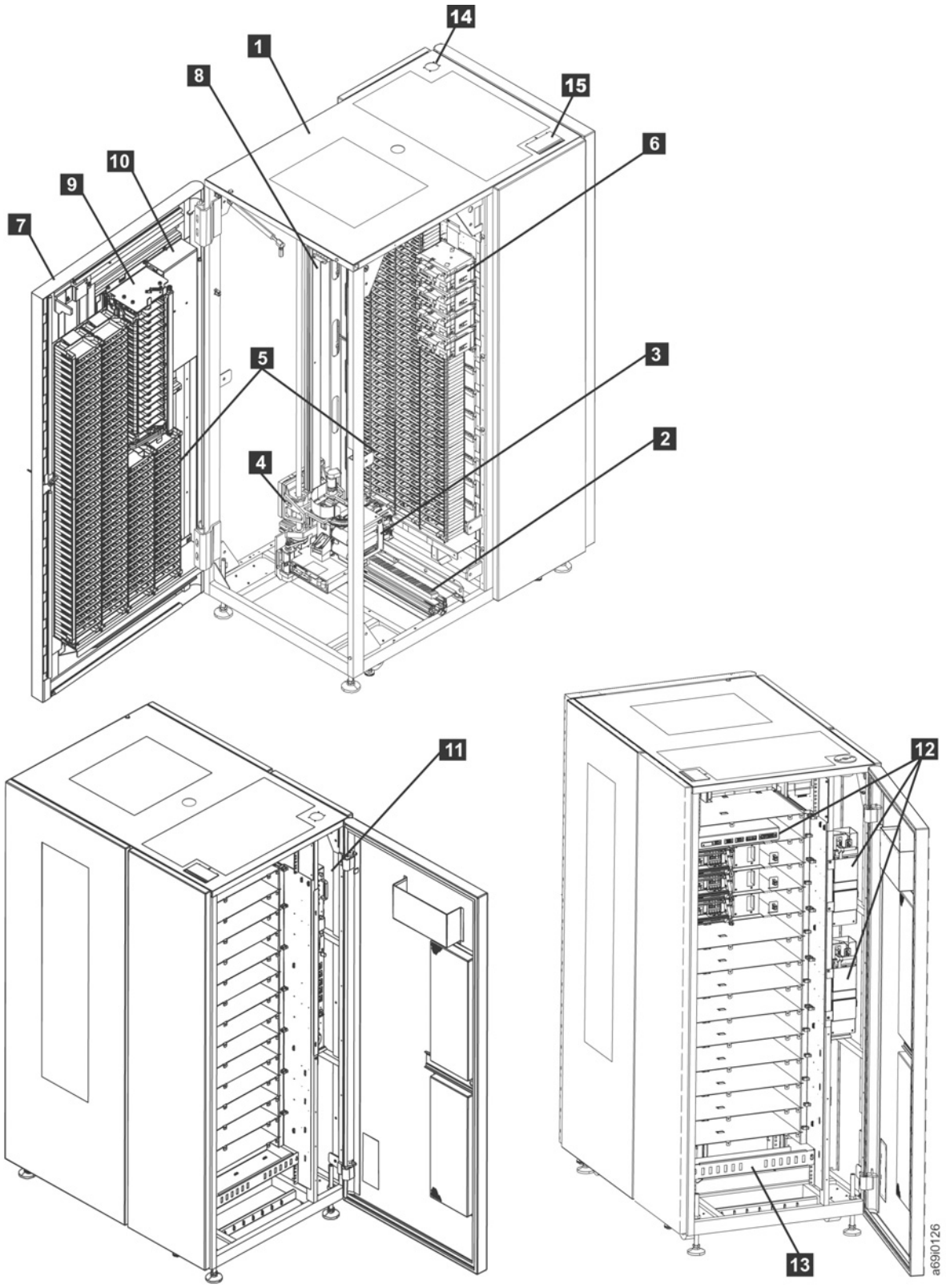



*Figure 6. Components of the IBM System Storage TS3500 Tape Library.* The front of a Model L52 is show at the top. The bottom part of the graphic shows the rear of Models L52 (at left) and L53 (at right).

## Supported Tape Drives

This section introduces the types of drives that can be installed in the 3584 Tape Library.

The LTO Ultrium Tape Drives and the 3592 Tape Drives are high-performance, high-capacity data-storage units that can be installed in the 3584 Tape Library. Up to 12 drives may be installed in each frame of the library, but the two types of drives may not be mixed in the same frame. You can identify a drive by examining the logo at its front or by inspecting the label at the rear of the drive's canister.

**Note:** The features and functions of this release are not supported by frames that contain Digital Linear Tape (DLT) drives (called *DLT libraries*). A DLT library can be upgraded to a library that uses all Ultrium Tape Cartridges or a mix of Ultrium and 3592 tape cartridges by converting the D42 frames to D32 frames, or by removing all D42 frames. When this is done, this release will be supported on the 3584 Tape Library. Most field upgrades will require new library firmware that supports all current features of the 3584 Tape Library, except for DLT drives and media.

You or your IBM Service Representative can update firmware for the LTO Ultrium 2 Tape Drive, Ultrium 3 Tape Drives, Ultrium 4 Tape Drives, the 3592 J1A, and the TS1120 Tape Drive without scheduling downtime. This enhancement is called a *nondisruptive drive firmware update*. It is available through the IBM System Storage Tape Library Specialist web interface and (for IBM Service Representatives) through CETool, but is not supported by the SCSI interface. For more information, go to the section about updating drive firmware in the *IBM System Storage TS3500 Tape Library Operator Guide*.

### LTO Ultrium Tape Drives

The new IBM System Storage TS1040 Tape Drive Model F4A is a Linear Tape-Open (LTO) tape drive that facilitates 4 Gbps Fibre Channel connectivity. Like its predecessors, the IBM System Storage TS1030 Tape Drive Models F3A (which facilitates 2 Gbps Fibre Channel connectivity), and F3B (which facilitates 4 Gbps Fibre Channel connectivity), the drive is also commonly called the Ultrium 4 Tape Drive and is differentiated by its model number.

You can identify Ultrium 4 Tape Drives (Model F4A), Ultrium 3 Tape Drives (Models F3A or F3B), or the Ultrium 2 Tape Drive by the logo at the front of the drive or by the label at the rear of the drive's canister. You can identify the Ultrium 1 Tape Drive by the label at the rear of its canister. An Ultrium 3 WORM-capable drive can be identified by the level of code it contains. If the code level is 54K1 or higher, the Ultrium 3 drive is capable of WORM functionality. Ultrium 3 or Ultrium 4 Tape Drives with WORM capability can recognize WORM-compatible media.

An Ultrium 3 or Ultrium 4 Tape Drive, both with and without WORM-capable firmware, reads and writes non-WORM media. This means that you can load WORM-capable firmware on your Ultrium 3 or Ultrium 4 Tape Drives and use any media that is supported by LTO Ultrium 3 or Ultrium 4 Tape Drives. In this case, only the data that is written on the WORM media is treated as WORM data; data written on other types of media can be overwritten.

Ultrium Tape Drives do not read or write to 3592 Tape Cartridges, and 3592 Tape Drives do not read or write to Ultrium Tape Cartridges.

The 3584 Tape Library supports Ultrium 3 and Ultrium 4 Tape Drives and Ultrium 3 and Ultrium 4 tape cartridges in newly purchased L52, D52, L53, and D53 frames, as well as in installed L32, D32, L52, and D52 frames.

Table 4 gives cartridge compatibility for the Ultrium Tape Drive s.

*Table 4. Cartridges that are compatible with Ultrium Tape Drives*

| Cartridge | Ultrium 4 Tape Drives | Ultrium 3 Tape Drives | Ultrium 2 Tape Drive | Ultrium 1 Tape Drive |
|---|---|---|---|---|
| IBM System Storage 800 GB LTO Data Cartridge (xxxxxxL4) | Y | N | N[1] | N[1] |
| IBM System Storage 800 GB LTO WORM Data Cartridge (xxxxxxLU) | Y | Y | N[1] | N[1] |
| IBM System Storage 400 GB LTO Data Cartridge (xxxxxxL3) | Y | Y | N[1] | N[1] |
| IBM System Storage 400 GB LTO WORM Data Cartridge (xxxxxxLT) | Y | Y | N[1] | N[1] |
| IBM System Storage 200 GB LTO Data Cartridge (xxxxxxL2) | Y[2] | Y | Y | N[1] |
| IBM System Storage 100 GB Data Cartridge (xxxxxxL1) | N | Y[2] | Y | Y |
| IBM System Storage Universal LTO Cleaning Cartridge (universal, CLNUxxL1) | Y | Y | Y | Y[3] |
| LTO Ultrium Cleaning Cartridge (IBM only, CLNIxxL1) | Y | Y | Y | Y |

**Notes:**

- Y = supported.
- N = unsupported.

1. The library rejects any command to move unsupported media to a drive and returns a sense key of 5 and an additional sense code/additional sense code qualifier of 30/00.
2. Supported for read-only.
3. Requires drive firmware level 25D4 or higher.

The Ultrium Tape Drives can read tapes that have been written by non-IBM Ultrium drives. They also write to tapes that can be read by non-IBM Ultrium drives.

Ultrium 1, Ultrium 2, Ultrium 3, or Ultrium 4 Tape Drives and cartridges can reside in the same frame.

When a cartridge is labeled according to proper IBM bar code label specifications, the last character of its volume serial (VOLSER) number indicates the generation of the media. For example, a cartridge with a VOLSER of 000764**L4** is an Ultrium 4 cartridge; a cartridge with a VOLSER of 000764**L3** is an Ultrium 3 cartridge; a cartridge with a VOLSER of 003995**L2** is an Ultrium 2 cartridge.

To enhance library performance, Ultrium 2, Ultrium 3, and Ultrium 4 Tape Drives include speed matching, channel calibration, and power management. Speed matching dynamically adjusts the drive's native (uncompressed) data rate to the slower data rate of a server. Channel calibration customizes each read/write data channel for optimum performance. The customization enables compensation for

variations in the recording channel transfer function, media characteristics, and read/write head characteristics. Power management reduces the drive's power consumption during idle power periods.

**Encryption**

Ultrium 4 tape drives are encryption-capable, which means they can convert data into a cipher that ensures data security. To perform encryption, the drive must be made encryption-enabled by your selection of one of three methods of encryption management. Two of these methods, system-managed and library-managed encryption, require the purchase of FC 1604 (Transparent LTO Encryption). A key is required to encrypt and decrypt the data. How a key is generated, maintained, controlled, and transmitted depends on the operating environment where the TS1040 (Ultrium 4) or TS1120 Tape Drive is installed. Some applications are capable of performing key management. In their absence IBM provides an Encryption Key Manager (EKM) that works in conjunction with the keystore of your choice to perform all necessary key management tasks. There is no recovery for lost encryption keys. For more information about encryption, see Chapter 8, "Tape Encryption Overview," on page 183. Also refer to the *IBM Encryption Key Manager component for the Java platform Introduction, Planning, and User's Guide*. To choose a method of encryption management, see the section about setting a drive's method of encryption in the *IBM System Storage TS3500 Tape Library Operator Guide*.

The following table gives specifications for the Ultrium 3 and Ultrium 4 Tape Drives.

*Table 5. Specifications for the IBM System Storage 3588 Tape Drive Model F3A, F3B, and the IBM System Storage TS1040 Tape Drives Model F4A Ultrium 4 Tape Drives*

| **Specifications for the IBM System Storage 3588 Tape Drive Model F3A, the IBM System Storage TS1030 Tape Drive Model F3B, and the IBM System Storage TS1040 Tape Drive Model F4A** | |
|---|---|
| **Specification** | **Value** |
| Height | 93 mm (3.7 in.) |
| Width | 210 mm (8.3 in.) overall |
| Depth | 458 mm (18.0 in.) |
| Weight | 5.7 kg (12.6 lbs) |
| Heat output | 49 watts (0.17 kBTU/hr) |
| Power requirements (see Note) | 5.0 A @ 5 V dc and 2.0 A @ 12 V dc (maximum) |
| **Note:** dc voltages are provided by power supplies in the tape library. | |

**Related concepts**

"Ultrium Bar Code Label" on page 122
This section describes the appearance and specifications of the Ultrium bar code label.

**Related reference**

"Mixing Drives in Frames" on page 33
This section contains a matrix of the drives that are compatible in a physical frame (model) of the 3584 Tape Library.

"Mixing Drives in a Logical Library" on page 34
This section contains information about drives that are compatible in a logical library of the 3584 Tape Library.

"Mixing Media in Drives" on page 35
This section contains information about compatible media and drives in the 3584 Tape Library.

## 3592 Tape Drives

Data encryption is a new feature offered by the TS1120 Tape Drive. You can order the drive with encryption capability or upgrade a Model E05 canister to include encryption capability. Any TS1120 Tape Drive, whether encryption capable, may be installed with the 3592 J1A Tape Drive in Models L22, D22, L23 and D23. For information about encryption-capable drives and media, encryption enablement, and encryption-key management, see Chapter 8, "Tape Encryption Overview," on page 183.

For minimal upgrade disruption, the features and behaviors of the TS1120 Tape Drive closely resemble those of the 3592 J1A Tape Drive. The TS1120 Tape Drive has dual-port, 4 Gbps, native switch fabric Fibre Channel interfaces, while the 3592 J1A Tape Drive offers the same but at a 2 Gbps rate. These features offer flexibility in an Open Systems environment because the drives can directly attach to Open Systems servers with Fibre Channel attachments.

Both drives include an RS-422 library interface port for communication with the 3584 Tape Library. Both use the Statistical Analysis and Reporting System (SARS) to isolate failures between media and hardware. Like the 3592 J1A Tape Drive, the TS1120 Tape Drive has a service panel port for use by an IBM Service Representative.

A 3592 Tape Drive cannot read or write to a High Performance Cartridge Tape (media type J) or to an Extended High Performance Cartridge Tape (media type K).

Table 6 shows the basic features of both the TS1120 Tape Drive and the 3592 J1A Tape Drive.

*Table 6. Features of the 3592 Tape Drives*

| Feature | 3592 Tape Drives | |
|---|---|---|
| | **TS1120 Tape Drive** | **Model J1A** |
| Native sustained data rate | 100 MB/s (using Model E05 format) | 40 MB/s (using Model J1A format) |
| | 50 MB/s (using Model J1A format) | |
| Compressed sustained data rate | 200 MB/s (using Model E05 format) | 80 MB/s (using Model J1A format) |
| | 100 MB/s (using Model J1A format) | |
| Native capacity | 500 GB (using Model E05 format) | 300 GB (using Model J1A format) |
| | 300 GB (using Model J1A format) | |
| Write once, read many (WORM) capability | Yes | Yes |
| Capacity scaling and short cartridge | Yes | Yes |
| Read/write capability | If encryption-enabled, reads and writes Model E05 encrypted format | Cannot read or write to Model E05 encrypted format |
| | Reads and writes Model E05 format | Cannot read or write to Model E05 format |
| | Reads and writes Model J1A format | Reads and writes Model J1A format |
| Host (server) attachment | Supports dual-port, 4 Gbps Fibre Channel interface | Supports dual-port, 2 Gbps Fibre Channel interface |
| | Maximum interface burst transfer rate of 400 MB/s | Maximum interface burst transfer rate of 200 MB/s |
| | Supports N and L ports with autoconfigure | Supports N and L ports with autoconfigure |
| Encryption | With feature code 9592 or 5592 | Not supported |

The following additional features of the 3592 J1A Tape Drive help to improve performance, capacity, and availability:

- N+1 power supplies when installed in the 3584 frame
- Large 128-MB internal data buffer
- Digital speed matching to adjust the drive's native data rate to the net host data rate (after data compressibility has been factored out) throughput performance
- Channel calibration which is designed to allow for customization of each read/write data channel for optimum performance
- High resolution tape directory plus enhanced search speed to improve nominal and average access times

- Streaming Lossless Data Compression (SLDC) algorithm which is designed to offer an improvement over previous IBM lossless compression algorithms

The TS1120 Tape Drive offers all of the preceding features of the 3592 J1A Tape Drive, plus the following. For additional information, see Chapter 5, "Using 3592 Tape Drive Media," on page 143.

**Media reuse**

The TS1120 Tape Drive and the 3592 J1A Tape Drive can reuse different types of tape and multiple densities (logical formats) across various drive generations. Certain models may only support a subset of densities (such as the 3592 J1A Tape Drive, which can only read and write at a single density), while others (such as the TS1120 Tape Drive) can read and write at multiple densities.

The TS1120 Tape Drive reads and writes at 512 tracks and 8 channels (J1A emulation mode) on the JA, JR, JJ, and JW media types. The JB and JX media types can only be written and read at a density of 896 tracks and 16 channels (TS1120 native mode). 3592 J1A emulation is not supported on the JB and JX media. These logical formats can be divided into multiple sub-format options, such as segmentation and capacity scaling. For more information, go to the section about capacity scaling and segmentation or refer to the*IBM System Storage TS1120 Tape Drive and Controller Introduction and Planning Guide*.

**Speed matching**

When operating in a host environment where the net host data rate is less than the maximum drive native data rate, the TS1120 Tape Drive automatically performs dynamic speed matching to minimize backhitches. Dynamic speed matching adjusts the native data rate of the drive as closely as possible to the net host data rate (after data compressibility has been factored out). A reduction in backhitches improves system performance.

**High resolution tape directory (HRTD)**

Located in the TS1120 Tape Drive, this directory structure allows the drive to have fast and consistent nominal and average access times for Locate operations.

**Channel calibration and on-the-fly adaptive equalization**

To gain optimum performance, channel calibration allows the drive to automatically customize each read and write data channel. The customization compensates for variations in the recording channel transfer function, for media characteristics, and for read and write head characteristics. Initial calibration settings are calculated and stored at the time of manufacture. For optimum error rate performance, the TS1120 Tape Drive also uses on-the-fly adaptive equalization hardware on an ongoing basis to adjust the read equalization response.

**Recursive accumulating backhitchless flush**

The TS1120 Tape Drive uses an algorithm known as recursive accumulating backhitchless flush (or non-volatile caching) to increase effective data rate performance from host servers that force explicit Synchronize operations during Write operations.

**Backhitchless backspace**

Backhitchless backspacing enables some backspace operations to be virtualized without physical backhitching. If you write and overwrite multiple trailer labels, this firmware feature provides major performance

improvements. For more information, refer to the appendix about WORM behavior in the *IBM System Storage TS1120 Tape Drive SCSI Reference*.

**Capacity scaling**

If you want to exchange capacity for improved access times, the TS1120 Tape Drive supports multiple format options, such as scaling and segmentation modes. The TS1120 Tape Drive can sense and report the scaling state of current medium by using the SCSI Mode Sense command and specifying Mode Page X'23'. Capacity scaling is only offered on the JA and JB media types. For the exact Mode Select commands and settings necessary to invoke scaling, refer to the *IBM System Storage TS3500 Tape Library SCSI Reference*.

**WORM**

The TS1120 Tape Drive supports write once, read many (WORM) behaviors and format attributes that are identical to the 3592 J1A Tape Drive, but the support is extended into the WORM logical format of the TS1120 Tape Drive, as well as continuing the support for the WORM logical format of the 3592 J1A Tape Drive. Three WORM cartridge types are supported: JW (full length), JR (short length), and (for TS1120) JX Extended WORM cartridge. WORM cartridges are factory-formatted as WORM cartridges and may not be converted to data cartridges. Both 3592 Tape Drives allow append operations to data already on WORM cartridges, but do not allow data to be overwritten under any circumstances.

**Capacity-based and position-based LEOT reporting**

The TS1120 Tape Drive uses enhanced logic to report logical end-of-tape (LEOT) data. The drive reports LEOT based on a combination of indicators of capacity-based LEOT and position-based LEOT. The TS1120 Tape Drive monitors the total accumulated physical tape files written to the cartridge and reports the LEOT based on the capacity-based LEOT value, rather than reporting LEOT based on the physical position on the tape (position-based LEOT). To summarize, this technique reports LEOT based on the amount of compressed data that is recorded to the cartridge and reduces the variation in the amount of data recorded before LEOT is issued. For applications that use LEOT to stop the write process, a more consistent capacity is recorded to the media. For a higher percentage of the time, this process allows tape copies to complete without overflow.

**Enhanced format for recording error-correction codes (ECCs)**

The logical format of the TS1120 Tape Drive offers improved error-correction-code capabilities over the 3592 J1A and LTO formats by increasing the power of one of the two orthogonal Reed-Solomon ECCs that protect the data on tape. The correction power of the inner code is approximately doubled from that of the 3592 J1A and thus offers superior reliability of the data.

**Drive mechanical and electrical reliability**

The mechanism of the TS1120 Tape Drive is specified at a mean-cycles-between-failure rate of 300,000 cycles, which is the highest reliability rating in the industry. The mechanism contains special mechanical and electrical features to prevent damage to the media on power-down or reset and to prevent the dropping of the leader pin or other thread failures during similar interruptions. It also tolerates extremely high vibration and shock environments without data loss or degraded operation.

**Multiple subsystem and automation support**

The TS1120 Tape Drive and its cartridge support multiple automation

libraries and can be easily transported between environments. The TS1120 Tape Drive supports all automation systems that are supported by the 3592 J1A Tape Drive at identical drive-packaging densities.

**Data compression**

The TS1120 Tape Drive uses the data-compression method known as streaming lossless data compression (SLDC) algorithm. The method is identical to one used by the 3592 J1A Tape Drive, although the compression logic for the TS1120 Tape Drive operates at more than twice the overall transfer rates of the 3592 J1A Tape Drive.

**512 MB data buffer with read ahead feature**

The TS1120 Tape Drive includes a data buffer of 512 MB. Along with enabling performance characteristics in buffered Write and Read commands, the data buffer also supports a Read Ahead feature. When the drive processes a command to locate or read a block, the drive automatically continues to stream down the tape and read ahead until the data buffer is full. This allows subsequent Locate or Read commands to be fulfilled from the data buffer at silicon speeds, rather than requiring access to the tape.

**Offboard data string searching**

The TS1120 Tape Drive can search the data content of host server records for string matches. The function is called *offboard data string searching* because the data search workload can be performed offboard from the host. The drive can perform a search at the maximum data rate (100 MB/s), which greatly reduces the amount of data transfer and host search times.

**Encryption**

With IBM feature code 9592 or 5592, TS1120 Tape Drives are encryption-capable, which means they can convert data into a cipher that ensures data security. To perform encryption, the drive must be made encryption-enabled by your selection of one of three methods of encryption management. A key is required to encrypt and decrypt the data. How a key is generated, maintained, controlled, and transmitted depends on the operating environment where the TS1120 Tape Drive is installed. Some applications are capable of performing key management. In their absence IBM provides an Encryption Key Manager (EKM) that works in conjunction with the keystore of your choice to perform all necessary key management tasks. There is no recovery for lost encryption keys.

The LTO Ultrium 4 Tape Drive also supports data encryption on the base drive with Ultrium 4 media, which meets LTO consortium specifications and Application Managed Encryption (see "LTO Ultrium Tape Drives" on page 12).

For more information about encryption, see Chapter 8, "Tape Encryption Overview," on page 183. Also refer to the *IBM Encryption Key Manager component for the Java platform Introduction, Planning, and User's Guide*. To choose a method of encryption management, see the section about setting a drive's method of encryption in the *IBM System Storage TS3500 Tape Library Operator Guide*.

Firmware for the TS1120 Tape Drive will not work in the 3592 J1A Tape Drive, and firmware for the 3592 J1A Tape Drive will not work in the TS1120 Tape Drive.

The 3592 Tape Drive supports four types of the IBM TotalStorage 3592 Enterprise Tape Cartridge. For more information about the supported cartridges, see “Mixing Media in Drives” on page 35.

**Related concepts**

“Capacity Scaling and Segmentation” on page 146
This section describes how the 3592 Tape Drives use capacity scaling and segmentation to place data in a designated section of tape to speed access and manage efficient capacity.

Chapter 8, “Tape Encryption Overview,” on page 183

**Related reference**

“Mixing Media in Drives” on page 35
This section contains information about compatible media and drives in the 3584 Tape Library.

**Related information**

Chapter 5, “Using 3592 Tape Drive Media,” on page 143
The section introduces information about the 3592 Tape Drive media.

## Supported Tape Cartridges

This section gives information about the tape cartridges that you can use in the 3584 Tape Library.

In the 3584 Tape Library, frames that are installed with Ultrium Tape Drives use Ultrium Tape Cartridges; frames that are installed with 3592 Tape Drives use 3592 Tape Cartridges. A frame cannot house both Ultrium Tape Drives and 3592 Tape Drives. However, in a library that includes both types of frames, you may insert 3592 Tape Cartridges into the lower I/O station of a Model L53, L52, or L32 frame for transport (by the cartridge accessor) to a Model D23 or D22 frame (your library must contain an I/O station that will accept 3592 Tape Cartridges). Similarly, you may insert Ultrium Tape Cartridges into the lower I/O station of a Model L23 or L22 frame for transport (by the cartridge accessor) to a Model D53, D52, or D32 frame (again, your library must contain an I/O station that will accept Ultrium Tape Cartridges).

Certain restrictions apply to the use of tape cartridges with drives. For additional information about compatibility between cartridges and drives, see "Mixing Media in Drives" on page 35.

Cleaning cartridges are identified by a volume serial (VOLSER) number that begins with a prefix of `CLNI` or `CLNU` for LTO Ultrium Cleaning Cartridges, and `CLN` for 3592 Cleaning Cartridges.

**Related reference**

"Mixing Media in Drives" on page 35
This section contains information about compatible media and drives in the 3584 Tape Library.

**Related information**

Chapter 4, "Using Ultrium Media," on page 115
The section introduces information about Ultrium Tape Media.

Chapter 5, "Using 3592 Tape Drive Media," on page 143
The section introduces information about the 3592 Tape Drive media.

## Compatible Servers and Software

This section identifies ways to determine the servers and software that support the 3584 Tape Library.

The 3584 Tape Library is supported by a wide variety of servers, operating systems, and adapters. These attachments can change throughout the product's life cycle. To determine the latest attachments, or to get a comprehensive list of compatible software, perform one of the following:

- Visit the web:
  - For a list of compatible software, operating systems, and servers for Ultrium Tape Drives, visit the web at `http://www.ibm.com/storage/lto`. Under `IBM System Storage TS3500 Tape Library`, select `Product details`. Under `Learn more`, select `Interoperability matrix` or select `Independent Software Vendor (ISV) matrix for LTO`.
  - For a list of compatible software, operating systems, and servers for TS1120 Tape Drives, visit the web at `http://www.ibm.com/servers/storage/tape/drives`. Under `IBM System Storage TS1120 Tape Drive`, select `Product details`. Under `Learn more`, select `Interoperability matrix` or `Independent Software Vendor (ISV) matrix`.

  - For a list of compatible software, operating systems, and servers for 3592 Tape Drives, visit the web at http://www.ibm.com/servers/storage/tape/drives. Under IBM TotalStorage 3592 Tape Drive, select Product details. Select Resource library. Select Interoperability , then 3592 Tape Drive. Or select Compatibility information, then Independent Software Vendor (ISV) Matrix for 3592 Tape Drive.
- Contact your IBM Sales Representative.

**Notes:**

1. IBM does not provide application software with the 3584 Tape Library. To order software, contact your IBM Sales Representative, IBM Business Partner, or an independent software provider.
2. If you attach your library to a non-IBM platform with non-IBM software, IBM recommends that you contact your software vendor to obtain a matrix of compatible hardware, software, firmware revisions, and adapter cards.

## Supported Device Drivers

This section identifies ways to determine the latest device drivers for the drives and robotics of the 3584 Tape Library.

IBM provides device driver support for the Ultrium Tape Drives, 3592 Tape Drives, and the robotics in the 3584 Tape Library. The device drivers also provide support for application-managed encryption on AIX, Windows, Linux, Solaris, and HP-UX platforms, and for system-managed encryption in Open Systems, on AIX, Windows, Linux, and Solaris platforms.

IBM maintains the latest levels of device drivers and driver documentation on the Internet. To access this material, go to the following URL and select the folder for the platform that you want.

```
ftp://ftp.software.ibm.com/storage/devdrvr/
```

For a complete description of the mtlib program and command syntax, see the *IBM Tape Device Drivers Installation and User's Guide*.

### Using mtlib for Communication

This section describes the mtlib program, which facilitates communication between the 3584 Tape Library and the IBM TotalStorage 3494 Tape Library, the IBM TotalStorage Virtual Tape Server (VTS), or the IBM Virtualization Engine™ TS7700 Series.

The mtlib program is a command-line interface that was originally designed to control the 3494 Tape Library. It comes as part of the 3494 device driver, similar to the way the tapeutil utility comes with the SCSI tape device driver.

The mtlib program provides an interface from the server to a 3494 Tape Library, and also to the virtual tape drives and cartridges within an attached VTS or TS7700 Virtualization Engine.

The mtlib program has recently been enhanced to also work with SCSI tape libraries, such as the 3584 Tape Library installed with only 3592 Tape Drives. Some customers have written mtlib scripts to work with the 3494 Tape Library. If a customer with a 3494 Tape Library decides to migrate to the 3584 Tape Library, this mtlib enhancement will ease the migration.

Existing customer scripts that use the mtlib program require no changes or minor changes, depending on the functions of the 3494 Tape Library that are used. For example, there is no *category* concept in SCSI tape libraries, so that any mtlib command that references categories might need to be changed.

For a complete description of the mtlib program and command syntax, see the *IBM TotalStorage and System Storage Tape Device Drivers Installation and User's Guide*.

## Secure Socket Layer (SSL) Functionality

New with this release, the 3584 Tape Library supports secure socket layer (SSL). SSL is a protocol for transmitting private documents through the Internet. SSL uses a cryptographic system that uses these two keys to encrypt data:

- a public key known to everyone

- a private key known only to the recipient of the message

Many web sites use this protocol to obtain confidential user information, such as credit card numbers. By convention, URLs that require an SSL connection start with https: instead of http:.

The 3584 Tape Library provides the ability to enable or disable SSL for encryption key manager (EKM) or web browser communication. The action is performed using the Tape Library Specialist web specialist.

## IPv6 Functionality

New with this release, the 3584 Tape Library supports internet protocol (IP) addresses in both IPv4 and IPv6 format. IPv6 is designed to allow the Internet to grow steadily, both in terms of the number of hosts connected and the total amount of data traffic transmitted. Both the Operator Panel and the Tape Library Specialist web interface allow the definition of IPv4 and IPv6 addresses. The Key Proxy determines the IP version used and presents the correct IP address and parameters to the IP Stack.

### IPv4 and IPv6 Address Formats

An IPv4 address has the following format: `x . x . x . x` where *x* is called an *octet* and must be a decimal value between 0 and 255. Octets are separated by periods. An IPv4 address must contain three periods and four octets. Examples of valid IPv4 addresses include:

- `1 . 2 . 3 . 4`
- `01 . 102 . 103 . 104`

Here is an example of a screen that uses IPv4 addresses:

```
Ethernet IPv4               Panel 0175

Current Settings Frame 1:

MAC Address: 18:36:F3:98:4F:9A
IP Address (IPv4):  19.117.63.126
Subnet Mask (IPv4): 255.255.253.0
Gateway (IPv4):     19.117.63.253

Ethernet Mode:  Manual IP Entry

Press ENTER to Change Settings

[BACK]  [ UP ]  [DOWN]   [ENTER]
```

An IPv6 address can have two formats:

- Normal - Pure IPv6 format
- Dual - IPv6 plus IPv4 formats (not used in this release)

An IPv6 (Normal) address has the following format: `y : y : y : y : y : y : y : y` where *y* is called a *segment* and can be any hexadecimal value between 0 and FFFF. The segments are separated by colons - not periods. An IPv6 normal address must have eight segments, however a short form notation can be used the Tape Library Specialist web interface for segments that are zero, or those that have leading zeros. The short form notation can not be used from the Operator Panel.

Examples of valid IPv6 (Normal) addresses:

- `2001 : db8: 3333 : 4444 : 5555 : 6666 : 7777 : 8888`
- `2001 : db8 : 3333 : 4444 : CCCC : DDDD : EEEE : FFFF`
- `: :` (implies all 8 segments are zero)
- `2001: db8: :` (implies that the last six segments are zero)
- `: : 1234 : 5678` (implies that the first six segments are zero)
- `2001 : db8: : 1234 : 5678` (implies that the middle four segments are zero)
- `2001:0db8:0001:0000:0000:0ab9:C0A8:0102` (This can be compressed to eliminate leading zeros, as follows: `2001:db8:1::ab9:C0A8:102` )

Here is an example of a screen that uses IPv6 addresses:

```
Ethernet IPv6                Panel 0178

Current Settings
Frame 1, Port B÷

MAC Address: 18:36:F3:98:4F:9A
Manual IP (IPv6):  684D:1111:222:3333:4444:5555:6:77
DHCP IP (IPv6): Disabled
Stateless Auto IP (IPv6): 0:0:0:0:0:0:0:0

Press ENTER to Change Settings

[BACK]  [ UP ]  [DOWN]   [ENTER]
```

An IPv6 (Dual) address combines an IPv6 and an IPv4 address and has the following format: `y : y : y : y : y : y : x . x . x . x`. The IPv6 portion of the address (indicated with y's) is always at the beginning, followed by the IPv4 portion (indicated with x's).

- In the IPv6 portion of the address, *y* is called a *segment* and can be any hexadecimal value between 0 and FFFF. The segments are separated by colons - not periods. The IPv6 portion of the address must have six segments but there is a short form notation for segments that are zero.
- In the IPv4 portion of the address *x* is called an *octet* and must be a decimal value between 0 and 255. The octets are separated by periods. The IPv4 portion of the address must contain three periods and four octets.

Examples of valid IPv6 (Dual) addresses:

- `2001 : db8: 3333 : 4444 : 5555 : 6666 : 1 . 2 . 3 . 4`
- `: : 11 . 22 . 33 . 44` (implies all six IPv6 segments are zero)
- `2001 : db8: : 123 . 123 . 123 . 123` (implies that the last four IPv6 segments are zero)
- `: : 1234 : 5678 : 91 . 123 . 4 . 56` (implies that the first four IPv6 segments are zero)
- `: : 1234 : 5678 : 1 . 2 . 3 . 4` (implies that the first four IPv6 segments are zero)
- `2001 : db8: : 1234 : 5678 : 5 . 6 . 7 . 8` (implies that the middle two IPv6 segments are zero)

## Subnet Masks (IPv4) and Prefix Lengths (IPv6)

All IP addresses are divided into portions. One part identifies the network (the network number) and the other part identifies the specific machine or host within the network (the host number). Subnet masks (IPv4) and prefixes (IPv6) identify

the range of IP addresses that make up a subnet, or group of IP addresses on the same network. For example, a subnet can be used to identify all the machines in a building, department, geographic location, or on the same local area network (LAN).

Dividing an organization's network into subnets allows it to be connected to the Internet with a single shared network address. Subnet masks and prefixes are used when a host is attempting to communicate with another system. If the system is on the same network or subnet, it will attempt to find that address on the local link. If the system is on a different network, the packet is sent to a gateway which will then route the packet to the correct IP address. This is called Classless-InterDomain Routing (CIDR).

In IPv4, the subnet mask `255.255.255.0` is 24 bits and consists of four eight-bit octects. The address: `10.10.10.0` subnet mask `255.255.255.0` means that the subnet is a range of IP addresses from `10.10.10.0 - 10.10.10.255.`

The prefix-length in IPv6 is the equivalent of the subnet mask in IPv4. However, rather than being expressed in 4 octets like it is in IPv4, it is expressed as an integer between 1-128. For example: `2001:db8:abcd:0012::0/64` specifies a subnet with a range of IP addresses from: **`2001:db8:abcd:0012`**`:0000:0000:0000:0000 -` **`2001:db8:abcd:0012`**`:ffff:ffff:ffff:ffff`. The portion in bold is called the network portion of the IP address, or the prefix. The non-bold portion is called the host portion of the IP address, since it identifies an individual host on the network.

## Attachment Interfaces

This section describes the types of interfaces that are available with the 3584 Tape Library.

The 3584 Tape Library supports the following attachment interfaces.

**The SCSI Medium Changer Device, which supports:**

**Parallel SCSI interface**
Models L32 and D32 support Ultrium 1 and Ultrium 2 Tape Drives with parallel SCSI Low Voltage Differential (LVD) and High Voltage Differential (HVD) interfaces.

**Fibre Channel interface**
The library supports Ultrium Tape Drives and 3592 Tape Drives with a Fibre Channel interface.

**The Ethernet 10/100 interface, and the following protocols:**

**Simple Network Management Protocol (SNMP)**
SNMP traps are supported for drive and library events. SNMP management query functionality is supported by using a standard Management Information Block (MIB).

**Hyper Text Transfer Protocol (HTTP)**
An embedded web server provides a web user interface for library management and query capabilities. Except for certain service capabilities, most of the operator panel functionality is provided on the web user interface.

The 3584 Tape Library supports the Ethernet 10/100 interface in auto negotiation or fixed modes of 10 Mb/s and 100 Mb/s, and by using half or full duplex.

The library cannot be directly connected to a System z server (mainframe host) with a Fibre Connection (FICON) or Enterprise System Connection (ESCON) interface. Instead, the System z server must connect to a 3953 Tape System and a Tape Control Unit (a 3592 J70, a 3494 VTS Model B10, a 3494 VTS Model B20, or a TS7700 Virtualization Engine), then to the 3584 Tape Library. This provides the interconnection to the 3584 Tape Library.

The sections that follow describe the Fibre Channel, SCSI, and FICON and ESCON interfaces.

## Fibre Channel Interface


**Attention:** This product contains an assembly that complies with the performance standards set by the U.S. Food and Drug Administration for a Class I Laser Product. This laser assembly is registered with the Department of Health and Human Services and is in compliance with IEC825.

In the 3584 Tape Library, for drives that use a Fibre Channel interface the following information is available:

- For a list of compatible software, operating systems, and servers for Ultrium Tape Drives, visit the web at `http://www.ibm.com/storage/lto`. Under `IBM System Storage TS3500 Tape Library`, select `Product details`. Under `Learn more`, select `Interoperability matrix` or select `Independent Software Vendor (ISV) matrix for LTO`.
- For a list of compatible software, operating systems, and servers for TS1120 Tape Drives, visit the web at `http://www.ibm.com/servers/storage/tape/drives`. Under `IBM System Storage TS1120 Tape Drive`, select `Product details`. Under `Learn more`, select `Interoperability matrix` or `Independent Software Vendor (ISV) matrix`.
- For a list of compatible software, operating systems, and servers for 3592 Tape Drives, visit the web at `http://www.ibm.com/servers/storage/tape/drives`. Under `IBM TotalStorage 3592 Tape Drive`, select `Product details`. Select `Resource library`. Select `Interoperability` , then `3592 Tape Drive`. Or select `Compatibility information`, then `Independent Software Vendor (ISV) Matrix for 3592 Tape Drive`.

Fibre Channel technology combines the best features of traditional input/output (I/O) interfaces (such as the throughput and reliability of SCSI and Programmed Control Interrupt) with the best features of networking interfaces (such as the connectivity and scalability of Ethernet and Token Ring). The technology offers a transport mechanism for delivering commands, and provides high performance by allowing processing to be done in the hardware.

You can establish Fibre Channel connections between Fibre Channel ports that reside in the 3584 Tape Library, one or more servers, and the network interconnecting them. The network can consist of such elements as switches, hubs, bridges, and repeaters used in the interconnection.

**Related information**

Chapter 6, “Using the Fibre Channel Interface,” on page 167
This section introduces the use of the Fibre Channel interface with the 3584 Tape Library.

## SCSI Interface

The 3584 Tape Library operates as a set of SCSI-3 devices. For drives that use a SCSI interface, the following conditions apply:

- The Ultrium 2 Tape Drive attaches to a server through a LVD Ultra160 SCSI interface or a High Voltage Differential (HVD) Ultra SCSI interface
- The Ultrium 1 Tape Drive attaches to a server through an LVD Ultra2 SCSI interface or an HVD Ultra SCSI interface

Each SCSI drive canister uses shielded, VHDCI, 68-pin connectors and can attach directly to a 2-byte-wide SCSI cable.

**Note:** The earlier version of the SCSI drive used HD68 connectors and was packaged on a tray (sled). While drive trays are still supported, they can no longer be ordered. For information about the replacement design, contact your IBM representative.

Any combination of up to two initiators (servers) and up to four targets (devices) is allowed on a single SCSI bus if the following conditions are met:

- The SCSI bus is terminated properly at each end
- Cable restrictions are followed according to SCSI-3 standards

Under the SCSI-3 protocol, this type of attachment allows cable lengths of up to 25 m (81 ft) with the appropriate cable and terminator for HVD devices and up to 12 m (39 ft) for LVD devices.

For more information about the SCSI interface, see the *IBM System Storage TS3500 Tape Library SCSI Reference*.

**Related concepts**

"FICON and ESCON Interfaces"

## FICON and ESCON Interfaces

The 3584 Tape Library does not provide native attachment to Fibre Connection (FICON) or Enterprise System Connection (ESCON) interfaces. Instead, the 3953 Tape System (3953 F05 Frame and 3953 L05 Library Manager) allows attachment of the 3584 Tape Library with 3592 Tape Drives (not LTO Ultrium Tape Drives) to the IBM System z server (mainframe host). The System z servers then attach through a FICON or ESCON interface to one of the following components:

- IBM TotalStorage 3592 Tape Controller Model J70 (known as the 3592 J70)
- IBM TotalStorage 3494 Virtual Tape Server Model B10 (known as the 3494 B10)
- IBM TotalStorage 3494 Virtual Tape Server Model B20 (known as the 3494 B20)
- IBM Virtualization Engine TS7700 Series (known as the TS7700 Virtualization Engine)

The 3953 Tape System includes attachment to a master console. IBM recommends that the 3584 Tape Library also be connected to a master console. This connection reduces the number of analog phone lines needed for remote support and improves collaboration between the systems in resolving hardware problems.

The library needs a minimum of two Ethernet ports to use remote support to a master console: one attached to your network for use by the storage administrator and one attached to the private master console network for remote support. In the past, a library only had a single Ethernet port. To ensure a separate Ethernet connection from the library to the master console, at least one additional Model D22, D32, or D52 frame was required, with a frame control assembly (feature code 1452 or 1453) that contained a Medium Changer card pack (MCP) with an Ethernet connection (feature code 1660). However, with the design and inclusion of the new enhanced frame control assembly in Models L23, D23, L53, and D53, each frame now contains a Medium Changer assembly (MCA) with two Ethernet ports. This eliminates the need for an additional Model D22, D32, or D52 frame.

The 3584 Tape Library feature code 9217 (Attached toSystem z OS) provides an Ethernet cable for the library connection to the master console.

When a 3953 L05 Library Manager attaches to a 3584 Tape Library, all of the following functionality must be enabled on the tape library to ensure proper operation:

- Advanced Library Management System (ALMS)
- Cartridge Assignment Policy
- Insert Notification

Figure 7 on page 31 shows a flowchart of how the zSeries server attaches to the 3584 Tape Library. For detailed information about attaching the IBM System z server to the 3584 Tape Library, see the *IBM 3953 Tape System Introduction and Planning Guide*. Refer also to the *IBM System Storage TS3000 System Console (TSSC) Maintenance Information* guide.

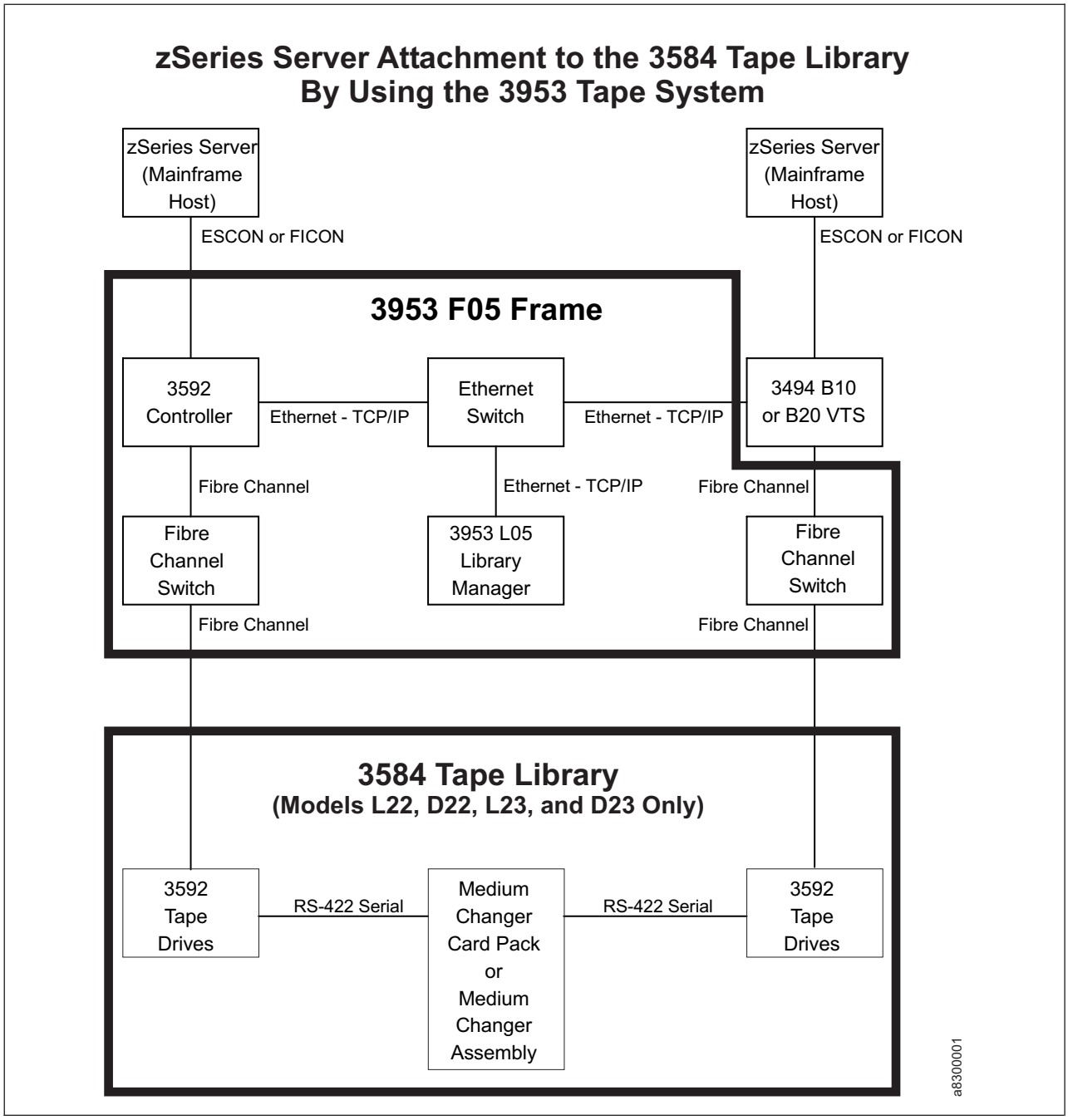



*Figure 7. Attaching the 3584 Tape Library to the System z server (mainframe host)*

**Related concepts**

"Advanced Library Management System" on page 42
This section gives an overview of the Advanced Library Management System (ALMS), which virtualizes the locations of cartridges in the 3584 Tape Library. Logical libraries can then consist of unique drives and ranges of volume serial numbers instead of fixed locations.

"Cartridge Assignment Policy" on page 46

"Insert Notification Setting" on page 47
This section describes the insert notification setting, an option that enables the 3584 Tape Library to monitor only the I/O station for any new media which does not have a logical library assignment.

## SNMP Messaging

This section describes the Simple Network Management Protocol (SNMP), which allows the 3584 Tape Library to send alerts about problems over a LAN network to a monitoring server.

Occasionally, the 3584 Tape Library may encounter a situation that you want to know about, such as an open door that causes the library to stop. Because many servers can attach to the library by differing attachment methods, the library provides a standard TCP/IP protocol called SNMP to send alerts about conditions (such as an opened door) over a TCP/IP LAN network to an SNMP monitoring server. These alerts are called SNMP traps. Using the information supplied in each SNMP trap, the monitoring server (together with customer-supplied software) can alert operations staff of possible problems or operator interventions that occur. Many monitoring servers (like NetView(R)) can be used to send e-mail or pager notifications when they receive an SNMP alert (for more information, see your NetView documentation or the manuals for your network management application).

The monitoring server must be loaded with systems management software that can receive and process the trap, or the trap is discarded. SNMP supports a get/get-response mechanism for an operator to gather more information about a problem or query the library about its current status. A get is a request for information about the library that the operator issues through a monitoring server and which is transmitted by SNMP. A get-response is the information that is provided in response to the get. This type of support generally requires an up-to-date library Management Information Base (MIB). The library's MIB contains units of information that specifically describe an aspect of a system, such as the system name, hardware number, or communications configuration.

IBM provides the MIBs that are supported by the library. They include:

- IBM 3584 MIB for Version 1 or Version 2c traps
- Storage Networking Industry Association (SNIA) Storage Media Library (SML) MIB Version 1.12
- SNIA SML MIB Version 1.20b

To obtain the MIBs, visit `http://ftp.software.ibm.com/storage/358x/3584/`. Microsoft(R) Windows(R) users select `3584mib.zip` and UNIX(R) users select `3584mib.tar`.

An operator cannot change library settings by using SNMP. Settings can only be changed by using the Tape Library Specialist web interface or operator panel.

Figure 8 on page 33 shows the flow of SNMP communication from the library over the Ethernet local area network (LAN) to an SNMP monitoring server.

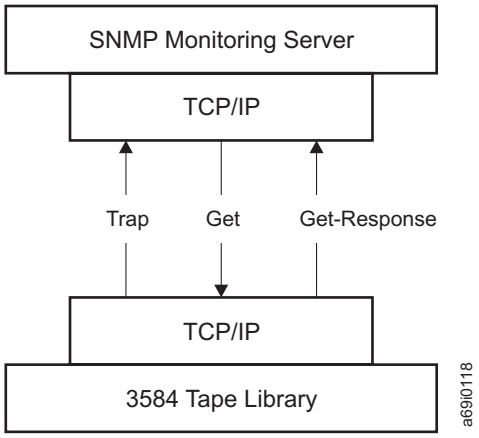



*Figure 8. The SNMP messaging system*

For information about interpreting an SNMP trap or using SNMP MIBs to monitor your library, see the appropriate sections in the *IBM System Storage TS3500 Tape Library Operator Guide*. Additional information is available in *Implementing IBM Tape in Linux and Windows*; this book is available on the web at `http://www.redbooks.ibm.com/redpieces/pdfs/sg246268.pdf`. Also see *Implementing IBM Tape in Unix Systems*; this book is available on the web at `http://www.redbooks.ibm.com/redbooks/pdfs/sg246502.pdf`.

## Mixing Drives in Frames

This section contains a matrix of the drives that are compatible in a physical frame (model) of the 3584 Tape Library.

*Table 7. Mixing drives in the physical frames of the 3584 Tape Library*

| Drive Types | Models L22 and D22 | Models L23 and D23 | Models L32 and D32 | Models L52 and D52 | Models L53 and D53 |
|---|---|---|---|---|---|
| Ultrium 4 Tape Drives | N | N | Y | Y | Y |
| Ultrium 3 Tape Drives | N | N | Y | Y | Y |
| Ultrium 2 Tape Drive | N | N | Y | Y | Y |
| Ultrium 1 Tape Drive | N | N | Y | Y | Y |
| 3592 J1A | Y | Y | N | N | N |
| TS1120 Tape Drive | Y | Y | N | N | N |
| **Notes:**<br>• N = not supported.<br>• Y = supported. | | | | | |

**Related reference**

"Mixing Drives in a Logical Library" on page 34
This section contains information about drives that are compatible in a logical library of the 3584 Tape Library.

"Mixing Media in Drives" on page 35
This section contains information about compatible media and drives in the 3584 Tape Library.

## Mixing Drives in a Logical Library

This section contains information about drives that are compatible in a logical library of the 3584 Tape Library.

The 3584 Tape Library supports a mixture of Ultrium drive types in a logical library, but it does not support a mixture of Ultrium and 3592 Tape Drives in a logical library. Some independent software vendors (ISVs) support mixed drive types within logical libraries; others do not. Some ISVs that support mixed drive types do so with restrictions. For details, contact your ISV.

For situations where the ISV support does not exist or does not meet your requirements, the 3584 Tape Library provides another option to protect your investment by partitioning the tape drives into separate logical libraries. You can customize the partition to any number of slots by using menus or special bar code labels.

Figure 9 shows examples of methods for mixing Ultrium drive types in a logical library.

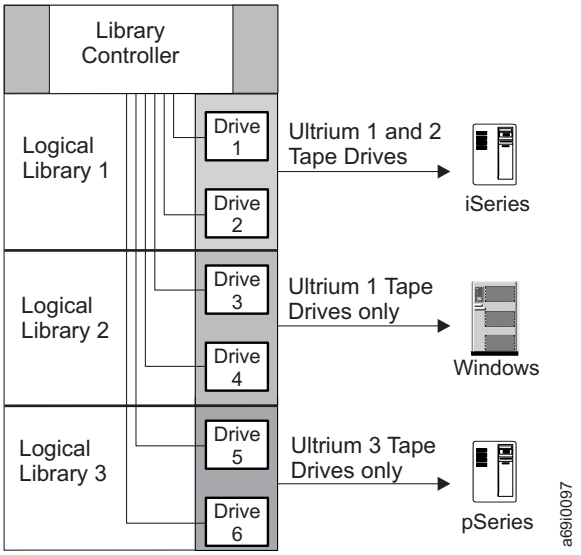



*Figure 9. Examples of methods for mixing Ultrium drive types in a logical library*

## Mixing Media in Drives

This section contains information about compatible media and drives in the 3584 Tape Library.

Not all cartridges that are supported by the 3584 Tape Library are compatible with all drives. Ultrium cartridges are not supported by 3592 Tape Drives, and 3592 Tape Cartridges are not supported by Ultrium drives.

When labeled according to proper IBM bar code label specifications, the last character of an Ultrium cartridge's volume serial (VOLSER) number indicates the generation of the media. For example, a cartridge with a VOLSER of 000764L4 is an Ultrium 4 cartridge; a cartridge with a volume serial (VOLSER) number of 000764L3 is an Ultrium 3 cartridge; a cartridge with a VOLSER of 003995L2 is an Ultrium 2 cartridge. On a 3592 Tape Cartridge, the IBM product label represents whether it is a R/W cartridge with a capacity of 60 GB, 300 GB, or 700 GB , or a WORM cartridge with a capacity of 60 GB, 300 GB, or 700 GB.

The TS1120 Tape Drive reuses existing JA, JJ, JR, and JW media types at 1.67X capacity increase. The drive also supports reading and writing these media types in 3592 E05 Tape Drive logical format (both base (EFMT2) and encrypted (EEFMT2) formats) or in 3592 J1A Tape Drive logical format (EFMT1). The TS1120 Tape Drive supports reading and writing to the JB and JX media types only in EFMT2 and EEFMT2 formats. In all cases, both Read/Write and WORM formats are supported.

Table 8 gives a matrix of cartridges that are compatible with Ultrium Tape Drives. Table 9 on page 36 gives a matrix of cartridges that are compatible with 3592 Tape Drives.

*Table 8. Cartridges that are compatible with Ultrium Tape Drives*

| Cartridges | Ultrium Tape Drives | | | |
|---|---|---|---|---|
| | **Ultrium 4** | **Ultrium 3** | **Ultrium 2** | **Ultrium 1** |
| Ultrium 4 WORM Data Cartridge (xxxxxxLU) | Y | N | N | N |
| Ultrium 4 Data Cartridge (xxxxxxL4) | Y | Y | N | N |
| Ultrium 3 WORM Data Cartridge (xxxxxxLT) | Y | Y | N | N |
| Ultrium 3 Data Cartridge (xxxxxxL3) | Y | Y | N | N |
| Ultrium 2 Data Cartridge (xxxxxxL2) | Y[2] | Y | Y | N[1] |
| Ultrium 1 Data Cartridge (xxxxxxL1) | N | Y[2] | Y | Y |
| IBM TotalStorage LTO Ultrium Cleaning Cartridge (universal, CLNUxxL1) | Y | Y | Y | Y[3] |
| LTO Ultrium Cleaning Cartridge (IBM only, CLNIxxL1) | Y | Y | Y | Y |

**Notes:**

- Y = supported.
- N = not supported.

1. The library rejects any command to move unsupported media to a drive and returns a sense key of 5 and an additional sense code/additional sense code qualifier of 30/00.
2. Supported for read-only.
3. Requires drive firmware level 25D4 or higher.

*Table 9. Cartridges that are compatible with 3592 Tape Drives*

| Type of Cartridge | Recording Format | TS1120 Tape Drive | | 3592 J1A Tape Drive |
|---|---|---|---|---|
| | | With Encryption Enabled | With Encryption Disabled | |
| 3592 Data Cartridge (JA, JW, JJ, JR) | Encrypted E05 | R/W[1] | Reformat only[2] | Reformat only |
| | E05 | R/W | R/W | Reformat only |
| | Encrypted J1A | R/W | Reformat only | Reformat only |
| | J1A | R/W | R/W | R/W |
| 3592 Data Cartridge (JB, JX) | Encrypted E05 | R/W | Reformat only | Not supported |
| | E05 | R/W | R/W | Not supported |
| 3592 Cleaning Cartridge (CLNnnnJA, where nnn is individual cleaning cartridge number) | N/A[3] | Supported | Supported | Supported |

**Notes:**

1. R/W = reads from and writes to a cartridge.
2. WORM tapes (JX, JW and JR) may be reformatted only if they are initialized and labeled; if data exists on the tape, reformatting is not allowed.
3. N/A = not applicable.

**Related concepts**

"Ultrium Bar Code Label" on page 122
This section describes the appearance and specifications of the Ultrium bar code label.

"3592 Bar Code Label" on page 153
This section describes the appearance and specifications of the 3592 bar code label.

## Multi-Path Architecture

This section discusses Multi-Path Architecture, a feature of the 3584 Tape Library that allows open systems applications to share the library's robotics.

The 3584 Tape Library features the Storage Area Network (SAN)-ready Multi-Path Architecture, which allows homogeneous or heterogeneous open systems applications to share the library's robotics without middleware or a dedicated server (host) acting as a library manager. The SAN-ready Multi-Path Architecture makes sharing possible by letting you partition the library's storage slots and tape drives into *logical libraries*. Servers can then run separate applications for each logical library. This partitioning capability extends the potential centralization of storage that the SAN enables. Partitioning also provides investment protection for Ultrium 1 and Ultrium 2 Tape Drives if your application does not support the mixing of Ultrium 1, Ultrium 2, Ultrium 3 and Ultrium 4 Tape Drives and media in the same logical library. The Multi-Path Architecture is compliant with the following attachment interfaces:

- Small Computer Systems Interface (SCSI)
- Fibre Channel

The Multi-Path Architecture of the TS3500 Tape Library is designed to provide the capability for sharing of the library robotics. This is accomplished by partitioning the library into up to 192 multiple logical libraries (up to the number of drives installed), and providing each logical library its own separate and distinct drive(s), storage slots, and control paths. I/O slots are shared on a first-come-first-served basis. This type of partitioning is designed to allow heterogeneous applications to share the library robotics independent of each other. Cartridges under library control are not shared between logical libraries, nor allowed to be moved between logical libraries. An example of heterogeneous sharing is a Microsoft Windows 2003 application using the drive and storage slots of one logical li- brary, while a UNIX application uses the drive and slots of another logical library. Logical libraries can also be used for separating Ultrium 2 Tape Drives and cartridges from Ultrium 4 Tape Drives and cartridges, or TS1120 or 3592 Tape Drives and cartridges, for applications which do not support mixing the drives in the same logical library.

Whether partitioned or not, the 3584 Tape Library is certified for SAN solutions (such as LAN-free backup).

The Multi-Path Architecture also lets you configure additional control paths for any one logical library. A *control path* is a logical path into the library through which a server sends standard SCSI Medium Changer commands to control the logical library. Additional control paths reduce the possibility that failure in one control path will cause the entire library to be unavailable. Use of the control path failover feature further reduces that possibility.

**Related concepts**

"Using Multiple Control Paths for Control Path Failover" on page 42

"Library Sharing" on page 38
This section describes ways that you can configure the 3584 Tape Library into one or more logical libraries that can be shared by multiple applications.

## Library Sharing

This section describes ways that you can configure the 3584 Tape Library into one or more logical libraries that can be shared by multiple applications.

The default configuration for the 3584 Tape Library allows a single application to operate the library through a single control path. Often, however, it is advantageous to be able to share a single library between heterogeneous (dissimilar) or homogeneous (similar) applications. Some applications (and some servers) do not allow for sharing a library between systems. With the 3584 Tape Library, however, you can create configurations that enable the library to process commands from multiple heterogeneous applications (such as an IBM pSeries application and a Windows application) and multiple homogeneous applications (for example, the same application run by several pSeries servers).

From the library's web interface or operator panel, you can perform the following actions:

- Configure the library so that is partitioned into separate logical libraries that independently communicate with separate applications through separate control paths. This configuration (see example **1** in Figure 10 on page 39) requires no special capabilities from the server or application.
- Configure any single logical library (including the entire physical library) so that it is shared by two or more servers that are running the same application. Depending on the capabilities of the server and application, there are several ways to set up this type of configuration. Three typical ways include:
  - Configuring one server (mainframe host) to communicate with the library through a single control path; all other servers send requests to that server through a network (see example **2** in Figure 10 on page 39). This configuration is used by Tivoli® Storage Manager (TSM).
  - Configuring all of the servers to communicate with the library through a single, common control path (see example **3** in Figure 10 on page 39). This configuration is used in high-availability environments such as High Availability Clustered Microprocessing (HACMP) from IBM and Systems Management Server (SMS) and Clustered Server Environments from Microsoft(TM). Multi-initiator configurations are only supported by certain adapters and ISVs. Check with your ISV.
  - Configuring a single logical library to communicate with multiple servers through multiple control paths. This configuration (see example **4** in Figure 10 on page 39) requires that you add control paths. It is used by Backup Recovery and Media Services (BRMS).

Your library configuration is not limited to the examples shown in Figure 10 on page 39. Many configurations are possible, and you can design them according to your business needs.

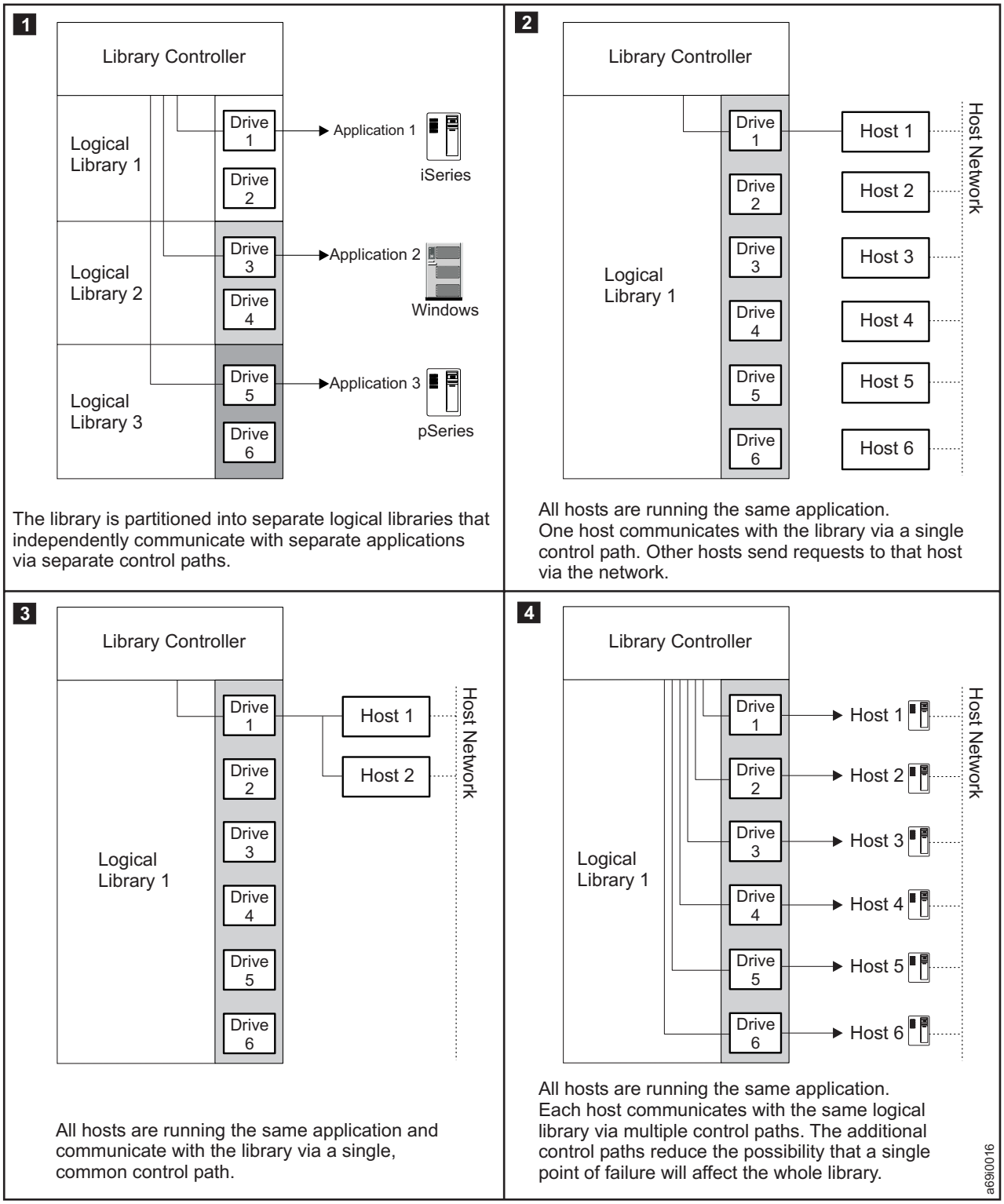



*Figure 10. Examples of configurations for sharing an IBM System Storage TS3500 Tape Library.* Lines from one or more drives to the library controller represent control paths.

**Related concepts**

"Using Multiple Control Paths for Control Path Failover" on page 42

"Multi-Path Architecture" on page 37
This section discusses Multi-Path Architecture, a feature of the 3584 Tape Library that allows open systems applications to share the library's robotics.

## Using Multiple Logical Libraries

To maximize your investment, you can use multiple logical libraries to share the physical 3584 Tape Library between applications or to support mixed drive types for any application. The sections that follow give guidelines for both processes.

You can create multiple logical libraries by partitioning the physical library's storage slots and tape drives into two or more logical libraries. Each logical library consists of:

- Tape drives
- Storage slots
- Input/output (I/O) slots
- Cartridge accessor

Each logical library has its own control path (a logical path into the library through which a server sends standard SCSI Medium Changer commands to control the logical library). For both Ultrium and 3592 frames, each logical library control path is available to servers through logical unit number 1 (LUN 1) of the first drive that is defined within that logical library. A logical unit number is a number used by a server to identify a drive.

A logical library cannot share another logical library's tape drives and storage slots unless the Advanced Library Management System (ALMS) is enabled. However, it does share the I/O slots and the cartridge accessor on a first-come, first-served basis. In addition, a logical library cannot include both LTO and 3592 elements. That is, you must configure LTO and 3592 elements (drives, storage slots, I/O slots, and grippers) into separate logical libraries.

A frame that uses Ultrium Tape Drives can be partitioned into up to twelve logical libraries; a frame that uses 3592 Tape Drives can also be partitioned into up to twelve logical libraries. Depending on the type of frames that you have, you can partition multiple logical libraries by using the following methods:

- Equipping the library with ALMS (recommended method).
- Identifying the quantity of elements that you want to include in each logical library, then using the Tape Library Specialist configuration wizard or the operator panel menus to create the logical libraries (see the section about configuring the library by using menus in the *IBM System Storage TS3500 Tape Library Operator Guide*). Applicable to models other than L23, D23, L53, or D53, this method makes it unnecessary for you to manually label the elements, but without labels you cannot view your partition when you open the front doors.
- Opening the door of the library and manually labeling the elements (storage slot columns and drives) that you want to include in each logical library (see the section about configuring the library by using labels in the *IBM System Storage TS3500 Tape Library Operator Guide*). This method enables you to view your partition at a glance whenever you open the front doors. **Note:** The ability to configure the library by using labels is no longer supported except by the Request for Price Quotation (RPQ) process.

To create or change the configurations for your 3584 Tape Library, see the *IBM System Storage TS3500 Tape Library Operator Guide*.

When automatic cleaning is enabled, any appropriate cleaning cartridge may be used to clean a drive in any configured logical library, even if the cartridge resides in a different logical library.

The following sections describe two uses for multiple logical libraries.

**Related concepts**

"Advanced Library Management System" on page 42
This section gives an overview of the Advanced Library Management System (ALMS), which virtualizes the locations of cartridges in the 3584 Tape Library. Logical libraries can then consist of unique drives and ranges of volume serial numbers instead of fixed locations.

"Methods of Cleaning Drives" on page 63
This section describes the methods of cleaning that the 3584 Tape Library uses for its drives.

### Using Multiple Logical Libraries for Library Sharing

Multiple logical libraries are an effective way for the 3584 Tape Library to simultaneously back up and restore data from heterogeneous applications. For example, you can partition the library so that it processes commands from Application 1 (about Department A) in Logical Library 1, commands from Application 2 (about Department B) in Logical Library 2, and commands from Application 3 (about Department C) in Logical Library 3. In this configuration, the storage slots and drives in each logical library are dedicated to that library and are not shared among other libraries. Commands issued by the applications travel to the library through three unique control paths. Thus, the data processing for Department A is confined to the storage slots and drives in Logical Library 1, processing for Department B is confined to the storage slots and drives in Logical Library 2, and so forth.

### Using Multiple Logical Libraries for Mixed Drive Types

For applications that do not support mixed drive types and media in the same logical library, the 3584 Tape Library can use partitioning and multiple logical libraries to keep them separate. For example, you can partition Ultrium 4, Ultrium 3, Ultrium 2, and Ultrium 1 Tape Drives and their media into multiple and separate logical libraries.

## Using Multiple Control Paths

With the 3584 Tape Library, in addition to creating multiple logical libraries, you can also configure any logical library to have more than one control path. When you configure additional control paths, additional library sharing configurations and availability options are made possible. Access to the logical library is on a first-come, first-served basis and each control path for a logical library can accept commands while the library is in use by another control path.

**Note:** Microsoft Windows 2000 Removable Storage Manager (RSM) does not support multiple control paths within a logical library. IBM recommends that you disable RSM to use this feature.

To add or remove additional control paths, see the *IBM System Storage TS3500 Tape Library Operator Guide*.

The sections that follow describe two potential uses for multiple control paths.

### Using Multiple Control Paths for iSeries and AS/400 Attachment

The use of control paths for the iSeries and AS/400 servers is unique. In general, every iSeries adapter must "see" the control path that is associated with the drives to which it is connected. Different scenarios exist:

- For a High Voltage Differential (HVD) SCSI Ultrium 1 Tape Drive, IBM supports single drive configurations so that every HVD Ultrium 1 Tape Drive must have a control path when connected to the iSeries server.
- For HVD and Low Voltage Differential (LVD) SCSI Ultrium 2 Tape Drives, the iSeries server supports multiple drives that are connected per adapter, and one of the drives must have a control path.
- For the Fibre-Channel-attached drives (Ultrium 1, Ultrium 2, Ultrium 3, Ultrium 4, and 3592 Tape Drives), OS/400(R) V5R1 supports only one drive per adapter and every drive requires a control path.
- For an OS/400 V5R2 Fibre Channel connection, the adapter supports multiple drives per adapter, so that only one control path for the group of drives is required.

### Using Multiple Control Paths for Control Path Failover

The 3584 Tape Library offers an optional control path failover feature that enables the host device driver to resend the command to an alternate control path for the same logical library.

**Related concepts**

"Control Path Failover, Data Path Failover, and Load Balancing" on page 49
This section discusses measures that the 3584 Tape Library uses to control library and data path failure, and to balance workload.

## Advanced Library Management System

This section gives an overview of the Advanced Library Management System (ALMS), which virtualizes the locations of cartridges in the 3584 Tape Library. Logical libraries can then consist of unique drives and ranges of volume serial numbers instead of fixed locations.

ALMS is an extension of IBM's patented Multi-Path Architecture. With ALMS, the 3584 Tape Library is the industry's first standards-based tape library to virtualize the locations of cartridges (called SCSI element addresses) while maintaining native SAN attachment for the tape drives. ALMS enables logical libraries to consist of unique drives and ranges of volume serial (VOLSER) numbers, instead of fixed locations.

When you enable ALMS with its license key, you can assign tape drives to any logical library by using the Tape Library Specialist web interface. Logical libraries can also be added, deleted, or easily changed without disruption. Storage capacity can be changed without impact to host applications.

An optional feature, ALMS offers dynamic management of cartridges, cartridge storage slots, tape drives, and logical libraries. It enables the 3584 Tape Library to achieve unprecedented levels of integration for functionality through dynamic partitioning, storage slot pooling, and flexible drive assignment. ALMS eliminates downtime when you add Capacity On Demand (COD) storage, add or remove logical libraries, or change logical library storage allocation. ALMS also reduces downtime when you add expansion frames, add or remove tape drives, or change logical drive allocation.

The capabilities of ALMS include:

- Dynamic partitioning (storage slot pooling and flexible drive assignment)
- The transparent ability to add or remove storage capacity to any host application
- The ability to configure drives or to configure Model L22, L23, L32, L52, or L53 storage capacity without taking the library offline
- Virtual I/O slots to automatically manage the movement of cartridges between I/O slots and storage slots

If you purchase an entry-capacity or intermediate-capacity library, you can purchase the new Entry ALMS or Intermediate ALMS at a price lower than the Full ALMS. For more information, contact your IBM Marketing Representative.

The sections that follow describe the capabilities of ALMS.

**Related concepts**

"Multi-Path Architecture" on page 37
This section discusses Multi-Path Architecture, a feature of the 3584 Tape Library that allows open systems applications to share the library's robotics.

"Using Multiple Logical Libraries" on page 40

## Dynamic Partitioning

Dynamic partitioning in the 3584 Tape Library is comprised of storage slot pooling and flexible drive assignment.

### Storage Slot Pooling

When enabled in the 3584 Tape Library, the Advanced Library Management System (ALMS) allows logical libraries to be added or deleted without disrupting operation. All storage slots are pooled (available on a first-come, first-served basis) to each logical library based on cartridge insert operations. They are a shared resource such that changes to the capacity allocation for each logical library can occur without downtime or administrator involvement. The minimum logical library simply has a name and can be thought of as a file folder that has no contents. Drives can be placed in the file folder by using the Drive Assignment screen of the Tape Library Specialist web interface. Cartridges can also be placed in the file folder, based on their volume serial (VOLSER) numbers and by using one of the following methods (in priority order):

- Migration of static partitioning to dynamic partitioning (requires web enablement of ALMS)
- Cartridge assignment policy (automatic at the time of insertion)
- Insert notification function (the operator selects the VOLSER from the operator panel at the time of insertion)
- Software application move from the I/O station (based on the source application that issued the command)
- Manual assignment by an operator using the Tape Library Specialist web interface

For information about migrating to dynamic partitioning and manually assigning cartridges to a logical library, refer to the *IBM System Storage TS3500 Tape Library Operator Guide*.

The VOLSER assignment and physical location of cartridges are stored in non-volatile RAM (both primary and backup copies).

**Related concepts**

"Insert Notification Setting" on page 47
This section describes the insert notification setting, an option that enables the 3584 Tape Library to monitor only the I/O station for any new media which does not have a logical library assignment.

"Web Interface" on page 53
This section gives basic information about the IBM System Storage Tape Library Specialist, the web interface for the 3584 Tape Library.

### Flexible Drive Assignment

After you enable the Advanced Library Management System (ALMS) in the 3584 Tape Library, you can assign drives to a logical library by using the Drive Assignment screen of the Tape Library Specialist web interface. You can assign a drive to be shared by multiple logical libraries (for example, a drive used for a once-a-month job or as a temporary replacement for a failed drive). Thus, each logical library can consist of dedicated drives and shared drives. Each logical library maps a drive element address to the locations of both dedicated and shared drives. This allows multiple applications to be pre-configured to quickly use a shared drive in the future. After you pre-configure the applications for future drive usage, you must take each shared drive offline at all but one of the applications that have access to it. Otherwise, an application may attempt to use a drive that is in use by another application. This may cause failed backup jobs. Also, most applications will consider the symptoms of a drive already in use to be an error that will be reported as such.

The Drive Assignment web screen supports the following point-and-click capabilities which are non-disruptive to other logical libraries:

- Assign the drive
- Remove the drive assignment
- Reassign the drive

When a cartridge is mounted in a shared drive, the library only accepts a demount command that is requested by the source logical library. Any demount command that is requested by another logical library is rejected.

**Related concepts**

"Using Multiple Logical Libraries" on page 40

"Web Interface" on page 53
This section gives basic information about the IBM System Storage Tape Library Specialist, the web interface for the 3584 Tape Library.

## Transparent Addition or Removal of Storage Capacity

With the Advanced Library Management System (ALMS) enabled in the 3584 Tape Library, you can change the total logical library capacity (quantity of addressable storage slots). The change is transparent to each host application because the value in the `Maximum Number of Cartridges` field in the Tape Library Specialist web interface is not impacted by changes to the quantity of storage slots. The additional storage slots are simply new candidates for cartridges to be moved to upon insertion. To change the cartridge capacity of a logical library, refer to the *IBM System Storage TS3500 Tape Library Operator Guide* and see the section about changing the maximum allowable quantity of cartridges in a logical library.

## Configuration of Storage Capacity without Disruption

With the Advanced Library Management System (ALMS) enabled, no downtime is required when you enable Intermediate Capacity On Demand or Full Capacity On Demand for Models L22, L23, L52, and L53 of the 3584 Tape Library.

**Related concepts**

"Intermediate, Full, and Capacity On Demand Features for Models L22, L23, L52, and L53" on page 52

## Virtual I/O Slots

This section describes the configuration of virtual I/O slots in the 3584 Tape Library so that to the host application it appears that the library has more physical I/O slots than actually exists.

**Note:** If your library does not have the virtual I/O slot capability and you want to enable it, you must first install the license key for the Advanced Library Management System (ALMS). With the ALMS license key installed, you have the option to enable ALMS and the virtual I/O slot feature through the Tape Library Specialist web interface. ALMS must be enabled and the I/O station must be empty before you can enable or disable virtual I/O slots. For information about enabling or disabling ALMS, see the appropriate section in the *IBM System Storage TS3500 Tape Library Operator Guide*.

When the Advanced Library Management System (ALMS) is enabled, you can enable virtual I/O slots in the 3584 Tape Library so that the library automatically queues all cartridge moves between the I/O station and the storage slots. This makes the process of adding and removing cartridges easier and faster.

The 3584 Tape Library has input/output (I/O) stations and I/O slots that allow you to import and export up to 32 cartridges at any given time. The I/O slots are also known as import/export elements (IEEs). Virtual I/O slots increase the quantity of available I/O slots by allowing storage slots to appear to the host as I/O slots. These storage slots are called virtual import/export elements (VIEEs). With virtual I/O slots, the library automatically moves cartridges from the I/O stations to the VIEEs. In this way, the library enhances its import and export capabilities.

The goal of virtual I/O slots is to reduce the dependencies between the system administrator and library operator so that each performs their import and export tasks without needing the other to perform any actions:

- In a typical import scenario without virtual I/O slots, a library operator is needed to stand at the physical library and fill the I/O station with cartridges; a system administrator is needed to cause the applications to send commands for moving cartridges out of the I/O station and into library storage slots. After the operator fills the I/O station with cartridges, he must wait for the I/O station to be cleared before he is able to insert additional cartridges, which means he is waiting on the system administrator to clear the I/O station of each set of inserted cartridges. If the library is enabled with virtual I/O slots, the operator can continuously insert cartridges into the I/O station and the administrator does not need to issue commands to move each new set of inserted cartridges. Instead, the library automatically moves the cartridges and places them into virtual I/O slots until they are ready to be processed later as one composite set of inserted cartridges.
- In a typical export scenario without virtual I/O slots, the system administrator may need to export a large number of cartridges from the library. However, after

the I/O station is filled, he must wait for the operator to physically remove cartridges from the entire I/O station before he can issue another export command. This operation can be inconvenient. If the library is enabled with virtual I/O slots, the administrator does not have to wait to issue all export commands (up to 255 export commands can be issued at the same time for each logical library) and the operator can remove cartridges from the I/O stations as soon as the accessor automatically moves them from the storage slots.

When you enable virtual I/O slots, the library can use the Cartridge Assignment Policy and Insert Notification features to determine the best storage slot location for each inserted cartridge. This determination is designed to optimize the mount throughput for the logical library to which the inserted cartridge is assigned. For more information, see "Cartridge Assignment Policy" and "Insert Notification Setting" on page 47.

**Related concepts**

"Cartridge Assignment Policy"

"Insert Notification Setting" on page 47
This section describes the insert notification setting, an option that enables the 3584 Tape Library to monitor only the I/O station for any new media which does not have a logical library assignment.

## Cartridge Assignment Policy

You identify a cartridge by affixing a label to it that bears a volume serial (VOLSER) number. The cartridge assignment policy allows you to specify one or more *ranges* of VOLSERs for logical libraries. For example, you can create a cartridge assignment policy of 36 cartridge VOLSERs that range from 000764 to 000800 for a specific logical library. Note that VOLSERs in ranges do not include the media-type indicator, such as L2, L3, JA, and so forth.

When you insert a cartridge into the library and its VOLSER is within a range, the cartridge assignment policy assigns the cartridge to its logical library. The cartridge must be of the same media type as that logical library. For example, if you create for Logical Library 1 (a library of Ultrium drives) a cartridge assignment policy of VOLSERs that range from ABC000 to ABC999 then you insert a cartridge with VOLSER ABC123, the library recognizes that VOLSER as belonging to the range and assigns it to Logical Library 1, provided that the cartridge is an Ultrium Tape Cartridge (and not a different media type, such as a 3592 Tape Cartridge).

When an unassigned cartridge is present in the I/O station, the library reads its VOLSER label and automatically assigns it to the logical library that is specified in the range of VOLSERs which was previously selected by the system administrator when creating a cartridge assignment policy. Similarly (when the ALMS is enabled), if you open and close the library's front door the library automatically performs an inventory and, if it detects a newly inserted, unassigned cartridge, it assigns the cartridge to the logical library of the VOLSER range that was previously selected by the system administrator when creating a cartridge assignment policy.

For unassigned cartridges that do not fall within a cartridge assignment policy, you can assign those cartridges by doing one of the following:

- If the unassigned cartridge is in the I/O station and the Insert Notification setting is disabled, the assignment is automatically on a first-come, first-served basis.

- If the unassigned cartridge is in the I/O station and the Insert Notification setting is enabled, you can assign the cartridge to a logical library by using the Settings and Insert Notification selections from the library's operator panel or you can keep the cartridge as unassigned and assign it later by using the IBM System Storage Tape Library Specialist web interface.
- Use the Cartridge Assignment Policy to create a new VOLSER range, then perform an inventory to assign those cartridges through the cartridge assignment policy.
- Use the Tape Library Specialist web interface to assign the cartridges.

Within a physical library, the maximum quantity of ranges that can be created by cartridge policy assignment is 300.

For more information, see "Insert Notification Setting." For information about creating a new VOLSER range, performing an inventory, or assigning cartridges to a logical library, see the appropriate sections in the *IBM System Storage TS3500 Tape Library Operator Guide*.

**Related concepts**

"Insert Notification Setting"
This section describes the insert notification setting, an option that enables the 3584 Tape Library to monitor only the I/O station for any new media which does not have a logical library assignment.

## Insert Notification Setting

This section describes the insert notification setting, an option that enables the 3584 Tape Library to monitor only the I/O station for any new media which does not have a logical library assignment.

An insert notification event can be caused if you open the I/O station door and place a cartridge into an empty I/O slot, or if you open the I/O station door and move a cartridge from one I/O slot to another. If you enable the Insert Notification setting, when new media is detected in the I/O station the operator panel displays a message that asks you to select a logical library. Any unassigned cartridges in the I/O station will be assigned to the logical library that you select (and all other logical libraries will not be able to access the cartridges). If you do not select a logical library within 60 seconds or if you select the BACK button, the library makes the cartridges unassigned and the operator panel returns to the Activity Screen. You can later assign the unassigned cartridges by using the IBM System Storage Tape Library Specialist web interface. For more information, see the sections about enabling or disabling the insert notification setting and assigning cartridges to a logical library in the*IBM System Storage TS3500 Tape Library Operator Guide*.

## Power Structure of the 3584 Tape Library

This section introduces the two power structures that are offered by the 3584 Tape Library.

Depending on the frames that you have, the library offers two power structures:

- For Models L22, D22, L32, D32, L52, and D52, the library offers the *frame control assembly* power structure, with the option of ordering dual ac line cords for redundancy.

- For Models L23, D23, L53, and D53, the library offers the new *enhanced frame control assembly* power structure, which combines drive power, library power, and standard dual ac line cord capabilities.

The two power structures are compatible among frames in the same library.

## Frame Control Assembly and Dual ac Power

This section describes the frame control assembly power (FCA) structure and the optional dual ac power feature of the 3584 Tape Library. This power structure and feature apply to Models L22, D22, L32, D32, L52, and D52.

The frame control assembly power structure is designed so that each Ultrium Tape Drive and 3592 Tape Drive is paired with an associated power supply. Adjacent power supplies are cabled together such that redundant power becomes a standard function. Each pairing is packaged side by side on a shelf in a frame. Drives are housed in removable canisters and power supplies are housed in fixed trays. The design enables a drive with a failed power supply to continue operating by using power from the adjacent power supply.

The library's optional dual ac power feature further enhances library availability by making another power source available in case of planned or unplanned power grid outages. The feature provides a power switch that connects to two independent ac line cords which connect to two independent branch power feeds. The line cords support 110 V ac or 220 V ac. The switch monitors the ac line voltage from the feed it uses and automatically connects to the alternate power feed if the incoming voltage is lost. Dual ac power is available when you order feature code 1901.

## Enhanced Frame Control Assembly

This section describes the enhanced frame control assembly of the 3584 Tape Library.

The enhanced frame control assembly is a power structure that combines drive power, library power, and dual ac line cord capabilities. The assembly includes only two power supplies, dual ac line cords, and a Medium Changer assembly (MCA) unit.

The enhanced frame control assembly comes standard with Models L23 and L53, and can be ordered as a feature code for Models D23 and D53. For two or more frames that are properly configured, the assembly is constructed such that failure or repair of a single, particular part does not cause the entire system to fail or require scheduled downtime for maintenance. For example, the replacement of any single, failed power supply can be accomplished without affecting the operation of the library. The two redundant power supplies are fed directly by independent, dual ac line cords that support only 220 V ac (110 V ac is not supported). The dual ac line cords come standard on Models L23, D23, L53, and D53, and do not need to be ordered as an additional feature code.

If dual A/C line cords are not desired, both power supplies can be fed by a single customer outline by using feature code 1509.

The enhanced frame control assembly is compatible with the following model conversions, which must be performed by an IBM Service Representative:

- Model L22 to L23

- Model D22 to D23
- Model L52 to L53
- Model D52 to D53
- Model L23 to L53
- Model D23 to D53
- Model L53 to L23
- Model D53 to D23

## Control Path Failover, Data Path Failover, and Load Balancing

This section discusses measures that the 3584 Tape Library uses to control library and data path failure, and to balance workload.

Command failures and time-outs are costly. You want your library to run smoothly and efficiently. To ensure continued processing, libraries that are equipped with Fibre Channel Ultrium 4, Ultrium 3, Ultrium 2, and 3592 Tape Drives offer path failover and load balancing capabilities that enable the IBM device driver to resend a command to an alternate path. The alternate path can include another host bus adapter (HBA), Storage Area Network (SAN), or library control path drive. The device driver initiates error recovery and continues the operation on the alternate path without interrupting the application. Path failover and load balancing are built-in features that are enabled by using a purchased license key.

Two types of path failover capabilities exist: *control path failover (CPF)* and *data path failover (DPF)*. *Control* refers to the command set that controls the library (the SCSI Medium Changer command set on LUN 1 of the tape drives). *Data* refers to the command set that carries the customer data to and from the tape drives (the SCSI-3 Stream Commands (SSC) device on LUN 0 of the tape drives). Path failover means the same thing in both: that is, where there is redundancy in the path from the application to the intended target (the library accessor or the drive mechanism, respectively), the device driver transparently fails over to another path in response to a break in the active path.

Both types of failover include host-side failover when configured with multiple HBA ports into a switch, but CPF includes target-side failover through the control paths that are enabled on more than one tape drive. DPF includes target-side failover for 3592 Tape Drives only by using the dual-ported interface of the drive.

DPF includes load balancing of the HBAs because the channel is a data-intensive path (the control path carries very little data, so load balancing is not an issue). The dynamic load balancing support optimizes resources for devices that have physical connections to multiple HBAs in the same machine. When an application opens a device that has multiple HBA paths configured, the device driver determines which path has the HBA with the lowest usage and assigns that path to the application. When another application opens a different device with multiple HBA paths, the device driver again determines the path with the lowest HBA usage and assigns that path to the second application. The device driver will update the usage on the HBA assigned to the application when the device is closed. Dynamic load balancing will use all HBAs whenever possible and balance the load between them to optimize the resources in the machine.

Both CPF and DPF require the use of the IBM device driver, and are supported exclusively with products that bear the IBM logo on the operating systems indicated in Table 10 on page 50.

Table 10 summarizes the differences between CPF, DPF, and load balancing.

*Table 10. Differences between DPF and CPF*

| Characteristic | CPF | DPF and Load Balancing for Ultrium 4, Ultrium 3 and Ultrium 2 Tape Drive | DPF and Load Balancing for 3592 Tape Drive |
|---|---|---|---|
| Device type | SMC[1] | SSC[2] | SSC |
| LUN[3] | LUN 1 | LUN 0 | LUN 0 |
| Host-side failover | Y[4] | Y | Y |
| Target-side failover | Y | N[5] | Y |
| IBM device driver required | Y | Y | Y |
| Operating systems supported | AIX(R), SuSE Linux(TM), Red Hat Enterprise Linux, Solaris, Windows, HP-UX, Asian UX | AIX, SuSE Linux, Red Hat Enterprise Linux, Solaris, Windows[6] (DPF only), Asian UX | AIX, SuSE Linux, Red Hat Enterprise Linux, Solaris, Windows[6] (DPF only), HP-UX, Asian UX |
| Order feature to obtain license key | Y | Y[7, 8] | N |
| SCSI attachment supported | Y | N | N |
| Fibre Channel attachment supported | Y | Y | Y |

**Notes:**

1. SMC = SCSI-3 Medium Changer Specification (library)
2. SSC = SCSI-3 Stream Commands (drive)
3. LUN = logical unit number
4. Y = Yes
5. N = No
6. Load balancing is not supported on Windows
7. For Ultrium 2 Tape Drives, DPF and load balancing do not require a license key on AIX.
8. Ultrium 4 Tape Drives, do not require license keys at the host when configuring Data Path Failover.

The path failover features can be ordered from the factory, or you may order them as field upgrades. To order features, contact your IBM Sales Representative.

**Note:** The control path failover feature for Ultrium Tape Drives is activated by a license key that you enter at the library operator panel. The data path failover feature for Ultrium 1, Ultrium 2, and Ultrium 3 Tape Drives is activated by a license key that you enter at the host. For Ultrium 4 Tape Drives, license keys do not need to be entered at the host when configuring Data Path Failover.

For more information about using these features, see the *IBM Ultrium Device Drivers Installation and User's Guide*.

## Expanded I/O Capacity

This section describes the extra input/output (I/O) stations that you can order for a base frame of the 3584 Tape Library.

To insert cartridges into and remove them from the 3584 Tape Library (without requiring a reinventory), the library offers an input/output (I/O) station located on

the front door of the base frame (Models L22, L23, L32, L52, or L53). You can also order an additional I/O station to be installed on the door.

For bulk media handling, the TS3500 Tape Library supports four I/O stations in newly purchased Models D23 and D53 frames. The D-frame with I/O installed is comprised of four independently accessible I/O station doors with a total of 64 slots (16 in each I/O station door). The I/O stations increase the maximum I/O slot capacity from 32 to 224 (four I/O stations of 16 slots each or 64 I/O slots that can accommodate either the D23 or D53 Model) for a maximum of three D23 or D53 I/O frames in a 16-frame library. The multiple I/O stations double the maximum insert/eject throughput. The D23 and D53 Models are compatible with existing Models L22, L32, L52, D22, D32.

A frame cannot combine both the 3592 Tape Drive and Ultrium Tape Drive. However, in a library that mixes frame types, you may insert 3592 Tape Cartridges into the lower I/O station of a Model L53, L52, or L32 frame for transport (by the cartridge accessor) to a Model D23 or D22 frame (your library must contain an I/O station that will accept 3592 Tape Cartridges). Similarly, you may insert LTO Ultrium Tape Cartridges into the lower I/O station of a Model L23 or L22 frame for transport (by the cartridge accessor) to a Model D53, D52, or D32 frame (again, your library must contain an I/O station that will accept Ultrium Tape Cartridges).

Table 11 shows how I/O stations can be mixed among frames.

*Table 11. Mixing I/O stations among frames of the 3584 Tape Library*

| Type of Frame | Number of Slots in Upper I/O Station | Number of Slots in Lower I/O Station |
|---|---|---|
| L22 and L23 | 16 (3592) | 16 (Ultrium or 3592) |
| L32 | 10 (Ultrium) | 20 (Ultrium) or 16 (3592) [1] |
| L52 and L53 | 16 (Ultrium) | 16 (Ultrium or 3592) |
| L22, L32, L52 ( with 4 I/O station option) [2, 4] | 16 in each of the two upper slots, for a total of 32 slots, either all Ultrium or all 3592) [3] | 16 in each of the two lower slots, for a total of 32 slots, of the same type of those in the upper slots. [3] |

**Notes:**

1. The 3592 I/O station for Model L32 is included with feature code 1608.
2. For the 4 I/O station option, feature code 1405 must be installed as a pre-requisite, then either feature code 1655 for LTO ultrium media, or feature code 1656 for 3592 media. Feature codes 1655 and 1656 assume the 4-I/O door frame will be installed at the end of the library string ("string" refers to the very last frame in a single accessor library or the last frame before SBB in HS) for both HA and single accessor libraries. If the customer prefers the 4-I/O door frame be installed elsewhere in the string, the Service Rep must obtain a "Services Contract" to uninstall additional frames as necessary to accommodate the customer's request.
3. Mixed media is not allowed in 4 I/O station frames. All cartridges must be either LTO Ultrium or 3592.
4. A maximum of three 4 I/O station doors can be installed per library.

## Capacity Configurations

This section introduces information about capacity configurations for frames of the 3584 Tape Library.

Depending on whether you have the Capacity Expansion feature or the Capacity On Demand feature installed in your library, different capacity configurations exist for the frames.

The sections that follow describe each feature.

## Capacity Expansion Feature for Model L32

The Capacity Expansion Feature is a license key that lets you enable the storage slots inside the front door of Model L32 of the 3584 Tape Library. With the Capacity Expansion Feature installed, the library offers 140 additional slots for Ultrium Tape Cartridges in the Model L32 if the second I/O station is not present and 88 additional slots if the second I/O station is present. The Capacity Expansion Feature is required when you add one or more expansion frames to the base frame.

When you purchase your library, you may specify that the Capacity Expansion Feature be installed at the factory, or you may order the feature later and have your IBM Service Representative install it. To order the Capacity Expansion Feature, contact your IBM Sales Representative.

To determine the quantity of LTO Ultrium Tape Cartridges and 3592 Tape Cartridges that the library supports, see Chapter 7, “Frame Capacity,” on page 179.

**Related reference**

“Capacity of Model L22, D22, L23, and D23 Frames” on page 179
This section gives the type of eligible Capacity On Demand feature and quantity of drives, I/O slots, and storage slots for L22, D22, L23, and D23 frames.

“Capacity of Model L32 and D32 Frames” on page 180
This section gives the quantity of drives and cartridge storage slots in Model L32 and D32 frames that do not have the Capacity Expansion feature. It also gives the quantity of cartridge storage slots in L32 and D32 frames that have the Capacity Expansion feature and differing numbers of I/O slots.

“Capacity of Model L52, D52, L53, and D53 Frames” on page 181
This section gives the type of eligible Capacity On Demand feature and quantity of drives, I/O slots, and storage slots for Model L52, D52, L53, and D53 frames.

## Intermediate, Full, and Capacity On Demand Features for Models L22, L23, L52, and L53

In the 3584 Tape Library, the initial (entry) capacity of a Model L22 or Model 23 frame is enabled to use 58 cartridge slots for 3592 Tape Cartridges. If you add the Intermediate Capacity or Full Capacity features, you can enable additional storage elements in the Model L22 or Model L23 to increase the available capacity to 117 cartridge slots, or from 199 to 260 cartridge slots (depending on the features that you order).

The initial capacity of a Model L52 or Model 53 frame is enabled to use 64 cartridge slots for LTO Ultrium Tape Cartridges. If you add the Intermediate Capacity or Full Capacity features, you can enable additional storage elements in the Model L52 or Model 53 to increase the available capacity to 129 cartridge slots, or from 219 to 287 cartridge slots (depending on the features that you order).

The Intermediate Capacity feature is available through an IBM plant site as feature code 1641 and through the field as feature code 1643.

The Full Capacity feature is available through an IBM plant site as feature code 1642 and through the field as feature code 1644. This feature is required to add a 16-slot I/O station. The Intermediate capacity feature is a prerequisite to the Full Capacity feature. The Full Capacity feature is required when you add one or more expansion frames to a base frame.

Capacity features that are available through the field are known as Capacity On Demand.

To determine the quantity of LTO Ultrium Tape Cartridges and 3592 Tape Cartridges that the library supports, see Chapter 7, “Frame Capacity,” on page 179.

**Related reference**

“Capacity of Model L22, D22, L23, and D23 Frames” on page 179
This section gives the type of eligible Capacity On Demand feature and quantity of drives, I/O slots, and storage slots for L22, D22, L23, and D23 frames.

“Capacity of Model L32 and D32 Frames” on page 180
This section gives the quantity of drives and cartridge storage slots in Model L32 and D32 frames that do not have the Capacity Expansion feature. It also gives the quantity of cartridge storage slots in L32 and D32 frames that have the Capacity Expansion feature and differing numbers of I/O slots.

“Capacity of Model L52, D52, L53, and D53 Frames” on page 181
This section gives the type of eligible Capacity On Demand feature and quantity of drives, I/O slots, and storage slots for Model L52, D52, L53, and D53 frames.

## Web Interface

This section gives basic information about the IBM System Storage Tape Library Specialist, the web interface for the 3584 Tape Library.

The Tape Library Specialist web interface enables operators and administrators of the 3584 Tape Library to manage storage devices from any location in an enterprise. The Tape Library Specialist allows you to communicate directly with your library and perform a full range of end user, operator, and administrator tasks without being at the operator panel. The web interface is included with Models L22, L23, L52, and L53, and is available as feature code 1662 for Model L32.

The Tape Library Specialist requires a Category 5 Ethernet cable (not supplied with the tape library). It may be installed by you or your IBM Service Representative.

You can use the Tape Library Specialist web interface to download the following flat files, which contain information for analyzing the library, drives, Fibre Channel ports, and the health of the cartridges. Information is available only from the Ultrium 2 Tape Drives, Ultrium 3 Tape Drives, TS1040 (LTO Ultrium 4 Tape Drives), TS1120 Tape Drives, and 3592 J1A Tape Drives.

- Library Statistics.csv - contains information about the maximum cartridge residency, mount, and eject times, average cartridge residency, mount, and eject times, and total cartridge inserts, mounts and ejects. The information is provided for each hour of a 24-hour period and for each logical library. **Note:** To obtain this log, your library must include Model L23 or L53.
- Drive Statistics.csv - contains information about each drive’s last mount; only installed drives are shown in drive statistics log.

- Port Statistics.csv - contains Fibre Channel port information about the last mount; only installed drives with Fibre Channel ports are shown in the port statistics log.
- Mount History.csv - includes statistics about the last 100 cartridges that were demounted in the library and information about the TS1040 (Ultrium 4) and TS1120 Tape Drives (at firmware level 16E4 or later) that is derived from the customer-centric Statistical Analysis and Reporting System (ccSARS).

The 3584 Tape Library downloads the files in comma-separated value (.csv) format. You can use the data to identify storage area network (SAN), drive, or media performance trends. The .csv file format can easily be imported into most spreadsheet and database programs.

For more information about using the Tape Library Specialist web interface, see the section about operating the library from the web in the *IBM System Storage TS3500 Tape Library Operator Guide*.

## Remote Support

This section describes the types of remote support that the 3584 Tape Library and its drives use to detect and solve problems.

Optional remote support is available for the 3584 Tape Library through its Call Home capability. The Call Home feature uses a modem connection or a master console to report failures that are detected by the library or a tape drive. Whenever a failure is detected, Call Home sends detailed error information to IBM (*home*). The IBM Service Representative can then prepare an action plan to handle the problem before traveling to the library. The library may also periodically send support information (such as configuration, library and drive code versions, and error logs) to IBM.

The Call Home feature of the 3584 Tape Library has three different, but related, capabilities:

**Problem Call Home**

The 3584 Tape Library or one of its drives detects a problem and the library performs a Call Home operation to create a Problem Management Record (PMR) in the IBM Remote Technical Assistance Information Network (RETAIN(R)). This is a single page of text data that enables the Support Center or the Service Representative to access an action plan and a list of parts (called *field replaceable units* or *FRUs*). When servicing the library, the Service Representative can issue a test Call Home operation to RETAIN from the library's operator panel. The library allows the Service Representative to include drive dumps in the test Call Home for analysis, rather than collect dumps by using CETool and transmitting them through an IBM messaging system. In this way, a drive dump can be accessed by Support Center personnel through the Call Home database.

**Heartbeat Call Home**

On a scheduled basis (once a week or one hour after a code update has been completed), the 3584 Tape Library sends home (to IBM) the following files: a Machine Reported Product Data (MRPD) file, a library error log file, and a drive error log file. The MRPD file contains information about the machine (library), including the number of frames and drives, the model and serial number of each frame, the type and serial number of each drive, the code version of the library and each drive, and any machine-detectable features such as additional I/O stations, capacity expansion, and so forth.

**Data Call Home**

When a Problem Call Home or a Heartbeat Call Home is initiated, the 3584 Tape Library also sends data files that may be helpful to Support Center personnel. In the case of a Heartbeat Call Home, the library also sends the library error log and drive error log. In the case of a Problem Call Home, the library sends any trace files that might be related to the problem.

For more information, see:

- "Remote Support Through a Modem"
- "Remote Support Through a Master Console"
- "Remote support security" on page 57
- "Power Requirements for Remote Support Features" on page 97

**Related concepts**

"Remote Support Through a Modem"
This section describes remote support to the 3584 Tape Library (or its drives) through a modem.

"Remote Support Through a Master Console"
This section describes remote support to the 3584 Tape Library through a master console.

## Remote Support Through a Modem

This section describes remote support to the 3584 Tape Library (or its drives) through a modem.

Hardware requirements for remote support by modem vary, depending on whether you already have one or more IBM tape products that have the remote support capability. Table 12 indicates the requirements.

*Table 12. Requirements for remote support (the Call Home feature)*

| Quantity of IBM Tape Products with Remote Support Capability | Requirement |
|---|---|
| 1 | Remote Support Facility (modem and cable; feature code #2710) |
| 2 | Remote Support Switch (feature code #2711). This feature applies only if you are attaching multiple libraries to one modem. While still valid, this feature cannot be ordered. |
| 3 or more | Remote Support Attachment (cable; feature code #2712) |

## Remote Support Through a Master Console

This section describes remote support to the 3584 Tape Library through a master console.

A master console is a service tool that is present in most environments where one or more IBM tape storage devices, such as the IBM 3953 Tape System (3953 F05 Tape Frame and 3953 L05 Library Manager), are connected to a System z server (mainframe host).

The TS3000 System Console (TSSC) provides the same functionality to attach a 3584 Tape Library that is connected to an Open Systems server. The TSSC is a personal computer (PC), complete with an Ethernet port. A desktop and a customer rack-mountable version of the TS3000 System Console are available by

ordering either feature code 2720 or 2730.

*Table 13. Desktop and Rack Mountable TS3000 System Consoles*

| Feature Code | Supported Models | Customer-Setup Unit (CSU) | Description |
|---|---|---|---|
| 2720 | L22, L23, L32, L52, L53 | No | Desktop TS3000 System Console (provides desktop console, Ethernet switch, cable, and connectors to connect one machine to an IBM-supplied modem for enabling remote enhanced service)<br>**Note:** FC 2719 is also required when ordering FC 2720 for libraries that are attached to the TS7700 Virtualization Engine. This provides additional memory and an ethernet adapter. |
| 2730 | L22, L23, L32, L52, L53 | No | Customer rack-mountable TS3000 System Console (TSSC) (provides 1U server, keyboard, display, mouse, bifurcated cables, connectors, 115 v AC cables, and Ethernet switch for customer-provided 19 inch rack) |

Also included are two MT5600BA external modems (one for the IBM 3953 Tape System), serial cables, a color monitor, and a keyboard. The TSSC is preloaded with software, and is tested prior to shipment.

When the 3584 Tape Library is in an environment that includes a master console, IBM recommends that the library perform the Electronic Customer Care (ECC) Call Home function through the master console instead of through a direct modem connection. .

To perform an ECC Call Home operation through a master console, the 3584 Tape Library sends Call Home information across a private ethernet connection to the master console. The master console then performs the ECC Call Home operation and sends the information to the IBM Remote Technical Assistance Information Network (RETAIN) through the master console's modem or ethernet (broadband) connection.

For remote support through a master console, the 3584 Tape Library needs a minimum of two Ethernet ports: one attached to your network for use by your administrator and one attached to the private master console network for remote support. Because a typical 3584 Tape Library only has a single Ethernet port, additional features are needed. So that there is a separate Ethernet connection from the library to the master console, at least one 3584 Tape Library Model D22, D32, or D52 frame must have a frame control assembly (feature code 1452 or 1453) that contains a medium changer card pack (MCP) with Ethernet (feature code 1660). New Models L23, D23, L53, and D53 provide two Ethernet ports per frame through the Medium Changer assembly, thereby eliminating the need for an additional feature code.

The library feature code 9217 provides an Ethernet cable for the remote support connection from the 3584 Tape Library to a master console.

Figure 11 on page 57 shows the attachment of the master console to the 3584 Tape Library and the 3953 Tape System for remote support.

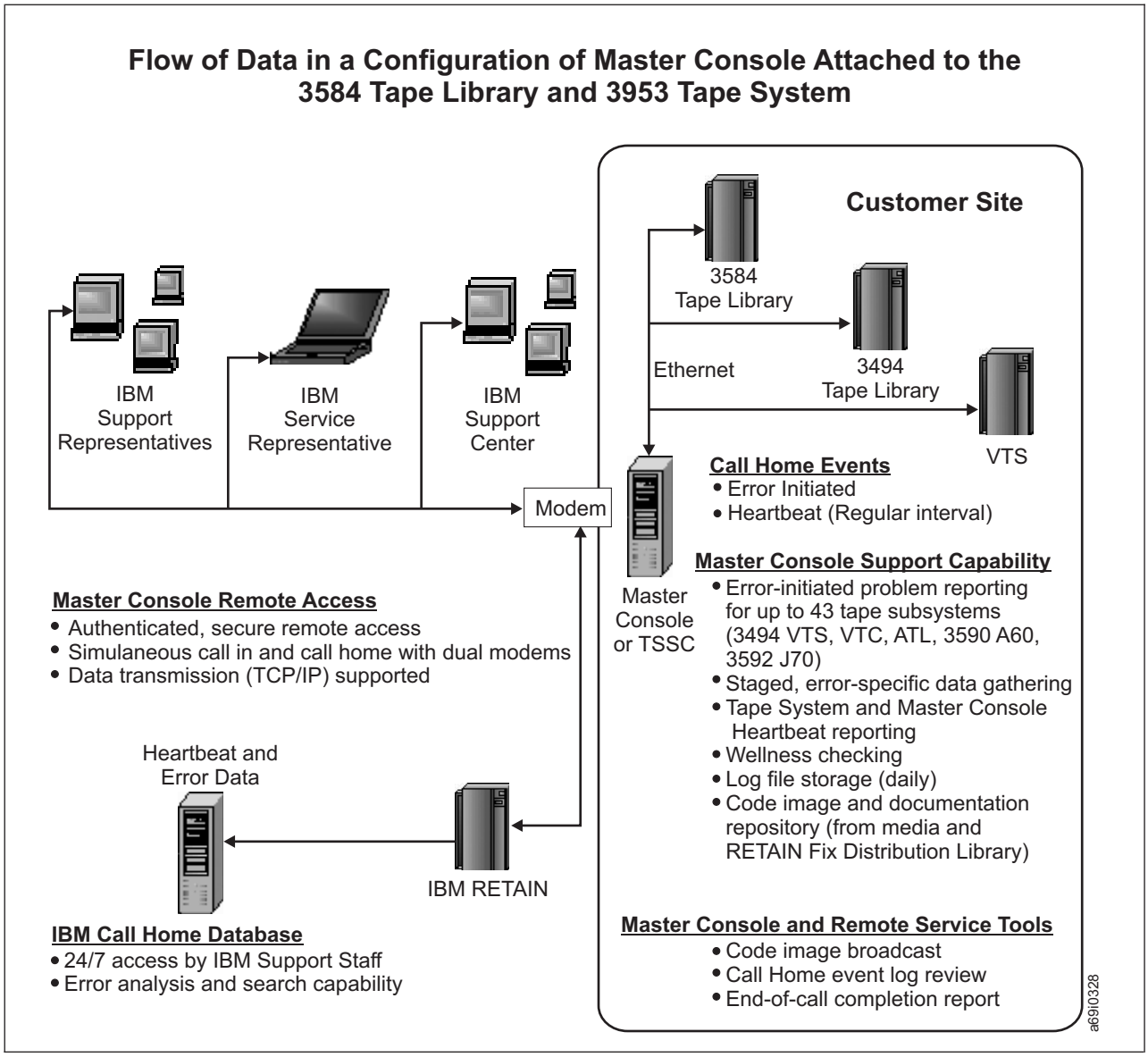



*Figure 11. Attachment of the master console to the 3584 Tape Library and the 3953 Tape System for remote support*

Complete information on how to configure the TSSC for ECC Call Home is in the *IBM TS3000 System Console Maintenance Information* publication.

## Remote support security

This section describes the security design for remote support for the 3584 Tape Library through a master console.

The TSSC provides ethernet connectivity to all attached systems via a private internal network. Up to two modems can be attached to the TSSC. The TSSC provides Point-to-Point Protocol (PPP) connectivity via the modems to the private Ethernet network.

The TSSC also provides optional ethernet outbound connectivity through the customer's network to the IBM service support system, RETAIN®. All inbound

communication over this connection is restricted. The TSSC uses the following ports: HTTPS: Port 443 HTTP: Port 80, and DNS: Port 53.

Figure 12 shows an overview of network connectivity.

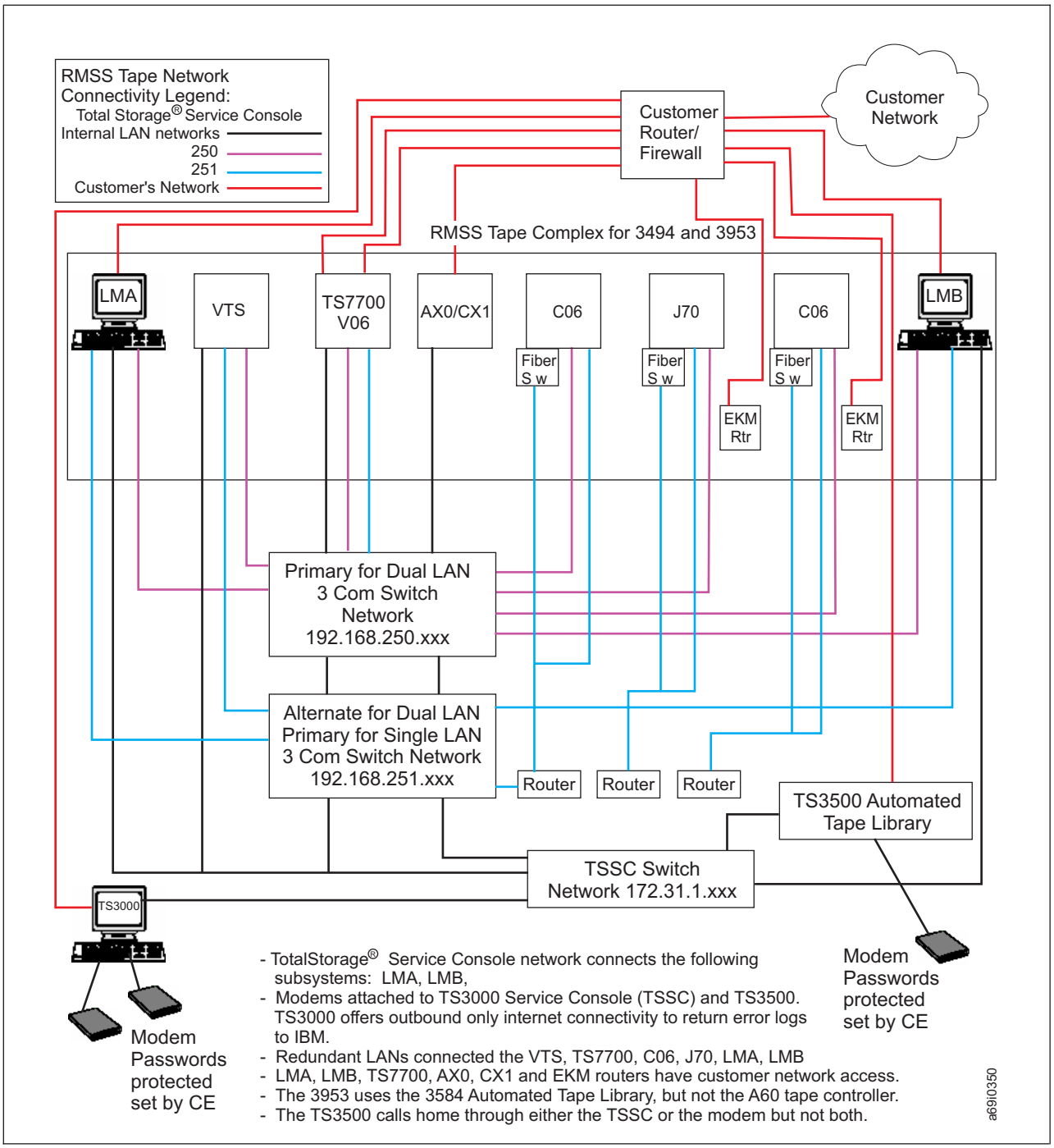



*Figure 12. Attachment of the master console to the 3584 Tape Library and the 3953 Tape System for remote support*

### Dial Out security features

Dial out is used by the Call Home feature to send service-related information from the attached systems to the IBM service support system,

RETAIN®; and to optionally send a pager message to a customer-designated number. Dial out is available through the TSSC and the modem.

**Note:** The 3953 and 3494 Tape Library Managers and the TS7700 Virtualization Engine do not support this feature.

Dial out security properties for the Attached Systems are as follows:

1. Dial-out is from the customer location to the IBM connection point. The IBM service support system (RETAIN®) does not initiate connections to the attached systems.
2. Dial out through the TSSC can either be over a modem connection or over an outbound ethernet connection to the customer network. All outbound traffic is limited to HTTP, HTTPS, and DNS information. All service-related data is communicated using HTTPS and is therefore encrypted.
3. The data exchanged between the attached systems and RETAIN® is service-related data. The protocol used is specific to this application and not publicly available.
4. On the first data exchange of each transmission, RETAIN® validates that the calling system is entitled to service. If the calling system is not validated, it is disconnected.
5. The default setting for the call home feature is enabled. The Call Home feature may be disabled by an IBM Service Representative.

None of the customer data stored on the tape or in memory for the 3584 Tape Library is transmitted or accessed in a call home session. Call home is enabled or disabled by a CETool menu selection. When properly configured, call home uses an IBM Global Services secure network or an internet connection. A unique account code is used which establishes connections only to RETAIN®.

**Dial In security features**

Dial in is used by IBM Service Representatives to logon to and provide service support. Dialing in through the modem and TSSC, or WTI switch for legacy systems, provides connectivity to the 3953 and 3494 Tape Library managers. All dial in connectivity to the TSSC must be through the modem connection. The optional ethernet connection restricts all incoming traffic. Separate log ons are required for access to each of the Attached Systems.

**Note:** 3584 Tape Library does not support dial in.

The TSSC supports the following data security requirements when properly configured:

- Customer data, stored on tape or in memory, can not be transmitted or accessed in remote support sessions.
- Remote dial in is enabled or disabled through an operator panel or web specialist menu selection by the customer. The default is to disable remote call in. When remote call in is enabled, the default is to enable it for 24 hours.
- Remote dial in requires a password for access. The password is managed by the customer.

The following dial in security properties are available:

**Modem**
The default modem setting for dial in is no password required. A password can be specified by the customer and set by the IBM Service Representative.

**WTI Switch (used with some legacy systems)**
The WTI Switch has a default password. A different password can be set locally by the IBM Service Representative.

### Security for Encryption Support

Encryption support in the 3584 Tape Library and TS1120 tape controllers models C06 and J70 allow system-managed tape encryption on IBM System z™ platforms. An IBM Service Representative installs routers between the internal LAN network, which is connected to the controllers, and the customer's LAN network. The router provides access to the customer's Encryption Key Manager (EKM). Network traffic through this router is out bound only. The Network Address Translation (NAT) function in the router prevents externally-initiated connections to any internal components.

### Port information for firewall environments

Table 14 shows the only ports that are required to be opened on the firewall for environments where the tape configuration is separated from the LAN-attached hosts and/or web clients by a firewall. All other ports may be closed.

*Table 14. Port Information for firewall environments*

| Function | Port | Direction (from library) | Protocol |
|---|---|---|---|
| Library Operations | 3494 | Bi-directional | TCP/IP |
| TotalStorage® Specialist | 80 | Inbound | TCP/IP |
| SNMP Traps | 161/162 | Bi-directional | UDP/IP |
| Encryption Key Manager | 1443 | Outbound | SSL |
| Encryption Key Manager | 3801 | Outbound | TCP/IP |

**Note:** The TS3000 System Console uses the following ports: HTTPS: Port 443 HTTP: Port 80, and DNS: Port 53.

Port information communications can be initiated either by the tape library or by the host. Typically, the library only initiates a connection when responding to the host; however, in the case of unsolicited messages such as statistics notifications and operator interventions, the library initiates a connection through port 3494. If the library manager needs to make a connection to the host, it chooses a temporary port and uses that port to make an outbound connection to a 3494 listening port on the host. When the host has a message to deliver to the library manager, it chooses its own ephemeral port by which to make an outbound connection to listening port 3494 on the library manager. The connection is only maintained for the duration required to pass a single message, and then it is disabled.

Table 14 describes the minimum level of connectivity required to perform library operations. Other ports that could be opened up on the firewall, but are not necessary in order to have full functionality include:

- The standard HTTP port, 80, allows inbound communication to the library from the IBM System Storage Tape Library Specialist (IBM's Enterprise Storage Resource Management solution).
- Ports 161 and 162, which are the standard ports for sending SNMP traps. The tape library can be configured to send traps to SNMP target machines in the case of operator interventions, if so desired. In this case the firewall needs to allow outbound connections from the library from its port 161 to port 162 on the listening SNMP target machine.

## Remote support security for the 3584 Tape Library through a master console

This section describes remote support security for the 3584 Tape Library through a master console.

Figure 13 illustrates all of the external communication connections to the 3584 Tape Library control system.

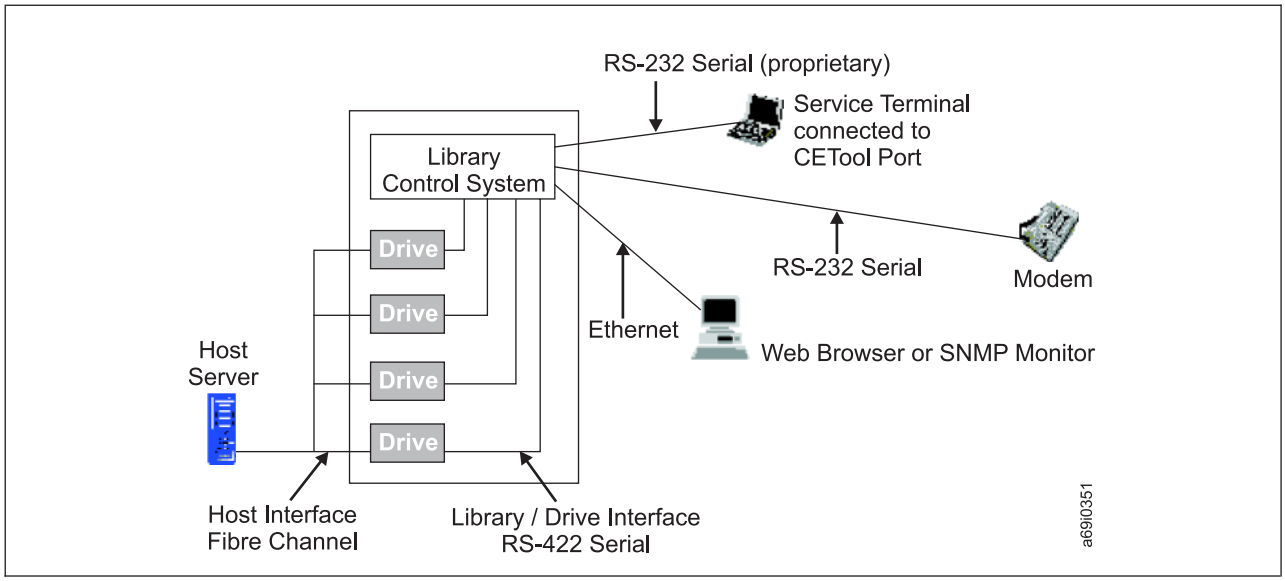



*Figure 13. External communication connections to the 3584 Tape Library control system*

Access to read and write data to and from tape cartridges is only available on the host interface (Fibre channel or SCSI). The host interface is provided by the drives. The library communicates with the drives though the Library/Drive Interface. The ethernet port, modem port, and CETool port do not have any direct access to the Library/Drive Interface. All communication between the various interfaces is through the library control system.

All library communication requires explicit support by the library firmware running in the library control system. The library firmware does not provide capability for any of the following functions:

- Answering an incoming call to the modem.
- Communications between the Ethernet port and the modem port.
- Communications between the Ethernet port and the CETool port.
- Communications between the CETool port and the modem port.
- Accessing data from tape cartridges through the Library/Drive Interface.

- Sending or receiving data from tape cartridges through any port.

For more information about installing and using the CETool, see the *IBM System Storage TS3500 Tape Library 3584 Maintenance Information* manual.

## Security considerations when using the 3584 Tape Library Specialist web interface

This section describes remote support security for the 3584 Tape Library through a master console when using the Tape Library Specialist web interface.

The 3584 Tape Library Tape Library Specialist web interface does not allow any access to customer data, and it does not allow FTP or TELNET type operations. It only provides those functions that are specifically coded in the library firmware. The only files it can offload are library logs, drive logs, a backup of the nonvolatile random access memory (NVRAM) configuration information for the library, and certain usage and error statistics files. It cannot be used to read or write a customer cartridge or otherwise access customer data.

The Tape Library Specialist web interface allows the customer to set up an administrator password, and no one without the password can use the Tape Library Specialist web interface to do anything to the library. The Tape Library Specialist web interface also provides several levels of access through roles, and these roles have lower levels of access than the administrator. . See Understanding Roles Defined by the Web Interface in the *IBM System Storage TS3500 Tape Library Operator Guide*.

Security concerns when using the Tape Library Specialist web interface are similar to those of using the operator panel. For example:

- A specialist user could move a cartridge from one location to another within the library, potentially confusing a host application or making a cartridge unavailable by moving it to a different partition.
- A user could re-configure the library, possibly causing problems at the hosts because of changes in partitioning or device IDs.
- A remote user could update library or drive code. However, since the library and drives will ignore any code they don't recognize, the only exposure is to loading down level code.

## Security considerations for the IBM 3584 Tape Library RS/232 Port

This section describes security information for the IBM 3584 RS/232 Port through the debug/CETool interface.

When servicing a 3584 Tape Library, IBM Service Representatives may connect a service terminal (laptop computer) to an RS-232 serial port on the 3584 Tape Library. Serial port J1 (also known as the CETool Port) provides an interface which allows IBM Service Representatives to send messages to the library and receive information from the library. This is a proprietary interface which provides specific commands and only passes the data associated with those commands.

A program called CETool.exe is used to interface with the library through this port. The CETool program provides the following capabilities:

- Update library and/or drive firmware by transferring a library code image or a drive code image from the service terminal to the library.

- Get error/statistics logs and configuration information from the library and/or drive.
- Configure the library settings related to the Call Home facility.
- Backup and restore the library NVRAM (configuration data).
- Correct a tape drive serial number that has been corrupted.
- Specify whether to report five characters or seven characters of the library serial number in inquiry data.

The CETool Port interface does not provide any capability to access data that has been written on the tape cartridges within the library. In addition, the CETool Port interface does not provide any capability to access any Ethernet network connected to the library.

For more information about installing and using the CETool, see the *IBM System Storage TS3500 Tape Library 3584 Maintenance Information* manual.

## Methods of Cleaning Drives

This section describes the methods of cleaning that the 3584 Tape Library uses for its drives.

The head of every tape drive in the 3584 Tape Library must be kept clean to prevent errors caused by contamination. To help you keep the drives clean, IBM provides a cleaning cartridge with the library. Whenever a drive determines that it needs to be cleaned, it alerts you with a message on the library's display or host console. The library uses the cleaning cartridge to clean the drive with whatever cleaning method that you choose. In all methods, cleaning is performed after the data cartridge has been unloaded from the drive and before the next load.

Three methods of cleaning are available:

**Automatic cleaning (preferred)**
Automatic cleaning enables the library to automatically respond to any tape drive's request for cleaning and to begin the cleaning process. The cleaning process is transparent to any host application that uses the library. You can enable or disable automatic cleaning by using the library's operator panel or by using the Tape Library Specialist web interface. The setting is stored in non-volatile memory and becomes the default during subsequent power-on cycles. It applies to all logical libraries that are configured for the 3584 Tape Library. For more information, see the section about enabling or disabling automatic cleaning in the *IBM System Storage TS3500 Tape Library Operator Guide*.

**Host cleaning**
Host cleaning enables the server (mainframe host) to detect the need to clean an Ultrium Tape Drive or 3592 Tape Drive, and to control the cleaning process. Host cleaning with a cleaning cartridge is only supported when you disable automatic cleaning and only for the logical library in which each cleaning cartridge is stored. When you enable automatic cleaning, or when the cleaning cartridge is stored in a different logical library, the host application does not have access to the cleaning cartridge. For more information, see the section about cleaning in your application software's documentation.

**Manual cleaning**
Manual cleaning requires that you select a menu option from the library's operator panel or Tape Library Specialist web interface to perform cleaning

on one or more of the tape drives. Manual cleaning is always supported, regardless of whether automatic cleaning is enabled or disabled. For more information, see the section about performing a manual cleaning operation in the *IBM System Storage TS3500 Tape Library Operator Guide*.

IBM recommends that you make sure that the automatic cleaning method is always enabled.

**Related concepts**

"Web Interface" on page 53
This section gives basic information about the IBM System Storage Tape Library Specialist, the web interface for the 3584 Tape Library.

"Ultrium Cleaning Cartridge" on page 120
This section gives information about the appearance and usage of the IBM TotalStorage LTO Ultrium Cleaning Cartridge.

"3592 Cleaning Cartridge" on page 151
This section gives information about the appearance and usage of the IBM TotalStorage 3592 Enterprise Cleaning Cartridge.

## TapeAlert Support

This section gives an overview of TapeAlert technology, which provides error and diagnostic information about the IBM System Storage TS3500 Tape Library and its drives to the host application.

The 3584 Tape Library is compatible with TapeAlert technology, which provides error and diagnostic information about the drives and the library to the host application. The library provides this information as TapeAlert *flags* that are reported to the application by the SCSI LOG SENSE command.

For a list of the TapeAlert flags for the drives and the library, see the appropriate section in the *IBM System Storage TS3500 Tape Library Operator Guide*.

## SMI-S Support

This section describes how the 3584 Tape Library uses the Storage Management Initiative - Specification (SMI-S) to communicate in a Storage Area Network (SAN) environment.

To communicate with storage devices in a SAN environment, management software, such as the IBM TotalStorage Productivity Center (TPC), uses other software known as the Storage Management Initiative - Specification (SMI-S) Agent for Tape.

New with this release, the 3584 Tape Library provides native support for SMI-S. It is no longer necessary to run the SMI-S agent on a separate Linux machine. All the functions present in the proxy SMI-S agency have been replicated in this embedded version. The library web user accounts are used for authentication. This is used in conjunction with secure socket layer (SSL) functionality.

The embedded SMI-S agent provides the following profiles:

*Table 15. Embedded SIM-S Agent Profiles*

| Profile | Sub Profiles | SMI-S Version |
|---|---|---|
| Server Profile | n/a | 1.1 |

| | | |
|---|---|---|
| Storage Media Library | | 1.1 |
| | Limited Access Port | 1.1 |
| | Chassis | 1.1 |
| | FC Port | 1.1 |
| | Software | 1.1 |
| | Physical Package | 1.1 |

The SMI-S Agent for Tape is designed to be compliant with the Storage Management Initiative - Specification. The SMI-S is a design specification of the Storage Management Initiative (SMI) that was launched by the Storage Networking Industry Association (SNIA). The SMI-S specifies a secure and reliable interface that allows storage management systems to identify, classify, monitor, and control physical and logical resources in a Storage Area Network (SAN). The interface is intended as a solution that integrates the various devices to be managed in a SAN and the tools used to manage them. The SMI-S was developed to address the problems that many vendors face in managing heterogeneous storage environments. It creates a management interface protocol for multi-vendor storage networking products. By enabling the integration of diverse multi-vendor storage networks, the initiative is able to expand the overall market for storage networking technology.

To download the SMI-S Agent for Tape and its user's guide, refer to the *IBM System Storage TS3500 Tape Library Operator Guide* and the section about configuring the library to work with your SMI-S Agent for Tape. For detailed information about the SMI-S Agent for Tape, see the *IBM TotalStorage SMI-S Agent for Tape on Linux Systems Installation Guide*. This document is available through the IBM Publications Center on the web at http://www.elink.ibmlink.ibm.com/public/applications/publications/cgibin/pbi.cgi . To learn more about TPC, go to `http://www-03.ibm.com/servers/storage/software/center/`.

## Drive Performance

This section gives performance data for the Ultrium Tape Drives and the 3592 Tape Drive.

Table 16 provides drive performance of the Ultrium 4, Ultrium 3, Ultrium 2, and Ultrium 1 Tape Drives with different media. Table 17 on page 67 provides drive performance of the TS1120 Tape Drive and 3592 J1A. Table 18 on page 67 provides additional information for 3592 media.

*Table 16. Performance specifications of the Ultrium 4, Ultrium 3, Ultrium 2, and Ultrium 1 Tape Drives*

| Performance Parameter | Tape Drive | | | |
|---|---|---|---|---|
| | **Ultrium 4** | **Ultrium 3** | **Ultrium 2** | **Ultrium 1** |
| Sustained data rate (native)[1] | 120 MB/s (with L4 media) | N/A | N/A | N/A |
| | 80 MB/s (with L3 media) | 80 MB/s (with L3 media) | N/A | N/A |
| | 35 MB/s (with L2 media) | 35 MB/s (with L2 media) | 35 MB/s (with L2 media) | N/A |
| | N/A | 20 MB/s (with L1 media) | 20 MB/s (with L1 media) | 15 MB/s (with L1 media) |
| Sustained data rate (compressed at 2:1 compression)70 | 240 MB/s (with L4 media) | N/A | N/A | N/A |
| | 160 MB/s (with L3 media) | 160 MB/s (with L3 media) | N/A | N/A |
| | 70 MB/s (with L2 media) | 70 MB/s (with L2 media) | 70 MB/s (with L2 media) | N/A |
| | N/A | 40 MB/s (with L1 media) | 40 MB/s (with L1 media) | 30 MB/s (with L1 media) |
| Maximum sustained data rate (at maximum compression) | 340 MB/s (read)<br>350 MB/s (write) | 175 MB/s | 110 MB/s | 60 MB/s |
| Burst data rate for Fibre Channel drives | 400 MB/s | 400 MB/s | 200 MB/s | 100 MB/s |
| Burst data rate for Low Voltage Differential (LVD) SCSI drives | N/A | N/A | 160 MB/s (Ultra160) | 80 MB/s (Ultra2) |
| Burst data rate for High Voltage Differential (HVD) SCSI drives | N/A | N/A | 40 MB/s (Ultra) | 40 MB/s (Ultra) |
| Time to load, thread, and initialize a cartridge | 12 seconds | 15 seconds | 15 seconds | 20 seconds |
| Time to unload cartridge from load point | 17 seconds | 15 seconds | 15 seconds | 18 seconds |
| Average search time to first byte of data (load time) | 57 seconds | 49 seconds | 49 seconds | 73 seconds |

**Notes:** N/A = not applicable.

1. All sustained data rates are dependent on the capabilities of the interconnect (for example, an Ultra SCSI bus is limited to less than 40 MB/s).

*Table 17. Performance specifications of the TS1120 Tape Drive and the 3592 J1A*

| Performance Parameter | Tape Drive | |
|---|---|---|
| | **TS1120 Tape Drive** | **3592 J1A Tape Drive** |
| Sustained data rate (native)[1] | 100 MB/s (in TS1120 Tape Drive format) | N/A |
| | 50 MB/s (in J1A format) | 40 MB/s |
| Sustained data rate (compressed at 2:1 compression) | 200 MB/s (in TS1120 Tape Drive format) | N/A |
| | 100 MB/s (in J1A format) | 80 MB/s |
| Maximum sustained data rate (at maximum compression) | 260 MB/s | 110 MB/s |
| Burst data rate for Fibre Channel drives | 400 MB/s | 200 MB/s |
| Load-to-ready time | 13 seconds | 19 seconds |
| Unload time | 23 seconds | 21 seconds |
| | 40 seconds[3] | |
| Maximum rewind time | 66 seconds (100% scaled JA) | 77 seconds (100% scaled JA) |
| | 89 seconds (100% scaled JB) | Not supported |
| | 18 seconds (20% scaled JA) | 18 seconds (20% scaled JA) |
| | 24 seconds (20% scaled JB) | Not supported |
| Average rewind time | 33 seconds (100% scaled JA) | N/A |
| | 46 seconds (100% scaled JB) | Not supported |
| | 11 seconds (20% scaled JA) | N/A |
| | 15 seconds (20% scaled JB) | Not supported |
| Average block locate time from load point | See Table 18 | See Table 18 |

**Notes:** N/A = not applicable.

1. All sustained data rates are dependent on the entire data path (host system to tape drive).
2. After an encryption key change, a subsequent unload is longer.

*Table 18. Average block locate time from load point for 3592 Tape Cartridge in 3592 Tape Drives*

| Type of 3592 Tape Cartridge | Average Block Locate Time from Load Point[1] | | Comments[2] |
|---|---|---|---|
| | **TS1120 Tape Drive** | **3592 J1A Tape Drive** | |
| JA cartridge type - 100 % scaled | 33 seconds | 40 seconds | JA cartridge type at full, unscaled capacity 300 GB J1A format; 500 GB E05 or E05-EF format. |
| JA cartridge type - 20% scaled | 11 seconds | 12 seconds | JA cartridge type capacity scaled with 0x35 setting, 60 GB J1A format; 100 GB E05 or E05-EF format. |
| JB cartridge type - 100 % scaled | 46 seconds | Not supported | JB cartridge type at full, unscaled capacity 700 GB E05 or E05-EF format. |
| JB cartridge type - 20% scaled | 15 seconds | Not supported | JB cartridge type capacity scaled with 0x35 setting, 140 GB E05 or E05-EF format. |

*Table 18. Average block locate time from load point for 3592 Tape Cartridge in 3592 Tape Drives (continued)*

| Type of 3592 Tape Cartridge | Average Block Locate Time from Load Point[1] | | Comments[2] |
|---|---|---|---|
| | TS1120 Tape Drive | 3592 J1A Tape Drive | |
| JJ cartridge type | 11 seconds | 12 seconds | Economy - short length 60 GB J1A format; 100 GB E05 or E05-EF format. |
| JW cartridge type | 33 seconds | 40 seconds | WORM - standard length 300 GB J1A format; 500 GB E05 or E05-EF format. |
| JX cartridge type | 46 seconds | Not supported | Extended WORM - 700 GB E05 or E05-EF format. |
| JR cartridge type | 11 seconds | 12 seconds | Economy WORM - short length 60 GB J1A format; 100 GB E05 or E05-EF format. |

**Notes:**

- For an encrypted format, an additional 5 seconds may be required to obtain a encryption key to read the first block accessed on the cartridge.
- Encrypted format is referred to as E05-EF.

By using the built-in data-compression capability of the tape drives, you can achieve greater data rates than the native data transfer rate. However, the actual throughput is a function of many components, such as the host system processor, disk data rate, block size, data compression ratio, interconnect (for example, SCSI or Fibre Channel), and system or application software.

For maximum performance with SCSI drives, multiple SCSI buses may be required and the 3584 Tape Library devices must be the only target devices that are active on each SCSI bus. For more information, see the section about the SCSI interface in the *IBM System Storage TS3500 Tape Library Operator Guide*.

## Library Performance

This section explains how performance values such as cartridge inventory times, mount performance, and cartridge move time were obtained for the 3584 Tape Library.

Performance values for the 3584 Tape Library, whether measured on test systems or modeled through simulations, are based on a fixed set of workload assumptions to ensure accurate comparisons; however, the results were not evaluated in all production environments. Thus, the performance values show the relative performance of the systems and may not be absolute indicators of performance in your specific environment.

Some of the specific assumptions may not pertain to a given operating environment. Actual performance may vary. Accordingly, the performance information for this product does not constitute a performance guarantee or warranty. Verify that the performance of the library is acceptable in your specific environment.

The sections that follow describe the library's performance.

**Related concepts**

"Dual Accessors and Service Bays" on page 7

## Cartridge Inventory Times

The typical time required for the 3584 Tape Library to inventory cartridges is less than 60 seconds per frame.

A cartridge inventory operation includes a check to determine whether each cartridge storage slot in the library is empty or full, and a scan of the bar code labels. An inventory occurs whenever you:

- Power-on the 3584 Tape Library
- Issue the SCSI Initialize Element Status with Range command
- Select the appropriate menus from the Tape Library Specialist web interface (see the section about performing an inventory of the library in the *IBM System Storage TS3500 Tape Library Operator Guide*)
- Go to the library's operator panel and select Inventory from the Manual Operations menu
- Close the front door after manually accessing the inventory

**Note:** The 3584 Tape Library tracks the logical location of all of its elements by performing an automatic inventory as required (if you issue the SCSI Initialize Element Status command, it is allowed but ignored). The automatic inventory improves application audit performance.

When the library performs an automatic inventory because the front door was closed, the inventory occurs only for those frames whose doors have been opened.

## Mount Performance and Cartridge Move Time

Mount per hour is a measure of the overall capability of the cartridge accessor and tape drives. It is defined as the number of cartridges that the 3584 Tape Library can mount in one hour. A mount, often called the mount/demount cycle, involves removing the cartridge from a drive, returning it to its storage slot, collecting another cartridge from a random storage slot, moving it to the drive, and loading the cartridge into the drive.

Move time is the time required for the cartridge accessor to pick a cartridge from a random slot, move the cartridge to a drive, pivot (if required), and insert the cartridge into the drive.

Table 19 shows the mount performance and average move time for the 3584 Tape Library. The table does not apply to libraries that contain dual accessors.

*Table 19. Mount performance and move time for drives in a 3584 Tape Library without dual accessors*. This information does not apply to libraries that contain dual accessors.

| Library Configuration | Drives in Frame 1 | | Drives in Center Frame | |
|---|---|---|---|---|
| | Mounts Per Hour | Average Move Time in Seconds | Mounts Per Hour | Average Move Time in Seconds |
| 1 frame | 550 | 2.7 | N/A | N/A |
| 2 frames | 520 | 2.6 | N/A | N/A |
| 4 frames | 410 | 3.3 | 430 | 2.9 |
| 6 frames | 350 | 3.8 | 380 | 3.3 |

*Table 19. Mount performance and move time for drives in a 3584 Tape Library without dual accessors (continued).* This information does not apply to libraries that contain dual accessors.

| Library Configuration | Drives in Frame 1 | | Drives in Center Frame | |
|---|---|---|---|---|
| | Mounts Per Hour | Average Move Time in Seconds | Mounts Per Hour | Average Move Time in Seconds |
| 8 frames | 310 | 4.4 | 350 | 3.7 |
| 12 frames | 255 | 5.3 | 300 | 4.3 |
| 16 frames | 215 | 6.2 | 260 | 4.7 |
| Specifications were produced from models, but are consistent with test results. | | | | |

Table 20 shows the mount performance for the 3584 Tape Library. The table applies to libraries that contain dual accessors.

*Table 20. Mount performance for drives in a 3584 Tape Library with dual accessors.* This information applies to libraries that contain dual accessors.

| Library Configuration (Active Frames[1]) | Mounts Per Hour[2] |
|---|---|
| 4 frames | 1000 |
| 6 frames | 900 |
| 8 frames | 800 |
| 12 frames | 700 |
| 16 frames | 600 |

**Notes:**

1. Except for service bays, active frames are all frames in a dual-accessor library.
2. Specifications were produced from models, but are consistent with test results. This data assumes that the library is partitioned into at least two logical libraries such that each of the cartridges located in the two zones are mounted in drives within each zone with no accessor path overlap. Detailed performance data and tips about maximizing the performance of a 3584 Tape Library are available in the *IBM TotalStorage 3584 Tape Library Performance* white paper. For information about this document, contact your IBM Representative.

# Chapter 2. Physical Planning Specifications

For optimum operation of the 3584 Tape Library, make sure that you place it in an environment that meets the requirements described in the following sections. The library is installed by an IBM Service Representative.

## Height and Length of Library

This section gives information about the casters and leveling jackscrews that attach to the 3584 Tape Library and affect its height. It also introduces how to calculate the length of the library.

Each frame of the 3584 Tape Library has a set of casters and 4 leveling jackscrews. The nominal height from the bottom of the jackscrews to the top of the frame is 1840 mm (72.4 in.) and can be varied by ±40 mm (±1.6 in.). The shipping height of the library (on its casters and with jackscrews raised) is 1800 mm (70.9 in.).

To calculate the length of your fully configured library, go to the section about clearance specifications for models of the 3584 Tape Library.

**Related reference**

"Clearance Specifications for Models of the Library" on page 80
This section helps you to calculate the length of a 3584 Tape Library and the clearances for service.

## Physical Specifications for Models L22 and D22

This section gives physical specifications (such as height, width, depth, and weight) of Models L22 and D22 of the 3584 Tape Library.

*Table 21. Physical characteristics of the 3584 Tape Library, Models L22 and D22*

| **Physical Characteristic** | **Measurement** | |
|---|---|---|
| Height of L22 and D22 frames (on casters) | 1800 mm (70.9 in.) | |
| Width of L22 frame with covers | 782 mm (30.8 in.) | |
| Width of L22 or D22 frame without covers[1] | 725 mm (28.5 in.) | |
| Depth of L22 or D22 frame (including front and rear doors) | 1212 mm (47.72 in.) | |
| Weight of second accessor | 15.1 kg (33.3 lbs) | |
| | **Model L22** | **Model D22** |
| Weight of base frame with 1 drive and 0 cartridges[2] | 364 kg (802 lb) | N/A[3] |
| Weight of base frame with 12 drives and maximum cartridges (238 for 3592 Tape Cartridges)[2] | 534 kg (1178 lb) | N/A |
| Weight of expansion frame with 0 drives and 0 cartridges[2] | N/A | 270 kg (596 lb) |
| Weight of expansion frame with 12 drives and maximum cartridges (360 for 3592 Tape Cartridges)[2] | N/A | 494 kg (1089 lb) |

**Notes:**

1. Frame width only. Additional interframe spacing of 30 mm (1.2 in.) is required.
2. The weight with cartridges assumes a cartridge weight of .242 kg (.534 lb) for a standard 3592 Tape Cartridge. The actual weight of the library varies, depending on the configuration and cartridge capacity.
3. N/A = Not applicable.

## Physical Specifications for Models L23 and D23

This section gives physical specifications (such as height, width, depth, and weight) of Models L23 and D23 of the 3584 Tape Library.

*Table 22. Physical characteristics of the 3584 Tape Library, Models L23 and D23*

| **Physical Characteristic** | **Measurement** | |
|---|---|---|
| Height of L23 and D23 frames (on casters) | 1800 mm (70.9 in.) | |
| Width of L23 frame with covers | 782 mm (30.8 in.) | |
| Width of L23 or D23 frame without covers[1] | 725 mm (28.5 in.) | |
| Depth of L23 or D23 frame (including front and rear doors) | 1212 mm (47.72 in.) | |
| Weight of second accessor | 15.1 kg (33.3 lbs) | |
| | **Model L23** | **Model D23** |
| Weight of base frame with 1 drive and 0 cartridges[2] | 361 kg (796 lb) | N/A |
| Weight of base frame with 12 drives and maximum (238[2]) 3592 Tape Cartridges | 489 kg (1079 lb) | N/A |
| Weight of expansion frame with 0 drives and 0 cartridges and 4 I/O stations[2] | N/A | 296 kg (645 lb) |
| Weight of expansion frame with 12 drives and maximum (360[2]) 3592 Tape Cartridges | N/A | 451 kg (994 lb) |

**Notes:** N/A = Not applicable.

1. Frame width only. Additional interframe spacing of 30 mm (1.2 in.) is required.
2. The weight with cartridges assumes a cartridge weight of .242 kg (.534 lb) for a standard 3592 Tape Cartridge. The actual weight of the library varies, depending on the configuration and cartridge capacity.

## Physical Specifications for Models L32 and D32

This section gives physical specifications (such as height, width, depth, and weight) of Models L32 and D32 of the 3584 Tape Library.

*Table 23. Physical characteristics of the 3584 Tape Library, Models L32 and D32*

| **Physical Characteristic** | **Measurement** | |
|---|---|---|
| Height of L32 and D32 frames (on casters) | 1800 mm (70.9 in.) | |
| Width of frame with covers | 748 mm (29.4 in.) | |
| Width of frame without covers[1] | 725 mm (28.5 in.) | |
| Depth of L32 or D32 frame (including front and rear doors) | 1520 mm (59.8 in.) | |
| | **Model L32** | **Model D32** |
| Weight of base frame with 1 drive and 0 cartridges[2] | 425 kg (937 lb) | N/A |
| Weight of base frame with 12 drives and maximum cartridges (227 for Ultrium Tape Cartridges)[2] | 570 kg (1256 lb) | N/A |
| Weight of expansion frame with 0 drives and 0 cartridges[2] | N/A | 355 kg (784 lb) |
| Weight of expansion frame with 12 drives and maximum cartridges (396 Ultrium Tape Cartridges)[2] | N/A | 558 kg (1229 lb) |

**Notes:** N/A = Not applicable.

1. Frame width only. Additional interframe spacing of 30 mm (1.2 in.) is required.
2. The weight with cartridges assumes a cartridge weight of .206 kg (.454 lb) for a standard LTO Ultrium Tape Cartridge. The actual weight of the library varies, depending on the configuration and cartridge capacity.

## Physical Specifications for Models L52 and D52

This section gives physical specifications (such as height, width, depth, and weight) of Models L52 and D52 of the 3584 Tape Library.

*Table 24. Physical characteristics of the 3584 Tape Library, Models L52 and D52*

| **Physical Characteristic** | **Measurement** | |
|---|---|---|
| Height of L52 and D52 frames (on casters) | 1800 mm (70.9 in.) | |
| Width of L52 frame with covers | 782 mm (30.8 in.) | |
| Width of L52 or D52 frame without covers[1] | 725 mm (28.5 in.) | |
| Depth of L52 or D52 frame (including front and rear doors) | 1212 mm (47.72 in.) | |
| Weight of second accessor | 15.1 kg (33.3 lbs) | |
| | **Model L52** | **Model D52** |
| Weight of base frame with 1 drive and 0 cartridges[2] | 366 kg (806 lb) | N/A |
| Weight of base frame with 12 drives and maximum cartridges (262 for Ultrium Tape Cartridges)[2] | 526 kg (1160 lb) | N/A |
| Weight of expansion frame with 0 drives and 0 cartridges[2] | N/A | 274 kg (604 lb) |
| Weight of expansion frame with 12 drives and maximum cartridges (396 for Ultrium Tape Cartridges)[2] | N/A | 483 kg (1065 lb) |

**Notes:** N/A = Not applicable.

1. Frame width only. Additional interframe spacing of 30 mm (1.2 in.) is required.
2. The weight with cartridges assumes a cartridge weight of .206 kg (.454 lb) for a standard LTO Ultrium Tape Cartridge. The actual weight of the library varies, depending on the configuration and cartridge capacity.

## Physical Specifications for Models L53 and D53

This section gives physical specifications (such as height, width, depth, and weight) of Models L53 and D53 of the 3584 Tape Library.

*Table 25. Physical characteristics of the 3584 Tape Library, Models L53 and D53*

| Physical Characteristic | Measurement | |
|---|---|---|
| Height of L53 and D53 frames (on casters) | 1800 mm (70.9 in.) | |
| Width of L53 frame with covers | 782 mm (30.8 in.) | |
| Width of L53 or D53 frame without covers[1] | 725 mm (28.5 in.) | |
| Depth of L53 or D53 frame (including front and rear doors) | 1212 mm (47.72 in.) | |
| Weight of second accessor | 15.1 kg (33.3 lbs) | |
| | **Model L53** | **Model D53** |
| Weight of base frame with 1 drive and 0 cartridges[2] | 363 kg (799 lb) | N/A |
| Weight of base frame with 12 drives and maximum (262[2]) Ultrium Tape Cartridges | 481 kg (1061 lb) | N/A |
| Weight of expansion frame with 0 drives and 0 cartridges and 4 I/O stations[2] | N/A | 296 kg (654 lb) |
| Weight of expansion frame with 12 drives and maximum (396[2]) Ultrium Tape Cartridges | N/A | 440 kg (970 lb) |

**Notes:** N/A = Not applicable.

1. Frame width only. Additional interframe spacing of 30 mm (1.2 in.) is required.
2. The weight with cartridges assumes a cartridge weight of .242 kg (.534 lb) for a standard 3592 Tape Cartridge. The actual weight of the library varies, depending on the configuration and cartridge capacity.

## Physical Specifications for HA1 Frame

This section gives the height, width, depth, and weight of the HA1 frame of the 3584 Tape Library.

If your 3584 Tape Library contains a second accessor, the following are the physical specifications for the HA1 frame (service bay A).

*Table 26. Physical characteristics of the HA1 frame (service bay A)*

| Physical Characteristic | Measurement |
|---|---|
| Height of HA1 frames (on casters) | 1800 mm (70.9 in.) |
| Width of HA1 frame without covers (see Note) | 725 mm (28.5 in.) |
| Depth of HA1 frame | 1212 mm (47.72 in.) |
| Weight of HA1 frame | 261 kg (575 lb) |
| **Note:** Frame width only. Additional interframe spacing of 30 mm (1.2 in.) is required. | |

## Floor Requirements

The section specifies the required conditions of a floor on which a 3584 Tape Library is installed.

Install the library on a raised or solid floor. The floor must have a smooth surface and, if raised, must not have ventilation panels beneath the leveling jackscrews. If carpeted, ensure that the carpet is approved for computer-room applications.

To accommodate unevenness in the floor, you can raise or lower the leveling jackscrews to the following specifications:

- Maximum allowable variance must not exceed 7 mm (.27 in.) per 76 mm (3 in.).
- Maximum out-of-level condition must not exceed 40 mm (1.6 in.) over the entire length and width of the library.

The floor on which the 3584 Tape Library is installed must be able to support:

- Up to 4.8 kilograms per square centimeter (68.6 lb per square inch) of point loads exerted by the leveling jackscrews
- Up to 211 kilograms per square meter (43.4 pounds per square foot) of overall floor loading

The number of point loads exerted depends on the number of frames that make up the library. There are four point loads per frame (located at the corners of each frame).

## Delivery Route

This section defines the conditions of the route by which the 3584 Tape Library will be delivered.

Check the delivery route that the library must travel from your loading dock to the installation location. Ensure that the library will fit through all doors, hallways, and elevators.

You must remove the library from the pallet and place it at the final location before you call your IBM Service Representative to arrange for the installation. Refer to the instructions on the shipping carton for correct unpacking procedures.

## Delivery and Subsequent Transportation of the Equipment


Only professional movers or riggers should transport the equipment. The customer should prepare his environment to accept the new product based on the installation planning information provided, with assistance from an IBM Installation Planning Representative (IPR) or IBM-authorized service provider. In anticipation of the equipment delivery, the final installation site should be prepared in advance such that professional movers or riggers can transport the equipment to the final installation site within the computer room. If, for some reason, this is not possible at the time of delivery, the customer will need to make arrangements to have professional movers or riggers return to finish the transportation at a later date. The customer is also responsible for using professional movers or riggers in the case of equipment relocation or disposal. The IBM-authorized service provider will only perform minimal frame repositioning within the computer room, as needed, to perform required service actions.

## Security

This section recommends where to locate the 3584 Tape Library to ensure controlled access. It also discusses the library's locking mechanisms.

To prevent unauthorized access to data, IBM recommends locating the 3584 Tape Library and all shelf-resident cartridges in an area where access is controlled.

You are responsible for the physical security of the library, the cartridges contained within the library, and shelf-resident cartridges. The I/O stations have locking mechanisms that prevent you from opening an I/O station door when the accessor is manipulating cartridges in a station.

The library's front door has a keylock. The keylock is the same for every front door, and the keys are shipped with the library. The library's rear door has a different keylock. The keylock is the same for every rear door and the keys are shipped with the library.

You are also responsible for evaluating, selecting, and implementing security features, administrative procedures, and appropriate controls in application systems and communication facilities.

Data security is the responsibility of the application program controlling the library. If you are an administrator or superuser, you can enable or disable security for the operator panel. If you enable security, you can provide further protection by creating a password. You can also specify a timeout period which, when exceeded, will cause the operator panel to lock. For more information, see the *IBM System Storage TS3500 Tape Library Operator Guide* and refer to the sections about enabling or disabling security for the operator panel and locking and unlocking the operator panel.

## Move Restraints

This section discusses the location of points on the 3584 Tape Library that you can use to restrain the unit from potential movement (such as an earthquake).

Should you want to restrain the 3584 Tape Library from potential movement (for example, from earthquake), restraining points are located at the bottom of the unit (see **1** in Figure 14). Affix restraints to each of the four points (two on each long side) and secure the library as needed. Figure 15 on page 82 and Figure 16 on page 83 show the locations of the four points. The restraint points provide threaded holes, thread size M10.

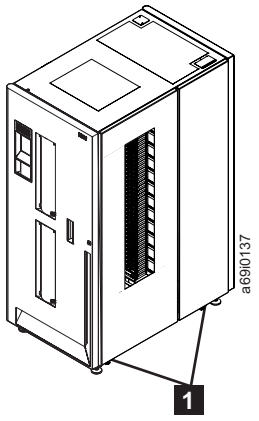



*Figure 14. Location of restraining points.* Two restraining points are located on each long side of the library.

## Clearance Specifications for the Library

This section discusses the space that is required for you or IBM Service Representatives to use or work on the 3584 Tape Library.

Plan for appropriate clearances around your 3584 Tape Library to allow you and IBM Service Representatives to use and work on it. Operator clearance is required in front of all frames; service clearance is required as follows:

- In front of and behind all frames.
- At one or both ends of the library, depending on the following conditions:
  - At one end if the library contains fewer than three frames.
  - At both ends if the library contains three or more frames; this access allows the IBM Service Representative to see the two-character display on the left of the cartridge accessor.

Ensure that clearance space does not overlap into walkways and other access areas. As you plan clearances, be sure to leave room on the library's right end (as you face the front door) for future expansion. Libraries with three or more frames also require service clearance on the left end, so if you expand the library to three or more frames be sure to leave room on the library's left end.

## Clearance Specifications for Models of the Library

This section helps you to calculate the length of a 3584 Tape Library and the clearances for service.

Table 27 shows the length of the 3584 Tape Library both with and without service bays and including side clearances; Figure 15 on page 82 shows the location of the clearances for Models L22, D22, L23, D23, L52, D52, L53, D53, and the service bays. Figure 16 on page 83 shows the location of the clearances for Models L32 and D32.

*Table 27. Clearance requirements for the 3584 Tape Library*. The table gives the clearances for a library both with and without service bays.

| Number of Active Frames | Length of A in Figure 15 on page 82 or in Figure 16 on page 83 (Not Including Service Bays) (see Notes 1 and 2) | Length of A in Figure 15 on page 82 or in Figure 16 on page 83 (Including Service Bays) (see Notes 1 and 2) |
|---|---|---|
| 1 | 1544 mm (60.79 in.) | Not applicable |
| 2 | 2298 mm (90.47 in.) | 4569 mm (179.88 in.) |
| 3 | 3815 mm (150.20 in.) | 5324 mm (209.61 in.) |
| 4 | 4569 mm (179.88 in.) | 6079 mm (239.33 in.) |
| 5 | 5324 mm (209.61 in.) | 6833 mm (269.02 in.) |
| 6 | 6079 mm (239.33 in.) | 7588 mm (298.74 in.) |
| 7 | 6833 mm (269.02 in.) | 8342 mm (328.43 in.) |
| 8 | 7588 mm (298.74 in.) | 9097 mm (358.15 in.) |
| 9 | 8342 mm (328.43 in.) | 9852 mm (387.87 in.) |
| 10 | 9097 mm (358.15 in.) | 10606 mm (417.56 in.) |
| 11 | 9852 mm (387.87 in.) | 11361 mm (447.28 in.) |
| 12 | 10606 mm (417.56 in.) | 12115 mm (476.97 in.) |

*Table 27. Clearance requirements for the 3584 Tape Library (continued).* The table gives the clearances for a library both with and without service bays.

| Number of Active Frames | Length of A in Figure 15 on page 82 or in Figure 16 on page 83 (Not Including Service Bays) (see Notes 1 and 2) | Length of A in Figure 15 on page 82 or in Figure 16 on page 83 (Including Service Bays) (see Notes 1 and 2) |
|---|---|---|
| 13 | 11361 mm (447.28 in.) | 12870 mm (506.69 in.) |
| 14 | 12115 mm (476.97 in.) | 13625 mm (536.42 in.) |
| 15 | 12870 mm (506.69 in.) | 14379 mm (566.10 in.) |
| 16 | 13625 mm (536.42 in.) | 15134 mm (595.3 in.) |

**Note:**

1. For Models L22, D22, L23, D23, L52, D52, L53, D53, and the service bays, the size of a clearance is measured by its depth from the outside of the frame and its width along the library. At the ends of the library, the depth of the service clearance is measured from the front of the library to the rear. In Figure 15 on page 82, B refers to the distance (2737 mm or 107.8 in.) that is the total service clearance between the front and the rear of the library.
2. For Models L32 and D32, the size of a clearance is measured by its depth from the outside of the frame and its width along the library. At the ends of the library, the depth of the service clearance is measured from the front of the library to the rear. In Figure 16 on page 83, B refers to the distance (3044 mm or 119.8 in.) that is the total service clearance between the front and the rear of the library.

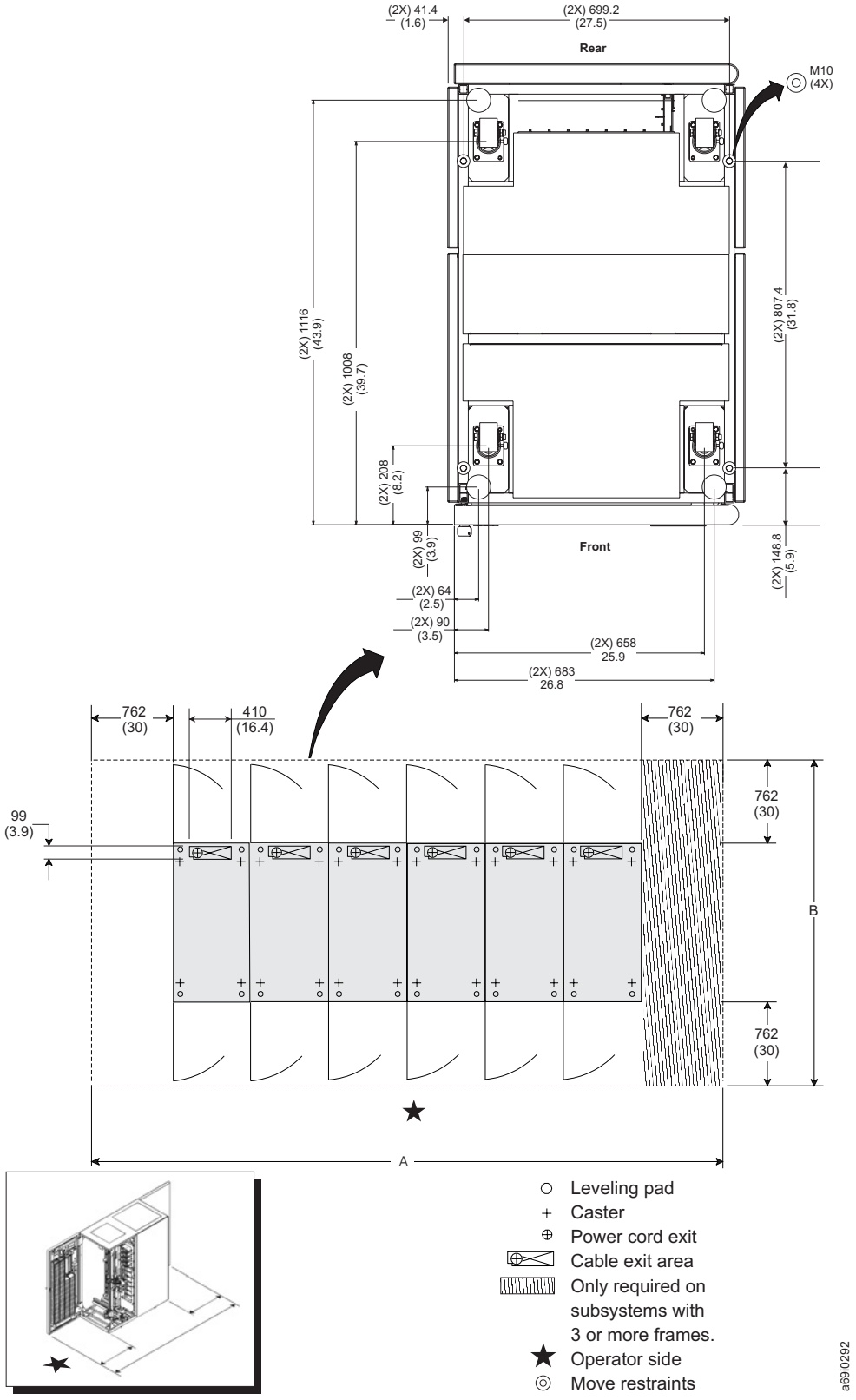



*Figure 15. Size of operator and service clearances for the IBM System Storage TS3500 Tape Library, Models L22, D22, L23, D23, L52, D52, L53, D53, and the service bays.* The top measurements are in millimeters; the bottom measurements are in inches. The service clearance area (and operator clearance area at the front of both frames) is denoted by dotted lines.

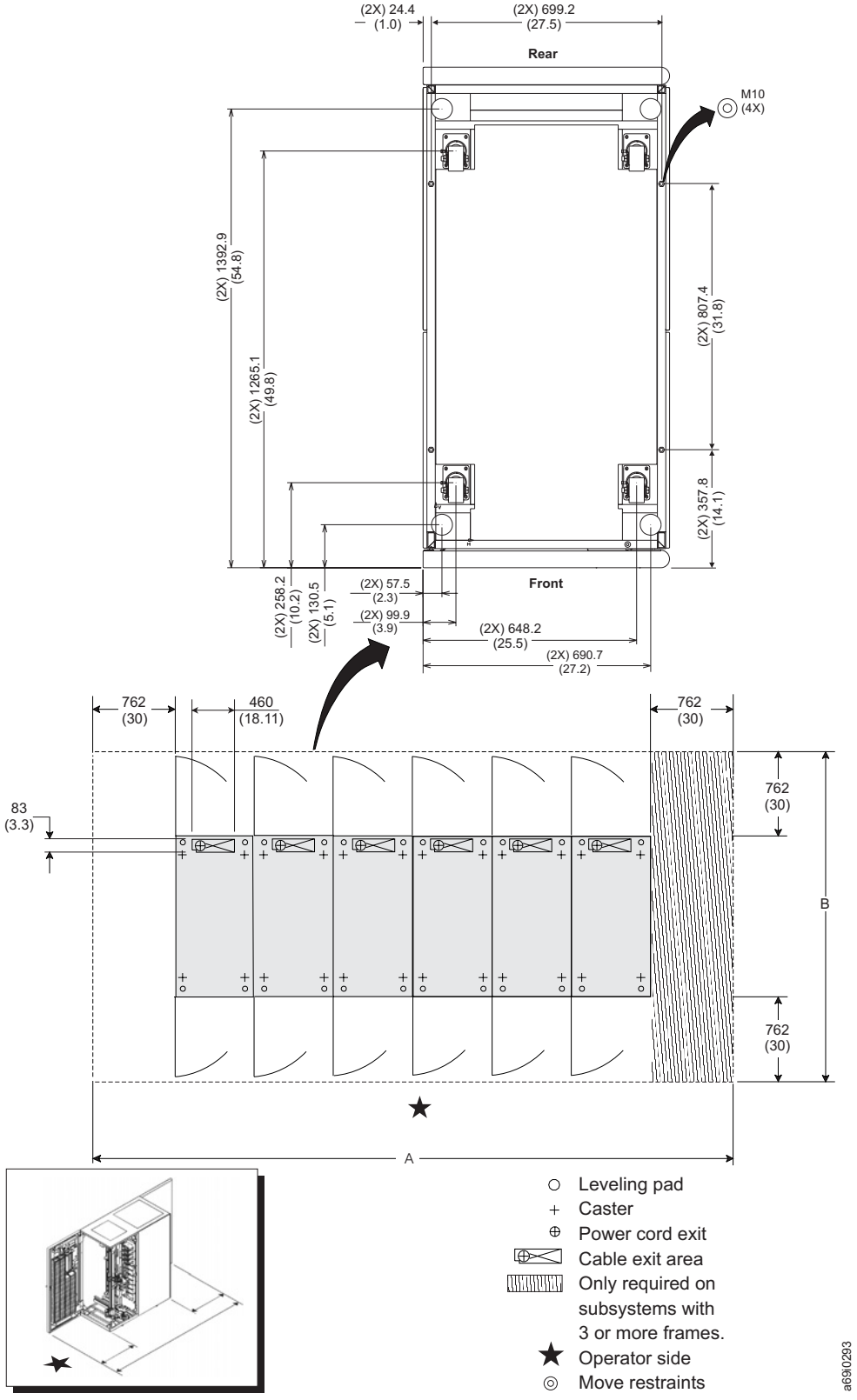



*Figure 16. Size of operator and service clearances for the IBM System Storage TS3500 Tape Library, Models L32 and D32.* The top measurements are in millimeters; the bottom measurements are in inches. The service clearance area (and operator clearance area at the front of both frames) is denoted by dotted lines.

## Routing Fibre Channel Cables Through the Top of a Frame

This section describes how to route Fibre Channel cables from servers through the top of a frame in the 3584 Tape Library.

As an alternative to routing Fibre Channel cables from servers to the bulkhead at the bottom rear of the 3584 Tape Library, you can route the cables through the top of the library frame (see **1** in Figure 17).

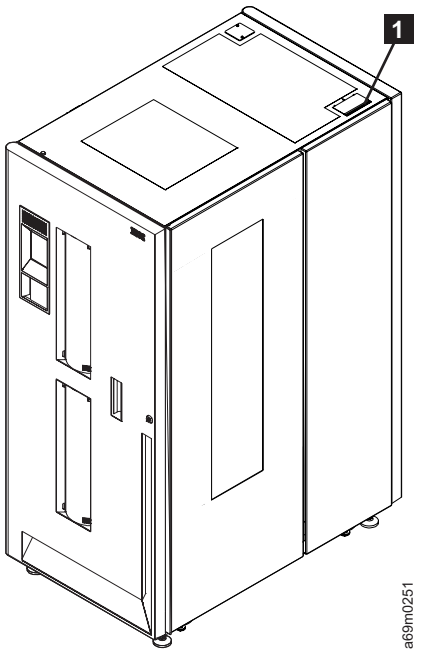



*Figure 17. Opening for routing Fibre Channel cables from servers through the top of a frame*

To route the cables through the top of a frame, perform the following procedure.

1. Open the cable access door at the top of the frame (see **1** in Figure 18).

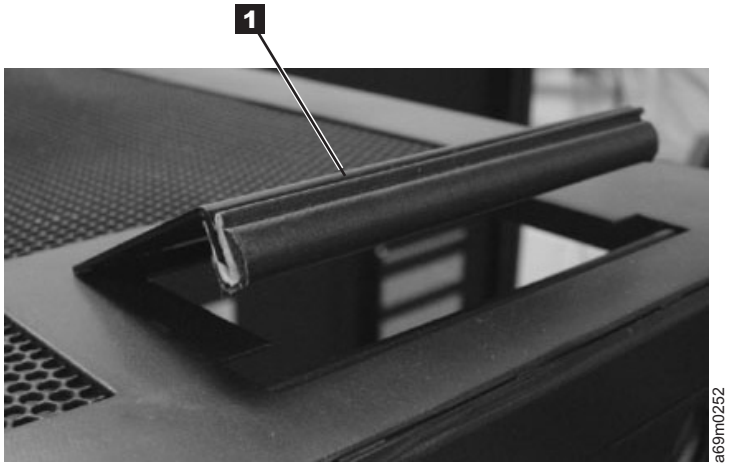



*Figure 18. Opening the cable access door at the top of a frame*

2. Route Fibre Channel cables from the servers into the cable access door and down to the bulkhead assembly.

3. Open the rear door of the frame.
4. Attach the Fibre Channel cables to the appropriate location in the bulkhead.
5. Use the Velcro ties to secure the Fibre Channel cables along the left side of the frame.
6. After you route the cables inside the frame, position them as shown in Figure 19

   **Note:** Ensure that all Fibre Channel cables are parallel to each other as shown. Do not cross one cable over the other, as this could damage the cable.

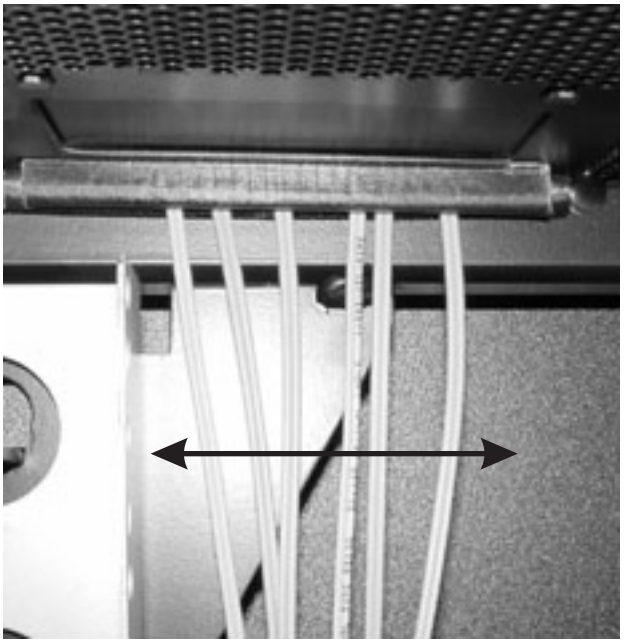



*Figure 19. Positioning the Fibre Channel cable inside the frame*

7. Position all of the Fibre Channel cables outside the frame as shown in Figure 20 on page 86.


*Figure 20. Positioning the Fibre Channel cable outside the frame*

8. Carefully close the cable access door. Padding on the door holds the cables in place safely and securely.

## Routing Cables Through the Top for Installations on a Solid Floor

This section gives information about the placement of power cables through the top of a 3584 Tape Library that is installed on a non-raised floor.

When your 3584 Tape Library is installed on a solid (non-raised) floor, your IBM Service Representative can route the power cables through the top of the library. For information about this procedure refer to the section titled "Attach Power and Bring-Up," located in the Installation chapter of the *IBM System Storage TS3500 Tape Library Maintenance Information* guide.

## Fire Suppression for the Library

This section discusses how the 3584 Tape Library is constructed to allow third-party installation of fire-suppression equipment.

**Attention:** A fire-suppression system is the responsibility of the customer. The customer's own insurance underwriter, local fire marshal, or a local building inspector, or both, should be consulted in selecting a fire-suppression system that provides the correct level of coverage and protection. IBM designs and manufactures equipment to internal and external standards that require certain environments for reliable operation. Because IBM does not test any equipment for compatibility with fire-suppression systems, IBM does not make compatibility claims of any kind nor does IBM provide recommendations on fire-suppression systems.

The 3584 Tape Library allows for mechanical connections to permit third-party installation of fire-suppression equipment. When deciding whether to implement fire-suppression equipment, refer to your local and national standards and regulations.

The sections that follow describe the fire-suppression design for Models L32 and D32, and for Models L22, D22, L52, D52, and the HA1 frame.

## Fire Suppression for Models L32 and D32

Each L32 or D32 frame in the 3584 Tape Library has an allowable area on the top that may be cut to allow entrance of pipes, conduits, or other parts (see **1** in Figure 21). The area is 82.7 mm (3.3 in.) wide by 504.7 mm (19.8 in.) long. The equipment can extend through the top cover for a maximum intrusion of 175 mm (6.9 in.).

**Note:** Do not cut the opening larger than required.

Within the frame, a depth of 175 mm (6.9 in.) is available for installing pipes, sensors, sprinklers, or other components. Piping, conduits, and cabling can be run from frame to frame only if they stay within an allowable area (see **2** in Figure 21) and do not interfere with library components.

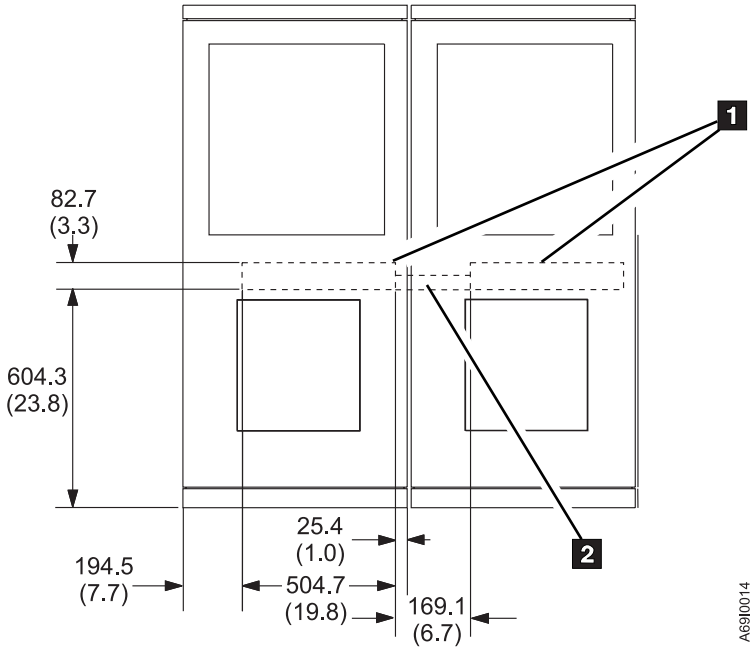



*Figure 21. Allowable area for mounting fire-suppression equipment (top view of Model L32 or D32 frames)*

## Fire Suppression for the HA1 Frame and Other Models

Each L22, D22, L23, D23, L52, D52, L53, D53, and HA1 frame in the 3584 Tape Library has an allowable area on the top that may be cut to allow entrance of pipes, conduits, or other parts (see **1** in Figure 22 on page 88). The area is 82.7 mm (3.3 in.) wide by 504.7 mm (19.8 in.) long. The equipment can extend through the top cover for a maximum intrusion of 175 mm (6.9 in.).

**Note:**

1. Do not cut the opening larger than required.
2. Models L22, D22, L23, D23, L52, D52, L53, D53, and the HA1 frame are equipped with a single perforated receptacle ( **2** in Figure 22 on page 88) in diameters of both 30 mm (1.2 in.) and 50 mm (2.0 in.).

Within the frame, a depth of 175 mm (6.9 in.) is available for installing pipes, sensors, sprinklers, or other components. Piping, conduits, and cabling can be run from frame to frame only if they stay within an allowable area (see **3** in Figure 22) and do not interfere with library components.

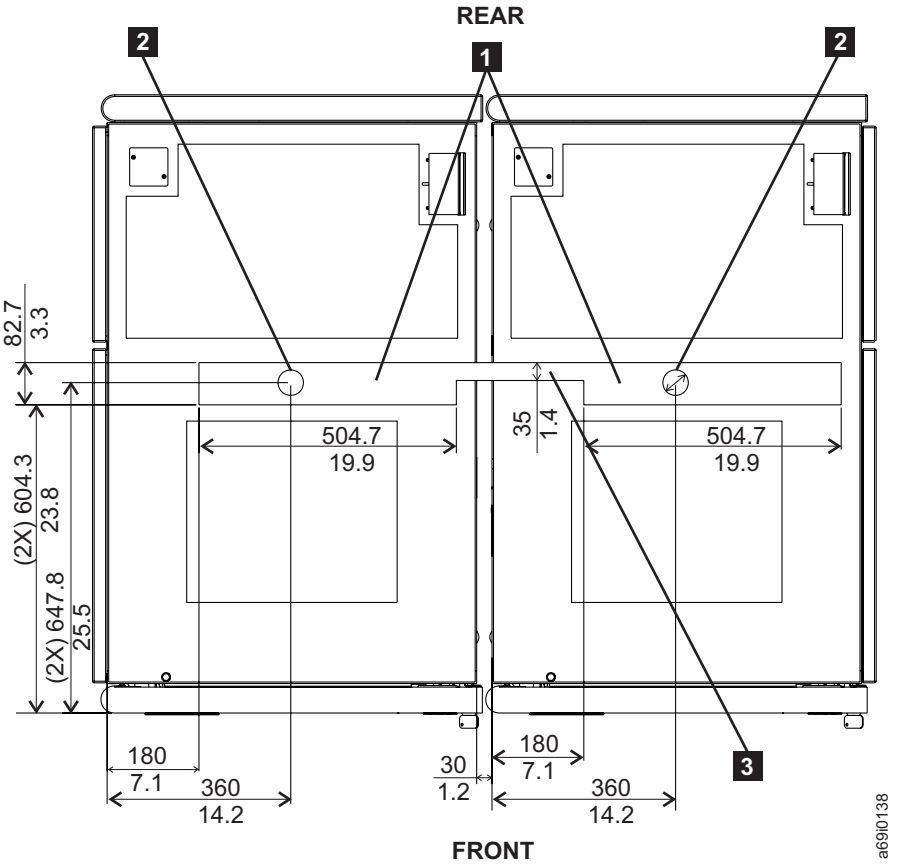



*Figure 22. Allowable area for mounting fire-suppression equipment (top view of Models L22, D22, L23, D23, L52, D52, L53, D53, or the HA1 frame)*

## Running Cables, Wiring, and Pipes Between Frames

Figure 23 shows a side view of the area available to run cables, wiring, and pipes between frames of the 3584 Tape Library. The area is a triangular section that is 81 mm (3.2 in.) wide by 140 mm (5.5 in.) long (see **1** in Figure 23). Your fire-suppression mechanical equipment must fit within the allowable area or be installed outside the library.

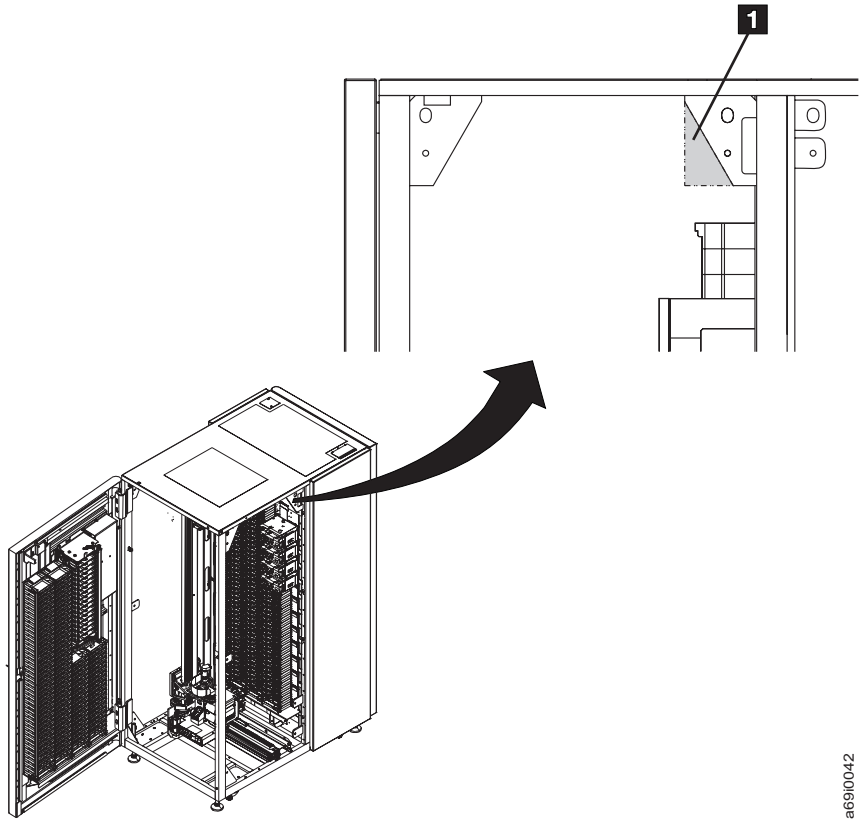



*Figure 23. Location for routing fire-suppression equipment between frames*

All water systems must be external to the library's frame, with mechanical support provided for piping. Sprinkler heads that extend through the top of the frame must not extend more than 175 mm (6.9 in.) below the top of the frame.

Route gaseous system piping with discharge nozzles on the top of the frames or inside the frames, below the top of the frame and within the 175-mm (6.9-in.) specification. The discharge nozzles can extend vertically no lower than 175 mm (6.9 in.) from the top of the frame. Gas cylinders and control equipment must be external to the library. IBM does not supply heat or smoke detectors.

## Environmental Specifications

This section provides a table of environmental specifications for the 3584 Tape Library.

**Attention:** The environments in Table 28 refer to the hardware of the 3584 Tape Library and may lead to temperatures greater than allowable for the cartridges and media stored in the library. For frames that contain Ultrium Tape Cartridges or IBM TotalStorage 3592 Enterprise Tape Cartridges, refer to their environmental and shipping specifications. Then, adjust the operating environment for the library accordingly.

*Table 28. Environmental specifications for the IBM System Storage TS3500 Tape Library*

| Environment | Operating | Nonoperating | Storage | Shipping |
|---|---|---|---|---|
| Temperature | 16 to 32°C<br>(61 to 90°F) | 16 to 32°C<br>(61 to 90°F) | 1 to 60°C<br>(34 to 140°F) | -40 to 60°C<br>(-40 to 140°F) |
| Relative Humidity | 20 to 80% | 20 to 80% | 5 to 80% | 5 to 100%<br>(excluding precipitation) |
| Maximum Wet Bulb Temperature | 23°C<br>(73.4°F) | 26°C<br>(79°F) | 29°C<br>(84°F) | 29°C<br>(84°F) |

**Related concepts**

"Environmental and Shipping Specifications for Ultrium Cartridges" on page 138
This section gives a table of the operating, storage, and shipping requirements for Ultrium Tape Cartridges.

"Environmental and Shipping Specifications for 3592 Cartridges" on page 161
This section gives a table of the operating, storage, and shipping requirements for 3592 Tape Cartridges.

## Acoustical Specifications

This section introduces acoustical specifications for the 3584 Tape Library.

For the purposes of acoustical specifications, when the 3584 Tape Library is both operating and idling the following conditions apply:

- Power is on.
- All air-moving devices are operating.
- Tape cartridges are loaded in all drives.

When the library is operating, the cartridge accessor loads, unloads, or moves tape cartridges; when the library is idling, the accessor does not move.

The 3584 Tape Library is a Category 1 product as defined in C-S 1-1710-006.

## Acoustical Specifications for Models L32 and D32

*Table 29. Noise emission values for the IBM System Storage TS3500 Tape Library, Models L32 and D32*

| Declared Sound Power Level $L_{WAd}$ | | Mean A-weighted Sound Pressure Level at the 1 m (Bystander) Positions $<L_{pA}>_m$ | |
|---|---|---|---|
| **Operating (bels)** | **Idling (bels)** | **Operating (dB)** | **Idling (dB)** |
| 7.5 B | 7.4 B | 54 dB | 51 dB |
| All measurements are in accordance with ANSI S12.10, and conform with ISO 9296. | | | |

## Acoustical Specifications for Models L22, D22, L52, and D52

**Note:** No additional noise is created by adding the HA1 frame.

*Table 30. Noise emission values for the IBM System Storage TS3500 Tape Library, Models L22, D22, L52, and D52 filled with 3592 Tape Drives*

| Declared Sound Power Level $L_{WAd}$ | | Mean A-weighted Sound Pressure Level at the 1 m (Bystander) Positions $<L_{pA}>_m$ | |
|---|---|---|---|
| **Operating (bels)** | **Idling (bels)** | **Operating (dB)** | **Idling (dB)** |
| 7.5 B | 7.2 B | 57 dB | 53 dB |
| The machines emit no prominent tones or impulsive noise.<br>All measurements are in accordance with ISO 7779, and reported in conformance with ISO 9296. | | | |

## Acoustical Specifications for Models L23, D23, L53, and D53

**Note:** No additional noise is created by adding the HA1 frame.

*Table 31. Noise emission values for the IBM System Storage TS3500 Tape Library, Models L23, D23, L53, and D53 filled with Ultrium Tape Drives*

| Declared Sound Power Level $L_{WAd}$ | | Mean A-weighted Sound Pressure Level at the 1 m (Bystander) Positions $<L_{pA}>_m$ | |
|---|---|---|---|
| **Operating (bels)** | **Idling (bels)** | **Operating (dB)** | **Idling (dB)** |
| 7.5 B | 7.2 B | 55 dB | 53 dB |
| The machines emit no prominent tones or impulsive noise.<br>All measurements are in accordance with ISO 7779, and reported in conformance with ISO 9296. | | | |

## Power and Cooling Requirements

Power and cooling for components of the 3584 Tape Library are provided by the frame in which they are housed. This section introduces the power and cooling specifications used by the two power structures: the frame control assembly (FCA) used by Models L22, D22, L32, D32, L52, and D52, and the enhanced frame control assembly used by Models L23, D23, L53, and D53.

**Related reference**

"Power Cords for Models L32 and D32" on page 98

"Power Cords for Models L22, D22, L52, and D52" on page 101

"Power Cords for Models L23, D23, L53, and D53" on page 102

## Power and Cooling Specifications for Models L22, D22, L32, D32, L52, and D52

This section gives an overview of the power and cooling requirements of Models L22, D22, L32, D32, L52, and D52 of the 3584 Tape Library.

For Models L22, D22, L32, D32, L52, and D52, each base frame and each expansion frame that contains drives has its own frame control assembly (FCA), which receives ac power from a customer-supplied outlet and, in turn, provides ac power to all tape drives within the frame. The FCA and tape drives have their own cooling as part of their packages, but air must be allowed to flow freely from the top of the library. Therefore, do not stack cartridges, books, or other materials on the top of the library.

For redundancy, the FCA in the base frame (Models L22, L32, or L52) contains two dc power supplies for the accessor. As an option, an additional dc power supply for the accessor can be added to any expansion frame (Models D22, D32, or D52) that has an FCA installed. The FCA is not required in expansion frames that contain no tape drives.

Each frame receives single-phase (200-240 V ac) power on its own power cord from a customer-supplied outlet.

Countries in North America have the option of operating at 100-127 V ac power. For more information, see:

- Table 36 on page 100
- Table 37 on page 101

Each frame also has the option of receiving ac power from two independent line cords (feature code 1901). For details, see:

- Table 35 on page 99
- Table 36 on page 100
- Table 37 on page 101

For libraries that include a second accessor and the high-availability Model HA1, at least one D22, D32, or D52 frame (not a service bay) must be equipped with a frame control assembly (feature code 1452 for Model D32 or feature code 1453 for Models D22 and D52) and at least one additional 37 V dc power supply (feature code 1902). IBM recommends that, where possible, you order two 37 V dc power supplies (feature code 1902) plus a dual line cord (feature code 1901) for each L-frame and D-frame with an FCA.

**Related reference**

"Power Cords for Models L32 and D32" on page 98
"Power Cords for Models L22, D22, L52, and D52" on page 101

## Power and Cooling Specifications for Models L23, D23, L53, and D53

This section gives an overview of the power and cooling requirements of Models L23, D23, L53, and D53 of the 3584 Tape Library.

For Models L23, D23, L53, and D53, each base frame and expansion frame that contains drives has its own enhanced frame control assembly, which receives ac power from two customer-supplied outlets and provides dc power to all tape drives within the frame as well as to the accessor. Like the frame control assembly, the enhanced frame control assembly and tape drives have their own cooling, but must have free airflow. Do not stack cartridges, books, or other materials on the top of the library.

For redundancy, the enhanced frame control assembly contains two dc power supplies, each with its own ac line cord. Under normal conditions, the tape drives and the accessor draw power from both of the power supplies, but each power supply is capable of providing all power needs so that failure of a power supply or loss of ac power on either line cord does not disrupt library operation. The enhanced frame control assembly is required in expansion frames that contain tape drives and the 4 I/O door option (feature code 1656).

Each frame receives single-phase (200-240 V ac) power on its own pair of power cords from two customer-supplied outlets. The two power supplies support only 220 V ac (110 V ac is not supported).

For libraries that include a second accessor and the high-availability Model HA1, at least one D23 or D53 frame (not a service bay) must be equipped with an enhanced frame control assembly (feature code 1451).

**Related reference**

"Power Cords for Models L23, D23, L53, and D53" on page 102

## Power Requirements for Frames

Table 32 lists the power requirements for the base frame and the expansion frames in the 3584 Tape Library.

*Table 32. Power requirements for frames in the IBM System Storage TS3500 Tape Library*

| Power | Rating | |
|---|---|---|
| | **Models L23, D23, L53, D53[1]** | **Models L22, D22, L32, D32, L52, D52** |
| Voltage | 200 to 240 V ac @ 50-60 Hz single phase (auto-ranging) | 100 to 240 V ac @ 50-60 Hz single phase (auto-ranging) |
| Library frame without drives (operating maximum continuous - not peak[2]) | L23, L53: 185 watts, 0.63 kBTU/hr<br><br>D23, D53: 110 watts, 0.38 kBTU/hr<br><br>HA1 [3]: 65 watts, 0.22 kBTU/hr | 2.66 A @ 120 V ac, 1.33 A @ 208 V ac, 200 watts, 0.68 kBTU/hr<br><br>HA1 [3]: 65 watts, 0.22 kBTU/hr |
| Drives (operating maximum continuous - not peak[4, 5] | 0.25 A @ 208 V ac, 50 watts, 0.17 kBTU/hr | 0.54 A @ 120 V ac, 0.27 A @ 208 V ac, 65 watts, 0.22 kBTU/hr |
| Nameplate electrical limits[6] | 200 to 240 V ac, 8.0 A, 50-60 Hz, 1.6 kVA, single phase | 100 to 127 V ac, 12.0 A, 50-60 Hz, 1.2 kVA, single phase |
| | | 200 to 240 V ac, 8.0 A, 50-60 Hz, 1.6 kVA, single phase |
| Inrush current | 150 A @ 200 to 240 V ac (peak for 1/2 cycle) | 100 A @ 120 V ac, 200 A @ 240 V ac (peak for 1/2 cycle) |
| Leakage current | 1 mA | 8 mA maximum with 12 drive power supplies installed |

**Notes:**

1. These models come equipped with dual ac line cords. The figures in this table show the total power consumed; each individual line cord supplies approximately half of the power.
2. Library power is supplied by power supplies in the L-frames and D-frames that are equipped with power. Frames with no frame control assemblies consume no power and dissipate no heat.
3. The HA1 frame is not connected to ac power. The power shown is the total consumed by the 2nd accessor and is provided by the power supplies in the L-frames and D-frames that are equipped with power.
4. The figures in this table include drive, cooling, and all drive power supplies (including redundant power). For the total drive power consumption and dissipation, multiply the figures by the total number of drives that are installed.
5. The power shown is for drives actively reading and writing data. Drives with no tape cartridge loaded consume 30 watts.
6. Maximum certified electrical limits for a single frame. Nameplate limits should not be used to calculate product power or cooling requirements.

Table 33 provides an example of how to calculate total library power and cooling requirements.

*Table 33. Calculating total library power and cooling requirements*

| Configuration | Power |
|---|---|
| L23 with 10 drives (185W + 10x50W) | 685 watts |
| 4 D23 with 6 drives each (4x110W + 4x6x50W) | 1640 watts |
| 3 D23 with no enhanced FCA feature installed | 0 watts |
| HA1 (65W) | 65 watts |

*Table 33. Calculating total library power and cooling requirements (continued)*

| Configuration | Power |
|---|---|
| **Total power**[1] | **2390 watts** |
| **Total cooling**[2] | **8.1 kBTU/hr** |

**Notes:**

1. Library power consumption is dynamic and usage dependent. Short peaks may exceed the total shown. Typical average power consumption will be lower than this total because all drives are not likely to be active simultaneously.
2. Multiply power in watts by 3.4 to convert to BTU/hr. 1000 BTU/hr = 1 kBTU/hr.

## Power Requirements for Remote Support Features

Table 34 lists the power requirements for the devices that comprise remote support.

*Table 34. Power requirements for remote support features*

| Feature Code | Description | Input Voltage (see Note) | Hertz | Power Usage |
|---|---|---|---|---|
| 2710 | Remote support facility | 115 or 230 V ac | 50 or 60 | 16 w |
| 2711 | Remote support switch | 115 or 230 V ac | 50 or 60 | 5 w |
| 2714 | LAN switch | 115 or 230 V ac | 50 or 60 | Minimum 50 w<br>Maximum 120 w |
| 2720 | TS3000 System Console | 115 or 230 V ac | 50 or 60 | Minimum 80 w<br>Maximum 300 w |
| | Monitor | 115 or 230 V ac | 50 or 60 | Minimum 15 w<br>Maximum 70 w |
| | LAN switch | 115 or 230 V ac | 50 or 60 | Minimum 50 w<br>Maximum 120 w |
| | Modem | 115 or 230 V ac | 50 or 60 | 16 w |
| | Modem | 115 or 230 V ac | 50 or 60 | 16 w |
| 2730 | TS3000 System Console (1U rack mount with one internal modem) | 115 or 230 V ac | 50 or 60 | Minimum 80 w<br>Maximum 300 w |
| | Monitor and keyboard (1U rack mount) | 115 or 230 V ac | 50 or 60 | Minimum 15 w<br>Maximum 70 w |
| | Power Cords (Two bifurcated power cords with two C13 connectors and one C14 connector for providing rack power to the console, the KVM and the switch.) | | | |
| | Power Cords (3 country-specific AC cords) | 115 V ac | | |
| | Ethernet cables (One 1.0M ethernet cable from TSSC to switch and one 31M ethernet cable to first downstream tape system) | | | |
| | LAN switch (16 port 1U rack mount) | 115 or 230 V ac | 50 or 60 | Minimum 50 w<br>Maximum 120 w |
| | Modem (internal) | 115 or 230 V ac | 50 or 60 | 16 w |
| | Modem | 115 or 230 V ac | 50 or 60 | 16 w |
| **Note:** Input voltage must be supplied by a customer-provided outlet. | | | | |

## Power Cords for Models L32 and D32

The appropriate power cord for the 3584 Tape Library is attached at the factory (based on the destination code of your country or region). Chicago, Illinois (U.S.A.) requires a 1.8-m (.07-in.) power cord (feature code 9986). Power cords used in the United States and Canada are listed by the Underwriter's Laboratories (UL) and certified by the Canadian Standards Association (CSA). Table 35 on page 99 lists the 200 to 240 V ac power cords and Table 36 on page 100 lists the 100 to 127 V ac power cords to use with the library (the term "power cord" refers to the cable that connects the library to the receptacle). Refer to Figure 24 on page 100 and match the number that is beside each receptacle to the receptacle number listed in the tables.

Be aware that each frame that contains a frame control assembly (FCA) is protected by a main line circuit protector in the FCA. Each FCA must be further protected by a circuit breaker of the proper rating at the service rail (customer outlet).

The service rating for all 200 to 240 V ac plug types is as follows:

- Maximum voltage: 250 V ac
- Current: see Table 35
- Phases: 1
- Wires: 3

*Table 35. Specifications for 200 to 240 V ac power cord used with the IBM System Storage TS3500 Tape Library, Models L32 and D32*

| Length and Type of Power Cord | Single Branch Circuit 30 A Service Rating | | Dual ac Line Cords 15 A Service Rating (Feature Code 1901) | |
|---|---|---|---|---|
| | Part Number and Feature Code | Type of Service Receptacle | Part Number and Feature Code | Type of Service Receptacle |
| 4.3 m (14 ft) non-watertight twistlock (default in the U.S., Canada, Japan, Korea, Philippines, and Taiwan) | 11F0113 / 9987 | NEMA L6-30R (receptacle #3) | 14F1550 / 9987 | NEMA L6-15R (receptacle #2) |
| 4.3 m (14 ft) (in countries or regions other than the U.S., Canada, Japan, Korea, Philippines, and Taiwan) | 46F6063 / None | Per local requirements | 36L8823 / None | IEC 309 Type 2P+GND, 16 A for example, Hubbell HBL316R6W (receptacle #6) |
| 4.3 m (14 ft) watertight (in the U.S., Canada, Japan, Korea, Philippines, and Taiwan) | 46F4594 / 9988 | Russellstoll connectors 3933 or 9C33U0 or receptacles 3753 or 9R33U0W (receptacle #5) | 86F2646 / 9988 | Russellstoll connectors 3913U2 or 9C23U2 or receptacles 3743U2 or 9R23U2W (receptacle #4) |
| 1.8 m (6 ft) watertight (in Chicago, Illinois, U.S.) | 46F4593 / 9986 | Russellstoll connectors 3933 or 9C33U0 or receptacles 3753 or 9R33U0W (receptacle #5) | 86F2645 / 9986 | Russellstoll connectors 3913U2 or 9C23U2 or receptacles 3743U2 or 9R23U2 (receptacle #4) |

The service rating for all 100 to 127 V ac plug types is as follows:

- Maximum voltage: 125 V ac
- Current: see Table 36
- Phases: 1
- Wires: 3

*Table 36. Specifications for 100 to 127 V ac power cords used with the IBM System Storage TS3500 Tape Library, Models L32 and D32*

| Length and Type of Power Cord | Single Branch Circuit 20 A Service Rating | | Dual ac Line Cords 20 A Service Rating (Feature Code 1901) | |
|---|---|---|---|---|
| | Part Number and Feature Code | Type of Service Receptacle | Part Number and Feature Code | Type of Service Receptacle |
| 4.3 m (14 ft) non-watertight twistlock (in the U.S. and Canada) | 19P5903 / 9951 and 9987 | NEMA L5-20R (receptacle #1) | 12J5117 / 9951 and 9987 | NEMA L5-20R (receptacle #1) |
| 1.8 m (6 ft) non-watertight twistlock (in Chicago, Illinois, U.S.) | 19P5904 / 9951 and 9986 | NEMA L5-20R (receptacle #1) | 12J5115 / 9951 and 9986 | NEMA L5-20R (receptacle #1) |

Refer to Figure 24 and match the number that is beside each receptacle to the number in each table.

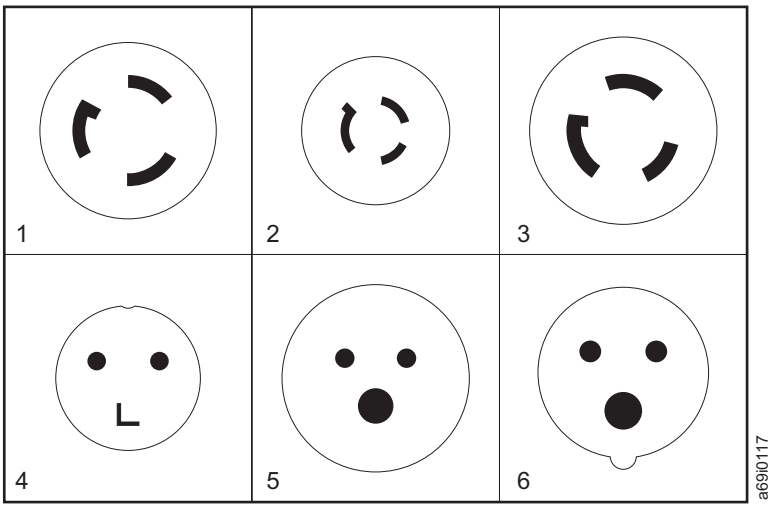



*Figure 24. Types of receptacles for power cords used by Models L32 and D32 of the 3584 Tape Library*

## Power Cords for Models L22, D22, L52, and D52

Refer to Figure 25 on page 102 and match the number that is beside each receptacle to the receptacle number listed in the table.

*Table 37. Specifications for power cords used with the IBM System Storage TS3500 Tape Library, Models L22, D22, L52, and D22*

| Length and Type of Power Cord | Part Number and Feature Code | Type of Service Receptacle |
|---|---|---|
| 4.3 m (14 ft) international 250 V ac, 30 A. This is the default power cord, if no other feature is specified, in all countries except the United States, Canada, Japan, Korea, Philippines, and Taiwan. | 46F6063 or 23R2333 / 9960 | No connector (a connector can be attached per local requirements) |
| 1.8 m (6 ft) watertight, in Chicago, Illinois, U.S. 250 V ac, 30 A | 46F4593 / 9961 | Russellstoll 3753 or 9R33UOW receptacle, or a Russellstoll 3933 or 9C33UO connector (receptacle #5) |
| 4.3 m (14 ft) non-watertight, twistlock 250 V ac, 30 A. This is the default power cord if no other feature is specified in the United States, Canada, Japan, Korea, Philippines, and Taiwan. | 11F0113 / 9962 | NEMA L6-30R (receptacle #3) |
| 4.3 m (14 ft) watertight in U.S., Canada, Asia/Pacific 250 V ac, 30 A | 46F4594 / 9963 | Russellstoll 3753 or 9R33UOW receptacle, or a Russellstoll 3933 or 9C33UO connector (receptacle #5) |
| 1.8 m (6 ft) non-watertight (in Chicago, Illinois, U.S.), 110 V ac, 20 A | 19P5904 / 9964 | NEMA L5-20R (receptacle #1) |
| 4.3 m (14 ft) non-watertight (in U.S. and Canada only), 110 V ac, 20 A | 19P5903 / 9965 | NEMA L5-20R (receptacle #1) |
| Dual 4.3 m (14 ft) non-watertight, international 250 V ac, 16 A single phase. In all countries except the United States, Canada, Japan, Korea, Philippines, and Taiwan, if no other feature is specified, this is the default power cord that is supplied when the dual ac power feature (1901) is ordered. | 36L8823 / 9970 | IEC-309 2P +GND 16 A (receptacle #6) |
| Dual 1.8 m (6 ft) watertight (in Chicago, Illinois, U.S.) 250 V ac, 15 A | 86F2645 / 9971 | Russellstoll 3743U2 or 9R23U2W receptacles, or Russellstoll 3913U2 or 9C23U2 connectors (receptacle #4) |
| Dual 4.3 m (14 ft) non-watertight, twistlock 250 V ac, 15 A. This is the default power cord if no other feature is specified in the United States, Canada, Japan, Korea, Philippines, and Taiwan. | 14F1550 / 9972 | NEMA L6-15R (receptacle #2) |
| Dual 4.3 m (14 ft) watertight in U.S., Canada, Asia/Pacific 250 V ac, 15 A. This feature is available in the United States, Canada, Japan, Korea, Philippines, and Taiwan. | 86F2646 / 9973 | Russellstoll 3743U2 or 9R23U2W receptacles, or Russellstoll 3913U2 or 9C23U2 connectors (receptacle #4) |
| Dual 1.8 m (6 ft) in Chicago, Illinois, U.S.110 V ac, 20 A | 12J5115 / 9974 | NEMA L5-20R (receptacle #1) |
| Dual 4.3 m (14 ft) in U.S. and Canada only 110 V ac, 20 A | 12J5117 / 9975 | NEMA L5-20R (receptacle #1) |

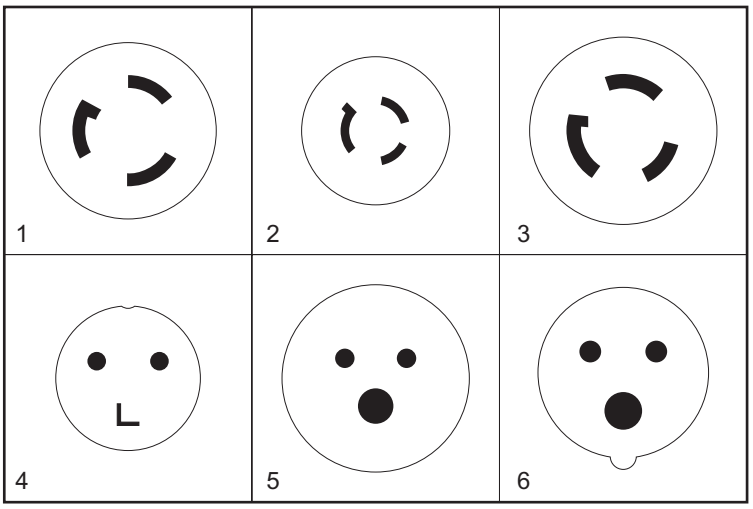



*Figure 25. Types of receptacles for power cords used by Models L22, D22, L52, and D52 of the 3584 Tape Library*

## Power Cords for Models L23, D23, L53, and D53

Refer to Figure 26 on page 103 and match the number that is beside each receptacle to the receptacle number listed in the table.

*Table 38. Specifications for power cords used with the IBM System Storage TS3500 Tape Library, Models L23, D23, L53, and D53*

| Length and Type of Power Cord | Part Number and Feature Code | Type of Service Receptacle |
|---|---|---|
| Dual 4.3 m (14 ft) watertight, international 250 V ac, 16 A single phase. This power cord is for countries other than the United States and Canada (IEC-309). | 39M5177 / 9970 | IEC-309 2P +GND 16 A, Uses receptacle #2. |
| Dual 4.3 m (14 ft) watertight, 250 V ac, 20 A single phase. This power cord is for the United States and Canada (IEC-309). | 23R9540 / 9970 | Hubbell HBL320R6W, IEC-309 2P +GND 20 A Uses receptacle #2. |
| Dual 4.3 m (14 ft) non-watertight, twistlock 250 V ac, 15 A. This power cord is for the United States and Canada. | 39M5114 / 9972 | NEMA L6-15R. Uses receptacle #1. |
| Dual 4.3 m (14 ft) non-watertight, 250 V ac, 10 A, IRAM 2073. This power cord is for Argentina. | 39M5066 / 9976 | Uses receptacle #3. |
| Dual 4.3 m (14 ft) non-watertight, 250 V ac, 15 A, Earth Pin InMetro NBR 14136. This power cord is for Brazil. | 39M5238 / 9977 | Uses receptacle #4. |
| Dual 4.3 m (14 ft) non-watertight, 250 V ac, 10 A, AS/NZS 3112/2000. This power cord is for Australia and New Zealand. | 39M5100 / 9978 | Uses receptacle #3. |
| Dual 4.3 m (14 ft) non-watertight, 250 V ac, 15 A, JIS C8303, C8306. This power cord is for Japan. | 39M5184 / 9979 | Uses receptacle #5. |

*Table 38. Specifications for power cords used with the IBM System Storage TS3500 Tape Library, Models L23, D23, L53, and D53 (continued)*

| Length and Type of Power Cord | Part Number and Feature Code | Type of Service Receptacle |
|---|---|---|
| Dual 4.3 m (14 ft) non-watertight, 250 V ac, 10 A, GB 2099.1, 1002. This power cord is for China. | 39M5204 / 9980 | Uses receptacle #3. |
| Dual 4.3 m (14 ft) non-watertight, 250 V ac, 15 A, with earth pin KS C8305, K60884-1. This power cord is for Korea. | 39M5217 / 9981 | Uses receptacle #6. |
| Dual 4.3 m (14 ft) non-watertight, 250 V ac, 10 A, CNS 10917-3. This power cord is for Taiwan. | 39M5252 / 9982 | Uses receptacle #5. |
| Dual 4.3 m (14 ft) non-watertight, 250 V ac, 16 A, SANS 164-1. This power cord is for South Africa. | 39M5142 / 9983 | Uses receptacle #7. |
| Dual 4.3 m (14 ft) 250 V, 15A, single phase line cord, non-watertight twistlock 20A receptacles. This power cord is for US and Canada. | 23R9760/9984 | NEMA L6-20R, Uses receptacle #8. |
| Dual 4.3 m (14 ft) 250 V, 15A, single phase line cord, watertight 15A plugs. This power cord is for US and Canada. | 23R9972/9985 | Russellstoll 3743U2 or 9R23U2W receptacles, or Russellstoll 3913U2 or 9C23U2 connectors Uses receptacle #9. |

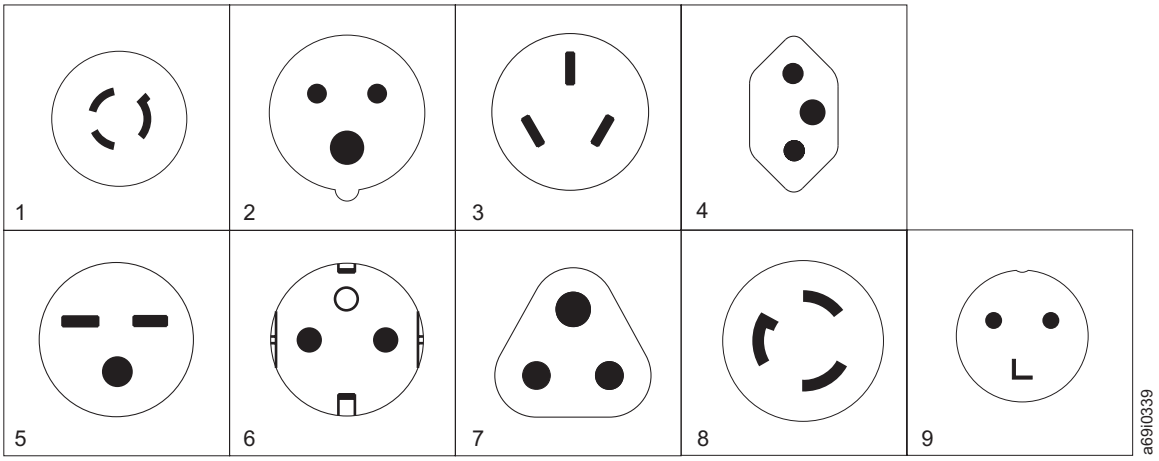



*Figure 26. Types of receptacles for Models L23, D23, L53, and D53 of the 3584 Tape Library*

## Customer Circuit Breakers (CBs) for Models L23, D23, L53 and D53

For the L23, D23, L53 and D53 models, the maximum permissible customer circuit breaker (CB) rating is 20A. Depending on the specific line cord feature selected, some local building codes may require the use of smaller CB ratings. Using a CB rating smaller than 10A may result in nuisance trips and is not recommended. The various 3584 line cord features come with plugs rated at 20A, 16A, 15A or 10A and wiring appropriate for the 3584 load current (8A maximum). In general, customers should provide a CB rated to match the current rating of the line cord plug on the feature they have selected (20A, 16A, 15A or 10A), unless their local building codes specify a different rating.

# Chapter 3. Standard Features of the Library

This section introduces a pictorial representation of the elements of the 3584 Tape Library and the feature codes for those elements.

When ordering the 3584 Tape Library, you can use feature codes to perform the following actions:

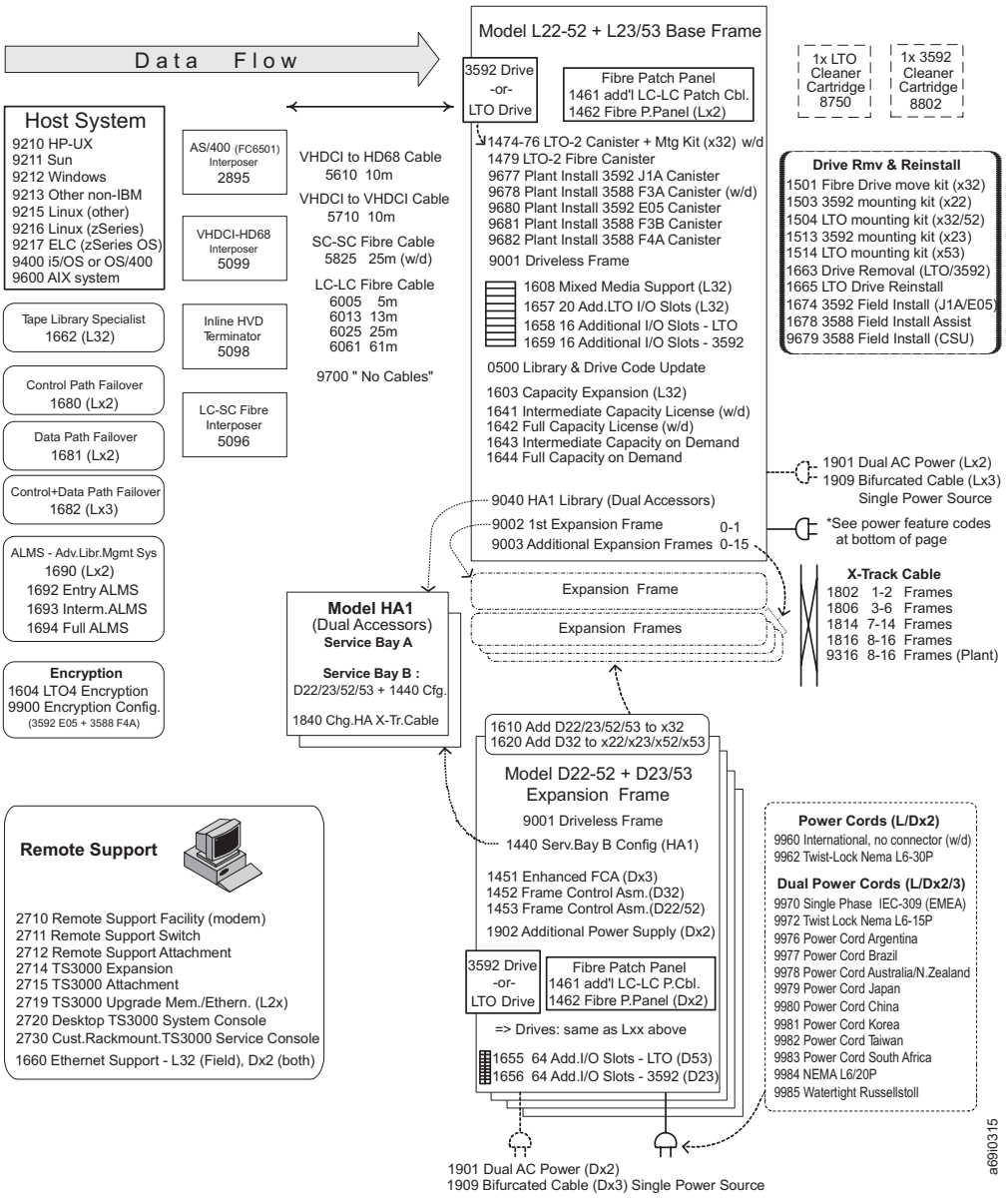
- Specify plant or field installation of tape drives
- Specify host configurations
- Identify the specific attachment type
- Order open systems device drivers

# Elements in the Library

This section provides a flowchart of the elements that are available for a 3584 Tape Library.

Figure 27 shows the elements in the 3584 Tape Library. Depending on the model of the library, different features are available.

*Figure 27. Elements in the 3584 Tape Library*




**Related reference**

"Feature Codes for Elements in the Library" on page 107
This section provides a list and description of the feature codes for the 3584 Tape Library. It also indicates to which models the feature codes apply and whether you, the customer, can set up (install) the feature.

## Feature Codes for Elements in the Library

This section provides a list and description of the feature codes for the 3584 Tape Library. It also indicates to which models the feature codes apply and whether you, the customer, can set up (install) the feature.

Table 39 lists the feature codes for the models of the 3584 Tape Library.

*Table 39. Feature codes for the models of the 3584 Tape Library*

| Feature Code | Model | Customer-Setup Unit (CSU)[1] | Description |
|---|---|---|---|
| 0500 | L22, L23, L32, L52, L53 | No | Library and drive code update (by IBM Service Representative) |
| 1440 | D22, D23, D52, D53 | No | Service bay B configuration with accessor |
| 1451 | D23, D53 | No | Enhanced frame control assembly (does not apply to D22, D52 or D32) |
| 1452[2] | D32 | No | Frame control assembly (does not apply to D22, D23, D52, or D53) |
| 1453 | D22, D52 | No | Frame control assembly (does not apply to D23, D32, or D53) |
| 1461 | L22, D22, L23, D23 | No | Additional LC-to-LC drive-to-patch-panel cable |
| 1462 | L22, D22, L32, D32, L52, D52 | No | Fibre Channel patch panel |
| 1501 | L32, D32 | No | Fibre Channel Tape Drive move kit |
| 1503 | L22, D22 | No | 3592 Fibre Channel Tape Drive mounting kit |
| 1504[16] | L32, D32, L52, D52 | Yes | LTO Fibre Channel Tape Drive mounting kit |
| 1513 | L23, D23 | No | 3592 Fibre Channel Tape Drive mounting kit |
| 1514[16] | L53, D53 | Yes | LTO Fibre Channel Tape Drive mounting kit |
| 1603 | L32 | No | Capacity expansion |
| 1604 | L22, L23, L32, L52, L53 | Yes | Transparent LTO Encryption. Provides license keys to enable transparent LTO encryption on 3588 F4A, LTO Ultrium 4 tape drive. |
| 1608 | L32 | No | Mixed media/D22/D23 support |
| 1610 | D22, D23, D52, D53 | No | Add D22/D23/D52/D53 to existing L32 or D32 |
| 1620 | D32 | No | Add D32 to existing L22, D22, L23, D23, L52, D52, L53, or D53 |
| 1641 | L22, L52 | No | Intermediate capacity storage (already enabled) |
| 1642 | L22, L52 | No | Full capacity storage[2] (already enabled) |
| 1643 | L22, L23, L52, L53 | Yes | Intermediate capacity storage On Demand (installed but not enabled) |
| 1644 | L22, L23, L52, L53 | Yes | Full capacity storage On Demand[2] (installed but not enabled) |
| 1655 | D53 | No | 64 Additional I/O Slots - LTO ) (Plant-only) (see Note 14) |
| 1656 | D23 | No | 64 Additional I/O Slots - 3592 (Plant-only) (see Note 14) |
| 1657 | L32 | No | 20 additional I/O slots for LTO cartridges |
| 1658 | L22, L23, L52, L53 | No | 16 additional I/O slots for LTO cartridges[3] |

*Table 39. Feature codes for the models of the 3584 Tape Library (continued)*

| Feature Code | Model | Customer-Setup Unit (CSU)[1] | Description |
|---|---|---|---|
| 1659 | L22, L23, L52, L53 | No | 16 additional I/O slots for 3592 cartridges[3] |
| 1660 | L32, D22, D32, D52 | No | 10/100 Ethernet support[4] |
| 1662 | L32 | No | System Storage Tape Library Specialist web interface[4] |
| 1663 | L22, D22, L23, D23, L32, D32, L52, D52, L53, D53 | No | Drive removal. Used only when drives are removed and not replaced. |
| 1665 | L32, D32, L52, D52, L53, D53 | No | LTO Ultrium Tape Drive reinstall |
| 1674 | L22, D22, L23, D23 | No | 3592 Tape Drive field install |
| 1678[15] | L32, D32, L52, D52, L53, D53 | No | 3588 Tape Drive field install assist. Feature code 1678 provides a charge for an IBM Representative to install or reinstall the 3588 Fibre Channel Tape Drive ordered through FC 9679. Customers are not required to order FC1678 when ordering a 3588 drive. |
| 1680 | L22, L32, L52 | Yes | Control path failover |
| 1681 | L22, L32, L52 | Yes | Data path failover |
| 1682 | L23, L53 | Yes | Path failover |
| 1690 | L22, L23, L32, L52, L53 | Yes | Advanced Library Management System (ALMS) |
| 1692 | L22, L23, L52, L53 | Yes | Entry ALMS |
| 1693 | L22, L23, L52, L53 | Yes | Intermediate ALMS. Requires FC 1692. |
| 1694 | L22, L23, L52, L53 | Yes | Full ALMS. Requires FC 1693. |
| 1802 | L22, L23, L32, L52, L53 | No | 1- to 2-frame X-track cable[5] |
| 1806 | L22, L23, L32, L52, L53 | No | 3- to 6-frame X-track cable[6,7] |
| 1814 | L22, L23, L32, L52, L53 | No | 7- to 14-frame X-track cable[8,9,10] |
| 1816 | L22, L23, L32, L52, L53 | No | 8- to 16-frame X-track cable[11] |
| 1840 | L22, L23, L32, L52, L53 | No | Change HA X-track cable |
| 1901 | L22, D22, L32, D32, L52, D52 | No | Dual AC power |
| 1902 | D22, D32, D52 | No | Additional redundant (37 V) power supply |
| 1909 | L23, D23, L53, D53 | No | Single Power Source Bifurcated Cable. (Allows attachment of an xx3 frame to a single power outlet while maintaining drive redundant power). |
| 2710 | L22, L23, L32, L52, L53 | No | Remote support facility |
| 2711 | L22, L32, L52 | No | Remote support switch |
| 2712 | L22, L23, L32, L52, L53 | No | Remote support attachment |
| 2714 | L22, L23, L32, L52, L53 | No | TS3000 Expansion (two cables to connect one machine and an Ethernet switch to increase quantity of machines that can attach to the TSSC (FC 2720 or 2730) for Service) |
| 2715 | L22, L23, L32, L52, L53 | No | TS3000 Attachment cable (to attach a unit to the Ethernet switch provided by feature code 2720 or 2714) |

*Table 39. Feature codes for the models of the 3584 Tape Library (continued)*

| Feature Code | Model | Customer-Setup Unit (CSU)[1] | Description |
|---|---|---|---|
| 2719 | L22, L23 | No | TS3000 Upgrade (Prereq for FC 2720 when attaching to TS7700. This FC provides additional memory and an ethernet adapter.) |
| 2720 | L22, L23, L32, L52, L53 | No | Desktop TS3000 System Console (TSSC) (provides desktop console, Ethernet switch, cable, and connectors to connect one machine to an IBM-supplied modem for enabling remote enhanced service) |
| 2730 | L22, L23, L32, L52, L53 | No | Customer rack-mountable TS3000 System Console (TSSC) (provides 1U server, keyboard, display, mouse, bifurcated cables, connectors, 115 v AC cables, and Ethernet switch for customer-provided 19 inch rack) |
| 2895 | L32, D32 | No | Interposer, AS/400, feature 6501 |
| 5096 | L22, D22, L23, D23, L32, D32, L52, D52, L53, D53 | Yes | Interposer SC-to-LC Fibre |
| 5098 | L32, D32 | No | Inline HVD SCSI terminator |
| 5099 | L32, D32 | Yes | VHDCI/HD68 cable/interposer |
| 5610 | L32, D32 | Yes | VHDCI-to-HD68 SCSI cable, 10 meters (33 ft) |
| 5710 | L32, D32 | Yes | VHDCI-to-VHDCI SCSI cable, 10 meters (33 ft) |
| 5805 | L32, D32 | Yes | SC-to-SC Fibre Channel cable, 5 meters (16 ft) |
| 5813 | L32, D32 | Yes | SC-to-SC Fibre Channel cable, 13 meters (43 ft) |
| 5825 | L32, D32 | Yes | SC-to-SC Fibre Channel cable, 25 meters (82 ft) |
| 5861 | L32, D32, L52, D52 | Yes | SC-to-SC Fibre Channel cable, 61 meters (200 ft) |
| 5907 | L22, D22, L32, D32, L52, D52 | Yes | SC-to-LC Fibre Channel cable, 7 meters (23 ft) |
| 5913 | L22, D22, L32, D32, L52, D52 | Yes | SC-to-LC Fibre Channel cable, 13 m (43 ft) |
| 5922 | L22, D22, L23, D23, L32, D32, L52, D52, L53, D53 | Yes | SC-to-LC Fibre Channel cable, 22 m (72 ft) |
| 5961 | L22, D22, L32, D32, L52, D52 | Yes | SC-to-LC Fibre Channel cable, 61 m (200 ft) |
| 6005 | L22, D22, L23, D23, L32, D32, L52, D52, L53, D53 | Yes | LC-to-LC Fibre Channel cable, 5 m (17 ft) |
| 6013 | L22, D22, L23, D23, L32, D32, L52, D52, L53, D53 | Yes | LC-to-LC Fibre Channel cable, 13 m (43 ft) |
| 6025 | L22, D22, L23, D23, L32, D32, L52, D52, L53, D53 | Yes | LC-to-LC Fibre Channel cable, 25 m (82 ft) |
| 6061 | L22, D22, L23, D23, L32, D32, L52, D52, L53, D53 | Yes | LC-to-LC Fibre Channel cable, 61 m (200 ft) |
| 6200 | L32, D32 | No | AAP RFI Gasket |
| 6203 | L32, D32 | No | AAP drive power cord |
| 6204 | L32, D32 | No | AAP LVD SCSI wrap plug, LTO |
| 6205 | L32, D32 | No | AAP HVD SCSI wrap plug, LTO |
| 6206 | L32, D32 | No | AAP Ultrium 1 Fibre wrap plugs |
| 8750 | L32, D32, L52, D52, L53, D53 | No | Ultrium cleaning cartridge |

*Table 39. Feature codes for the models of the 3584 Tape Library (continued)*

| Feature Code | Model | Customer-Setup Unit (CSU)[1] | Description |
|---|---|---|---|
| 8802 | L22, D22, L23, D23 | No | 3592 cleaning cartridge |
| 9001 | L22, D22, L23, D23, L32, D32, L52, D52, L53, D53 | No | Frame without drives (if you have a library with both LTO frames (x32, x52, x53) and 3592 frames (x22, x23), and you want to configure the library for mixed media, you must have at least one drive of each type (LTO and 3592) installed in the library before you can configure mixed media) |
| 9002 | L22, L23, L32, L52, L53 | No | First expansion frame attachment |
| 9003 | L22, L23, L32, L52, L53 | No | Additional expansion frame attachment |
| 9040 | L22, L23, L32, L52, L53 | No | High availability library |
| 9210 | L22, L23, L32, L52, L53 | No | Attached to HP-UX System |
| 9211 | L22, L23, L32, L52, L53 | No | Attached to Sun(TM) Solaris System |
| 9212 | L22, L23, L32, L52, L53 | No | Attached to Windows System |
| 9213 | L22, L23, L32, L52, L53 | No | Attached to other non-IBM system |
| 9215 | L22, L23, L32, L52, L53 | No | Attached to Linux System (other) |
| 9216 | L22, L32, L52 | No | Attached to System z Linux System |
| 9217 | L22, L23, L32, L52, L53 | No | Attached to System z Operating System [12] |
| 9316 | L22, L23, L32, L52, L53 | No | 8- to 16-frame X-track cable (plant)[13] |
| 9400 | L22, L23, L32, L52, L53 | No | Attached to i5/OS or OS/400 System |
| 9600 | L22, L23, L32, L52, L53 | No | Attached to AIX System |
| 9677 | L22, D22 | No | 3592 J1A Tape Drive plant install in a 3584 Tape Library |
| 9678 | L52, D52 | No | 3588 Tape Drive Model F3A plant install in the 3584 Tape Library |
| 9679[15] | | Yes | 3588 Tape Drive field install in a 3584 Tape Library (see feature code 1678) |
| 9680 | L22, D22, L23, D23 | No | TS1120 Tape Drive plant install |
| 9681 | L52, D52, L53, D53 | No | 3588 Tape Drive Model F3B plant install in the 3584 Tape Library |
| 9682 | L53 / D53 | No | 3588 F4A Plant Install (in the 3584 Tape Library). Prerequisite: requires an equal to or greater than number of fibre drive mounting kits (FC 1514). |
| 9700 | L22, D22, L23, D23, L32, D32, L52, D52, L53, D53 | No | No host cables from plant |
| 9724 | L32, D32, D42 | No | OEM power cord |
| 9962 | L22, D22, L52, D52 | No | Power cord, non-watertight, 4.3 m (14 ft) |

*Table 39. Feature codes for the models of the 3584 Tape Library (continued)*

| Feature Code | Model | Customer-Setup Unit (CSU)[1] | Description |
|---|---|---|---|
| 9970 | L22, D22, L23, D23, L52, D52, L53, D53 | No | Dual 4.3 Meter Power Cord Watertight: Provides dual 4.3 meter (14-foot) 250 volt (V) AC power cords with IEC 309 2P+GND watertight connectors. For countries other than the United States and Canada the connector is rated at 16A (plug type Hubbell HBL316P6W or equivalent) for connection to Hubbell type HBL316R6W or equivalent receptacles. In the United States and Canada the connector is rated at 20A (plug type Hubbell HBL320P6W) for connection to Hubbell type HBL320R6W or equivalent receptacles. This is the default power cord if no other feature is specified, in all countries except Argentina, Australia, Brazil, Canada, China, Japan, Korea, New Zealand, Philippines, South Africa, Taiwan, and the United States. |
| 9972 | L22, D22, L23, D23, L52, D52, L53, D53 | No | Dual power cords, non-watertight, 4.3 m (14 ft), twistlock 250 V ac, 15 A. This power cord is for the United States and Canada. |
| 9973 | L22, D22, L52, D52 | No | Dual power cords, watertight, 4.3 m (14 ft) |
| 9974 | L22, D22, L52, D52 | No | Dual power cords, Chicago, non-watertight, 110 V ac, 1.8 m (6 ft) |
| 9975 | L22, D22, L52, D52 | No | Dual power cords, non-watertight, 110 V ac, 4.3 m (14 ft) |
| 9976 | L23, D23, L53, D53 | No | Dual power cords, non-watertight, 4.3 m (14 ft), 250 V ac, 10 A, with IRAM 2073 plug. This power cord is for Argentina. |
| 9977 | L23, D23, L53, D53 | No | Dual power cords, non-watertight, 4.3 m (14 ft), 250 V ac, 15 A, with Earth Pin InMetro NBR 14136 plug. This power cord is for Brazil. |
| 9978 | L23, D23, L53, D53 | No | Dual power cords, non-watertight, 4.3 m (14 ft), 250 V ac, 10 A, with AS/NZS 3112/2000 plug. This power cord is for Australia and New Zealand. |
| 9979 | L23, D23, L53, D53 | No | Dual power cords, non-watertight, 4.3 m (14 ft), 250 V ac, 15 A, with JIS C8303, C8306 plug. This power cord is for Japan. |
| 9980 | L23, D23, L53, D53 | No | Dual power cords, non-watertight, 4.3 m (14 ft), 250 V ac, 10 A, with GB 2099.1, 1002 plug. This power cord is for China. |
| 9981 | L23, D23, L53, D53 | No | Dual power cords, non-watertight, 4.3 m (14 ft), 250 V ac, 15 A, with earth pin KS C8305, K60884-1 plug. This power cord is for Korea. |
| 9982 | L23, D23, L53, D53 | No | Dual power cords, non-watertight, 4.3 m (14 ft), 250 V ac, 10 A, with CNS 10917-3 plug. This power cord is for Taiwan. |
| 9983 | L23, D23, L53, D53 | No | Dual power cords, non-watertight, 4.3 m (14 ft), 250 V ac, 16 A, with SANS 164-1 plug. This power cord is for South Africa. |

*Table 39. Feature codes for the models of the 3584 Tape Library (continued)*

| Feature Code | Model | Customer-Setup Unit (CSU)[1] | Description |
|---|---|---|---|
| 9984 | L23, D23, L53, D53 | No | NEMA L6/20P. Dual 4.3 m (14 ft) 250V, 15A single phase line cord assemblies with NEMA L6-20P non-watertight twistlock 20A plugs. UL / CSA certified for use in US and Canada. Mates with customer-supplied NEMA L6-20R receptacles. |
| 9985 | L23, D23, L53, D53 | No | Watertight 15A/250V Russellstoll. Dual 4.3 m (14 ft) 250V, 15A single phase line cord assemblies with watertight 15A Russellstoll plugs (RS p/n 3720DPU2). UL / CSA certified for use in US and Canada. Mates with customer-supplied Russellstoll 3743U2 or 9R23U2W receptacles. |
| 9900 | L22/L23/D22/D23 L32/L52/L53/D32/D52/D53 | No | Encryption Configuration - 3592 E05 drives and LTO Ultrium 4 |

*Table 39. Feature codes for the models of the 3584 Tape Library (continued)*

| Feature Code | Model | Customer-Setup Unit (CSU)[1] | Description |
|---|---|---|---|

**Notes:**

1. A feature that you, the customer, can install yourself. You do not need an IBM Service Representative to install a customer-setup unit.
2. The Full Capacity Storage feature (1642 or 1644) is required to attach the optional expansion frame Models D22, D32, or D52.
3. The Full Capacity Storage feature (1642 or 1644) is required to add an Additional I/O Slots feature (1658 or 1659).
4. With feature code 1451, feature codes 1660 and 1662 are standard in Models L22, L23, L52, L53, D23, and D53.
5. Required when you have 3 to 16 frames and you want to remove frames such that 1 or 2 frames remain. Does not apply to a library that contains dual accessors.
6. Required when you have 1 to 2 frames and you want to add frames for a total of 3 to 6 frames. Does not apply to a library that contains dual accessors.
7. Required when you have 7 to 16 frames and you want to remove frames for a total of 3 to 6 frames. Does not apply to a library that contains dual accessors.
8. Required when you have 1 to 6 frames and you want to add one frame for a total of 7 frames. Does not apply to a library that contains dual accessors.
9. Required when you have 1 to 6 frames and you want to add frames for a total of 8 to 14 frames. Does not apply to a library that contains dual accessors.
10. Required when you have 8 to 16 frames, when you have feature code 1816 or 9316 installed, and when you want to remove frames such that you have a total of 7 frames. Does not apply to a library that contains dual accessors.
11. Required when you have 1 to 14 frames, when feature code 9316 is not installed, and when you want to add frames for a total of 15 to 16 frames. Does not apply to a library that contains dual accessors.
12. ALMS feature code 1690, 1692, 1693, or 1694 is required for the System z Operating System attachment.
13. Must be added to any IBM System Storage TS3500 Tape Library that comes from the plant and has 15 to 16 frames (14 or 15 Model D22, 32, or 52 expansion frames attached to the Model L22, 32, or 52). Does not apply to a library that contains dual accessors.
14. Maximum limit of 3 per subsystem (no mixed media support). These feature codes assume the 4-I/O door frame will be installed at the end of the library string ("string" refers to the very last frame in a single accessor library or the last frame before SBB in HS) for both HA and single accessor libraries. If the customer prefers the 4-I/O door frame be installed elsewhere in the string, the Service Rep must obtain a "Services Contract" to uninstall additional frames as necessary to accommodate the customer's request.
15. This feature (FC 9679) indicates that one 3588 Tape Drive Model F3A or F3B will be field installed into a 3584 Model D32, D52, D53, L32, L52, or L53. If it is added to the order of a new 3584 frame coming from the plant, it indicates that the drive will be installed in the field rather than at the plant. Installation of a 3588 Tape Drive canister requires that a LTO Fibre Drive Mounting Kit feature (FC 1504 on the Model D32, D52, L32, or L52; FC 1514 on the Model D53 or L53) be installed in the 3584 Frame to contain the canister. The 3588 Model F3A or F3B Tape Drive must be separately ordered through FC 9679. Because the 3588 Tape Drive is designated as customer setup, if assistance is required to field install the drive, the 3588 Tape Drive Field Install Assist feature (FC 1678) should be ordered.
16. The quantity of the LTO Fibre Drive Mounting Kit feature (FC 1504 or FC 1514) must be equal to or greater than the quantity of LTO Fibre Channel Tape Drives installed (FC 9678, FC 9679, FC 9681, and FC 1479) plus Fiber Channel tape drives reinstalled with feature FC 1665).

**Related reference**

"Elements in the Library" on page 106
This section provides a flowchart of the elements that are available for a 3584 Tape Library.

## Customer-Setup Units

This section lists the features for the 3584 Tape Library that are customer-setup units (CSUs), which means you can install them by yourself when they are ordered as a field upgrade.

Should you choose not to install a CSU, IBM can install it for an additional charge. Detailed instructions are included when you order and receive these features. To access the instructions from the web, go to `http://www-03.ibm.com/servers/storage/tape/resource-library.html#publications`, then select `Publications`. Under the `Publications` category, select `3584 Tape Library`.

| Feature Code | CSU Feature |
|---|---|
| 1504 | LTO Fibre Drive mounting kit (for Models L52, L22, D52, and D22 only) |
| 1514 | LTO Fibre Channel Tape Drive mounting kit (for Models L53 and D53 only) |
| 1643 | Intermediate Capacity On Demand |
| 1644 | Full Capacity On Demand |
| 1680 | Control path failover |
| 1681 | Data path failover |
| 1682 | Path failover |
| 1690 | Advanced Library Management System (ALMS) |
| 1692 | Entry ALMS |
| 1693 | Intermediate ALMS |
| 1694 | Full ALMS |
| 9679 | 3588 Tape Drive field install in a 3584 Tape Library (see feature code 1678) |
| Assorted feature codes | SCSI cables, fibre cables, and SCSI interposers |

# Chapter 4. Using Ultrium Media

The section introduces information about Ultrium Tape Media.

The IBM System Storage TS3500 Tape Library automates the storage and movement of IBM LTO Ultrium Tape Cartridges.

## Overview of Ultrium Media

This section describes Ultrium media.

Within the 3584 Tape Library and subject to certain restrictions, the Ultrium Tape Drives use the following cartridge types:

- IBM System Storage 800 GB LTO Data Cartridge (Ultrium 4 cartridge without WORM capability; part number 95P4436)
- IBM System Storage 800 GB LTO WORM Data Cartridge (Ultrium 4 cartridge; part number 95P4450)
- IBM System Storage 400 GB LTO WORM Data Cartridge (Ultrium 3 cartridge; part number 96P1203)
- IBM System Storage 400 GB LTO Data Cartridge (Ultrium 3 cartridge without WORM capability; part number 24R1922)
- IBM System Storage 200 GB LTO Data Cartridge (Ultrium 2 cartridge; part number 08L9870)
- IBM System Storage 100 GB LTO Data Cartridge (Ultrium 1 cartridge; part number 08L9213 or 08L9120)
- IBM System Storage Universal LTO Cleaning Cartridge (part number 35L2086)
- IBM System Storage LTO Cleaning Cartridge
- Diagnostic cartridge

Figure 28 shows the IBM TotalStorage LTO Ultrium Data Cartridge.

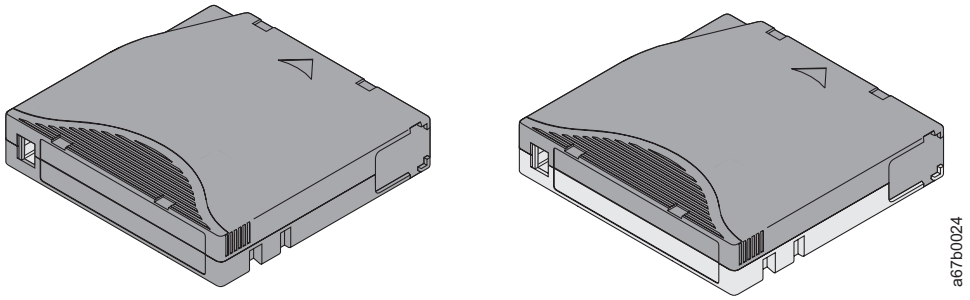



*Figure 28. The IBM System Storage LTO Data Cartridge for Ultrium 3 Tape Drives*

**Related concepts**

"WORM Functionality for Ultrium 3 and Ultrium 4 Tape Drives and Media" on page 116
This section describes the write once read many (WORM) functionality that is used by the LTO Ultrium 3 and Ultrium 4 Tape Drives and supported cartridges.

"Ultrium Data Cartridge" on page 118
This section describes the capacity, construction, operation, and components of the IBM LTO Ultrium Data Cartridge.

"Ultrium Cleaning Cartridge" on page 120
This section gives information about the appearance and usage of the IBM TotalStorage LTO Ultrium Cleaning Cartridge.

"Ultrium Diagnostic Cartridge" on page 121
This section gives information about the appearance and usage of the Ultrium diagnostic cartridge.

"Ultrium Bar Code Label" on page 122
This section describes the appearance and specifications of the Ultrium bar code label.

**Related reference**

"Ordering Additional Ultrium Cartridges and Media Supplies" on page 140
This section tells how to order additional Ultrium Tape Cartridges and other related media supplies.

"Ordering Bar Code Labels for Ultrium Cartridges" on page 142

## WORM Functionality for Ultrium 3 and Ultrium 4 Tape Drives and Media

This section describes the write once read many (WORM) functionality that is used by the LTO Ultrium 3 and Ultrium 4 Tape Drives and supported cartridges.

The Ultrium 3 and Ultrium 4 Tape Drives include the write once read many (WORM) feature, which is supported by the IBM System Storage LTO WORM Data Cartridge (formerly the IBM TotalStorage 3589 Ultrium Tape Cartridge Models 028 and 029). All IBM Ultrium 3 Tape Drives with firmware levels of 54K1 or higher and all Ultrium 4 Tape Drives support the WORM function. An Ultrium 3 Tape Drive or Ultrium 4 Tape Drive with WORM capability can recognize WORM-compatible media. Information and the required drive firmware can be found at:

`http://www.ibm.com/servers/storage/support/lto/3584/downloading.html`

The IBM System Storage LTO WORM Data Cartridge is only for use on Ultrium 3 and Ultrium 4 Tape Drives with WORM capable-microcode. The cartridge is designed for applications such as archiving and data retention, and is also suitable for applications that require an audit trail. The cartridge works with the Ultrium 3 and Ultrium 4 Tape Drives to prevent the alteration or deletion of user data. Additionally, IBM has taken the following steps to reduce tampering with data:

- The bottom of the WORM cartridge is molded in a color (gray) that is different from rewritable cartridges.
- A unique format is factory-written on each WORM cartridge.
- The WORM cartridge's memory, along with its unique format, protects the WORM character of the media.

Based on LTO technology, the format for the 3589 LTO WORM Data Cartridge provides up to 400 GB native capacity and 800 GB at 2:1 compression for Ultrium 3, and up to 800 GB native capacity and 1600 GB at 2:1 compression for Ultrium 4.

## Compatibility Among Ultrium Drives and Cartridges

This section defines compatibility among Ultrium 1, Ultrium 2, Ultrium 3, and Ultrium 4 Tape Drives and cartridges.

Table 40 shows the compatibility among the Ultrium drives and cartridges.

*Table 40. Compatibility among Ultrium Tape Drives and tape cartridges*

| Cartridge Type | | Drive Type | | | |
|---|---|---|---|---|---|
| **Media Type** | **Cartridge Capacity** | **Ultrium 4 (F4A)** | **Ultrium 3 (F3A, F3B)** | **Ultrium 2** | **Ultrium 1** |
| Ultrium 1 Cartridge | 100 GB | Not compatible | R | R/W | R/W |
| Ultrium 2 Cartridge | 200 GB | R | R/W | R/W | Not compatible |
| Ultrium 3 Cartridge | 400 GB | R/W | R/W | Not compatible | Not compatible |
| Ultrium 3 WORM Cartridge | 400 GB | R/W | R/W | Not compatible | Not compatible |
| Ultrium 4 Cartridge | 800 GB | R/W | Not compatible | Not compatible | Not compatible |
| Ultrium 4 WORM Cartridge | 800 GB | R/W | Not compatible | Not compatible | Not compatible |
| **Notes:**<br>• R = Read-only capability<br>• R/W = Read and write capability | | | | | |

If you want to control the capacity of the cartridge (for example, if you want to limit the capacity to obtain a faster seek time) you can do so by issuing the SCSI command SET CAPACITY. For information about this command, refer to the *IBM TotalStorage LTO Ultrium Tape Drive SCSI Reference*.

To ensure that your tape drive conforms to IBM's specifications for reliability, use only IBM LTO Ultrium Tape Cartridges. You may use other LTO-certified data cartridges, but they may not meet the standards of reliability that are established by IBM. The IBM System Storage 400 GB LTO Data Cartridge cannot be interchanged with the media used in other IBM non-LTO Ultrium tape products.

## Ultrium Data Cartridge

This section describes the capacity, construction, operation, and components of the IBM LTO Ultrium Data Cartridge.

The IBM Ultrium 4 cartridge is green with a silkscreen label on the top which specifies ″Ultrium 4 - 800 GB.″ The IBM Ultrium 3 WORM Data Cartridge is blue-gray on the top and gray on the bottom. The IBM Ultrium 3 Data Cartridge is blue-gray. The IBM Ultrium 2 Data Cartridge is purple, and the Ultrium 1 Data Cartridge is black. All generations contain 1/2-inch, dual-coat, metal-particle tape. Capacity for the four types of cartridges is as follows:

- Ultrium 4 and Ultrium 4 WORM cartridges have a native data capacity of 800 GB (1600 GB at 2:1 compression)
- Ultrium 3 and Ultrium 3 WORM cartridges have a native data capacity of 400 GB (800 GB at 2:1 compression)
- Ultrium 2 cartridge has a native data capacity of 200 GB (400 GB at 2:1 compression)
- Ultrium 1 cartridge has a native data capacity of 100 GB (200 GB at 2:1 compression)

When processing tape in the cartridges, the Ultrium Tape Drives use a linear, serpentine recording format. The Ultrium 4 drives read and write data on 896 tracks; the Ultrium 3 drives read and write data on 704 tracks; the Ultrium 2 drive, on 512 tracks; and the Ultrium 1 drive, on 384 tracks. Ultrium 1 and Ultrium 2 drives read and write eight tracks at a time. The Ultrium 4 drives read and write 16 tracks at a time by using Ultrium 4 and Ultrium 3 cartridges and read 8 tracks at a time by using Ultrium 2 cartridges. The Ultrium 3 drives read and write 16 tracks at a time by using an Ultrium 3 cartridge and 8 tracks at a time by using Ultrium 1 or 2 cartridges. The first set of tracks is written from near the beginning of the tape to near the end of the tape. The head then repositions to the next set of tracks for the return pass. This process continues until all tracks are written and the tape is full, or until all data is written. Figure 29 on page 119 shows the IBM System Storage LTO Data Cartridge and its components

| | | | |
|---|---|---|---|
| 1 | LTO cartridge memory | 4 | Write-protect switch |
| 2 | Cartridge door | 5 | Label area |
| 3 | Leader pin | 6 | Insertion guide |

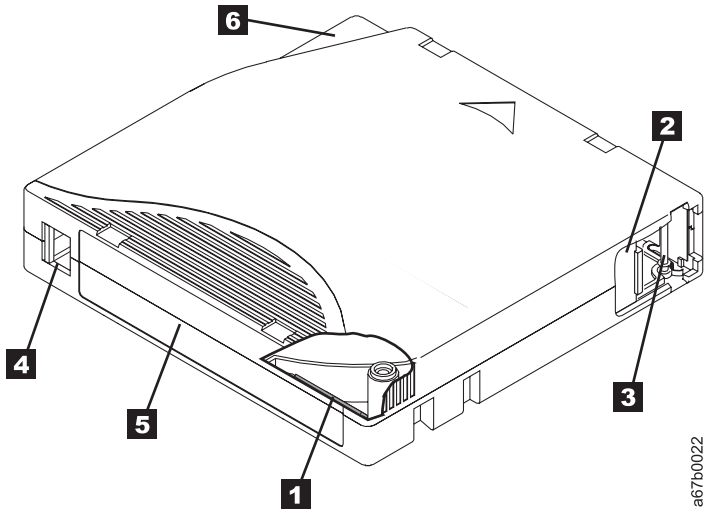



*Figure 29. The IBM System Storage LTO Data Cartridge*

All generations of the IBM LTO Ultrium Data Cartridge include a Linear Tape-Open Cartridge Memory (LTO-CM) chip ( **1** in Figure 29), that contains information about the cartridge and the tape (such as the name of the manufacturer that created the tape), as well as statistical information about the cartridge's use. The LTO-CM enhances the efficiency of the cartridge. For example, the LTO-CM stores the end-of-data location which, when you next insert a cartridge and issue the Write command, enables the drive to quickly locate the recording area and begin recording. The LTO-CM also aids in determining the reliability of the cartridge by storing data about its age, how many times it has been loaded, and how many errors it has accumulated. Whenever you unload a tape cartridge, the tape drive writes any pertinent information to the cartridge memory. The storage capacity of the LTO-CM is 4096 bytes.

The cartridge door **2** protects the tape from contamination when the cartridge is out of the drive. Behind the door, the tape is attached to a leader pin **3** . When you insert the cartridge into the drive, a threading mechanism pulls the pin (and tape) out of the cartridge, across the drive head, and onto a non-removable takeup reel. The head can then read or write data from or to the tape.

The write-protect switch **4** prevents data from being written to the tape cartridge. The label area **5** provides a location for you to place a label. Affix only a bar code label. When affixing a label, place it only in the recessed label area. A label that extends outside of the recessed area can cause loading problems in the internal drive or in the 3584 Tape Library. The insertion guide **6** is a large, notched area that prevents you from inserting the cartridge incorrectly. You can order tape cartridges with the bar code labels included, or you can order custom labels.

Generation 3 and 4 of the LTO Ultrium Data Cartridge has a nominal cartridge life of 20,000 load and unload cycles; Generations 1 and 2 of the LTO Ultrium Data Cartridge have a nominal cartridge life of 10,000 load and unload cycles.

**Related reference**

"Ordering Additional Ultrium Cartridges and Media Supplies" on page 140
This section tells how to order additional Ultrium Tape Cartridges and other related media supplies.

"Ordering Bar Code Labels for Ultrium Cartridges" on page 142

## Ultrium Cleaning Cartridge

This section gives information about the appearance and usage of the IBM TotalStorage LTO Ultrium Cleaning Cartridge.

To maintain the operating efficiency of the drive, IBM supplies a cleaning cartridge with the first frame of each media type. Thus if the 3584 Tape Library contains frames with both LTO Ultrium and 3592 Tape Drives, IBM supplies one LTO Ultrium Cleaning Cartridge and one 3592 Cleaning Cartridge regardless of how many frames of each type are in the library. Each drive determines when it needs to be cleaned and alerts the library. Depending on which cleaning method you choose (automatic, host, or manual), the library uses the cleaning cartridge to automatically clean the drive or you are required to select menus to initiate cleaning.

**Note:** The volume serial (VOLSER) number on the cleaning cartridge's bar code label must begin with **CLNI** or **CLNU**, or the library treats the cleaning cartridge as a data cartridge during an inventory.

The IBM TotalStorage LTO Ultrium Cleaning Cartridge (known as the universal cleaning cartridge) and the LTO Ultrium Cleaning Cartridge are compatible with the Ultrium 1, Ultrium 2, Ultrium 3, and Ultrium 4 Tape Drives. To enable your Ultrium 1 drive to use these cartridges, update the drive with the latest drive firmware (for instructions, see the section for updating drive firmware in the *IBM System Storage TS3500 Tape Library Operator Guide*).

Before a drive can be cleaned, ensure that a cleaning cartridge is loaded in the library (to determine whether one or more cleaning cartridges are loaded, see the section about removing a cleaning cartridge in the *IBM System Storage TS3500 Tape Library Operator Guide*). You can load multiple cleaning cartridges and store them in any cartridge storage slot except the slot that is reserved for the diagnostic cartridge (see the section about non-addressable storage slots in the *IBM System Storage TS3500 Tape Library Operator Guide*).

The 3584 Tape Library monitors the use of all cleaning cartridges. The IBM Cleaning Cartridges are valid for 50 uses. When the cartridge expires, the library displays the following sample message on the Activity screen (where xx equals characters of the cartridge's VOLSER):

```
Remove CLNUxxL1
Cleaning Cartridge Expired
```

The cartridge's LTO-CM chip tracks the number of times that the cartridge is used. To remove a cleaning cartridge, see the appropriate section in the *IBM System Storage TS3500 Tape Library Operator Guide*.

**Related concepts**

"Methods of Cleaning Drives" on page 63
This section describes the methods of cleaning that the 3584 Tape Library uses for its drives.

## Ultrium Diagnostic Cartridge

This section gives information about the appearance and usage of the Ultrium diagnostic cartridge.

The Ultrium diagnostic cartridge is a cartridge with known good media that is reserved for diagnostic purposes only. One cartridge slot is reserved in the first Ultrium frame for the Ultrium diagnostic cartridge. The slot is located at Column 1, Row 1. The volume serial (VOLSER) number for a diagnostic cartridge is represented as `DG IxxLy`, where `xx` equals alphanumeric characters and `y` equals the generation of the cartridge type (1 for Ultrium 1, or 2 for Ultrium 2, Ultrium 3, or Ultrium 4). The characters of the VOLSER are white on a black background. During service calls, your IBM Service Representative will use the cartridge to ensure that the tape drives run correctly and to specification.

If your library is installed with a second accessor, service bay A (the HA1 frame) contains only gripper test slots for diagnostic cartridges. Service bay B contains gripper test slots for diagnostic cartridges, and also contains unusable storage slots. The storage slots in service bay B are not usable if the frame is configured as a service bay. Never insert any type of cartridge into service bays. Each service bay contains gripper test slots for three Ultrium diagnostic cartridges and three 3592 diagnostic cartridges.

Because internal diagnostics for the LTO Ultrium Tape Drive will not permit it to write to a WORM cartridge, all diagnostic tests that are selected from the operator panel and performed in maintenance mode will cause the drive to eject a WORM cartridge and issue error code 7 on its single-character display. To run diagnostics, use a non-WORM cartridge.

## Ultrium Bar Code Label

This section describes the appearance and specifications of the Ultrium bar code label.

Each Ultrium data, cleaning, and diagnostic cartridge that is processed by the 3584 Tape Library must bear a bar code label. The label contains:

- A volume serial (VOLSER) number that you can read
- A bar code that the library can read

When read by the library's bar code reader, the bar code identifies the cartridge's VOLSER to the tape library. The bar code also tells the library whether the cartridge is a data, cleaning, or diagnostic cartridge. In addition, the bar code includes the two-character media-type identifier Lx, where x equals 1, 2, 3, 4, T, or U. L identifies the cartridge as an LTO cartridge. 1 indicates that the cartridge is the first generation of its type; 2, 3, or 4 indicates that the cartridge is the second, third or forth generation of its type; T indicates that the cartridge is generation 3 WORM cartridge; and U indicates that the cartridge is generation 4 WORM cartridge. Figure 30 on page 123 shows a sample bar code label for the LTO Ultrium 3 Tape Cartridge.

You can order tape cartridges with the labels included, or you can order custom labels. The bar code must meet predefined specifications. They include (but are not limited to):

- Eight uppercase alphanumeric characters, where the last two characters must be L1, L2, L3, L4, LT, or LU
- Label and printing to be non-glossy
- Nominal narrow line or space width of 0.423 mm (0.017 in.)
- Wide to narrow ratio of 2.75:1
- Minimum bar length of 11.1 mm (0.44 in.)

To determine the complete specifications of the bar code and the bar code label, visit the web at http://www.ibm.com/servers/storage/support/lto/3584/. Under Additional resources, select LTO Ultrium media. Under Learn more, select LTO label specifications. Under Abstract, select the .pdf file to view the *IBM LTO Ultrium Cartridge Label Specification (Revision 2)*. You can also contact your IBM Sales Representative for this specification.

When attaching a bar code label to a tape cartridge, place the label only in the recessed label area. A label that extends outside of the recessed area can cause loading problems in the drive or the library.

**Attention:** Do not place any type of mark on the white space at either end of the bar code. A mark in this area may prevent the 3584 Tape Library from reading the label.

By using the Tape Library Specialist web interface, you can configure the library so that it reports to the server all eight characters of the VOLSER on the bar code label or only the first six characters. To configure a six-character VOLSER, refer to the section about enabling or disabling the reporting of a six-character VOLSER in the *IBM System Storage TS3500 Tape Library Operator Guide*.

**Note:** If you suspect that the library is having problems reading the bar code labels, you can slow the scanner speed as part of problem determination. You may choose to slow the scanner speed rather than replace all labels, or

you may want to slow the scanner speed while you wait for an opportunity to re-label the media. Depending on the severity of the problem, the error recovery procedure (ERP) for poor labels may greatly exceed the time lost by slowing the scanner. If you have cartridge bar code labels that meet the LTO bar code label specification, there is no need to slow the scanner speed. For information about slowing the scanner speed, see the section about adjusting the scanner speed in the *IBM System Storage TS3500 Tape Library Operator Guide*.

To order bar code labels, see "Ordering Bar Code Labels for Ultrium Cartridges" on page 142.

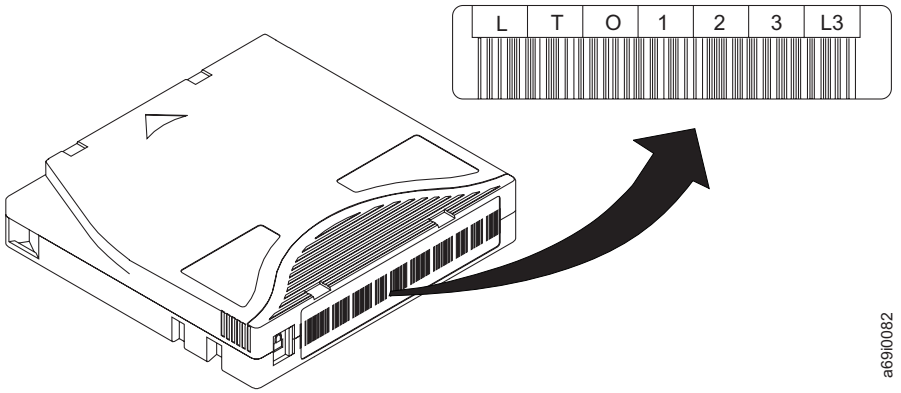



*Figure 30. Sample bar code label on the LTO Ultrium 3 Tape Cartridge.* The volume serial number (LTO123) and bar code are printed on the label.

**Related reference**

"Ordering Additional Ultrium Cartridges and Media Supplies" on page 140
This section tells how to order additional Ultrium Tape Cartridges and other related media supplies.

"Guidelines for Using Ultrium Bar Code Labels"

"Ordering Bar Code Labels for Ultrium Cartridges" on page 142

## Guidelines for Using Ultrium Bar Code Labels

Apply the following guidelines whenever you use Ultrium bar code labels:

- Use only IBM-approved bar code labels.
- Do not reuse a label or reapply a used label over an existing label.
- Before you apply a new label, remove the old label by slowly pulling it at a right angle to the cartridge case.
- Use peel-clean labels that do not leave a residue after they are removed. If there is glue residue on the cartridge, remove it by gently rubbing it with your finger; do not use a sharp object, water, or a chemical to clean the label area.
- Examine the label before you apply it to the cartridge. Do not use the label if it has voids or smears in the printed characters or bar code (an application's inventory operation will take much longer if the bar code label is not readable).
- Remove the label from the label sheet carefully. Do not stretch the label or cause the edges to curl.
- Position the label within the recessed label area.
- With light finger pressure, smooth the label so that no wrinkles or bubbles exist on its surface.

- Verify that the label is smooth and parallel, and has no roll-up or roll-over. The label must be flat to within 0.5 mm (0.02 in.) over the length of the label and have no folds, missing pieces, or smudges.
- Do not place other machine-readable labels on other surfaces of the cartridge. They may interfere with the ability of the bar code reader to read the bar code.

## Setting the Write-Protect Switch on an Ultrium Cartridge

This section gives instructions for setting the write-protect switch on an Ultrium Tape Cartridge.

The position of the write-protect switch on an Ultrium Tape Cartridge (see **1** in Figure 31) determines whether you can write to the tape:

- If the switch is set to (solid red), data cannot be written to the tape.
- If the switch is set to unlocked (black void), data can be written to the tape.

If possible, use your server's application software to write-protect your cartridges (rather than manually setting the write-protect switch). This allows the server's software to identify a cartridge that no longer contains current data and is eligible to become a scratch cartridge. Do not write-protect scratch (blank) cartridges; the tape drive will not be able to write new data to them.

If you must manually set the write-protect switch, slide it left or right to the desired position.

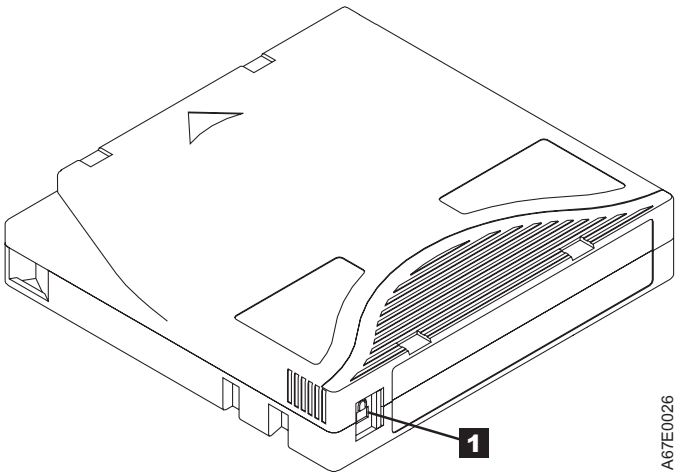



*Figure 31. Setting the write-protect switch on an Ultrium Tape Cartridge*

## Handling Ultrium Tape Cartridges

This section introduces ways to handle Ultrium Tape Cartridges to avoid damage to the cartridge case and the tape.

**Attention:** Do not insert a damaged tape cartridge into your 3584 Tape Library. A damaged cartridge can interfere with the reliability of a drive and may void the warranties of the drive and the cartridge. Before inserting a tape cartridge, inspect the cartridge case, cartridge door, and write-protect switch for breaks. If you need to recover data from a damaged cartridge, contact your IBM Service Representative.

Incorrect handling or an incorrect environment can damage the IBM LTO Ultrium Tape Cartridges or their magnetic tape. To avoid damage to your tape cartridges and to ensure the continued high reliability of your IBM LTO Ultrium Tape Drives, use the following guidelines:

### Provide Training for Using Ultrium Tape Cartridges

- Post procedures that describe proper media handling in places where people gather.
- Ensure that anyone who handles tape has been properly trained in handling and shipping procedures. This includes operators, users, programmers, archival services, and shipping personnel.
- Ensure that any service or contract personnel who perform archiving are properly trained in media-handling procedures.
- Include media-handling procedures as part of any services contract.
- Define and make personnel aware of data recovery procedures.

## Ensure Proper Packaging of Ultrium Tape Cartridges

- When you ship a cartridge, ship it in its original or better packaging.
- Always ship or store a cartridge in a jewel case.
- Use only a recommended shipping container that securely holds the cartridge in its jewel case during transportation. Ultrium Turtlecases (by Perm-A-Store) have been tested and found to be satisfactory (see Figure 32). They are available at `http://www.turtlecase.com`.


*Figure 32. Tape cartridges in a Turtlecase*

- Never ship a cartridge in a commercial shipping envelope. Always place it in a box or package.
- If you ship the cartridge in a cardboard box or a box of a sturdy material, ensure the following:
  - Place the cartridge in polyethylene plastic wrap or bags to protect it from dust, moisture, and other contaminants.
  - Pack the cartridge snugly; do not allow it to move around.
  - Double-box the cartridge (place it inside a box, then place that box inside the shipping box) and add padding between the two boxes (see Figure 33 on page 128).

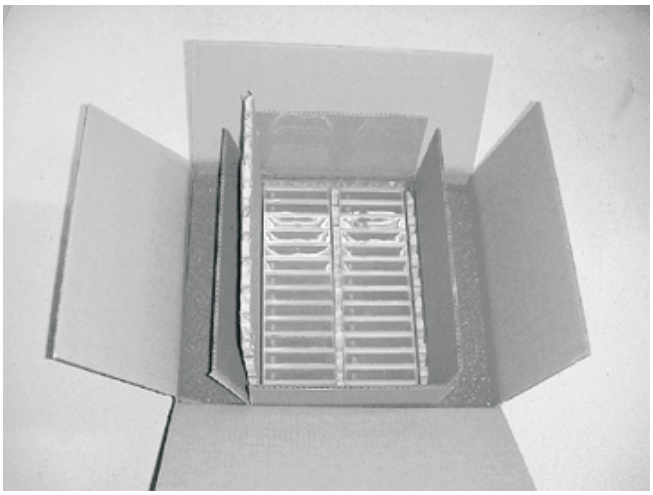



*Figure 33. Double-boxing tape cartridges for shipping*

## Provide Proper Acclimation and Environmental Conditions for Ultrium Tape Cartridges

- Before you use a cartridge, let it acclimate to the normal operating environment for 1 hour. If you see condensation on the cartridge, wait an additional hour.
- Ensure that all surfaces of a cartridge are dry before inserting it.
- Do not expose the cartridge to moisture or direct sunlight.
- Do not expose recorded or blank cartridges to stray magnetic fields of greater than 100 Oersteds (for example, terminals, motors, video equipment, X-ray equipment, or fields that exist near high-current cables or power supplies). Such exposure can cause the loss of recorded data or make the blank cartridge unusable.
- Maintain the proper conditions for storing and shipping the cartridges.

**Related concepts**

"Environmental and Shipping Specifications for Ultrium Cartridges" on page 138
This section gives a table of the operating, storage, and shipping requirements for Ultrium Tape Cartridges.

## Perform a Thorough Inspection of Ultrium Tape Cartridges

After purchasing a cartridge and before using it, perform the following steps:

- Inspect the cartridge's packaging to determine potential rough handling.
- When inspecting a cartridge, open only the cartridge door. Do not open any other part of the cartridge case. The upper and lower parts of the case are held together with screws; separating them destroys the usefulness of the cartridge.
- Inspect the cartridge for damage before using or storing it.
- Inspect the rear of the cartridge (the part that you load first into the tape load compartment) and ensure that there are no gaps in the seam of the cartridge case (see **1** in Figure 34 on page 129). If there are gaps in the seam, the leader pin may be dislodged and may need to be repositioned.

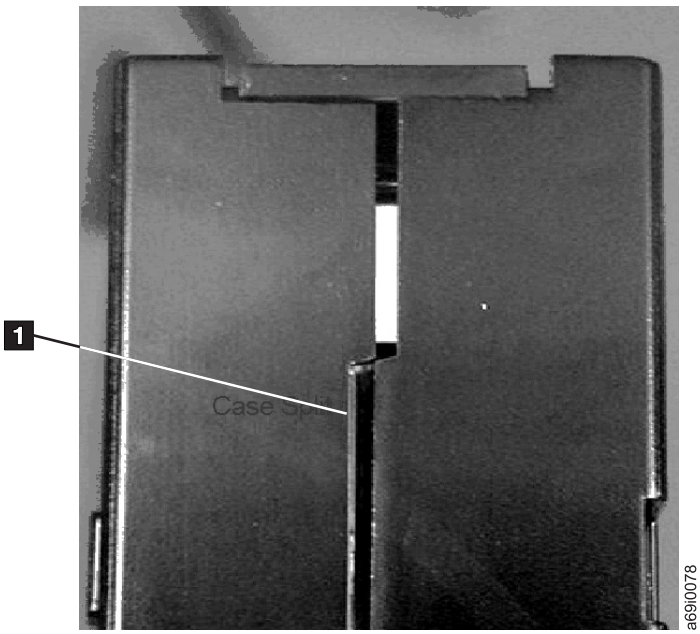



*Figure 34. Checking for gaps in the seams of a cartridge*

- Check that the leader pin is properly positioned.
- If you suspect that the cartridge has been mishandled but it appears usable, copy any data onto a good cartridge immediately for possible data recovery. Discard the mishandled cartridge.
- If you must recover data from a damaged cartridge, contact your service representative.
- Review handling and shipping procedures.

**Related tasks**

"Repositioning a Leader Pin in an Ultrium Cartridge" on page 131

## Handle the Ultrium Tape Cartridge Carefully

- Do not drop the Ultrium Tape Cartridge. If the cartridge drops, slide the cartridge door back and ensure that the leader pin is properly positioned in the pin-retaining spring clips. If the leader pin has become dislodged, perform the procedure to reposition it.
- Do not handle tape that is outside the cartridge. Handling the tape can damage the tape's surface or edges, which may interfere with read or write reliability. Pulling on tape that is outside the cartridge can damage the tape and the brake mechanism in the cartridge.
- Do not stack more than six cartridges.
- Do not degauss a cartridge that you intend to reuse. Degaussing makes the tape unusable.

**Related tasks**

"Repositioning a Leader Pin in an Ultrium Cartridge" on page 131

## Examples of Problems with Ultrium Tape Cartridges

### Example: Split Cartridge Case

The cartridge's case is damaged. There is a high possibility of media damage and potential loss. Perform the following steps:

1. Look for cartridge mishandling.
2. Use the IBM Leader Pin Reattachment Kit (part number 08L9129) to correctly position the pin. Then, immediately use data recovery procedures to minimize chances of data loss.
3. Review media-handling procedures.

### Example: Improper Placement of Leader Pin

The leader pin is misaligned. Perform the following steps:

1. Look for cartridge damage.
2. Use the IBM Leader Pin Reattachment Kit (part number 08L9129) to correctly position the pin. Then, immediately use data recovery procedures to minimize chances of data loss.

**Related concepts**

"Perform a Thorough Inspection of Ultrium Tape Cartridges" on page 128

**Related tasks**

"Repositioning a Leader Pin in an Ultrium Cartridge" on page 131

## Repositioning or Reattaching a Leader Pin in an Ultrium Cartridge

This section introduces the procedures to use when you move a leader pin into its proper position in an Ultrium Tape Cartridge, or when you reattach the pin if it has separated from the tape.

**Attention:** Use a repaired tape cartridge only to recover data and move it to another cartridge. Continued use of a repaired cartridge may void the warranties of the drive and the cartridge.

If the leader pin in your Ultrium Tape Cartridge becomes dislodged from its pin-retaining spring clips or detaches from the tape, you must use the IBM Leader Pin Reattachment Kit (part number 08L9129) to reposition or reattach it. (Do not reattach the pin if you must remove more than 7 meters (23 feet) of leader tape.)

**Attention:** Use a repaired tape cartridge only to recover data and move it to another cartridge. Continued use of a repaired cartridge may void the warranties of the drive and the cartridge.

### Repositioning a Leader Pin in an Ultrium Cartridge

A leader pin that is improperly positioned inside an Ultrium Tape Cartridge can interfere with the operation of the drive. Figure 35 on page 132 shows a leader pin in the incorrect **1** and correct **2** positions.

To place the leader pin in its proper position, you will need the following tools:

- Plastic or blunt-end tweezers
- Cartridge manual rewind tool (from Leader Pin Reattachment Kit, part number 08L9129)

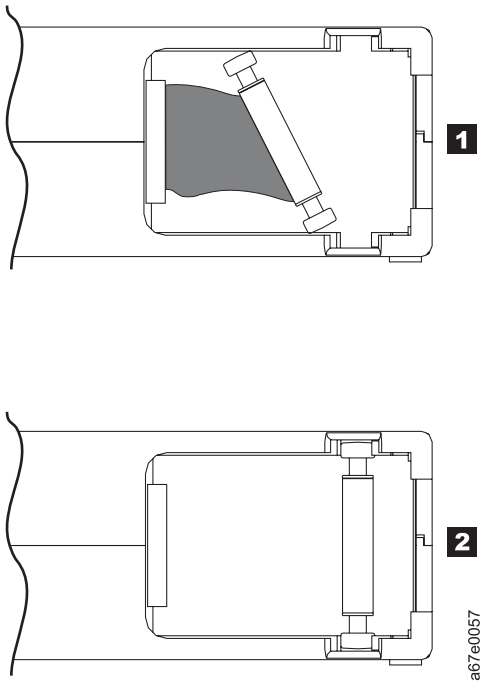



*Figure 35. Leader pin in the incorrect and correct positions in an Ultrium Tape Cartridge.* The cartridge door is open and the leader pin is visible inside the cartridge.

To reposition the leader pin, perform the following steps.

1. Slide open the cartridge door ( **1** in Figure 36 on page 133) and locate the leader pin **2** . You may need to shake the cartridge gently to roll the pin toward the door.
2. With plastic or blunt-end tweezers, grasp the leader pin and position it in the pin-retaining spring clips **3** .
3. Press the leader pin gently into the clips until it snaps into place and is firmly seated. Ensure that there are no gaps in the seam of the cartridge **4** . **Note:** If gaps exist, do not continue with this procedure and do not use the cartridge. Instead, contact your IBM Service Representative.
4. Close the cartridge door.

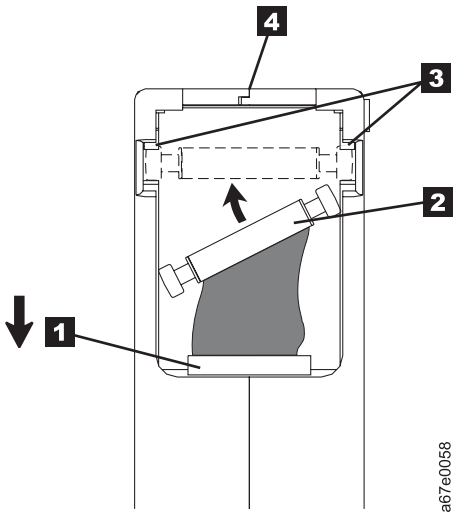



*Figure 36. Placing the dislodged leader pin into the correct position..* The cartridge door is open to show the leader pin.

5. To rewind the tape, insert the cartridge manual rewind tool ( **1** in Figure 37) into the cartridge's hub **2** and turn it clockwise until the tape becomes taut.

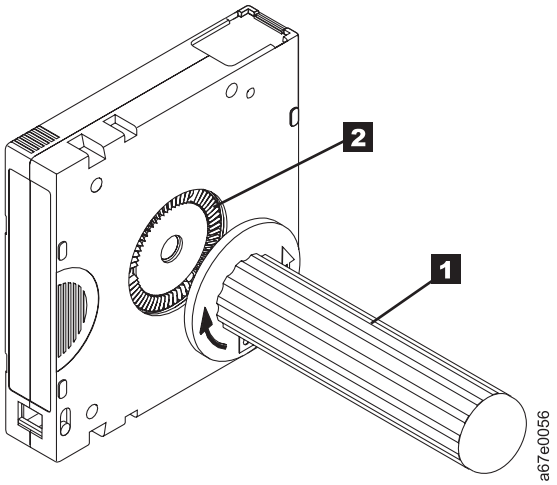



*Figure 37. Rewinding the tape into the cartridge*

6. Remove the rewind tool by pulling it away from the cartridge.

## Reattaching a Leader Pin in an Ultrium Cartridge

The first meter of tape in a Ultrium Tape Cartridge is leader tape. Once the leader tape has been removed there is a possibility of tape breakage. After reattaching the leader pin, transfer data from the defective tape cartridge. **Do not reuse the defective tape cartridge**.

The Leader Pin Reattachment Kit contains three parts:

- **Leader pin attach tool** (see 1 in Figure 38). A plastic brace that holds the cartridge door open.
- **Cartridge manual rewind tool** (see 2 in Figure 38). A device that fits into the cartridge's hub and lets you wind the tape into and out of the cartridge.
- **Pin supplies** (see 3 in Figure 38). Leader pins and C-clips.

**Attention:**

- Use only the IBM Leader Pin Reattachment Kit to reattach the leader pin to the tape. Other methods of reattaching the pin will damage the tape, the drive, or both.
- Use this procedure on your tape cartridge only when the leader pin detaches from the magnetic tape and you must copy the cartridge's data onto another cartridge. Destroy the damaged cartridge after you copy the data. This procedure may affect the performance of the leader pin during threading and unloading operations.
- Touch only the end of the tape. Touching the tape in an area other than the end can damage the tape's surface or edges, which may interfere with read or write reliability.

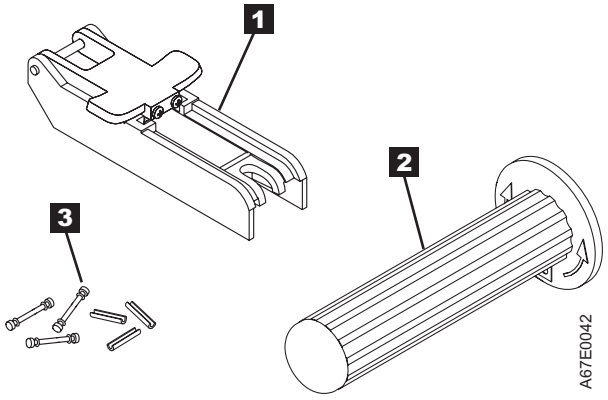



*Figure 38. Leader Pin Reattachment Kit*

To reattach a leader pin by using the IBM Leader Pin Reattachment Kit, perform the following steps:

1. Attach the leader pin attach tool ( 1 in Figure 39 on page 135) to the cartridge 2 so that the tool's hook 3 latches into the cartridge's door 4 . Pull the tool back to hold the door open, then slide the tool onto the cartridge. Open the tool's pivot arm 5 .

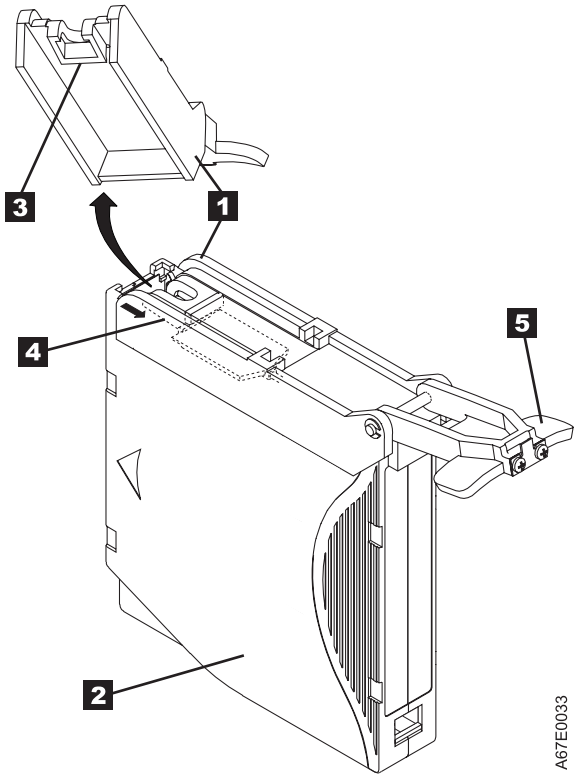



*Figure 39. Attaching the leader pin attach tool to an Ultrium Tape Cartridge.* To hold the cartridge door open, hook the tool into the door and pull the tool back.

2. To find the end of the tape inside the cartridge, attach the cartridge manual rewind tool ( **1** in Figure 40 on page 136) to the cartridge's hub **2** by fitting the tool's teeth between the teeth of the hub. Turn the tool clockwise until you see the end of the tape inside the cartridge. Then, slowly turn the rewind tool counterclockwise to bring the tape edge toward the cartridge door **3** .
3. Continue to turn the rewind tool counterclockwise until approximately 13 cm (5 in.) of tape hangs from the cartridge door. If necessary, grasp the tape and pull gently to unwind it from the cartridge.
4. Remove the rewind tool by pulling it away from the cartridge. Set the tool and the cartridge aside.

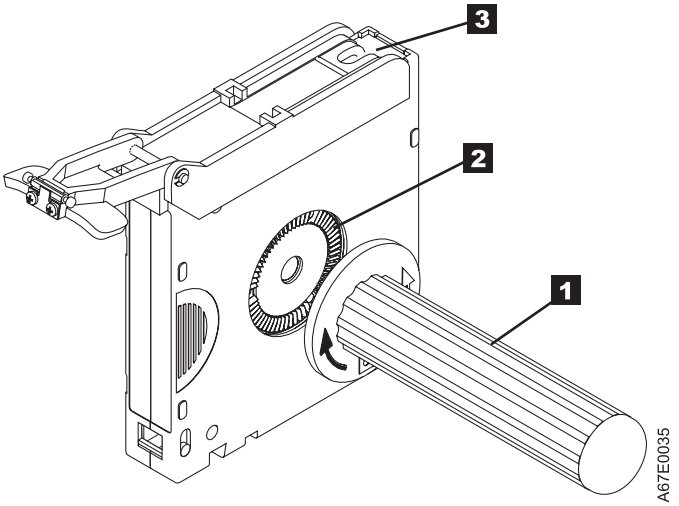



*Figure 40. Winding the tape out of the Ultrium Tape Cartridge.* Turn the cartridge manual rewind tool clockwise to see the end of the tape, then turn it counterclockwise to bring the tape to the cartridge door.

5. On the leader pin ( **1** in Figure 41), locate the open side of the C-clip **2** . The C-clip is a small black part that secures the tape 3 to the pin.
6. Remove the C-clip from the leader pin by using your fingers to push the clip away from the pin. Set the pin aside and discard the clip.

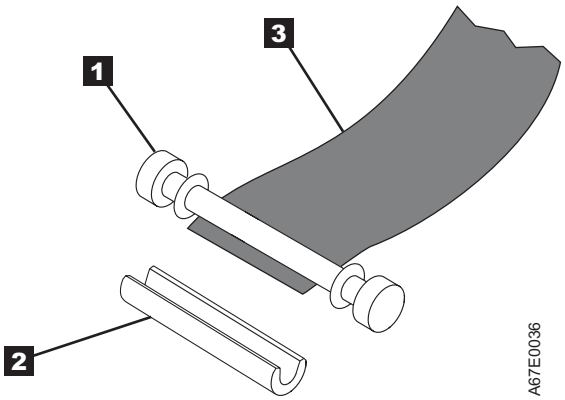



*Figure 41. Removing the C-clip from the leader pin.* Use your fingers to push the C-clip from the leader pin.

7. Position the tape in the alignment groove of the leader pin attach tool (see **1** in Figure 42 on page 137).
8. Place a new C-clip into the retention groove **2** on the leader pin attachment tool and make sure that the clip's open side faces up.
9. Place the leader pin (from step 6) into the cavity **3** of the leader pin attach tool.
10. **Attention:** To prevent the leader pin from rolling into the cartridge, in the following step use care when folding the tape over the pin.
11. Fold the tape over the leader pin and hold it with your fingers (see Figure 42 on page 137). **Note:** Use care to ensure that the tape is centered over the leader pin. Failure to properly center the tape on the pin will cause the repaired cartridge to fail. When the tape is properly centered, a 0.25-mm (0.01-in.) gap exists on both sides of the pin.

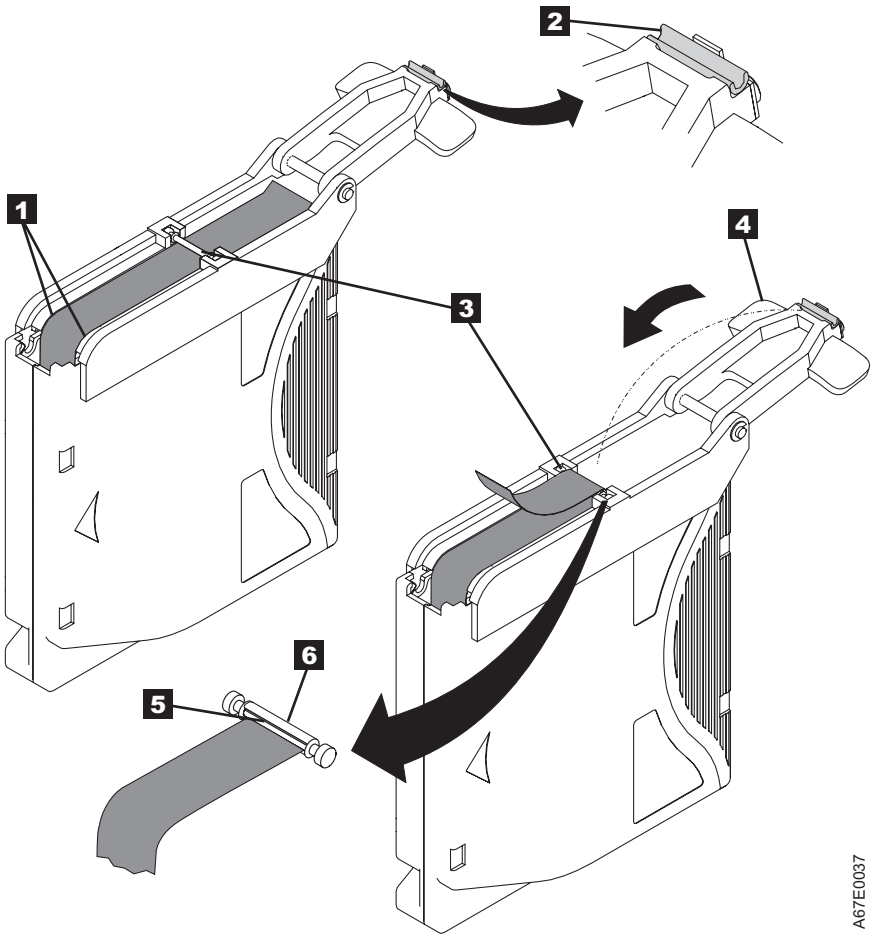



*Figure 42. Attaching the leader pin to the tape*

12. Close the pivot arm **4** of the leader pin attach tool by swinging it over the leader pin so that the C-clip snaps onto the pin and the tape.
13. Swing the pivot arm open and trim the excess tape **5** so that it is flush with the reattached leader pin **6**.
14. Use your fingers to remove the leader pin from the cavity **3** in the leader pin attach tool.
15. Use the cartridge manual rewind tool to wind the tape back into the cartridge (wind the tape clockwise). Ensure that the leader pin is latched by the pin-retaining spring clips on each end of the leader pin.
16. Remove the rewind tool.
17. Remove the leader pin attach tool by lifting its end up and away from the cartridge.

## Environmental and Shipping Specifications for Ultrium Cartridges

This section gives a table of the operating, storage, and shipping requirements for Ultrium Tape Cartridges.

Before you use an Ultrium Tape Cartridge, acclimate it to the operating environment for 24 hours or the time necessary to prevent condensation in the drive (the time will vary, depending on the environmental extremes to which the cartridge was exposed).

The best storage container for the cartridges (until they are opened) is the original shipping container. The plastic wrapping prevents dirt from accumulating on the cartridges and partially protects them from humidity changes.

**Attention:** Depending on how many drives you have installed in the frame of a 3584 Tape Library, the temperature inside the frame may be as much as 5°C (9°F) above the temperature outside the frame. To ensure continued reliability of your media, be sure to take this temperature difference into account when you set up the environment around your library.

When you ship a cartridge, place it in its jewel case or in a sealed, moisture-proof bag to protect it from moisture, contaminants, and physical damage. Ship the cartridge in a shipping container that has enough packing material to cushion the cartridge and prevent it from moving within the container.

Table 41 gives the environment for operating, storing, and shipping LTO Ultrium Tape Cartridges.

*Table 41. Environment for operating, storing, and shipping the LTO Ultrium Tape Cartridges*

| **Environmental Specifications** | | | | |
|---|---|---|---|---|
| **Environmental Factor** | **Operating** | **Operational Storage**[1] | **Archival Storage**[2] | **Shipping** |
| Temperature | 10 to 45°C (50 to 113°F | 16 to 32°C (61 to 90°F) | 16 to 25°C (61 to 77°F) | -23 to 49°C (-9 to 120°F) |
| Relative humidity (noncondensing) | 10 to 80% | 20 to 80% | 20 to 50% | 5 to 80% |
| Maximum wet bulb temperature | 26°C (79°F) | 26°C (79°F) | 26°C (79°F) | 26°C (79°F) |
| Magnetic field | Stray magnetic field at any point on tape not to exceed 50 Oersteds. | | | |
| **Notes:**<br>1. Operational storage equals less than 6 months.<br>2. Archival storage equals greater than 6 months. | | | | |

## Disposing of Ultrium Tape Cartridges

This section describes how to dispose of Ultrium Tape Cartridges according to federal and other regulations.

Under the current rules of the U.S. Environmental Protection Agency (EPA), regulation 40CFR261, the LTO Ultrium Tape Cartridge is classified as non-hazardous waste. As such, it may be disposed of in the same way as normal office trash. These regulations are amended from time to time, and you should review them at the time of disposal.

If your local, state, country (non-U.S.A.), or regional regulations are more restrictive than EPA 40CFR261, you must review them before you dispose of a cartridge. Contact your account representative for information about the materials that are in the cartridge.

If a tape cartridge must be disposed of in a secure manner, you can erase the data on the cartridge by using a high-energy ac degausser (use a minimum of 2800 Oersteds over the entire space that the cartridge occupies). Degaussing makes the cartridge unusable.

If you burn the cartridge and tape, ensure that the incineration complies with all applicable regulations.

## Ordering Additional Ultrium Cartridges and Media Supplies

This section tells how to order additional Ultrium Tape Cartridges and other related media supplies.

You can use one of the following methods to order the cartridges and media supplies shown in Table 42:

- Order from your IBM Sales Representative or any authorized IBM Business Partner.
- Order by calling 1-888-IBM-MEDIA.
- Order a through an IBM-authorized distributor (for the closest distributor, visit the web at `http://www.ibm.com/storage/media`).

**Note:** For cartridges with preapplied bar code labels, specify the VOLSER characters that you want.

*Table 42. Ordering Ultrium cartridges and media supplies*

| Supply Item | Method of Ordering |
|---|---|
| **IBM TotalStorage LTO Ultrium 800 GB WORM Data Cartridge**<br><br>Bar code labels are preapplied to cartridges. | Specify Machine Type 3589 Model 032 and the VOLSER characters that you want. |
| **IBM TotalStorage LTO Ultrium 800 GB WORM Data Cartridge**<br><br>Order VOLSER labels separately. | Specify Machine Type 3589 Model 033. |
| **IBM TotalStorage LTO Ultrium 800 GB Data Cartridge**<br><br>Bar code labels are preapplied to cartridges. | Specify Machine Type 3589 Model 010 and the VOLSER characters that you want. |
| **IBM TotalStorage LTO Ultrium 800 GB Data Cartridge**<br><br>Order VOLSER labels separately. | Specify Machine Type 3589 Model 011. |
| **IBM TotalStorage LTO Ultrium 400 GB WORM Data Cartridge**<br><br>Bar code labels are preapplied to cartridges. | Specify Machine Type 3589 Model 028 and the VOLSER characters that you want. |
| **IBM TotalStorage LTO Ultrium 400 GB WORM Data Cartridge**<br><br>Order VOLSER labels separately. | Specify Machine Type 3589 Model 029. |
| **IBM TotalStorage LTO Ultrium 400 GB Data Cartridge**<br><br>Bar code labels are preapplied to cartridges. | Specify Machine Type 3589 Model 008 and the VOLSER characters that you want. |
| **IBM TotalStorage LTO Ultrium 400 GB Data Cartridge**<br><br>Order VOLSER labels separately. | Specify Machine Type 3589 Model 009. |
| **IBM TotalStorage LTO Ultrium 200 GB Data Cartridge**<br><br>Bar code labels are preapplied to cartridges. | Specify Machine Type 3589 Model 006 and the VOLSER characters that you want. |
| **IBM TotalStorage LTO Ultrium 200 GB Data Cartridge**<br><br>Order VOLSER labels separately. | Specify Machine Type 3589 Model 007. |
| **IBM LTO Ultrium 100 GB Data Cartridge**<br><br>Bar code labels are preapplied to cartridges. | Specify Machine Type 3589 Model 002 and the VOLSER characters that you want. |

*Table 42. Ordering Ultrium cartridges and media supplies (continued)*

| Supply Item | Method of Ordering |
|---|---|
| **IBM LTO Ultrium 100 GB Data Cartridge**<br><br>Order VOLSER labels separately. | Specify Machine Type 3589 Model 003. |
| **IBM TotalStorage LTO Ultrium Cleaning Cartridge** (universal cleaning cartridge for use with Ultrium 1, Ultrium 2, Ultrium 3, and Ultrium 4 drives)<br><br>VOLSER labels are included. | Specify Machine Type 3589 Model 004 and the VOLSER characters that you want. |
| **Jewel Case for IBM TotalStorage LTO Ultrium 400 GB WORM Data Cartridge** | Order the jewel case as feature code 8000. This case can also be used for the Ultrium 2 and Ultrium 1 Tape Cartridges. |
| **Leader Pin Reattachment Kit** | Order as part number 08L9129. |

**Related concepts**

"Ultrium Data Cartridge" on page 118
This section describes the capacity, construction, operation, and components of the IBM LTO Ultrium Data Cartridge.

"Ultrium Cleaning Cartridge" on page 120
This section gives information about the appearance and usage of the IBM TotalStorage LTO Ultrium Cleaning Cartridge.

**Related reference**

"Ordering Bar Code Labels for Ultrium Cartridges" on page 142

## Ordering Bar Code Labels for Ultrium Cartridges

Bar code labels with volume serial (VOLSER) numbers are required for Ultrium Tape Cartridges that are read by the 3584 Tape Library. You can order these labels separately from the IBM Data Cartridges and Cleaning Cartridges.

You can order bar code labels directly from the authorized label suppliers in Table 43.

**Attention:** The IBM System Storage TS3500 Tape Library is designed to work with bar code labels that meet the specifications and requirements set forth in the *IBM LTO Ultrium Cartridge Label Specification (Revision 2)*. The following label providers have demonstrated the ability to produce finished bar code labels that meet the foregoing specifications and requirements. This information is provided for the convenience of 3584 Tape Library users only, and is not an endorsement or recommendation of such providers. IBM is not responsible for the quality of bar code labels procured from sources other than IBM. This information is applicable to bar code labels actually printed by the listed companies. IBM has not reviewed the quality of any labels produced by software or services offered by such companies which allow end users to print labels on their own printing equipment.

*Table 43. Authorized suppliers of custom bar code labels for Ultrium Tape Cartridges*

| In the Americas | In Europe and Asia |
|---|---|
| Dataware<br>7570 Renwick<br>Houston, TX 77081<br>U. S. A.<br>Telephone: 800-426-4844<br>http://www.datawarelabels.com/ | Not applicable |
| EDP/Colorflex<br>2550 West Midway Boulevard<br>Broomfield, CO 80020-1633<br>U. S. A.<br>Telephone: 800-522-3528 or 303-666-2160<br>Fax: 303-666-2166<br>http://www.colorflex.com/colortrax.asp | EDP Europe Limited<br>43 Redhills Road<br>South Woodham Ferrers<br>Chelmsford, Essex CM3 5UL<br>U. K.<br>Telephone: 44 (0) 1245 322380<br>Fax: 44 (0)1245 323484<br>http://www.edpeurope.com/media-labels.html |
| Netc, L. L. C.<br>100 Corporate Drive<br>Trumbull, CT 06611<br>U. S. A. Telephone: 203-372-6382<br>http://www.NetcLabels.com | Netc Europe Ltd<br>Town Farm Bungalow<br>North Curry<br>Taunton<br>Somerset U. K. TA3 6LX<br>Telephone: 44 (0) 1823 491439<br>http://www.NetcLabels.co.uk |
| | Netc Asia Pacific Pty Ltd<br>Locked Bag 14<br>Kenthurst<br>NSW Australia 2156<br>Telephone: 61 (0) 2 4563 6556<br>http://www.NetcLabels.com.au |

# Chapter 5. Using 3592 Tape Drive Media

The section introduces information about the 3592 Tape Drive media.

In addition to automating the storage and movement of IBM LTO Ultrium Tape Cartridges, the 3584 Tape Library does the same for IBM TotalStorage 3592 Enterprise Tape Cartridges.

## Overview of 3592 Media

This section describes the tape cartridges that are used by 3592 Tape Drives in the 3584 Tape Library.

The 3592 Tape Drive uses four different data cartridge types and a cleaning cartridge. Characteristics of these cartridges are summarized in Table 44 on page 144.

Figure 43 shows the IBM TotalStorage 3592 Enterprise Tape Cartridge.

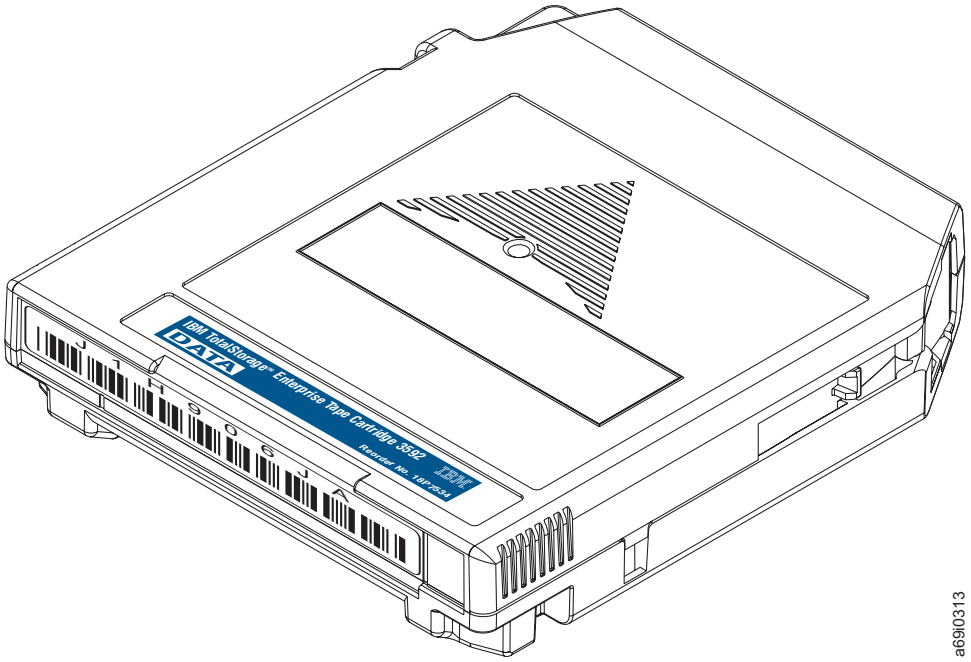



*Figure 43. Components of the IBM TotalStorage 3592 Enterprise Tape Cartridge*

Cartridges can be distinguished by the text on the product label, as well as by the color of the cartridge case. Table 44 on page 144 gives the differences of the 3592 Tape Cartridges.

*Table 44. Types of IBM 3592 TotalStorage Enterprise Tape Cartridges*

| Text on Product Label and Type of Media[1] | Native Capacity | | Color of Case | Color of Label, Door, and Write-Protect Switch | Part Number |
|---|---|---|---|---|---|
| | E05 | J1A | | | |
| Data, JA | 500 GB (E05 format) | 300 GB[2] | Black | Dark Blue | 18P7534 |
| | 300 GB (J1A format) | | | | |
| Extended Data, JB | 700 GB (E05 format) | Not supported | Black | Dark Green | 23R9830 |
| Economy, JJ | 100 GB (E05 format) | 60 GB | Black | Light Blue | 24R0316 |
| | 60 GB (J1A format) | | | | |
| WORM, JW | 500 GB (E05 format) | 300 GB | Platinum (silvery gray) | Dark Blue | 18P7538 |
| | 300 GB (J1A format) | | | | |
| Extended WORM, JX | 700 GB (E05 format) | Not supported | Platinum (silvery gray) | Dark Green | 23R9831 |
| Economy WORM, JR | 100 GB (E05 format) | 60 GB | Platinum (silvery gray) | Light Blue | 24R0317 |
| | 60 GB (J1A format) | | | | |
| Cleaning, CLNxxxJA[3] | N/A[4] | N/A | Black | Gray | 18P7535 |

**Notes:**

1. This designation appears as the last two characters on standard bar code labels. In addition, for cleaning cartridges, the first three characters of the volume serial (VOLSER) number are `CLN`.
2. The Data type cartridge can also be ordered in a 260 GB segmented, capacity scaled format providing 60 GB of high-performance random access, and an additional 200 GB of capacity.
3. Where `xxx` equals three numerals.
4. N/A = not applicable.

**Note:** In addition to these cartridges, there is a Customer Engineer (CE) diagnostic cartridge for use by IBM Service Representatives only. The VOLSER for this cartridge is `CE xxxJA` where a space occurs after `CE` and `xxx` equals three numerals.

The 3592 Tape Drive does not support Ultrium formats.

Firmware for the TS1120 Tape Drive will not work in the 3592 J1A Tape Drive, and firmware for the 3592 J1A Tape Drive will not work in the TS1120 Tape Drive.

You can update firmware for the 3592 Tape Drive without scheduling downtime. This enhancement is called a *nondisruptive drive firmware update*. It is available through the IBM System Storage Tape Library Specialist web interface and (for IBM Service Representatives) through CETool, but is not supported by the SCSI interface. For more information, go to the section about updating drive firmware in the *IBM System Storage TS3500 Tape Library Operator Guide*.

**Related concepts**

"3592 Data Cartridge" on page 148
This section describes the capacity, construction, operation, and components of the IBM TotalStorage 3592 Enterprise Tape Cartridge.

"3592 Cleaning Cartridge" on page 151
This section gives information about the appearance and usage of the IBM TotalStorage 3592 Enterprise Cleaning Cartridge.

"3592 Diagnostic Cartridge" on page 153
This section gives information about the appearance and usage of the 3592 diagnostic cartridge.

"3592 Bar Code Label" on page 153
This section describes the appearance and specifications of the 3592 bar code label.

"Ordering 3592 Media Supplies" on page 162
This section gives an overview of the methods for ordering 3592 Tape Cartridges and other related media supplies.

**Related reference**

"Ordering 3592 Bar Code Labels" on page 165

## WORM Functionality for 3592 Tape Drives and Media

This section describes the write once read many (WORM) functionality that is used by the 3592 Tape Drive and supported cartridges.

All 3592 Tape Drives with the appropriate microcode version installed are capable of reading and writing WORM cartridges. The TS1120 Tape Drive supports WORM behaviors and format attributes that are identical to the 3592 J1A, but the support is extended into the TS1120 Tape Drive WORM logical format and continues for the 3592 J1A WORM logical format. The 3592 Tape Drives support three WORM media types, JW (full length), JR (short length), and (for TS1120) JX Extended WORM cartridge.

WORM cartridges are formatted at the factory and may not be converted to data cartridges. The WORM tape media is formatted differently than the standard read/write media. One field in the servo manufacturer's word (SMW) on the tape designates that the media is WORM. In addition, the cartridge memory (CM) has a WORM indicator byte in the cartridge type field. Both of these conditions must be true for the drive to work with a WORM cartridge. If one condition is true and the other is false, an `ATTN DRV - Invalid Cartridge` message will post. When the drive senses that a cartridge is a WORM cartridge, the microcode prohibits the changing or altering of user data already written on the tape. The microcode keeps track of the last appendable point on the tape by means of an overwrite-protection pointer stored in the cartridge memory (CM). Statistical Analysis and Reporting System (SARS) data can be written and updated on WORM tapes because the SARS data is not in the user area of the tape.

Each WORM cartridge is identified by using a unique cartridge identifier (UCID) that is permanent and locked, and which provides another level of security for data that must be maintained. This permanent locked information is stored in both the cartridge CM and on the tape itself, and can also be associated with the unique bar code volume serial (VOLSER) number.

Some records retention and data security applications require the WORM function of tape data storage. This WORM function is accomplished on the 3592 Tape Drive

by a combination of microcode controls in the drive and a WORM tape cartridge. Special tamper-proofing techniques and checking prevent WORM cartridges from being transported to or from a data cartridge shell or cartridge memory and being inadvertently processed as a read or write (R/W) cartridge. The drive microcode leverages this support by providing an interface and control mechanisms which allow an application or system to manage as needed. The control and status mechanisms for this can be found primarily in mode pages X'23' and X'24'. For more information, see the *IBM System Storage TS1120 Tape Drive and Controller SCSI Reference*.

The 3592 Tape Drives allow append operations to data already on WORM cartridges, and allow overwrite of file marks and other non-data attributes to provide application transparency. However, they do not allow data overwrite under any circumstances. Once full of data, WORM cartridges may not be reused or erased by the drive and must be physically destroyed or bulk degaussed to delete data. For full tape application usage, certain trailer and label record overwrites are allowed.

## Capacity Scaling and Segmentation

This section describes how the 3592 Tape Drives use capacity scaling and segmentation to place data in a designated section of tape to speed access and manage efficient capacity.

The 3592 Tape Drive supports capacity scaling for tape cartridges of media types JA and JB over a broad range of capacities. The effect of capacity scaling is to contain data in a specified fraction of the tape. This yields faster locate and read times. Alternatively, you can purchase Economy tapes (the JJ media type) to achieve this faster performance.

The 3592 J1A Tape Drive divides tape into longitudinal segments. Using this capability, it is possible, for example, to segment 300 GB data tapes into two segments: one segment with 60 GB and very fast access, and another 200 GB segment for additional capacity. You can purchase 300 GB data tapes that are pre-formatted in these segments, or you can segment and capacity scale them at a later time. Segmentation is only available within a specified range of capacity scaling settings. Capacity scaling is not supported for Economy (60 GB) or write once read many (WORM) (60 GB or 300 GB) tapes. For information about implementing segmentation and capacity scaling, see the README files in the FTP directory that pertains to your device driver, which you can find by navigating in a web browser to the following URL:

```
ftp://ftp.software.ibm.com/storage/devdrvr
```

For more technical information regarding WORM, capacity scaling, and segmentation, see also the *IBM System Storage TS1120 Tape Drive and Controller SCSI Reference*.

Like the 3592 J1A Tape Drive, the TS1120 Tape Drive also supports multiple format options, such as scaling and segmentation modes, to allow you to trade capacity for improved access times. While 256 settings of the Capacity Scaling byte (and resulting fractional capacities) are supported on the TS1120 Tape Drive, three primary setting are recommended for use:

- Full capacity default mode.

- 20% scaled fast access mode (20% capacity scaled, front of tape used). The Capacity Scaling byte is x'35'.
- Performance scaling for 87% capacity and a segmented format with recursive accumulating backhitchless flush (RABF) capability (a non-volatile caching technique) for the full cartridge. For WORM firmware for the 3592 J1A Tape Drive and the 3592 E05 Tape Drive, the Capacity Scaling byte is x'E0'.

These settings are fully certified and are available as labeled and intialized part-numbered cartridges. For the exact Mode Select commands and settings that are necessary to invoke scaling, see the *IBM System Storage TS1120 Tape Drive and Controller SCSI Reference*.

**Scaling Support in Drive**

Capacity scaling in the TS1120 Tape Drive is controlled by the host program performing a Scaling operation. This is performed using the Capacity Scaling byte and the Capacity Scaling Valid control bit in Mode page X'23'. The TS1120 Tape Drive does not change current cartridge scaling unless a SCSI Mode Select command that specifies Mode Page X'23' (with appropriate non-default parameter settings) is received while the cartridge is positioned at the beginning of the tape. The TS1120 Tape Drive can sense and report the scaling state of the current medium by using a Mode Sense command that specifies Mode Page X'23'. The default unscaled capacity is 300 GB for a JA cartridge in J1A density, 500 GB for a JA cartridge in E05 density, and 700 GB for a JB cartridge (which supports E05 density only).

- The cartridge can be rescaled from any current Capacity Scaling byte value to any supported new value. The tape is logically erased by this (End of Data mark written at beginning of tape), but not physically erased as with the long erase command. Scaling or rescaling one cartridge does not cause rescaling of the next cartridge; an explicit command must be issued for each cartridge to be rescaled.
- The drive provides the option of setting the scaling values of N/256ths of full capacity, where N ranges from X'16' (22 -- equals about 8% capacity) to X'EC' (236 -- equals about 92%)
- For scaling factors N, between X'4B' and X'EB' , the drive scales to the specified amount and creates a fast-access 20% capacity segment in the beginning of the scaled region.
- At all scaling factors, the drive supports early warning at the end of the scaled region (with the appropriate unit attention to inform the software that it should flush buffers and close volume) and reports a physical end-of-tape check condition at the end of the scaled region, just as it would if unscaled tape had reached the real physical end of the tape.

Capacity scaling is not offered on either of the short length cartridge types (JJ or JR), or on the WORM cartridges (JW, JX and JR). Capacity scaling is only offered on the JA and JB cartridge types.

Three important attributes are controlled by the setting of the Capacity Scaling byte value:

- The total Medium Capacity.
- The ability to perform the RABF function on an entire cartridge, including last wraps.
- Information about whether the format is segmented. If the format is segmented, a fast-access segment is created on the front part of the tape followed by a larger remainder segment that occupies the remainder of the tape. The fast access segment is always filled (written) first, followed by the filling of the remainder

segment. For some applications that want improved access attributes for partially filled cartridges but still want to use full capacity (if required) without re-scaling, this option is available.

It is important to note that the scaled state and attributes (segmentation, RABF) of the cartridge format is retained when a cartridge is reformatted between the J1A and E05 logical formats, although the exact resulting used capacity as a percentage of full capacity is not identical for all mapped settings.

## 3592 Data Cartridge

This section describes the capacity, construction, operation, and components of the IBM TotalStorage 3592 Enterprise Tape Cartridge.

The 3592 Tape Drive has a bidirectional read/write head with an Enterprise Tape 3592 format. The 3592 J1A writes or reads eight tracks at a time; the TS1120 Tape Drive writes or reads 16 tracks at a time. The 3592 Data cartridge has a native capacity of 300 GB, while the 3592 Economy cartridge has a native capacity of 60 GB. Capacities of data cartridges can be increased through data compression, with the actual compression and capacity depending upon the specific data. Write once read many (WORM) cartridges are also available in both 60 GB and 300 GB capacities.

TS1120 Tape Drives that are encryption-enabled perform encryption after compression.

Figure 44 on page 149 shows the IBM TotalStorage 3592 Enterprise Tape Cartridge and its components.

| | | | |
|---|---|---|---|
| 1 | Cartridge case | 5 | IBM product label |
| 2 | Cartridge bar code label | 6 | Cartridge door |
| 3 | Volume serial (VOLSER) number | 7 | Write-protect switch |
| 4 | Label area | | |

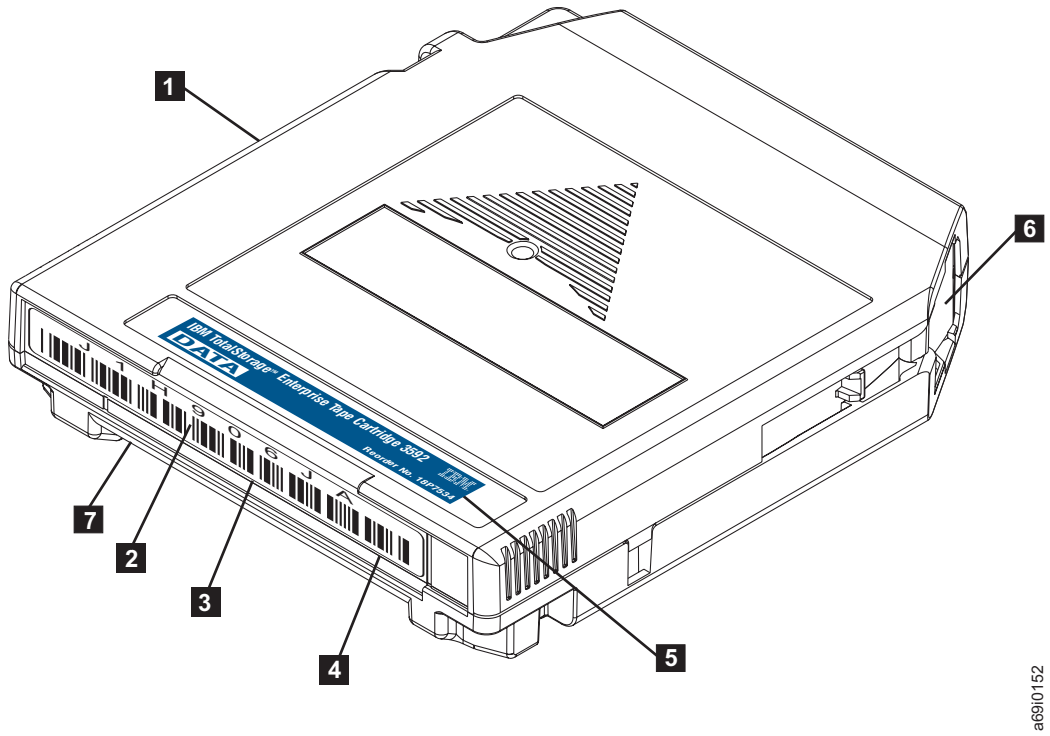



*Figure 44. Components of the IBM TotalStorage 3592 Enterprise Tape Cartridge*

Through its vision system, the 3584 Tape Library identifies the types of cartridges it contains during an inventory operation. The bar code reader reads the VOLSER (see **3** in Figure 44) of the cartridge bar code label **2** that is in the label area **4** of the cartridge. If your cartridge does not have a pre-attached bar code label and you attach one to it, place it entirely within the recessed label area (see **3** and **4** as an example of proper placement). The label must be flat to within 0.5 mm (0.02 in.) over the length of the label and have no folds, missing pieces, tears, or any extraneous markings. Failure to follow these placement requirements will result in degraded readability.

The IBM product label **5** specifies the type of cartridge: data, Economy, WORM, Economy WORM, or cleaning.

The cartridge door **6** protects the tape from contamination when the cartridge is out of the drive. When you insert the cartridge into the drive, a threading mechanism pulls the tape out of the cartridge, across the drive head, and onto a non-removable takeup reel. The head can then read or write data from or to the tape.

Each data cartridge includes a write-protect switch **7** that you can set to prevent data from being over-written or erased from the tape by the drive.

You can order tape cartridges with the bar code labels included, or you can order custom labels.

The 3592 Data Cartridge has a nominal cartridge life of 20,000 load and unload cycles. The quantity of load and unload cycles to reach this number depends on the environment in which the tape is used.

**Related concepts**

"Ordering 3592 Media Supplies" on page 162
This section gives an overview of the methods for ordering 3592 Tape Cartridges and other related media supplies.

## Cartridge Memory in 3592 Tape Cartridges

Each 3592 data cartridge contains a passive, contactless, silicon storage device called cartridge memory (CM). The CM module holds information about that specific cartridge, the media in the cartridge, and the data on the media. The cartridge and media information is stored in a protected, read-only area of the CM. When the cartridge is loaded into the drive, a CM reader in the drive uses a contactless, radio-frequency interface to read the information. The media's performance statistics are stored in an unprotected, read/write area of the CM module. Prior to when the cartridge is unloaded, these statistics are updated by the CM reader. They are maintained by a portion of the drive's microcode known as the Statistical Analysis and Reporting System (SARS). Each cleaning cartridge also contains a CM module, which tracks the number of cleaning uses and the location of the used cleaning media.

## 3592 Cleaning Cartridge

This section gives information about the appearance and usage of the IBM TotalStorage 3592 Enterprise Cleaning Cartridge.

To help prevent errors caused by debris, it is important to clean the tape path of the 3592 Tape Drives and to manually clean the outside of its data cartridges, when needed. For each 3584 Tape Library, IBM supplies a specially labeled IBM TotalStorage 3592 Enterprise Cleaning Cartridge with the first 3592 Tape Drive in the library. This cleaning cartridge may be used in both the 3592 J1A and the TS1120 Tape Drive.

**Attention:** Insert only clean and undamaged cleaning cartridges into a tape system. Before you insert a cartridge into a drive or storage slot, inspect the cartridge for damage or debris. **Damaged or dirty cartridges can reduce system reliability and cause the loss of recorded data.** If debris appears on the cartridge, wipe the outside surfaces with a lint-free cloth lightly moistened with water. Do not allow any liquid to contact the tape. Ensure that all cartridge surfaces are dry and that the leader pin is in place (see **1** in Figure 45 on page 152) before you load the cartridge.

The cleaning of the tape path in the drive is an automatic procedure initiated by the drive when changes in drive performance generates a request for cleaning, when more than 5000 mounts have occurred, when more than 20 full file passes of data have been processed, or when the drive detects a degraded head or channel condition. If you load an expired cleaning cartridge, the drive will eject the cartridge and post a status message to indicate that cleaning was not performed. Failure to clean a drive can result in buildup of debris on the read/write head and malfunction. If no cleaning cartridges are installed in the library, or if the available cleaning cartridges have reached the maximum number of 50 uses, cleaning will not be completed. For information about different cleaning methods (automatic, host, or manual), see “Methods of Cleaning Drives” on page 63. Also refer to the sections about cleaning drives and enabling or disabling automatic cleaning in the *IBM System Storage TS3500 Tape Library Operator Guide*.

Before you insert a cartridge into a drive or storage cell, inspect the cartridge for damage or debris. **Damaged or dirty cartridges can reduce system reliability and cause the loss of recorded data.** If debris appears on the cartridge, wipe the outside surfaces with a lint-free cloth lightly moistened with water. No visible water residue or droplets should be observable on the cartridge during or after the wiping effort.

**Attention:** Do not allow any liquid to contact the tape itself. Special care should be made to never allow liquid water to enter the cartridge which can potentially wick into the layers of the tape and cause them to adhere to each other. This creates the risk that the coatings may pull out during unwind.

Ensure that all cartridge surfaces are dry and that the leader pin is in place (see **1** in Figure 45 on page 152) before you load the cartridge.

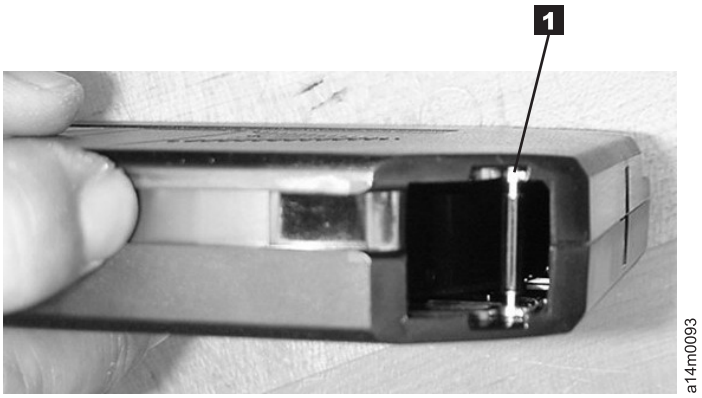



*Figure 45. Leader pin in proper position in the 3592 Cleaning Cartridge (the cartridge door is manually retracted)*

While the cleaning is in process, the 8-character message display on the drive shows the message, `CLEAN*`.

The IBM TotalStorage 3592 Enterprise Cleaning Cartridge contains a Cartridge Memory (CM) device that automatically keeps track of the number of times it has been used. Cleaning cartridges need to be replaced after 50 uses. Automatic cleaning is only available if the appropriate cleaning cartridges are installed in the library and have remaining use.

The physical characteristics of the 3592 Cleaning Cartridge distinguish it from the 3592 Data Cartridge. The product label on the top of the cartridge is white, with the word `CLEANING` printed on it. In place of the write-protect switch, there is a non-moveable light gray block (see **1** in Figure 46). If you order cleaning cartridges with pre-attached labels, the first three characters of the volume serial (VOLSER) number **2** are `CLN`. The cartridge door (see **1** in Figure 47 on page 153) is also light gray.

| | |
|---|---|
| **1** | Non-moveable light gray block |
| **2** | Sample label for cleaning cartridge |


*Figure 46. Characteristics that identify the 3592 Cleaning Cartridge*


*Figure 47. Door of the 3592 Cleaning Cartridge*

Before a drive can be cleaned, you must ensure that an IBM TotalStorage 3592 Enterprise Cleaning Cartridge is loaded in the library (to determine whether one or more cleaning cartridges are loaded, see the section about removing or loading a cleaning cartridge in the *IBM TotalStorage 3584 Tape Library Operator Guide*). You can load multiple cleaning cartridges and store them in any cartridge storage slot except the slot that is reserved for the diagnostic cartridge (see the section about non-addressable storage slots in the *IBM System Storage TS3500 Tape Library Operator Guide*).

**Related concepts**

"Methods of Cleaning Drives" on page 63
This section describes the methods of cleaning that the 3584 Tape Library uses for its drives.

"Ordering 3592 Media Supplies" on page 162
This section gives an overview of the methods for ordering 3592 Tape Cartridges and other related media supplies.

## 3592 Diagnostic Cartridge

This section gives information about the appearance and usage of the 3592 diagnostic cartridge.

The 3592 diagnostic cartridge is a cartridge with verified media that is reserved for diagnostic purposes only. In the 3584 Tape Library, one storage slot is reserved in the first Model L22 or Model D22 frame for the 3592 diagnostic cartridge. The slot is located at Column 1, Row 1. During a service call, your IBM Service Representative uses the cartridge to ensure that the tape drives run correctly and to specification. The volume serial (VOLSER) number for the diagnostic cartridge is `CE xxxJJ`, where a space occurs after `CE` and `xxx` equals three numerals.

**Related concepts**

"Ordering 3592 Media Supplies" on page 162
This section gives an overview of the methods for ordering 3592 Tape Cartridges and other related media supplies.

## 3592 Bar Code Label

This section describes the appearance and specifications of the 3592 bar code label.

Each 3592 data, cleaning, and diagnostic cartridge that is processed by the 3584 Tape Library must bear a bar code label. The label contains:

- A volume serial (VOLSER) number that you can read
- A bar code that the library can read

When read by the library's bar code reader, the bar code identifies the cartridge's VOLSER to the tape library. The bar code also tells the library whether the

cartridge is a data, Economy, write once read many (WORM), Economy WORM, cleaning, or diagnostic cartridge. In addition, the bar code gives the cartridge type (JA for Data, JB for Extended Data, JJ for Economy, JW for WORM, JX for Extended WORM, JR for Economy WORM, and CLNxxxJA for a cleaning cartridge). Figure 48 on page 155 shows a sample bar code label for the IBM TotalStorage 3592 Enterprise Tape Cartridge.

You can order tape cartridges with the labels included, or you can order custom labels. The labels have a peel-and-stick backing. The bar code must meet predefined specifications. The recommended specifications include (but are not limited to):

- Eight uppercase alphanumeric characters, where the last two characters must be JA, JB, JJ, JW, JX, or JR
- Label and printing to be non-glossy
- Nominal narrow line or space width of 0.500 mm (0.019 in.)
- Wide to narrow ratio of 2.75:1
- Minimum bar length of 7.0 mm (0.27 in.)

To determine the complete specifications of the bar code and the bar code label, visit the web at http://www.storage.ibm.com/media/tapecartridges/index.html. Under Enterprise storage media, select 3592 tape cartridges. Under Learn more, select Barcode Label Specification for use with 3592 Tape Media. Under Content, select the .pdf file to view the *Label Specification for IBM 3592 Cartridges when used in IBM Libraries*. You can also contact your IBM Sales Representative for this specification.

When attaching a bar code label to a tape cartridge, place the label only in the recessed label area (see Figure 48 on page 155). A label that extends outside of the recessed area can cause loading problems in the drive or the library.

**Attention:** Do not place any type of mark on the white space at either end of the bar code. A mark in this area may prevent the 3584 Tape Library from reading the label.

By using the Tape Library Specialist web interface, you can configure the library so that it reports to the server all eight characters of the VOLSER on the bar code label or only the first six characters. To configure a six-character VOLSER, refer to the section about enabling or disabling the reporting of a six-character VOLSER in the *IBM System Storage TS3500 Tape Library Operator Guide*.

**Note:** If you suspect that the library is having problems reading the bar code labels, you can slow the scanner speed as part of problem determination. You may choose to slow the scanner speed rather than replace all labels, or you may want to slow the scanner speed while you wait for an opportunity to re-label the media. Depending on the severity of the problem, the error recovery procedure (ERP) for poor labels may greatly exceed the time lost by slowing the scanner. If you have cartridge bar code labels that meet the LTO bar code label specification, there is no need to slow the scanner speed.For information about slowing the scanner speed, see the section about adjusting the scanner speed in the *IBM System Storage TS3500 Tape Library Operator Guide*.

To order bar code labels, see “Ordering 3592 Bar Code Labels” on page 165.

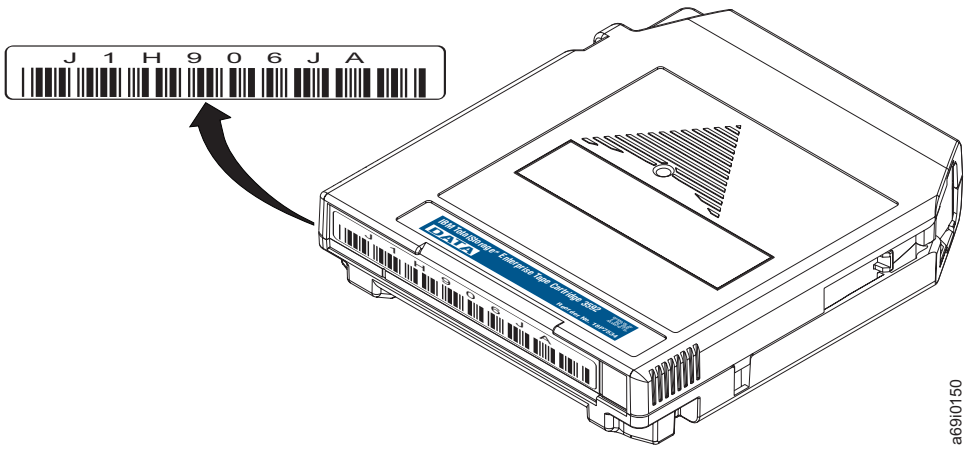



*Figure 48. Sample bar code label on the IBM TotalStorage 3592 Enterprise Tape Cartridge.* The volume serial number (J1H906JA) and bar code are printed on the label.

**Related concepts**

"Ordering 3592 Media Supplies" on page 162
This section gives an overview of the methods for ordering 3592 Tape Cartridges and other related media supplies.

**Related reference**

"Ordering 3592 Bar Code Labels" on page 165

"Guidelines for Using 3592 Bar Code Labels"

## Guidelines for Using 3592 Bar Code Labels

Apply the following guidelines whenever you use bar code labels:

- Use only IBM-approved bar code labels.
- Do not reuse a label or reapply a used label over an existing label.
- Examine the label before you apply it to the cartridge. Do not use the label if it has voids or smears in the printed characters or bar code (an application's inventory operation will take much longer if the bar code label is not readable).
- Position the label within the recessed label area.
- Verify that the label is smooth and parallel, and has no roll-up or roll-over. The label must be flat to within 0.5 mm (0.02 in.) over the length of the label and have no folds, missing pieces, or smudges.
- Do not place other machine readable labels on other surfaces of the cartridge. They may interfere with the ability of the bar code reader to read the bar code.
- Use peel-clean labels that do not leave a residue after they are removed. If there is glue residue on the cartridge, remove it by gently rubbing it with your finger; do not use a sharp object, water, or a chemical to clean the label area.
- Before you apply a new label, remove the old label by slowly pulling it at a right angle to the cartridge case.
- Remove the label from the label sheet carefully. Do not stretch the label or cause the edges to curl.
- With light finger pressure, smooth the label so that no wrinkles or bubbles exist on its surface.

## Setting the Write-Protect Switch on a 3592 Cartridge

This section gives instructions for setting the write-protect switch on a 3592 Tape Cartridge.

The position of the write-protect switch on the 3592 Tape Cartridge (see Figure 49) determines whether you can write to the tape.

- To write data to or erase data from the cartridge, set the switch to **1** . This exposes a square hole.
- To prevent data from being overwritten or erased from the cartridge, set the switch to **2** . This covers the hole.

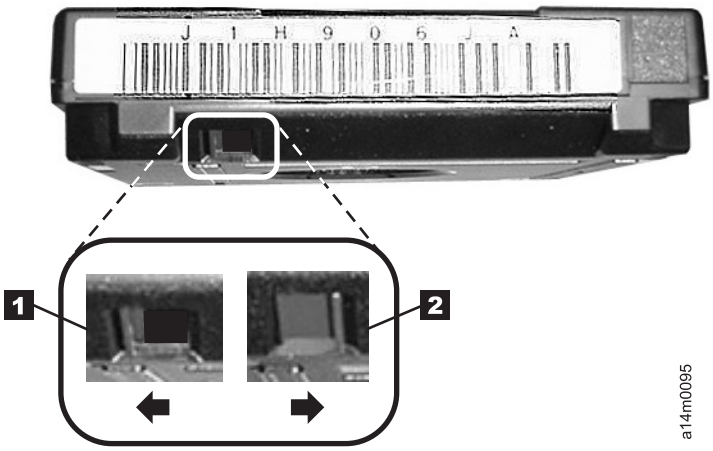



*Figure 49. Setting the write-protect switch on the 3592 Tape Cartridge*

## Handling 3592 Tape Cartridges

This section introduces ways to handle 3592 Tape Cartridges to avoid damage to the cartridge case and the tape.

**Attention:** Do not insert a damaged tape cartridge into your tape drive. A damaged cartridge can interfere with the reliability of a drive and may void the warranties of the drive and the cartridge. Before inserting a tape cartridge, inspect the cartridge case, cartridge door, and write-protect switch for breaks.

Incorrect handling or an inhospitable environment can damage the IBM TotalStorage 3592 Enterprise Tape Cartridge or its magnetic tape. To avoid damage to your tape cartridges and to ensure the continued high reliability of your 3584 Tape Library, use the following guidelines:

### Provide Training for Using 3592 Tape Cartridges

- Post procedures that describe proper media handling in places where people gather.
- Ensure that anyone who handles tape has been properly trained in handling and shipping procedures. This includes operators, users, programmers, archival services, and shipping personnel.
- Ensure that any service or contract personnel who perform archiving are properly trained in media-handling procedures.
- Include media-handling procedures as part of any services contract.
- Define and make personnel aware of data recovery procedures.

### Ensure Proper Packaging of 3592 Tape Cartridges

- When you ship a cartridge, ship it in its original or better packaging.
- Use only shipping container that securely hold the cartridge in place during transportation. Such containers can be procured from Perm-A-Store on the web at `www.turtlecase.com`. The 3592 tape cartridges support racks and storage containers designed for 3590 tape cartridges.
- Never ship a cartridge in a commercial shipping envelope. Always place it in a box or package.
- If you ship the cartridge in a cardboard box or a box of a sturdy material, ensure the following:
  - Place the cartridge in polyethylene plastic wrap or bags to protect it from dust, moisture, and other contaminants.
  - Pack the cartridge snugly; do not allow it to move around.
  - Double-box the cartridge (place it inside a box, then place that box inside the shipping box) and add padding between the two boxes.

### Provide Proper Acclimation and Environmental Conditions for 3592 Tape Cartridges

- Before you use a cartridge, let it acclimate to the normal operating environment for a minimum of 24 hours. If you see condensation on the cartridge, wait an additional hour.
- Ensure that all surfaces of a cartridge are dry before inserting it.
- Do not expose the cartridge to moisture or direct sunlight.

- Do not expose recorded or blank cartridges to stray magnetic fields of greater than 100 Oersteds (for example, terminals, motors, video equipment, X-ray equipment, or fields that exist near high-current cables or power supplies). Such exposure can cause the loss of recorded data or make the blank cartridge unusable.
- Maintain the proper conditions for storing and shipping the cartridges.

**Related concepts**

"Environmental and Shipping Specifications for 3592 Cartridges" on page 161
This section gives a table of the operating, storage, and shipping requirements for 3592 Tape Cartridges.

## Perform a Thorough Inspection of 3592 Tape Cartridges

After purchasing a 3592 Tape Cartridge and before using it, perform the following steps:

- Inspect the cartridge's packaging to determine potential rough handling.
- Ensure that no moisture or condensation exists on or in the cartridge shell or media.
- When inspecting a cartridge, open only the cartridge door. Do not open any other part of the cartridge case. The upper and lower parts of the case are welded and held together with screws; separating them destroys the usefulness of the cartridge.
- Inspect the cartridge for damage before using or storing it.
- Check that the leader pin is properly positioned.
- Ensure that labels are affixed in a manner that does not adversely affect drive operation. Labels must only be affixed in the recessed areas provided on the cartridge.
- If you suspect that the cartridge has been mishandled but it appears usable, copy any data onto a good cartridge immediately for possible data recovery. Discard the mishandled cartridge.

**Related tasks**

"Repositioning a Leader Pin in a 3592 Cartridge" on page 159
This section gives the procedure to use when you move a leader pin into its proper position in a 3592 Tape Cartridge.

## Handle the 3592 Tape Cartridge Carefully

- Do not drop the 3592 Tape Cartridge. If the cartridge drops, slide the cartridge door back and ensure that the leader pin is properly positioned.
- Avoid mechanical loads that would distort the cartridge's shape.
- Do not handle tape that is outside the cartridge. Handling the tape can damage the tape's surface or edges, which may interfere with read or write reliability. Pulling on tape that is outside the cartridge can damage the tape and the brake mechanism in the cartridge.
- Do not stack more than six cartridges.
- Do not degauss a cartridge that you intend to reuse. Degaussing the tape erases the servo tracks and makes the tape unusable. An attached host can be used to run a Data Security Erase if the data on the tape needs to be physically erased. This physically overwrites the data on the tape without damaging the servo tracks.

**Related tasks**

"Repositioning a Leader Pin in a 3592 Cartridge"
This section gives the procedure to use when you move a leader pin into its proper position in a 3592 Tape Cartridge.

## Repositioning a Leader Pin in a 3592 Cartridge

This section gives the procedure to use when you move a leader pin into its proper position in a 3592 Tape Cartridge.

**Attention:** Use a repaired tape cartridge only to recover data and move it to another cartridge. Continued use of a repaired cartridge may void the warranties of the drive and the cartridge.

If the leader pin in your 3592 Tape Cartridge becomes dislodged from its pin-retaining spring clips, you must use the IBM Leader Pin Reattachment Kit (part number 18P8887) to reposition it.

A leader pin that is improperly seated inside a cartridge can interfere with the operation of the drive. Figure 50 shows a leader pin in the incorrect 1 and correct 2 positions.

To place the leader pin in its proper position, you will need the following tools:

- Plastic or blunt-end tweezers
- Cartridge manual rewind tool (from the Leader Pin Reattachment Kit, part number 18P8887)

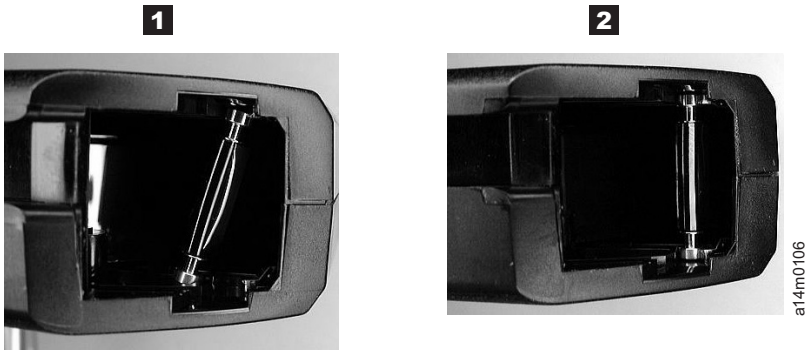



*Figure 50. Leader pin in the incorrect and correct positions in a 3592 Tape Cartridge.* The cartridge door is open and the leader pin is visible inside the cartridge.

To reposition the leader pin, perform the following steps.

1. Slide open the cartridge door (see 1 in Figure 51 on page 160) and locate the leader pin 2 (you may need to shake the cartridge gently to roll the pin toward the door).
2. With plastic or blunt-end tweezers, grasp the leader pin and position it in the pin-retaining spring clips 3.
3. Press the leader pin gently into the clips until it snaps into place and is firmly seated.
4. Close the cartridge door.

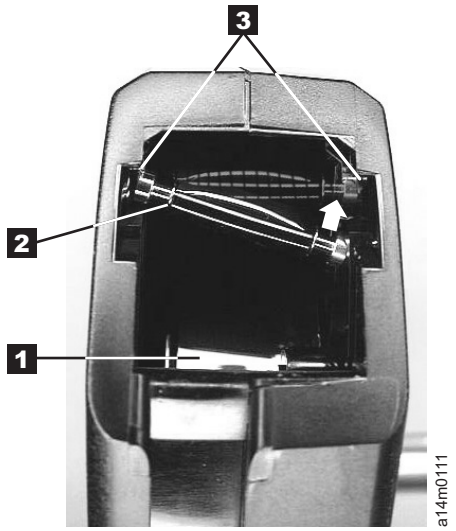



*Figure 51. Placing the dislodged leader pin into the correct position..* The cartridge door is open, showing the leader pin out of position

5. To rewind the tape, insert the cartridge manual rewind tool (see **1** in Figure 52) into the cartridge's hub **2** and turn it clockwise until the tape becomes taut.

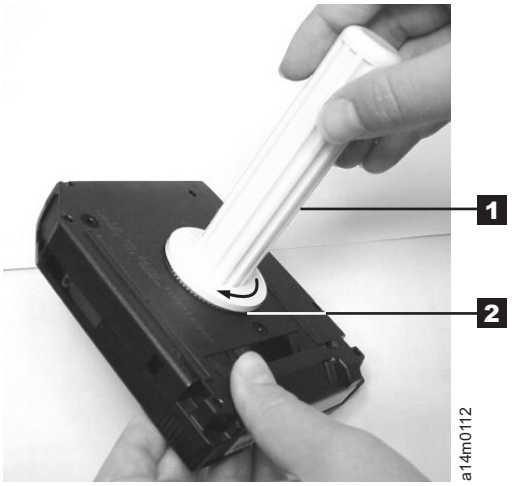



*Figure 52. Rewinding the tape into the cartridge*

6. Remove the rewind tool by pulling it away from the cartridge.

## Environmental and Shipping Specifications for 3592 Cartridges

This section gives a table of the operating, storage, and shipping requirements for 3592 Tape Cartridges.

Before you use a tape cartridge, acclimate it to the operating environment for 24 hours or the time necessary to prevent condensation in the drive (the time will vary, depending on the environmental extremes to which the cartridge was exposed).

The best storage container for the cartridges (until they are opened) is the original shipping container. The plastic wrapping prevents dirt from accumulating on the cartridges and partially protects them from humidity changes.

**Attention:** Depending on how many drives you have installed in the frame, the temperature inside the frame may be as much as 5°C (9°F) above the temperature outside the frame. To ensure continued reliability of your media, be sure to take this temperature difference into account when you set up the environment around your library.

When you ship a cartridge, place it in a sealed, moisture-proof bag to protect it from moisture, contaminants, and physical damage. Ship the cartridge in a shipping container that has enough packing material to cushion the cartridge and prevent it from moving within the container.

Table 45 lists the environmental conditions for operating, storing, and shipping IBM TotalStorage 3592 Enterprise Tape Cartridges.

*Table 45. Environment for operating, storing, and shipping the IBM TotalStorage 3592 Enterprise Tape Cartridge*

| Environmental Specifications | | | |
|---|---|---|---|
| **Environmental Factor** | **Operational Storage[1,3]** | **Archival Storage[2,4]** | **Shipping** |
| Temperature | 16 to 32°C (61 to 90°F) | 16 to 25°C (61 to 77°F) | -23 to 49°C (-9 to 120°F) |
| Relative humidity (noncondensing) | 20 to 80% | 20 to 50% | 5 to 80% |
| Wet bulb maximum temperature | 26°C (79°F) | 26°C (79°F) | 26°C (79°F) |
| Magnetic field | Stray magnetic field at any point on tape not to exceed 50 Oersteds. | | |

**Notes:**

1. Operational storage equals less than 6 months.
2. Archival storage equals greater than 6 months.
3. Cartridges shall be stored under these conditions if they will also be used in a drive during storage.
4. Cartridges shall be stored under these conditions for archiving.

## Disposing of 3592 Cartridges

This section describes how to dispose of 3592 Tape Cartridges according to federal and other regulations.

Under the current rules of the U.S. Environmental Protection Agency (EPA), regulation 40CFR261, the IBM TotalStorage 3592 Enterprise Tape Cartridge is classified as non-hazardous waste. As such, it may be disposed of in the same way as normal office trash. These regulations are amended from time to time, and you should review them at the time of disposal.

If your local, state, country (non-U.S.A.), or regional regulations are more restrictive than EPA 40CFR261, you must review them before you dispose of a cartridge. Contact your account representative for information about the materials that are in the cartridge.

If a tape cartridge must be disposed of in a secure manner, IBM recommends that you use a qualified service provider to degauss and destroy the media.

If you burn the cartridge and tape, ensure that the incineration complies with all applicable regulations.

## Cartridge Quality and Library Maintenance

This section describes how to maintain 3592 Tape Cartridges and the 3584 Tape Library to ensure proper operation.

The 3592 Tape Cartridge provides high performance and reliability with IBM magnetic tape cartridge drives when the cartridge is properly handled and stored. As stated previously, repeated handling or inadvertent mishandling can damage the physical parts of the cartridge and make it unusable.

The magnetic tape inside the cartridge is made of highly durable materials. However, the tape wears after repeated cycles in the tape system. Eventually, such wear can cause an increase in tape errors.

Track the error data available by monitoring both the cartridge and cartridge library performance. By monitoring error data, you can identify and replace cartridges that are no longer acceptable for continued use.

Proper maintenance of the 3584 Tape Library helps to keep IBM magnetic tape cartridge systems operating in a reliable and efficient manner.

## Ordering 3592 Media Supplies

This section gives an overview of the methods for ordering 3592 Tape Cartridges and other related media supplies.

You can order media supplies in two ways. The 3599 Tape Media method is available for ordering all types of data and cleaning cartridges. This method is typically used for ordering larger quantities and for ordering initialized or pre-labeled cartridges. Media supplies can also be ordered by using part numbers through IBM-authorized distributors.

**Related reference**

"Ordering Supplies for Repairs" on page 165

"Ordering 3592 Bar Code Labels" on page 165

## Ordering 3592 Media Supplies by Using the 3599 Tape Media Method

If you order media by using the 3599 Tape Media method, IBM TotalStorage Enterprise Tape Media 3599 provides the ability to order unlabeled, pre-labeled, initialized, and bulk-packaged data cartridges in a variety of combinations. You can also order cleaning cartridges. The following data cartridges may be ordered by using the 3599 Tape Media method:

- 300 GB or 500 GB Data cartridges
- 700 GB Extended Data cartridges
- 60 GB or 100 GB Economy cartridges
- 60 GB or 100 GB WORM cartridges
- 300 GB or 500 GB WORM cartridges
- 700 GB Extended WORM cartridges

Segmentation and capacity scaling options are also available for the following:

- 300 GB or 500 GB Data cartridge for a 60 GB or 100 GB Fast Access capability, and a segmented tape with 60 GB or 100 GB of fast access and additional capacity
- 700 GB Extended Data cartridge for a 140 GB Fast Access capability, and a segmented tape with 140 GB of fast access and additional capacity

With the 3599 Tape Media method of ordering, model numbers are used to identify the cartridge types, and feature code combinations are used to specify the quantities, labeling, and initialization options. Table 46 shows a few examples of ordering options for each cartridge type. Note that additional feature codes are required to completely specify all desired characteristics of the cartridges. Orders may be placed by calling 1-800-IBM-CALL (1-800-426-2255).

*Table 46. Descriptions of 3599 tape media features*

| 3599 Model | Media ID/ Feature Code | Feature Code for Labeling, Initialization, and Quantity | Format | Individual Cartridge Capacity | Description |
|---|---|---|---|---|---|
| 011 | JA/9030 | 1020 | 9081 | 500 GB | 20-pack 3592 Data cartridges, labeled and initialized |
| | | | 9080 | 300 GB | |
| 012 | JA/9030 | 2020 | 9081 | 500 GB | 20-pack 3592 Data cartridges, labeled, not initialized |
| | | | 9080 | 300 GB | |
| 013 | JA/9030 | 3020 | 9081 | 500 GB | 20-pack 3592 Data cartridges, not labeled or initialized |
| | | | 9080 | 300 GB | |
| 014 | JB/9032 | 4020 | 9081 | 700 GB | 20-pack 3592 Extended Data cartridges, labeled and initialized |
| 015 | JB/9032 | 5020 | 9081 | 700 GB | 20-pack 3592 Extended Data cartridges, labeled, not initialized |
| 016 | JB/9032 | 6020 | 9081 | 700 GB | 20-pack 3592 Extended Data cartridges, not labeled or initialized |

*Table 46. Descriptions of 3599 tape media features (continued)*

| 3599 Model | Media ID/ Feature Code | Feature Code for Labeling, Initialization, and Quantity | Format | Individual Cartridge Capacity | Description |
|---|---|---|---|---|---|
| E11 | JJ/9050 | 1020 | N/A (see Note) | 60 GB | 20-pack 3592 Economy cartridges, labeled and initialized |
| E12 | JJ/9050 | 2020 | N/A | 60 GB | 20-pack 3592 Economy cartridges, labeled, not initialized |
| E13 | JJ/9050 | 3020 | N/A | 60 GB | 20-pack 3592 Economy cartridges, not labeled or initialized |
| 021 | JW/9040 | 1020 | 9081 | 500 GB | 20-pack 3592 WORM cartridges, labeled and initialized |
| | | | 9080 | 300 GB | |
| 022 | JW/9040 | 2020 | 9081 | 500 GB | 20-pack 3592 WORM cartridges, labeled, not initialized |
| | | | 9080 | 300 GB | |
| 023 | JW/9040 | 3020 | 9081 | 500 GB | 20-pack 3592 WORM cartridges, not labeled or initialized |
| | | | 9080 | 300 GB | |
| 024 | JX/9044 | 2420 | 9081 | 700 GB | 20-pack 3592 Extended WORM cartridges, labeled and initialized |
| 025 | JX/9044 | 2520 | 9081 | 700 GB | 20-pack 3592 Extended WORM cartridges, labeled, not initialized |
| 026 | JX/9044 | 2620 | 9081 | 700 GB | 20-pack 3592 Extended WORM cartridges, not labeled or initialized |
| E21 | JR/9042 | 1020 | 9081 | 100 GB | 20-pack 3592 Economy WORM cartridges, labeled and initialized |
| | | | 9080 | 60 GB | |
| E22 | JR/9042 | 2020 | 9081 | 100 GB | 20-pack 3592 Economy WORM cartridges, labeled, not initialized |
| | | | 9080 | 60 GB | |
| E23 | JR/9042 | 3020 | 9081 | 100 GB | 20-pack 3592 Economy WORM cartridges, not labeled or initialized |
| | | | 9080 | 60 GB | |
| 017 | JA | 7005 | N/A | cleaning, 50 uses | 5-pack 3592 Cleaning Cartridges, labeled and initialized |
| 017 | JA | 7006 | N/A | cleaning, 50 uses | 5-pack 3592 Cleaning Cartridges without media identification labels |

**Note:** N/A = not applicable.

## Ordering 3592 Media Supplies by Using Part Numbers

Table 47 lists the data cartridges and media supplies that you can order for 3592 Tape Drives by using part numbers. The different methods for ordering are listed at the bottom of the table.

*Table 47. Ordering 3592 media supplies by using part numbers*

| Supply Item | Capacity | Part Number |
|---|---|---|
| IBM TotalStorage 3592 Enterprise Tape Cartridge - Data | 300 GB | 18P7534 |
| IBM TotalStorage 3592 Enterprise Tape Cartridge - Extended Data | 700 GB | 23R9830 |
| IBM TotalStorage 3592 Enterprise Tape Cartridge - Economy | 60 GB | 24R0316 |
| IBM TotalStorage 3592 Enterprise Tape Cartridge - WORM | 300 GB | 18P7538 |
| IBM TotalStorage 3592 Enterprise Tape Cartridge - Extended WORM | 700 GB | 23R9831 |
| IBM TotalStorage 3592 Enterprise Tape Cartridge - Economy WORM | 60 GB | 24R0317 |
| IBM TotalStorage 3592 Enterprise Tape Cartridge - Cleaning | Cleaning, 50 uses | 18P7535 |

**Methods of Ordering**

Use any of the three methods below to order media supplies by part number.

- Order by part number through an IBM-authorized distributor (for the closest distributor, visit the web at `http://www.ibm.com/storage/media`)
- If you do not have Internet access, order the cartridges from any authorized IBM Business Partner or your IBM Sales Representative
- Call 1-888-IBM-MEDIA

**Note:** Be sure to order bar code labels for all cleaning and data cartridges. Order volume serial (VOLSER) labels separately.

## Ordering Supplies for Repairs

We recommend that you keep the **Leader Pin Reattachment Kit** to maintain your cartridges. This kit contains the necessary tools to reattach the leader pin to the tape. It includes the rewind tool, which can be used to add tension to a tape if the leader pin is displaced. To order the kit, call 1-888-IBM-MEDIA to order as IBM part number 18P8887.

## Ordering 3592 Bar Code Labels

Bar code labels with volume serial (VOLSER) numbers are required for 3592 Tape Cartridges that are used within a library. You can order these labels separately from the IBM data cartridges and cleaning cartridges.

You can order bar code labels directly from the authorized label suppliers in Table 48 on page 166.

**Attention:** The IBM System Storage TS3500 Tape Library is designed to work with bar code labels that meet the specifications and requirements set forth in the *Label Specification for IBM 3592 Cartridges when used in IBM Libraries*. The following label providers have demonstrated the ability to produce finished bar code labels that meet the foregoing specifications and requirements. This information is provided for the convenience of 3584 Tape Library users only, and is not an endorsement or recommendation of such providers. IBM is not responsible for the quality of bar code labels procured from sources other than IBM. This information is applicable to bar code labels actually printed by the listed companies. IBM has not reviewed the quality of any labels produced by software or services offered by such companies which allow end users to print labels on their own printing equipment.

*Table 48. Authorized suppliers of custom bar code labels for 3592 Tape Cartridges*

| In the Americas | In Europe and Asia |
|---|---|
| Dataware<br>7570 Renwick<br>Houston, TX 77081<br>U. S. A.<br>Telephone: 800-426-4844<br>http://www.datawarelabels.com/ | Not applicable |
| EDP/Colorflex<br>2550 West Midway Boulevard<br>Broomfield, CO 80020-1633<br>U. S. A.<br>Telephone: 800-522-3528 or 303-666-2160<br>Fax: 303-666-2166<br>http://www.colorflex.com/colortrax.asp | EDP Europe Limited<br>43 Redhills Road<br>South Woodham Ferrers<br>Chelmsford, Essex CM3 5UL<br>U. K.<br>Telephone: 44 (0) 1245 322380<br>Fax: 44 (0)1245 323484<br>http://www.edpeurope.com/media-labels.html |
| Netc, L. L. C.<br>100 Corporate Drive<br>Trumbull, CT 06611<br>U. S. A. Telephone: 203-372-6382<br>http://www.NetcLabels.com | Netc Europe Ltd<br>Town Farm Bungalow<br>North Curry<br>Taunton<br>Somerset U. K. TA3 6LX<br>Telephone: 44 (0) 1823 491439<br>http://www.NetcLabels.co.uk |
| | Netc Asia Pacific Pty Ltd<br>Locked Bag 14<br>Kenthurst<br>NSW Australia 2156<br>Telephone: 61 (0) 2 4563 6556<br>http://www.NetcLabels.com.au |

# Chapter 6. Using the Fibre Channel Interface

This section introduces the use of the Fibre Channel interface with the 3584 Tape Library.

The IBM System Storage TS3500 Tape Library uses a Fibre Channel interface (*port*) to communicate with servers.

Your IBM Service Representative must perform setup and Fibre Channel configuration of the library. The related information is for reference only.

## Overview of Fibre Channel Interface

This section gives a basic description of the Fibre Channel interface that is used by the 3584 Tape Library.


**Attention:** A Class I laser assembly, in the optical transceiver, is mounted on the Fibre Channel drive's electronics card. This laser assembly is registered with the Department of Health and Human Services and is in compliance with IEC825.

To communicate with a server, the IBM System Storage TS3500 Tape Library uses a Fibre Channel interface (also called a *port*). In accordance with the standards of the American National Standards Institute (ANSI), the port runs Fibre Channel Protocol (which includes SCSI commands on the Fibre Channel) with ANSI-defined Fibre Channel Tape Support. The method by which the drive and server communicate is determined by the type of topology in which they reside and the type of connection that you choose.

## Physical Characteristics of the Fibre Channel Interface

This section describes the ports and protocol used by the Fibre Channel interface for the 3584 Tape Library.

Each Ultrium Tape Drive in a 3584 Tape Library contains one Fibre Channel interface (called a port). Each 3592 Tape Drive contains two ports. A Fibre Channel port runs SCSI protocol with Fibre Channel tape support.

The host server attaches to the library by using fiber cables that connect directly to a drive canister or through the library's patch panel. Connections are as follows:

- The canister for the TS1120 Tape Drive has two independent LC Duplex FC-4 fiber connections.
- The canister for the 3592 J1A has two independent LC Duplex FC-2 fiber connections.
- The canister for the Ultrium 4 Tape Drive has one LC Duplex FC-4 fiber connection.
- The canister for the Ultrium 3 Tape Drive has either one LC Duplex FC-4 fiber connection or one LC Duplex FC-2 fiber connection.
- The canister for the Ultrium 2 Tape Drive has one LC Duplex FC-2 fiber connection.

- The canister for the Ultrium 1 Tape Drive has one SC Duplex FC-1 fiber connection.

## Cables and Speeds of Fibre Channel Drives

This section defines the types of cables that are used by Fibre Channel drives in the 3584 Tape Library. It also gives the speedsd for varying lengths of cables.

The Fibre Channel drives in the 3584 Tape Library use the following cables:

- TS1120 Tape Drives and any Ultrium 4 andUltrium 3 Tape Drives that are equipped with 4 Gbps hardware use LC duplex, 50-micron fiber optics cables and operate at 4 Gbps, 2 Gbps, and 1 Gbps
- 3592 J1A Tape Drives, Ultrium 2 Tape Drives, and any Ultrium 3 Tape Drives that are equipped with 2 Gbps hardware use LC duplex, 50-micron fiber optics cables and operate at 2 Gbps and 1 Gbps
- Ultrium 1 Tape Drives use SC duplex, 50-micron fiber optics cables and operate at speeds of 1 Gbps

The library can be used in a 62.5-micron-cable Storage Area Network (SAN). However, the cable that connects the library to the SAN must be a 50-micron cable because the library uses 50-micron cables internally.

The maximum distances that the 3584 Tape Library supports on a Fibre Channel link is determined by the link speed, the type of fiber (50 or 62.5 micron), and the device to which the library is attached.

If your library attaches to a host bus adapter (HBA), refer to the documentation for the HBA for the supported cable distances.

When you attach to a port in the library, because 50-micron cables are used internally, you must use a 50-micron cable. Typical supported distances are:

- 4 Gbps link speed = up to 150 m (492 ft)
- 2 Gbps link speed = up to 300 m (984 ft)
- 1 Gbps link speed = up to 500 m (1640 ft)

In a Storage Area Network (SAN), the typical distances are:

- For a 50-micron cable:
  - 4 Gbps link speed = up to 150 m (492 ft)
  - 2 Gbps link speed = up to 300 m (984 ft)
  - 1 Gbps link speed = up to 500 m (1640 ft)
- For a 62.5-micron cable:
  - 4 Gbps link speed = up to 70 m (230) ft)
  - 2 Gbps link speed = up to 150 m (492 ft)
  - 1 Gbps link speed = up to 175 m (574 ft)

Refer to your switch vendor to determine what is supported for the switches in your SAN.

The cable connections between each drive and each server are housed in a patch panel that is located at the rear of the base frame or at the rear of any expansion frame that contains drives.

## Supported Topologies

This section discusses the ways that the Fibre Channel drives in the 3584 Tape Library connect to other Fibre Channel end points.

Fibre Channel devices (such as the 3584 Tape Library and a server) are known as nodes and have at least one port through which to receive and send data. The collection of components that connect two or more nodes is called a topology. Fibre Channel systems consist solely of two components: nodes with ports and topologies.

Each port uses a pair of fibers: one fiber carries data into the port, and the other carries data out of the port. The fibers in the channel are optical strands. The fiber pair is called a *link* and is part of the topology. Data is transmitted over the links in units known as *frames*. A frame contains an address identifier that gives the fabric and node for which the frame is destined.

The 3584 Tape Library can be attached in a two-node configuration, either directly to a switch as a public device (switched fabric) or directly to a host bus adapter (HBA) as a private device (direct connection). Depending on whether it has been attached through an Ultrium 1 Tape Drive (as an L_port), attached through an Ultrium 4, Ultrium 3, Ultrium 2, TS1120 Tape Drive, or 3592 J1A (as any supported topology), or configured by using vital product data (VPD) settings, the library automatically configures to an L_port or an N_port when it boots. The type of connection also depends on whether the drive recognizes the connection as a loop or a fabric connection:

- An L_port supports a Fibre Channel Arbitrated Loop connection to an L_port or FL_port.
- An N_port supports direct connection to an F_port (for example, a director-class switch) in a fabric topology.

Regardless of the port to which you connect the drive, it automatically configures to a public device (through an F_port or FL_port to a switch) or to a private device (through an L_port by using direct attachment to a server).

The 3584 Tape Library supports two topologies: two-node switched fabric and two-node direct connection. Table 49 on page 170 lists the topologies in which the library can operate, the Fibre Channel server connections that are available, and the port (NL, N, FL, or F) through which communication must occur. The sections that follow describe each topology.

*Table 49. Choosing the port and topology through which your Fibre Channel connection can be made*

| Drive Port Configuration | Type of Fibre Channel Port to Which the Drive Port Connects | | | |
|---|---|---|---|---|
| | Server Port (HBA) (Private - Direct Connection) | | Switch Port (Public - Switched Fabric) | |
| | Point-to-Point Topology (N_Port) | Arbitrated Loop Topology (FC-AL) | | Fabric Topology (F_Port) |
| | | (L-Port) | (FL_Port) | |
| Drive port configured to operate as L_Port[1] | Invalid system configuration | L_Port | L_Port | Invalid system configuration |
| Drive port configured to operate as N_Port[2] | N_Port (not supported) | Invalid system configuration | N_Port (switched fabric) | N_Port |
| Drive port configured to operate as LN_Port[2] | N_Port (not supported; will force L_Port attempt) | L_Port | L_Port | N_Port |
| Drive port configured to operate as NL_Port[2] | N_Port (not supported; will force L_Port attempt) | L_Port | N_Port | N_Port |

**Notes:**

1. Applies to Ultrium 1, 2, 3, 4 or 3592 Tape Drives.
2. Applies to Ultrium 2, 3, 4 or 3592 Tape Drives.

## Two-Node Switched Fabric Topology

Two or more Fibre Channel end points can interconnect through a device called a switch. The Fibre Channel architecture supports up to 256 ports through each switch.

A switched fabric allows all of its ports to simultaneously use the Fibre Channel's full architectural bandwidth. To determine the switches to which you can directly attach the 3584 Tape Library, visit the web at:

`http://www.ibm.com/servers/storage/support/san/index.html`

Switches include a function called zoning. This function allows you to partition the switch's ports and share access to a drive. For more information about sharing access, see "Sharing on a Storage Area Network" on page 177).

The two-node switched fabric topology supports two protocols:

- Use the two-node switched fabric loop protocol when attaching the library to an FL_port. This protocol is supported when you attach the library through the Ultrium 1, Ultrium 2, Ultrium 3, Ultrium 4, or 3592 Tape Drives.
- Use the two-node switched fabric protocol when attaching the library to an F_port. This protocol is supported when you attach the library through the Ultrium 2, Ultrium 3, Ultrium 4 or 3592 Tape Drives.

## Two-Node Direct Connection Topology

A two-node direct connection occurs when two Fibre Channel end points are connected together. The difference is in the topology. Either Arbitrated Loop or Point-to-Point topology is usable, but both end points must use the same topology. Most Fibre Channel adapters have settings that allow selection of the topology or they default to the loop topology when they are not directly connected to a fabric. In addition, the 3584 Tape Library allows you to set the drive port to any of these topologies. To set a port to a topology, see the section about viewing or changing Fibre Channel port speeds and topologies in the *IBM System Storage TS3500 Tape Library Operator Guide*.

Use the Arbitrated Loop (L_port) topology in a two-node direct connection. This topology is supported when you attach the 3584 Tape Library through the Ultrium 1, Ultrium 2, Ultrium 3, Ultrium 4, or 3592 Tape Drives. Use of the Point-to-Point topology in a two-node direct connection in the library to an N_port is not supported.

# Fibre Channel Addressing

This section defines and lists the default Loop ID and Arbitrated Loop Physical Address (AL_PA) for each Ultrium Tape Drive and 3592 Tape Drive that communicates in a Fibre Channel topology.

Each Ultrium Tape Drive and 3592 Tape Drive in a 3584 Tape Library must have a Loop ID and corresponding Arbitrated Loop Physical Address (AL_PA) to communicate in a Fibre Channel topology. Table 50 lists the default Loop IDs and AL_PAs for each drive in the library.

The AL_PAs defined here are used when connecting to other devices in Arbitrated Loop topology only. When connected in a switched fabric point-to-point topology, the AL_PA is assigned by the fabric and these AL_PAs are not used.

**Note:** In Table 50, the values for Port 2 do not apply to tape drives that have a single port.

*Table 50. Default Loop IDs and their associated AL_PAs for drives with single or dual ports.* For drives with single ports, use the values for Port 1; for drives with dual ports, use Ports 1 and 2.

| Drive | Frames 1, 7, 13 | | Frames 2, 8, 14 | | Frames 3, 9, 15 | | Frames 4, 10, 16 | | Frames 5, 11 | | Frames 6, 12 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Loop ID | AL_PA | Loop ID | AL_PA | Loop ID | AL_PA | Loop ID | AL_PA | Loop ID | AL_PA | Loop ID | AL_PA |
| Row 1 | | | | | | | | | | | | |
| Port 1 | 17 | X'CC' | 33 | X'B1' | 49 | X'97' | 65 | X'71' | 81 | X'54' | 97 | X'39' |
| Port 2 | 81 | X'54' | 97 | X'39' | 18 | X'CB' | 34 | X'AE' | 17 | X'CC' | 33 | X'B1' |
| Row 2 | | | | | | | | | | | | |
| Port 1 | 18 | X'CB' | 34 | X'AE' | 50 | X'90' | 66 | X'6E' | 82 | X'53' | 98 | X'36' |
| Port 2 | 82 | X'53' | 98 | X'36' | 19 | X'CA' | 35 | X'AD' | 18 | X'CB' | 34 | X'AE' |
| Row 3 | | | | | | | | | | | | |
| Port 1 | 19 | X'CA' | 35 | X'AD' | 51 | X'8F' | 67 | X'6D' | 83 | X'52' | 99 | X'35' |
| Port 2 | 83 | X'52' | 99 | X'35' | 20 | X'C9' | 36 | X'AC' | 19 | X'CA' | 35 | X'AD' |
| Row 4 | | | | | | | | | | | | |
| Port 1 | 20 | X'C9' | 36 | X'AC' | 52 | X'88' | 68 | X'6C' | 84 | X'51' | 100 | X'34' |

*Table 50. Default Loop IDs and their associated AL_PAs for drives with single or dual ports (continued).* For drives with single ports, use the values for Port 1; for drives with dual ports, use Ports 1 and 2.

| Drive | Frames 1, 7, 13 | | Frames 2, 8, 14 | | Frames 3, 9, 15 | | Frames 4, 10, 16 | | Frames 5, 11 | | Frames 6, 12 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Loop ID | AL_PA | Loop ID | AL_PA | Loop ID | AL_PA | Loop ID | AL_PA | Loop ID | AL_PA | Loop ID | AL_PA |
| Port 2 | 84 | X'51' | 100 | X'34' | 21 | X'C7' | 37 | X'AB' | 20 | X'C9' | 36 | X'AC' |
| Row 5 | | | | | | | | | | | | |
| Port 1 | 21 | X'C7' | 37 | X'AB' | 53 | X'84' | 69 | X'6B' | 85 | X'4E' | 101 | X'33' |
| Port 2 | 85 | X'4E' | 101 | X'33' | 22 | X'C6' | 38 | X'AA' | 21 | X'C7' | 37 | X'AB' |
| Row 6 | | | | | | | | | | | | |
| Port 1 | 22 | X'C6' | 38 | X'AA' | 54 | X'82' | 70 | X'6A' | 86 | X'4D' | 102 | X'32' |
| Port 2 | 86 | X'4D' | 102 | X'32' | 23 | X'C5' | 39 | X'A9' | 22 | X'C6' | 38 | X'AA' |
| Row 7 | | | | | | | | | | | | |
| Port 1 | 23 | X'C5' | 39 | X'A9' | 55 | X'81' | 71 | X'69' | 87 | X'4C' | 103 | X'31' |
| Port 2 | 87 | X'4C' | 103 | X'31' | 24 | X'C3' | 40 | X'A7' | 23 | X'C5' | 39 | X'A9' |
| Row 8 | | | | | | | | | | | | |
| Port 1 | 24 | X'C3' | 40 | X'A7' | 56 | X'80' | 72 | X'67' | 88 | X'4B' | 104 | X'2E' |
| Port 2 | 88 | X'4B' | 104 | X'2E' | 25 | X'BC' | 41 | X'A6' | 24 | X'C3' | 40 | X'A7' |
| Row 9 | | | | | | | | | | | | |
| Port 1 | 25 | X'BC' | 41 | X'A6' | 57 | X'7C' | 73 | X'66' | 89 | X'4A' | 105 | X'2D' |
| Port 2 | 89 | X'4A' | 105 | X'2D' | 26 | X'BA' | 42 | X'A5' | 25 | X'BC' | 41 | X'A6' |
| Row 10 | | | | | | | | | | | | |
| Port 1 | 26 | X'BA' | 42 | X'A5' | 58 | X'7A' | 74 | X'65' | 90 | X'49' | 106 | X'2C' |
| Port 2 | 90 | X'49' | 106 | X'2C' | 27 | X'B9' | 43 | X'A3' | 26 | X'BA' | 42 | X'A5' |
| Row 11 | | | | | | | | | | | | |
| Port 1 | 27 | X'B9' | 43 | X'A3' | 59 | X'79' | 75 | X'63' | 91 | X'47' | 107 | X'2B' |
| Port 2 | 91 | X'47' | 107 | X'2B' | 28 | X'B6' | 44 | X'9F' | 27 | X'B9' | 43 | X'A3' |
| Row 12 | | | | | | | | | | | | |
| Port 1 | 28 | X'B6' | 44 | X'9F' | 60 | X'76' | 76 | X'5C' | 92 | X'46' | 108 | X'2A' |
| Port 2 | 92 | X'46' | 108 | X'2A' | 29 | X'B5' | 45 | X'9E' | 28 | X'B6' | 44 | X'9F' |
| **Note:** Loop IDs are given in decimal format and AL_PA values are given in hexadecimal format. | | | | | | | | | | | | |

You can change a Loop ID by using the library's operator panel or Tape Library Specialist web interface (see the section about changing the Loop ID in the *IBM System Storage TS3500 Tape Library Operator Guide*). Using a method called hard addressing, the drive then automatically selects the corresponding AL_PA, which is the identifier that devices use to communicate. Valid Loop ID values range between 0 and 125. The higher the number of the Loop ID (which relates to AL_PA), the higher the priority of the device in the loop.

You can also specify Loop IDs that allow the drive to dynamically arbitrate the AL_PA with other Fibre Channel devices on the loop. This method avoids conflicts over the address and is called soft addressing. To dynamically arbitrate the AL_PA, specify a Loop ID of 126 or 127.

For a complete list of Loop IDs and their corresponding AL_PAs, see Table 51.

*Table 51. Valid Loop IDs and their associated AL_PAs for Ultrium Tape Drives, 3592 Tape Drives, and TS1120 Tape Drives in the IBM System Storage TS3500 Tape Library*

| 7-bit Loop ID (decimal) | 8-bit AL_PA (hexadecimal) | 7-bit Loop ID (decimal) | 8-bit AL_PA (hexadecimal) | 7-bit Loop ID (decimal) | 8-bit AL_PA (hexadecimal) |
|---|---|---|---|---|---|
| 0 | X'EF' | 43 | X'A3' | 86 | X'4D' |
| 1 | X'E8' | 44 | X'9F' | 87 | X'4C' |
| 2 | X'E4' | 45 | X'9E' | 88 | X'4B' |
| 3 | X'E2' | 46 | X'9D' | 89 | X'4A' |
| 4 | X'E1' | 47 | X'9B' | 90 | X'49' |
| 5 | X'E0' | 48 | X'98' | 91 | X'47' |
| 6 | X'DC' | 49 | X'97' | 92 | X'46' |
| 7 | X'DA' | 50 | X'90' | 93 | X'45' |
| 8 | X'D9' | 51 | X'8F' | 94 | X'43' |
| 9 | X'D6' | 52 | X'88' | 95 | X'3C' |
| 10 | X'D5' | 53 | X'84' | 96 | X'3A' |
| 11 | X'D4' | 54 | X'82' | 97 | X'39' |
| 12 | X'D3' | 55 | X'81' | 98 | X'36' |
| 13 | X'D2' | 56 | X'80' | 99 | X'35' |
| 14 | X'D1' | 57 | X'7C' | 100 | X'34' |
| 15 | X'CE' | 58 | X'7A' | 101 | X'33' |
| 16 | X'CD' | 59 | X'79' | 102 | X'32' |
| 17 | X'CC' | 60 | X'76' | 103 | X'31' |
| 18 | X'CB' | 61 | X'75' | 104 | X'2E' |
| 19 | X'CA' | 62 | X'74' | 105 | X'2D' |
| 20 | X'C9' | 63 | X'73' | 106 | X'2C' |
| 21 | X'C7' | 64 | X'72' | 107 | X'2B' |
| 22 | X'C6' | 65 | X'71' | 108 | X'2A' |
| 23 | X'C5' | 66 | X'6E' | 109 | X'29' |
| 24 | X'C3' | 67 | X'6D' | 110 | X'27' |
| 25 | X'BC' | 68 | X'6C' | 111 | X'26' |
| 26 | X'BA' | 69 | X'6B' | 112 | X'25' |
| 27 | X'B9' | 70 | X'6A' | 113 | X'23' |
| 28 | X'B6' | 71 | X'69' | 114 | X'1F' |
| 29 | X'B5' | 72 | X'67' | 115 | X'1E' |
| 30 | X'B4' | 73 | X'66' | 116 | X'1D' |
| 31 | X'B3' | 74 | X'65' | 117 | X'1B' |
| 32 | X'B2' | 75 | X'63' | 118 | X'18' |
| 33 | X'B1' | 76 | X'5C' | 119 | X'17' |
| 34 | X'AE' | 77 | X'5A' | 120 | X'10' |
| 35 | X'AD' | 78 | X'59' | 121 | X'0F' |
| 36 | X'AC' | 79 | X'56' | 122 | X'08' |

*Table 51. Valid Loop IDs and their associated AL_PAs for Ultrium Tape Drives, 3592 Tape Drives, and TS1120 Tape Drives in the IBM System Storage TS3500 Tape Library (continued)*

| 7-bit Loop ID (decimal) | 8-bit AL_PA (hexadecimal) | 7-bit Loop ID (decimal) | 8-bit AL_PA (hexadecimal) | 7-bit Loop ID (decimal) | 8-bit AL_PA (hexadecimal) |
|---|---|---|---|---|---|
| 37 | X′AB′ | 80 | X′55′ | 123 | X′04′ |
| 38 | X′AA′ | 81 | X′54′ | 124 | X′02′ |
| 39 | X′A9′ | 82 | X′53′ | 125 | X′01′ |
| 40 | X′A7′ | 83 | X′52′ | 126 | X′00′ |
| 41 | X′A6′ | 84 | X′51′ | 127 | – – |
| 42 | X′A5′ | 85 | X′4E′ | – – | – – |

## LUN Assignments

This section defines the logical unit number (LUN) for a Sequential Access device (drive) and the Medium Changer device (library).

The logical unit number (LUN) for the Sequential Access device (the SCSI term for a drive) is always LUN 0, and the LUN for the Medium Changer device (the SCSI term for the library) is always LUN 1 (all other LUNs are invalid addresses). These devices are compatible with the SCSI-2 or SCSI-3 standard. For information about the SCSI commands for the tape drives, see the *IBM TotalStorage LTO Ultrium Tape Drive SCSI Reference* or *IBM System Storage TS1120 Tape Drive and Controller SCSI Reference*. For information about the SCSI commands for the library, see the *IBM System Storage TS3500 Tape Library SCSI Reference*.

**Note:** The Medium Changer SCSI ID is the same as the SCSI ID for Drive 1, Frame 1. You can enable additional drives to optionally provide Medium Changer (LUN 1) addressing by configuring more than one logical library or by enabling additional control paths (see the sections about configuring the library with partitions or changing a control path in the *IBM System Storage TS3500 Tape Library Operator Guide*).

## Using World Wide Names

This section discusses the World Wide Name (WWN) addresses that the 3584 Tape Library assigns to drives. The WWN does not change when the drive is swapped or replaced, and host parameters do not need to be changed or reconfigured.

Normally, blocks of World Wide Name (WWN) addresses are assigned to manufacturers by the IEEE Standards Committee, and are built into devices during manufacture. In the case of the 3584 Tape Library, however, the library assigns World Wide Node Names and World Wide Port Names to the drives. This technique is referred to as “library-centric world wide names.” Potential drive slots are each assigned a WWN which does not change when a drive is swapped or replaced.

In the 3584 Tape Library, a WWN for a drive is implemented through an algorithm that uses the frame serial number of the library and the drive’s position within the library. Only the last two digits change within the library. The second-to-the-last digit represents the frame number (starting at 0 for Frame 1) and the last digit is the drive row (starting at 1). The WWN of the drive is location-dependent and not device-dependent. That is, each time that the drive is reset or powered on, the library reestablishes the WWN so that a drive in frame x, row y always keeps the

same WWN, even if the drive is replaced. The design of a WWN is such that if a drive needs service or replacement, host parameters do not need to be changed or reconfigured. The library's configuration can also easily survive a reboot. The following sections describe methods that involve World Wide Names in resolving these issues.

### Using Persistent Binding to Ensure SCSI ID Assignment

When a server is booted, devices are discovered and assigned SCSI target and LUN IDs. It is possible for these SCSI assignments to change between boots. Some operating systems do not guarantee that devices will always be allocated the same SCSI target ID after rebooting. Also, some software depends on this association, so you do not want it to change. The issue of SCSI ID assignment is addressed by persistent binding.

Persistent binding is a host bus adapter (HBA) function that allows a subset of discovered targets to be bound between a server and device. Implemented by a World Wide Node Name (WWNN) or World Wide Port Name (WWPN), persistent binding causes a tape drive's World Wide Name to be bound to a specific SCSI target ID. After a configuration has been set, it survives reboots and any hardware configuration changes because the information is preserved. If a drive needs to be replaced, the new drive assumes the WWNN of the old drive because the WWNN for the drive is location-dependent within the library. Because the WWNN does not change, persistent binding does not need to be changed which would cause an outage.

### Using Zoning to Isolate Devices and Enhance Security

For security reasons, it is important to limit the devices that a server or servers can recognize or access. Also, some performance configurations and Storage Area Network (SAN) configurations can result in a device being seen multiple times from the same server. For example, if you have two host bus adapters (HBAs) from the same server connected to a tape drive in the 3584 Tape Library, the drive will be detected and appear as two logical devices. That is, there will be two special files for one physical device. Zoning can address these issues.

Zoning allows you to partition your SAN into logical groupings of devices so that each group is isolated from the other and can only access the devices in its own group. Two types of zoning exist: hardware zoning and software zoning. Hardware zoning is based on physical fabric port number. Software zoning is defined with the World Wide Node Name (WWNN) or World Wide Port Name (WWPN). While zoning can be reconfigured without causing an outage, some zoning configurations can become complicated. The advantage of the library's WWNN implementation is that you can avoid the exposure of introducing zoning errors because you do not have to change the zoning configuration if a drive needs service or replacement.

## Connectors and Adapters

This section provides web sites that give information about the latest connectors and adapters for the 3584 Tape Library.

The 3584 Tape Library is supported by a wide variety of servers (mainframe hosts), operating systems, and adapters. These attachments can change throughout the product's life cycle. To determine the latest attachments, visit the following web sites or contact your IBM Sales Representative.

- For a list of compatible software, operating systems, and servers for Ultrium Tape Drives, visit the web at `http://www.ibm.com/storage/lto`. Under `IBM`

System Storage TS3500 Tape Library, select Product details. Under Learn more, select Interoperability matrix or select Independent Software Vendor (ISV) matrix for LTO.

- For a list of compatible software, operating systems, and servers for TS1120 Tape Drives, visit the web at http://www.ibm.com/servers/storage/tape/drives. Under IBM System Storage TS1120 Tape Drive, select Product details. Under Learn more, select Interoperability matrix or Independent Software Vendor (ISV) matrix.
- For a list of compatible software, operating systems, and servers for 3592 Tape Drives, visit the web at http://www.ibm.com/servers/storage/tape/drives. Under IBM TotalStorage 3592 Tape Drive, select Product details. Select Resource library. Select Interoperability , then 3592 Tape Drive. Or select Compatibility information, then Independent Software Vendor (ISV) Matrix for 3592 Tape Drive.

## Connecting the Library to the iSeries Server

This section gives information that is necessary for connecting the 3584 Tape Library to the iSeries server (mainframe host).

The OS/400 operating system supports a maximum of:

- 96 tape drives per logical library
- 32 tape drives per library device description
- 16 devices per tape adapter (a device is a media changer or tape drive)

The iSeries does not require or allow you to set the Fibre Channel adapter settings. The adapter automatically detects the connection type and device addressing. OS/400 support is as follows:

- For V5R1, the adapter supports:
  - A single target with multiple LUNs
  - 1 Gbps connection
  - For a Fibre Channel-Arbitrated Loop topology, connection through an L_ port to a device, hub or switch
  - Does not support fabric
- For V5R2, the adapter supports:
  - Up to 16 devices, including multiple targets and multiple LUNs (each LUN on each target counts as a device)
  - 2 Gbps connection (but will negotiate down to 1 Gbps if necessary)
  - For a Fibre Channel-Arbitrated Loop topology, connection through an L_ port to a device, hub or switch
  - For a point-to-point topology, connection through an N_port to an F_port

The iSeries Fibre Channel adapter does not support D-mode Alternate IPL. The Alternate Installation function is used to restore a system from a Fibre Channel-attached device. With Alternate Installation support, the system is loaded from a compact disc (CD) and directed to the Fibre Channel-attached device for a restore from the tape that contains the saved data. The code on the CD is only used to get the restore from tape started. All code and program temporary fixes (PTFs) are restored from the tape that contains the saved data.

When enabled in the 3584 Tape Library, the Advanced Library Management System (ALMS) allows for changes in the logical library and drive configurations

without taking the library off-line. These changes are not transparent to iSeries and OS/400 servers that are attached to any logical libraries which have changed. Any time that changes are made to the logical library or device configuration, you must reset the associated adapter or perform an initial program load (IPL) of the associated system to reconfigure the changes.

For additional information, see *The LTO Ultrium Primer for IBM eServer iSeries Customers* available on `http://www.redbooks.ibm.com`.

## Sharing on a Storage Area Network

This section gives guidelines for sharing drives with software and systems.

With Storage Area Network (SAN) components, the possibilities for connecting multiple systems and multiple drives have increased. Not all software and systems are designed to share drives. Before you install a drive that would allow two systems to share it, check that the systems and their software support sharing. If your software does not support sharing, note that Fibre Channel switches have a zoning capability to form a SAN partition. For systems that do not cooperate, use zoning to prevent the systems from sharing the same drive. You can remove zoned partitions as you upgrade software and system levels.

# Chapter 7. Frame Capacity

This section introduces the quantity of LTO Ultrium Tape Cartridges and 3592 Tape Cartridges that the 3584 Tape Library supports, depending on whether the Capacity On Demand or Capacity Expansion Features are installed, the upper and lower I/O stations are used, and a specified quantity of drives are installed.

## Capacity of Model L22, D22, L23, and D23 Frames

This section gives the type of eligible Capacity On Demand feature and quantity of drives, I/O slots, and storage slots for L22, D22, L23, and D23 frames.

*Table 52. Quantity of storage slots in L22, D22, L23, and D23 frames.* The quantity depends on the type of Capacity On Demand feature installed, whether the upper and lower I/O stations are used, and the quantity of drives in a frame.

| Type of Frame | Type of Capacity On Demand Feature | Quantity of Drives | Quantity of I/O Slots | Quantity of Storage Slots |
|---|---|---|---|---|
| L22, L23 | Entry | 0 to 12 | 16 | 58 |
| L22, L23 | Intermediate | 0 to 12 | 16 | 117 |
| L22, L23 | Full | 0 to 4 | 16 | 260 |
| L22, L23 | Full | 5 to 8 | 16 | 248 |
| L22, L23 | Full | 9 to 12 | 16 | 237 |
| L22, L23 | Full | 0 to 4 | 32 | 222 |
| L22, L23 | Full | 5 to 8 | 32 | 210 |
| L22, L23 | Full | 9 to 12 | 32 | 199 |
| D22, D23[1] | N/A[2] | 0 | N/A | 400 |
| D22, D23[1] | N/A | 1 to 4 | N/A | 383 |
| D22, D23[1] | N/A | 5 to 8 | N/A | 371 |
| D22, D23[1] | N/A | 9 to 12 | N/A | 360 |

**Notes:**

1. If the L frame is not an L22 or L23, then the first D frame of a mixed media library will have one less storage slot to accommodate a diagnostic cartridge.
2. N/A = not applicable.

**Related reference**

"Capacity of Model L32 and D32 Frames" on page 180
This section gives the quantity of drives and cartridge storage slots in Model L32 and D32 frames that do not have the Capacity Expansion feature. It also gives the quantity of cartridge storage slots in L32 and D32 frames that have the Capacity Expansion feature and differing numbers of I/O slots.

"Capacity of Model L52, D52, L53, and D53 Frames" on page 181
This section gives the type of eligible Capacity On Demand feature and quantity of drives, I/O slots, and storage slots for Model L52, D52, L53, and D53 frames.

## Capacity of Model L32 and D32 Frames

This section gives the quantity of drives and cartridge storage slots in Model L32 and D32 frames that do not have the Capacity Expansion feature. It also gives the quantity of cartridge storage slots in L32 and D32 frames that have the Capacity Expansion feature and differing numbers of I/O slots.

*Table 53. Quantity of storage slots in Model L32 and D32 frames.* The quantity depends on whether the Capacity Expansion feature is installed, whether the upper and lower I/O stations are used, and the quantity of drives in a frame.

| Type of Frame | Quantity of Drives | Quantity of Slots in Frame (without Capacity Expansion Feature) | Quantity of Slots with Capacity Expansion Feature and 26 or 30 I/O Slots | Quantity of Slots with Capacity Expansion Feature and 10 I/O Slots |
|---|---|---|---|---|
| L32 | 1 to 4 | 141 | 229 | 281 |
| L32 | 5 to 8 | 113 | 201 | 253 |
| L32 | 9 to 12 | 87 | 175 | 227 |
| D32 | 0 | 440 | N/A (see Note) | N/A |
| D32 | 1 to 4 | N/A | 423 | 423 |
| D32 | 5 to 8 | N/A | 409 | 409 |
| D32 | 9 to 12 | N/A | 396 | 396 |
| **Note:** N/A = not applicable. | | | | |

**Related reference**

"Capacity of Model L22, D22, L23, and D23 Frames" on page 179
This section gives the type of eligible Capacity On Demand feature and quantity of drives, I/O slots, and storage slots for L22, D22, L23, and D23 frames.

"Capacity of Model L52, D52, L53, and D53 Frames" on page 181
This section gives the type of eligible Capacity On Demand feature and quantity of drives, I/O slots, and storage slots for Model L52, D52, L53, and D53 frames.

## Capacity of Model L52, D52, L53, and D53 Frames

This section gives the type of eligible Capacity On Demand feature and quantity of drives, I/O slots, and storage slots for Model L52, D52, L53, and D53 frames.

*Table 54. Quantity of storage slots in Model L52, D52, L53, and D53 frames.* The quantity depends on the type of Capacity On Demand Expansion feature installed, whether the upper and lower I/O stations are used, and the quantity of drives in a frame.

| Type of Frame | Type of Capacity On Demand Feature | Quantity of Drives | Quantity of I/O Slots | Quantity of Storage Slots |
|---|---|---|---|---|
| L52, L53 | Entry | 0 to 12 | 16 | 64 |
| L52, L53 | Intermediate | 0 to 12 | 16 | 129 |
| L52, L53 | Full | 0 to 4 | 16 | 287 |
| L52, L53 | Full | 5 to 8 | 16 | 273 |
| L52, L53 | Full | 9 to 12 | 16 | 261 |
| L52, L53 | Full | 0 to 4 | 32 | 245 |
| L52, L53 | Full | 5 to 8 | 32 | 231 |
| L52, L53 | Full | 9 to 12 | 32 | 219 |
| D52, D53[1] | N/A[2] | 0 | N/A | 440 |
| D52, D53[1] | N/A | 1 to 4 | N/A | 422 |
| D52, D53[1] | N/A | 5 to 8 | N/A | 408 |
| D52, D53[1] | N/A | 9 to 12 | N/A | 396 |

**Notes:**

1. If the L frame is not an L32, L52, or L53, then the first D frame of a mixed media library will have one less storage slot to accommodate a diagnostic cartridge.
2. N/A = not applicable.

**Related reference**

"Capacity of Model L22, D22, L23, and D23 Frames" on page 179
This section gives the type of eligible Capacity On Demand feature and quantity of drives, I/O slots, and storage slots for L22, D22, L23, and D23 frames.

"Capacity of Model L32 and D32 Frames" on page 180
This section gives the quantity of drives and cartridge storage slots in Model L32 and D32 frames that do not have the Capacity Expansion feature. It also gives the quantity of cartridge storage slots in L32 and D32 frames that have the Capacity Expansion feature and differing numbers of I/O slots.

# Chapter 8. Tape Encryption Overview

Data is one of the most highly valued resources in a competitive business environment. Protecting that data, controlling access to it, and verifying its authenticity while maintaining its availability are priorities in our security-conscious world. Data encryption is a tool that answers many of these needs.

The IBM System Storage TS1120 Tape Drive is capable of encrypting data as it is written to any size IBM TotalStorage Enterprise Tape Cartridge 3592, including WORM cartridges. The IBM System Storage TS1040 LTO Ultrium 4 Tape Drive is also capable of encrypting data as it is written to any LTO 4 Data Cartridge. Encryption is performed at full line speed in the tape drive after compression. (Compression is more efficiently done before encryption.) This new capability adds a strong measure of security to stored data without the processing overhead and performance degradation associated with encryption performed on the server or the expense of a dedicated appliance.

Three major elements comprise the tape drive encryption solution:

**The encryption-enabled tape drive**
All TS1120 Tape Drives with Feature Code 5592 or 9592 are *encryption-capable*. All LTO Ultrium 4 Tape Drives are *encryption-capable*. This means that they are functionally capable of performing hardware encryption, but this capability has not yet been activated. In order to perform hardware encryption, the TS1120 and LTO Ultrium 4 Tape Drives must be *encryption-enabled*. In an IBM System Storage TS3500 Tape Library, TS1120 Tape Drives can be encryption-enabled through the IBM System Storage Tape Specialist. For all other TS1120 Tape Drives this process consists of having an IBM representative set up the drive for encryption. Only encryption-enabled TS1120 Tape Drives can be used to read and write encrypted 3592 tape cartridges. All LTO Ultrium 4 Tape Drives can be encryption-enabled through the IBM System Storage Tape Specialist.

**Encryption key management**
Encryption involves the use of several kinds of keys, in successive layers. How these keys are generated, maintained, controlled, and transmitted depends upon the operating environment where the encrypting tape drive is installed. Some applications, such as Tivoli Storage Manager (TSM), are capable of performing key management. For environments without such applications or those where application agnostic encryption is desired, IBM provides the IBM Encryption Key Manager component for the Java™ platform (EKM) to perform all necessary key management tasks. “Managing Encryption” on page 184 describes these tasks in more detail.

**Encryption policy**
This is the method used to implement encryption. It includes the rules that govern which volumes are encrypted and the mechanism for key selection. How and where these rules are set up depends on the operating environment. See “Managing Encryption” on page 184 for more information.

**Note:** In the Tape Storage environment, the Encryption function on tape drives (desktop, stand-alone and within libraries) is configured and managed by the customer and not the IBM System Services Representative (SSR). In some instances SSRs will be required to enable encryption at a hardware level

when service access or service password controlled access is required. Customer setup support is by Field Technical Sales Specialist (FTSS), customer documentation, and software support for encryption software problems. Customer "how to" support is also provided via support line contract.

## Managing Encryption

The IBM Encryption Key Manager component for the Java platform (EKM) is a Java software program that assists IBM encryption-enabled tape drives in generating, protecting, storing, and maintaining encryption keys that are used to encrypt information being written to, and decrypt information being read from, tape media (tape and cartridge formats). EKM operates on z/OS®, i5/OS®, AIX®, Linux®, HP-UX, Sun Solaris, and Windows®, and is designed to be a shared resource deployed in several locations within an Enterprise. EKM is capable of serving numerous IBM encrypting tape drives, regardless of where those drives reside (for example, in tape library subsystems, connected to mainframe systems through various types of channel connections, or installed in other computing systems.)

EKM uses a keystore to hold the certificates and keys (or pointers to the certificates and keys) required for all encryption tasks. EKM supports the following IBM keystores: JCEKS, JCE4758KS/JCECCAKS, JCE4785RACFKS/JCECCARACFKS, JCERACFKS, PKCS11IMPLKS, and IBMi5OSKeyStore. See *IBM Encryption Key Manager component for the Java platform Introduction, Planning, and User's Guide*, GA76-0418, for detailed information about EKM and the keystores it supports.

EKM acts as a daemon process awaiting key generation or key retrieval requests sent to it through a TCP/IP communication path between the EKM and the tape library, tape controller, tape subsystem, device driver, or tape drive. When a tape drive writes encrypted data, it first requests an encryption key from EKM. Upon receipt of the request, EKM generates an Advanced Encryption Standard (AES) key and serves it to the tape drives in two protected forms:

**For TS1120 Tape Drives:** EKM generates an Advanced Encryption Standard (AES) key and serves it to the tape drives in two protected forms:

- Encrypted or *wrapped*, using Rivest-Shamir-Adleman (RSA) key pairs. The tape drive writes this copy of the key to the cartridge memory and three additional places on the tape media in the cartridge for redundancy.
- Separately wrapped for secure transfer to the tape drive where it is unwrapped upon arrival and the key inside is used to encrypt the data being written to tape.

When an encrypted tape cartridge is read by a TS1120 Tape Drive, the protected AES key on the tape is sent to EKM where the wrapped AES key is unwrapped. The AES key is then wrapped with a different key for secure transfer back to the tape drive, where it is unwrapped and used to decrypt the data stored on the tape. EKM also allows protected AES keys to be rewrapped, or rekeyed, using different RSA keys from the original ones used when the tape was written. Rekeying is useful when an unexpected need arises to export volumes to business partners whose public keys were not included; it eliminates the need to rewrite the entire tape and enables a tape cartridge's data key to be reencrypted with a business partner's public key.

**For TS1040 LTO Ultrium 4 Tape Drives:** EKM fetches an existing AES key from a keystore and wraps it for secure transfer to the tape drive where it is unwrapped upon arrival and used to encrypt the data being written to tape.

When an encrypted tape is read by an LTO Ultrium 4 Tape Drive, EKM fetches the required key from the keystore, based on the information in the Key ID on the tape, and serves it to the tape drive wrapped for secure transfer.

There are three methods of encryption management to choose from. These methods differ in where the encryption policy engine resides and where key management is performed for your encryption solution, and how the EKM is connected to the drive. Your operating environment determines which is the best for you. Key management and the encryption policy engine may be located in any one of the following three environmental layers.

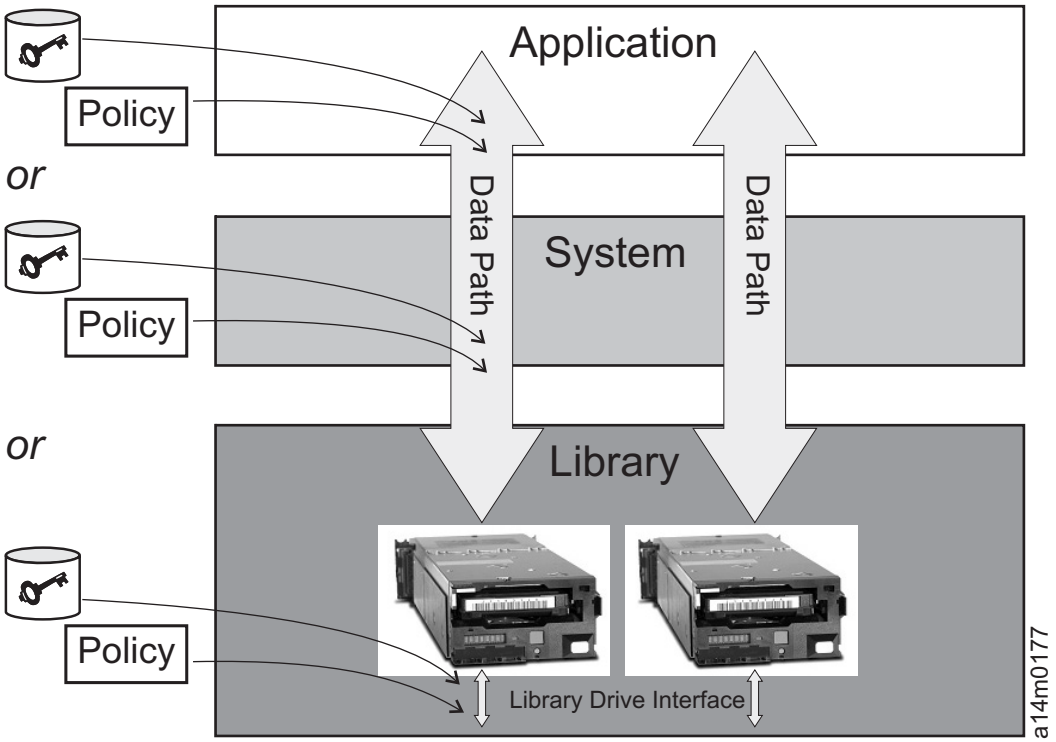



*Figure 53. Three possible locations for encryption policy engine and key management.*

**Application Layer**
Initiates data transfer for tape storage, for example TSM.

**System Layer**
Everything between the application and the tape drives, for example the operating system, z/OS DFSMS, device drivers, and FICON/ESCON controllers.

**Library Layer**
The enclosure for tape storage, such as the IBM System Storage TS3500 Tape Library. A modern tape library contains an internal interface to each tape drive within it.

## Application-Managed Tape Encryption

This method is best where operating environments run an application already capable of generating and managing encryption policies and keys, such as Tivoli Storage Manager (TSM). Policies specifying when encryption is to be used are defined through the application interface. The policies and keys pass through the data path between the application layer and the encrypting tape drives. Encryption is the result of interaction between the application and the encryption-enabled tape drive, and does not require any changes to the system and library layers. Since the application manages the encryption keys, volumes written and encrypted using the application method can only be read using the application-managed encryption method, by the same application that wrote them.

EKM is not required by, or used by, application-managed tape encryption.

Application-managed tape encryption on IBM TS1120 Tape Drives and LTO Ultrium 4 Tape Drives may use either of two encryption command sets, the IBM encryption command set developed for EKM, or the T10 command set defined by the InterNational Committee for Information Technology Standards (INCITS).

Application-managed tape encryption using the TS1120 Tape Drives is supported in the following IBM libraries:

- IBM System Storage TS3400 Tape Library
- IBM System Storage TS3500 Tape Library
- IBM TotalStorage 3494 Tape Library

Application-managed tape encryption using LTO Ultrium 4 Tape Drives is supported in the following IBM tape drives and libraries:

- IBM System Storage TS2340 Tape Drive Express Model S43 and via Xcc/HVEC 3580S4X
- IBM System Storage TS3100 Tape Library
- IBM System Storage TS3200 Tape Library
- IBM System Storage TS3310 Tape Library
- IBM System Storage TS3500 Tape Library

For details on setting up Application-Managed tape encryption, see your Tivoli Storage Manager documentation or visit http://publib.boulder.ibm.com/infocenter/tivihelp/v1r1/index.jsp for more information.

## System-Managed Tape Encryption

This method is best for encryption on TS1120 and LTO Ultrium 4 Tape Drives in Open Systems and System z operating environments if any of the applications that write or read from tape have not been updated to be capable of performing the key management required to do application-managed encryption.

### Open Systems

Encryption policies specifying when to use encryption are set up in the IBM tape device driver. System-managed tape encryption and library-managed tape encryption interoperate with one another. In other words, a tape encrypted using system-managed encryption may be decrypted using library-managed encryption, and vice versa, provided they both have access to the same keys and certificates. Otherwise, this may not be feasible.

For details on setting up system-managed encryption on tape drives in an AIX, Linux, Windows, or Solaris environment, see *IBM Tape Device Drivers Installation and User's Guide*, and the *Planning and Operator Guide* for your tape library.

### System z

Encryption policies specifying when to use encryption are set up in z/OS DFSMS™ (Data Facility Storage Management Subsystem) or implicitly through each instance of IBM device driver. Additional software products such as IBM Integrated Cryptographic Service Facility (ICSF) and IBM Resource Access Control Facility (RACF®) may also be used. Key generation and management is performed by the Encryption Key Manager (EKM), a Java application running on the host or externally on another host. Policy controls and keys pass through the data path between the system layer and the encrypting tape drives. Encryption is transparent to the applications.

For TS1120 Tape Drives connected to an IBM Virtualization Engine TS7700, encryption key labels are assigned on a per-storage pool basis using the TS7700 Maintenance Interface. DFSMS storage constructs are used by z/OS to control the use of storage pools for logical volumes, resulting in an indirect form of encryption policy management. For more information, see the white paper, *IBM Virtualization Engine TS7700 Series Encryption Overview,* available at http://www.ibm.com/support/docview.wss?&uid=ssg1S4000504.

For details on setting up system-managed encryption on TS1120 Tape Drive in a System z platform environment, see *z/OS DFSMS Software Support for IBM System Storage TS1120 Tape Drive (3592)*.

## Library-Managed Tape Encryption

This method is best for TS1120 Tape Drives and LTO Ultrium 4 Tape Drives in an open-attached IBM System Storage TS3100, TS3200, TS3310, TS3400 or TS3500 Tape Library. For TS3500, barcode encryption policies may be used to specify when to use encryption, and are set up through the IBM System Storage Tape Library Specialist Web interface. In such cases, policies are based on cartridge volume serial numbers. Library-managed encryption also allows other options, such as encryption of all volumes in a library, independent of bar codes. Key generation and management is performed by EKM, a Java application running on a library network-attached host. Policy control and keys pass through the library-to-drive interface, therefore encryption is transparent to the applications.

Library-managed encryption, when used with certain applications such as Symantec Netbackup, includes support for an *internal label option*. When the internal label option is configured, the TS1120 Tape Drive or LTO Ultrium 4 Tape Drive automatically derives the encryption policy and key information from the metadata written on the tape volume by the application. Refer to your *Tape Library Operator's Guide* for more information.

System-managed tape encryption and library-managed tape encryption interoperate with one another. In other words, a tape encrypted using system-managed encryption may be decrypted using library-managed encryption, and vice versa, provided they both have access to the same keys and certificates. Otherwise, this may not be feasible.

# About Encryption Keys

An encryption key is typically a random string of bits generated specifically to scramble and unscramble data. Encryption keys are created using algorithms designed to ensure that each key is unique and unpredictable. The longer the key constructed this way, the harder it is to break the encryption code. Both the IBM and T10 methods of encryption use 256-bit AES algorithm keys to encrypt data. 256-bit AES is the encryption standard currently recognized and recommended by the U.S. government, which allows three different key lengths. 256-bit keys are the longest allowed by AES.

Two types of encryption algorithms may be used by EKM: symmetric algorithms and asymmetric algorithms. Symmetric, or secret key encryption, uses a single key for both encryption and decryption. Symmetric key encryption is generally used for encrypting large amounts of data in an efficient manner. 256-bit AES keys are symmetric keys. Asymmetric, or public/private encryption, uses a pair of keys. Data encrypted using one key can only be decrypted using the other key in the public/private key pair. When an asymmetric key pair is generated, the public key is typically used to encrypt, and the private key is typically used to decrypt.

EKM uses both symmetric and asymmetric keys; symmetric encryption for high-speed encryption of user or host data, and asymmetric encryption (which is necessarily slower) for protecting the symmetric key.

Encryption keys may be generated by EKM, by applications such as TSM, or by a utility such as keytool. The responsibility for generating AES keys and the manner in which they are transferred to the tape drive depends on the tape drive type and the method of encryption management. However, it may be helpful to understand the difference between how EKM uses encryption keys and how other applications use them.

## How EKM Processes Encryption Keys

### On the TS1120 Tape Drive

In system-managed and library-managed tape encryption, unencrypted data (clear text) is sent to the TS1120 Tape Drive and converted to ciphertext using a symmetric 256-bit AES Data Key (DK) generated by EKM and is then written to tape. EKM uses a single, unique Data Key for each TS1120 tape cartridge. This Data Key is also encrypted, or wrapped, by EKM using the public key from an asymmetric Key Encrypting Key (KEK) pair. This process creates an Externally Encrypted Data Key (EEDK). The EEDK is written to the cartridge memory and to three additional places on the tape media in the cartridge. The tape cartridge now holds both the encrypted data and the means to decrypt it for anyone holding the private part of the KEK pair. Figure 54 on page 189 illustrates this process.

The DK is also wrapped a second time, possibly using the public key of another party, to create an additional EEDK. Both EEDKs can be stored on the tape cartridge. In this way, the tape cartridge can be shipped to a business partner holding the corresponding private key that would allow the DK to be unwrapped and the tape decrypted by the business partner.

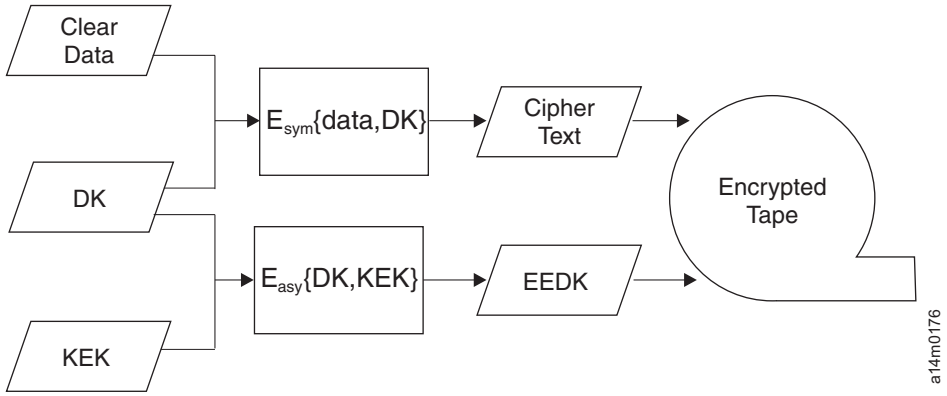



*Figure 54. Encryption Using both Symmetric and Asymmetric Encryption Keys.* System-Managed and Library-Managed Encryption on TS1120 Tape Drives

**On the LTO Ultrium 4 Tape Drive**

In system-managed and library-managed tape encryption, unencrypted data is sent to the LTO Ultrium 4 Tape Drive and converted to ciphertext using a pre-generated symmetric Data Key (DK) from a keystore available to EKM, and is then written to tape. EKM selects a pre-generated Data Key in round robin fashion. Data Keys are reused on multiple tape cartridges when an insufficient number of Data Keys have been pre-generated. The Data Key is sent to the LTO 4 tape drive in encrypted, or wrapped, form by EKM. The LTO 4 tape drive unwraps this Data Key and uses it to perform encryption or decryption. However, no wrapped key is stored anywhere on the LTO 4 tape cartridge. This is a major difference between the way TS1120 and LTO devices operate with EKM. Once the encrypted volume is written, the Data Key must be accessible based on the alias or key label, and available to EKM in order for the volume to be read. Figure 55 on page 190 illustrates this process.

EKM also gives you the ability to organize your symmetric keys for LTO encryption into key groups. In this way, you can group keys according to the type of data they encrypt, the users who have access to them, or by any other meaningful characteristic.

## Encryption Key Processing by Other Applications (EKM not Used)

**On TS1120 and LTO Ultrium 4 Tape Drives**

In application-managed tape encryption, unencrypted data is sent to the TS1120 or LTO Ultrium 4 Tape Drive and converted to ciphertext using a symmetric Data Key (DK) provided by the application, and is then written to tape. The Data Key is not stored anywhere on the tape cartridge. Once the encrypted volume is written, the Data Key must be in a location available to the application, a server database, for example, in order for the volume to be read.

TS1120 and LTO Ultrium 4 Tape Drives can use applications such as Tivoli Storage Manager for application-managed encryption. TSM uses a single, unique Data Key for each tape cartridge.

Alternatively, TS1120 and LTO Ultrium 4 Tape Drives can be used by applications that use the T10 command set to perform encryption. The T10 command set uses symmetric 256-bit AES keys provided by the application. T10 can use multiple,

unique Data Keys per tape cartridge, and even write encrypted data and clear data to the same tape cartridge. When the application encrypts a tape cartridge, it selects or generates a Data Key using a method determined by the application and sends it to the tape drive. The key is **not** wrapped with an asymmetric public key and it is **not** stored on the tape cartridge. Once the encrypted data is written to tape, the Data Key must be in a location available to the application in order for the data to be read.

The process for application-managed tape encryption (as well as system-managed and library-managed encryption on LTO) is shown in Figure 55.

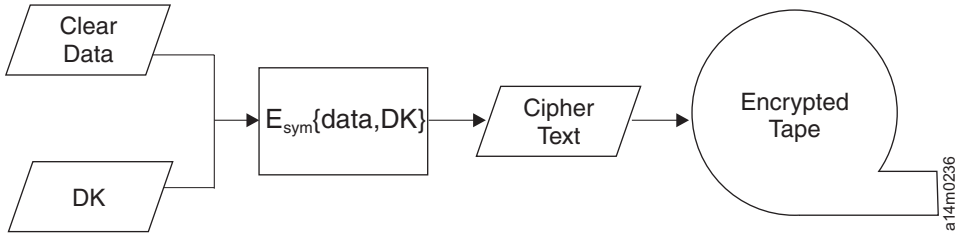



*Figure 55. Encryption Using only Symmetric Encryption Keys.* Application-Managed Encryption on TS1120 Tape Drives, and System-Managed, Library-Managed, and Application-Managed Encryption on LTO Ultrium 4 Tape Drives.

### In Summary

The number of encryption keys that may be used for each volume depends on the tape drive, the encryption standard, and method used to manage the encryption. For transparent encryption of LTO 4, (that is, using system-managed or library-managed encryption with EKM,) the uniqueness of Data Keys depends on the availability of a sufficient number of pre-generated keys to EKM.

*Table 55. Encryption Key Summary*

| Encryption Management Method | Keys used by | | |
|---|---|---|---|
| | **TS1120 (IBM Encryption)** | **LTO 4 (IBM Encryption)** | **TS1120/LTO 4 (T10 Encryption)** |
| System-Managed Encryption / Library-Managed Encryption (EKM) | 1 unique DK / cartridge | 1 DK / cartridge | N/A |
| Application-Managed Encryption (non-EKM) | 1 unique DK / cartridge | 1 DK / cartridge | Multiple DKs / cartridge |
| DK = Symmetric AES 256-bit Data Key | | | |

## Example of Encryption Setup Tasks at a Glance for TS1120 Tape Drives

Before you can use the encryption capability of the TS1120 Tape Drive, you must be sure that certain software and hardware requirements are met. The following checklists are intended to help you meet these requirements.

**Note:** Please contact your IBM Representative for additional information about encryption on the TS1120 Tape Drive.

## Planning for Application-Managed Tape Encryption

In order to perform encryption the following is required:

- Encryption-capable TS1120 or LTO Ultrium 4 Tape Drive(s)

### Application-Managed Tape Encryption Setup Tasks

Any task not identified as an IBM service task is the responsibility of the customer.

1. Install and cable the TS1120 Tape Drive (IBM service task) or LTO Ultrium 4 Tape Drive.
   - Update library firmware (3494, TS3500 where applicable)
   - Update tape drive firmware (all tape drives in same library or environment)
2. Encryption-enable the TS1120 (3592 E05) or LTO Ultrium 4 Tape Drive. Refer to *IBM System Storage TS3500 Operator's Guide* for configuring TS1120 or LTO Ultrium 4 Tape Drive on TS3500. For TS1120 Tape Drives on all others, this is an IBM service task.
3. Install appropriate IBM tape device driver level (Atape, for example) where required by application.
4. Set up encryption policies. Refer to *IBM Tivoli Storage Manager for AIX Administrator's Guide* .
5. Perform write/read operation to test encryption.
6. Verify encryption of the test volume by Autonomic Management Engine (AME): issue

   ```
   QUERY VOLUME FORMAT=DETAILED
   ```

   Verify that `Drive Encryption Key Manager` is set to `Tivoli Storage Manager`.

## Planning for System-Managed Tape Encryption

In order to perform system-managed encryption the following is required:

- Encryption-capable TS1120 or LTO Ultrium 4 Tape Drive(s).
- Key(s) and corresponding certificates.
- IBM Encryption Key Manager component for the Java platform (EKM).
- Routers and cables for out-of-band EKM-to-TS1120 Tape Drive path (System z platforms only).

### Setup Tasks for System-Managed Tape Encryption on IBM System z Platforms

Any task not identified as an IBM service task is the responsibility of the customer.

1. Install and cable the TS1120 Tape Drive (IBM service task).
   - Update tape drive firmware (3592 Models E05, J1A in same environment)
   - Update 3494, TS3500, and 3953 tape system library firmware (System z platforms or 3953 in heterogeneous environment)
   - Update 3592 Models C06, J70 Tape Controller firmware (System z platforms or tape controllers in heterogeneous environment) (optional)
   - Update TS7700 Virtualization Engine microcode.
2. Encryption-enable the TS1120 (3592 E05) Tape Drive. Refer to *IBM System Storage TS3500 Operator's Guide* for configuring TS1120 Tape Drive on TS3500. For TS7700-attached drives, specify the system-managed encryption method. For all others, this is an IBM service task.
3. Install tape controller code update, Feature Code 5595 (IBM service task).

4. Install, cable, and configure routers to EKM, Feature Code 5593 (for out-of-band path to EKM only) (IBM service task).
   - Define Primary/Secondary EKM IP ports for the tape controller.
5. Update z/OS and DFSMS host software with appropriate PTFs.
6. Install Feature Code 9900 License Key on TS7700.
7. Set up encryption policies.
   - Update DFSMS Data Class to specify encryption (recording format EE2) and other optional parameters (media type, performance scaling, etc.) as appropriate.
   - Specify the key labels through the DD statement, data class or EKM defaults.
   - Update other DFSMS polices (as appropriate) to steer allocation to correct library.
   - Encryption on the TS7700 VE is controlled on a storage pool basis. Use the Maintenance Interface (MI) web interface for the TS7700 VE "Pool Encryption Settings" panel (in the "Configuration" group) to specify the key labels and modes to use for each storage pool.

   Refer to *IBM z/OS DFSMS Software Support for IBM System Storage TS1120 Tape Drive (3592)*.
8. For in-band key management use the IECIOSxx PARMLIB member or **SETIOS** command to define Primary/Secondary EKM. Also define the IOSAS OMVS segment to RACF.
9. Make the appropriate HCD changes.
10. Determine if coexistence support is needed.
11. Contact your tape management system or application vendor for any required code changes and any installation exit changes that are needed.
12. Set up the system-managed encryption method. For 3494 or stand-alone drives, have the your IBM service representative update the drives. For TS3500, update using the IBM System Storage Tape Library Specialist.
13. Schedule an IPL
14. Verify encryption:

    For in-band path to EKM:

    a. Use the `DISPLAY IOS,EKM` command (with the VERIFY option) to verify the in-band path to EKM.
    b. Verify that a job (or application) requesting encryption (through data class) has its data encrypted.

    For out-of-band path to EKM:

    a. Use RAS functions to verify (IBM service task) EKM paths and encryption configuration.

## Setup Tasks for System-Managed Tape Encryption on Open Systems Platforms

Any task not identified as an IBM service task is the responsibility of the customer.

1. Install and cable the TS1120 Tape Drive (IBM service task) or LTO Ultrium 4 Tape Drive.
   - Update tape drive firmware (all tape drives in same environment)
   - Update 3494 and TS3500 Tape Library firmware, where applicable
   - For LTO Ultrium 4 Tape Drives, install Feature Code 1604 (IBM service task).

2. Encryption-enable the TS1120 (3592 E05) or LTO Ultrium 4 Tape Drive. Refer to *IBM System Storage TS3500 Operator's Guide* for configuring TS1120 or LTO Ultrium 4 Tape Drive on TS3500. For TS1120 Tape Drives on all others, this is an IBM service task.
3. Update the device driver.
4. Update the EKM Proxy Config file with EKM IP Addresses.
5. Update device attributes
   - Use System Encryption FCP Proxy Manager.
   - System Encryption for Write Commands at BOP.

   Refer to *IBM Tape Device Drivers Installation and User's Guide*
6. Use tapeutil functions to verify EKM paths and encryption configuration.

# Planning for Library-Managed Tape Encryption

In order to perform encryption the following is required:

- Encryption-capable TS1120 or LTO Ultrium 4 Tape Drive(s)
- Keystore
- IBM Encryption Key Manager component for the Java platform (EKM)

## Library-Managed Tape Encryption Tasks

Any task not identified as an IBM service task is the responsibility of the customer.

1. Install and cable the TS1120 Tape Drive (IBM service task) or LTO Ultrium 4 Tape Drive.
   - Update tape system library firmware ( TS3500)
   - Update tape drive firmware (all tape drives in same library)
   - For TS1120 Tape Drives in TS3500, order Feature Code 9900 for Encryption Configuration (IBM service task)
   - For LTO Ultrium 4 Tape Drives, install Feature Code 1604 for Transparent LTO Encryption (IBM service task).
2. Use IBM System Storage Tape Library Specialist to enable TS1120 or LTO Ultrium 4 Tape Drive and 3494 or TS3500 Tape Library for library-managed tape encryption (refer to appropriate tape library operator guide.)
   - Add EKM IP addresses
   - Specify key label
   - Set up scratch encryption policy
3. Set up key mapping for ILEP (optional)
4. Use library diagnostic functions to verify EKM paths and encryption configuration.

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# Glossary

This glossary defines the special terms, abbreviations, and acronyms that are used in this publication.

## Numbers

**2:1 or 3:1 compression.** The relationship between the quantity of data that can be stored with compression as compared to the quantity of data that can be stored without compression. In 2:1 compression, twice as much data can be stored with compression as can be stored without compression. In 3:1 compression, three times as much data can be stored with compression as can be stored without compression.

**2N.** Twice the amount of a system's electrical power load. If the system has 2N power supplies, then there are two power supplies available for every load, which means greater redundancy and availability of electrical power. The Enhanced Frame Control Assembly of the 3584 Tape Library offers a 2N power design with no single point of failure or single point of repair.

**3584 Tape Library.** See *IBM System Storage TS3500 Tape Library*.

**3588 Tape Drive.** See *IBM System Storage 3588 Tape Drive Model F3A* or *IBM System Storage TS1030 Tape Drive Model F3B*. Also known as the *Ultrium 3 Tape Drive*.

**3592 Tape Controller Model J70.** See *IBM TotalStorage 3592 Tape Controller Model J70*.

**3592 Tape Drive.** See *IBM TotalStorage 3592 Tape Drive Model J1A* or *IBM System Storage TS1120 Tape Drive*.

**3593 Tape System.** The IBM 3953 Tape Frame Model F05 and the IBM 3953 Library Manager Model L05.

## A

**A.** Ampere.

**AAP.** See *authorized assembler program*.

**ac.** See *alternating current*.

**accessor controller.** The logic card for the cartridge accessor. The accessor controller handles accessor motion requests, including calibrations, moves, and inventory updates. It also provides centralized management for other aspects of the entire library, including configuration, insert and eject operations, automatic drive cleaning, and determination of element status.

**ac line voltage.** The input voltage (in volts) that is required by the 3584 Tape Library for normal operation.

**Activity screen.** The primary screen on the touchscreen of the 3584 Tape Library. The Activity screen gives the level of firmware in the library, shows whether the library is ready, not ready, or initializing, and tells the quantity of tape cartridges currently in the I/O stations. The screen also indicates the current activity being performed, the volume serial (VOLSER) number of the cartridge associated with the activity, and a history of previous activities. The Activity screen leads to the Main Menu.

**adapter.** See *adapter card*.

**adapter card.** A circuit board that adds function to a computer.

**addressable cartridge storage slots.** Within the 3584 Tape Library, units that can contain tape cartridges and that are recognizable to the library by both a physical address (such as F01-C05-R19) and a SCSI element (logical) address (such as 1112(X'458'). Addressable cartridge storage slots do not include I/O station slots or the non-addressable slots that are reserved for the diagnostic cartridges. The quantity of addressable

cartridge storage slots per frame varies, depending on the quantity of drives that are installed in the frame.

**Advanced Interactive eXecutive (AIX).** A UNIX operating system developed by IBM that is designed and optimized to run on POWER™ microprocessor-based hardware such as servers, workstations, and blades.

**Advanced Library Management System (ALMS).** The next generation of IBM's patented Multi-Path Architecture. ALMS enables logical libraries to consist of unique drives and ranges of VOLSERs, instead of fixed locations. It offers the ability to assign tape drives to any logical library by using the IBM System Storage Tape Library Specialist web interface. Logical libraries can also be added, deleted, or easily changed without disruption. ALMS is optional and requires a license key.

**aggregate sustained data transfer rate.** For all of the drives in the 3584 Tape Library, the sum of their average throughput of uninterrupted data.

**AIX.** See *Advanced Interactive eXecutive*.

**AL_PA.** See *Arbitrated Loop Physical Address*.

**alphanumeric.** Pertaining to a character set that contains letters, numerals, and usually other characters, such as punctuation marks.

**alternating current (ac).** An electric current that reverses its direction at regularly recurring intervals.

**amp.** Ampere.

**ampere (A, amp).** A unit of measure for electric current that is equivalent to a flow of one coulomb per second, or to the current produced by one volt applied across a resistance of one ohm.

**Arbitrated Loop Physical Address (AL_PA).** An 8-bit value used to identify a device in an arbitrated loop. Device ports communicate by using AL_PAs.

**authorized assembler program (AAP).** A training program for selected IBM Business Partners that enables them to purchase incomplete machines and parts, and provides them with the knowledge to assemble the components into a final configured product for sale to customers.

**automatic cleaning.** A method by which the 3584 Tape Library automatically responds to any tape drive's request for cleaning by beginning the cleaning process. An operator enables or disables automatic cleaning by using the menus on the library's touchscreen or the IBM System Storage Tape Library Specialist web interface.

**automatic inventory.** A survey of the location of cartridges in the 3584 Tape Library. The library performs the survey at power-on or whenever the front door of any frame is opened and closed during operation.

# B

**backhitch.** When the speed of the host server is slower than that of the drive, the action of stopping the tape, rewinding some distance, and restarting.

**backup.** The short-term retention of records used for restoring essential business and system files when vital data has been lost because of program or system errors or malfunctions.

**Backup Recovery and Media Services (BRMS).** A software program that runs on OS/400 and allows a business to plan, control, and automate the backup, recovery, and media management services for its AS/400 systems.

**bar code.** A code that represents characters by sets of parallel bars of varying thickness and separation. The bars are read optically by transverse scanning.

**bar code label.** A slip of paper bearing a bar code and having an adhesive backing. The bar code label must be affixed to a tape cartridge to enable the library to identify the cartridge and its volume serial number.

**bar code reader.** Located on the dual-gripper transport mechanism of the 3584 Tape Library, a laser device specialized for scanning and reading bar codes and converting them into either the ASCII or EBCDIC digital character code. The bar code reader reads the bar code on the labels of cartridges or at the rear of empty storage slots.

**base frame.** The primary unit of the 3584 Tape Library (also known as Models L22, L23, L32, L52, or L53). The base frame is distinguished from an expansion frame by its I/O stations and operator panel. The base frame includes a rail assembly for the cartridge accessor, and up to 12 tape drives.

**bel.** Ten decibels.

**bit.** Either of the digits 0 or 1 when used in the binary numbering system.

**bpi.** Bits per inch.

**bridge.** A storage controller that forms a bridge between two external I/O buses.

**British thermal unit (Btu).** The quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit at a specified temperature.

**browser.** A client program that initiates requests to a web server and displays the information that the server returns.

**BRSM.** See *Backup Recovery and Media Services*.

**Btu.** See *British thermal unit*.

**bulk load.** To manually insert large quantities of tape cartridges into a tape library's empty storage slots.

**bus.** See *SCSI bus*.

**byte.** A string consisting of a certain number of bits (usually 8) that are treated as a unit and represent a character. A byte is a fundamental data unit.

# C

**calibration.** Adjustment, tuning.

**calibration sensor.** Located on the cartridge accessor of the 3584 Tape Library, the component that provides the means to find certain positions within the library very precisely during the calibration operation.

**Call Home.** A feature that allows the 3584 Tape Library to report failures to a support center by using a modem.

**capacity.** See *media capacity*.

**Capacity Expansion Feature.** Applicable only to the base frame (Models L22, L23, L32, L52, or L53) of the 3584 Tape Library, the cartridge storage slots that are located on the interior of the front door and enabled for additional storage. The Capacity Expansion Feature increases the maximum quantity of storage slots in the base frame.

**Capacity On Demand.** Applicable only to Models L22, L23, L52, and L53, a feature that adds capacity to the library and that is only available through the field.

**cartridge.** See *tape cartridge*.

**cartridge accessor.** The mechanism in the 3584 Tape Library that moves cartridges between the storage slots, tape drives, and the I/O stations. The accessor includes the X-axis motion assembly, Y-axis motion assembly, pivot assembly, cartridge gripper, bar code reader, and calibration sensor.

**cartridge gripper.** An electromechanical device on the cartridge accessor of the 3584 Tape Library that gets or puts cartridges from or to a storage slot, tape drive, or I/O station. Two grippers (Gripper 1 and Gripper 2) are located on the pivot assembly of the accessor. One gripper can grip a single cartridge.

**cartridge inventory time.** The amount of time required for the 3584 Tape Library to determine whether each cartridge storage slot in the library is empty or full.

**cartridge manual rewind tool.** A device that can be fitted into the reel of a cartridge and used to rewind tape into or out of the cartridge.

**cartridge memory.** See *LTO cartridge memory*.

**cartridge move time.** The time required for a cartridge accessor to pick a cartridge from a slot (or drive), move the cartridge to a drive (or slot), pivot (if required), and insert the cartridge into the drive (or slot).

**cartridge storage slot.** One of several containers that are mounted inside the frames of the 3584 Tape Library and are used to store tape cartridges.

**caster.** One of four wheels that are mounted in swivel frames and used to support the weight of the 3584 Tape Library.

**CETool.** CETool is a software program that is used by IBM Service personnel (also known as customer engineers or CEs) to update library and drive firmware, configure the Call Home program for the 3584 Tape Library, collect library and drive logs, backup and restore the configuration for non-volatile random access memory (NVRAM), and perform other service-related tasks.

**cell top cap.** Located on each column of storage slots within the 3584 Tape Library, a plastic component to which a bar code label holder can be attached. The library uses the bar code label to establish the boundary of a logical library.

**circuit board.** A thin plate on which chips and other electronic components are placed. Computers consist of one or more boards, often called cards or adapters.

**cleaning cartridge.** A tape cartridge that is used to clean the heads of a tape drive. Contrast with *data cartridge*.

**clearance.** The distance by which one object clears another or the clear space between them.

**compression.** The process of eliminating gaps, empty fields, redundancies, and unnecessary data to shorten the length of records or blocks.

**configure.** To describe to a system the devices, optional features, and programs installed on the system.

**controller.** A device that coordinates and controls the operation of one or more input/output devices (such as sensors and actuators), and synchronizes the operation of such devices with the operation of the system as a whole.

**control path.** (1) Designated by the operator of the 3584 Tape Library, a logical path into the library through which a server sends standard SCSI Medium Changer commands to control a specific logical library.

(2) A tape drive that is designated by the operator of the 3584 Tape Library to manage communication to and from a server and the library.

**control path failover.** In the event of a command failure, an optional feature of the 3584 Tape Library that enables the host device driver to resend the command to an alternate control path for the same logical library. The device driver initiates error recovery and continues the operation on the alternate control path without interrupting the application.

**current.** The quantity of charge per unit of time. Measured in amperes (amps, A).

# D

**daisy-chain.** To serially interconnect a series of SCSI connectors for multiple devices on the SCSI bus.

**data.** Any representations such as characters or analog quantities to which meaning is, or might be, assigned.

**data cartridge.** A tape cartridge dedicated to storing data. Contrast with *cleaning cartridge*.

**data compression.** See *compression*.

**Data Facility Storage Management Subsystem (DFSMS).** An operating environment that helps automate and centralize the management of storage. To manage storage, DFSMS provides the storage administrator with control over data class, storage class, management class, storage group, and automatic class selection routine definitions.

**data transfer element (DTE).** In SCSI terms, a tape drive.

**data transfer element (DTE) address.** In SCSI terms, the physical location of a tape drive.

**data transfer rate.** The average number of bits, characters, or blocks per unit of time that pass between corresponding equipment in a data transmission system. The rate is expressed in bits, characters, or blocks per second, minute, or hour.

**dB.** Decibel.

**decibel.** A unit of measure that expresses the ratio of two amounts of electric or acoustic signal power that is equal to 10 times the common logarithm of this ratio.

**decrypt.** (1) To decipher data. (2) In Cryptographic Support, to convert ciphertext into plaintext. See also *encrypt*.

**dc.** Direct current.

**degauss.** To make a magnetic tape nonmagnetic by means of electrical coils carrying currents that neutralize the magnetism of the tape.

**degausser.** A device that makes magnetic tape nonmagnetic.

**device.** Any hardware component or peripheral, such as a tape drive or tape library, that can receive and send data.

**device driver.** A file that contains the code needed to use an attached device.

**DFSMS.** See *Data Facility Storage Management Subsystem*.

**differential.** See *High Voltage Differential*.

**diagnostic cartridge.** A tape cartridge that enables the detection and isolation of errors in programs and faults in equipment.

**differential.** See *High Voltage Differential*.

**disable.** To make nonfunctional.

**door safety switch.** Located on each frame of the 3584 Tape Library, a mechanism that automatically turns off the power to the cartridge accessor whenever you open the front door.

**drive.** See *IBM TotalStorage LTO Ultrium 1 Tape Drive*, *IBM TotalStorage LTO Ultrium 2 Tape Drive*, *IBM System Storage 3588 Tape Drive Model F3A*, *IBM System Storage TS1030 Tape Drive Model F3B*, *IBM System Storage TS1120 Tape Drive* or *IBM TotalStorage 3592 Tape Drive Model J1A*.

**drive head.** The component that records an electrical signal onto magnetic tape, or reads a signal from tape into an electrical signal.

**DTE.** See *data transfer element*.

**dual-gripper transport mechanism.** Located on the cartridge accessor of the 3584 Tape Library and mounted on the pivot assembly, the device that contains the two grippers which get and put cartridges into storage slots, drives, or the I/O stations.

# E

**eject.** To remove or force out from within.

**EKM.** See *enterprise key manager*.

**electronic mail.** Correspondence in the form of messages transmitted between user terminals over a computer network.

**element address.** The SCSI term for the host's view of a cartridge location.

**e-mail.** See *electronic mail*.

**enable.** To make functional.

**encrypt.** In Cryptographic Support, to systematically scramble information so that it cannot be read without knowing the coding key. See also *decrypt*.

**encryption.** The conversion of data into a cipher. A key is required to encrypt and decrypt the data. Encryption provides protection from persons or software that attempt to access the data without the key.

**encryption key manager (EKM).** A Java software program that assists IBM-encrypting tape drives in generating, protecting, storing, and maintaining encryption keys, which encrypt information written to and decrypt information read from tape media.

**error-recovery procedures (ERP).** Procedures designed to help isolate and, where possible, to recover from errors in equipment. The procedures are often used with programs that record the statistics of machine malfunctions.

**Ethernet.** A 10-Mbps baseband local area network that allows multiple stations to access the transmission medium at will without prior coordination, avoids contention by using carrier sense and deference, and resolves contention by using collision detection and delayed retransmission.

**Expanded I/O Station.** On the front door of the 3584 Tape Library, the lower compartment into which you insert and remove cartridges into and from the library. Both stations are accessed by the cartridge accessor.

**expansion frame.** A unit that may be added to the base frame of the 3584 Tape Library. Also known as the Model D22, D23, D32, D52, or D53, the expansion frame includes a rail assembly for the cartridge accessor and up to 12 tape drives.

# F

**FCA.** See *frame control assembly*.

**FCB.** Frame control box. See *frame control assembly*.

**Fibre Channel.** A high-speed, full-duplex, serial communications technology that is capable of interconnecting Ultrium Tape Drives and 3592 Tape Drives to servers which are separated by as much as 11 kilometers (7 miles). Fibre Channel technology combines features of the input/output (I/O) and networking interfaces.

**Fibre Channel address.** For a tape drive that uses a Fibre Channel interface, an identifier (such as an AL_PA or Loop ID) that enables other device ports to communicate with that drive.

**Fibre Channel cable.** The cable that connects a Fibre Channel tape drive to another device. The conductive element within the cable is constructed of either copper wires or optical fibers. Generally, copper wires are used for short distances (up to 30 meters or 98 feet); optical fibers are used for longer distances. Fiber-optic cabling is referred to by mode or the frequencies of light waves that are carried by a particular cable type. Multi-mode fiber cables are generally used for distances up to 500 meters (1640 feet) and with short-wave (780 nanometer) laser light. Single-mode fiber cables are used for distances greater than 500 m (1640 feet) and with long-wave (1300 nanometer) laser light.

**fiber optics.** A branch of optics dealing with the transmission of light through fibers or thin rods of glass or some other transparent material of high refractive index.

**file.** A named set of records stored or processed as a unit.

**file transfer protocol (FTP).** In the Internet suite of protocols, an application layer protocol that uses TCP and Telnet services to transfer bulk-data files between machines or hosts.

**firmware.** Proprietary code that is usually delivered as part of an operating system. Firmware is more efficient than software loaded from an alterable medium and is more adaptable to change than pure hardware circuitry. An example of firmware is the Basic Input/Output System (BIOS) in read-only memory (ROM) on a PC motherboard.

**frame.** (1) In Fibre Channel technology, a unit of transmission that includes delimiters, control characters, information, and checking characters. (2) See *library frame*.

**frame control assembly (FCA).** The power structure for Models L22, D22, L32, D32, L52, and D52. The assembly is a group of parts that consists of a frame control box (FCB), one or two 37 V power supplies for the cartridge accessor, operator panel, and I/O stations, and an MCC card pack that runs the firmware that controls the ac and dc power distribution in the 3584 Tape Library. The assembly also provides an RS-422 communication port to each tape drive in a frame. The FCB contains 3 circuit protectors, 10 ac outlets for powering the tape drives and all other components in that frame, and a receptacle for the incoming main ac power.

**front door.** Located at the front of each frame in the 3584 Tape Library, the swinging barrier by which entry is closed or opened to the frame.

**FTP site.** Any electronic repository of information that uses the File Transfer Protocol (FTP) for transferring files to and from servers. Use of an FTP site requires a user ID and possibly a password.

**full capacity expansion.** A feature that increases the initial capacity of Model L22, L23, L52, and L53 frames. Models L22 and L23 increase from 58 to 199 or 260

cartridge slots for 3592 Tape Cartridges. Models L52 and L53 increase from 64 to 219 or 287 cartridge slots for LTO Ultrium Tape Cartridges.

**full duplex.** Simultaneous transmission and reception of data between two nodes of a network.

# G

**GB.** See *gigabyte*.

**Gb.** See *gigabit*.

**Gbps.** Gigabits per second. One gigabit equals 1 000 000 000 bits.

**get.** (1) In library operation, the act of a cartridge gripper retrieving a tape cartridge from a storage slot, drive, or I/O station. (2) In Simple Network Management Protocol (SNMP), a request for information about the library that the operator issues through a monitoring server and which is transmitted by SNMP.

**get-response.** The information that is provided in response to an SNMP get.

**gigabit (Gb).** 1 000 000 000 bits.

**gigabyte (GB).** 1 000 000 000 bytes.

# H

**HACMP™.** See *High Availability Clustered Multiprocessing*.

**HBA.** See *host bus adapter*.

**head.** See *drive head*.

**heat output.** The amount of heat (in kBtu/hr) that the 3584 Tape Library dissipates during normal operation.

**hertz (Hz).** A unit of frequency equal to cycle per second.

**heterogeneous.** Of unlike kind.

**hex, hexadecimal.** (1) Pertaining to a selection, choice, or condition that has 16 possible different values or states. (2) Pertaining to a fixed-radix numeration system, with radix of 16. (3) Pertaining to a system of numbers to the base 16; hexadecimal digits range from 0 through 9 and A through F, where A represents 10 and F represents 15.

**High Availability Clustered Multiprocessing (HACMP).** An IBM AIX solution that automatically detects system or network failures and eliminates a single point of failure by managing failover to a recovery processor. High availability clustering refers to the linking of two or more computers, one of which can provide operation if the other one fails.

**High Voltage Differential (HVD).** A logic signaling system that enables data communication between a supported server and the 3584 Tape Library. HVD signaling uses a paired plus and minus signal level to reduce the effects of noise on the SCSI bus. Any noise injected into the signal is present in both a plus and minus state, and is thereby canceled. Synonymous with *differential*.

**homogeneous.** Of the same kind.

**host.** The controlling or highest-level system in a data communication configuration. Synonymous with *server*.

**host bus adapter (HBA).** An adapter that provides I/O processing and physical connectivity between a server and storage.

**host cleaning.** A method that enables the host (server) to detect the need to clean a tape drive and to control the cleaning process. Host cleaning with a cleaning cartridge is only supported when automatic cleaning is disabled, and only for the logical library in which each cleaning cartridge is stored.

**HTTP.** See *Hyper Text Transfer Protocol*.

**hub.** A communications device to which nodes on a multi-point bus or loop are physically connected. Hubs are commonly used in Fibre Channel networks to improve the manageability of physical cables. They maintain the logical loop topology of the network of which they are a part, while creating a "hub and spoke" physical star layout. Unlike switches, hubs do not aggregate bandwidth. They typically support the addition or removal of nodes from the bus while it is operating.

**HVD.** See *High Voltage Differential*.

**Hyper Text Transfer Protocol (HTTP).** The primary Internet protocol that is used to connect to most web servers. HTTP delivers content for web pages or downloads files.

**Hz.** Hertz.

# I

**IBM System Storage 3588 Tape Drive Model F3A.** A data-storage device that controls the movement of the magnetic tape in an IBM LTO Ultrium Tape Cartridge. The drive houses the mechanism (drive head) that reads and writes data to the tape. Its native data capacity is 400® GB per cartridge; with 2:1 compression, its capacity is up to 800 GB. The Model F3A drive provides 2 Gbps Fibre Channel connectivity. Also known as the Ultrium 3 Tape Drive.

**IBM System Storage Tape Library Specialist web interface.** A platform-independent, web-based interface that allows a user to configure and monitor the 3584 Tape Library from a remote location.

**IBM System Storage TS1030 Tape Drive Model F3B.** A data-storage device that controls the movement of the magnetic tape in an IBM LTO Ultrium Tape Cartridge. The drive houses the mechanism (drive head) that reads and writes data to the tape. Its native data capacity is 400 GB per cartridge; with 2:1 compression, its capacity is up to 800 GB. The Model F3B drive provides 4 Gbps Fibre Channel connectivity. Also known as the Ultrium 3 Tape Drive.

**IBM System Storage TS1120 Tape Drive.** Located within the 3584 Tape Library, a high-performance, high-capacity streaming cartridge tape product designed for efficient back-up for mid-range and high-end computing systems. The drive houses the mechanism (drive head) that reads and writes data to the tape. When the media is formatted for a J1A format, the drive's native data capacity is 300 GB and its data rate is 40 MB/s; with 3:1 compression, its capacity is 900 GB. When the media is formatted for a E05 format, the drive's native data capacity is 500 GB and its data rate is 100 MB/s; with 3:1 compression, its capacity is 1.5 TB. Formerly known as the IBM TotalStorage 3592 Tape Drive Model E05.

**IBM System Storage TS3500 Tape Library.** Formerly known as the IBM TotalStorage 3584 Tape Library, a device that can be attached to one or more supported servers and used to write data to and from magnetic tape. The library, also known as the 3584 Tape Library, can include up to 16 frames and 192 drives, and any combination of Ultrium 3, Ultrium 2, and Ultrium 1 Tape Drives in Ultrium frames, and 3592 Tape Drives in 3592 frames.

**IBM TotalStorage 3592 Tape Drive Model J1A.** Located within the 3584 Tape Library, high-performance, high-capacity streaming cartridge tape product designed for efficient back-up for mid-range and high-end computing systems. The drive houses the mechanism (drive head) that reads and writes data to the tape. Its native data capacity is 300 GB; with 3:1 compression, its capacity is 900 GB. The drive has a native data rate of 40 MB/s (80 MB/s at 2:1 compression).

**IBM TotalStorage 3592 Tape Controller Model J70.** Located in the Tape Frame Model F05, a device that links the IBM eServer zSeries server (mainframe host), the L05 Library Manager, and the 3592 Tape Drives in the 3584 Tape Library.

**IBM TotalStorage LTO Ultrium 1, 2, 3, and 4 Tape Drives.** Located within the 3584 Tape Library, a data-storage device that controls the movement of the magnetic tape in an IBM LTO Ultrium Tape Cartridge (Ultrium 1). The drive houses the mechanism (drive head) that reads and writes data to the tape. Native data capacities are:

- Ultrium 1: native data capacity is 100 GB per cartridge; with 2:1 compression, its capacity is up to 200 GB. The drive is also known as the IBM Ultrium Internal Tape Drive.
- Ultrium 2: native data capacity is 200 GB per cartridge; with 2:1 compression, its capacity is up to 400 GB.
- Ultrium 3: native data capacity is 400 GB per cartridge; with 2:1 compression, its capacity is up to 800 GB.
- Ultrium 4: native data capacity is 800 GB per cartridge; with 2:1 compression, its capacity is up to 1600 GB.

**IBM TotalStorage Productivity Center (TPC).** A software solution that manages storage infrastructures in Open Systems environments.

**ID.** Identifier.

**IEE.** See *import/export element*.

**IEEA.** See *import/export element address*.

**IEEE.** Institute of Electrical and Electronics Engineers.

**import/export element (IEE).** In SCSI terms, an I/O slot.

**import/export element address (IEEA).** In SCSI terms, the location of an I/O slot.

**independent software vendor (ISV).** A company that makes and sells software products that run on one or more computer hardware or operating system platforms.

**initial program load (IPL).** (1) The initialization procedure that causes an operating system to commence operation. (2) The process by which a configuration image is loaded into storage at the beginning of a work day or after a system malfunction. (3) The process of loading system programs and preparing a system to run jobs.

**initialize.** To format a magnetic tape, write a label (VOLSER) on the tape, and leave the tape empty except for the system files containing the structure information. All former contents of the tape are lost.

**initializing.** The act of performing an inventory on the 3584 Tape Library.

**initiator.** In SCSI terms, a SCSI device that requests an I/O process to be performed by another SCSI device (a target). In many cases, an initiator can also be a target.

**input/output (I/O) station.** On the front door of the 3584 Tape Library, one or two compartments into which

you insert and remove cartridges into and from the library. Both stations are accessed by the cartridge accessor.

**inrush current.** The momentary peak current (in amperes) into the 3584 Tape Library when the ac line voltage is first applied.

**insert.** Pertaining to the 3584 Tape Library, a term used to describe the act of putting a tape cartridge into an I/O station.

**install.** (1) To set up for use or service. (2) The act of adding a product, feature, or function to a system or device either by a singular change or by the addition of multiple components or devices.

**interchange.** The ability to process (read or write) given tape data on any one of a set of tape devices that support the form factor and recording format of the tape data.

**interchange application.** The preparation of tapes for use on other systems or devices, either local or remote, or the use of tape data prepared by another system.

**intermediate capacity expansion.** A feature that increases the initial capacity of Model L22, L23, L52, and L53 frames. Models L22 and L23 increase from 58 to 117 cartridge slots for 3592 Tape Cartridges. Models L52 and L53 increase from 64 to 129 cartridge slots for LTO Ultrium Tape Cartridges.

**Internet.** The worldwide collection of interconnected networks that use the Internet suite of protocols and permit public access.

**interposer.** An adapter-like device that allows a connector of one size and style to connect to a mating connector of a different size and style.

**inventory.** (1) A survey of tape cartridges in the library and frames. (2) To make an inventory of.

**I/O station.** See *input/output station*.

**IPL.** Initial program load.

**ISV.** See *independent software vendor*.

# K

**kBtu.** KiloBtu.

**key label.** An alias to a encryption key (cipher) used by the encryption key manager.

**key manager.** In cryptography, a software application that manages one or more secret encryption keys.

**key manager address.** In cryptography, the IP address of an encryption key manager.

**keystore.** A database of private keys and their associated digital certificate chains used to authenticate the corresponding public keys.

**KiloBtu.** 1000 Btu's.

**KiloVolt.** 1000 volts.

**KiloWatt.** 1000 watts.

**kVA.** KiloVolt.

**kW.** KiloWatt.

# L

**label.** See *bar code label*.

**label area.** On the LTO Ultrium Tape Cartridge or 3592 Tape Cartridge, a recessed area next to the write-protect switch where a bar code label must be affixed.

**LAN.** See *local area network*.

**LCD.** See *liquid crystal display*.

**leader pin.** On the LTO Ultrium Tape Cartridge and 3592 Tape Cartridge, a small metal column attached to the end of the magnetic tape. During tape processing the leader pin is grasped by a threading mechanism, which pulls the pin and the tape out of the cartridge, across the drive head, and onto a takeup reel. The head can then read or write data from or to the tape.

**leveling jackscrews.** Located on the bottom the 3584 Tape Library, one of four screw-operated jacks for raising or lowering the library.

**library frame.** The basic unit of the 3584 Tape Library. The frame includes the hardware support structure, covers, mechanisms, and parts. Two types of frames are available: base frame (Models L22, L23, L32, L52, or L53) and expansion frame (Models D22, D23, D32, D52, or D53).

**Library Manager.** See *IBM 3953 Library Manager Model L05*.

**library power switch.** Located on the front of the 3584 Tape Library, a toggle switch that enables you to turn the power to the library on and off.

**license key.** A password or table that is needed to decipher encoded data.

**Linear Tape-Open (LTO).** A type of tape storage technology developed by the IBM Corporation, Hewlett-Packard, and Certance. LTO technology is an "open format" technology, which means that its users have multiple sources of product and media. The "open" nature of LTO technology enables compatibility between different vendors' offerings by ensuring that

vendors comply with verification standards. The LTO technology is implemented in two formats: the Accelis format focuses on fast access; the Ultrium format focuses on high capacity. The Ultrium format is the preferred format when capacity (rather than fast access) is the key storage consideration. An Ultrium cartridge has a compressed data capacity of up to 800 GB (at 2:1 compression) and a native data capacity of up to 400 GB. The Ultrium format is designed with a four-generation road map that provides for up to 1.6 TB per cartridge (2:1 compression) in Generation 4 and a compressed transfer rate of up to 320 MB per second.

**line frequency.** The frequency (in hertz) of the ac line voltage that the 3584 Tape Library requires for normal operation.

**link.** In Fibre Channel technology, the physical (optical) connection between two nodes of a network, which includes the combination of the link connection (the transmission medium) and two link stations, one at each end of the link connection.

**liquid crystal display (LCD).** A low-power display technology used in computers and other I/O devices.

**load.** Pertaining to the 3584 Tape Library and following the insertion of a tape cartridge into a cartridge storage slot, the act (performed by the cartridge accessor) of transferring the cartridge from the storage slot to the drive and of positioning the tape (performed by the tape drive) for reading or writing by the drive head.

**load and unload cycle.** The act of inserting a cartridge into a tape drive, loading the tape to load point, rewinding the tape into the cartridge, and ejecting the cartridge from the drive.

**load point.** The beginning of the recording area on magnetic tape.

**load-to-ready time.** After a cartridge has been inserted into a drive, the amount of time between when the drive threads the tape and when the drive becomes ready to accept server commands.

**local area network (LAN).** (1) A computer network located on a user's premises within a limited geographical area. Communication within a local area network is not subject to external regulations; however, communication across the LAN boundary may be subject to some form of regulation. (2) A network in which a set of devices is connected to other sets of devices for communication and that can be connected to a larger network.

**logical library.** A set of cartridge storage slots and tape drives that are defined as a library by an operator. The operator identifies the slots and drives to the library by their location or count. The ability of the 3584 Tape Library to create logical libraries makes it possible for similar and dissimilar hosts (servers) to share its robotics. As a result, hosts can simultaneously run separate applications in separate logical libraries.

**logical library bar code label.** A specially coded label that can be affixed to the tops of storage slot columns and drives inside the 3584 Tape Library. The tape library reads the labels and uses them to establish the boundaries of one or more logical libraries.

**logical library configuration.** A way of using the 3584 Tape Library so that its robotics are shared by homogenous (similar) and heterogeneous (dissimilar) servers. The 3584 Tape Library can be partitioned into individual logical libraries that independently communicate with individual servers via individual control paths.

**logical unit number (LUN).** A number associated with the target address of a drive. The server uses the number to identify the address of the drive.

**loop ID.** In Fibre Channel technology, the identifier that the 3584 Tape Library assigned to an Ultrium Tape Drive or 3592 Tape Drive. The ID is based on the drive's physical location within the library and is used by other devices in the topology to communicate.

**Low Voltage Differential (LVD).** A low-noise, low-power, and low-amplitude electrical signaling system that enables data communication between a supported server and the 3584 Tape Library. LVD signaling uses two wires to drive one signal over copper wire. The use of wire pairs reduces electrical noise and crosstalk.

**LTO.** See *Linear Tape-Open*.

**LTO cartridge memory (LTO-CM).** Within each LTO Ultrium Data Cartridge, an embedded electronics and interface module that can store and retrieve a cartridge's historical usage and other information.

**LTO-CM.** See *LTO cartridge memory*.

**LUN.** See *logical unit number*.

**LVD.** See *Low Voltage Differential*.

# M

**m.** Meter.

**magnetic tape.** A tape with a magnetizable surface layer on which data can be stored by magnetic recording.

**Management Information Base (MIB).** Units of managed information that specifically describe an aspect of a system, such as the system name, hardware number, or communications configuration. A collection of related MIB objects is defined as a MIB. The 3584 Tape Library can use the MIB to interpret problem alerts that are transmitted by SNMP traps.

**manual cleaning.** A method by which an operator selects a menu option from the touchscreen of the 3584 Tape Library or IBM System Storage Tape Library Specialist web interface to perform cleaning on one or more of its tape drives.

**master console.** Located in the 3953 Tape Frame Model F05, a device that attaches to each installed 3953 L05 Library Manager, 3592 J70 Controller, 3494 B10 VTS, 3494 B20 VTS, and TS7700 Virtualization Engine. The master console monitors these components for early detection of unusual conditions and for error information that the components send to IBM's Remote Technical Assistance Information Network (RETAIN).

**MB.** See *megabyte*.

**Mbps.** Megabits per second.

**MCA.** See *Medium Changer assembly*.

**MCC.** See *Medium Changer card pack*.

**MCP.** See *Medium Changer card pack*.

**media.** The plural of *medium*.

**media capacity.** The amount of data that can be contained on storage media and expressed in bytes of data.

**media-type identifier.** Pertaining to the bar code on the bar code label of the IBM LTO Ultrium Tape Cartridge, a 2-character code (Lx), that represents information about the cartridge. L identifies the cartridge as one that can be read by devices that incorporate LTO technology; x indicates the generation of cartridge (1 represents the Ultrium 1 Tape Cartridge, 2 represents the Ultrium 2 Tape Cartridge, 3 represents the Ultrium 3 Tape Cartridge, and T represents the Ultrium 3 WORM Tape Cartridge).

**medium.** A physical material in or on which data may be represented, such as magnetic tape.

**Medium Changer assembly (MCA).** In the enhanced frame control assembly power structure, the device that facilitates communication between host applications and the library. The MCA is located above the drives and the fixed power trays in Model L23, D23, L53, and D53 frames. It houses two Ethernet ports for connection to the Tape Library Specialist web interface or a master console.

**Medium Changer card pack (MCC or MCP).** In the 3584 Tape Library, a circuit board that provides a communication path to each tape drive (via the RS-422 interface) so that library commands can be funneled from the tape drives to the accessor. It includes one RS-422 interface allotted for each drive in the frame. It also provides management and service interfaces to outside servers. For each library frame that contains at least one drive, there is one MCP. The electronics of the card pack are located in the FCB.

**Medium Changer Device.** In SCSI terms, an instrument that moves removable storage units from and to storage slots and tape drives. The 3584 Tape Library is a Medium Changer Device.

**megabyte (MB).** 1 000 000 bytes.

**metal-particle tape.** In the LTO Ultrium Tape Cartridges and 3592 Tape Cartridge, tape that uses very small, pure metal particles (rather than oxide coatings) in the magnetic layer.

**meter.** In the Metric System, the basic unit of length; equal to approximately 39.37 inches.

**MIB.** See *Management Information Base*.

**middleware.** A vague term that refers to the software between an application program and the lower-level platform functions.

**micron.** One millionth of a meter (.000001 m).

**Microsoft Systems Management Server (SMS) and Clustered Server Environments.** A solution from Microsoft that automatically detects system or network failures in Windows operating systems and eliminates a single point of failure by managing failover to a recovery processor.

**mid-range systems.** A set of multi-user servers with a hard disk capacity of between 50 GB and 250 GB.

**mixed drive types.** The concept of using both LTO Ultrium Tape Cartridges and 3592 Tape Cartridges in the 3584 Tape Library. A library can consist of frames that house all LTO Ultrium Tape Cartridges or all 3592 Tape Cartridges, but the two types of cartridges cannot be mixed in a single frame. However, both types of cartridges may be inserted or removed from the library through the base frame, provided that a lower I/O station is installed for the 3592 Tape Cartridges.

**Model J1A.** See *IBM TotalStorage 3592 Tape Drive Model J1A*.

**mount.** The act of making a tape available for processing by a specific tape device. A mount consists of removing the cartridge from a drive, returning it to its storage slot, collecting another cartridge from a storage slot, moving it to the drive, and loading it into the drive.

**mount/demount cycle.** See *mount*.

**mounted.** The state of a tape while it is available for processing by a specific tape device.

**mount throughput.** The number of cartridges that a tape library can mount in a one-hour period.

# N

**N.** A measure of the electrical power load in a system. If there are N loads in the system, N power supplies are required to power all of the loads.

**N/A.** Not applicable.

**native data capacity.** The amount of data that can be stored without compression on a tape cartridge.

**NetView.** (1) Pertaining to an IBM licensed program that is used to monitor a network, manage it, and diagnose its problems. The NetView licensed program can be used to provide network management services for OSI Communications Subsystem. (2) A network management product that can provide automated operations and rapid notification of events.

**network.** A configuration of data processing devices and software connected for information interchange.

**network server.** In a local area network, a personal computer that provides access to files for all of the workstations in the network.

**node.** In Fibre Channel technology, a communicating device.

**node card.** Within the 3584 Tape Library, one of four circuit assemblies (accessor controller card, motor driver assembly, Medium Changer card pack, and operator panel assembly) that communicate with each other.

**nominal.** Approximate.

**nominal power.** The amount of power (in kilowatts) that the 3584 Tape Library dissipates during normal operation.

**non-addressable cartridge storage slot.** A cartridge storage slot that is designated for the diagnostic cartridge, which is used during service procedures. The Models L22, L23, L32, L52, and L53 base frames each contain one non-addressable cartridge storage slot for a diagnostic cartridge at physical address F01,C01,R01. Additionally, the first expansion frame of a different media type (3592 or LTO) in a mixed media library contains one non-addressable cartridge slot for a diagnostic cartridge at physical addresses Fxx,C01,R01 (where xx equals the first expansion frame for the second type of media).

**nondisruptive firmware update.** The ability to update drive or library firmware without scheduling downtime. The 3584 Tape Library provides the ability to perform a nondisruptive update for its library firmware as well as firmware for the 3592 J1A Tape Drive, TS1120 Tape Drive, IBM System Storage 3588 Tape Drive Model F3A, and IBM System Storage TS1030 Tape Drive Model F3B.

**non-volatile memory.** Types of memory that retain their contents when the power is turned off. ROM is nonvolatile, whereas RAM is volatile.

# O

**Oersted.** The unit of magnetic field strength in the unrationalized centimeter-gram-second (cgs) electromagnetic system. The Oersted is the magnetic field strength in the interior of an elongated, uniformly wound solenoid that is excited with a linear current density in its winding of one abamper per $4\pi$ centimeters of axial length.

**operating environment.** The temperature, relative humidity rate, and wet bulb temperature of the room in which the 3584 Tape Library routinely conducts processing.

**operating system.** The master computer control program that translates the user's commands and allows software application programs to interact with the computer's hardware.

**operator panel.** A functional unit that controls the tape library. The unit's LCD touchscreen provides information about the operation of the 3584 Tape Library, and one or two I/O stations for inserting and removing cartridges.

**operator panel controller.** Within the 3584 Tape Library, a circuit board that facilitates communication between the accessor controller and the operator panel. The controller provides input to and output from the LCD, and senses and locks the I/O stations. In addition, the LCD activity and service menus are executed in the operator panel controller with support from the accessor controller and the drives (via the Medium Changer card packs).

**optimized dual gripper.** An electromechanical device that is mounted on the pivot assembly and gets or puts cartridges from or to a storage slot, tape drive, or I/O station.

# P

**partition.** A fixed-size division of storage.

**patch panel.** Located at the rear of the base or expansion frame in a 3584 Tape Library, an optional unit that houses the fiber cable connections between the servers and the individual drives.

**Pause key.** On the touchscreen of the 3584 Tape Library, a touch key that causes the cartridge accessor to park itself and provide clear access to the library's interior when you power-off the library or open the front door. The Pause key enables quick recovery when you power-on the library or close the front door.

**PDF.** See *Portable Document Format*.

**ping.** (1) A command that calls an IP address. (2) The act of issuing a command that calls an IP address.

**pivot assembly.** On the cartridge accessor of the 3584 Tape Library, a group of parts that provides a mounting platform for the gripper mechanism and the bar code reader. The pivot assembly is capable of 180° rotation about the vertical axis.

**point load.** On a floor, one or more locations where the weight of an object is concentrated.

**point-to-point topology.** In communications, the physical or logical arrangement of nodes in a network to facilitate data transmission between two locations without the use of any intermediate display station or computer.

**port.** (1) A system or network access point for data entry or exit. (2) A connector on a device to which cables for other devices such as display stations and printers are attached. (3) The representation of a physical connection to the link hardware. A port is sometimes referred to as an adapter; however, there can be more than one port on an adapter.

**Portable Document Format (PDF).** A standard specified by Adobe Systems, Incorporated, for the electronic distribution of documents. PDF files are compact, can be distributed globally (via e-mail, the web, intranets, or CD-ROM), and can be viewed with the Acrobat Reader, which is software from Adobe Systems that can be downloaded at no cost from the Adobe Systems home page.

**power cord.** A cable that connects a device to a source of electrical power.

**power cord plug.** On a power cord, the male fitting for making an electrical connection to a circuit by insertion into a receptacle.

**power-off, powered-off.** (1) To remove electrical power from a device. (2) The state of a device when power has been removed from it.

**power-on, powered-on.** (1) To apply electrical power to a device. (2) The state of a device when power has been applied to it.

**power-on indicator.** Located beside the library power switch on the operator panel, a green light that, when lit, indicates that dc power is available within the 3584 Tape Library.

**power receptacle.** The mounted female electrical fitting that contains the live parts of the circuit.

**power supply.** The electrical component of a computer system that converts standard ac current to the lower voltage dc current used by the computer. The amount of current a power supply can provide is rated in amperes.

**power switch.** See *library power switch*.

**protocol.** The meanings of, and the sequencing rules for, requests and responses used for managing a network, transferring data, and synchronizing the states of network components.

**put.** Pertaining to the 3584 Tape Library, to place, by means of a robotic device, a tape cartridge into a storage slot, drive, or I/O station.

# Q

**quiesce.** To put a device into a temporarily inactive or inhibited state, but not remove it from the system.

# R

**RABF.** See *recursive accumulating backhitchless flush*.

**rail system.** Within the 3584 Tape Library, the support structure over which the cartridge accessor moves.

**read.** To acquire or interpret data from a storage device, from a data medium, or from another source.

**ready.** The operating condition that the 3584 Tape Library is in when the host applications can interact with it.

**recursive accumulating backhitchless flush (RABF).** A non-volatile caching technique that is used by the IBM TotalStorage 3592 Tape Drive Model J1A or the IBM System Storage TS1120 Tape Drive.

**rekey.** In cryptography, the process of encrypting a data key a second time by using the public key of another party to create an additional externally encrypted data key. The cartridge can then be shipped to a business partner that holds the corresponding private key which allows the data key to be unwrapped and the tape decrypted on a different TS1120 Tape Drive.

**relative humidity.** The ratio of the amount of water vapor actually present in the air to the greatest amount possible at the same temperature.

**remote support.** See *Call Home*.

**Remote Technical Assistance Information Network (RETAIN).** Used by IBM Service Representatives, an internal host-based software application that contains records of service problems with IBM hardware and software, as well as tips on how to deal with the problems.

**remove.** Pertaining to the 3584 Tape Library, a term used to describe the act of taking a tape cartridge out of an I/O station.

**repeater.** A device that regenerates signals to extend the range of transmission between data stations or to interconnect two branches. A repeater is a node of a local area network.

**RETAIN.** See *Remote Technical Assistance Information Network*.

**robotics.** The cartridge accessor and any associated mechanisms that move a tape cartridge within the 3584 Tape Library.

**RS-422 interface.** An electrical interface standard approved by the Electronic Industries Association (EIA) for connecting serial devices. The RS-422 standard, which supports higher data rates and greater immunity to electrical interference, is an alternative to the older RS-232 interface and uses individual differential signal pairs for data transmission. Depending on data transmission rates, RS-422 can be used at distances to 1,275 m (4,000 ft). The RS-422 interface also supports multi-point connections.

# S

**SAN.** See *Storage Area Network*.

**SARS.** See *Statistical Analysis and Reporting System*.

**scratch cartridge.** A labeled cartridge that is blank or contains no valid data, that is not currently defined, and that is available for use.

**scratch encryption policy.** A means of identifying to a TS1120 Tape Drive which scratch cartridges will be encrypted on the next attempt to write from the beginning of the tape. A scratch encryption policy specifies what scratch cartridges to encrypt; it does not indicate which cartridges are currently encrypted. When used with library-managed encryption, a policy optionally lets you control cartridge encryption by VOLSER ranges in all logical libraries.

**SCSI.** See *Small Computer Systems Interface*.

**SCSI-2.** A variation of the SCSI interface. See *Small Computer Systems Interface*.

**SCSI bus.** (1) A collection of wires through which data is transmitted from one part of a computer to another. (2) A generic term that refers to the complete set of signals that define the activity of the Small Computer Systems Interface (SCSI).

**SCSI address.** See *SCSI ID*.

**SCSI connector.** One of the set of all female and male connectors on the SCSI bus.

**SCSI device.** Anything that can connect into the SCSI bus and actively participate in bus activity.

**SCSI element address.** A value that defines a logical location in the 3584 Tape Library to the SCSI interface. This logical address is represented on the operator panel or IBM System Storage Tape Library Specialist web interface as `xxxx(yyyh)`, where `xxxx` is a decimal value and `yyyh` is a hexadecimal value. It is assigned by the library and used by the server when the server processes SCSI commands. The SCSI element address is not unique to a storage slot, drive, or I/O slot; it varies, depending on the quantity of drives in the library, whether the Capacity Expansion feature is installed, and whether an Expanded I/O Station is included.

**SCSI ID.** The hexadecimal representation of the unique address (0-F) that is assigned to a SCSI device. This identifier would normally be assigned and set in the SCSI device during system installation.

**search time.** The average time it takes for a tape drive to locate the starting point of a block of data.

**secure sockets layer (SSL).** Protocol for transmitting private documents via the Internet. SSL uses a cryptographic system that uses two keys to encrypt data – a public key known to everyone and a private or secret key known only to the recipient of the message. Both Netscape Navigator and Internet Explorer support SSL, and many Web sites use the protocol to obtain confidential user information, such as credit card numbers. By convention, URLs that require an SSL connection start with https: instead of http:.

**sequential access.** The processing of information on a tape cartridge in a manner that requires the device to access consecutive storage locations (logical blocks) on the medium.

**Sequential Access Device.** In SCSI terms, a tape drive.

**serial number.** See *volume serial number*.

**server.** A functional unit that provides services to one or more clients over a network. Examples include a file server, a print server, and a mail server. The IBM pSeries, IBM iSeries, HP, and Sun are servers. Synonymous with *host*.

**service clearance.** Surrounding the 3584 Tape Library, the space required for an IBM Service Representative to perform maintenance on the unit.

**service location protocol.** (SLP) Protocol that provides a framework to allow networking applications to discover the existence, location, and configuration of networked services in enterprise networks. With SLP, the user only needs to know the description of the service he is interested in. SLP is then able to return the URL of the desired service.

**service ratings.** The values for criteria associated with an electrical power cord. The criteria include maximum voltage, current, phases, and wires.

**ship group.** The group of supplies, cords, or documentation that is shipped with the 3584 Tape Library.

**shipping environment.** The temperature, relative humidity rate, and wet bulb temperature of the environment to which the 3584 Tape Library is exposed when being transferred from one location to another.

**short-wave cable.** In Fibre Channel technology, a laser cable that uses a wavelength of 780 nanometers and is only compatible with multi-mode fiber.

**Simple Network Management Protocol (SNMP).** In the Internet suite of protocols, a network management protocol that is used to monitor routers and attached networks. SNMP is an application layer protocol. Information on devices that are managed is defined and stored in the application's Management Information Base (MIB).

**single-phase power.** Pertaining to the 3584 Tape Library, electricity that is transmitted via three wires (line, neutral, and ground), with a line-to-neutral voltage of 200-240 V ac.

**SLP.** See *Service Location Protocol* .

**Small Computer Systems Interface (SCSI).** A standard used by computer manufacturers for attaching peripheral devices (such as tape drives, hard disks, CD-ROM players, printers, and scanners) to computers (servers). Pronounced "scuzzy." Variations of the SCSI interface provide for faster data transmission rates than standard serial and parallel ports (up to 160 megabytes per second). The variations include:

- Fast/Wide SCSI: Uses a 16-bit bus, and supports data rates of up to 20 MBps.
- SCSI-1: Uses an 8-bit bus, and supports data rates of 4 MBps.
- SCSI-2: Same as SCSI-1, but uses a 50-pin connector instead of a 25-pin connector, and supports multiple devices.
- Ultra SCSI: Uses an 8- or 16-bit bus, and supports data rates of 20 or 40 MBps.
- Ultra2 SCSI: Uses an 8- or 16-bit bus and supports data rates of 40 or 80 MBps.
- Ultra3 SCSI: Uses a 16-bit bus and supports data rates of 80 or 160 MBps.
- Ultra160 SCSI: Uses a 16-bit bus and supports data rates of 80 or 160 MBps.

**SMI-S.** See *Storage Management Initiative - Specification*.

**SMI-S Agent for Tape.** See *Storage Management Initiative - Specification (SMI-S) Agent for Tape*.

**SNMP.** See *Simple Network Management Protocol*.

**Specialist web interface.** A platform-independent, web-based interface that allows a user to configure and monitor the 3584 Tape Library from a remote location.

**speed matching.** The ability of the Ultrium 3 and Ultrium 2 Tape Drives to adjust their native data rate as closely as possible to the net host data rate (after data compressibility has been factored out).

**SSL.** See *Secure Sockets Layer*.

**stand-alone.** Pertaining to operation that is independent of any other device, program, or system.

**Statistical Analysis and Reporting System (SARS).** Firmware that is built into the 3592 Tape Drives and the Ultrium Tape Drives and which is used by the drive during problem determination to identify which single-character display code, ASC/ASCQ, and/or TapeAlert to report.

**StE.** See *storage element*.

**Storage Area Network (SAN).** A high-speed subnetwork of shared storage devices. A SAN's architecture makes all storage devices available to all servers on a LAN or WAN. As more storage devices are added to a SAN, they too will be accessible from any server in the larger network. Because stored data does not reside directly on any of a network's servers, server power is used for business applications, and network capacity is released to the end user.

**storage element (StE).** In SCSI terms, a cartridge storage slot.

**storage environment.** The temperature, relative humidity rate, and wet bulb temperature of the environment in which the 3584 Tape Library is nonoperational and being kept for future use.

**Storage Management Initiative - Specification (SMI-S).** A design specification of the Storage Management Initiative (SMI) that was launched by the Storage Networking Industry Association (SNIA). The SMI-S specifies a secure and reliable interface that allows storage management systems to identify, classify, monitor, and control physical and logical resources in a Storage Area Network (SAN).

**Storage Management Initiative - Specification (SMI-S) Agent for Tape.** Software that is used by management software to communicate with storage devices in a SAN environment. The SMI-S Agent for Tape communicates by using the Web-Based Enterprise Management (WBEM) protocol, which allows management software to communicate with the 3584 Tape Library.

**sustained data transfer rate.** Between the server and the tape drive, the average transfer rate of data across

the SCSI interface to and from the tape drive during a transition from one end of the tape to the other end.

**switch.** A network infrastructure component to which multiple nodes attach. Unlike hubs, switches typically have the ability to switch node connections from one to another. A typical switch can facilitate several simultaneous bandwidth transmissions between different pairs of nodes.

# T

**TapeAlert.** A patented technology from Hewlett-Packard that monitors the status of a tape device and media, and detects problems as they occur.

**TapeAlert flags.** Status and error messages that are generated by the TapeAlert utility and display on the host console. The messages indicate the type of problem and tell how to resolve it.

**tape cartridge.** A removable storage device that consists of a housing containing a belt-driven magnetic tape wound on a supply reel and a takeup reel.

**tape drive.** See *IBM TotalStorage LTO Ultrium 1 Tape Drive*, *IBM TotalStorage LTO Ultrium 2 Tape Drive*, *IBM System Storage 3588 Tape Drive Model F3A*, *IBM System Storage TS1030 Tape Drive Model F3B*, *IBM TotalStorage 3592 Tape Drive Model J1A*, or *IBM System Storage TS1120 Tape Drive*.

**Tape Frame.** See *IBM 3953 Tape Frame Model F05*.

**target.** A SCSI device that performs an operation requested by the initiator. A target can also be an initiator.

**TB.** Terabyte.

**TCP/IP.** See *transmission control protocol/Internet protocol*.

**terabyte.** 1 000 000 000 000 bytes.

**terminate, termination.** To prevent unwanted electrical signal reflections by applying a device (a terminator) that absorbs the energy from the transmission line.

**terminator.** (1) A part used to end a SCSI bus. (2) A single-port, 75-Ω device that is used to absorb energy from a transmission line. Terminators prevent energy from reflecting back into a cable plant by absorbing the radio frequency signals. A terminator is usually shielded, which prevents unwanted signals from entering or valid signals from leaving the cable system.

**Tivoli Storage Manager (TSM).** An IBM client/server product that provides storage management and data access services in a heterogeneous environment. TSM supports various communication methods, provides administrative facilities to manage the backup and storage of files, and provides facilities for scheduling backups.

**topology.** In communications, the physical or logical arrangement of nodes in a network, especially the relationships among nodes and the links between them.

**Total Productivity Center (TPC).** See *IBM Total Productivity Center*.

**touch keys.** On the touchscreen of the 3584 Tape Library, an array of small, touch-sensitive keypads that lets you select and navigate through menus. To acknowledge that it has been pressed, a touch key initiates an audible beep (if enabled) whenever you press it. The audible beep is the default.

**touchscreen.** See *liquid crystal display*.

**TPC.** See *IBM Total Productivity Center*.

**track.** A linear or angled pattern of data written on a tape surface.

**transfer rate.** See *data transfer rate*.

**transmission control protocol/Internet protocol (TCP/IP).** (1) The Transmission Control Protocol and the Internet Protocol, which together provide reliable end-to-end connections between applications over interconnected networks of different types. (2) The suite of transport and application protocols that run over the Internet Protocol.

**TS1120 Tape Drive.** See *IBM System Storage TS1120 Tape Drive*.

**TSM.** See *Tivoli Storage Manager*.

**two-node arbitrated loop.** In Fibre Channel technology, the connection of two nodes that communicate directly (without the use of a switch) and use the same protocol.

**two-node switched fabric loop.** In Fibre Channel technology, the connection of two or more nodes that may not use the same protocol and communicate by using a switch.

**two-phase power.** Pertaining to the 3584 Tape Library, electricity that is transmitted via three wires (line, line, and ground), with a line-to-line voltage of 200-240 V ac. Sometimes referred to as *single phase power*.

# U

**Ultra SCSI.** See *Small Computer Systems Interface*.

**Ultra160 SCSI.** See *Small Computer Systems Interface*.

**Ultra2 SCSI.** See *Small Computer Systems Interface*.

**Ultra3 SCSI.** See *Small Computer Systems Interface*.

**Ultra320 SCSI.** See *Small Computer Systems Interface*.

**Ultrium Tape Drive.** See *IBM TotalStorage LTO Ultrium 1 Tape Drive*, *IBM TotalStorage LTO Ultrium 2 Tape Drive*, *IBM System Storage 3588 Tape Drive Model F3A*, or *IBM System Storage TS1030 Tape Drive Model F3B*.

**Ultrium 3 Tape Drive.** See *IBM System Storage 3588 Tape Drive Model F3A* or *IBM System Storage TS1030 Tape Drive Model F3B*.

**uniform resource locator (URL).** The address of an item on the World Wide Web. It includes the protocol followed by the fully qualified domain name (sometimes called the host name) and the request. The web server typically maps the request portion of the URL to a path and file name. For example, if the URL is http://www.networking.ibm.com/nsg/nsgmain.htm, the protocol is http; the fully qualified domain name is www.networking.ibm.com; and the request is /nsg/nsgmain.htm.

**unload.** Pertaining to the 3584 Tape Library, a term used to describe the act of the drive unthreading the tape from the internal tape path and returning the leader block to the tape cartridge.

**URL.** See *uniform resource locator*.

# V

**V ac.** Volts ac (alternating current).

**vital product data (VPD).** Pertaining to the 3584 Tape Library, information about a product such as a library, drive, or node card. The VPD may include a machine type, model number, serial number, part number, or level of firmware.

**void.** In character recognition, the inadvertent absence of ink within a character outline.

**VOLSER.** Volume serial number.

**volt.** The SI (international) unit of potential difference and electromotive force, formally defined to be the difference of electric potential between two points of a conductor carrying a constant current of one ampere, when the power dissipated between these points is equal to one watt.

**volume serial number (VOLSER).** A number that a computer assigns to a tape cartridge when it prepares (initializes) the cartridge for use.

**VPD.** See *vital product data*.

# W

**W.** Watts.

**watt.** A metric unit of measure of power; the power required to keep a current of one ampere flowing under a potential drop of one volt; about 1/736 of one horsepower.

**web.** See *World Wide Web*.

**wet bulb temperature.** The temperature at which pure water must be evaporated adiabatically at constant pressure into a given sample of air in order to saturate the air under steady-state conditions. Read from a wet-bulb thermometer.

**World Wide Node Name.** In Fibre Channel technology, the fixed, 64-bit name assigned to a device by its manufacturer and used to identify participants in a topology. The World Wide Node Name will be unique if the manufacturer has registered a range of addresses with the IEEE.

**World Wide Port Name.** Within a parent node, a unique 64-bit name that is assigned to a node port. The World Wide Port Name aids the accessibility of the port.

**World Wide Web.** A network of servers that contain programs and files. Many of the files contain hypertext links to other documents available through the network.

**WORM.** See *write once read many*.

**write.** To make a permanent or transient recording of data in a storage device or on a data medium.

**write once read many (WORM).** A technology that allows data to be written only once to LTO Ultrium 3 and 3592 tape cartridges. After being written, the data cannot be altered, but can be read any number of times.

**write protected.** A tape cartridge is write protected if some logical or physical mechanism causes the device that is processing the tape to prevent the program from writing on the tape.

**write-protect switch.** Located on the LTO Ultrium Tape Cartridge or 3592 Tape Cartridge, a switch that prevents accidental erasure of data. Pictures of a locked and unlocked padlock appear on the switch. When you slide the switch to the locked padlock, data cannot be written to the tape. When you slide the switch to the unlocked padlock, data can be written to the tape.

# X

**X-axis and Y-axis motion assemblies.** Within the 3584 Tape Library, a group of parts that provides the motive force to move the accessor side to side (on the X-axis) and up and down (on the Y-axis).

# Y

**Y-axis motion assembly.** See *X-axis and Y-axis motion assemblies*.

# Z

**zoning.** A method of subdividing a storage area network into disjoint zones, or subsets of nodes on the network. Storage area network nodes outside a zone are invisible to nodes within the zone. Moreover, with switched SANs, traffic within each zone may be physically isolated from traffic outside the zone.

# Index

## Special characters



## Numerics



## A



## B



## C

## D



## E



## F

## G



## H



## I



## J



## L



## M

## N



## O



## P

# R



# S



# T

## U



## V



## W



## Z

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**Introduction and Planning Guide**
**IBM 3584 Tape Library**

**Publication No. GA32-0559-04**

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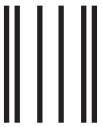

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