IBM System Storage TS2260

IBM

Setup, Operator, and Service Guide

Machine Type 3580 Model H6S

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Read This First

This product may not be certified in your country for connection by any means whatsoever to interfaces of public telecommunications networks. Further certification may be required by law prior to making any such connection. Please contact IBM® for information.

Accessing Online Technical Support

It is the customer's responsibility to set up this tape drive or library and to ensure that the drive and library have the latest firmware (unless you have purchased a service contract).

For online Technical Support:
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3. Click **Customer Support** and follow on-screen instructions.

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Safety notices

Observe the safety notices when using this product. These safety notices contain danger and caution notices. These notices are sometimes 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 *IBM Systems Safety Notices*, G229-9054 manual.

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 generally hazardous condition not represented by other safety symbols.
Class II	This product contains a Class II laser. Do not stare into the beam. *(C029)* 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.
> 18 kg (40 lb)	This part or unit is heavy but has a weight smaller than 18 kg (39.7 lb). Use care when lifting, removing, or installing this part or unit. *(C008)*

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

The system contains circuit cards, assemblies, or both that contain lead solder. To avoid the release of lead (Pb) into the environment, do not burn. Discard the circuit card as instructed by local regulations. (*C014*)

Caution

When removing the Modular Refrigeration Unit (MRU), immediately remove any oil residue from the MRU support shelf, floor, and any other area to prevent injuries because of slips or falls. Do not use refrigerant lines or connectors to lift, move, or remove the MRU. Use handholds as instructed by service procedures. (*C016*)

Caution

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®, 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.

Performing the Safety Inspection Procedure

Before you service the unit, perform the following safety inspection procedure:

1. Stop all activity on the host bus.
2. Turn off the power to the tape drive.
3. Disconnect the host interface cable.
4. Unplug the tape drive's power cord from the electrical outlet.
5. Check the tape drive's power cord for damage, such as a pinched, cut, or frayed cord.
6. Check the tape drive's host interface cable for damage.
7. Check the cover of the tape drive for sharp edges, damage, or alterations that expose its internal parts.
8. Check the cover of the tape drive for proper fit. It should be in place and secure.
9. Check the product label on the tape drive to make sure that it matches the voltage at your outlet.

Tape drive ac grounding inspection

1. Power off the drive.
2. Disconnect all cables.
3. See Figure 1 on page xiii which is provided for reference only. Disconnect the power cord from its source.

4. Inspect the power cable for visible cracks, wear, or damage.

Legend:

$\overline{\underline{XX}}$ External tooth lock washer
Green/yellow ground wire terminated to chassis or ground

$\oplus$ Green/yellow ground wire terminated with slip-on spade terminal

XXX Redundant ground path to frame

$\overline{\underline{XXX}}$ External tooth lock washer
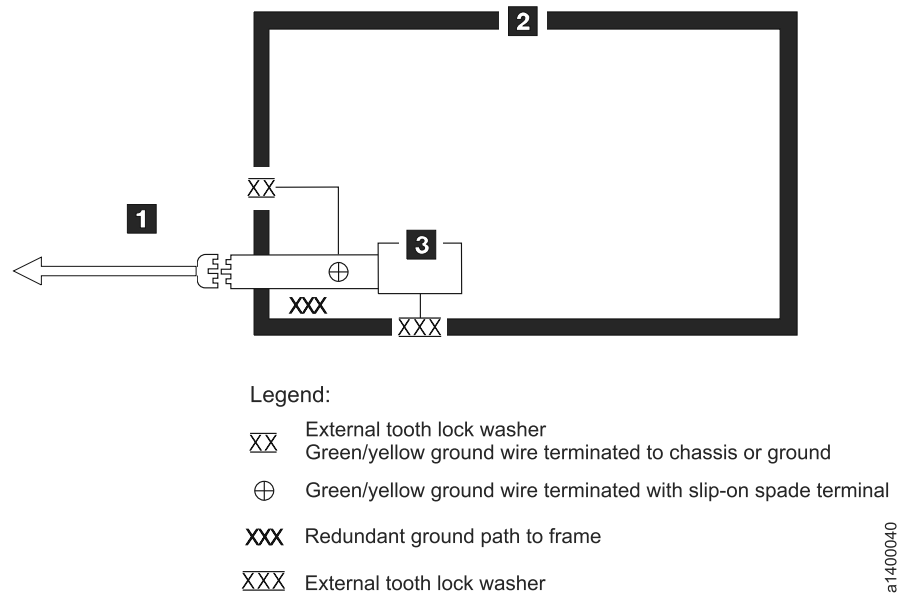
Figure 1. AC grounding diagram (50 Hz and 60 Hz)

Class I Laser Product

The product may contain 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. The product has the necessary protective housing and scanning safeguards to ensure that laser radiation is inaccessible during operation or is within Class I limits. External safety agencies have reviewed the product and have obtained approvals to the latest standards as they apply.

Rack Safety

The following general safety information should be used for all rack mounted devices.

DANGER
- Always lower the leveling pads on the rack cabinet.
- Always install stabilizer brackets on the rack cabinet.
- To avoid hazardous conditions due to uneven mechanical loading, always install the heaviest devices in the bottom of the rack cabinet. Always install servers and optional devices starting from the bottom of the rack cabinet.
- Rack mounted devices are not to be used as a shelf or work space. Do not place any object on top of rack mounted devices.
- Each rack cabinet might have more than one power cord. Be sure to disconnect all power cords in the rack cabinet before servicing any device in the rack cabinet.
- Connect all devices installed in a rack cabinet to power devices installed in the same rack cabinet. Do not plug a power cord from a device installed in one rack cabinet into a power device installed in a different rack cabinet.

- An electrical outlet that is not correctly wired could place hazardous voltage on the 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.

CAUTION:
- **Do not install a unit in a rack where the internal rack ambient temperatures will exceed the manufacturer's recommended ambient temperature for all your rack mounted devices.**
- **Do not install a unit in a rack where the air flow is compromised. Ensure that air flow is not blocked or reduced on any side, front, or back of a unit used for air flow through the unit.**
- **Consideration should be given to the connection of the equipment to the supply circuit so that overloading of the circuits does not compromise the supply wiring or overcurrent protection. To provide the correct power connection to a rack, refer to the rating labels located on the equipment in the rack to determine the total power requirement of the supply circuit.**
- *(For sliding drawers)* **Do not pull out or install any drawer or feature if the rack stabilizer brackets are not attached to the rack. Do not pull out more than one drawer at a time. The rack may become unstable if you pull out more than one drawer at a time.**
- *(For fixed drawers)* **This drawer is a fixed drawer and should not be moved for servicing unless specified by the manufacturer. Attempting to move the drawer partially or completely out of the rack may cause the rack to become unstable or cause the drawer to fall out of the rack.**

(R001)

CAUTION:
Removing components from the upper positions in the rack cabinet improves rack stability during relocation. Follow these general guidelines whenever you relocate a populated rack cabinet within a room or building:

- **Reduce the weight of the rack cabinet by removing equipment starting at the top of the rack cabinet. When possible, restore the rack cabinet to the configuration of the rack cabinet as you received it. If this configuration is not known, you must do the following:**
  - **Remove all devices in the 32U position and above.**
  - **Ensure that the heaviest devices are installed in the bottom of the rack cabinet.**
  - **Ensure that there are no empty U-levels between devices installed in the rack cabinet below the 32U level.**
- **If the rack cabinet you are relocating is part of a suite of rack cabinets, detach the rack cabinet from the suite.**
- **Inspect the route that you plan to take to eliminate potential hazards.**
- **Verify that the route that you choose can support the weight of the loaded rack cabinet. Refer to the documentation that comes with your rack cabinet for the weight of a loaded rack cabinet.**
- **Verify that all door openings are at least 760 x 2032 mm (30 x 80 in.).**
- **Ensure that all devices, shelves, drawers, doors, and cables are secure.**
- **Ensure that the four leveling pads are raised to their highest position.**
- **Ensure that there is no stabilizer bracket installed on the rack cabinet during movement.**
- **Do not use a ramp inclined at more than ten degrees.**
- **Once the rack cabinet is in the new location, do the following:**
  - **Lower the four leveling pads.**
  - **Install stabilizer brackets on the rack cabinet.**
  - **If you removed any devices from the rack cabinet, repopulate the rack cabinet from the lowest position to the highest position.**
- **If a long distance relocation is required, restore the rack cabinet to the configuration of the rack cabinet as you received it. Pack the rack cabinet in the original packaging material, or equivalent. Also lower the leveling pads to raise the casters off of the pallet and bolt the rack cabinet to the pallet.**

(R002)

Power cords

For your safety, IBM provides a power cord with a grounded attachment plug to use with this IBM product. To avoid electrical shock, always use the power cord and plug with a properly grounded outlet.

IBM power cords used in the United States and Canada are listed by Underwriter's Laboratories (UL) and certified by the Canadian Standards Association (CSA).

For units intended to be operated at 115 volts: Use a UL-listed and CSA-certified cord set consisting of a minimum 18 AWG, Type SVT or SJT, three-conductor cord, a maximum of 15 feet in length and a parallel blade, grounding-type attachment plug rated 15 amperes, 125 volts.

For units intended to be operated at 230 volts (U.S. use): Use a UL-listed and CSA-certified cord set consisting of a minimum 18 AWG, Type SVT or SJT, three-conductor cord, a maximum of 15 feet in length and a tandem blade, grounding-type attachment plug rated 15 amperes, 250 volts.

For units intended to be operated at 230 volts (outside the U.S.): Use a cord set with a grounding-type attachment plug. The cord set should have the appropriate safety approvals for the country in which the equipment will be installed.

IBM power cords for a specific country or region are usually available only in that country or region.

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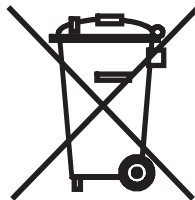
Notice: This mark applies only to countries within the European Union (EU) and Norway.

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 Policy

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:
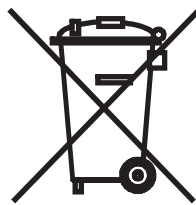
Batteries or packaging for batteries are labeled in accordance with European Directive 2006/66/EC concerning batteries and accumulators and waste batteries and accumulators. The Directive determines the framework for the return and recycling of used batteries and accumulators as applicable throughout 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 `http://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.

Monitors

Connecticut - Please see the web site of the Department of Environmental Protection at http://www.ct.gov/dep for information about recycling covered electronic devices in the State of Connecticut, or telephone the Connecticut Department of Environmental Protection at 1-860-424-3000.

Washington - Please see the web site of the Department of Ecology at http://1800recycle.wa.gov/ for information about recycling covered electronic devices in the State of Washington, or telephone the Washington Department of Ecology at 1-800Recycle.

End of Life (EOL) Plan

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

Environmental notices

The environmental notices that apply to this product are provided in the *Environmental Notices and User Guide*, Z125-5823-*xx* manual. A copy of this manual is located on the publications CD.

Preface

This guide describes how to install and use the IBM TS2260 Tape Drive in the following chapters:

Chapter 1, "Introduction," on page 1-1 describes the product, discusses supported servers, operating systems, and device drivers, and lists hardware specifications.

Chapter 2, "Installation," on page 2-1 gives unpacking, set up, and configuration information.

Chapter 3, "Operations," on page 3-1 describes the Power Button, Unload Button, and Status lights and explains the function of the Single-character Display. It gives instruction on inserting and removing a tape cartridge, describes methods of updating drive firmware, and explains how to clean the tape drive. It also lists diagnostic and maintenance functions.

Chapter 4, "Using Ultrium Media," on page 4-1 describes the types of tape cartridges to use and defines the conditions for storing and shipping them. It also describes how to handle the cartridges, how to set a cartridge's write-protect switch, and how to order additional cartridges.

Chapter 5, "Troubleshooting," on page 5-1 gives tips for solving problems with the drive.

Appendix A, "Error Codes and Messages," on page A-1 describes the error and informational codes that appear on the single-character display.

Appendix B, "TapeAlert flags," on page B-1 describes where to find information on TapeAlert messages that are supported and that may aid during problem determination.

Appendix C, "Ordering Optional Features, Replacement Parts, and Power Cords," on page C-1 lists parts and supplies and provides information about the power cords that are used in different countries or regions.

Appendix D, "Installing a 19-inch Rack Mount Kit (optional)," on page D-1 gives the procedure for installing a 19-inch rack mount kit.

Appendix E, "Information for Trained Service Personnel," on page E-1 gives the procedure for removing a tape cartridge that will not eject from the drive and other servicing procedures.

Related Publications

- *IBM System Storage Ultrium Tape Drive Quick Reference*, GC27-2278 illustrates how to install the drive.
- *IBM System Storage LTO Ultrium Tape Drive SCSI Reference*, GA32-0450, gives information about the supported SCSI commands and protocol that govern the behavior of the SCSI interface for LTO drives. The SCSI reference also includes information about the TapeAlert flags that are supported.
- *IBM Tape Device Drivers Installation and User's Guide*, GC27-2130, provides instructions for attaching IBM-supported hardware to open-systems operating

systems. It indicates what devices and levels of operating systems are supported, gives the requirements for adapter cards, and tells how to configure servers to use the device driver with the Ultrium family of devices.You can obtain this reference at the web site **http://www.ibm.com/support/fixcentral**.

- *IBM Tape Device Drivers Programming Reference*, GA32-0566, supplies information to application developers who want to integrate their open-systems applications with IBM-supported Ultrium hardware. The reference contains information about the application programming interfaces (APIs) for each of the various supported operating-system environments. You can obtain this reference at the web site **http://www.ibm.com/support/fixcentral**.

- *IBM Translated Safety Notices*, 96P0851, provides translation of danger and caution notices.

Chapter 1. Introduction

The IBM TS2260 Tape Drive is a high-performance, high-capacity data-storage device that is designed to back up and restore open systems applications. It is the sixth generation in the Ultrium series of products, and is available with a Serial Attached SCSI interface (SAS). This model incorporates the Linear Tape-Open (LTO) IBM Ultrium 6 Half-High Tape Drive.
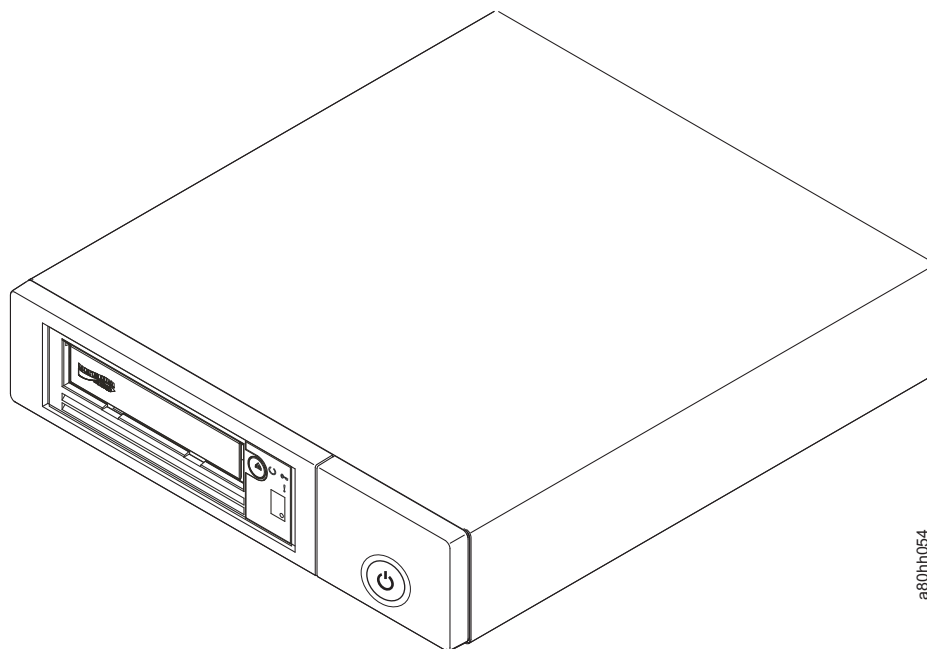
Figure 1-1. View of the drive

Drive Features

The drive offers the following features:

- Native storage capacity of 2500 GB per cartridge (6250 GB at 2.5:1 compression when using Ultrium 6 cartridges)
- Maximum native data transfer rate of up to 160 MB per second
- Burst data transfer rate of 600 MB per second
- Dual port 6 Gbps Serial Attached Small Computer Systems Interface (SAS)
- Half height form factor
- Support for WORM (Write Once Read Many) on WORM cartridge types
- 512 MB read-and-write cache
- Support for encryption on Ultrium 5 and Ultrium 6 tape cartridges
- Single Character Display (SCD) operator panel
- Ready, Fault, and Encryption status lights
- Maintenance Mode functions
- 1 Gbps Ethernet port for drive status and service
- LTFS capable

Front Panel of the Drive
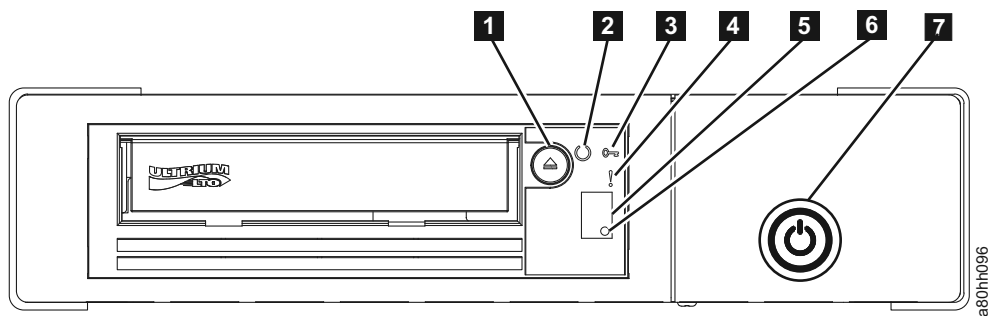
Figure 1-2. Front panel element descriptions

1	Cartridge unload button	4	Fault light (amber)
2	Ready light (green)	5	Single Character Display (SCD)
3	Encryption light (white)	6	SCD dot
		7	Drive power button

Rear Panel of the Drive
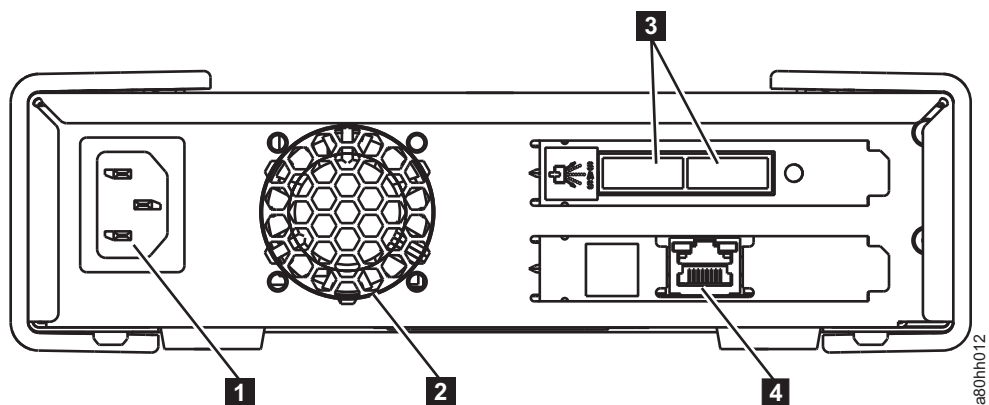
Figure 1-3. Drive rear panel element descriptions

1	Power receptacle
2	Fan vent
3	SAS connectors
4	Ethernet connector (for drive status and service only)

Drive Performance

If you run applications that are highly dependent on tape-processing speed, take advantage of the significant performance improvements provided by this tape drive.

Table 1-1. Performance characteristics

Performance Characteristics	TS2260 Tape Drive
Native data rate	160 MB/s (with Ultrium 6 media)
Maximum sustained data rate (at maximum compression)	550 MB/s
Burst data rate	600MB/s
Nominal load-to-ready time	12 seconds
Nominal unload time	17 seconds
Average rewind time	62 seconds
Note: All sustained data rates are dependent on the capabilities of the interconnect.	

By using the built-in data-compression capability of the tape drive, greater data rates than the native data transfer rate can be achieved. However, the actual throughput is a function of many components, such as the host system processor, disk data rate, block size, data compression ratio, SAS bus capabilities, and system or application software.

Cartridge Compatibility

The TS2260 uses the IBM LTO Ultrium 2500 GB Data Cartridge and is compatible with the cartridges of its predecessors, the IBM Ultrium Tape Drive Generation 5, and Generation 4. The drive performs the following functions:

- Reads and writes Ultrium 6 cartridges to Ultrium 6 format, including WORM and Data Encryption
- Reads and writes Ultrium 5 cartridges to Ultrium 5 format, including WORM and Data Encryption
- Reads but does not write Ultrium 4 cartridges
- Does not read or write Ultrium 3, Ultrium 2, and Ultrium 1 cartridges

The drive reads tapes that have been written by other licensed Ultrium 4, 5, and 6 drives, and writes to tapes that can be read by other licensed Ultrium 5 and 6 drives.

In addition to using the IBM LTO Ultrium Data Cartridge with up to 2500 GB capacity, the drive also offers read/write capability for certified LTO Ultrium tape cartridges.

Speed Matching

To improve system performance, the drive uses a technique called *speed matching* to dynamically adjust its native (uncompressed) data rate to the slower data rate of a server. With speed matching, the drive operates at different speeds when reading or writing the Ultrium 5 or Ultrium 6 cartridge format. Native data rates are as follows in the table below.

Table 1-2. Performance Parameters

	Ultrium Generation Media		
	Generation 6 Media	Generation 5 Media	Generation 4 Media
Speed matching data rates (MB/sec)	160.0	140.0	120.0
	150.77	130.0	113.1
	141.54	120.0	106.0
	132.31	112.7	99.2
	123.08	105.5	92.3
	113.85	98.2	85.3
	104.62	90.9	78.5
	95.38	83.6	71.4
	86.15	76.4	64.6
	76.92	69.1	57.6
	67.69	61.8	50.7
	58.46	53.5	43.8
	49.23	46.3	36.9
	40.00	40.0	30.5

If the server's net (compressed) data rate is between two of the preceding native data rates, the drive calculates the appropriate data rate at which to operate. Speed matching dramatically reduces backhitch, the condition that occurs when a tape stops, reverses, and restarts motion. A backhitch is usually the result of a mismatch between the data rates of the server and the drive.

Channel Calibration

System performance is further optimized by a feature called *channel calibration*, in which the drive automatically customizes each read/write data channel to compensate for variations in such things as the recording channel's transfer function, the media, and characteristics of the drive head.

Data Cartridge Capacity Scaling

The SET CAPACITY SCSI command enables a customer to capacity scale a data cartridge to enable faster random access. As an example, a customer could capacity scale a data cartridge to 20% of its normal length which improves the average access time by almost a factor of 5; however, it also reduces the native capacity of the tape to 500 GB.

Encryption

The IBM TS2260 Tape Drive supports host Application Managed Encryption (AME), using T10 encryption methods. Data encryption is supported with LTO Ultrium 4, Ultrium 5 and Ultrium 6 Data Cartridges only.

The encryption enabled drive contains the necessary hardware and firmware to encrypt and decrypt host tape application data. Encryption policy and encryption keys are provided by the host application. A drive digital certificate is installed at

manufacturing time. Each drive receives a unique serial number and certificate. The T10 Application may validate each drive instance by checking the drive's digital certificate.

Application-managed encryption is supported on AIX®, Windows Server, Linux®, and Solaris. Encryption requires the latest device drivers available on the web site: **http://www.ibm.com/support/fixcentral**.

For more details, see the IBM Tape Device Drivers Encryption Support documentation, and the IBM TotalStorage LTO Ultrium Tape Drive SCSI Reference documentation.

Inhibit Firmware Down-leveling

The drive provides the capability to prevent loading and installing drive microcode via a Field Microcode Replace (FMR tape) if the firmware level contained in the FMR tape is older than the code level already installed. This option is controlled by the host application. No checking will be performed if the firmware level is loaded via the host interface or the library interface.

SAS Interface

The drive has a dual port 6 Gbps SAS (Serial Attached SCSI) host interface.

A drive with a SAS interface can be linked directly to controllers. SAS is a performance improvement over traditional SCSI because SAS enables multiple devices (up to 128) of different sizes and types to be connected simultaneously with thinner and longer cables; its full-duplex signal transmission supports 6.0 Gb/s. In addition, SAS drives can be hot-plugged.

SAS drives will auto-negotiate speed. There are no configurable topologies thus no feature switches associated with SAS.

Physical Characteristics

The drive contains a dual port, SFF-8088 SAS connector. A list of compatible cables is shown in Appendix C, "Ordering Optional Features, Replacement Parts, and Power Cords," on page C-1.

Supported Servers and Operating Systems

To determine the latest supported attachments, visit the web at **http://www.ibm.com/storage/lto** and look for the System Storage interoperability information. For specific instructions about attaching the drive, see Chapter 2, "Installation," on page 2-1.

Supported Device Drivers

Device drivers enable the drive to interact with a variety of servers. To properly install an IBM device driver (if required), refer to the *IBM Tape Device Drivers Installation and User's Guide*. For applications that use other device drivers, see the application's documentation to determine which drivers to use.

IBM maintains the levels of device drivers and driver documentation for the drive on the Internet. You can access this material at the web site: http://www.ibm.com/support/fixcentral

Note: If you do not have Internet access and you need information about device drivers, contact your Marketing Representative.

Note: The device driver for System i® servers is included in the OS/400® operating system.

Ethernet Port

The IBM System Storage TS2260 Tape Drive has a single 1 Gbps Ethernet port on the rear panel, with a RJ45 connector. The Default IP address is **169.254.0.3**, but the drive's IP address can be changed as needed. Refer to ITDT to see how to make this change.

The ethernet port is used only for monitoring drive status and servicing the drive, not for data transmission.

Linear Tape File System (LTFS)

The Linear Tape File System (LTFS) is a file system that works in conjunction with LTO Generation tape technology to access data stored on an IBM tape cartridge.

LTFS uses the file system's format and resources of the operating system (OS) on which it is running to graphically display the contents of a tape cartridge in the OS's graphical user interface (GUI) format; typically a folder/tree structure. Using the host operating system's graphical file manager, reading data on a LTO tape cartridge is as easy as dragging and dropping. Users can run any application designed for disk files against tape data without concern for the fact that the data is physically stored on tape.

Specifications

The following are specifications for the tape drive. Specifications for tape cartridges are given in "Environmental and Shipping Specifications for Tape Cartridges" on page 4-17.

Table 1-3. Specifications

Physical Specifications	
Specification	**Dimensions**
Width	213 mm (8.4 in.)
Length	332 mm (13.1 in.)
Height	58 mm (2.3 in.)
Weight	4.3 kg (9.4 lbs.)
Power Specifications	
AC line voltage	100 to 240 Vac
Line frequency	50 to 60 Hz, auto-ranging
Line current at 100 Vac	0.48 A
Line current at 240 Vac	0.20 A
Other Specifications	
Maximum altitude	3048 m (10,000 ft)

Table 1-3. Specifications (continued)

Maximum altitude for shipping	12192 m (40,000 ft)		
Environmental Specifications			
Environmental Factor	**Operating**	**Storage**	**Shipping**
Temperature	10 to 38°C (50 to 100°F)	-40 to 60°C (-40 to 140°F)	-40 to 60°C (-40 to 140°F)
Relative humidity	20 to 80%	10 to 90%	10 to 90%
Maximum wet bulb temperature	26°C(79°F)	Non-condensing	Non-condensing

Chapter 2. Installation

This is a customer setup unit. It is the customer's responsibility to install this product.

Installation involves the following steps:

1. "Avoiding Drive Damage"
2. "Unpack the Drive"
3. "Verify the Shipment" on page 2-2
4. "Install the Rack Mount Kit (optional)" on page 2-2
5. "Inspect the Power Cord and Outlet" on page 2-2
6. "Position the Tape Drive" on page 2-3
7. "Install the SAS Host Adapter Card (if required)" on page 2-3
8. "Connect the SAS Interface Cable" on page 2-3
9. "Connect Power" on page 2-4
10. "Run Drive Diagnostics" on page 2-4
11. "Install Device Drivers" on page 2-4
12. "Configure the Tape Drive to a Server/Host" on page 2-5
13. "Updating Firmware" on page 2-5
14. "Register for *My Support*" on page 2-7

Avoiding Drive Damage

To avoid static electricity damage when handling the drive, use the following precautions:

- Limit your movement. Movement can cause static electricity to build around you.
- Always handle the drive carefully. Never touch exposed circuitry.
- Prevent others from touching the drive.
- Before unpacking and installing the drive into an enclosure, touch its static-protective packaging to an unpainted metal surface on the enclosure for at least two seconds. This reduces static electricity in the packaging and your body.
- When possible, remove the drive from its static-protective packaging and install it directly into an enclosure without setting it down. When this is not possible, place the drive's packaging on a smooth, level surface and place the drive on the packaging.
- Do not place the drive on the cover of the enclosure or on any other metal surface.

Unpack the Drive

Unpack the drive and store the packaging for future moves or shipping.

Attention: If you return the unit for service, ship it in its original or equivalent packing material, or the warranty may be invalidated.

1. Inspect the unit for shipping damage. If there is damage, do not install the unit. Report the damage immediately by contacting your place of purchase.

2. Locate the label on the bottom panel of the unit with the machine type, model number, and serial number of the unit. Make a note of these numbers and store them in an easily accessible place. Should you need to contact Technical Support, you will be asked for these numbers.

Verify the Shipment

Ensure that the following items are included in the shipment:

- Power cord (For the appropriate cord for your country or region, see Appendix C, "Ordering Optional Features, Replacement Parts, and Power Cords," on page C-1.)
- IBM LTO Ultrium Cleaning Cartridge
- Single-connector SAS wrap tool
- Optional Rack Mount Kit
- The *IBM System Storage TS2260 Tape Drive Quick Reference* (GC27-2276-01)
- The *IBM System Storage TS2260 Tape Drive Setup, Operator and Service Guide* GA32-2226-00 (this guide)
- Documentation CD (includes library documentation, translated safety information, and translated warranty information
- SAS cables are not part of the ship group. They must be ordered separately.

Install the Rack Mount Kit (optional)

Refer to Appendix D, "Installing a 19-inch Rack Mount Kit (optional)," on page D-1. If you did not order the optional kit, proceed to "Inspect the Power Cord and Outlet."

If you ordered a 24-inch rack mount kit, refer to the installation instructions included in the kit.

Inspect the Power Cord and Outlet

1. Inspect the power cord plug to ensure that it matches the power receptacle. If it does not match, see "Power Cords" on page C-1 to determine the appropriate power cord.
2. Ensure that all associated electrical outlets are properly grounded and that the circuit breaker is turned on.

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)*

Position the Tape Drive

Position the unit so it is convenient to the server. The only restrictions are the length of the power cord and the length of the cable to the server. Recommended locations are:

- Away from high-traffic areas, especially if the floor is carpeted.
- Out of printer or copy rooms to avoid toner and paper dust. Do not store paper supplies next to any unit.
- Away from moving air, such as doorways, open windows, fans, and air conditioners.
- Off the floor.
- In a horizontal position.
- Where the tape cartridge can be easily inserted.

The unit should not be stacked. Do not place anything on top of the unit.

Install the SAS Host Adapter Card (if required)

If there are no other devices attached to your server, a SAS host adapter card may need to be installed in the server. To install an adapter, refer to the instructions that accompany it, as well as to the section about host adapter card installation in your server's documentation. For a list of supported adapters and required interposers, visit the web at **http://www.ibm.com/storage/lto**.

Connect the SAS Interface Cable

Each tape drive is required to have a dedicated bus to the initiator, referred to as point-to-point connection. SAS architecture does not support multiple tape drives connected to a single host adapter port. The maximum SAS cable length that can be used to connect the host adapter to the tape drive is 5.5 m.

To connect the cable:

1. Ensure the tape drive is powered OFF.
2. Since there are several types of SAS connectors, verify the SAS cable has the correct connectors for the SAS host adapter and for the tape drive.
3. The tape drive has two SAS ports and can be connected to two servers, if desired. Refer to the appropriate figure that represents your configuration for cabling information (see Figure 2-1 or Figure 2-2 on page 2-4) and then connect the SAS cable(s) to SAS host adapter(s) and to the tape drive as shown.
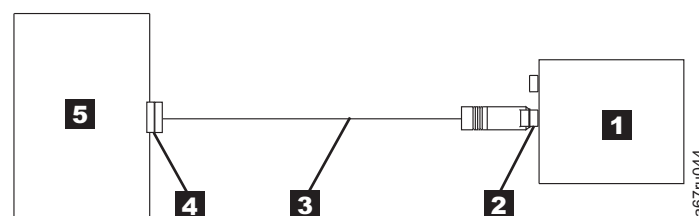
Figure 2-1. Example of connecting one SAS device to the server

1	Tape drive		**4**	SAS host adapter card
2	SAS connector		**5**	Server
3	SAS cable			
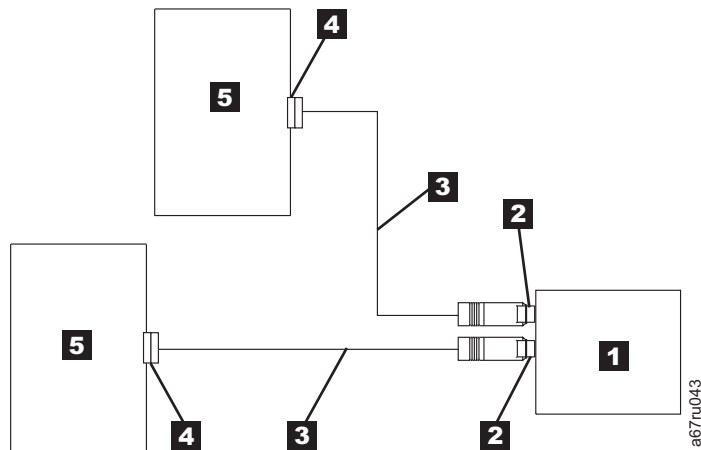
Figure 2-2. Example of connecting the SAS device to two servers

1	Tape drive		4	SAS host adapter card
2	SAS connectors		5	Servers
3	SAS cables			

   4. Ensure the host adapter and the server are configured correctly for a SAS bus operation. Refer to the host adapter and server documentation for instructions.

   5. If the power cord has already been installed, turn power to the tape drive ON.

Connect Power

   1. If the power cord has already been installed, skip to step 3.

   2. Plug the power cord into the rear panel (see Figure 1-3 on page 1-2), then plug the other end into a grounded electrical outlet.

   3. Power-on the unit by pressing the Power Button. The POST runs, which checks all hardware except the drive head. During the POST, the Single-character Display (SCD) flashes several segmented characters. Each segmented character represents a test performed during the POST. When the POST finishes, the SCD momentarily lights all segmented characters and then goes blank.

Run Drive Diagnostics

Run the Standalone Diagnostic (see "Function Code 1: Run Drive Diagnostics" on page 3-12) for instructions.

Install Device Drivers

A device driver is firmware that enables the tape drive to interact with a variety of servers. Refer to "Supported Device Drivers" on page 1-5 for instructions on downloading the latest device drivers.

If you intend to use the tape drive with a commercial software application, refer to that application's installation instructions to install the device driver and configure the tape drive.

If you do not intend to use the tape drive with a commercial software application, refer to the *IBM Ultrium Device Drivers Installation and User's Guide.*

Configure the Tape Drive to a Server/Host

1. Ensure the tape drive is powered on.
2. To configure the tape drive, refer to the documentation for your server/host and application software.

Updating Firmware

Attention: When updating firmware, do not power-off the drive until the update is complete, or the firmware may be lost.

It is the customer's responsibility to ensure that this drive has the latest firmware. Periodically check for updated levels of drive firmware by visiting the web at **http://www.ibm.com/support/fixcentral**. The drive firmware can be downloaded from this website. Update drive firmware using:

- The host interface
- The ITDT tool
- A field microcode replacement (FMR) tape cartridge
- The ethernet interface

For instructions on obtaining a new firmware image, visit **http://www.ibm.com/support/fixcentral**. To update the firmware, refer to the following sections.

Updating Firmware through the Host Interface

When updating drive firmware by using the host interface, the procedure varies depending on whether your server uses an IBM tape device driver or a non-IBM tape device driver (such as a driver from Sun, Hewlett-Packard, or Microsoft).

For instructions about updating firmware from a server that uses an IBM tape device driver, refer to the *IBM Ultrium Device Drivers Installation and User's Guide*.

To update firmware from a server that uses a non-IBM tape device driver, refer to the documentation for that device driver.

ITDT Firmware Update, Dump Retrieval and Library/Drive Test Tool

ITDT is a tool with multiple functional capability and is a very quick, convenient, and efficient method for both drive and library firmware updates. As a note, both drive and library dump retrievals can be performed by the tool as well.

Below are some of the capabilities of this tool:

- Firmware update capability to all IBM LTO Tape Drive and Tape Library products.
- The tool does not require any special device drivers.
- The tool is available for most major platforms (Windows, AIX®, Solaris, Linux, HP-UX, i5/OS).
- The tool is capable of uploading drive and library dump files.
- The tool's primary function is thoroughly testing a drive. However, if the library is online to the server/host where the tool resides, ITDT will communicate with the drive through the library to load and unload a test cartridge thereby exercising some library functions.

- The tool scans the host bus and will find and display for selection all IBM LTO devices. The tool will not display and allow for selection any non-IBM device.
- Each function has a "Help" selection which explains the required syntax as well as a brief explanation of the particular function.
- A Readme text file will be posted with the .exe for a thorough explanation of initial tool download information from the web as well as explanation of tool capabilities. Refer to the ITDT Readme text file for information on tool usage. You can also refer to the web at **http://www.ibm.com/support/fixcentral** and look for information about the ITDT site.
- The tool is available in two editions, ITDT-SE (Standard Edition) and ITDT-GE (Graphical Edition). More information about the ITDT editions can be found at **http://www.ibm.com/support/fixcentral**.

Updating the Firmware with an FMR Tape Cartridge

Attention: A SAS drive requires a SAS firmware image. Other types of firmware images will not load on the SAS drive.

To update the drive's firmware from an FMR tape cartridge:

1. Create an FMR tape (see "Function Code 3: Create FMR Tape" on page 3-13). A single FMR tape can be used to update multiple drives if the drives are the same drive type (e.g. LTO Gen 6) and host interface (e.g. SAS).
2. Update the drive firmware (see "Function Code 2: Update Drive Firmware from FMR Tape" on page 3-13).

After updating the drive firmware, the FMR tape can be used as a data cartridge by using the "Unmake FMR Tape" function (see "Function Code 8: Unmake FMR Tape" on page 3-17).

The SCD presents a series of random characters during the firmware download and update. The SCD briefly displays $\boxed{8}$, then becomes blank (not lit) when the firmware download and update is complete and there are no errors. An error code will be displayed if a firmware download or update error has been detected. The Ready light and the Fault light flash briefly during the firmware download and update. The Ready light turns On after the firmware download and update are complete.

Updating the Firmware using the Ethernet Port

Note: The drive uses a limited version of FTP protocol to communicate on the ethernet interface. It is recommended to use a simple, command line FTP session, such as the DOS command prompt, when communicating with the drive.

1. Obtain the latest drive firmware from the web, as described above.
2. Connect an ethernet patch cable to the drive's ethernet interface and to a computer. In order to meet electromagnetic immunity requirements, a shielded ethernet cable is required.
3. Create an FTP session between the drive and the computer. The drive's IP address: **169.254.0.3**
4. At the user prompt, type *guest* and press **Enter**.
5. At the password prompt, press **Enter**. No response is needed.
6. Type *bin* to set the communication mode to binary.

7. Type *put <firmware name>* to transfer the firmware to the drive. Replace *<firmware name>* with the actual firmware name. The drive will reset automatically when the transfer is complete and the FTP session will close.

8. After the drive resets, the new firmware will be loaded on the drive.

9. Remove the ethernet patch cable from the drive's ethernet interface and the computer.

Register for *My Support*

My Support registration provides e-mail notification when new firmware levels have been updated and are available for download and installation. To register for *My Support*, visit the web at **http://www.ibm.com/support/mySupport**

Chapter 3. Operations

Operating the drive involves using the following front panel items:

- Power button
- Single-character Display (SCD)
- SCD Dot
- Ready and Fault status lights
- Unload Button
- Encryption status light

Operating Modes

The drive functions in the following modes:

- Operation mode - functions include reading and writing data, cartridge manipulation, error reporting, and firmware updating using an FMR cartridge. For more information, see "Status Lights" on page 3-2.
- Maintenance mode - functions include drive diagnostic, creation/unmake FMR cartridge, and drive dump manipulation (force to RAM, copy to tape, copy to flash memory, and erase flash). For more information, see "Diagnostic and Maintenance Functions" on page 3-9.

The Unload button is used to switch between modes. For more information, see "Unload Button" on page 3-5.

Power Button

The Power Button is a push button that turns the tape drive on or off. The button is located on the front panel (see **7** in "Front Panel of the Drive" on page 1-2). When the Power Button is in the off position, the primary electrical power within the enclosure is still active. To remove all electrical power to the enclosure, unplug the power cord from the receptacle at the rear of the drive.

When the unit is powered-on but idle, the Ready light (see **2** in "Front Panel of the Drive" on page 1-2) is solid green; when it is performing a function, the Ready light is flashing green.

Single-character Display (SCD)

The SCD (**5** in "Front Panel of the Drive" on page 1-2) presents a single-character code for:

- Error conditions and informational messages
- Diagnostic or maintenance functions (while in maintenance mode only)

Appendix A, "Error Codes and Messages," on page A-1 lists the codes for error conditions and informational messages. If multiple errors occur, the code with the highest priority (represented by the lowest number) displays first. When the error is corrected, the code with the next highest priority displays, and so on until no errors remain.

"Diagnostic and Maintenance Functions" on page 3-9 lists the single-character codes that represent diagnostic or maintenance functions. To initiate a function the unit must be in maintenance mode.

The SCD is blank during normal operation.

SCD Dot

If a drive dump is present while the drive is in maintenance mode, a single dot illuminates in the lower right corner of the SCD (see **6** in "Front Panel of the Drive" on page 1-2). To copy the dump, see "Function Code 5: Copy Drive Dump" on page 3-14.

The SCD Dot is on solid if the dump is in RAM memory. The SCD Dot flashes if the dump is in FLASH memory.

The SCD Dot turns off when you obtain a dump (by using ITDT or a SCSI command) or update the drive firmware.

Note: If the drive dump is stored in RAM memory (SCD Dot on solid), the dump will be lost when you turn OFF the power or reset the drive.

Status Lights

The status lights (**2**, **3** and **4** in "Front Panel of the Drive" on page 1-2) are light-emitting diodes (LEDs) that provides information about the state of the drive. The Ready status light is green and the Fault status light is amber, and (when lit) solid or flashing. The Encryption status light is white.

Mode	SCD	Ready LED (green)	Fault LED (amber)
Operational	blank	On	Off
Activity (tape movement) in Operational Mode	blank	Flashing	Off
Maintenance	solid character	Flashing	On
Executing Maintenance Selection	flashing character	Off	On
Error Condition	solid character	Off	Flashing
Power-On / Reset Initialization	random segments	Off	On

Note: The white Encryption status light will be on when the tape drive has a cartridge loaded and all data on this cartridge is encrypted (excluding the label). LTO Ultrium 6 and Ultrium 5 cartridges only.

Table 3-1 on page 3-3 lists the conditions of the status lights and Single-character Display (SCD) and provides an explanation of what each condition means.

Table 3-1. Meaning of Status Lights and Single-character Display (SCD)

If the green Ready Status Light is...	and the amber Fault Status Light is...	and the Encryption Status Light is...	and the SCD is...	and the SCD Dot is...	Meaning
Off	Off	Off	Off	Off	The drive has no power or is powered off.
On	Off	On/Off	Off	Off	The drive is powered on and in an idle state. **Note:** If a cartridge is loaded, the white Encryption status light will be on when all the data on the cartridge is encrypted (excluding the label). LTO Ultrium 6 and Ultrium 5 cartridges only.
Flashing (once per second)	Off	On/Off	Off	Off	The drive is reading from the tape, writing to the tape, rewinding the tape, locating data on the tape, loading the tape, or unloading the tape. **Note:** The white Encryption status light will be on when all the data on the cartridge is encrypted (excluding the label). LTO Ultrium 6 and Ultrium 5 cartridges only.
Flashing (once per second)	Off	Off	Off	Off	If the drive contains a cartridge during the power-on cycle, the drive completes POST and slowly rewinds the tape (the process may take up to thirteen minutes). The light stops blinking and becomes solid when the drive completes the recovery and is ready for a read or write operation. To eject the cartridge, press the Unload button.
Off	On	Off	Displaying an error code or Maintenance Mode Function	On/Off	The drive is displaying error code(s) from the error code log on the SCD. For more information, see "Function Code 9: Display Error Code Log" on page 3-18 and Appendix A, "Error Codes and Messages," on page A-1.

Table 3-1. Meaning of Status Lights and Single-character Display (SCD) (continued)

If the green Ready Status Light is...	and the amber Fault Status Light is...	and the Encryption Status Light is...	and the SCD is...	and the SCD Dot is...	Meaning
On/Off	On/Off	On/Off	Displaying random segments/ Blank/ displaying random segments/ displaying ⑧ /Blank	On/Off	During power on, or a drive reset, the drive front panel will display drive progress as follows: 1. SCD will display random segments (no Lights ON). 2. SCD will display random segments (Ready light ON). 3. SCD will display random segments (Fault light ON) 4. SCD will display [8] (Ready, Fault, Encryption, and SCD Dot lights ON). 5. SCD will go blank (Ready light ON) after a successful power on or reset. If an error is detected during the power on or reset, the tape drive posts an error code to the SCD. To determine the error, locate the code in Appendix A, "Error Codes and Messages," on page A-1.
Off	On	Off	⓪	On/Off	The drive is entering or exiting from maintenance mode. For more information, see "Function Code 0: Maintenance Mode" on page 3-12.
Off	On	Off	Flashing selected function	On/Off	The drive is executing the selected function while in maintenance mode.
Off	Flashing (once per second)	Off	Displaying error code	Off	An error occurred and the drive or media may require service, or it may require cleaning. Note the code on the SCD, then go to Appendix A, "Error Codes and Messages," on page A-1 to determine the action that is required.
Off	Flashing	Off	Displaying Ⓒ	Off	The drive needs cleaning.
Off	Flashing	Off	Displaying Function Code ② or Flashing	Off	The drive is updating firmware.[1] The SCD will display a ② if using an FMR cartridge. The SCD will be off if using the host interface. For more information, see "Updating Firmware" on page 2-5.
Off	Flashing (twice per second)	Off	Off	Off	The drive detected an error and is performing a firmware recovery. It will reset automatically.
Off	On	Off	Flashing Ⓒ	Off	The drive is requesting a cartridge to be loaded.
Off	Flashing (twice per second)	Off	Off	On	There is a drive dump in flash memory.

If the green Ready Status Light is...	and the amber Fault Status Light is...	and the Encryption Status Light is...	and the SCD is...	and the SCD Dot is...	Meaning
[1] Power should not be removed from the drive until the microcode update is complete. The drive indicates that the update is complete by resetting and performing POST.					

Unload Button

The Unload Button (**1** in "Front Panel of the Drive" on page 1-2) performs the following functions:

Table 3-2. Functions that the Unload Button performs

Unload Button Function	How to Initiate the Function
Rewind the tape into the cartridge and eject the cartridge from the drive	Press the Unload Button once. The Ready light flashes while the drive is rewinding and unloading. **Note:** During a rewind and eject operation, the drive does not accept host interface commands.
Place the drive in maintenance mode	Ensure that the drive is unloaded. Then, within two seconds, press the Unload Button three times. The drive is in maintenance mode when the Ready light is flashing and 🔲 appears in the SCD. **Note:** While in maintenance mode, the drive does not accept host interface commands. **Note:** If you attempt to enter Maintenance Mode with a cartridge in the drive, the drive will rewind and eject the cartridge. Remove the cartridge and repeat the steps for entering Maintenance Mode.
Scroll through the maintenance functions	While in maintenance mode, press the Unload Button once per second to increment the display characters by one. When you reach the character of the diagnostic or maintenance function that you want (see "Diagnostic and Maintenance Functions" on page 3-9), press and hold the Unload Button for three seconds.
Exit maintenance mode	Press the Unload Button once per second to increment the display character until 🔲 displays. Then press and hold the Unload Button for three seconds. Maintenance mode is exited when the Ready light is On and the SCD becomes blank.
Force a drive dump (part of the maintenance mode)	**Attention:** If the drive detects a permanent error and displays an error code, it automatically forces a drive dump (also known as a save of the firmware trace). If you force a drive dump, the existing dump will be overwritten and data will be lost. After you force a drive dump, do not turn off the power to the drive or you may lose the dump data. Choose one of the following procedures: • If the drive is in maintenance mode (Ready light is flashing and Fault light is On for Maintenance mode), refer to "Function Code 4: Force a Drive Dump" on page 3-14. • If the drive is in operating mode (Ready light is On or flashing), press and hold the Unload Button for ten seconds. If captured dump data exists, the drive places it into a dump area (for information about retrieving the data, see "Procedure 1: Determining Firmware Level and Capturing Drive Dump" on page 5-1).

Table 3-2. Functions that the Unload Button performs (continued)

Unload Button Function	How to Initiate the Function
Reset the drive	Press and hold the Unload Button until the drive begins the reset procedure (Fault light will turn On when reset starts). **Note:** If a tape cartridge is loaded in the drive the drive will unload the tape. Repeat the "Reset the drive" procedure after the tape is unloaded. The drive saves a dump of the current drive state, then reboots to allow communication. Do not cycle power as this will erase the contents of the dump.

Inserting a Tape Cartridge

To insert a tape cartridge:

1. Ensure that the drive is powered-on.

2. Ensure that the write-protect switch on the tape cartridge is properly set (see "Write-Protect Switch" on page 4-7).

3. Grasp the cartridge so that the write-protect switch faces you (see **1** in Figure 3-1).

4. Slide the cartridge into the tape load compartment.

   Note:

   a. If the cartridge is already in an ejected position and you want to reinsert it, remove the cartridge then insert it again.

   b. If the cartridge is already loaded and you cycle the power (turn it off, then on), the tape will reload.

   c. Do not attempt to load a cartridge when the drive is in Maintenance Mode until the drive requests it.
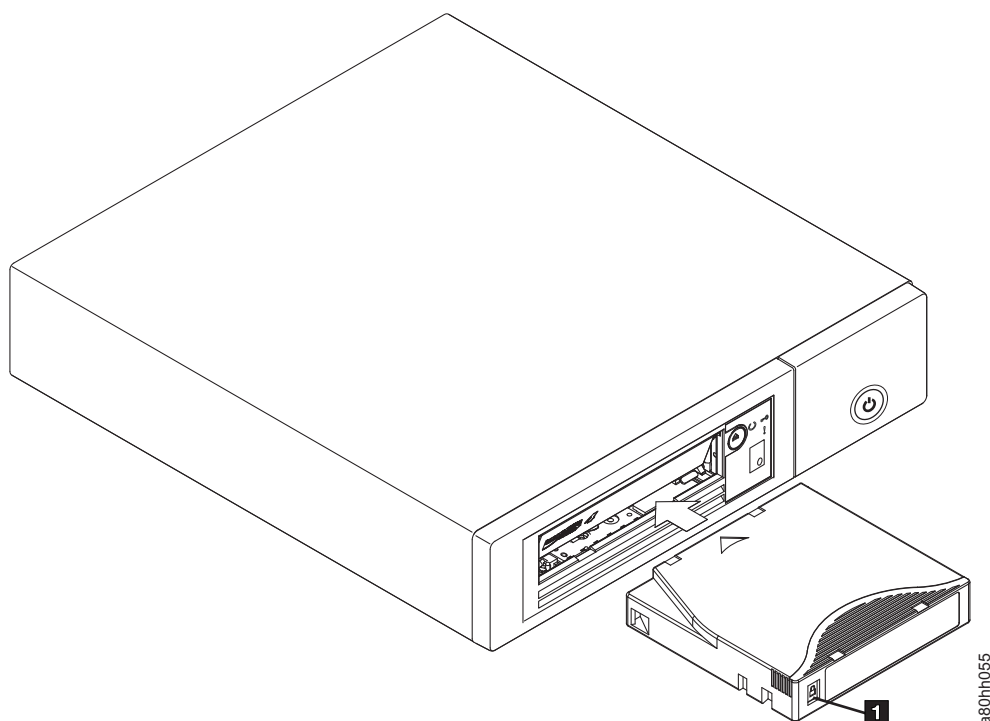
Figure 3-1. Inserting a cartridge into the drive

Removing a Tape Cartridge

To remove a tape cartridge:

1. Ensure that the drive is powered-on.
2. Press the Unload Button. The drive rewinds the tape and partially ejects the cartridge. The Ready light flashes while the tape rewinds, then goes out before the cartridge partially ejects.
3. After the cartridge partially ejects, grasp the cartridge and remove it.

   Important: Always remove an ejected cartridge before reinserting.

Whenever you unload a tape cartridge, the drive writes any pertinent information to the cartridge memory.

Mid-tape Recovery

If reset occurs while a cartridge is loaded, the drive will slowly rewind the tape and eject the cartridge. If a power cycle occurs while a cartridge is loaded, the drive will slowly rewind the tape. The drive will not automatically eject the cartridge.

The Ready light flashes and the SCD will be counting down from 9 to 0, indicating the approximate cartridge rewinding status. Between the counts, the SCD displays random segments while the tape is rewinding into the cartridge. Push the Unload Button to eject the cartridge when the Ready light stops flashing.

Cleaning the Drive Head

Attention: When cleaning the drive head, use the IBM LTO Ultrium Cleaning Cartridge (see "Ordering Media Supplies" on page 4-19). You may use another LTO cleaning cartridge, but it may not meet the standards of reliability established by IBM.

Clean the drive head whenever $\boxed{C}$ displays on the Single-character Display and the Fault light is flashing once per second. It is not recommended that you clean the drive head on a periodic basis; only when the drive requests to be cleaned.

Note: In Maintenance Mode, a flashing $\boxed{C}$ with the Fault light On, means to insert a cartridge, not clean the drive head.

To clean the head, insert the cleaning cartridge into the tape load compartment (see "Front Panel of the Drive" on page 1-2). The drive performs the cleaning automatically in less than three minutes, then ejects the cartridge. The drive will perform a short Load/Unload Test while ejecting the cartridge. Wait for the drive to finish before removing the cartridge.

Note: The drive will automatically eject an expired cleaning cartridge.

The IBM LTO Ultrium Cleaning Cartridge is valid for 50 uses, and then must be replaced.

Cleaning the Tape Drive

Clean the exterior surface of the tape drive with a damp towel. If a liquid all-purpose cleaner is used, apply it to the towel. Do not spray the tape drive.

Do not clean the interior of the tape drive; damage may result.

Tape Drive Status Web Page

The status of the tape drive is accessible from the tape drive's Ethernet port. The drive status can only be viewed; the status can not be changed from this page. The tape drive status is available when the drive is operating or idle (the drive must be powered on).

1. Connect the host computer or a laptop to the tape drive's Ethernet port (RJ45 connector) using an Ethernet patch cable.
2. Using a web browser, connect to http://169.254.0.3 to view the current tape drive status on an HTML web page. (If the drive's IP address has been changed, use that address instead.) The web page is static, so it must be refreshed frequently to show the latest drive status.

ULT3580-HH6 Drive YR1013000128

☐ **Text Only version (for cut and paste)**

```
system time: 2012/06/15 09:06:39
drive time : 259 seconds
```

☐ **Drive Information**	
☐ **Host Interface**	
☐ **Ethernet Settings**	☐ **VPD Encryption Settings**
☐ **Drive Statistics**	☐ **Tape Statistics**
☐ **Error Code Log**	

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Figure 3-2. Drive Status Web page

The tape drive model and serial number are shown at the top of the page.

The web page is divided into sections by topic. The topics are:
- Drive Information
- Host Information
- Ethernet Settings
- VPD Encryption Settings
- Drive Statistics
- Tape Statistics (if a cartridge is loaded in the tape drive)
- Engineering Error Log

Click in the box by the title of the section to see the topic details.

ULT3580-HH6 Drive YR1013000128

☐ **Text Only version (for cut and paste)**

```
system time: 2012/06/15 09:06:39
drive time : 259 seconds
```

☑ **Drive Information**

Serial Number	YR1013000128	Single Character Display	
Model	ULT3580-HH6	Status Indicators	
Code Level	LTO6_C68N	Current Time (origin)	259 seconds (Power On)
Status	idle		

☑ **Host Interface**

	Port 0	Port 1
Status	unknown	unknown
WWID	50050763124B6B89	50050763128B6B89
SAS Address		
Speed	unknown	unknown
Transport Layer Retries this Power-On	0	0

☑ **Ethernet Settings**

	Port 0
IP Addresses (Current)	169.254.0.3/24 fe80::221:5eff:fed5:e49d/64
MAC Address (VPD)	00:21:5E:D5:E4:9D
Drive IP Address 1 (VPD)	not set
Drive IP Address 2 (VPD)	not set
DHCP (VPD)	disabled

☑ **VPD Encryption Settings**

Encryption Method	None
Key Management	Default (by Method)
BOP Encryption	Disabled

☑ **Drive Statistics**

Drive Mounts	45
Drive MB Written	280830
Drive MB Read	948131
Power On Hours (current / VPD)	36 / 35

☑ **Tape Statistics**

Volume Serial	
Tape Mounts	94
Tape MB Written	1894168
Tape MB Read	1434841

☐ **Error Code Log**

a67b0027

Figure 3-3. Drive Status Web page - Topic details

The web page format can be changed to text mode by selecting the "Text Only version" box near the top of the web page. In text mode, the tape drive status information can be copied and pasted easily if it needs to be sent to support personnel.

Diagnostic and Maintenance Functions

The drive can:
- Run diagnostics
- Test write and read functions
- Test a suspect tape cartridge
- Update firmware
- Perform other diagnostic and maintenance functions

The drive must be in maintenance mode to perform these functions.

Attention: Maintenance functions cannot be performed concurrently with read or write operations. While in maintenance mode, the tape drive does not accept host interface commands from the server. The tape drive does accept LDI or RS-422 commands.

Table 3-3 describes each diagnostic and maintenance function that the drive can perform, gives the function code which appears on the Single-character Display (SCD), and directs you to the instructions for performing the function. It is recommended that you use a customer-supplied scratch (blank) data cartridge for diagnostic testing. The diagnostic and maintenance functions are not supported on the WORM and partitioned data tape cartridges.

Table 3-3. Diagnostic and maintenance functions

Function Code	Diagnostic or Maintenance Function	Instructions Location
0	**Exit Maintenance Mode:** Causes the drive to become available for reading and writing data.	"Function Code 0: Maintenance Mode" on page 3-12
1	**Run Drive Diagnostics:** Runs tests to determine whether the drive can properly load and unload cartridges, and read and write data.	"Function Code 1: Run Drive Diagnostics" on page 3-12
2	**Update Tape Drive Firmware from FMR Tape:** Loads updated firmware from a field microcode replacement (FMR) tape.	"Function Code 2: Update Drive Firmware from FMR Tape" on page 3-13
3	**Create FMR Tape:** Copies its field microcode replacement (FMR) data to a customer-supplied scratch (blank) data cartridge.	"Function Code 3: Create FMR Tape" on page 3-13
4	**Force a Drive Dump:** Performs a dump of data (also known as saving a microcode trace).	"Function Code 4: Force a Drive Dump" on page 3-14
5	**Copy Drive Dump:** Copies data from a drive dump (captured by using Function Code 4) to the beginning of a customer-supplied scratch (blank) data cartridge, copies a drive dump to flash memory, or erases a dump from flash memory.	"Function Code 5: Copy Drive Dump" on page 3-14
6	**Run Host Interface Wrap Test:** Performs a check of the circuitry from and to the connector.	"Function Code 6: Run Host Interface Wrap Test" on page 3-16
7	**Run RS-422 Wrap Test:** This test causes the drive to perform a check of the circuitry and connector for the RS-422 interface.	"Function Code 7: Run RS-422 Wrap Test" on page 3-17
8	**Unmake FMR Tape:** Erases the FMR data on a customer-supplied scratch (blank) data cartridge and rewrite the cartridge memory on the tape. This turns the cartridge into a valid customer-supplied scratch data cartridge.	"Function Code 8: Unmake FMR Tape" on page 3-17
9	**Display Error Code Log:** Displays the last 10 error codes, one at a time (the codes are ordered; the most recent is presented first and the oldest (tenth) is presented last).	"Function Code 9: Display Error Code Log" on page 3-18
A	**Clear Error Code Log:** Erases the contents of the error code log.	"Function Code A: Clear Error Code Log" on page 3-18
C	**Insert Cartridge into Tape Drive:** This function cannot be selected by itself, but is a part of other maintenance functions (such as Run Tape Drive Diagnostics and Create FMR Tape) that require a tape cartridge to be loaded.	"Function Code C: Insert Cartridge into Tape Drive" on page 3-19
E	**Test Cartridge & Media:** Performs tests to ensure that a suspect cartridge and its magnetic tape are acceptable.	"Function Code E: Test Cartridge & Media" on page 3-19
F	**Write Performance Test:** Performs tests to ensure that the drive can read from and write to tape.	"Function Code F: Write Performance Test" on page 3-20

Table 3-3. Diagnostic and maintenance functions (continued)

Function Code	Diagnostic or Maintenance Function	Instructions Location
H	**Test Head:** Performs tests to ensure that the tape drive's head and tape-carriage mechanics are working correctly.	"Function Code H: Test Head" on page 3-20
J	**Fast Read/Write Test:** Performs tests to ensure that the drive can read from and write to tape.	"Function Code J: Fast Read/Write Test" on page 3-22
L	**Load/Unload Test:** Tests the drive's ability to load and unload a tape cartridge.	"Function Code L: Load/Unload Test" on page 3-23
P	**Enable Post Error Reporting:** When selected, deferred-check conditions are reported to the host.	"Function Code P: Post Error Reporting Enabled" on page 3-23
U	**Disable Post Error Reporting:** When selected, deferred-check conditions are NOT reported to the host.	"Function Code U: Post Error Reporting Disabled" on page 3-24

Entering Maintenance Mode

The drive must be in maintenance mode to run drive diagnostics or maintenance functions. To place the unit in maintenance mode:

1. Make sure that no cartridge is in the drive.

2. Press the Unload Button three times within two seconds. ⃞ appears in the Single-character Display (SCD), the Ready light is flashing, and the Fault light turns On.

    Note: If a cartridge is in the tape drive, it will eject the first time that you press the Unload Button and the drive will not be placed in maintenance mode. To continue placing the drive in maintenance mode, perform the preceding step. While in Maintenance Mode, the drive will not accept a cartridge unless the drive requests it. The SCD will display a flashing ⃞ to indicate a cartridge needs to be inserted.

Maintenance functions cannot be performed concurrently with read or write operations. While in maintenance mode, the drive does not receive host interface commands from the server.

Exiting Maintenance Mode

The drive must be in Function Code ⃞ in order to exit Maintenance Mode.

To exit Maintenance Mode:

1. Press and hold the Unload Button for 3 or more seconds to take the drive out of maintenance mode. If no error is detected, ⃞ temporarily appears in the SCD, then goes blank. The drive then exits maintenance mode and the Ready light will turn On.

2. If an error is detected, the SCD shows an error code but still exits maintenance mode. To determine the error, locate the code in Appendix A, "Error Codes and Messages," on page A-1. To clear the error, turn the power off, then on again.

    Note: The drive also exits maintenance mode automatically after it completes a maintenance function or after 10 minutes if no action has occurred.

Function Code 0: Maintenance Mode

Function Code $\boxed{0}$ makes the drive available for running drive diagnostics or maintenance functions, or exiting from Maintenance Mode.

1. Place the drive in Maintenance Mode. For instructions, see"Entering Maintenance Mode" on page 3-11.
2. To exit Maintenance Mode, see "Exiting Maintenance Mode" on page 3-11.

The drive exits Maintenance Mode automatically after it completes a maintenance function or after 10 minutes if no action has occurred.

Function Code 1: Run Drive Diagnostics

Approximate Run Time = 5 minutes per loop

Total Number of Loops = 1

Function Code $\boxed{1}$ runs tests that determine whether the drive can properly load and unload cartridges and read and write data.

Record the time it takes for the test to complete. Compare the recorded time with the "Approximate Run Time" above. If the test runs successfully but the execution time is significantly longer than the "Approximate Run Time," run "Function Code F: Write Performance Test" on page 3-20. If the Write Performance Test fails, replace the media and exit maintenance mode.

Attention: For this test, insert only a scratch (blank) data cartridge or a cartridge that may be overwritten. During the test, the drive overwrites the data on the cartridge.

Note: If you inserted an invalid tape cartridge (e.g., Ultrium 3 or WORM tape cartridge), error code $\boxed{U}$ or $\boxed{7}$ appears in the SCD. If you inserted a write-protected cartridge, or the media has read-only compatibility (e.g., Ultrium 4 tape cartridge), error code $\boxed{P}$ appears in the SCD. In either case, the tape drive unloads the cartridge and exits Maintenance Mode after the cartridge is removed.

Steps to Execute Run Drive Diagnostics:

1. Place the drive in Maintenance Mode. For instructions, see "Entering Maintenance Mode" on page 3-11.

2. Press the Unload Button once per second until $\boxed{1}$ appears in the SCD. (If you cycle past the desired code, press the Unload Button once per second until the code reappears.)

3. Press and hold the Unload Button for three or more seconds, then release it to select function $\boxed{1}$. Wait for the SCD to change to a flashing $\boxed{C}$, requesting a cartridge.

4. Insert a scratch (blank) data cartridge. The SCD changes to a flashing $\boxed{1}$ and the test begins. During the test, the drive will Unload/Load the cartridge. Do not remove the cartridge during the test.

- If <u>no</u> error is detected, the diagnostic will loop and begin again. To stop the loop, press the Unload Button for one second and release. When the loop ends, $\boxed{0}$ temporarily appears in the SCD, and the tape drive exits Maintenance Mode.
- If an error is detected, the Fault light flashes and the drive posts an error code to the SCD. To determine the error, locate the code in Table A-1 on page A-1. To clear the error either turn the power off and then on again, or reboot the drive by pressing and holding the Unload Button for 10 seconds.

Function Code 2: Update Drive Firmware from FMR Tape

Attention: When updating drive firmware, do not power-off the drive until the update is complete or the firmware may be lost.

Function Code $\boxed{2}$ loads drive firmware from a field microcode replacement (FMR) tape. The FMR tape must have been created from a LTO Ultrium 6 tape drive with the same host interface (SAS or Fibre Channel).

1. Place the drive in Maintenance Mode. For instructions, see "Entering Maintenance Mode" on page 3-11.

2. Press the Unload Button once per second until $\boxed{2}$ appears in the SCD. (If you cycle past the desired code, press the Unload Button once per second until the code reappears.)

3. Press and hold the Unload Button for three or more seconds, then release it to select the function. The SCD changes to a flashing $\boxed{C}$, requesting a cartridge.

4. Insert the FMR tape cartridge. The SCD changes to a flashing $\boxed{2}$. The Fault light will be ON solid during tape movement and flashing while code is being loaded. The Ready light will be OFF. The tape drive loads the updated firmware from the FMR tape into its erasable programmable read-only memory (EPROM) area.
   - If the update completes successfully, the tape drive rewinds and unloads the FMR tape, resets itself, and is ready to use the new firmware. The drive automatically reboots.
   - If the update fails, the tape drive posts an error code to the SCD. To determine the error, locate the code in Table A-1 on page A-1. The drive then unloads the FMR tape and exits maintenance mode after the cartridge is removed. Contact IBM Technical Support for problem determination or machine replacement.

Function Code 3: Create FMR Tape

Function Code $\boxed{3}$ copies the drive's field microcode replacement (FMR) data to a scratch data cartridge. The resulting FMR tape can only be used to update the firmware on other LTO Ultrium 6 tape drives with the same host interface (SAS or Fibre Channel).

Attention: For this function, insert only a scratch (blank) data cartridge or a cartridge that may be overwritten. During the test, the drive overwrites the data on the cartridge.

Note: If you inserted an invalid tape cartridge (e.g., Ultrium 3 or WORM tape cartridge), error code ⊔ or 7 appears in the SCD. If you inserted a write-protected cartridge, or the media has read-only compatibility (e.g., Ultrium 4 tape cartridge), error code P appears in the SCD. In either case, the tape drive unloads the cartridge and exits Maintenance Mode after the cartridge is removed.

1. Place the drive in Maintenance Mode. For instructions, see "Entering Maintenance Mode" on page 3-11.

2. Press the Unload Button once per second until ∃ appears in the SCD. (If you cycle past the desired code, press the Unload Button once per second until the code reappears.)

3. Press and hold the Unload Button for three or more seconds, then release it to select the function. The SCD changes to a flashing C, requesting a cartridge.

4. Insert a scratch (blank) data cartridge that is not write protected (or the tape drive exits maintenance mode). The SCD changes to a flashing ∃. The tape drive copies the FMR data to the scratch data cartridge.

   • If the tape drive creates the FMR tape successfully, it rewinds and unloads the new tape, exits Maintenance Mode, and the tape is ready to use.

   • If the tape drive fails to create the FMR tape, it displays an error code. To determine the error, see Table A-1 on page A-1. The tape drive then unloads the FMR tape, and exits Maintenance Mode after the cartridge is removed.

Function Code 4: Force a Drive Dump

Function Code 4 performs a dump of data collected by the drive (this process is also known as saving a microcode trace).

1. Place the drive in Maintenance Mode. For instructions, see "Entering Maintenance Mode" on page 3-11.

2. Press the Unload Button once per second until 4 appears in the SCD. (If you cycle past the desired code, press the Unload Button once per second until the code reappears.)

3. Press and hold the Unload Button for three or more seconds, then release it to select the function. The drive performs the dump. The SCD shows 0, then goes blank, and the drive exits Maintenance Mode. To access the contents of the dump, see "Function Code 5: Copy Drive Dump."

   Note: You can also force a drive dump when the tape drive is in normal operating mode. Simply press and hold the Unload Button for ten seconds. This causes the drive to reboot.

Function Code 5: Copy Drive Dump

Function Code 5 copies data from a drive dump (captured in Function Code 4) to the beginning of a scratch (blank) data cartridge.

Attention: For this function, insert only a scratch (blank) data cartridge or a cartridge that may be overwritten. During the test, the drive overwrites the data on the cartridge.

Note: If you inserted an invalid tape cartridge (e.g., Ultrium 3 or WORM tape cartridge), error code $⊔$ or 7 appears in the SCD. If you inserted a write-protected cartridge, or the media has read-only compatibility (e.g., Ultrium 4 tape cartridge), error code P appears in the SCD. In either case, the tape drive unloads the cartridge and exits Maintenance Mode after the cartridge is removed.

1. Place the drive in Maintenance Mode. For instructions, see "Entering Maintenance Mode" on page 3-11.

2. Press the Unload Button once per second until 5 appears in the SCD. If you cycle past the desired code, press the Unload Button once per second until the code reappears.

3. Press and hold the Unload Button for three or more seconds, then release it to select the function.

4. Press the Unload Button once per second to cycle through the following functions:

   - 5 - 0 : no function

   - 5 - 1 : copy dump to tape; clears RAM dump

   - 5 - 2 : copy dump to flash memory; clears RAM dump

   - 5 - 3 : erase flash memory

   If you cycle past the desired code, press the Unload Button once per second until the code reappears.

5. Press and hold the Unload Button for three or more seconds, then release it to select one of the above functions.

6. If you selected 5 - 0 the drive will exit Maintenance Mode. If you selected 5 - 2 or 5 - 3 the SCD will change to a flashing 5 while the procedure is being performed. After the procedure is completed the drive will exit Maintenance Mode. If you selected 5 - 1 the SCD will change to a flashing C indicating that a data cartridge is to be inserted.

7. Insert a scratch (blank) data cartridge within 60 seconds, or the drive will exit Maintenance Mode. Ensure the scratch cartridge is not write protected, or the tape drive exits maintenance mode. The SCD flashes the selection number while performing the function.
   - If the copy operation completes successfully, the tape drive rewinds and unloads the tape, and exits Maintenance Mode after the cartridge is removed.
   - If the copy operation fails, an error code appears in the SCD. To determine the error, locate the code in Table A-1 on page A-1. The tape drive unloads the tape cartridge and exits Maintenance Mode after the cartridge is removed.

Function Code 6: Run Host Interface Wrap Test

Approximate Run Time = 10 seconds per loop

Number of Loops = This test runs until stopped by pressing the Unload Button.

Function Code **6** performs a check of the host interface circuitry and host connector on the drive.

1. Make sure that the host interface wrap plug is connected to the host interface connector at the rear of the drive.
   - Connect the wrap plug to the SAS port to be tested.

2. Place the drive in Maintenance Mode. For instructions, see "Entering Maintenance Mode" on page 3-11.

3. Press the Unload Button once per second until **6** appears in the SCD.
   - To test the SAS interface on the drive,

     a. Index through the Maintenance Mode options until **6** appears in the SCD.
     b. Press and hold the Unload Button for three seconds to select Function Code **6** .
     c. After selecting Function Code **6** the SCD will display option **6** - **1** .
     d. Press the Unload Button within 5 seconds to make a different selection. If no other selection is made, the drive will perform option **6** - **1** .

4. Continue to press the Unload Button once per second to cycle through the following functions:
   - **6** - **1** : test the primary SAS port
   - **6** - **2** : test the secondary SAS port
   - **6** - **3** : test both primary and secondary SAS ports at the same time (requires a wrap plug in both ports)
   - **6** - **0** : exit

5. Press and hold the Unload Button for three or more seconds, then release it to select one of the above functions. The drive automatically starts the test. If you cycle past the desired code, press the Unload Button once per second until the code reappears.

6. The SCD will display a flashing **6** during the test.
   - If <u>no</u> error is detected, the diagnostic will loop and begin again. To stop the loop, press the Unload Button for one second and release. When the loop ends, **0** temporarily appears in the SCD, and the tape drive exits Maintenance Mode.
   - If an error is detected, the Fault light flashes and the drive posts an error code to the SCD. To determine the error, locate the code in Table A-1 on page A-1. To clear the error either turn the power off and then on again, or reboot the drive by pressing and holding the Unload Button for 10 seconds.

Function Code 7: Run RS-422 Wrap Test

Note: This function is described here for information only. It is not supported on the IBM System Storage TS2260 Tape Drive.

This test causes the drive to perform a check of the circuitry and connector for the RS-422 interface. This connector supports the Library Drive Interface (LDI) and the Automation Drive Interface (ADI).

Before selecting this function, attach an LDI or RS-422 wrap plug to the drive's LDI or RS-422 connector (in place of the LDI or RS-422 cable).

1. Make sure that no cartridge is in the drive, and the appropriate wrap plug is attached to the RS-422 connector.
2. Place the drive in Maintenance Mode. For instructions, see "Entering Maintenance Mode" on page 3-11.
3. Press the Unload Button once per second until $\boxed{7}$ appears in the Single-character Display (SCD). If you cycle past $\boxed{7}$, continue to press the Unload Button until it displays again.
4. To select the function, press and hold the Unload Button for three seconds. After you select the function, $\boxed{7}$ flashes and the drive automatically starts the test.
   - If no error is detected, the diagnostic will loop and begin again. To stop the loop, press the Unload Button for one second and release. When the loop ends, $\boxed{0}$ temporarily appears in the SCD, and the tape drive exits Maintenance Mode.
   - If an error is detected, the Fault light flashes and the drive posts an error code to the SCD. To determine the error, locate the code in Table A-1 on page A-1. To clear the error either turn the power off and then on again, or reboot the drive by pressing and holding the Unload Button for 10 seconds.

Function Code 8: Unmake FMR Tape

Function Code $\boxed{8}$ erases the field microcode replacement (FMR) data and rewrites the cartridge memory on the tape. This converts the cartridge into a valid scratch (blank) data cartridge.

1. Place the drive in maintenance mode. For instructions, see "Entering Maintenance Mode" on page 3-11.
2. Press the Unload Button once per second until $\boxed{8}$ appears in the SCD. (If you cycle past the desired code, press the Unload Button once per second until the code reappears.)
3. Press and hold the Unload Button for three or more seconds, then release it to select function $\boxed{8}$. The SCD changes to a flashing $\boxed{C}$, requesting a cartridge.
4. Insert the FMR data cartridge (or the tape drive exits maintenance mode). The SCD changes to a flashing $\boxed{8}$. The tape drive erases the firmware on the tape and rewrites the header in the cartridge memory to change the cartridge to a valid scratch (blank) data cartridge: The drive then ejects the cartridge and exits Maintenance Mode.

Note: If you inserted an invalid tape cartridge (e.g., Ultrium 3 or WORM tape cartridge), error code ⎣⎦ or ⎡7⎦ appears in the SCD. If you inserted a write-protected cartridge, or the media has read-only compatibility (e.g., Ultrium 4 tape cartridge), error code ⎡P⎦ appears in the SCD. In either case, the tape drive unloads the cartridge and exits Maintenance Mode after the cartridge is removed.

- If the tape drive creates the scratch tape successfully, it rewinds and unloads the new tape, exits Maintenance Mode, and the tape is ready to use.
- If the tape drive fails to create the scratch tape, it displays an error code. To determine the error, see Table A-1 on page A-1. The tape drive then unloads the FMR tape, and exits Maintenance Mode after the cartridge is removed.

Function Code 9: Display Error Code Log

Function Code ⎡9⎦ displays the last ten error codes, one at a time (the codes are ordered; the most recent is presented first and the oldest is presented last). If there are no errors in the log, function code ⎡0⎦ displays in the Single-character Display (SCD) and exits Maintenance Mode.

1. Place the drive in Maintenance Mode. For instructions, see "Entering Maintenance Mode" on page 3-11.

2. Press the Unload Button once per second until ⎡9⎦ appears in the SCD. (If you cycle past the desired code, press the Unload Button once per second until the code reappears.)

3. Press and hold the Unload Button, then release it to view the most recent error code.

4. Press and release the Unload Button again to view successive error codes. Let two to three seconds pass between each depression. The Ready light and Fault light will flash On/Off once for each successive error code. The SCD will display ⎡0⎦ when all the error codes have been displayed.

5. After viewing all error codes, exit this function by pressing the Unload Button again. The SCD will display ⎡0⎦ and exit Maintenance Mode.

Function Code A: Clear Error Code Log

Function Code ⎡A⎦ erases the contents of the error code log.

1. Place the drive in Maintenance Mode. For instructions, see "Entering Maintenance Mode" on page 3-11.

2. Press the Unload Button once per second until ⎡A⎦ appears in the SCD. (If you cycle past the desired code, press the Unload Button once per second until the code reappears.)

3. Press and hold the Unload Button for three or more seconds, then release it to select the function. ⎡A⎦ flashes in the SCD, followed by ⎡0⎦ . The tape drive erases all errors from the error code log and exits Maintenance Mode.

Function Code C: Insert Cartridge into Tape Drive

This function cannot be selected by itself, but is part of other maintenance functions (such as Run Tape Drive Diagnostics and Create FMR Tape) that require a tape cartridge to be inserted.

Function Code E: Test Cartridge & Media

Approximate Run Time = 15 minutes per loop

Total Number of Loops = 10

Function Code $\boxed{E}$ performs tests that determine whether a suspect cartridge and its magnetic tape are acceptable.

Press the Unload Button to stop the diagnostic and exit maintenance mode. Pressing the Unload Button once will abort the test at the end of the current test loop. Pressing the Unload Button twice will abort the test immediately. Wait for the drive to rewind the tape and unload the cartridge.

Attention: When you perform this test, data on the suspect tape will be overwritten.

Note: If you inserted an invalid tape cartridge (e.g., Ultrium 3 or WORM tape cartridge), error code $\boxed{J}$ or $\boxed{7}$ appears in the SCD. If you inserted a write-protected cartridge, or the media has read-only compatibility (e.g., Ultrium 4 tape cartridge), error code $\boxed{P}$ appears in the SCD. In either case, the tape drive unloads the cartridge and exits Maintenance Mode after the cartridge is removed.

1. Place the drive in Maintenance Mode. For instructions, see "Entering Maintenance Mode" on page 3-11.

2. Press the Unload Button once per second until $\boxed{E}$ appears in the SCD. (If you cycle past the desired code, press the Unload Button once per second until the code reappears.)

3. Press and hold the Unload Button for three or more seconds, then release it to select the function. The SCD changes to a flashing $\boxed{C}$, requesting a cartridge.

4. Ensure that the write-protect switch on the cartridge is off, then insert the cartridge (or the tape drive exits maintenance mode). The SCD changes to a flashing $\boxed{E}$. The tape drive runs the tests.

   • If no error is detected, the diagnostic will loop and begin again. To stop the loop, press the Unload Button for one second and release. When the loop ends, $\boxed{0}$ temporarily appears in the SCD, and the tape drive exits Maintenance Mode.

   • If an error is detected, the Fault light flashes and the drive posts an error code to the SCD. To determine the error, locate the code in Table A-1 on page A-1. To clear the error either turn the power off and then on again, or reboot the drive by pressing and holding the Unload Button for 10 seconds.

Function Code F: Write Performance Test

Approximate Run Time = 7 minutes per loop

Total Number of Loops = 10

Function Code $\boxed{F}$ performs tests to ensure that the drive can read from and write to tape.

Press the Unload Button to stop the diagnostic and exit maintenance mode. Pressing the Unload Button once will abort the test at the end of the current test loop. Pressing the Unload Button twice will abort the test immediately. Wait for the drive to rewind the tape and unload the cartridge.

Attention: For this test, insert only a scratch (blank) data cartridge or a cartridge that may be overwritten. During the test, the drive overwrites the data on the cartridge.

Note: If you inserted an invalid tape cartridge (e.g., Ultrium 3 or WORM tape cartridge), error code $\boxed{\sqcup}$ or $\boxed{7}$ appears in the SCD. If you inserted a write-protected cartridge, or the media has read-only compatibility (e.g., Ultrium 4 tape cartridge), error code $\boxed{P}$ appears in the SCD. In either case, the tape drive unloads the cartridge and exits Maintenance Mode after the cartridge is removed.

1. Place the drive in Maintenance Mode. For instructions, see "Entering Maintenance Mode" on page 3-11.

2. Press the Unload Button once per second until $\boxed{F}$ appears in the SCD. (If you cycle past the desired code, press the Unload Button once per second until the code reappears.)

3. Press and hold the Unload Button for three or more seconds, then release it to select the function. The SCD changes to a flashing $\boxed{C}$, requesting a cartridge.

4. Insert a scratch (blank) data cartridge. The SCD changes to a flashing $\boxed{F}$ and the tape drive runs the tests.
   - If no error is detected, the diagnostic will loop and begin again. To stop the loop, press the Unload Button for one second and release. When the loop ends, $\boxed{0}$ temporarily appears in the SCD, and the tape drive exits Maintenance Mode.
   - If an error is detected, the Fault light flashes and the drive posts an error code to the SCD. To determine the error, locate the code in Table A-1 on page A-1. To clear the error either turn the power off and then on again, or reboot the drive by pressing and holding the Unload Button for 10 seconds.

Function Code H: Test Head

Approximate Run Time = 12 minutes per loop

Total Number of Loops = 10

Function Code H performs tests to ensure that the tape drive's head and tape-carriage mechanics work correctly.

Once you begin this test, the diagnostic begins the loop sequence. Time the first loop by pressing the Unload Button once to stop the diagnostic after the completion of the first loop, then record the time it takes for the test to complete. Compare the recorded time with the "Approximate Run Time" above. If the test runs successfully but the execution time is significantly longer than the "Approximate Run Time", run "Function Code F: Write Performance Test" on page 3-20. If the Write Performance Test fails, replace the media and exit maintenance mode.

Press the Unload Button to stop the diagnostic and exit maintenance mode. Pressing the Unload Button once will abort the test at the end of the current test loop. Pressing the Unload Button twice will abort the test immediately. Wait for the drive to rewind the tape and unload the cartridge.

Attention: For this test, insert only a scratch (blank) data cartridge or a cartridge that may be overwritten. During the test, the drive overwrites the data on the cartridge.

Note: If you inserted an invalid tape cartridge (e.g., Ultrium 3 or WORM tape cartridge), error code J or 7 appears in the SCD. If you inserted a write-protected cartridge, or the media has read-only compatibility (e.g., Ultrium 4 tape cartridge), error code P appears in the SCD. In either case, the tape drive unloads the cartridge and exits Maintenance Mode after the cartridge is removed.

1. Place the drive in Maintenance Mode. For instructions, see "Entering Maintenance Mode" on page 3-11.

2. Press the Unload Button once per second until H appears in the SCD. (If you cycle past the desired code, press the Unload Button once per second until the code reappears.)

3. Press and hold the Unload Button for three or more seconds, then release it to select the function. The SCD changes to a flashing C, requesting a cartridge.

4. Insert a scratch (blank) data cartridge. The SCD changes to a flashing H. The tape drive runs the tests.

   • If no error is detected, the diagnostic will loop and begin again. To stop the loop, press the Unload Button for one second and release. When the loop ends, 0 temporarily appears in the SCD, and the tape drive exits Maintenance Mode.

   • If an error is detected, the Fault light flashes and the drive posts an error code to the SCD. To determine the error, locate the code in Table A-1 on page A-1. To clear the error either turn the power off and then on again, or reboot the drive by pressing and holding the Unload Button for 10 seconds.

Function Code J: Fast Read/Write Test

Approximate Run Time = 7 minutes per loop

Total Number of Loops = 10

Function Code ⊔ performs tests to ensure that the drive can read from and write to tape.

Once you begin this test, the diagnostic begins the loop sequence. Time the first loop by pressing the Unload Button once to stop the diagnostic after the completion of the first loop, then record the time it takes for the test to complete. Compare the recorded time with the "Approximate Run Time" above. If the test runs successfully but the execution time is significantly longer than the "Approximate Run Time", run "Function Code F: Write Performance Test" on page 3-20. If the Write Performance Test fails, replace the media and exit maintenance mode.

Press the Unload Button to stop the diagnostic and exit maintenance mode. Pressing the Unload Button once will abort the test at the end of the current test loop. Pressing the Unload Button twice will abort the test immediately. Wait for the drive to rewind the tape and unload the cartridge.

Attention: For this test, insert only a scratch (blank) data cartridge or a cartridge that may be overwritten. During the test, the drive overwrites the data on the cartridge.

Note: If you inserted an invalid tape cartridge (e.g., Ultrium 3 or WORM tape cartridge), error code ⊔ or 7 appears in the SCD. If you inserted a write-protected cartridge, or the media has read-only compatibility (e.g., Ultrium 4 tape cartridge), error code P appears in the SCD. In either case, the tape drive unloads the cartridge and exits Maintenance Mode after the cartridge is removed.

1. Place the drive in Maintenance Mode. For instructions, see "Entering Maintenance Mode" on page 3-11.

2. Press the Unload Button once per second until ⊔ appears in the SCD. (If you cycle past the desired code, press the Unload Button once per second until the code reappears.)

3. Press and hold the Unload Button for three or more seconds, then release it to select the function. The SCD changes to a flashing C , requesting a cartridge.

4. Insert a scratch (blank) data cartridge. The SCD changes to a flashing ⊔ and the tape drive runs the tests.
   - If no error is detected, the diagnostic will loop and begin again. To stop the loop, press the Unload Button for one second and release. When the loop ends, 0 temporarily appears in the SCD, and the tape drive exits Maintenance Mode.
   - If an error is detected, the Fault light flashes and the drive posts an error code to the SCD. To determine the error, locate the code in Table A-1 on page A-1. To clear the error either turn the power off and then on again, or reboot the drive by pressing and holding the Unload Button for 10 seconds.

Function Code L: Load/Unload Test

Approximate Run Time = 30 seconds per loop

Total Number of Loops = 10

Function Code $\boxed{L}$ tests the drive's ability to load and unload a tape cartridge.

Press the Unload Button to stop the diagnostic and exit maintenance mode. Pressing the Unload Button once will abort the test at the end of the current test loop. Pressing the Unload Button twice will abort the test immediately. Wait for the drive to rewind the tape and unload the cartridge.

Attention: Even though no data is written during this test, it is recommended that you use a blank (scratch) cartridge for this test.

Note: If you inserted an invalid tape cartridge (e.g., Ultrium 3 or WORM tape cartridge), error code $\boxed{J}$ or $\boxed{7}$ appears in the SCD. If you inserted a write-protected cartridge, or the media has read-only compatibility (e.g., Ultrium 4 tape cartridge), error code $\boxed{P}$ appears in the SCD. In either case, the tape drive unloads the cartridge and exits Maintenance Mode after the cartridge is removed.

1. Place the drive in Maintenance Mode. For instructions, see "Entering Maintenance Mode" on page 3-11.

2. Press the Unload Button once per second until $\boxed{L}$ appears in the SCD. (If you cycle past the desired code, press the Unload Button once per second until the code reappears.)

3. Press and hold the Unload Button for three or more seconds, then release it to select the function. The SCD changes to a flashing $\boxed{C}$, requesting a cartridge.

4. Insert a scratch (blank) data cartridge. The SCD changes to a flashing $\boxed{L}$ and the tape drive runs the tests.
   - If <u>no</u> error is detected, the diagnostic will loop and begin again. To stop the loop, press the Unload Button for one second and release. When the loop ends, $\boxed{0}$ temporarily appears in the SCD, and the tape drive exits Maintenance Mode.
   - If an error is detected, the Fault light flashes and the drive posts an error code to the SCD. To determine the error, locate the code in Table A-1 on page A-1. To clear the error either turn the power off and then on again, or reboot the drive by pressing and holding the Unload Button for 10 seconds.

Function Code P: Post Error Reporting Enabled

When Post Error Reporting is enabled, deferred-check conditions are reported to the host and temporary errors are reported in the sense data. Function Code $\boxed{P}$ will be displayed in Maintenance Mode when the drive has Post Error Reporting enabled.

This selection is normally used as a request from support personnel.

1. Place the drive in Maintenance Mode. For instructions, see "Entering Maintenance Mode" on page 3-11.

2. Press the Unload Button once per second until either `P` or `U` appears in the SCD. `P` or `U` will appear in the SCD to indicate the current setting for Post Error Reporting. If you cycle past the desired code, press the Unload Button once per second until the code reappears.

3. Exit Maintenance Mode if you do not want to change the current setting for Post Error Reporting. For instructions, see "Exiting Maintenance Mode" on page 3-11.

4. To disable Post Error Reporting, Press and hold the Unload Button for three seconds while `P` appears in the SCD. The SCD changes to `U` after you release the Unload Button.

5. Press the Unload Button once per second to select another Maintenance Mode Function. To exit Maintenance Mode, refer to "Exiting Maintenance Mode" on page 3-11.

Function Code U: Post Error Reporting Disabled

When Post Error Reporting is disabled, deferred-check conditions are not reported to the host and temporary errors are not reported in the sense data. This is the normal (default) setting for the drive. When the drive has Post Error Reporting disabled, Function Code `U` will be displayed in Maintenance Mode. The drive will default to Post Error Reporting disabled after a reboot or power off/on cycle.

1. Place the drive in Maintenance Mode. For instructions, see "Entering Maintenance Mode" on page 3-11.

2. Press the Unload Button once per second until either `P` or `U` appears in the SCD. `P` or `U` will appear in the SCD to indicate the current setting for Post Error Reporting. If you cycle past the desired code, press the Unload Button once per second until the code reappears.

3. Exit Maintenance Mode if you do not want to change the current setting for Post Error Reporting. For instructions, see "Exiting Maintenance Mode" on page 3-11.

4. To disable Post Error Reporting, Press and hold the Unload Button for three seconds while `P` appears in the SCD. The SCD changes to `U` after you release the Unload Button.

5. Press the Unload Button once per second to select another Maintenance Mode Function. To exit Maintenance Mode, refer to "Exiting Maintenance Mode" on page 3-11.

Tape Drive Diagnostic and Maintenance Web Page

Several of the tape drive's maintenance functions are run using the tape drive's Ethernet port. These are the same maintenance functions that are performed using the Unload button on the drive's front panel.

Refer to the "Diagnostic and Maintenance Functions" on page 3-9 section in this User's Guide for information about these maintenance functions.

1. Connect the host computer or a laptop to the tape drive's Ethernet port (RJ45 connector) using an Ethernet patch cable.
2. Using a web browser, connect to http://169.254.0.3/service.html to access the tape drive maintenance function menu on an HTML web page. (If the drive's IP address has been changed, use that address instead.)

The tape drive model and serial number are shown at the top of the page. A list of the maintenance functions is shown on the page.

Figure 3-4. Tape Drive Diagnostic page

Click the radio button next the maintenance function, then click **Run** to start the maintenance function.

If the tape drive is installed in a library, some of the maintenance functions cannot be run using the Ethernet procedure.

The status of the maintenance function is shown under the Drive Response. The web page is static so it must be refreshed frequently to show the latest maintenance function status.

Press the **Cancel now** or **Cancel at end of loop** button to stop the maintenance function. It may take several minutes for the maintenance function to end.

Chapter 4. Using Ultrium Media

IBM Ultrium media is available in the following types:

- Data Cartridge
- WORM (Write Once, Read Many) Cartridge
- Cleaning Cartridge

To ensure that your IBM Ultrium 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 LTO Ultrium Data Cartridge cannot be interchanged with the media used in other IBM non-LTO Ultrium tape products.

Figure 4-1 shows the IBM LTO Ultrium 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
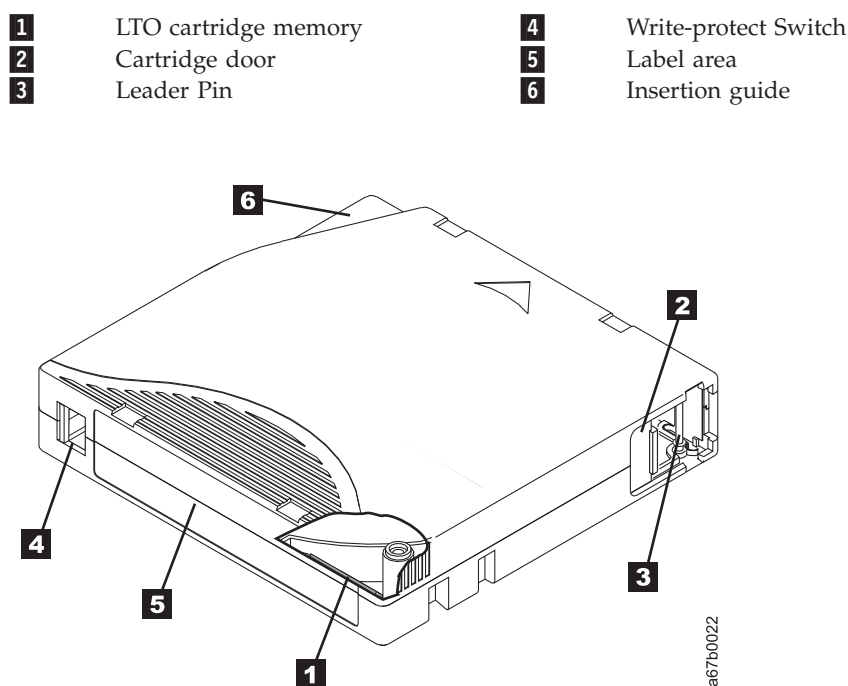
Figure 4-1. The IBM LTO Ultrium Data Cartridge

Data Cartridges

The different generations of IBM Ultrium data cartridges can be identified by color:

Type	Color
Ultrium 6	Black
Ultrium 6 WORM	Black and Silvery gray
Ultrium 5	Burgundy
Ultrium 5 WORM	Burgundy and Silvery gray
Ultrium 4	Green
Ultrium 4 WORM	Green and Silvery gray

Type	Color
Ultrium 3	Slate Blue
Ultrium 3 WORM	Slate Blue and Silvery gray
Ultrium 2	Purple
Ultrium 1	Black

All generations contain 1/2-inch, dual-coat, magnetic tape.

You can order tape cartridges with the bar code labels included, or you can order custom labels. To obtain tape cartridges and bar code labels, see "Ordering Media Supplies" on page 4-19.

When processing tape in the cartridges, Ultrium Tape Drives use a linear, serpentine recording format. The native data capacity and recording format of Ultrium data cartridges is as follows:

Type	Native Data Capacity	Recording Format
Ultrium 6	2500 GB (6250 GB at 2.5:1 compression)	Reads and writes data on 2176 tracks, sixteen tracks at a time
Ultrium 5	1500 GB (3000 GB at 2:1 compression)	Reads and writes data on 1280 tracks, sixteen tracks at a time
Ultrium 4	800 GB (1600 GB at 2:1 compression)	Reads and writes data on 896 tracks, sixteen tracks at a time.
Ultrium 3	400 GB (800 GB at 2:1 compression)	Reads and writes data on 704 tracks, sixteen tracks at a time
Ultrium 2	200 GB (400 GB at 2:1 compression)	Reads and writes data on 512 tracks, eight tracks at a time
Ultrium 1	100 GB (200 GB at 2:1 compression)	Reads and writes data on 384 tracks, eight tracks at a time

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 cartridge is full, or until all data is written.

The cartridge door (**2** Figure 4-1 on page 4-1) protects the tape from contamination when the cartridge is out of the drive. The tape is attached to a leader pin (**3** in in Figure 4-1 on page 4-1) behind the door. When the cartridge is inserted into the drive, a threading mechanism pulls the pin (and tape) out of the cartridge, across the drive head, and onto a non-removable take-up reel. The head can then read or write data from or to the tape.

The write-protect switch (**4** in Figure 4-1 on page 4-1) prevents data from being written to the tape cartridge. For more information, see "Write-Protect Switch" on page 4-7.

The label area (**5** in Figure 4-1 on page 4-1) provides a location to place a label. For more information, see "Bar Code Label" on page 4-5.

The insertion guide (**6** in Figure 4-1 on page 4-1) is a large, notched area that prevents the cartridge from being inserted incorrectly.

Table 4-1. Nominal Cartridge Life: Load/Unload Cycles

Type	Load/Unload Cycles
Ultrium 6	20,000 (20K)
Ultrium 5	20,000 (20k)
Ultrium 4	20,000 (20k)
Ultrium 3	20,000 (20k)
Ultrium 2	10,000 (10k)
Ultrium 1	5000 (5k)

Cartridge Compatibility

Table 4-2. Ultrium data cartridge compatibility with Ultrium tape drive

IBM Ultrium Tape Drive	IBM LTO Ultrium Data Cartridges					
	2500 GB Ultrium 6	1500 GB Ultrium 5	800 GB Ultrium 4	400 GB Ultrium 3	200GB Ultrium 2	100GB Ultrium 1
Ultrium 6	Read/Write	Read/Write	Read Only			
Ultrium 5		Read/Write	Read/Write	Read only		
Ultrium 4			Read/Write	Read/Write	Read only	
Ultrium 3				Read/Write	Read/Write	Read only
Ultrium 2					Read/Write	Read/Write
Ultrium 1						Read/Write

Capacity Scaling

To control the capacity of the cartridge (for example, to obtain a faster seek time) issue the SCSI command SET CAPACITY. For information about this command, refer to the *IBM Ultrium Tape Drive SCSI Reference*.

WORM (Write Once, Read Many) Cartridges

Certain records retention and data security applications require a Write Once, Read Many (WORM) method for storing data on tape. The LTO Ultrium 6, Ultrium 5, and Ultrium 4 drives enables WORM support when a WORM tape cartridge is loaded into the drive.

WORM Media

Because standard read/write media are incompatible with the WORM feature, a specially formatted WORM tape cartridge (see Figure 4-2 on page 4-4) is required. Each WORM cartridge has a unique, worldwide cartridge identifier (WWCID), which comprises the unique CM chip serial number and the unique tape media serial number. Ultrium 6 WORM cartridges are two-tone black and silvery-gray. See "Ordering Media Supplies" on page 4-19 for information on how to choose and purchase the appropriate WORM tape cartridges for your tape drive.
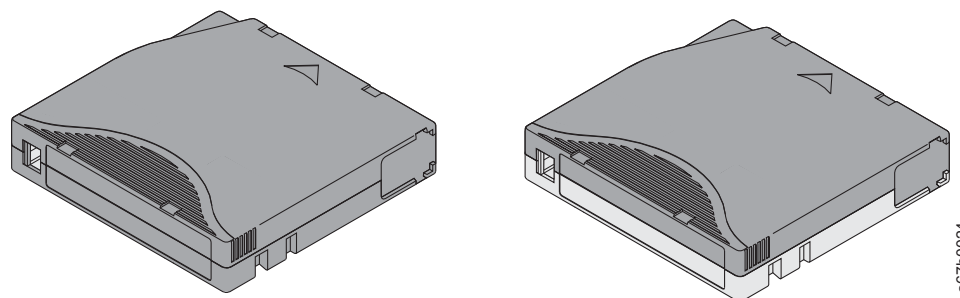
Figure 4-2. Ultrium Data and WORM Tape Cartridges

Data Security on WORM Media

Certain built-in security measures help ensure that the data written on a WORM cartridge does not become compromised, for example:

- The format of an IBM Ultrium 6, Ultrium 5, or Ultrium 4 WORM Tape Cartridge is unlike that of standard read/write media. This unique format prevents a drive that lacks WORM-capable firmware from writing on a WORM tape cartridge.
- When the drive senses a WORM cartridge, the firmware prohibits the changing or altering of user data already written on the tape. The firmware keeps track of the last appendable point on the tape.

WORM Media Errors

The following conditions cause WORM media errors to occur:

- Information in the servo manufacturer's word (SMW) on the tape must match information from the cartridge memory (CM) module in the cartridge. If it does not match, a media Error Code 7 will post on the drive's single-character display (SCD).
- Inserting a WORM tape cartridge into a drive that is not compatible with WORM causes the cartridge to be treated as an unsupported medium. The drive will report a media Error Code 7. Upgrading the drive firmware to the correct code level will resolve the problem.

Requirements for WORM Capability

To add WORM capability to your IBM LTO Ultrium 6 drive(s), you need to use either IBM Ultrium 6 2500 GB WORM tape cartridges or IBM Ultrium 5 1500 GB WORM tape cartridges (see "Ordering Media Supplies" on page 4-19).

Cleaning Cartridge

A specially labeled IBM LTO Ultrium Cleaning Cartridge is used to clean the drive head. The drive itself determines when a head needs to be cleaned. It alerts you by the SCD flashing a ⊏ . To clean the head manually, insert a cleaning cartridge into the tape load compartment (see Figure 3-1 on page 3-6). The drive performs the cleaning automatically. When the cleaning is finished, the drive ejects the cartridge, and the SCD will be blank.

Note: The drive will automatically eject an expired cleaning cartridge without running the cleaning process. Replace the expired cleaning cartridge with a new cleaning cartridge and insert it into the drive.

The IBM Cleaning Cartridge is valid for 50 uses. The cartridge's LTO-CM chip tracks the number of times that the cartridge is used.

Important: After 50 uses, the cleaning cartridge expires. It is no longer usable, and must be replaced

Cartridge Memory Chip (LTO-CM)

All generations of the IBM LTO Ultrium Data Cartridges include a Linear Tape-Open Cartridge Memory (LTO-CM) chip (**1** in Figure 4-1 on page 4-1), 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 the next time this cartridge is inserted and the Write command is issued, 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 a tape cartridge is unloaded, the tape drive writes any pertinent information to the cartridge memory.

The LTO-CM storage capacity of the LTO Ultrium 6 is 16320 bytes, LTO Ultrium 4 and 5 is 8160 bytes, and Ultrium 1, 2, and 3 is 4096 bytes.

Bar Code Label

A bar code label contains:
- A volume serial number (VOLSER) that is human-readable
- A bar code that the library can read

Note: The TS2260 Tape Drive does not require bar code labels, but you may choose to use labels for tape cartridge identification purposes.

Table 4-3. Bar code label requirements for Ultrium tape drives and libraries

Ultrium Tape Drive/Library	Bar Code Label Requirements
3573	Required
3576	Required
3580	Not required
3581	Required with optional Bar Code Reader
3582	Required
3583	Required
3584	Required

When read by a library's bar code reader, the bar code identifies the cartridge's VOLSER to the library. The bar code also tells the library whether the cartridge is a data cartridge or cleaning cartridge. In addition, the bar code includes the two-character media-type identifier Lx, where x equals 1, 2, 3, 4, 5 or 6. L identifies the cartridge as an LTO cartridge and the number represents the generation of cartridge for that cartridge type. Figure 4-3 on page 4-6 shows a sample bar code label for the LTO Ultrium Tape Cartridge.

Tape cartridges can be ordered with the labels included or with custom labels. To order tape cartridges and bar code labels, see "Ordering Media Supplies" on page 4-19. The bar code for usage in IBM tape libraries must meet predefined specifications. They include (but are not limited to):

- Eight uppercase alphanumeric characters, where the last two characters must be L6, L5, L4, L3, L2, or L1 (LW, LV, LU, or LT for Ultrium WORM cartridges)
- 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/** and enter "IBM LTO Ultrium Cartridge Label Specification" in the search box, or contact your IBM Sales Representative.

When attaching a bar code label to a tape cartridge, place the label only in the recessed label area (see **5** in Figure 4-1 on page 4-1). A label that extends outside of the recessed area can cause loading problems in the drive.

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 library from reading the label.
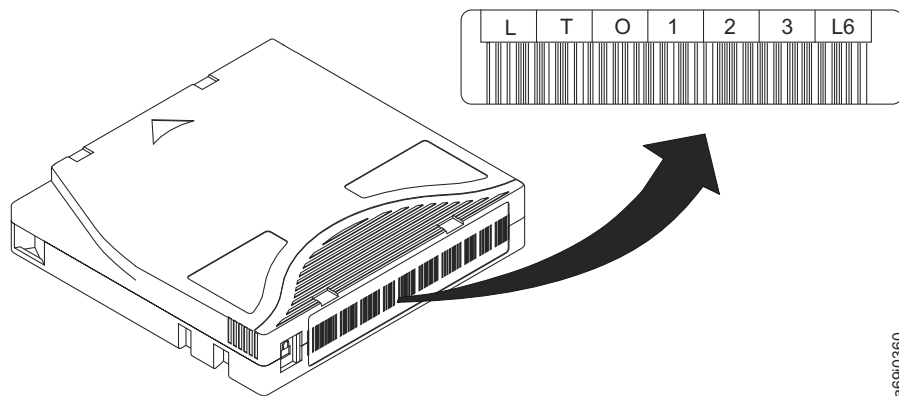
Figure 4-3. Sample bar code label on the LTO Ultrium 6 Tape Cartridge. The volume serial number (LTO123), cartridge type (L6), and bar code are printed on the label.

Guidelines for Using Bar Code Labels

Apply the following guidelines whenever using bar code labels:

- Use only IBM-approved bar code labels on cartridges to be used in an IBM tape library.
- 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 being 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 applying it to the cartridge. Do not use the label if it has voids or smears in the printed characters or bar code (a library'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 (see **5** in Figure 4-1 on page 4-1).
- 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 drive to load the cartridge.

Write-Protect Switch

The position of the write-protect switch on the tape cartridge (see **1**) determines whether you can write to the tape. If the switch is set to:

- The locked position ⊟ (solid red), data cannot be written to the tape.
- The unlocked position (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 (blank) data 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.
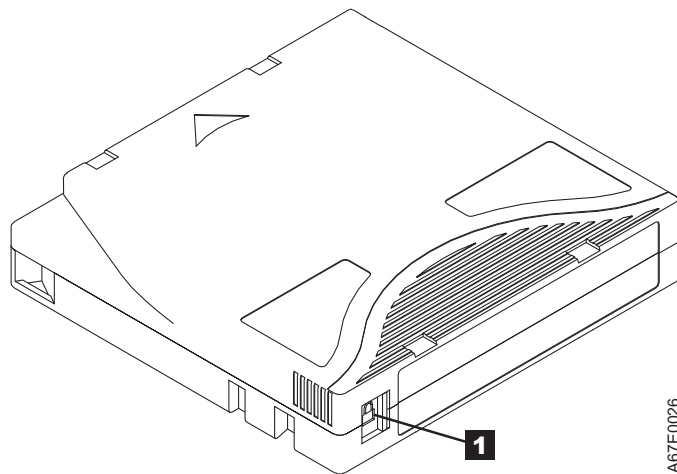
Figure 4-4. Setting the write-protect switch

Table 4-4. Location of the write-protect switch

1	Write-Protect Switch

Handling the Cartridges

Attention: Do not insert a damaged tape cartridge into the 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 incorrect environment can damage 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

- 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

- When shipping a cartridge, use the 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 4-5). They are available at **http://www.turtlecase.com**.

Figure 4-5. 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 4-6).

Figure 4-6. Double-boxing tape cartridges for shipping

Provide Proper Acclimation and Environmental Conditions

- Before using a cartridge, let it acclimate to the normal operating environment for 24 hours. There should be no visible condensation on the cartridge. If condensation is visible 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 50 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 conditions that are described in "Environmental and Shipping Specifications for Tape Cartridges" on page 4-17.

Perform a Thorough Inspection

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 loads first into the tape load compartment) and ensure that there are no gaps in the seam of the cartridge case (see **1** in Figure 4-7 on page 4-10 and **4** in Figure 4-9 on page 4-12). If there are gaps in the seam (see Figure 4-7 on page 4-10), the leader pin may be dislodged. Go to "Repositioning or Reattaching a Leader Pin" on page 4-11.
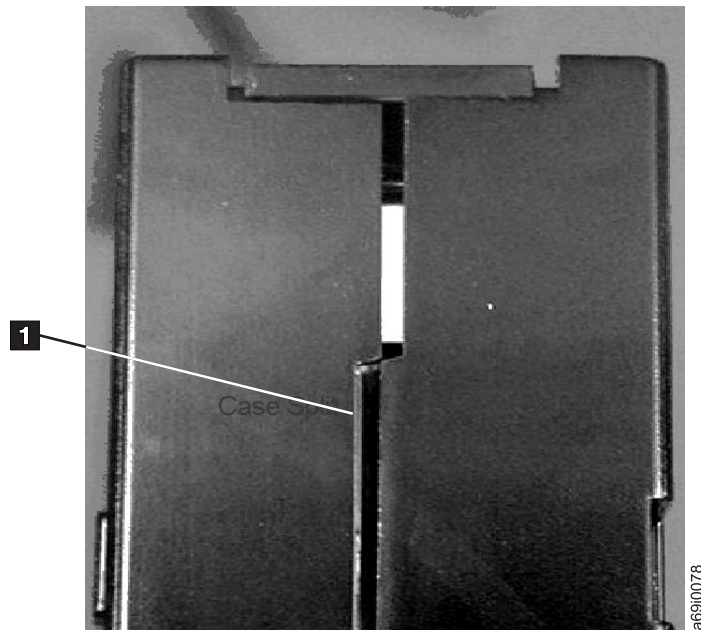
Figure 4-7. Checking for gaps in the seams of a cartridge

- Check that the leader pin is properly seated (see **2** in Figure 4-8 on page 4-12).
- 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.
- Review handling and shipping procedures.

Handle the Cartridge Carefully

- Do not drop the cartridge. If the cartridge drops, slide the cartridge door back and ensure that the leader pin is properly seated in the pin-retaining spring clips (see **2** in Figure 4-8 on page 4-12). If the leader pin has become dislodged, go to "Repositioning or Reattaching a Leader Pin" on page 4-11.
- 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.

Examples of Cartridge Problems

Example: Split Cartridge Case (see Figure 4-7)

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 seat the pin (see "Repositioning or Reattaching a Leader Pin" on page 4-11). Then, immediately use data recovery procedures to minimize chances of data loss.
3. Review media-handling procedures.

<u>Example: Improper Placement of Leader Pin (see Figure 4-8 on page 4-12)</u>

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 seat the pin (see "Repositioning or Reattaching a Leader Pin"). Then, immediately use data recovery procedures to minimize chances of data loss.

Repositioning or Reattaching a Leader Pin

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 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 seven meters (23 feet) of leader tape.) The sections that follow describe each procedure.

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

A leader pin that is improperly seated inside a cartridge can interfere with the operation of the drive. Figure 4-8 on page 4-12 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)
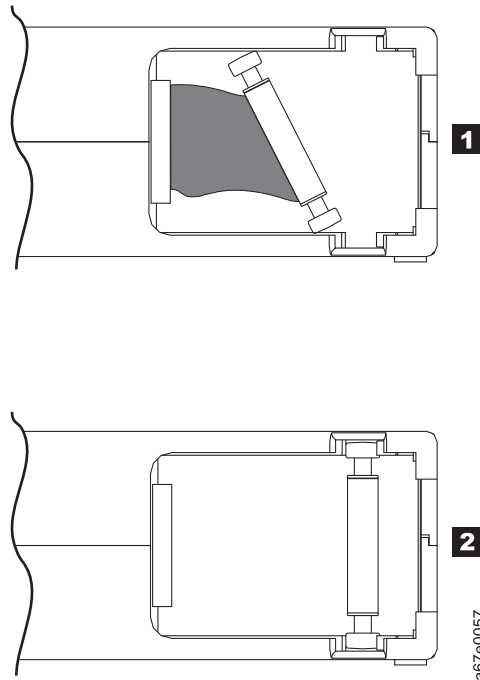
Figure 4-8. Leader pin in the incorrect and correct positions. The cartridge door is open and the leader pin is visible inside the cartridge.

To reposition the leader pin, perform the following steps.

1. Slide open the cartridge door (**1** in Figure 4-9) 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.
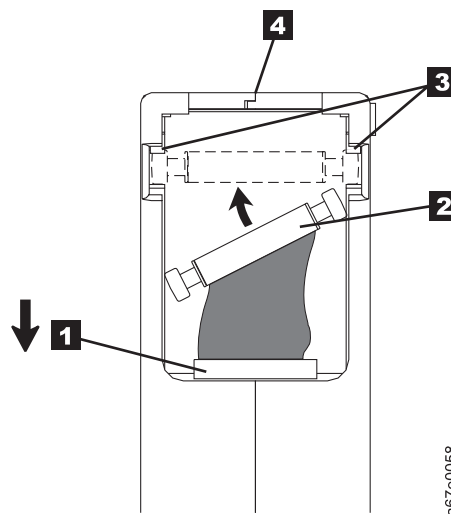
Figure 4-9. Placing the dislodged leader pin into the correct position. The cartridge door is open to show the leader pin.

5. To rewind the tape, insert the cartridge manual rewind tool (**1** in Figure 4-10) into the cartridge's hub **2** and turn it clockwise until the tape becomes taut.
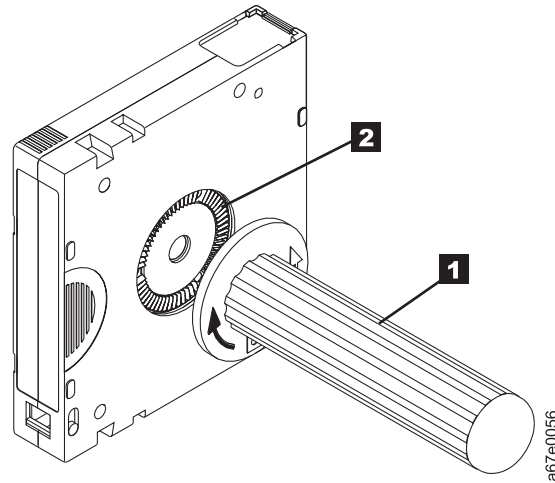
Figure 4-10. Rewinding the tape into the cartridge

6. Remove the rewind tool by pulling it away from the cartridge.
7. If you suspect that the cartridge has been mishandled but it appears useable, copy any data onto a good cartridge immediately for possible data recovery. Discard the mishandled cartridge.

Reattaching a Leader Pin

The first meter of tape in a 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 4-11 on page 4-14). A plastic brace that holds the cartridge door open.
- **Cartridge manual rewind tool** (see **2** in Figure 4-11 on page 4-14). 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 4-11 on page 4-14). 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.
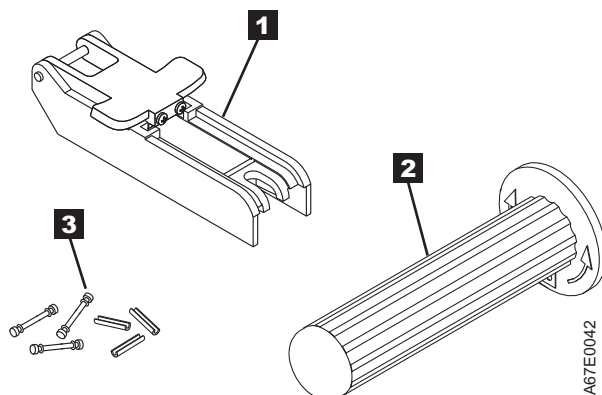
Figure 4-11. Leader Pin Reattachment Kit

The following procedure describes how to reattach a leader pin.

To reattach a leader pin by using the IBM Leader Pin Reattachment Kit:

1. Attach the leader pin attach tool (**1** in Figure 4-12 on page 4-15) 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** .
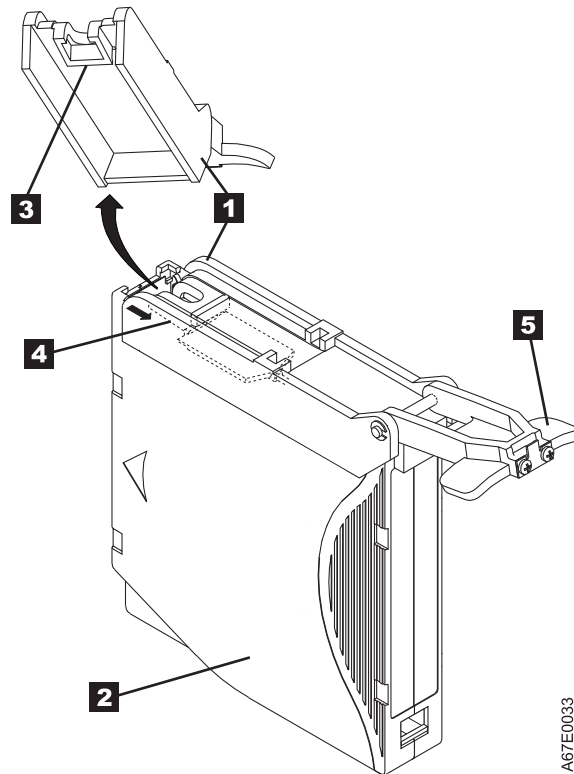
Figure 4-12. Attaching the leader pin attach tool to the cartridge. To hold the cartridge door open, hook the tool into the door and pull the tool back.

2. To find the end of the tape inside the cartridge, attach the cartridge manual rewind tool (**1** in Figure 4-13 on page 4-16) 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.
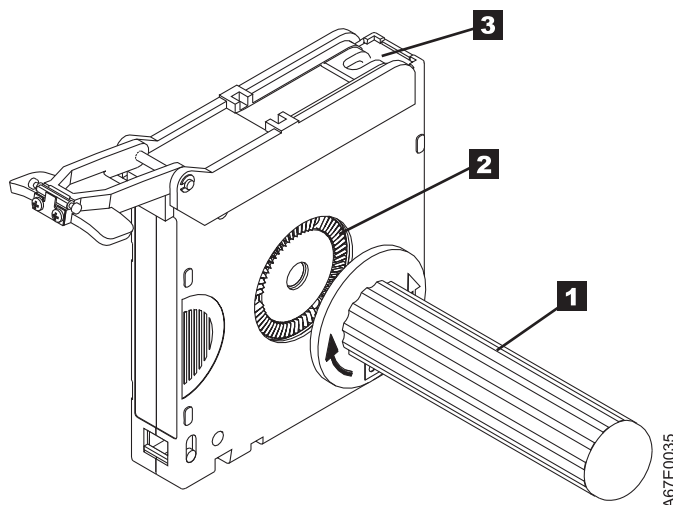
Figure 4-13. Winding the tape out of the cartridge. Turn the cartridge manual rewind tool clockwise to see the end of the tape, then turn it counterclockwise to bring the tape to the cartridge door.

5. On the leader pin (**1** in Figure 4-14), 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.
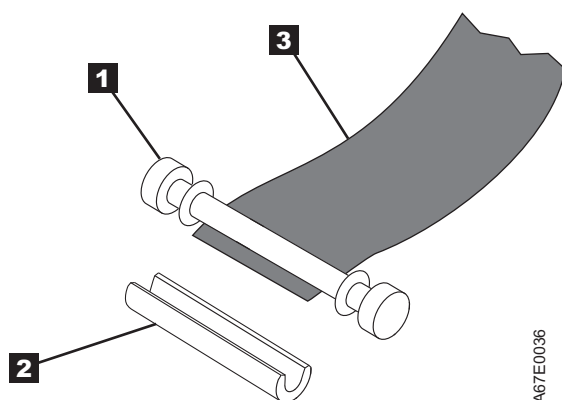
Figure 4-14. Removing the C-clip from the leader pin. Use your fingers to push the C-clip from the leader pin.

7. Position the tape in the alignment groove of the leader pin attach tool (see **1** in Figure 4-15 on page 4-17).

8. Place a new C-clip into the retention groove **2** (Figure 4-15 on page 4-17) 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** (Figure 4-15 on page 4-17) of the leader pin attach tool.

   Attention: To prevent the leader pin from rolling into the cartridge, in the following step use care when folding the tape over the pin.

10. Fold the tape over the leader pin and hold it with your fingers (see Figure 4-15 on page 4-17).

    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.
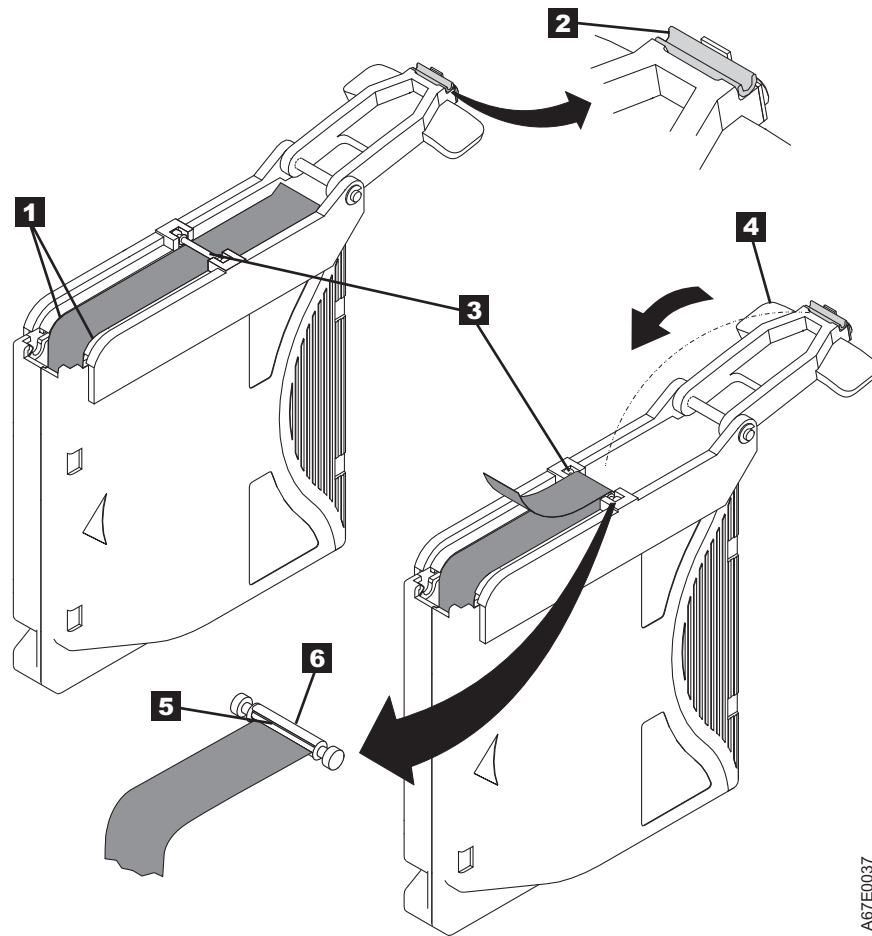
Figure 4-15. Attaching the leader pin to the tape

11. 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.
12. Swing the pivot arm open and trim the excess tape **5** so that it is flush with the reattached leader pin **6** .
13. Use your fingers to remove the leader pin from the cavity **3** in the leader pin attach tool.
14. 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.
15. Remove the rewind tool.
16. Remove the leader pin attach tool by lifting its end up and away from the cartridge.

Environmental and Shipping Specifications for 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.

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 4-5 gives the environment for operating, storing, and shipping LTO Ultrium Tape Cartridges.

Table 4-5. Environment for operating, storing, and shipping the LTO Ultrium Tape Cartridge

Environmental Factor	Environmental Specifications			
	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 (non-condensing)	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)
Note:				
1. The short term or operational storage environment is for storage durations of up to six months.				
2. The long term or archival storage environment is for durations of six months up to ten years.				

Disposing of Tape Cartridges

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 4000 oersted peak field over the entire space that the cartridge occupies). The tape should make two passes through the field at 90 degree orientation change for each pass to achieve complete erasure. Some commercial degaussers have two magnetic field regions offset 90 degrees from each other to accomplish complete erasure in one pass for higher throughput. Degaussing makes the cartridge unusable.

If you burn the cartridge and tape, ensure that the incineration complies with all applicable regulations.

Ordering Media Supplies

Table 4-6 lists the cartridges and media supplies that you can order for the drive.

Table 4-6. Media supplies

Supply Item	Methods of Ordering
20-PACK IBM LTO Ultrium 6 2500 GB Data Cartridge (with attached labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 550. Specify the VOLSER characters that you want. You can also order through an IBM-authorized distributor.
20-PACK IBM LTO Ultrium 6 2500 GB Data Cartridge (without labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 650. You can also order through an IBM-authorized distributor.
5-PACK IBM LTO Ultrium 6 2500 GB Data Cartridge (black and white labels unattached)	Order as part number 35P1902 through an IBM-authorized distributor.
20-PACK IBM Ultrium 6 2500 GB WORM Tape Cartridge (with attached labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 570. You can also order through an IBM-authorized distributor.
20-PACK IBM Ultrium 6 2500 GB WORM Tape Cartridge (without labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 670. You can also order through an IBM-authorized distributor.
20-PACK IBM LTO Ultrium 5 1500 GB Data Cartridge (with attached labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 014. Specify the VOLSER characters that you want. You can also order through an IBM-authorized distributor.
20-PACK IBM LTO Ultrium 5 1500 GB Data Cartridge (without labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 015. You can also order through an IBM-authorized distributor.
5-PACK IBM LTO Ultrium 5 1500 GB Data Cartridge (black and white labels unattached)	Order as part number 46C2084 through an IBM-authorized distributor.
20-PACK IBM Ultrium 5 1500 GB WORM Tape Cartridge (with attached labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 034. You can also order through an IBM-authorized distributor.
20-PACK IBM Ultrium 5 1500 GB WORM Tape Cartridge (without labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 035. You can also order through an IBM-authorized distributor.

Table 4-6. Media supplies (continued)

Supply Item	Methods of Ordering
20-PACK IBM LTO Ultrium 4 800 GB Data Cartridge (with attached labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 010. Specify the VOLSER characters that you want. You can also order through an IBM-authorized distributor.
20-PACK IBM LTO Ultrium 4 800 GB Data Cartridge (without labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 011. You can also order through an IBM-authorized distributor.
5-PACK IBM LTO Ultrium 4 800 GB Data Cartridge (black and white labels unattached)	Order as part number 95P4278 through an IBM-authorized distributor.
20-PACK IBM Ultrium 4 800 GB WORM Tape Cartridge (with attached labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 032. You can also order through an IBM-authorized distributor.
20-PACK IBM Ultrium 4 800 GB WORM Tape Cartridge (without labels)	Order the cartridge from your IBM Sales Representative or any authorized IBM Business Partner by specifying Machine Type 3589 Model 033. You can also order through an IBM-authorized distributor.
IBM LTO Ultrium 3 400 GB Data Cartridge Order VOLSER labels separately (see "Ordering Bar Code Labels" on page 4-21).	Order as part number 24R1922 through an IBM-authorized distributor.
IBM LTO Ultrium 3 400 GB WORM Tape Cartridge Order VOLSER labels separately (see "Ordering Bar Code Labels" on page 4-21).	Order as part number 96P1203 through an IBM-authorized distributor.
IBM LTO Ultrium 2 200 GB Data Cartridge Order VOLSER labels separately (see "Ordering Bar Code Labels" on page 4-21).	Order as part number 08L9870 through an IBM-authorized distributor.
IBM LTO Ultrium 1 100 GB Data Cartridge Order VOLSER labels separately (see "Ordering Bar Code Labels" on page 4-21).	Order as part number 08L9120 through an IBM-authorized distributor.
IBM LTO Ultrium Cleaning Cartridge (universal cleaning cartridge for use with Ultrium drives) VOLSER labels are included.	Order as part number 35L2086 through an IBM-authorized distributor.
Leader Pin Reattachment Kit	Order as part number 08L9129 through an IBM-authorized distributor.
Manual Rewind Tool	Order as part number 08L9130 through an IBM-authorized distributor.

To find the closest IBM-authorized distributor, visit the web at `http://www.ibm.com/storage/media`) or call 1-888-IBM-MEDIA.

Ordering Bar Code Labels

The IBM System Storage TS2260 Tape Drive does not require cartridge bar code labels. However, if you use your data cartridges or cleaning cartridges in an IBM tape library product, you may need cartridge bar code labels if your tape library product requires them. 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 4-7.

Table 4-7. Authorized suppliers of custom bar code labels

In America	In Europe and Asia
EDP/Colorflex Broomfield, CO U. S. A. Telephone: 800-438-8362 http://www.tri-optic.com	EDP Europe, Ltd. U. K. Telephone: 44 (0) 1245-322380 http://www.edpeurope.com/media-label
Dataware Houston, TX 77274 U. S. A. Telephone: 800-426-4844 http://www.datawarelabels.com/	Dataware Labels Europe Australia Telephone: (029) 496-1111 http://www.datawarelabels.com/
NetC Trumbell, CT U. S. A. Telephone: 203-372-6382 http://www.netcllc.com/	NetC Europe Ltd U. K. Telephone: 44 (0) 1823 49 1439 http://www.netclabels.co.uk NetC Asia Pacific Pty Ltd Australia Telephone: 61 (0) 7 5442 6263 http://www.netclabels.com.au

Chapter 5. Troubleshooting

If you encounter problems when running the drive, refer to the flowchart in Figure 5-1. For explanations of codes on the Single-character Display (SCD), see "Single-character Display (SCD)" on page 3-1. Please review the"Pre-Call Checklist" on page 5-4 before calling IBM Technical Support.

```
            ( Start )
               |
               v
          /Does the\        No    1. Try another electrical outlet.
         < Tape Drive >---------->  2. Try another power cord.
          \power on?/              3. Refer to the pre-call checklist in this chapter before calling
               |                      IBM Technical Support.
              Yes                   4. Contact IBM Technical Support.
               |
               v
         /Does air flow\    No     Refer to the pre-call checklist in this chapter before calling
        < from the fan? >-------->  IBM Technical Support. Contact IBM Technical Support.
         \             /
               |
              Yes
               |
               v
          /Does the \       Yes    1. Refer to the section about codes on the single-character
         / SCD and fault\-------->     display in this guide.
        <  light indicate >          2. Ensure that the latest level of firmware is installed on the
         \  an error?  /                drive (refer to Procedure 1 in this chapter).
               |                     3. Refer to the pre-call checklist in this chapter before calling
              No                        IBM Technical Support.
               |                     4. Contact IBM Technical Support.
               v
         /Does the tape \   No
        < cartridge load and>----->  Refer to Procedure 2 in this chapter.
         \unload properly?/
               |
              Yes
               |
               v
          /Does the  \      No     Ensure that the SAS communication path
         / Tape Drive  \--------->  between the host and the drive is functioning properly
        < correctly communicate>    (refer to Procedures 3 and 4 in this chapter).
         \with the server?/
               |
              Yes
               |
               v
        1. If you are still having
           problems running the Tape
           Drive refer to the pre-call
           checklist in this chapter
           before calling IBM Technical
           Support.
        2. Contact IBM Technical
           Support.
```

a80hh083

Figure 5-1. Flowchart for Analyzing Maintenance Problems

Procedure 1: Determining Firmware Level and Capturing Drive Dump

Customers are responsible for updating Firmware. For optimum performance, the customer must obtain the latest level of firmware for the unit by downloading the firmware from the web site **http://www.ibm.com/support/fixcentral**.

The ITDT utility (see "ITDT Firmware Update, Dump Retrieval and Library/Drive Test Tool" on page 2-5) can be used to update the firmware level as well as to capture a drive dump which may be requested by technical support to aid in problem analysis.

For instructions about updating firmware from a server that uses an IBM tape device driver, refer to the *IBM Tape Device Drivers Installation and User's Guide*.

To update firmware from a server that uses a non-IBM tape device driver, refer to the documentation for that device driver.

Perform the following steps to determine the current firmware level installed on the drive.

1. Use the ITDT utility (available on the web at **http://www.ibm.com/support/fixcentral**) to view the current drive firmware level.
2. Compare this level with the latest available firmware level by visiting the same website. For additional information about using the ITDT utility, see "Updating Firmware" on page 2-5.

   Note: The ITDT utility can be used to either update drive firmware to the latest level or to capture drive dumps from a drive which may be experiencing problems.

Another way to capture a drive dump is using the ethernet port. To capture a dump on the drive using the Ethernet interface follow the steps below.

Note: The drive uses a limited version of FTP protocol to communicate on the Ethernet interface. It is recommended to use a simple, command line FTP session, such as the DOS command prompt, when communicating with the drive.

1. Obtain the latest drive firmware from the web, as described above.
2. Connect an ethernet patch cable to the drive's ethernet interface and to a computer. In order to meet electromagnetic immunity requirements, a shielded ethernet cable is required.
3. Create an FTP session between the drive and the computer. The drive's IP address: 169.254.0.3
4. At the user prompt, type *guest* and press **Enter**.
5. At the password prompt, press **Enter**. No response is needed.
6. Type *bin* to set the communication mode to binary.
7. Type *mget *.dmp* to transfer a drive dump to the computer. If a dump already exists, the drive will show you the dump name and ask if you want to transfer it to the computer. Type *y* to transfer the existing dump or *n* to skip this dump file. Then the drive will ask if you want a forced dump. Type *y* to force a dump and to transfer the forced dump to the computer, or type *n* to skip forcing a dump.
8. Type *quit* to end the FTP session.
9. Remove ethernet patch cable from the drive's ethernet interface and the computer.

Procedure 2: Inspecting a Cartridge for Damage

If the cartridge fails to load or unload properly, perform the following steps:

1. Check that the leader pin is attached and properly seated (see "Repositioning a Leader Pin" on page 4-11) by opening the cartridge door and observing the pin's placement.
2. Inspect the cartridge case, the cartridge door, and the write-protect switch for damage.
3. 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 4-7 on page 4-10 and **4** in Figure 4-9 on page 4-12). If there are gaps, the leader pin may be dislodged. Go to "Repositioning or Reattaching a Leader Pin" on page 4-11.
4. Try loading or unloading another tape cartridge.
   - If it fails, contact your service representative for additional problem determination.
   - If it is successful, discard the cartridge that originally failed.

Note:

1. If a damaged or mishandled cartridge is the problem, see "Handling the Cartridges" on page 4-7 for proper instructions about handling media. It is possible that your other cartridges may also be damaged.
2. If your cartridge does not eject properly, contact your service representative. (IBM service personnel should go to Appendix E, "Information for Trained Service Personnel," on page E-1.)

Procedure 3: Checking SAS Host Connections

Check the host connections for your drive by following the steps below.

If your server is not communicating with the SAS drive, the problem may be with the SAS cable, the SAS host adapter or the SAS host adapter setup.

1. Check if the tape drive power is on.
2. Verify the SAS cable is connected properly to the server and to the tape drive.
3. Check whether the parameters for the SAS host adapter installation are correct.
4. Verify the SAS host adaptor is supported by the tape drive.
5. Ensure there is a point-to-point connectivity between the server and the tape drive. SAS connectivity does not support multiple drive connections (daisy-chaining of devices).
6. Check the length of the SAS cable. It can not exceed 5.5m (18 ft).

Procedure 4: Verifying Host Interface Communications

The Wrap Diagnostic tests the communication function at the device interface. However, to thoroughly verify host-to-device communications, it is highly recommended to exercise activity over the SAS interface bus from the host to the drive and back. A recommended utility to perform this test is the ITDT utility available on the web at **http://www.ibm.com/support/fixcentral**. This utility is especially effective for updating the drive firmware and for performing the Test Device function. For additional information about using the ITDT utility, see "Updating Firmware" on page 2-5. Perform the following steps:

1. If the ITDT utility is not installed on your system, download the appropriate operating system version from the web into a directory or folder of your choice on your system.

2. When installation is complete, run the SCAN (**s**) option to determine if your system can detect all of the Ultrium tape drive devices (including any libraries or autoloaders that may be on the bus).
3. Select the drive that is to be tested or to have firmware downloaded.
4. For testing, select the Test Device (**t**) option.

   Note: This option will perform a series of LOADS, UNLOADS, and WRITE/READ operations. Both tape drive control commands and data are sent to the device over the interface bus.
5. If allowed to complete, the test will run for at least 30 minutes. At any time an ABORT (**a**) can be entered to end the device test early if it is determined that interface communications have been satisfactorily achieved.

Resolving Problems Reported by the Server

The procedure for fixing interface bus errors varies, depending on whether the error is consistent or intermittent, and on your configuration. The sections that follow describe how to fix an error.

Fixing SAS Bus Errors

1. Check if the tape drive power is on.
2. Verify the SAS cable is connected properly to the server and to the tape drive.
3. Replace SAS cable if it shows any signs of damage.

Resolving Media-Related Problems

To resolve problems that are related to media, the drive's firmware includes:

- Test Cartridge & Media diagnostic that verifies whether a suspect cartridge and its magnetic tape are acceptable for use.
- Statistical Analysis and Reporting System (SARS) to assist in isolating failures between media and hardware. To determine the cause of failure, SARS uses the cartridge performance history that is saved in the cartridge memory (CM) and the drive performance history that is kept in the drive's VPD (Vital Product Data) area in NVRAM. Any failures that SARS detects are reported as TapeAlert flags on the server (see *IBM LTO Ultrium Tape Drive SCSI Reference*).

  Attention: If you insert the IBM LTO Ultrium Data Cartridge into another manufacturer's drive, the SARS data in the cartridge memory may become lost or invalid.

If you encounter a media-related problem, refer to "Function Code E: Test Cartridge & Media" on page 3-19.

Pre-Call Checklist

If you have questions or problems, go through this checklist before contacting IBM Technical Support. Ensure that the total SAS cable length does not exceed 5.5m (18 ft). Perform the following steps before you place a call to IBM Technical Support. Where instructions refer you to the web, visit **http://www.ibm.com/support/fixcentral**.

1. Perform a general checkup of the hardware and connections:
   - Verify that all cables are connected properly at both ends.
   - Before attaching the SAS cables, ensure that the connector does not contain bent or recessed pins.

- Ensure that all retention screws for the SAS cable are securely tightened.

2. Verify that the drive's firmware is at the most recent level. To determine the latest release of firmware, visit the web. See "Updating Firmware" on page 2-5 for instructions on downloading the latest firmware.

3. Verify that your device drivers are at the most recent level:
   - For IBM device drivers, visit the web.
   - For the device drivers of independent software vendors (ISVs), visit the appropriate third-party web site.

4. Verify whether your hardware and software configuration is supported. To determine the latest supported attachments, visit the web.

5. Review "Frequently Asked Questions and "Hints and Tips" on the web.

6. Run one of the following diagnostic methods:
   - Local diagnostic:
     a. Run "Function Code 1: Run Drive Diagnostics" on page 3-12 to determine whether the drive can properly load and unload cartridges, and read and write data. Optionally, you may run one of the following diagnostics:
        - "Function Code E: Test Cartridge & Media" on page 3-19 to determine whether a suspect cartridge and its magnetic tape are acceptable.
        - "Function Code F: Write Performance Test" on page 3-20 to ensure that the drive can read from and write to tape.
        - "Function Code H: Test Head" on page 3-20 to ensure that the tape drive's head and tape-carriage mechanics work correctly.
        - "Function Code J: Fast Read/Write Test" on page 3-22 to ensure that the drive can read from and write to tape.
        - "Function Code L: Load/Unload Test" on page 3-23 to test the drive's ability to load and unload a tape cartridge.
     b. Run "Function Code 6: Run Host Interface Wrap Test" on page 3-16.
   - Remote diagnostic:
     - Using the ITDT utility, run the SCAN as described in "Procedure 4: Verifying Host Interface Communications" on page 5-3

Replacing the Tape Drive

To replace your tape drive, perform the following steps:

1. Remove the replacement unit from its packaging.
2. Locate the repair identification (RID) tag (included with the replacement unit). See **1** in Figure 5-2 on page 5-6)
3. Write down the serial number of the failed unit on the RID tag.
4. Affix the repair tag to the rear panel of the replacement unit (below the serial number label).
5. Place the failed unit into the packaging of the replacement unit.
6. Follow the instructions (included with the replacement unit) for returning the failed unit.

IBM REPAIR IDENTIFICATION TAG

REPAIR ID TAG

MT_____

SN_____

PART NUMBER 19P5941

ATTENTION:

1. A Repair ID tag maintains the original serial number record of the machine and allows IBM to entitle the machine for future maintenance or warranty service. Mail in exchange requires the completion and securing a Repair ID tag (part number 19P5941) to the replacement unit.

   - Verify that the machine serial number on the failing unit matches the serial number reported to IBM technical support.
   - Transcribe the machine type, model, and serial number of the failing unit to the Repair ID tag for the replacement unit.
        USE BALLPOINT PEN TO
        COMPLETE THE RID TAG.
   - Place the Repair ID tag as close as possible, but not covering, the machine serial number of the replacement unit.
   - The original serial number must be visible.

2. The use of the Repair ID tag is important for customer inventory accuracy.

Figure 5-2. RID Tag on Rear Panel

Appendix A. Error Codes and Messages

If the drive detects a permanent error, it will display the error code on the SCD and flash the Fault light (Ready light will be Off).

- Make note of the SCD error code prior to removing a cartridge or clearing the SCD error code.
- If an error occurred with a cartridge in the drive, push the Unload Button to eject the cartridge.
- To clear the SCD error code and power cycle the drive, press the Unload Button for ten seconds. A drive dump will be created.

Attention: If the drive detects a permanent error and displays an error code other than $\boxed{0}$, it automatically performs a drive dump. If you force a drive dump, the existing dump will be overwritten and data will be lost. After you force a drive dump, do not turn off the power to the drive or you may lose the dump data.

Table A-1. Error codes on the Single-character Display

Error Code	Cause and Action
$\boxed{0}$	No error occurred and no action is required. This code displays when diagnostics have finished running and no error occurred. **Note:** The Single-character Display is blank during normal operation of the tape drive.
$\boxed{1}$	Temperature problem. The tape drive detected that the recommended operating temperature was exceeded. Perform one or more of the following actions: • Ensure that the cooling fan is rotating and is quiet. If not, refer to your enclosure documentation. • Remove any blockage that prevents air from flowing freely through the tape drive. • Ensure that the operating temperature and airflow is within the specified range (see "Specifications" on page 1-6). Clear the error code by power cycling the tape drive or placing the drive in Maintenance Mode. If the operating temperature and airflow are within the specified range, and the problem persists, replace the drive.
$\boxed{2}$	Power problem. The tape drive detected that the externally supplied power is outside the specified voltage limits (the tape drive is not operating). Perform the following action: 1. Ensure that the power connector is properly seated. 2. Turn power off/on the tape drive to see if the problem repeats. 3. Replace the tape drive if the problem persists. The error code clears when you place the tape drive in maintenance mode.

Table A-1. Error codes on the Single-character Display (continued)

Error Code	Cause and Action

$\boxed{3}$	Firmware problem. The tape drive determined that a firmware error occurred. Perform the following action:
	
	1. Collect a drive dump from one of the following:
	Note: Do not force a new dump; the tape drive has already created one.
	  • Server's host interface by using a device driver utility or system tool such as ITDT. For instructions about using ITDT, visit the Web at **http://www.ibm.com/support/fixcentral**.
	  • Ultrium Tape Drive (to copy and read a drive dump, use "Function Code 5: Copy Drive Dump" on page 3-14)
	2. Power the tape drive off and on, then retry the operation that produced the error.
	3. If the problem persists, download new firmware and retry the operation.
	4. If the problem persists, send the drive dump that you collected in step **1** to your IBM Support Center.
	
	The error code clears when you place the tape drive in maintenance mode.

$\boxed{4}$	Firmware or hardware problem. The tape drive determined that a firmware or tape drive hardware failure occurred. Perform the following action:
	
	1. Collect a drive dump from one of the following:
	Note: Do not force a new dump; one already exists.
	  • Server's host interface by using a device driver utility or system tool such as ITDT. For instructions about using ITDT, visit the Web at **http://www.ibm.com/support/fixcentral**.
	  • Ultrium Tape Drive (to copy and read a drive dump, use "Function Code 5: Copy Drive Dump" on page 3-14)
	2. Power the tape drive off and on, then retry the operation that produced the error. The error code clears when you place the tape drive in maintenance mode.
	3. If the problem persists, download new firmware and retry the operation; if new firmware is not available, replace the drive.

$\boxed{5}$	Tape drive hardware problem. The drive determined that a tape path or read/write error occurred. To prevent damage to the drive or tape, the tape drive will not allow you to insert a cartridge if the current cartridge was successfully ejected. The error code may clear when you cycle power to the tape drive or place it in maintenance mode. If the problem persists, replace the drive. **Note:** Copy the drive dump to flash memory before returning the drive. For instructions, refer to "Function Code 5: Copy Drive Dump" on page 3-14.
$\boxed{6}$	Tape drive or media error. The tape drive determined that an error occurred, but it cannot isolate the error to faulty hardware or to the tape cartridge. Ensure the tape cartridge is the correct media type: • Ultrium 1, 2 and 3 cartridges are not supported in the Ultrium 6 tape drive. • Drive will not accept an expired Cleaning Cartridge. • Drive will not accept a WORM cartridge when running diagnostic tests in Maintenance Mode. • Drive will not write over existing datasets on a WORM cartridge. Ensure you are appending datasets on WORM media rather than attempting to write over existing datasets. If the tape cartridge is the correct media type, perform the following action:

Error Code	Cause and Action
	For Problems with Writing Data:

	If the problem occurred while the tape drive was writing data to the tape, retry the operation with a different cartridge:
	• If the operation succeeds, the original cartridge was defective. Copy data from the defective cartridge and discard it.
	• If the operation fails and another tape drive is available, insert the cartridge into the other unit and retry the operation.
	  – If the operation fails, discard the defective cartridge.
	  – If the operation succeeds, insert a scratch data cartridge into the first unit and run "Function Code 1: Run Drive Diagnostics" on page 3-12.
	    - If the diagnostics fail, replace the tape drive.
	    - If the diagnostics succeed, the error was temporary.
	• If the operation fails and another tape drive is not available, insert a scratch data cartridge into the unit and run "Function Code 1: Run Drive Diagnostics" on page 3-12.
	  – If the diagnostics fail, replace the tape drive.
	  – If the diagnostics succeed, discard the cartridge.
	
	If the problem occurs with multiple tape cartridges, run "Function Code 1: Run Drive Diagnostics" on page 3-12:
	• If the diagnostics fail, replace the tape drive.
	• If the diagnostics succeed, run"Function Code H: Test Head" on page 3-20.
	  – If the diagnostic fails, replace the tape drive.
	  – If the diagnostic succeeds, replace the cartridges that caused the problem.
	
	The error code clears when you remove the tape cartridge or place the tape drive in maintenance mode.
	
	For Problems with Reading Data:
	
	If the problem occurred while the tape drive was reading data from the tape, perform one of the following procedures:
	• If another tape drive is available, insert the cartridge into the other unit and retry the operation:
	  – If the operation fails, discard the defective cartridge.
	  – If the operation succeeds, insert a scratch data cartridge into the first unit and run "Function Code 1: Run Drive Diagnostics" on page 3-12:
	    - If the diagnostic fails, replace the tape drive.
	    - If the diagnostic succeeds, the error was temporary.
	• If another tape drive is not available, insert a scratch data cartridge into the unit and run "Function Code 1: Run Drive Diagnostics" on page 3-12:
	  – If the diagnostic fails, replace the tape drive.
	  – If the diagnostic succeeds, discard the cartridge.
	
	If the problem occurs with multiple tape cartridges, run "Function Code 1: Run Drive Diagnostics" on page 3-12:
	• If the diagnostic fails, replace the tape drive.
	• If the diagnostic succeeds, run "Function Code H: Test Head" on page 3-20.
	  – If the diagnostic fails, replace the tape drive.
	  – If the diagnostic succeeds, replace the cartridges that caused the problem.
	
	The error code clears when you remove the tape cartridge or place the tape drive in maintenance mode.

Table A-1. Error codes on the Single-character Display (continued)

Error Code	Cause and Action

7	Media error. The tape drive determined an error occurred because of a faulty tape cartridge or an invalid tape cartridge. Ensure the tape cartridge is the correct media type:
	
	• Ultrium 1, 2 and 3 cartridges are not supported in the Ultrium 6 tape drive.
	• Drive will not accept an expired Cleaning Cartridge.
	• Drive will not accept a WORM cartridge when running diagnostic tests in Maintenance Mode.
	• Drive will not accept an FMR tape unless the drive is performing "Function Code 8: Unmake FMR Tape" on page 3-17.
	• Drive will not write over existing datasets on a WORM cartridge. Ensure you are appending datasets on WORM media rather than attempting to write over existing datasets.
	• Drive will not Create an FMR Tape (Maintenance Mode, Function Code 3) with a cartridge that is already an FMR tape. Use another cartridge or execute Maintenance Mode Function Code 8: Unmake FMR Tape.
	• Drive will not Unmake FMR Tape (Maintenance Code 8) with a cartridge that is not an FMR tape.
	
	If the tape cartridge is the correct media type, try another tape cartridge. If the problem occurs with multiple tape cartridges, use the following procedure:
	
	1. If possible, run the tape cartridge in a different tape drive. If the operation in the other unit fails and 6 or 7 displays, replace the media. If the operation succeeds, run "Function Code E: Test Cartridge & Media" on page 3-19.
	
	   Attention: When you run the Test Cartridge & Media diagnostic, data on the suspect tape is overwritten. Use only a scratch data cartridge to run the test.
	
	   • If the diagnostic fails, replace the media.
	   • If the diagnostic succeeds, clean the drive head (see "Cleaning the Drive Head" on page 3-7) and run "Function Code 1: Run Drive Diagnostics" on page 3-12.
	     – If the drive diagnostic fails, replace the drive.
	     – If the drive diagnostic succeeds, perform the operation that produced the initial media error.
	
	The error code clears when you remove the tape cartridge or place the tape drive in maintenance mode.

8	Interface problem. The tape drive determined that a failure occurred in the tape drive's hardware or in the host bus. See Chapter 5, "Troubleshooting," on page 5-1. If 8 was displayed while running "Function Code 6: Host Interface Test": 1. Verify the correct interface wrap tool was attached in the proper interface port during the test. The test will fail if the correct interface wrap tool is not attached. 2. If the correct interface wrap tool was attached during the test, replace the drive. The error code clears when you place the tape drive in maintenance mode.
9	Tape drive or RS-422 error. The tape drive determined that a failure occurred in the tape drive's hardware or in the RS-422 connection. See "Function Code 7: Run RS-422 Wrap Test" on page 3-17 or refer to the Library procedures to isolate the problem to the drive. The error code clears when you place the tape drive in maintenance mode.

Error Code	Cause and Action
⌑ (A)	Degraded operation. The tape drive determined that a problem occurred which degraded the operation of the tape drive, but it did not restrict continued use. If the problem persists, determine whether the problem is with the drive or the media. **Note:** The drive is usable, though the Single-character Display continues to indicate an error and the Fault light flashes. The error code may clear when you cycle power to the tape drive or place it in maintenance mode. To determine if the problem is with the drive hardware, or the tape media, perform the following procedures: 1. If possible, run the tape cartridge in a different drive. If the operation in the other drive fails and ⌑ (6) or ⌑ (7) displays, replace the media. If the operation succeeds, run the Test Cartridge & Media diagnostic (see "Function Code E: Test Cartridge & Media" on page 3-19). 2. If the Test Cartridge & Media diagnostic fails, replace the media. If it runs successfully, clean the failing drive and run the drive diagnostics (see "Cleaning the Drive Head" on page 3-7 and "Function Code 1: Run Drive Diagnostics" on page 3-12). Once you begin this test, the diagnostic begins the loop sequence. Time the first loop by pressing the Unload Button once to stop the diagnostic after the completion of the first loop, then record the time it takes for the test to complete. Compare the recorded time with the "Approximate Run Time" above. If the test runs successfully but the execution time is significantly longer than the "Approximate Run Time", run "Function Code F: Write Performance Test" on page 3-20. If the Write Performance Test fails, replace the media and exit maintenance mode. If the drive diagnostics run successfully, perform the operation that produced the initial drive error. 3. If the problem persists replace the drive. If it is not possible to run the tape cartridge in a different drive, perform the following procedures: 1. Clean the failing drive and run the drive diagnostics (see "Cleaning the Drive Head" on page 3-7 and "Function Code 1: Run Drive Diagnostics" on page 3-12). Once you begin this test, the diagnostic begins the loop sequence. Time the first loop by pressing the Unload Button once to stop the diagnostic after the completion of the first loop, then record the time it takes for the test to complete. Compare the recorded time with the "Approximate Run Time" above. If the test runs successfully but the execution time is significantly longer than the "Approximate Run Time", run "Function Code F: Write Performance Test" on page 3-20. If the Write Performance Test fails, replace the media and exit maintenance mode. If the drive diagnostics run successfully, run the Test Cartridge & Media diagnostic (see "Function Code E: Test Cartridge & Media" on page 3-19). 2. If the Test Cartridge & Media diagnostic fails, replace the media. If it runs successfully, perform the operation that produced the initial drive error. 3. If the problem persists replace the drive.
⌑ (C)	The tape drive needs to be cleaned. Clean the tape drive. See "Cleaning the Drive Head" on page 3-7. The error code clears when you clean the tape drive or place it in maintenance mode.
⌑ (d)	Fiber AL_PA conflict. Two drives on fiber loop have the same AL_PA. Modify the tape drive AL_PA to eliminate the conflict. NOT SUPPORTED ON THIS DRIVE.

Error Code	Cause and Action

P	Encryption Error. Displayed when the drive detects an error associated with a encryption operation. If the problem occurred while the tape drive was writing data to, or reading data from, tape:
	
	1. Check the host application to ensure the host application is providing the correct encryption key.
	
	    • Refer to the *IBM LTO Ultrium Tape Drive SCSI Reference* documentation for the Sense Data returned for an encryption operation.
	
	    • Retry the encryption operation after the host application problems have been resolved.
	
	2. Check the operation of the tape drive by resetting the drive and running POST. See Table 3-2 on page 3-5.
	
	    • Refer to the error code displayed on the SCD if the drive reset and POST fails.
	
	    • Retry the encryption operation if the drive reset and POST complete without errors.
	
	3. Check the media.
	
	    • Ensure the correct media is being used. Data encryption is supported with LTO Ultrium 4, 5 and 6 Data Cartridges only.
	
	    • Retry the encryption operation with the tape cartridge in another encryption enabled drive. Replace the media if the problem repeats with the same tape cartridge in multiple drives.
	
	If the problem occurred while the tape drive was running POST or diagnostics, replace the drive.
	
	The error code clears with the first attempted write/read after the encryption key is changed, or when the drive is placed in maintenance mode.

E	Fiber Port offline. NOT SUPPORTED ON THIS DRIVE.
F	Fiber Channel Error. NOT SUPPORTED ON THIS DRIVE.
J	Incompatible media. The tape drive detected an unsupported cartridge was loaded or the cartridge loaded has an incompatible format. Ultrium 1, 2 and 3 cartridges are not supported in the Ultrium 6 tape drive.
P	Write operation to a write protected cartridge has been attempted (this includes any attempt to overwrite a WORM protected tape). Ensure the tape cartridge is the correct media type. Writes to Ultrium 1, 2, 3 or 4 tape cartridges are not supported in the Ultrium 6 tape drive. If the tape cartridge is the correct media type, check the write-protect switch on the cartridge. The drive will not write to a write-protected cartridge. The error code clears when you remove the tape cartridge or place the tape drive in maintenance mode.

Appendix B. TapeAlert flags

TapeAlert is a patented technology and standard of the American National Standards Institute (ANSI) that defines conditions and problems that are experienced by tape drives. The technology enables a server to read TapeAlert flags from a tape drive through the host interface. The server reads the flags from Log Sense Page 0x2E. Refer to the *IBM LTO Ultrium Tape Drive SCSI Reference* for the list of TapeAlert flags that are supported by this tape drive.

Appendix C. Ordering Optional Features, Replacement Parts, and Power Cords

For ordering information, please refer to the following sections:

- "Optional Features"
- "Replacement Parts"
- "Power Cords"

For information on ordering media and bar code labels, see "Ordering Media Supplies" on page 4-19.

Optional Features

Table C-1. Optional Features

Feature Code	Description
5402	2.0 m SAS/Mini-SAS 1x Cable
5502	2.0 m Mini-SAS/Mini-SAS 1x Cable

Replacement Parts

Table C-2. Replacement Parts

Part Number	Description
46C2805	TS2260 (3580-H6S) Half High SAS Bridgebox CRU
95P4587	2 m SAS/Mini-SAS 1x Cable
95P4488	2 m Mini-SAS/Mini-SAS 1x Cable
95P6566	SAS wrap tool

Power Cords

To avoid electrical shock, a power cord with a grounded attachment plug has been provided. Use only properly grounded outlets.

The table below lists the power cord part number, feature code, the country or region where the power cord can be used, and the plug's standard reference. The last column in the table contains an index number that you can match to a specific receptacle type in Figure C-1 on page C-4.

All power cords use an appliance coupler that complies with the International Electrotechnical Commission (IEC) Standard 320, Sheet C13.

If the power cord that you receive does not match your receptacle, contact your local dealer.

Power cords used in the United States and Canada are listed by Underwriter's Laboratories (UL), are certified by the Canadian Standards Association (CSA), and comply with the plug standards of the National Electrical Manufacturers Association (NEMA). For other worldwide geographies, plug standards are listed in the table below.

Table C-3. Power Cords

Description, Feature Code (FC), and Part Number (PN)	Plug Standard Reference	Country or Region	Index Number in Figure C-1 on page C-4
US/Canada • 2.8 m, 125V • FC 9800 • PN 39M5081 • (See Note)	NEMA 5-15P	Aruba, Bahamas, Barbados, Bermuda, Bolivia, Brazil, Canada, Cayman Islands, Colombia, Costa Rica, Curacao, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Japan, Liberia, Mexico, Netherlands Antilles, Nicaragua, Panama, Peru, Philippines, Saudi Arabia, South Korea, Suriname, Taiwan, Trinidad Tobago, Venezuela, US	1
Chicago • 1.8 m, 125 V • FC 9986 • PN 39M5080	NEMA 5-15P	Chicago, U.S.A.	1
US/Canada • 2.8 m, 250 V • FC 9833 • PN 39M5095	NEMA 6-15P	Aruba, Bahamas, Barbados, Bermuda, Bolivia, Brazil, Canada, Cayman Islands, Costa Rica, Curacao, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Japan, Liberia, Netherlands Antilles, Nicaragua, Panama, Peru, Philippines, Suriname, Taiwan, Thailand, Trinidad Tobago, Venezuela, US	2
Australia • 2.8 m, 250V • FC 9831 • PN 39M5102	AS 3112 NZS 198	Argentina, Australia, China, Colombia, New Zealand, Papua New Guinea, Paraguay, Uruguay, Western Samoa	3
France, Germany • 2.8 m, 250V • FC 9820 • PN 39M5123	CEE 7 - VII	Afghanistan, Algeria, Andorra, Angola, Aruba, Austria, Belgium, Benin, Brazil, Bulgaria, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo-Brazzaville, Curacao, Czech Republic, Democractic Republic of Congo, Denmark, Egypt, Finland, France, French Guiana, Germany, Greece, Guinea, Hungary, Iceland, Indonesia, Iran, Ivory Coast, Jordan, Kenya, Korea, Lebanon, Luxembourg, Macau, Malagasy, Mali, Martinique, Mauritania, Mauritius, Monaco, Morocco, Mozambique, Netherlands, Netherlands Antilles, New Caledonia, Niger, Norway, Poland, Portugal, Romania, Russia, Saudi Arabia, Senegal, Spain, Sweden, Sudan, Syria, Togo, Tunisia, Turkey, Yugoslavia, Zaire, Zimbabwe, Vietnam	4
Denmark • 2.8 m, 250V • FC 9821 • PN 39M5130	DK2-5A	Denmark	5
South Africa • 2.8 m, 250V • FC 9829 • PN 39M5144	SABS 164	Bangladesh, Burma, Pakistan, South Africa, Sri Lanka	6
United Kingdom • 2.8 m, 250V • FC 9825 • PN 39M5151	BS 1363	Antigua, Bahrain, Bermuda, Brunei, Channel Islands, China (Hong Kong S.A.R.), Cyprus, Fiji, Ghana, Guyana, India, Iraq, Ireland, Jordan, Kenya, Kuwait, Malaysia, Malawi, Malta, Nepal, Nigeria, Oman, Polynesia, Qatar, Sierra Leone, Singapore, Tanzania, Uganda, UK, United Arab Emirate (Dubai), Yemen, Zambia	7
Switzerland • 2.8 m, 250V • FC 9828 • PN 39M5158	SEV SN 416534	Liechtenstein, Switzerland	8

Table C-3. Power Cords (continued)

Description, Feature Code (FC), and Part Number (PN)	Plug Standard Reference	Country or Region	Index Number in Figure C-1 on page C-4
Italy • 2.8 m, 250V • FC 9830 • PN 39M5165	CEI 23- 16	Chile, Ethiopia, Italy, Libya, Somalia	9
Israel • 2.8 m, 250V • FC 9827 • PN 39M5172	S11-32-1971	Israel	10
Argentina • 2.8 m, 250V • FC 9834 • PN 39M5068	IEC 83-A5	Argentina, Brazil, Colombia, Paraguay, Trinidad Tobago, Uruguay	11
China • 2.8 m, 250V • FC 9840 • PN 39M5206	CCEE	People's Republic of China	12
Taiwan LV* • 2.8 m, 125V • FC 9835 • PN 39M5247	CNS 10917-3	Taiwan	13
Taiwan HV** • 2.8 m, 250V • FC 9841 • PN 39M5254	CNS 10917-3	Taiwan	14
Japan LV* • 2.8 m, 125V • FC 9842 • PN 39M5199	JIS C8303, C8306	Japan	15
Japan HV** • 2.8 m, 250V • FC 9843 • PN 39M5186	JIS C8303, C8306	Japan	16
Korea HV** • 2.8 m, 250V • FC 9844 • PN 39M5219	KS C8305, K60884-1	Korea	17
India HV** • 2.8 m, 250V • FC 9845 • PN 39M5226	IS 6538	India	18
Brazil HV** • 2.8 m, 250V • FC 9847 • PN 39M5240	InMetro NBR 14136	Brazil	20
* Low Voltage ** High Voltage			

Types of Receptacles

The figure below shows the plugs that are available on the power cords in . Match the index number that is beside each plug to the index number in Table C-3 on page C-2.
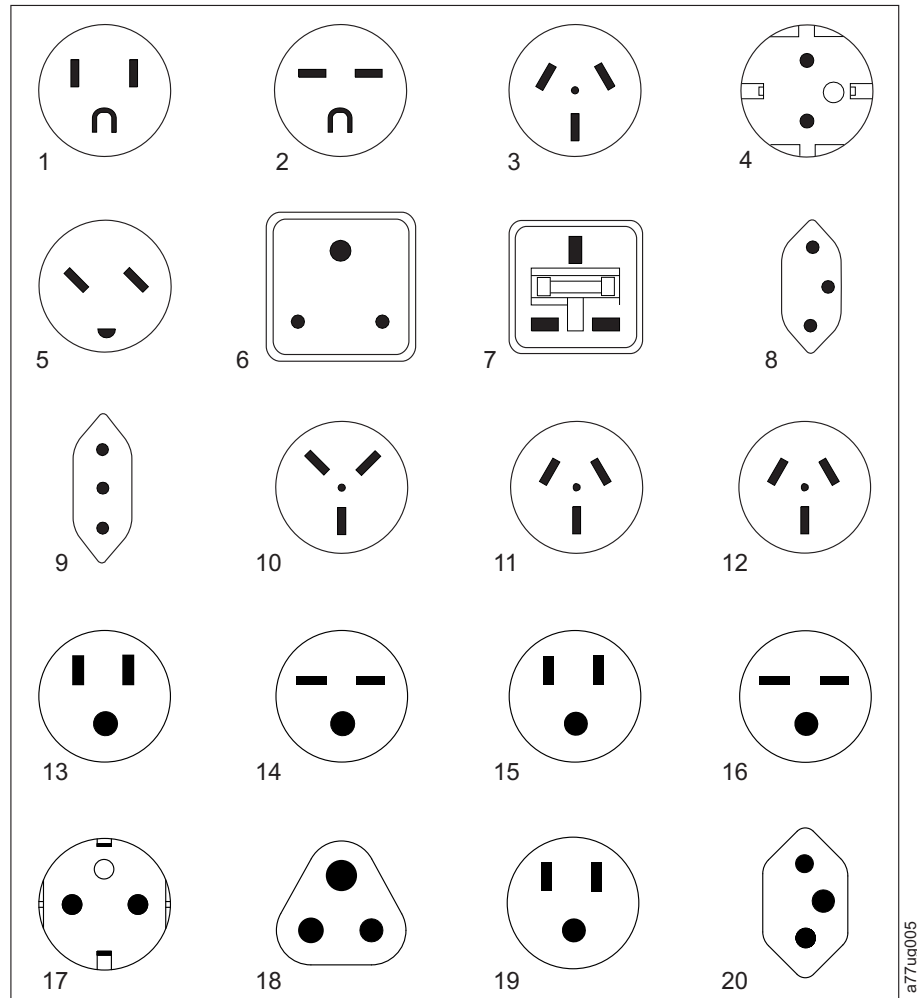

Figure C-1. Types of Receptacles

Appendix D. Installing a 19-inch Rack Mount Kit (optional)

Before you begin, read these instructions to familiarize yourself with the installation procedure.

Rack Safety

The following general safety information should be used for all rack-mounted devices:

DANGER

- Always lower the leveling pads on the rack cabinet.
- Always install stabilizer brackets on the rack cabinet.
- To avoid hazardous conditions due to uneven mechanical loading, always install the heaviest devices in the bottom of the rack cabinet. Always install servers and optional devices starting from the bottom of the rack cabinet.
- Rack-mounted devices are not to be used as a shelf or work space. Do not place any object on top of rack-mounted devices.
- Each rack cabinet might have more than one power cord. Be sure to disconnect all power cords in the rack cabinet before servicing any device in the rack cabinet.
- Connect all devices installed in a rack cabinet to power devices installed in the same rack cabinet. Do not plug a power cord from a device installed in one rack cabinet into a power device installed in a different rack cabinet.
- An electrical outlet that is not correctly wired could place hazardous voltage on the 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.

CAUTION:
- Do not install a unit in a rack where the internal rack ambient temperatures will exceed the manufacturer's recommended ambient temperature for all your rack-mounted devices.
- Do not install a unit in a rack where the air flow is compromised. Ensure that air flow is not blocked or reduced on any side, front, or back of a unit used for air flow through the unit.
- Consideration should be given to the connection of the equipment to the supply circuit so that overloading of the circuits does not compromise the supply wiring or overcurrent protection. To provide the correct power connection to a rack, refer to the rating labels located on the equipment in the rack to determine the total power requirement of the supply circuit.
- (*For sliding drawers.*) Do not pull out or install any drawer or feature if the rack stabilizer brackets are not attached to the rack. Do not pull out more than one drawer at a time. The rack may become unstable if you pull out more than one drawer at a time.
- (*For fixed drawers.*) This drawer is a fixed drawer and should not be moved for servicing unless specified by manufacturer. Attempting to move the drawer partially or completely out of the rack may cause the rack to become unstable or cause the drawer to fall out of the rack.

(R001)

CAUTION:

Removing components from the upper positions in the rack cabinet improves rack stability during relocation. Follow these general guidelines whenever you relocate a populated rack cabinet within a room or building:

- Reduce the weight of the rack cabinet by removing equipment starting at the top of the rack cabinet. When possible, restore the rack cabinet to the configuration of the rack cabinet as you received it. If this configuration is not known, you must do the following:
  - Remove all devices in the 32U position and above.
  - Ensure that the heaviest devices are installed in the bottom of the rack cabinet.
  - Ensure that there are no empty U-levels between devices installed in the rack cabinet below the 32U level.
- If the rack cabinet you are relocating is part of a suite of rack cabinets, detach the rack cabinet from the suite.
- Inspect the route that you plan to take to eliminate potential hazards.
- Verify that the route that you choose can support the weight of the loaded rack cabinet. Refer to the documentation that comes with your rack cabinet for the weight of a loaded rack cabinet.
- Verify that all door openings are at least 760 x 230 mm (30 x 80 in.).
- Ensure that all devices, shelves, drawers, doors, and cables are secure.
- Ensure that the four leveling pads are raised to their highest position.
- Ensure that there is no stabilizer bracket installed on the rack cabinet during movement.
- Do not use a ramp inclined at more than ten degrees.
- Once the rack cabinet is in the new location, do the following:
  - Lower the four leveling pads.
  - Install stabilizer brackets on the rack cabinet.
  - If you removed any devices from the rack cabinet, repopulate the rack cabinet from the lowest position to the highest position.
- If a long distance relocation is required, restore the rack cabinet to the configuration of the rack cabinet as you received it. Pack the rack cabinet in the original packaging material, or equivalent. Also lower the leveling pads to raise the casters off of the pallet and bolt the rack cabinet to the pallet.

(R002)

Verify Kit Contents

Qty	Description
1	fixed shelf
4	screws
2	tie wraps
	Installation Instructions (Feature 7003)

Tools Required

- 7 mm nut driver or 7 mm socket wrench

Installing the Shelf

1. Decide at what level you want to install the shelf. The 3580 requires 3 units (EIAs) of rack space (see **2** in Figure D-1).

   Note: All vertical rack measurements are given in rack units (U). One U is equal to 4.45 cm (1.75 in.). The U levels are marked on labels on one front mounting rail and one rear mounting rail.

2. With the sides and back of the shelf facing up, carefully lift the shelf into the rack between the front and back rack rails with the shelf flanges behind the front rack rails.

3. Align the holes in the shelf flange exactly with the holes in the front rack rails.

4. Holding the shelf **1** level, insert a screw through the top hole **3** in each front flange of the shelf. Loosely thread the screws into the front mounting rails.
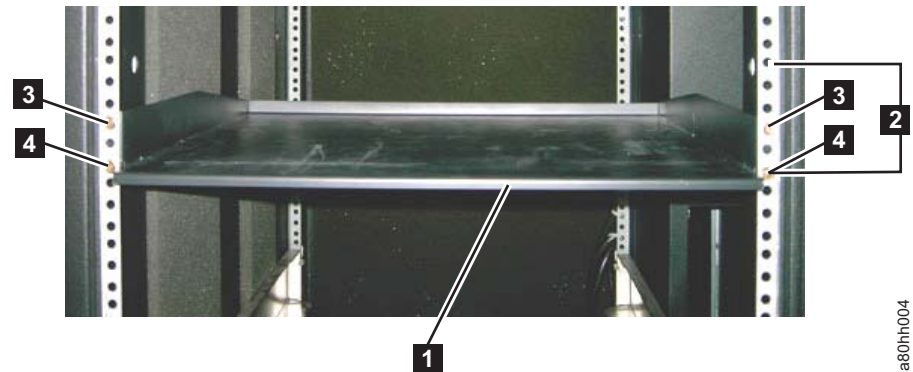
Figure D-1. Front view of shelf attached to rack rails

5. Check that the shelf is at the same level on the four mounting rails.

6. Insert a screw through the bottom hole **4** in each front flange of the shelf. Loosely thread the screws into the front mounting rails.

7. Tighten all mounting screws using a 7 mm nut driver or a 7 mm socket wrench.

8. Route cables down one of the rear rack rails by threading each tie wrap (see **5** in Figure D-2 on page D-4) through a hole in the rail and around the cables. One tie wrap should be located near the rear of the 3580; the other should be located farther down the rack rail. Tighten cable ties securely around the cables so the cables cannot be pulled out. Cut off tie wrap excess.

Figure D-2. Rear view of shelf with cables attached to rack rails with tie wraps

The shelf installation is complete. You can now install your equipment on the shelf.

Removing the Shelf from the Rack

To remove the shelf from the rack, reverse the steps in the installation procedure.

Appendix E. Information for Trained Service Personnel

Attention

- It is strongly recommended that the drive and stuck tape be returned to IBM for removal and recovery.
- If the cartridge in the drive is an INPUT tape containing ACTIVE or 'ONLY COPY' data (i.e., there is no backup), eject commands issued at the host fail to unload the tape, and power-cycling the drive fails to eject the cartridge, make no further attempts to unload this tape. Call Technical Support and open a PMR if one isn't already open, to initiate the process of sending the drive with the loaded cartridge in for recovery.
- These procedures must be performed only by a trained IBM service provider. SSRs should claim their time against service code 33 ECA 013 when performing this procedure.
- Inform the customer the following procedure has high risk of damaging the drive and high risk of not being able to recover the data.

Removing the Internal Drive

This Procedure is to be performed by IBM Service Personnel only.

Note: One of the four screws securing the cover to the chassis is a tamperproof screw. A T20 Torx tamperproof screwdriver is required to remove the cover.

Step 1. Remove the Cover

1. Unplug all cables from the rear panel of the unit.
2. Move the unit to a clean and sturdy work surface.
3. Turn the unit on its side with the bottom of the unit facing you.
4. Remove the 4 screws (**1** in Figure E-1 on page E-2) by the feet.

a80hh053
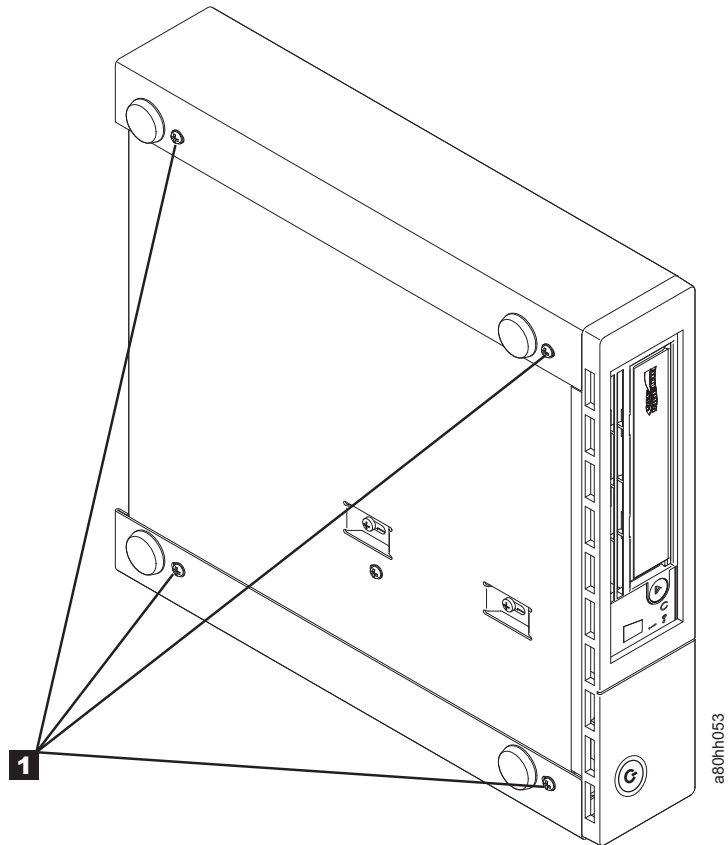
Figure E-1. Removing the screws that secure the cover and internal drive

5. Return the unit to its upright position.
6. Gently push on the drive's rear panel to remove the chassis from the cover (see Figure E-2 on page E-3).

Step 2. Remove the Internal Drive
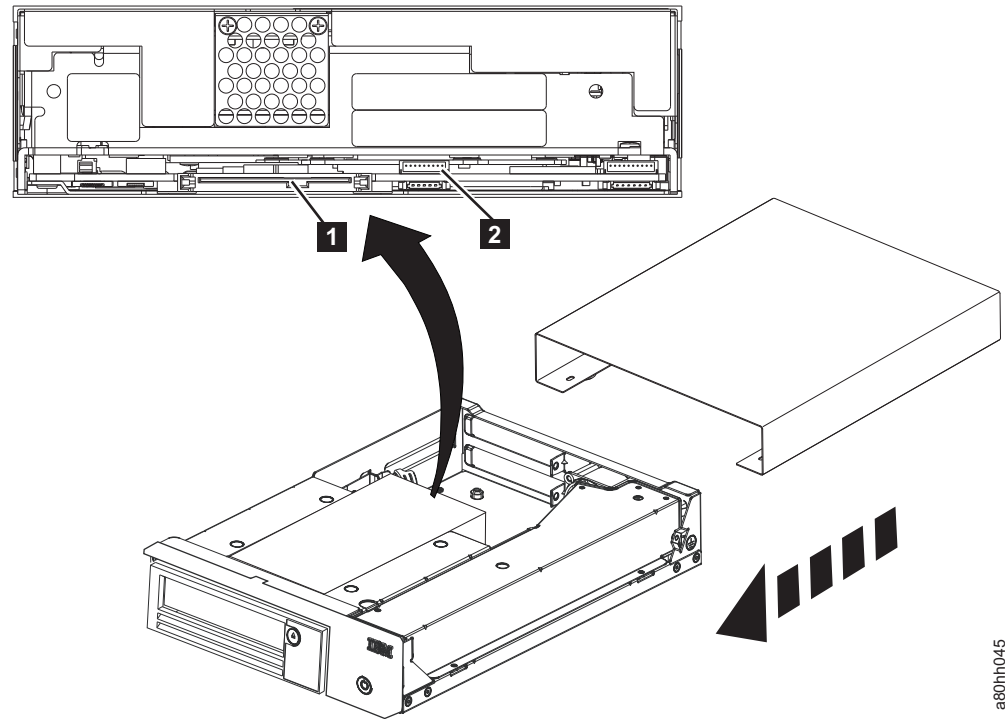
Figure E-2. Removing cables from the internal drive

1. Unplug the SAS interface cable and the ethernet interface cable (`1` and `2` in Figure E-2) from the drive. Disconnecting the internal SAS interface cable disconnects both the SAS interface and electrical power from the drive.

   Attention: DO NOT UNPLUG THE INTERNAL POWER CABLE.

2. Press the latch assembly to release the drive.
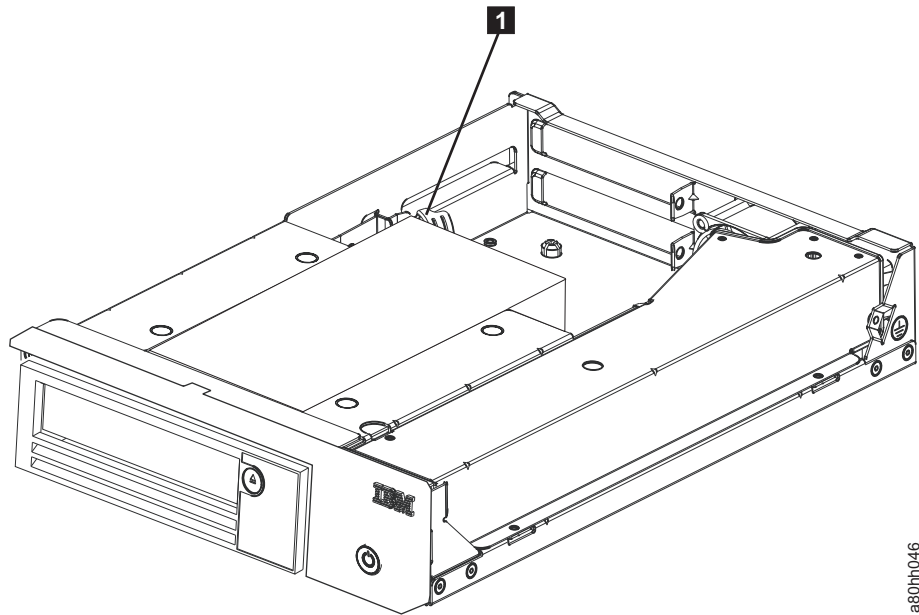
Figure E-3. Releasing the drive from the chassis

3. Slide the internal drive forward towards the front of the chassis to clear the front bezel.
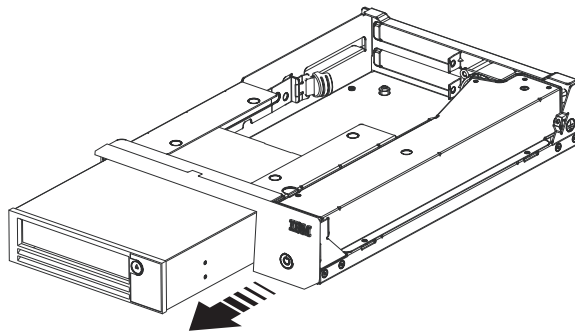
Figure E-4. Sliding the drive forward

Manually Removing a Tape Cartridge

This Procedure is to be performed by IBM Service Personnel only.

The purpose of this section is to assist you in determining the condition of the cartridge or the magnetic tape and to direct you to the procedure you must follow to remove the cartridge.

Attention

- The best solution for recovering data on a damaged cartridge is to send it to IBM for professional data recovery.
- Before using this procedure, you must have exhausted all other means of removing the tape cartridge from the drive. Use this procedure only if you cannot remove the tape cartridge by using any other means.

- Determine from the customer if the cartridge contains critical customer data. If the cartridge contains sensitive data that cannot leave the site, inform the customer that certain failure conditions diagnostics will be performed to test the drive for continued use.
- The following removal procedures can destroy customer data! Use extreme care when handling or removing the customer's tape cartridges to minimize tape damage and lost data.
- DO NOT TOUCH the magnetic tape or tape path. Both are extremely sensitive to the oil and salt from your skin. Use clean, lint-free gloves when working around magnetic tape or the tape path components.
- Electrostatic-sensitive components: Consider using an ESD Kit.
- After you remove the tape cartridge, advise the customer to copy the data to another cartridge and to remove this tape cartridge from service.
- Do not use power tools or magnetic tools to perform this procedure.
- To avoid contamination and electrostatic-discharge damage to the drive, never touch the head or electronic components inside the drive.
- If you cannot remove the cartridge from the drive using the following procedures, contact your next level of support.
- The cartridge will not eject automatically at the end of a mid-tape recovery. Instead, the tape will be reloaded into the drive and may result in the loss of data.
- INTERNAL COMPONENTS OF THE DRIVE ARE DELICATE AND CAN EASILY BE DAMAGED. EXERCISE EXTREME CAUTION WHEN MANUALLY REMOVING A CARTRIDGE THAT WILL NOT EJECT AFTER PRESSING THE UNLOAD BUTTON.

Before You Begin

1. If you have not already done so, attempt to remove the cartridge with the device power ON and using library manager, a host application, or the unload button. When using the Unload button, press and hold the button for 12 seconds. This will cause the drive to eject the cartridge when it has completed the mid-tape recovery.
2. If you have not already done so, attempt to remove the cartridge by power cycling the drive. Look for the drive to attempt a midtape recovery.

   Note: It can take as long as fifteen minutes for the cartridge to rewind and unload.
3. If the cartridge unloads, inform the operator that the cartridge is unloaded. If the cartridge does not unload, repeat steps 2 and 3 once before continuing with this procedure.

Recommended Tools

- #1 Phillips screwdriver
- ESD Kit
- Flashlight (optional)
- #1 Flathead screwdriver (optional)

Beginning Procedure

1. Refer to the enclosure documentation for instructions on removing the drive.
2. Place the drive on a non-slip, sturdy work surface.

3. Ground yourself to the drive by using the ESD Kit.

4. Remove the cover of the drive by performing the following steps:

   a. To remove the drive bezel, pull the right side of the bezel from the front of the drive, then pull the left side of the bezel out of the frame of the drive.

   b. Remove the cover of the internal drive by performing the following steps:

      1) Remove the four cover-mounting screws (**1** in Figure E-5). Two screws are located on each side of the drive.

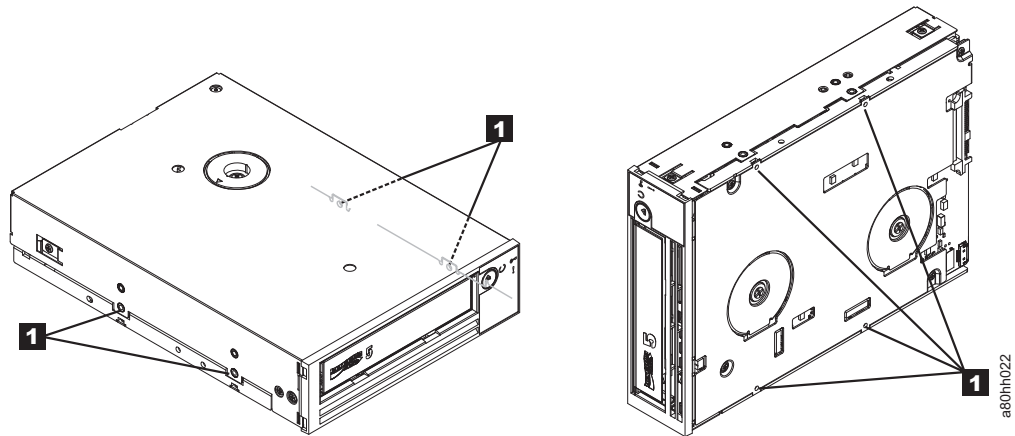   2) Remove the cover by lifting it up.

Figure E-5. Removing the bezel and the cover from the internal drive

5. Inspect the drive to decide which of the following conditions most closely matches the symptom on the drive:

   - **Tape spooled off the supply reel** - All the tape appears to be on the takeup reel and no tape is on the supply reel (inside the cartridge). Test the drive after the procedure is completed.

   - **Tape pulled from leader pin (or broken at the front end)** - All the tape appears to be on the supply reel (inside the cartridge) and very little or no tape appears to be on the takeup reel. The leader block is positioned in the takeup reel. Return the drive after the procedure is completed.

   - **Tape broken in mid-tape** - Tape appears to be on both the supply reel (inside the cartridge) and takeup reel. Test the drive after the procedure is completed.

   - **Tape tangled along tape path** - Tape appears to be tangled and damaged but intact. Return the drive after the procedure is completed.

     -- OR --

     No damage to tape (or no apparent failure) - There appears to be no damage or slack to the tape. Return the drive after the procedure is completed.

Tape Spooled off Supply Reel

Attention: DO NOT TOUCH THE OUTER GUIDE RAIL (2 in Figure E-6 on page E-7). THIS RAIL IS VERY DELICATE AND EASILY DAMAGED.

1. From the takeup reel, pull an arm's length of tape around the rear of the tape path and over the head and rollers on the left side of the drive.

2. Set the drive on its left side with the head and tape path facing up.

3. Make sure the tape is not twisted. Untwist tape if required.

4. Moisten a cotton swab with water and wet approximately 13 mm (0.5 in.) of the tape end and feed it onto the supply reel (inside the cartridge).
5. Turn the supply reel (**4** in Figure E-6) clockwise, allowing the moistened tape to adhere to the hub as it winds around the supply reel (inside the cartridge).
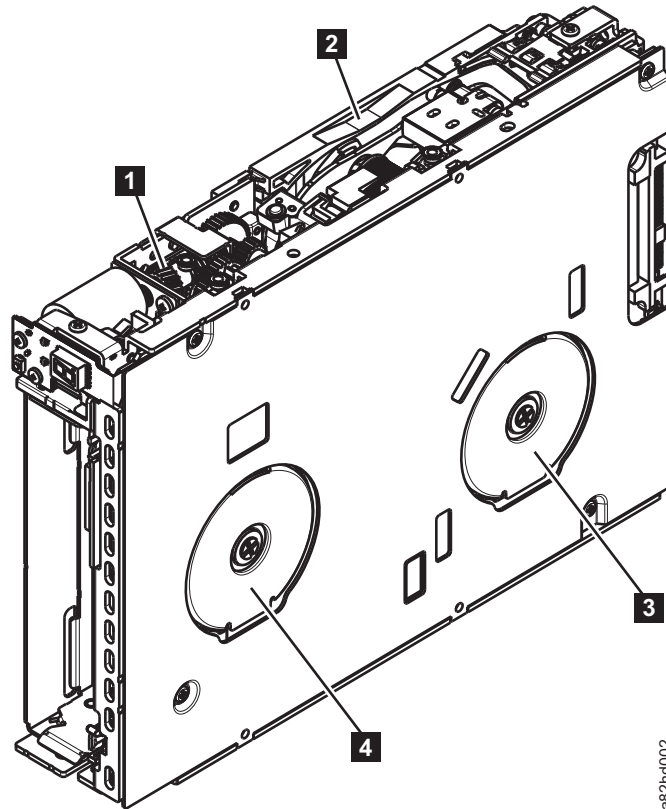
Figure E-6. Rewinding tape into cartridge

1	Loader motor worm gear	**3**	Takeup reel motor
2	Outer guide rail WARNING: DO NOT TOUCH	**4**	Supply reel motor

6. Continue spooling into the cartridge until the tape is taut and remains within the flanges of the tape guiding rollers. Turn the supply reel (**4** in Figure E-6) 10 additional turns. Ensure that you do not stretch the tape.
7. Reassemble the drive, reversing the steps in "Beginning Procedure" on page E-5.
8. Reassemble the drive chassis, following the steps in "Replacing the Internal Drive" on page E-14.
9. Reinstall the drive canister into the cradle assembly. Ensure that the connector on the drive is seated properly into the connector on the cradle.
10. Allow the drive to perform mid-tape recovery. This takes several minutes. When this activity completes, push the Unload button to eject the cartridge.
11. Test the drive (see "Function Code 1: Run Drive Diagnostics" on page 3-12) to determine if it should be replaced.

Tape Pulled from or Broken near Leader Pin

Figure E-7. Drive with cover removed to reveal gear train.

1	Threader intermediate gear	2	Threader mechanism gear	3	Loader motor worm gear

1. Pull out tape from the takeup reel.

   Note: If there is more than approximately 0.6 m (2 ft.) of tape on the takeup reel, go to "Tape Broken in Mid-tape" on page E-9.
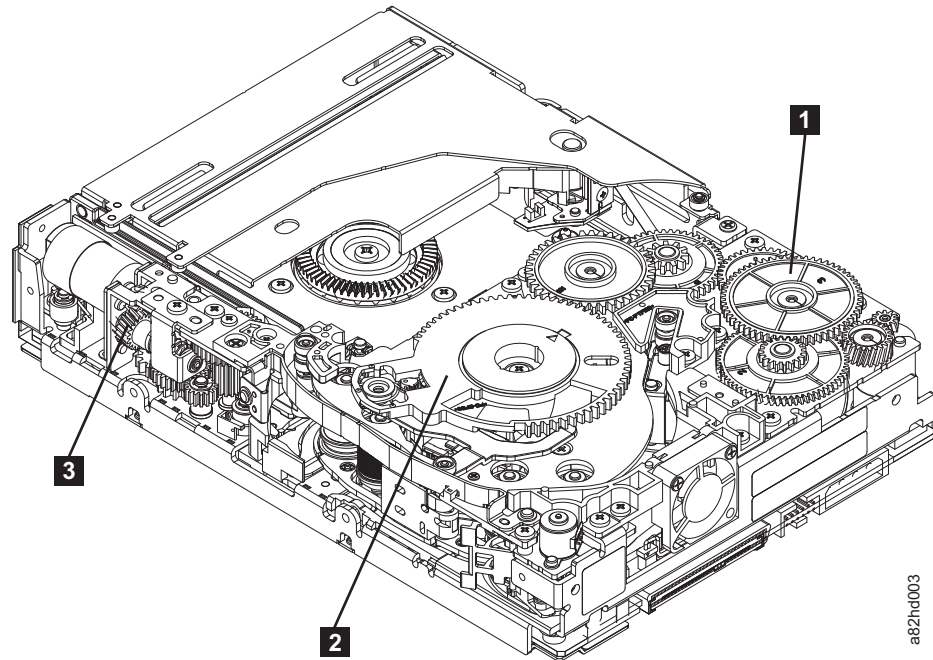
2. If there is less than approximately 0.6 m (2 ft.) of tape on the takeup reel, cut off the excess tape as close to the leader pin, as possible.

3. Reattach the leader pin to the remaining tape. For instructions, see "Repositioning or Reattaching a Leader Pin" on page 4-11.

4. Locate the threader intermediate gear (**1** in Figure E-7) near the rear of the drive. You can use your finger to rotate the threader intermediate gear (**1** in Figure E-7) and slowly rotate the threader mechanism gear (**2** in Figure E-7) clockwise.

   This draws the tape leader block assembly (LBA) into the cartridge.

5. As the leader pin is secured in the cartridge, you should hear the leader pin retention spring clips click into place. If you do not hear the click, continue rolling until the threader intermediate gear (**1** in Figure E-7) stops. The LBA is in the correct position.

   Note: Be sure to keep tension on the tape as the LBA is drawn into the cartridge.

6. Rotate the loader motor worm gear (**3** in Figure E-7) clockwise as viewed from the front of the drive until it stops. This releases the LBA leader pin.

7. Rotate the threader intermediate gear (**1** in Figure E-7) counterclockwise until the leader block is in front of the Read/Write head. This moves the LBA
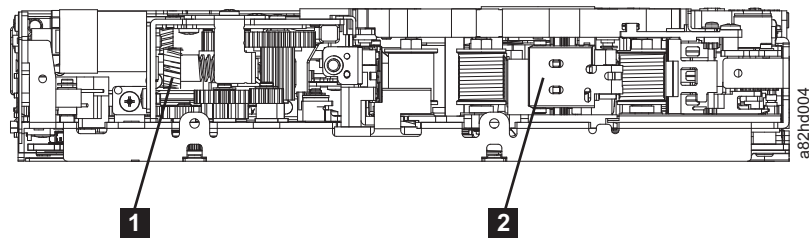
out of the cartridge.

Figure E-8. Leader Block Assembly (LBA)

1   Loader motor worm gear   **2**   Leader block assembly (LBA)

8. Rotate the loader motor worm gear (**3** in Figure E-7 on page E-8) counterclockwise as viewed from the front of the drive until it stops.
9. Remove the cartridge from the cartridge loader tray.
10. Reassemble the drive by reversing the procedure in Step 4 in "Beginning Procedure" on page E-5.
11. Reassemble the drive chassis.
12. Refer to the appropriate procedure to install the new drive and return the failed drive.

Tape Broken in Mid-tape

1. With the front of the drive facing you, pull an arm's length of tape out of the takeup reel. From the takeup reel, thread tape around the rear of the tape path and over the head rollers on the left side of the drive.

   Note: If there is less than approximately 5 cm (2 in.) of tape on the takeup reel, go to "Tape Pulled from or Broken near Leader Pin" on page E-8.
2. From the supply reel inside the cartridge, pull approximately 0.3 m (1 ft.) of tape.
3. Make sure the tape is not twisted. Untwist tape if required.
4. Moisten a cotton swab with water, and wet approximately 13 mm (0.5 in.) of the tape end. Overlap the tape ends, loosely mending them together.
5. Set the drive on its left side with the head and tape path facing up.
6. Turn the supply reel (**4** in Figure E-9 on page E-10) clockwise, carefully guiding the mended portion of the tape to wind around the hub of the supply reel located inside the cartridge. Continue spooling into the cartridge until the tape is taut. The tape must remain within the flanges of the tape guiding rollers. Turn the supply reel (**4** in Figure E-9 on page E-10) 10 additional turns. Ensure that you do not stretch the tape.

Figure E-9. Rewinding tape into cartridge

`1`	Loader motor worm gear	`3`	Takeup reel motor
`2`	Outer guide rail WARNING: DO NOT TOUCH	`4`	Supply reel motor

7. Reassemble the drive by reversing the procedure in Step 4 in "Beginning Procedure" on page E-5.
8. Reassemble the chassis by following the steps in "Replacing the Internal Drive" on page E-14.
9. Allow the drive to perform mid-tape recovery. This takes several minutes. When this activity completes, push the Unload button to eject the cartridge.
10. Test the drive (see "Function Code 1: Run Drive Diagnostics" on page 3-12) to determine if it should be replaced.

Tape Tangled along Tape Path

1. Carefully pull out excess tape and untangle.

    Note: If you find the tape to be broken, go to one of the following appropriate procedures:
    - "Tape Spooled off Supply Reel" on page E-6
    - "Tape Pulled from or Broken near Leader Pin" on page E-8
      --OR--
      "Tape Broken in Mid-tape" on page E-9

2. Set the drive on its left side with the head and tape path facing up.
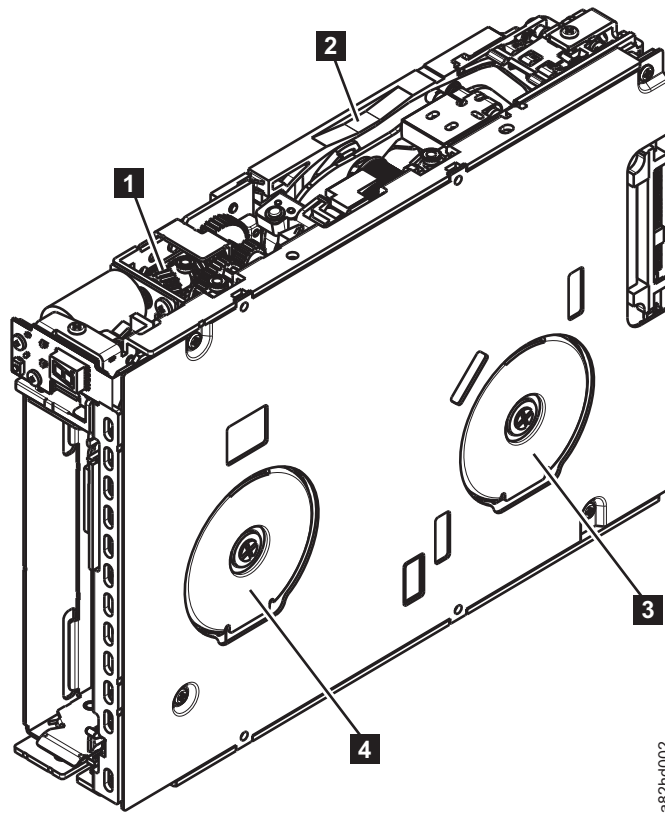
Figure E-10. Rewinding tape into cartridge

1	Loader motor worm gear	3	Takeup reel motor
2	Outer guide rail WARNING: DO NOT TOUCH	4	Supply reel motor

3. Turn the supply reel (4 in Figure E-10) clockwise.

4. Continue spooling into the cartridge until the tape is taut and remains within the flanges of the tape guiding rollers. turn the supply reel (4 in Figure E-10) 10 turns. Ensure that you do not stretch the tape.

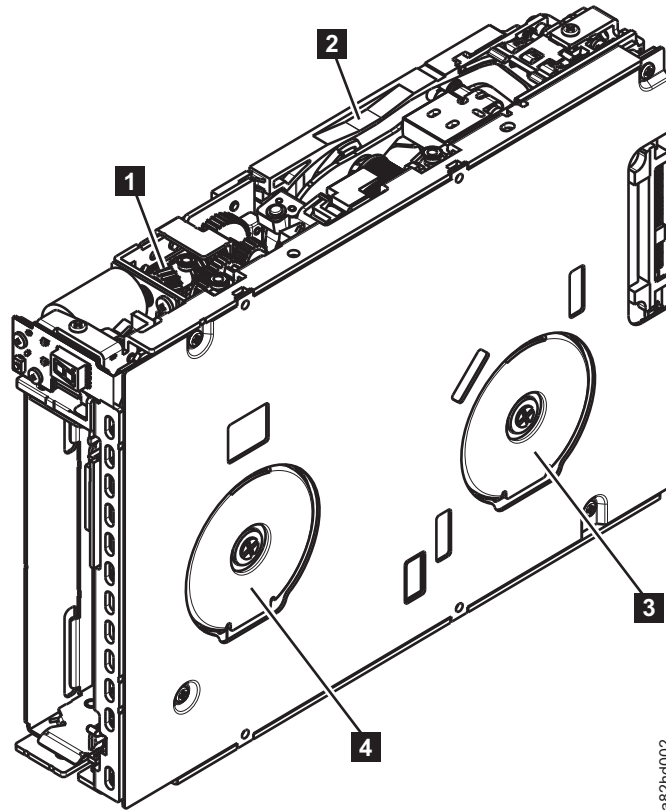5. Reassemble the chassis by following the steps in "Replacing the Internal Drive" on page E-14.

6. Allow the drive to perform mid-tape recovery. This takes several minutes. When this activity completes, push the Unload button to eject the cartridge.

7. Test the drive (see "Function Code 1: Run Drive Diagnostics" on page 3-12) to determine if it should be replaced.

No Apparent Failure or Damage to Tape

1. Set the drive on its left side with the head and tape path facing up.
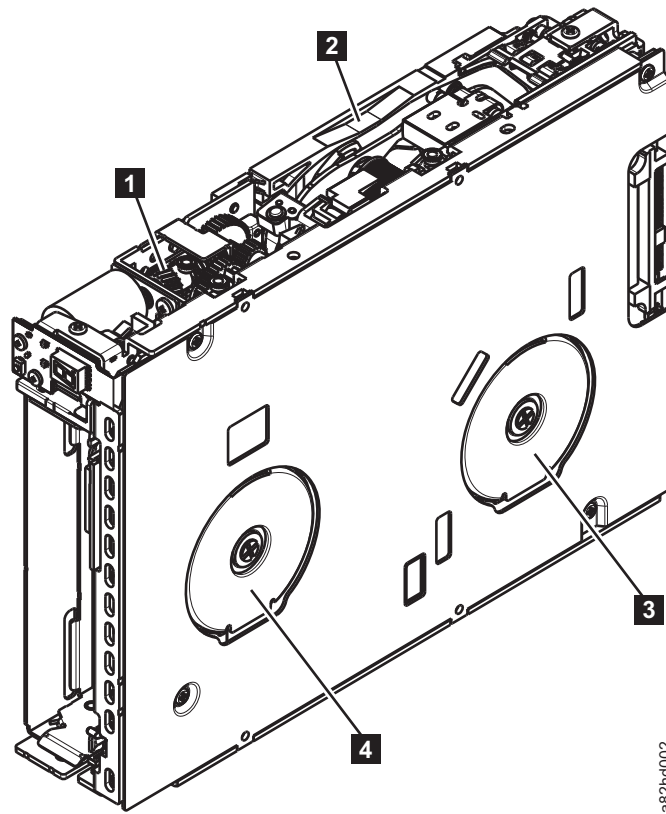
Figure E-11. Rewinding tape into cartridge

1	Loader motor worm gear	3	Takeup reel motor
2	Outer guide rail WARNING: DO NOT TOUCH	4	Supply reel motor

2. Begin spooling the tape back into the cartridge by turning the supply reel motor (4 in Figure E-11) clockwise.

3. Continue spooling into the cartridge until the tape is taut and remains within the flanges of the tape guiding rollers. Ensure that you do not stretch the tape. Continue spooling until all tape is removed from the takeup reel (3 in Figure E-11).

4. Locate the threader intermediate gear (1 in Figure E-12 on page E-13) near the rear of the drive. You can use your finger to rotate the threader intermediate gear (1 in Figure E-12 on page E-13) and slowly rotate the threader mechanism gear (2 in Figure E-12 on page E-13) clockwise.

   This draws the tape leader block assembly (LBA) into the cartridge.
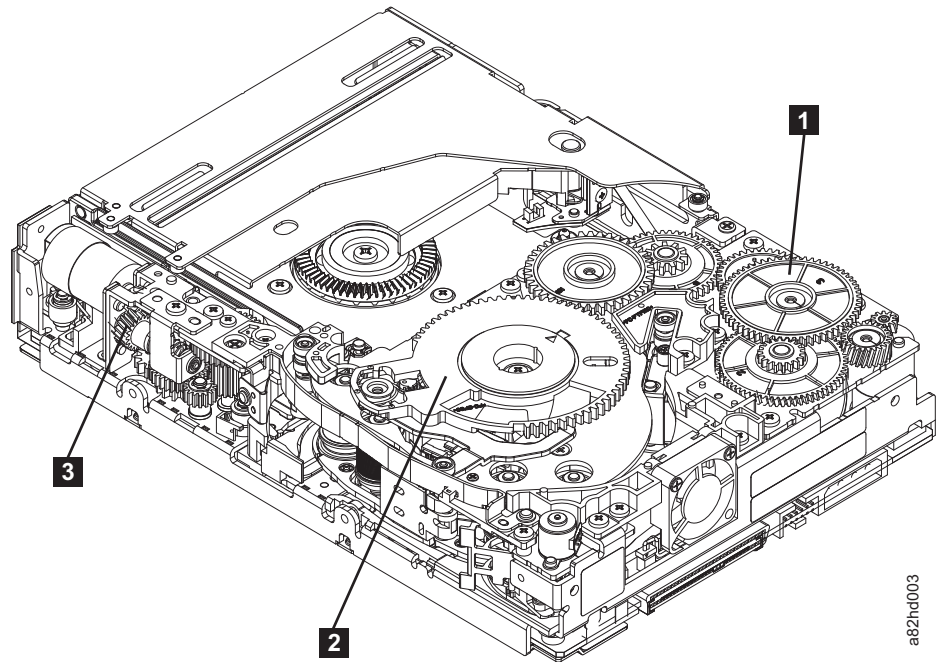
Figure E-12. Drive with cover removed to reveal gear train.

| 1 | Threader intermediate gear | 2 | Threader mechanism gear | 3 | Loader motor worm gear |

5. As the leader pin is secured in the cartridge, you should hear the leader pin retention spring clips click into place. If you do not hear the click, continue rolling until the threader intermediate gear (**1** in Figure E-12) stops. The LBA is in the correct position.

   Note: Be sure to keep tension on the tape as the LBA is drawn into the cartridge.

6. Rotate the loader intermediate gear (**1** in Figure E-13) clockwise as viewed from the front of the drive until it stops. This releases the LBA leader pin.

7. Rotate the threader motor worm gear (**3** in Figure E-13) counterclockwise until the leader block is in front of the Read/Write head. This moves the LBA out of the cartridge.
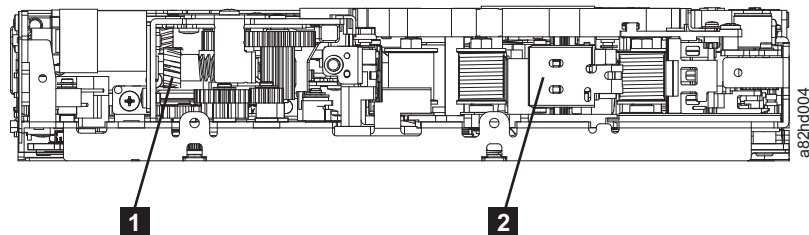
Figure E-13. Leader Block Assembly (LBA)

| 1 | Loader motor worm gear | 2 | Leader block assembly (LBA) |

8. Rotate the loader motor worm gear (**3** in Figure E-13) counterclockwise as viewed from the front of the drive until it stops.

9. Remove the cartridge from the cartridge loader tray.

10. Reassemble the drive by reversing the procedure in Step 4 in "Beginning Procedure" on page E-5.

11. Reassemble the drive chassis by following the steps in "Replacing the Internal Drive."

12. Refer to the appropriate procedure to install the new drive and return the failed drive.

Replacing the Internal Drive

Step 1. Replace the Internal Drive

1. Place the internal drive part way into the chassis.
2. Reconnect the internal interface cable to the drive.
3. Reconnect the internal power cable to the drive.
4. Slide the internal drive completely into the chassis until the latch assembly locks the drive in place.

Step 2. Replace the Cover

1. Gently push the chassis into the cover.
2. Turn the unit on its side with the bottom of the unit facing you.
3. Align the four screw holes in the cover by the feet with the screw holes in the chassis.
4. Replace the 4 screws by the feet.
5. Reconnect all cables to the rear panel of the unit.

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International Business Machines Corp.
New Orchard Road
Armonk, New York 10504
914-499-1900

European community contact:

IBM Deutschland GmbH
Technical Regulations, Department M372
IBM-Allee 1, 71139 Ehningen, Germany
Tele: +49 7032 15 2941
e-mail: lugi@de.ibm.com

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IBM Taiwan Corporation
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Glossary

This glossary defines the special terms, abbreviations, and acronyms that are used in this publication. If you do not find the term you are looking for, refer to the index or to the *Dictionary of Computing*, 1994.

Numbers

2:1 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.

A

A   Ampere.

ac   Alternating current.

access method
> A technique for moving data between main storage and input or output devices.

adapter card
> A circuit board that adds function to a computer.

adj   Adjustment.

AIX   Advanced Interactive Executive. IBM's implementation of the UNIX operating system. The RS/6000 system, among others, uses AIX as it's operating system.

alphanumeric
> Pertaining to a character set that contains letters, numerals, and usually other characters, such as punctuation marks.

alter   To change.

ambient temperature
> The temperature of air or other media in a designated area, particularly the area surrounding equipment.

ampere (A)
> 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.

ANSI   American National Standards Institute.

archive
> To collect and store files in a designated place.

ASCII   American National Standard Code for Information Interchange. A 7 bit coded character set (8 bits including parity check) that consists of control characters and graphic characters.

assigning a device
> The establishing of the relationship of a device to a running task, process, job, or program.

assignment
The naming of a specific device to perform a function.

asynchronous
Pertaining to two or more processes that do not depend upon the occurrence of specific events such as common timing signals.

attention (notice)
A word for calling attention to the possibility of danger to a program, device, or system, or to data. Contrast with *caution* and *danger*.

ATTN Attention.

B

backup
To make additional copies of documents or software for safekeeping.

bar code
A code representing characters by sets of parallel bars of varying thickness and separation which are read optically by transverse scanning.

bar code label
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
A laser device specialized for scanning and reading bar codes and converting them into either the ASCII or EBCDIC digital character code.

bezel Decorative and safety cover.

bicolored
Having two colors.

bit Either of the digits 0 or 1 when used in the binary numbering system.

BM or bill of materials
A list of specific types and amounts of direct materials expected to be used to produce a given job or quantity of output.

browser
A client program that initiates requests to a Web server and displays the information that the server returns.

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

bus A facility for transferring data between several devices located between two end points, only one device being able to transmit at a given moment.

byte A string consisting of a certain number of bits (usually 8) that are treated as a unit and represent a character. A fundamental data unit.

C

capacity
The amount of data that can be contained on storage media and expressed in bytes of data.

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 storage slot
Individual slot located within a magazine that is used to house tape cartridges.

caution (notice)
A word to call attention to possible personal harm to people. Contrast with *attention* and *danger*.

CE Customer engineer; field engineer; service representative.

centimeter (cm)
One one-hundredth of a meter (0.01 m). Approximately 0.39 inch.

channel command
An instruction that directs a data channel, control unit, or device to perform an operation or set of operations.

char Character.

CHK Check.

cleaning cartridge
A tape cartridge that is used to clean the heads of a tape drive. Contrast with *data cartridge*.

command
A control signal that initiates an action or the start of a sequence of actions.

compact disc (CD)
A disc, usually 4.75 inches in diameter, from which data is read optically by means of a laser.

compression
The process of eliminating gaps, empty fields, redundancies, and unnecessary data to shorten the length of records or blocks.

concurrent
Refers to diagnostic procedures that can be run on one control unit while the rest of the subsystem remains available for customer applications.

contingent connection
A connection between a channel path and a drive caused when a unit check occurs during an I/O operation.

controller
A device that provides the interface between a system and one or more tape drives.

CP Circuit protector.

ctrl Control.

CU Control unit.

D

danger (notice)
A word to call attention to possible lethal harm to people. Contrast with *attention* and *caution*.

data Any representations such as characters or analog quantities to which meaning is or might be assigned.

data buffer
The storage buffer in the control unit. This buffer is used to increase the data transfer rate between the control unit and the channel.

data cartridge
A tape cartridge dedicated to storing data. Contrast with *cleaning cartridge*.

data check
A synchronous or asynchronous indication of a condition caused by invalid data or incorrect positioning of data.

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.

degradation
A decrease in quality of output or throughput or an increase in machine error rate.

degraded
Decreased in quality of output or throughput or increased machine error rate.

deserialize
To change from serial-by-bit to parallel-by-byte.

detented
A part being held in position with a catch or lever.

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.

DIAG
Diagnostic section of maintenance information manual.

differential
See *High Voltage Differential (HVD)*.

direct access storage
A storage device in which the access time is independent of the location of the data.

DNS Directory Name System. This allows the library to recognize text-based addresses instead of numeric IP addresses.

download
To transfer programs or data from a computer to a connected device, typically a personal computer.

To transfer data from a computer to a connected device, such as a workstation or microcomputer.

DRAM
Dynamic random-access memory.

drive, magnetic tape
    A mechanism for moving magnetic tape and controlling its movement.

DRV   Drive.

DSE   Data security erase.

DSP   Digital signal processor.

E

EBCDIC
    Extended binary-coded decimal interchange code.

EC   Edge connector. Engineering change.

ECC   Error correction code.

EEPROM
    Electrically erasable programmable read-only memory.

EIA   Electronics Industries Association.

EIA unit
    A unit of measure, established by the Electronic Industries Association, equal to 44.45 millimeters (1.75 inches).

eject   To remove or force out from within.

electronic mail
    Correspondence in the form of messages transmitted between user terminals over a computer network.

e-mail   See *electronic mail*.

EPO   Emergency power off.

EPROM
    Erasable programmable read only memory.

EQC   Equipment check.

equipment check
    An asynchronous indication of a malfunction.

Error log
    A dataset or file in a product or system where error information is stored for later access.

ESD   Electrostatic discharge.

F

fault symptom code (FSC)
    A hexadecimal code generated by the drive or the control unit microcode in response to a detected subsystem error.

FC   Feature code.

FCC   Federal communications commission.

FE   Field engineer, customer engineer, or service representative.

fiducial
    A target used for teaching a physical location to a robot.

field replaceable unit (FRU)
>An assembly that is replaced in its entirety when any one of its components fails.

file A named set of records stored or processed as a unit. Also referred to as a dataset.

file protection
>The processes and procedures established in an information system that are designed to inhibit unauthorized access to, contamination of, or deletion of a file.

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 microcode as part of an operating system. Firmware is more efficient than software loaded from an alterable medium and 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.

FLASH EEPROM
>An electrically erasable programmable read-only memory (EEPROM) that can be updated.

FMR Field microcode replacement.

format
>The arrangement or layout of data on a data medium.

formatter
>Part of a magnetic tape subsystem that performs data conversion, speed matching, encoding, first level error recovery, and interfaces to one or more tape drives.

FP File protect.

frayed Damaged as if by an abrasive substance.

FRU Field replaceable unit.

FSC Fault symptom code.

FSI Fault symptom index.

functional microcode
>Microcode that is resident in the machine during normal customer operation.

G

g Gram.

GB gigabyte.

GBIC Gigabit Interface Converter.

Gbi gigabit

Generation 1
>The informal name for the IBM Ultrium 1 Tape Drive, which is the first

generation of the Ultrium tape drive. The Generation 1 drive has a native storage capacity of up to 100 GB per cartridge and a native sustained data transfer rate of 15 MB per second.

Generation 2
The informal name for the second-generation version of the IBM Ultrium Tape Drive. The Generation 2 drive has a native storage capacity of up to 200 GB per cartridge and a native sustained data transfer rate of 35 MB per second.

Generation 3
The informal name for the third-generation version of the IBM Ultrium Tape Drive. The Generation 3 drive has a native storage capacity of up to 400 GB per cartridge and a native sustained data transfer rate of 135 MB per second.

Generation 4
The informal name for the fourth-generation version of the IBM Ultrium Tape Drive. The Generation 4 drive has a native storage capacity of up to 800 GB per cartridge and a native sustained data transfer rate of 135 MB per second.

Generation 5
The informal name for the fifth-generation version of the IBM Ultrium Tape Drive. The Generation 5 drive has a native storage capacity of up to 1500 GB per cartridge and a native sustained data transfer rate of 140 MB per second.

Generation 6
The informal name for the sixth-generation version of the IBM Ultrium Tape Drive. The Generation 6 drive has a native storage capacity of up to 2500 GB per cartridge and a native sustained data transfer rate of 160 MB per second.

gigabit (Gbit)
1 000 000 000 bits.

gigabyte (GB)
1 000 000 000 bytes.

Gigabit Interface Converter (GBIC)
Converts copper interface to optic interface.

gnd   Ground.

H

hertz (Hz)
Unit of frequency. One hertz equals one cycle per second.

hex   Hexadecimal.

High Voltage Differential (HVD)
A logic signaling system that enables data communication between a supported host and the 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*.

HVD   SCSI Bus High Voltage Differential

Hz   Hertz (cycles per second).

I

IBM Ultrium Tape Drive
> Located within the library, 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.

ID Identifier.

identifier (ID)
> (1) In programming languages, a lexical unit that names a language object; for example, the names of variables, arrays, records, labels, or procedures. An identifier usually consists of a letter optionally followed by letters, digits, or other characters. (2) One or more characters used to identify or name data element and possibly to indicate certain properties of that data element. (3) A sequence of bits or characters that identifies a program, device, or system to another program, device, or system.

IML Initial microprogram load.

initial microprogram load (IML)
> The action of loading a microprogram from an external storage to writable control storage.

initiator
> The component that executes a command. The initiator can be the host system or the tape control unit.

INST Installation.

interface
> A shared boundary. An interface might be a hardware component to link two devices or it might be a portion of storage or registers accessed by two or more computer programs.

interposer
> The part used to convert a 68-pin connector to a 50-pin D-shell connector.

intervention required
> Manual action is needed.

INTRO
> Introduction.

I/O Input/output.

IOP Input/output processor.

IPL Initial program load.

ITST Idle-time self-test.

K

kilogram (kg)
> One thousand grams (approximately 2.2 pounds).

km kilometer. 1000 Meters, Approximately 5/8 mile.

L

LAN Local area network. A computer network within a limited area.

LCD See *liquid crystal display*.

LDAP Lightweight Directory Access Protocol. This allows the library to use login and password information stored on a server to grant access to the library functionality.

LED Light-emitting diode.

Linear Tape File System (LTFS)
A file system that works in conjunction with LTO Generation tape technology to access data stored on an IBM tape cartridge.

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 will 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 (2:1 compression) and a native data capacity of up to 400 GB.

liquid crystal display (LCD)
A low-power display technology used in computers and other I/O devices.

loadable
Having the ability to be loaded.

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.

LVD SCSI Bus Low Voltage Differential

M

m Meter. In the Metric System, the basic unit of length; equal to approximately 39.37 inches.

magnetic tape
A tape with a magnetical surface layer on which data can be stored by magnetic recording.

MAP Maintenance analysis procedure.

mask A pattern of characters that controls the retention or elimination of portions of another pattern of characters. To use a pattern of characters to control the retention or elimination of portions of another pattern of characters.

master file
A file used as an authority in a given job and that is relatively permanent, even though its contents may change. Synonymous with main file.

MB Mega Byte (usually expressed as data rate in MB/s or MB/second).

media capacity
The amount of data that can be contained on a storage medium, expressed in bytes of data.

media-type identifier
Pertaining to the bar code on the bar code label of the IBM Ultrium Tape

Cartridge, a 2-character code, L1, that represents information about the cartridge. L identifies the cartridge as one that can be read by devices which incorporate LTO technology; 1 indicates that it is the first generation of its type.

mega One million of.

meter In the Metric System, the basic unit of length; equal to approximately 39.37 inches.

micro One millionth of.

microcode
>   (1) One or more micro instructions. (2) A code, representing the instructions of an instruction set, implemented in a part of storage that is not program-addressable. (3) To design, write, and test one or more micro instructions. (4) See also *microprogram*.

microdiagnostic routine
>   A program that runs under the control of a supervisor, usually to identify field replaceable units.

microdiagnostic utility
>   A program that is run by the customer engineer to test the machine.

microinstruction
>   A basic or elementary machine instruction.

microprogram
>   A group of microinstructions that when executed performs a preplanned function.
>
>   The term microprogram represents a dynamic arrangement or selection of one or more groups of microinstructions for execution to perform a particular function. The term microcode represents microinstructions used in a product as an alternative to hard-wired circuitry to implement certain functions of a processor or other system component.

MIM Media information message.

mm Millimeter.

modifier
>   That which changes the meaning.

mount a device
>   To assign an I/O device with a request to the operator.

MP Microprocessor.

ms Millisecond.

MSG Message.

multipath
>   Pertaining to using more than one path.

N

N/A Not applicable.

node In a network, a point at which one or more functional units connect channels or data circuits.

NTP Network Time Protocol. This allows the library to set its internal date and time based on the date and time of a sever.

NVS Nonvolatile storage. A storage device whose contents are not lost when power is cut off.

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 abampere per 4π centimeters of axial length.

offline
Pertaining to the operation of a functional unit without the continual control of a computer. Contrast with *online*.

online Pertaining to the operation of a functional unit that is under the continual control of a computer. Contrast with *offline*.

OPER Operation.

ov Over voltage.

overrun
Loss of data because a receiving device is unable to accept data at the rate it is transmitted.

overtightening
To tighten too much.

P

parameter
A variable that is given a constant value for a specified application and that may denote the application.

p bit Parity bit.

PC Parity check.

PCC Power control compartment.

PDF Portable Document Format.

PE Parity error. Product engineer.

pick Pertaining to the library, to remove, by means of a robotic device, a tape cartridge from a storage slot or drive.

picker A robotic mechanism located inside the library that moves cartridges between the cartridge storage slots and the drive.

PM Preventive maintenance.

POR Power-on reset.

port A physical connection for communication between the 3590 and the host processor. The 3590 has two SCSI ports.

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.

PROM
> Programmable read only memory.

PS Power supply.

PWR Power.

R

rack A unit that houses the components of a storage subsystem, such as the library.

rackmount kit
> A packaged collection of articles used to install the rack mounted version of the library.

RAM Random access memory.

Random access memory
> A storage device into which data is entered and from which data is retrieved in a nonsequential manner.

RAS Reliability, availability, and serviceability.

record A collection of related data or words, treated as a unit.

recording density
> The number of bits in a single linear track measured per unit of length of the recording medium.

recoverable error
> An error condition that allows continued execution of a program.

ref Reference.

reg Register.

reinventory
> To inventory again.

retension
> The process or function of tightening the tape onto the cartridge, if it is sensed that the tape has a loose wrap on the cartridge.

robot Picker.

robotics
> Picker assembly.

RPQ Request for price quotation.

R/W Read/write.

S

s Seconds of time.

SAC Service Action Code. Code developed to indicate possible FRU or FRU's to replace to repair the hardware.

SAS Serial attached SCSI interface.

scratch cartridge
> A data cartridge that contains no useful data, but can be written to with new data.

SCSI Small computer system interface.

segment
A part.

sel Select.

serialize
To change from parallel-by-byte to serial-by-bit.

serializer
A device that converts a space distribution of simultaneous states representing data into a corresponding time sequence of states.

servo, servos
An adjective for use in qualifying some part or aspect of a servomechanism.

servomechanism
A feedback control system in which at least one of the system signals represents mechanical motion.

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.

SNS Sense.

special feature
A feature that can be ordered to enhance the capability, storage capacity, or performance of a product, but is not essential for its basic work.

SR Service representative, see also *CE*.

SRAM
Static random access memory.

SS Status store.

ST Store.

standard feature
The significant design elements of a product that are included as part of the fundamental product.

START
    Start maintenance.

subsystem
    A secondary or subordinate system, usually capable of operating
    independently of, or asynchronously with, a controlling system.

SUPP Support.

sync Synchronous, synchronize. Occurring with a regular or predictable time
    relationship.

T

tachometer, tach
    A device that emits pulses that are used to measure/check speed or
    distance.

tape cartridge
    A container holding magnetic tape that can be processed without
    separating it from the container.

tape void
    An area in the tape in which no signal can be detected.

TCP/IP
    Transmission Control Protocol/Internet Protocol.

TCU Tape control unit.

TH Thermal.

thread/load operation
    A procedure that places tape along the tape path.

TM Tapemark.

U

UART Universal asynchronous receiver/transmitter.

unload
    Prepare the tape cartridge for removal from the drive.

utilities
    Utility programs.

utility programs
    A computer program in general support of the processes of a computer; for
    instance, a diagnostic program.

uv Under voltage.

V

VOLSER
    Volume serial number.

volume
    A certain portion of data, together with its data carrier, that can be handled
    conveniently as a unit.

VPD Vital product data. The information contained within the tape drive that
    requires nonvolatile storage used by functional areas of the drive, and
    information required for manufacturing, RAS, and engineering.

W

word A character string that is convenient for some purpose to consider as an entity.

Write Write command.

WT world trade.

X

XR External register.

XRA External register address register.

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IBM System Storage TS2260
Setup, Operator, and Service Guide
Machine Type 3580 Model H6S

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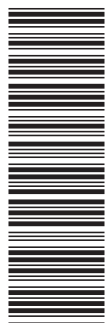
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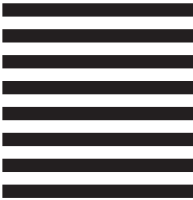
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