IBM 3592 Tape Drives
and TS1120 Controller

Operator Guide
3592 Models J1A, E05, E06, EU6, E07,
E08, EH7, EH8, 55F, 60F, J70, and C06

IBM

Note

Before using this information and the product it supports, read the information in "Safety and environmental notices" on page ix and "Notices" on page 75.

Edition notice

This edition applies to the tenth release of the *IBM® 3592 Tape Drives and Controller Operator Guide* and to all subsequent releases and modifications until otherwise indicated in new editions.

Read this first

This is the tenth edition of the *IBM 3592 Tape Drives and Controller Operator Guide* (November 2018).

What's new in this edition (November 2018)

Revision bars (|) appear next to information that was added or changed since the release of the last edition (GA32-0556-08). Changes include

- Added updates for the IBM Rack Mount Model 60F tape drive.
- Miscellaneous editorial changes.

Ninth Edition

Revision bars (|) appear next to information that was added or changed since the release of the last edition (GA32-0556-07). Changes include

- Added updates for the IBM Rack Mount Model 55F tape drive.
- Miscellaneous editorial changes.

Eighth Edition

- Added updates for the IBM Model EH7 and EH8 tape canisters and Rack Mount Kit, Feature code 4804.
- Miscellaneous editorial changes.

⚠ **Attention:** Do not put the system into a dusty or contaminated environment that contains corrosive gases (for example, high sulfur) or metallic shavings (for example, zinc whiskers). Dusty environments can impact the air-cooling of assemblies and corrosive gasses can degrade components, causing a change to their characteristics, leading to a breakdown of the equipment.

Seventh Edition

The following information was added in the seventh edition.

- Added updates for the IBM TS1150 Model E08 tape drive.
- Miscellaneous editorial changes.

Sixth Edition

The following information was added in the sixth edition.

- TS1140 (3592 Model E07) Tape Drive read only capability of the following cartridges -
  - IBM Tape Cartridge 3592 Standard Data (type JA)
  - IBM Tape Cartridge 3592 Economy (type JJ)
  - IBM Tape Cartridge 3592 Economy WORM (write-once, read-many) (type JR)
  - IBM Tape Cartridge 3592 Standard WORM cartridges (type JW)

  Refer to "Cartridge types and characteristics" on page 19 for information.
- Miscellaneous editorial changes.

Contents

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Safety and environmental notices

This section contains information about safety notices that are used in this guide and environmental notices for this product.

Safety notices

Observe the safety notices when you are 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 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 might place hazardous voltage on metal parts of the system or the devices that attach to the system. It is the responsibility of the customer to ensure that the outlet is correctly wired and grounded to prevent an electrical shock. *(D004)*

Caution notice

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

If the symbol is...	It means...
	A hazardous condition that is 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).
	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 the Modular Refrigeration Unit (MRU) is removed, 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

This product might not be certified in your country for connection by any means whatsoever to interfaces of public telecommunications networks. Further certification might be required by law before making any such connection. Contact IBM for information.

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 on the publications CD.

About this publication

This publication provides basic instructions for operating, cleaning, and troubleshooting the IBM 3592 tape drives and TS1120 Controller.

Accessibility

IBM strives to provide products with usable access for everyone, regardless of age or ability. This product uses standard Windows navigation keys. See Appendix H, "Accessibility," on page 74 for information.

Related information

Refer to the following publications and sources for information about the IBM 3592 tape drives and TS1120 Controller. To ensure that you have the current publications, see the IBM Model 3592 tape drive Knowledge Center.

IBM 3953 Tape System publications

- *IBM 3953 Library Manager Model L05 Operator Guide*, GA32-0558
- *IBM 3953 Tape System Introduction and Planning Guide*, GA32-0557

IBM 3592 tape drives and controller publications

- *IBM 3592 Tape Drives and TS1120 Controller Introduction and Planning Guide*, GA32-0555
- *IBM 3592 SCSI Reference*, GA32-0562
- *IBM TS1120, TS1130, TS1140, TS1150, TS1155, and TS1160 Tape Drives Maintenance Information*
- IBM 3592 Model E07/EH7, E08/EH8, 55F, and 60F Tape Drives Knowledge Center, available at http://www.ibm.com/support/knowledgecenter/STPRH6/com.ibm.storage.drives.doc/jag_ichome.html

IBM Encryption key management publications

- *IBM Tivoli Key Lifecycle Manager Quick Start Guide*, GI11-8744
- *IBM Security Key Lifecycle Manager for z/OS Planning and User's Guide*, SC14-7628
- *IBM Security Key Lifecycle Manager Knowledge Center*, available at http://www-01.ibm.com/support/knowledgecenter/SSWPVP/welcome?long=en

IBM 3590 Enterprise Tape System publications

- *IBM Enterprise Tape System 3590 Introduction and Planning Guide*, GA32-0329
- *IBM Silo Compatible Tape Frame 3590 Introduction, Planning, and User's Guide*, GA32-0366
- *IBM Enterprise Tape System 3590 Operator Guide*, GA32-0330
- *IBM 3590 Tape Subsystem Hardware Reference Guide*, GA32-0331

IBM TS3400 tape library publication

- *IBM TS3400 Tape Library Planning and Operator Guide*, GC27-2107

IBM TS3500 tape library publications

Note: Two versions of the *TS3500 tape library Introduction and Planning Guide,* and two versions of the *TS3500 tape library Operator Guide* are available. One version of each document is specific to the TS3500

tape library with the Advanced Library Management System (ALMS), and provides details about features and functions that are available only for libraries with ALMS installed and enabled. Refer to the title of each guide to determine which version you need.

- *IBM TS3500 tape library with ALMS Introduction and Planning Guide*, GA32-0593
- *IBM TS3500 tape library with ALMS Operator Guide*, GA32-0594
- *IBM TS3500 tape library Introduction and Planning Guide*, GA32-0559
- *IBM TS3500 tape library Operator Guide*, GA32-0560
- *IBM TS3500 tape library Maintenance Information* (provided with the TS3500 tape library)
- *IBM TS3500 tape library with ALMS Tape System Reporter User's Guide*, GA32-0589
- *IBM TS3500 tape library SCSI Reference*, GA32-0561
- IBM TS3500 tape library documentation is available in the IBM Knowledge Center at http://www-01.ibm.com/support/knowledgecenter/STCMML8/

IBM TS4500 tape library publications

Note: Refer to the title of each guide to determine which document you need.

- *IBM TS4500 tape library Introduction and Planning Guide*, SC27-5990
- *IBM TS3000 and TS4500 System Console Maintenance Information*, P/N 2727119
- IBM TS4500 tape library documentation is available in the IBM Knowledge Center at https://www.ibm.com/support/knowledgecenter/STQRQ9/com.ibm.storage.ts4500.doc/ts4500_ichome.html.
- The current TS4500 SCSI reference information is contained within the IBM Knowledge Center and can be viewed by selecting **Reference** > **SCSI Reference** or by using http://www.ibm.com/support/knowledgecenter/STQRQ9/com.ibm.storage.ts4500.doc/ts4500_ic_scsireference.html.

IBM Enterprise Automated Tape Library (3494) publications

- *IBM Automated Tape Library (3494) Introduction and Planning Guide*, GA32-0448
- *IBM Automated Tape Library (3494) Operator Guide*, GA32-0449

IBM System z publications

- *IBM z/OS DFSMS OAM Planning, Installation, and Storage Administration Guide for Tape Libraries*, SC35-0427
- *IBM z/VM DFSMS/VM Removable Media Services*, SC24-6185

IBM FICON and Fibre Channel publications

- *FICON Planning and Implementation Guide*, SG24-6497, IBM Redbooks® publication
- *IBM System z Connectivity Handbook*, SC24-5444, Redbooks publication
- *IBM Tape Solutions for Storage Area Networks and FICON*, SG24-5474, Redbooks publication
- *IBM System z Planning for Fiber Optic Links (ESCON, FICON, InfiniBand, Coupling Links, and Open System Adapters)*, GA23-0367
- *IBM System z Maintenance Information for Fiber Optic Links (ESCON, FICON, Coupling Links, and Open System Adapters)*, SY27-2597
- *IBM System z Fibre Channel Connection (FICON) I/O Interface Physical Layer*, SA24-7172

Related software publications

For information about software that is related to the IBM 3592 Tape System, refer to

- *IBM Tape Device Drivers Installation and User's Guide*, GC27-2130
- *IBM Tape Device Drivers Programming Reference*, GA32-0566

- *IBM Tape Device Drivers Encryption Support*, GA32-0565
- *Basic Tape Library Support User's Guide and Reference*, SC26-7016
- *Environmental Record Editing and Printing (EREP) Program User's Guide and Reference*, GC35-0151
- *z/OS DFSMS: Introduction*, SC26-7397
- *z/OS DFSMS: Object Access Method Planning, Installation, and Storage Administration Guide for Tape Libraries*, SC35-0427
- *z/OS DFSMS Software Support for IBM TS1130, TS1140, and TS1150 Tape Drives (3592)*, SC26-7514
- *z/VM General Information*, GC24-5991

Other publications

- *American National Standard Institute Small Computer System Interface* X3T9.2/86-109 X3.180, X3B5/91-173C, X3B5/91-305, X3.131-199X Revision 10H, and X3T9.9/91-11 Revision 1

IBM online access

IBM System z (zSeries) information

For information about IBM System z®, see

- *z/OS® V1R12.0 Information Center*, available at http://publib.boulder.ibm.com/infocenter/zos/v1r12/index.jsp
- z/OS® Internet Library
- IBM System z Redbooks, including these titles.
  - *DFSMS V1.10 and EAV Technical Guide,* IBM Redbooks publication
  - *IBM zEnterprise® System Technical Guide*, Redbooks publication

IBM pSeries-RS/6000, AIX information

For information about the IBM eServer™ pSeries servers, including the RS/6000®, see the IBM Knowledge Center at http://publib.boulder.ibm.com/infocenter/powersys/v3r1m5/index.jsp.

For information about AIX®, see

- http://publib16.boulder.ibm.com/pseries/en_US/infocenter/base/
- http://publib.boulder.ibm.com/infocenter/pseries/v5r3/index.jsp

IBM iSeries and AS/400 information

For information about iSeries and AS/400 systems, see the IBM Knowledge Center at http://publib.boulder.ibm.com/iseries/.

IBM Storage media support

The following website provides access to current regional and country-specific IBM addresses and telephone numbers.

- IBM Storage media

IBM 3592 tape systems support

For general information about the 3592 tape systems, including TS1120 and later tape drives, see IBM Tape systems.

For a list of compatible software, operating systems, and servers for TS1120 and later tape drives, see the website listed here. Select your tape drive, select **Product details**, then select **Independent Software Vendor (ISV) matrix**.

- IBM Tape drives

Device driver support

You can download device driver software and read documentation about various device drivers at IBM Fix Central.

Encryption management support

For the current versions of Encryption Key Servers and supporting documentation, go to the web at

- Tivoli® Key Lifecycle Manager
- IBM Security Key Lifecycle Manager for z/OS

IBM Network Integration and Deployment Services

The following website provides information about connectivity and the integration of cabling systems.

- IBM Integrated communications services

IBM Tape Storage publications

Refer to the following website for IBM hardware product documents in a PDF format for viewing and printing.

- IBM Tape Systems resources

Storage Area Network (SAN) fabric

For information on high-performance switches and gateways, go to the web at IBM Support Portal.

I/O connectivity

For updated information about FICON® and Fibre Channel connectivity, go to the web at IBM System z - I/O Connectivity.

Redbooks

To access the IBM Redbooks, go to the web at IBM Redbooks.

Vendor support

This website provides compatibility information in PDF format for implementing software, servers, and operating systems with IBM tape drives and libraries.

- IBM Tape systems

Non-IBM support

Brocade information

For information on Brocade products and support, go to the web at Brocade Mission-Critical Networks.

Cisco information

For information on Cisco products and support, go to the web at Cisco Systems, Inc..:

HP information

The following publications and website relate to HP-UX systems.

- *HP-UX Reference for HP-UX 10.20, 11.00, and 11i*, Hewlett-Packard Company
- *System Administration Tasks, HP-UX Release 10.20, 11.00, and 11i*, Hewlett-Packard Company
- HP-UX 11i—HP UNIX

Linux information

The following website relates to Red Hat Linux systems.

- Red Hat

The following website relates to SUSE Linux systems.

- SUSE Linux Enterprise

Microsoft Windows information

The following website provides access to information about Microsoft Windows systems.

- Microsoft Corporation

SGI information

The following website provides access to information about SGI systems.

- SGI techpubs library

Oracle SUN information

The following website provides access to information about Oracle (SUN) systems.

- Oracle Documentation

Data storage values

This documentation displays data storage values by using both decimal (base-10) and binary (base-2) units of measurement.

Decimal units such as KB, MB, GB, and TB are commonly used to express data storage values, though these values are more accurately expressed by using binary units such as KiB, MiB, GiB, and TiB. At the kilobyte level, the difference between decimal and binary units of measurement is relatively small (2.4%). This difference grows as data storage values increase, and when values reach terabyte levels the difference between decimal and binary units approaches 10%.

To reduce the possibility of confusion, this documentation represents data storage with both decimal and binary units. Data storage values are displayed with the following format.

```
#### decimal unit (binary unit)
```

By this example, the value 512 terabytes is displayed as

```
512 TB (465.6 TiB)
```

compares the names, symbols, and values of the decimal and binary units. shows the increasing percentage of difference between decimal and binary units.

Table 1: Comparison of decimal and binary units and values					
Decimal			**Binary**		
Name	**Symbol**	**Value (base-10)**	**Name**	**Symbol**	**Value (base-2)**
kilo	K	10^3	kibi	Ki	2^{10}

Table 1: Comparison of decimal and binary units and values (continued)						
Decimal			**Binary**		
Name	**Symbol**	**Value (base-10)**	**Name**	**Symbol**	**Value (base-2)**
mega	M	10^6	mebi	Mi	2^{20}
giga	G	10^9	gibi	Gi	2^{30}
tera	T	10^{12}	tebi	Ti	2^{40}
peta	P	10^{15}	pebi	Pi	2^{50}
exa	E	10^{18}	exbi	Ei	2^{60}

Table 2: Percentage difference between decimal and binary units		
Decimal Value	**Binary Value**	**Percentage Difference**
100 kilobytes (KB)	97.65 Kibibytes (KiB)	2.35%
100 megabytes (MB)	95.36 Mebibytes (MiB)	4.64%
100 gigabytes (GB)	93.13 Gibibytes (GiB)	6.87%
100 terabytes (TB)	90.94 Tebibytes (TiB)	9.06%
100 petabytes (PB)	88.81 Tebibytes (PiB)	11.19%
100 exabytes (EB)	86.73 Mebibytes (EiB)	13.27%

Send us your feedback

Your feedback is important in helping to provide the most accurate and highest quality information.

To submit any comments about this publication or any other IBM storage product documentation:

- Send your comments by email to ibmkc@us.ibm.com. Be sure to include the following information:
  - Exact publication title and version
  - Page, table, or illustration numbers that you are commenting on
  - A detailed description of any information that should be changed

Note: For suggestions on operating enhancements or improvements, contact your IBM Sales team.

Chapter 1. Introduction

This document provides operating instructions for the IBM Model 60F, Model 55F, Models EH7/EH8, TS1150 Model E08, TS1140 Model E07, TS1130 Model E06 and EU6, and the TS1120 Model E05 tape drives, and the IBM TS1120 (3592 C06) Controller. The IBM Model J1A tape drive and the IBM 3592-J70 Controller are no longer available for ordering but are covered for existing product support.

The 3592 tape drives and controllers offer a dramatic improvement in performance and cartridge capacity for Enterprise class tape customers that currently use the IBM Enterprise Tape System 3590. The 3592 tape drives and controllers can be used for

- Creating tapes for file archival
- Backing up and restoring systems
- Storing and accessing sequential application data sets
- Creating and accessing temporary data sets
- Satisfying off-site data storage requirements for disaster recovery
- Providing data interchange with other systems that use 3592 tape drives
- Meeting data acquisition needs
- Creating data tapes that cannot be altered, but can be read many times

Drive and media information

The 3592 drive is a single cartridge unit designed for automation. Six models are available: the 60F, 55F, EH8/E08, EH7/E07, E06, and E05 tape drives. The J1A tape drive is withdrawn.

An E05 tape drive canister can be upgraded through the Miscellaneous Equipment Specification (MES) process to contain an E06 tape drive. The result is an EU6 tape drive, which is the functional equivalent of the E06 tape drive. An E06 tape drive (not an EU6 tape drive) can be upgraded to an E07 tape drive through the MES process. An E07 tape drive can be upgraded to an E08 tape drive through the MES process. An E07 can be converted to an EH7, and an E08 converted to an EH8, through the MES process. An EH8 can also be converted to a 55F, through the MES process.

The 3592 tape drives come with dual ported, switched Fibre Channel attachments, 2 Gb/s (J1A tape drive) and 4 Gb/s (E06/EU6, and E05 tape drives), 8 Gb/s (E07/EH7, E08/EH8, 55F tape drives), and 16 Gb/s (60F tape drives), for attachment to multiple servers or a single server with redundancy. The E07 tape drive can attach to the C06 Controller. The E06, EU6, E05, and J1A tape drives can attach to the C06 and the J70 controllers. The J1A tape drive can also attach to the 3590 Model A60 controller. These tape drives use ESCON or FICON channels for attachment to System z servers.

Enhancements to the 3592 tape drives include

- AES 256-bit data encryption capability increases security with minimal performance impact.
- Five different generations of media provide native cartridge capacities from 300 GB (279.39 GiB) on the JA Standard cartridge, up to 20 TB (18.2 TiB) on the JE Advanced Type E cartridge.
- WORM and Economy cartridge versions provide extra capabilities for the different media generations.
- See Chap 3. IBM 3592 tape cartridge for details about capacities and capabilities of the different media types.
- Scaling capability to optimize fast access, storage capacity, or a combination of both
- Dual ported switched fabric Fibre Channel attachments
- High reliability and availability design.
- Performance and access improvements.

- Smaller form factor that allows double the number of drives, which are compared to the 3590 tape drives, in a single 3494 frame or stand-alone rack.
- The different drive models provide a native data rate from 40 MB/s for the J1A tape drive and up to 400 MB/s for the 60F tape drive.

A note on terminology and model names

Throughout the remainder of this publication, the 60F, 55F. EH8/E08, EH7/E07, E06, EU6, E05, and J1A tape drives are all referred to collectively as the "3592 tape drive" unless a specific model is being discussed. The E08, E07, E06 and EU6, and E05 tape drives are all referred to collectively as the "TS1120 and later tape drives." Where necessary the different models of the IBM Enterprise Tape Drive 3590 are referred to as the 3590 drives or the specific 3590 models B, E, or H.

Controller information

IBM's high-performance tape controller, the TS1120 (3592 C06), offers

- C06 Controller 1.21.5.x microcode provides limited IPv6 support for TS1120 controllers in a stand-alone rack or attached to one or more TS3400 (withdrawn) or TS3500 libraries.
- Support for E07 tape drive, C06 Controller 1.21.7.x microcode is required
- Support for up to four 4 Gb/s FICON attachments
- Support for up to eight ESCON attachments
- Support for an intermix of ESCON and FICON attachments
- Attachment of up to sixteen 3592 tape drives
- Support for all IBM 3592 tape cartridge types, including write-once, read-many (WORM) cartridges
- Increased hierarchical storage management (HSM) performance through use of new search CCW to speed HSM Audit functions

Tape encryption overview

This topic provides an introduction to tape encryption by using the 3592 tape drives.

Data is one of the most highly valued resources in a competitive business environment. Protecting that data, controlling access to it, and verifying its authenticity while its availability is maintained are priorities in our security-conscious world. Data encryption is a tool that answers many of these needs.

The IBM TS1120 and later tape drives can encrypt data as it is written to any compatible IBM 3592 tape cartridge, including write-once, read-many (WORM) cartridges. This capability adds a strong measure of security to stored data without the processing overhead and performance degradation that is associated with encryption that is run on the server or with a dedicated appliance.

Three major elements are in the tape drive encryption solution.

The encryption-enabled tape drive
All 60F, 55F, E08/EH8, E07/EH7, and E06/EU6 tape drives are *encryption-capable*. All E05 tape drives with feature code 5592 or 9592 are *encryption-capable*. That is, they are functionally capable of running hardware encryption, but this capability is not yet activated. To run hardware encryption, the tape drives must be *encryption-enabled*. In an IBM TS3500 tape library, TS1120 and later tape drives can be encryption-enabled through the **Tape Library Specialist** web interface.

Note: When a TS1120 and later tape drive is attached to a tape controller, the tape drive must be encryption-enabled for system-managed encryption. **This statement applies even when encryption is not being used by the host.** The E05 and E06/EU6 tape drives can attach to a J70 or C06 Controller. The E07 can attach only to the C06 Controller.

Note: The E05 tape drive is not supported by the C06 Controller.

When TS1120 and later tape drives are attached to a controller, this process consists of having an IBM System Services Representative (SSR) sets up the drive as *encryption-enabled*. Only encryption-enabled TS1120 and later tape drives can be used to read and write encrypted 3592 tape cartridges.

Encryption key management

Encryption involves the use of several kinds of keys, in successive layers. How these keys are generated, maintained, controlled, and transmitted depends upon the operating environment where the encrypting tape drive is installed. Some applications, such as *Tivoli Storage Manager*, can run key management. For environments without such applications or environments where application independent encryption is wanted, IBM offers an encryption key server (such as the *Tivoli Key Lifecycle Manager,* or the *IBM Security Key Lifecycle Manager for z/OS*). "Managing encryption" on page 3 describes key management in detail.

Encryption policy

Encryption policy is the method that is used to implement encryption. It includes the rules that govern which volumes are encrypted and the mechanism for key selection. How and where these rules are set up depends on the operating environment. See "Managing encryption" on page 3 for information.

Note: In the tape storage environment, the encryption function on tape drives (desktop, stand-alone, and within libraries) is configured and managed by the customer and not the SSR. In some instances, an SSR is required to enable encryption at a hardware level when service access or service password controlled access is required. Customer setup support is by Field Technical Sales Specialist (FTSS), customer documentation, and software support for encryption software problems. Customer "how to" support is also provided with customers who have a support line contract.

Managing encryption

The encryption key server (EKS) and the three methods for managing encryption.

An *encryption key server* is a software program that assists IBM encryption-enabled tape drives in generating, protecting, storing, and maintaining encryption keys. They are used to encrypt information that is written to, and decrypt information that is read from, tape media (tape and cartridge formats). IBM currently supports encryption key servers: *IBM Tivoli Key Lifecycle Manager*, and *IBM Security Key Lifecycle Manager for z/OS*. Throughout the remainder of this publication, the encryption key servers are referred to collectively as the "encryption key server" (EKS) unless a specific software program is being described. The EKS operates on z/OS, i5/OS, AIX, Linux, HP-UX, Sun Solaris, and Windows, and is a shared resource that is deployed in several locations within an Enterprise. It can serve numerous IBM encrypting tape drives, regardless of where those drives reside (for example, in tape library subsystems, which are connected to mainframe systems, through various types of channel connections, or installed in other computing systems).

The EKS uses a keystore to hold the certificates and keys (or pointers to the certificates and keys) required for all encryption tasks. Refer to the appropriate EKS documentation for information about the EKS and the keystores it supports.

The EKS acts as a daemon process that is awaiting key generation or key retrieval requests sent to it through a TCP/IP communication path between the EKS and the tape library, tape controller, tape subsystem, device driver, or tape drive. When a TS1120 or later tape drive writes encrypted data, it first requests an encryption key. Upon receipt of the request, the EKS generates an Advanced Encryption Standard (AES) key and serves it to the tape drives in two protected forms.

- Encrypted or *wrapped*, with Rivest-Shamir-Adleman (RSA) key pairs. The tape drive writes this copy of the key to the cartridge memory and three extra places on the tape media in the cartridge for redundancy.
- Separately wrapped for secure transfer to the tape drive where it is unwrapped upon arrival and the key inside is used to encrypt the data that is written to tape.

When an encrypted tape cartridge is read by a TS1120 or later tape drive, the protected AES key on the tape is sent to the EKS where the wrapped AES key is unwrapped. The AES key is then wrapped with a different key for secure transfer back to the tape drive, where it is unwrapped and used to decrypt the data that is stored on the tape. The EKS also allows protected AES keys to be rewrapped, or rekeyed, with

different RSA keys from the original ones used when the tape was written. Rekeying is useful when an unexpected need arises to export volumes to Business Partners whose public keys were not included. It eliminates the need to rewrite the entire tape and enables a tape cartridge's data key to be reencrypted with a Business Partner's public key.

Three methods of encryption management are available to choose from. These methods differ in where the encryption policy engine resides and where key management is completed for your encryption solution, and how the EKS is connected to the drive. Your operating environment determines which is the best for you. Key management and the encryption policy engine can be in any one of the following three environmental layers.
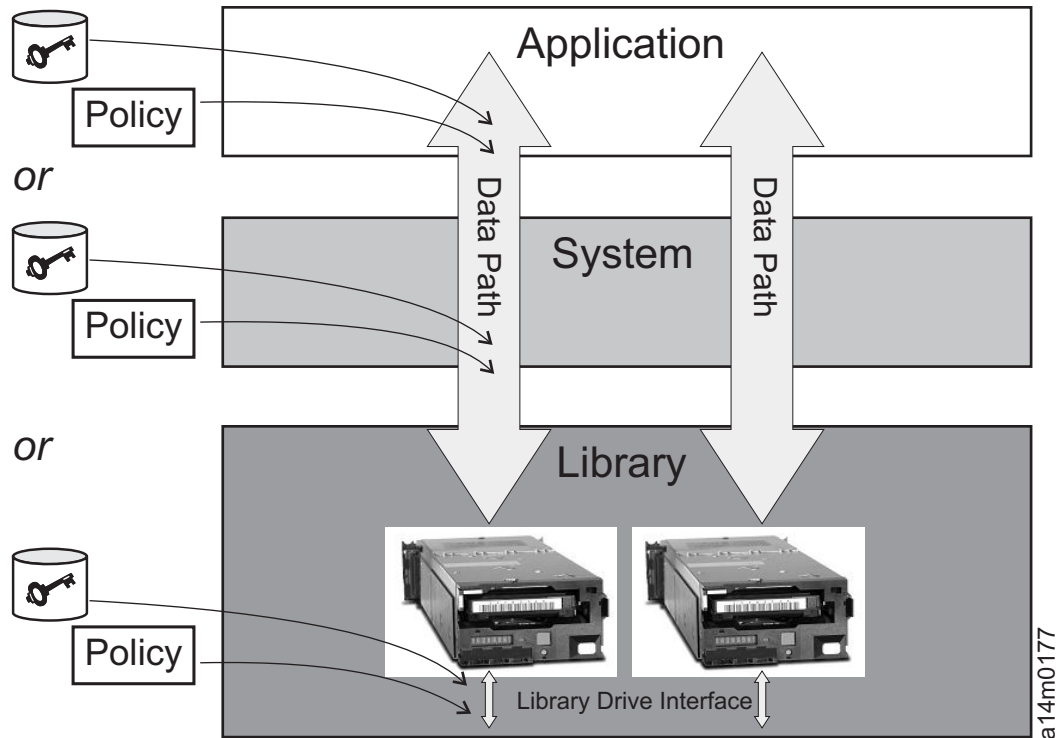
Figure 1: Three possible locations for encryption policy engine and key management.

Application Layer
Initiates data transfer for tape storage, for example Tivoli Storage Manager (TSM).

System Layer
Everything between the application and the tape drives, for example the operating system, z/OS DFSMS, device drivers, and FICON/ESCON controllers.

Library Layer
The enclosure for tape storage, such as the IBM TS3500 tape library. A modern tape library contains an internal interface to each tape drive within it.

Application-managed tape encryption
Application-managed tape encryption is described.

This method is best where operating environments run an application that is already capable of generating and managing encryption policies and keys, such as Tivoli Storage Manager. Policies that specify when encryption is to be used are defined through the application interface. The policies and keys pass through the data path between the application layer and the encrypting tape drives. Encryption is the result of interaction between the application and the encryption-enabled tape drive, and does not require any changes to the system and library layers. Because the application manages the encryption keys, data volumes that are written and encrypted with the application-managed encryption method can be read only by the same software application that wrote them.

An encryption key server is not required by, or used by, application-managed tape encryption.

Application-managed tape encryption on IBM TS1120 and later tape drives can use either of two encryption command sets:

- The IBM encryption command set developed for the encryption key server
- The T10 command set defined by the *InterNational Committee for Information Technology Standards* (INCITS)

Application-managed tape encryption with the TS1120 and TS1130 tape drives is supported in the following IBM libraries.

- IBM TS3400 tape library
- IBM TS3500 tape library
- IBM 3494 tape library

Application-managed tape encryption with the TS1140 and TS1150 tape drive is supported in the following IBM library.

- IBM TS3500 tape library
- IBM TS4500 tape library

Application-managed tape encryption with the TS1155 and TS1160 tape drive is supported in the following IBM library.

- IBM TS4500 tape library

For information about setting up application-managed encryption, see your Tivoli Storage Manager documentation or go to http://publib.boulder.ibm.com/infocenter/tivihelp/v1r1/index.jsp .

System-managed tape encryption
System-managed tape encryption is described.

This method is best for encryption on TS1120 and later tape drives in Open Systems and System z operating environments where the applications that write or read from tape are not capable of completing the key management that is required for application-managed encryption.

Open Systems

Encryption policies that specify when to use encryption are set up in the IBM tape device driver. System-managed tape encryption and library-managed tape encryption interoperate with one another. In other words, a tape encrypted with system-managed encryption can be decrypted with library-managed encryption, and vice versa, provided they both have access to the same keys and certificates. Otherwise, this procedure might not be feasible.

For details on setting up system-managed encryption on tape drives in an AIX, Linux, Windows, or Solaris environment, see the *IBM Tape Device Drivers Installation and User 's Guide*, and the *Planning and Operator Guide* for your tape library.

System z

Encryption policies that specify when to use encryption are set up in z/OS DFSMS (Data Facility Storage Management Subsystem) or implicitly through each instance of IBM device driver. Extra software products such as IBM Integrated Cryptographic Service Facility (ICSF) and IBM Resource Access Control Facility (RACF®) might also be used. Key generation and management are completed by the encryption key server that runs on the host or externally on another host. Policy controls and keys pass through the data path between the system layer and the encrypting tape drives. Encryption is transparent to the applications.

For TS1120 and later tape drives connected to an IBM Virtualization Engine TS7700, encryption key labels are assigned on a per-storage pool basis with the TS7700 Management Interface. DFSMS storage constructs are used by z/OS to control the use of storage pools for logical volumes, resulting in an indirect form of encryption policy management. For information, see the white paper, *IBM Virtualization Engine TS7700 Series Encryption Overview,* available at the IBM White Papers website.

With system-managed encryption, System z hosts can rekey an encrypted tape on the TS1120 and later tape drives. Refer to the appropriate operating system documentation for the mechanism that is used to initiate a rekey operation.

For details on setting up system-managed encryption on TS1120, TS1130, and TS1140 tape drives in a System z environment, see *z/OS DFSMS Software Support for IBM TS1120, TS1130, and TS1140 Tape Drives (3592)*, SC26-7514.

Library-managed tape encryption
Library-managed tape encryption is described.

This method is best for tape drives in an open-attached IBM tape library. TS1120 and TS1130 tape drives can attach to a IBM TS3400, TS3500, or IBM 3494 tape library. TS1140 and TS1150 tape drives can attach only to a TS3500 tape library. EH7, EH8, 55F, and 60F tape drives can attach only to a TS4500 library. For TS3500 and TS4500 tape library attachment, bar code encryption policies can be used to specify when to use encryption, and are set up through the IBM Tape Library Specialist web interface. In such cases, policies are based on cartridge volume serial numbers.

Library-managed encryption also allows other options, such as encryption of all volumes in a library, independent of bar codes. Key generation and management are completed by the encryption key server. Policy control and keys pass through the library-to-drive interface. Therefore, encryption is transparent to the applications.

Library-managed encryption, when used with certain applications such as Symantec Netbackup™ or the EMC Legato NetWorker, includes support for an internal label option. When the internal label option is configured, the TS1120 and later tape drives automatically derive the encryption policy and key information from the metadata that is written on the tape volume by the application. Refer to your *Tape Library Operator's Guide* for information.

Note: If you use library-managed encryption and IBM tape and changer drivers that are running on Open Systems platforms (AIX, HP-UX, Linux, Solaris, Windows), information for bulk rekey is available in the *IBM Tape Device Drivers Installation and User's Guide*, GC27-2130. This guide is available at the IBM Support Portal.

System-managed tape encryption and library-managed tape encryption interoperate with one another. In other words, a tape encrypted with system-managed encryption can be decrypted with library-managed encryption, and the other way around, provided they both have access to the same keys and certificates. Otherwise, this procedure cannot be feasible.

About encryption keys
The encryption keys that are used to encrypt data are described.

An encryption key is typically a random string of bits generated specifically to scramble and unscramble data. Encryption keys are created with algorithms designed to ensure that each key is unique and unpredictable. The longer the key constructed this way, the harder it is to break the encryption code. Both the IBM and T10 methods of encryption use 256-bit AES algorithm keys to encrypt data. 256-bit AES is the encryption standard that is recognized and recommended by the US government, which allows three different key lengths. 256-bit keys are the longest allowed by AES.

Two types of encryption algorithms can be used by the encryption key server: symmetric algorithms and asymmetric algorithms. Symmetric, or secret key encryption, uses a single key for both encryption and decryption. Symmetric key encryption is used for encrypting large amounts of data efficiently. 256-bit AES keys are symmetric keys. Asymmetric, or public/private encryption, uses a pair of keys. Data encrypted with one key are decrypted only with the other key in the public/private key pair. When an asymmetric key pair is generated, the public key is typically used to encrypt, and the private key is typically used to decrypt.

The encryption key server uses both symmetric and asymmetric keys; symmetric encryption for high-speed encryption of user or host data, and asymmetric encryption (which is necessarily slower) for protecting the symmetric key.

Encryption keys can be generated by the encryption key server, by applications such as Tivoli Storage Manager, or by a utility such as keytool. The responsibility for generating AES keys and the manner in

which they are transferred to the tape drive depends on the tape drive type and the method of encryption management. However, it can be helpful to understand the difference between how the encryption key server uses encryption keys and how other applications use them.

How the encryption key server processes encryption keys

TS1120 and later tape drives

In system-managed and library-managed tape encryption, unencrypted data (clear text) is sent to the tape drive and converted to ciphertext with a symmetric 256-bit AES Data Key (DK) generated by the encryption key server. The ciphertext is then written to tape. The encryption key server uses a single, unique data key for each 3592 tape cartridge. This data key is also encrypted, or wrapped, by the encryption key server with the public key from an asymmetric Key Encrypting Key (KEK) pair. This process creates an Externally Encrypted Data Key (EEDK). The EEDK is written to the cartridge memory and to three more places on the tape media in the cartridge. The tape cartridge now holds both the encrypted data and the means to decrypt it for anyone that is holding the private part of the KEK pair. illustrates this process.

The data key is also wrapped a second time, possibly with the public key of another party, to create an extra EEDK. Both EEDKs can be stored on the tape cartridge. In this way, the tape cartridge can be shipped to a Business Partner that is holding the corresponding private key that would allow the data key to be unwrapped and the tape that is decrypted by the Business Partner.
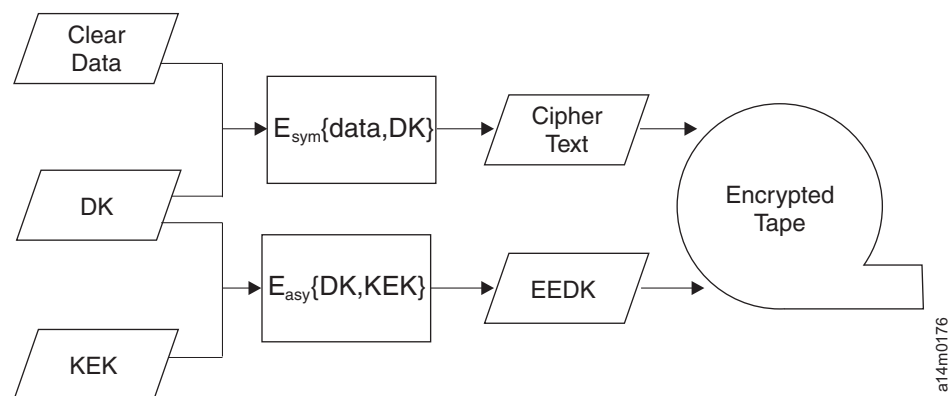
Figure 2: Encryption with both symmetric and asymmetric encryption keys

Encryption key processing by other applications (an encryption key server not used)

In application-managed tape encryption, unencrypted data (clear text) is sent to the tape drive and converted to ciphertext with a symmetric Data Key (DK) provided by the application, and is then written to tape. The data key is not stored anywhere on the tape cartridge. When the encrypted volume is written, the data key must be in a location available to the application, a server database, for example, in order for the volume to be read.

TS1120 and later tape drives can use applications such as Tivoli Storage Manager for application-managed encryption. Tivoli Storage Manager uses a single, unique data key for each tape cartridge.

Alternatively, the tape drives can be used by applications that use the T10 command set to complete encryption. The T10 command set uses symmetric 256-bit AES keys that are provided by the application. T10 can use multiple, unique data keys per tape cartridge, and even write encrypted data and clear data to the same tape cartridge. When the application encrypts a tape cartridge, it selects or generates a data key with a method determined by the application and sends it to the tape drive. The key is not wrapped with an asymmetric public key and it is not stored on the tape cartridge. When the encrypted data is written to tape, the data key must be in a location available to the application in order for the data to be read.

The process for application-managed tape encryption is shown in Figure 3 on page 8.
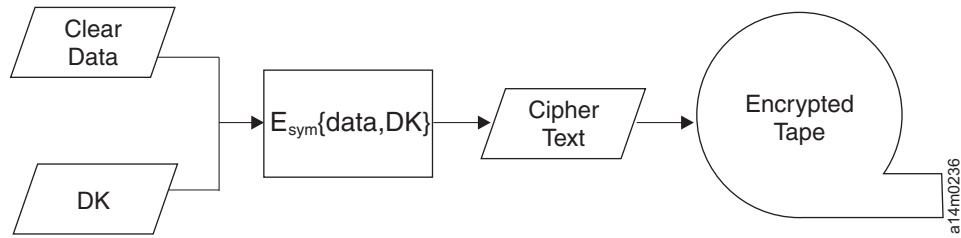
Figure 3: Encryption with only symmetric encryption keys

Supported installations

This topic describes the supported installations of the 3592 tape drives and controllers.

The 60F, 55F, EH8, and EH7 tape drives are supported in the following environments.

- IBM TS4500 tape library (see the *IBM TS4500 tape library Introduction and Planning Guide*, SC27-5990)
- Stand-alone racks

The E08 and E07 tape drives and the C06 Controller are supported in the following environments.

- IBM TS3500 tape library (see the *IBM TS3500 tape library Introduction and Planning Guide*, GA32-0559)
- Stand-alone racks

The J1A, E05, E06, and EU6 tape drives and the C06 Controller are supported in the following environments.

- IBM TS3400 tape library (see the *IBM TS3400 tape library Planning and Operator Guide*, GC27-2107)
- IBM TS3500 tape library (see the *IBM TS3500 tape library Introduction and Planning Guide*, GA32-0559)
- IBM Enterprise tape library 3494 (see the *IBM Enterprise Automated tape library (3494) Introduction and Planning Guide*, GA32-0448)
- Stand-alone racks

The C06 Controller does not support 3590 tape drives. When installed in the 3494 tape libraries, the C06 Controller is in the IBM 3952 Tape Frame F05 (3952 Tape Frame). When installed in the 3584 tape libraries, the C06 Controller is in the IBM 3953 Tape Frame F05 (3953 F05 Tape Frame).

The J1A, E05, E06, and EU6 tape drives, and the J70 Controller are supported in the following environments.

- IBM TS3500 tape library - 3592 tape drives only. The J70 Controller is not supported (see the *IBM TS3500 tape library Introduction and Planning Guide*, GA32-0559)
- IBM Enterprise tape library 3494 (see the *IBM Enterprise Automated tape library (3494) Introduction and Planning Guide*, GA32-0448)
- IBM Enterprise tape drive Frame 3590 Model A14 (see the *IBM Enterprise Tape System 3590 Introduction and Planning Guide*, GA32-0329)
- Stand-alone racks

The 3592 tape drives use a tape cartridge with a form factor similar to the 3590 tape cartridges. They can be used in automated environments, such as the ones listed, and also in StorageTek Automated Cartridge System (ACS) solutions. See the *IBM 3952 Tape Drive Frame Introduction, Planning, and User's Guide*, GA32-0463 or the *IBM Silo Compatible Tape Frame 3590 Introduction, Planning, and User's Guide*, GA32-0366.

The 3592 drive can connect to IBM tape controllers, including the C06 Controller, the J70 Controller, and the 3590 A60, for Fibre Connections (FICON) and Enterprise Systems Connection (ESCON). The J1A tape drive can connect to the C06 Controller, the J70 Controller, or the 3590 A60. The E05, and E06/EU6 tape drives can connect to the C06 Controller and the J70 Controller. The E07 tape drive can connect to the C06 Controller. For consistency of drive capability, all E06, EU6, E07, and E08 tape drives connected to IBM tape controllers must be configured as encryption-enabled. The 3592 tape cartridge has external dimensions (form factor) that allow it to be used within existing storage cells of libraries that contain 3590 tapes. However, the 3592 tape drives must be installed in frames separate from any 3590 drives. Model 3592 tape cartridges are not compatible with 3590 tape drives, and, likewise, 3590 tapes cannot be used in the 3592 drives.
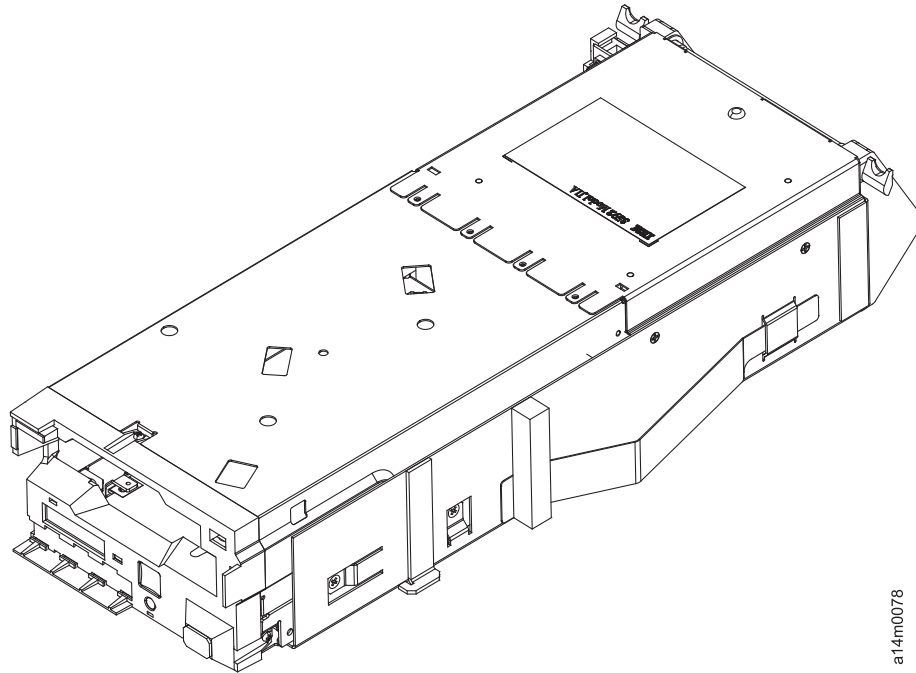
Figure 4: Tape drive in canister (E08, E07, E06/EU6, E05, J1A drives)
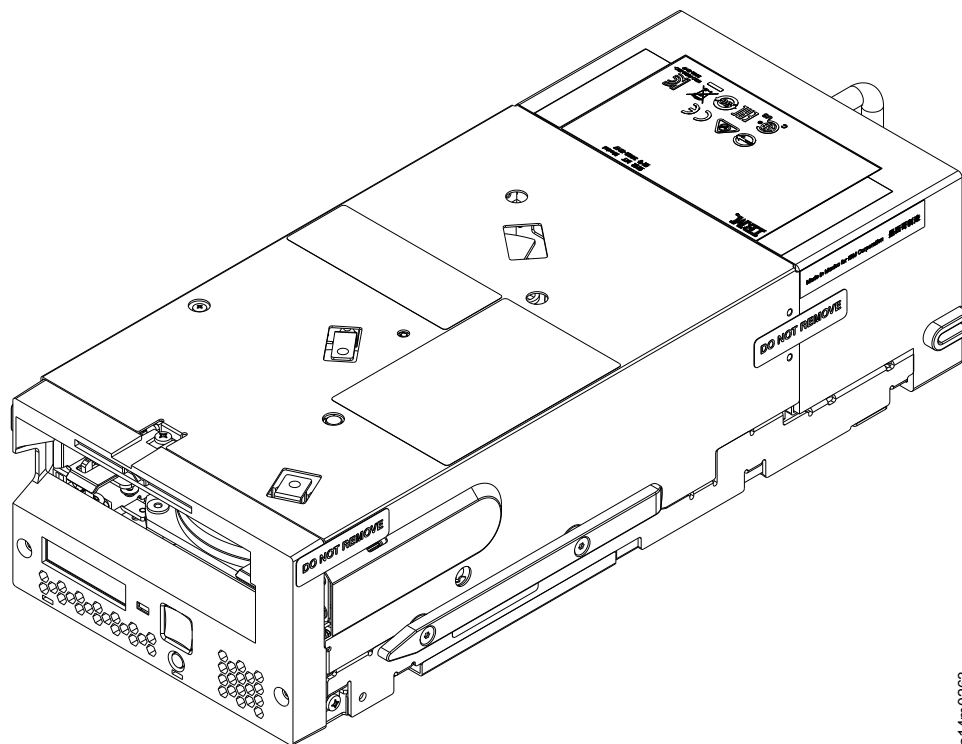
Figure 5: Tape drive in canister (60F, 55F, EH8, and EH7 drives)

The 3592 drive is enclosed in a canister, and is a hot-swappable/quick disconnect field-replaceable unit (FRU). An example of the drive in canister for J1A, E05, E06/EU6, E07, and E08 tape drives is shown in . An example of the drive in canister for EH7, EH8, 55F, and 60F tape drives is shown in . Installations and replacements are to be completed by qualified IBM service representatives only. The tape drive canister unit does not have its own power supply, but is powered on when the canister is plugged into the drive cradle, or frame installation. Each drive cradle has dual redundant power supplies, which provide power to the two canister slots. When power is supplied to the unit, the drive runs several self-tests. Fibre Channel connectors must not be connected to the canister until configuration is completed through the service panel by the service technician.

In certain installations, the 3592 tape drives can be attached through Fibre Channel switches to the C06 Controller, the J70 Controller, or the 3590 A60 (J1A tape drive only) controller. The J70 Controller also supports the attachment of 3590 models B, E, and H Fibre Channel attached tape drives. For information on these tape drives, controllers, and switches, see the *IBM 3592 tape drives and TS1120 Controller Introduction and Planning Guide*, GA32-0555 or the *IBM Enterprise Tape System 3590 Introduction and Planning Guide*, GA32-0329. When the tape controller is installed, no accessible operator controls or displays are available. All tape controller displays and controls are for use by qualified IBM service representatives only.

Drive environmental conditions

This topic describes the recommended environment for 3592 drives.

The table summarizes the recommended environmental conditions when you are operating, storing, and shipping the 3592 drive.

Table 3: Equipment environment specifications for the 3592 tape library.											
Product operation (equipment is powered on)									**Product power off[1]**		
Dry-bulb temperature			Humidity range, non-condensing			Maximum wet-bulb temperature [5]	Maximum dew point temperature [6]	Maximum elevation	Dry-bulb temperature	Relative humidity	Maximum wet-bulb temperature
Allowable[2]	Recom-mended[3]	Maximum rate of change	Allowable	Recom-mended	Maximum rate of change						
16 to 32°C (60 to 90°F)	16 to 25°C (60 to 77°F)	5°C/hour (9°F/hour)	20% to 80% RH	20% to 50% RH	5% RH/hour[4] with no condensation	26°C (79°F)	22°C (72°F)	3050 m (10,000 feet)	5 to 45°C (40 to 113°F)	8% to 80% RH	26°C (79°F)

Notes:

1. Product equipment is removed from the original shipping container and installed but not in use - for example, during repair, maintenance, or upgrade.

2. Derate maximum dry-bulb temperature 1°C/300 m above 900 m (1.8°F/1,000 feet above 3,000 feet).

3. Derate maximum recommended dry-bulb temperature 1°C/300 m above 1,800 m (1.8°F/1,000 feet above 6,000 feet).

4. For 3592 media, changes of up to 40% RH in 5 minutes are allowed as long as the 20% to 80% absolute limits are not exceeded.

5. Applies to LTO drive generations 1 through 8 and to legacy 3592 drives (TS1155 and prior generations).

6. Applies to TS1160 drives.

Substantial deviations in either direction from the recommended operating range, if sustained for extended periods of time, exposes the unit to greater risk of failure. Limited deviations from the recommended operating range minimize the risk of thermal and hygroscopic expansion effects.

When the drive is installed, acclimation time is required before the drives used if the temperature of the drive is different from the temperature of the environment it is operated in. The drive must be acclimated to the operating environment for a minimum of 4 hours after the drive is unpacked. If any condensation is observable on the exterior surfaces, acclimate the drive for at least 4 hours, plus one extra hour after all condensation is evaporated.

Chapter 2. Drive controls, displays, and messages

The 3592 drive is a highly automated device, and is typically managed through a Library Manager or host and its associated software. More displays and operations are available for the individual drives, primarily when the library is set to manual mode. The following sections describe components, operations, and messages that operators might need to become familiar with, in case of library automation failures.

> ⚠️ **CAUTION:** The operator must remember the importance of safe operation when any of the tasks in this book are run. The operator must know the location of, and how to use the switches and controls on the particular tape library where this drive is installed. The front doors on the library must not be opened during normal operation because of the moving components within the library. (72XXC356)

> ⚠️ **Attention:** Take care in handling the front of the drive. Keep the entire bezel, and particularly the white reflective fiducials and the black surfaces that surround the fiducials clean (see **1** in Figure 6 on page 13 and Figure 7 on page 13). Oil or dirt on the black surfaces next to the reflective fiducials can cause reflectance problems, interfering with the library cartridge-handling device's ability to locate the drive.

The **Unload** button (**4** in Figure 6 on page 13 and **3** in Figure 7 on page 13) is used to manually unload a tape from the drive. If you press **Unload** while a tape is loaded, the drive completes any operation in progress, then rewinds and unloads the cartridge. The **Reset** button (**5** in Figure 6 on page 13 and **4** in Figure 7 on page 13) generates a drive reset. The microcode terminates any current tape motion and comes to a complete stop before the reset starts **Reset** is recessed to prevent accidental activation. Use a pencil or small screwdriver to press **Reset**. The green LED power indicator (**6** in Figure 6 on page 13 and **5** in Figure 7 on page 13) shows whether power is provided to the drive. As part of the power-up process, the LED automatically comes on, and the drive runs a number of power-on self-tests. During reset, the LED might display in a flashing mode. This action indicates that the drive is attempting to unload the cartridge before the actual reset process.

Drive front panel components

This topic describes the front panel of the 3592 tape drive.

Figure 6 on page 13 and Figure 7 on page 13 show the front bezels of the 3592 drive and its main components. Since these components are on the front side of the drive, they are accessible only from the interior of the library, or with a rack mount drive.
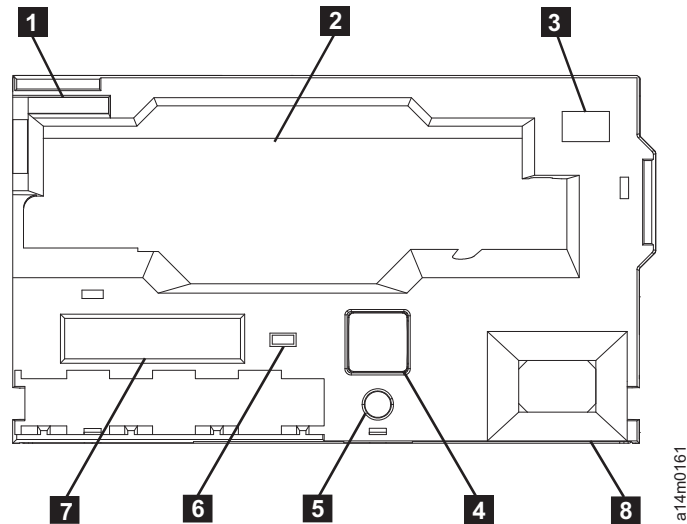
Figure 6: Front view, E08, E07, E06/EU6, E05, J1A tape drive

1 Reflective fiducials		**5** **Reset**	
2 Tape cartridge slot		**6** LED power indicator	
3 Non-reflective fiducial		**7** 8-character (message) display	
4 **Unload**		**8** 3494 fiducial	
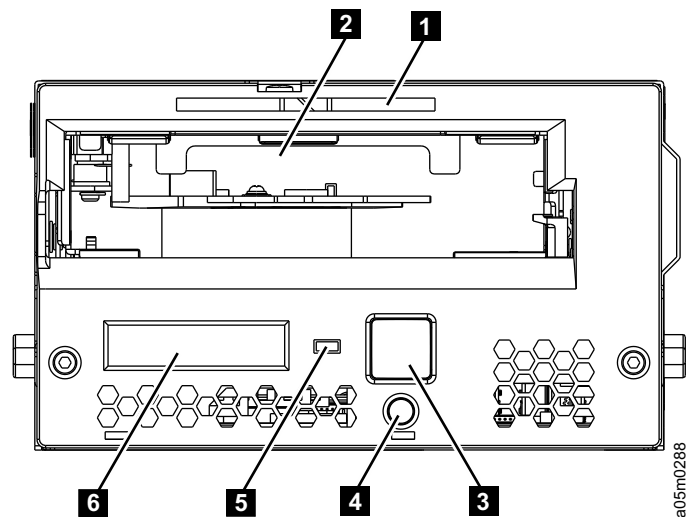
Figure 7: Front view, 60F, 55F, EH8, EH7 tape drive

1 Chevron fiducial		**4** **Reset**	
2 Tape cartridge slot		**5** LED power indicator	
3 **Unload**		**6** 8-character (message) display	

Fiducials

This topic describes the fiducials on the front bezel of the 3592 drive.

Reference keys **1** and **3** in Figure 6 on page 13 and **1** in Figure 7 on page 13 identify the fiducials on the front bezel of the 3592 drive. These fiducials are used by cartridge-handling devices to locate where the

tape system device is installed. The reflective fiducials **1** are white. Their light-reflective properties are used by the cartridge-handling devices to locate the drive. The non-reflective fiducial (**3** in Figure 6 on page 13) is a hole, which is used by a different type of locating mechanism. Any debris on these fiducials or shiny contamination on other areas of the bezel can interfere with this device-locating function. Do not cover or change any of the fiducials. **8** in Figure 6 on page 13 identifies the 3494 fiducial.

Display panels

This topic describes the 3592 drive display panels.

When the 3592 drive is managed through a host and its associated software, refer to the appropriate library operator guide and software manuals for information about retrieving drive information. At times, such as in manual mode, information about an individual drive might need to be viewed directly from the drive itself. Two different displays provide messages and action options. One is a message display for the operator on the front of the drive, and the other is a separate service panel for a qualified service representative.

On the front of the drive, an 8–character display panel (**7** in Figure 6 on page 13 and **6** in Figure 7 on page 13) displays drive status codes and also offers a limited actions menu. These display messages are described in detail in "Drive messages" on page 14.

Drive messages

This topic describes drive messages.

In case of library automation failures, the **Library Manager** operator panel or other host operator panel can indicate that manual operations are required for specific drives and tape cartridges. In addition to the messages on the library display panel, individual drives can also display messages on the 8–character drive message display.

These messages can be of four types.

- Mount messages (which are governed by the host control or library)
- Attention messages
- FID (failure ID) messages
- Drive status messages

Some of these messages require intervention by a service representative.

Mount messages

This topic describes mount messages.

These messages are governed by the host or library and its associated software. The messages that are displayed vary, depending upon the installed host software. As an example, it might indicate to manually mount a specific tape cartridge into the drive.

Attention messages

This topic describes attention messages.

When the drive message displays ATTN DRV, the drive experienced either a load error (indicated by the LOAD ERR alternating message) or an unload error (indicated by the UNLOAD E alternating message). If you receive either of these messages, call your service representative.

Failure ID messages

This topic describes Failure ID (FID) messages.

Failure ID (FID) messages are short codes that can be used by an IBM service support representative (SSR) to isolate problems with the device. If an FID message appears, you must record the message

before the SSR is contacted. This message is commonly a two-part, alternating message on the display. An FID error condition message has priority over all other types of messages, and persists until corrected. SSRs use the FID code to identify the failing field replaceable unit within the drive subsystem. Therefore, it is necessary for the operator to make note of the FID message to provide this information to the SSR. An example of the format of these messages is FID1 FF, alternating with an engineering error code, such as 931C9999. In this example, "FID" indicates to the operator that a hardware failure occurred, and "1" indicates the severity code. "FF" is the FID number that the SSR uses to enter the Maintenance Package. The alternating display of the engineering error code provides specific support information to the service organization. See for information on FID messages.

Drive status messages

This topic describes the drive status messages.

Various messages can be displayed on the 8-character panel that indicates the status of the drive. Typically, drive-generated status messages are right-aligned and have an * (asterisk) as the final character, and usually indicate the current process that is completed with the drive. If the first character is @ (*at* symbol), the drive is at the specified state, and the process is complete.

Table 4: Drive status messages	
Message	**Message meaning**
<blank>	If the message panel is blank - • The drive is not powered on • The drive is ready • No status • No cartridge is mounted
<all 8 elements fully lit>	During the reset or power-on process, the diagnostic test is verifying that all elements are working. **Note:** This message appears for J1A, E05, and E06 tape drives only.
AJAR*	A cartridge is in the drive and is not in a loadable position. Alternatively, if no cartridge or other obstruction is in the drive, the sensor might not be functioning correctly, and the hardware might be defective. If no cartridge or other obstruction is in the drive, contact your IBM service representative.
BOOTING	During the reset or power-on process, the diagnostic test is verifying that all elements are working. **Note:** This message displays for E07/EH7, E08/EH8, 55F, and 60F tape drives only.
CLEAN*	Drive cleaning is in process.
CODELOAD	Microcode is being loaded. This process takes a few minutes. The drive must not be powered off or reset in this condition.
DIAGS*	Diagnostics are running.

Table 4: Drive status messages (continued)	
Message	**Message meaning**
EMPTY*	No cartridge is in the drive. Alternatively, if a cartridge is in the drive, the sensor might not be functioning correctly, and the hardware might be defective. If a cartridge is present in the drive, contact your IBM service representative. **Note:** Microcode levels before release level 464 (October 2003) does not display "EMPTY*" when no cartridge is present in the drive (the display is blank). Not an error condition. If this result is not wanted, the drive code must be updated to the current version.
ERASE*	Data Erase is in process.
LOAD*	Load is in progress.
@LOAD*	Load is complete, cartridge is at load point.
LOCATE*	Locate is in progress.
MIDTAPE*	Drive was reset or powered on with a tape loaded, and is bringing drive and tape to cleanly recovered state. This process might take up to 15 minutes.
NEW CODE	Code load is complete, drive is resetting to apply that code.
READ*	Data Read is in progress.
READY*	Drive is in ready state. (Panel can also be blank in ready state.)
RESET* and RESET!!!	Drive is resetting.
REWIND*	Rewind operation is in progress.
UNLOAD*	Unload is in progress or unload is requested.
@UNLOAD*	Unload is complete, the cartridge is in the unloaded position. (The display is blank if the cartridge is removed.)
WRITE*	Data Write is in progress.

In addition to the drive status messages listed in Table 4 on page 15, the icons that are displayed in Figure 8 on page 16 might also be displayed as the first or last character in the message display. These icons provide information about the drive or the tape cartridge currently in the drive. All icons, except the "clean required" icon appear as the leftmost character. The "clean required" icon replaces the "*" symbol in the status messages, as the rightmost character.

Icon	Meaning
	Physical write protect
	Logical write protect
	Dump present
	Clean required
	WORM tape

a14m0144

Figure 8: Drive message display icons

- Physical write protect means that the cartridge write-protect switch is positioned to prevent writing data to the tape.

- Logical write protect means that either the host sent a command to prevent writing to the tape, or the drive disallowed writing due to some internally detected condition.
- Dump present indicates that performance-related data is stored within the drive dynamic random access memory. This dump data can be retrieved by an IBM service representative for troubleshooting purposes.
- Clean required means that the drive needs to be cleaned by using a cleaning cartridge.
- WORM tape indicates that the cartridge currently in the drive is a WORM cartridge.

Drive Status page (E07/EH7, E08/EH8, 55F, and 60F tape drives only)

The E07/EH7, E08/EH8, 55F, and 60F tape drives come with Ethernet ports for use by an IBM Service Support Representative for procedures such as updating microcode or viewing drive status. The Ethernet port can also be used by the customer for remote monitoring by attaching an Ethernet cable from the drive to the customer's network.

The Ethernet ports are on the rear of the E08, E07, and E06 tape drives (**7** in Figure 23 on page 56). For EH7/EH8/55F/60F tape drives, the Ethernet ports are on the front of the rack mount enclosure. See Figure 27 on page 61. The enclosure bezel is removed and the Ethernet ports are circled.

Note: This product might not be certified in your country for connection by any means whatsoever to interfaces of public telecommunications networks. Further certification might be required by law before any such connection is made. Contact IBM for information.

The **Drive Status** page is available by using HTTP to connect to `http 169.254.1.3/panel.html` on the drive. Login is not required. Refresh your browser to update the page with the current information.

The **Drive Status** page offers detailed information on the drive in table or text-only (for printing) formats. This page is for information purposes only and no changes can be made from the interface.

Drive information is divided into the following categories.

- Drive Information (initially displayed): Serial Number, Model, Code Level (build date), Status, Message Display Text, Status Indicators, Current Position, EOD Position, Logical Position, Physical Position, Current Time (origin)
- Host Interface (for Port 0 and Port 1): Status, WWID, FC Address (actual/configured), Speed (actual/configured), Topology (actual/configured)
- Ethernet Settings (for Port 0 and Port 1): IP addresses (Current), MAC address (VPD), Drive IP address 1 (VPD), Drive IP address 2 (VPD), EKM IP address 1, EKM IP address 2
- Library Information: Library Type/Model, Library Serial Number, Library Firmware Level, Library Interface Speed, Library IP address, Drive's Element address, Drive's Position
- VPD Encryption Settings
- Drive Statistics: Drive Mounts, Drive MB Written, Drive MB Read, Power On Hours (current/VPD)
- Tape Statistics: Volume Serial (origin), Tape Mounts, Tape MB Written, Tape MB Read
- Manufacturing Information: Serial Number, Part Number, and EC Number for Card, Bezel, Head, MCA, Deck, Drive
- Host Reservation (SPC-2): Create time, device path, host name, OS version, driver version, WWPN, reservation type
- Host Media Removal (prevented): Create time, device path, host name, OS version, driver version, WWPN
- FID Error Log
- TEMP Error Log

Display of the information in each category can be toggled by the associated check box.

Chapter 3. IBM 3592 tape cartridge

The 3592 tape drive has a bidirectional read/write head capable of operating at up to four different recording densities, depending on the tape drive model. See Table 6 on page 20 for cartridge densities and capacities.

Table 5: General information about tape cartridges			
Text on product and type of media[1]	**Case Color**	**Label door and write-protect switch color**	**Part number**
Data - JA	Black	Dark blue	18P7534
Extended Data - JB	Black	Dark green	23R9830
Advanced Data Type C - JC	Black	Dark purple	46X7452
Advanced Data Type D - JD	Black	Burnt orange	2727263
Advanced Data Type E - JE	Black	Brick red	02CE960
Economy - JJ	Black	Light blue	24R0316
Advanced Type C Economy - JK	Black	Light purple	46X7453
Advanced Type D Economy - JL	Black	Apricot	2727264
Advanced Type E Economy - JM	Black	Cherry red	02CE961
Economy WORM - JR	Platinum (silvery gray)	Light blue	24R0317
WORM - JW	Platinum (silvery gray)	Dark blue	18P7538
Extended WORM - JX	Platinum (silvery gray)	Dark green	23R9831
Advanced Type C WORM - JY	Platinum (silvery gray)	Dark purple	46X7454
Advanced Type D WORM - JZ	Platinum (silvery gray)	Burnt orange	2727265
Advanced Type E WORM - JV	Platinum (silvery gray)	Brick Red	No PN - aftermarket sales only
Cleaning Cl*xxx*JA[2]	Black	Gray	18P7535
Notes:			
1. This designation displays as the last 2 characters on standard bar code labels. In addition, for cleaning cartridges, the first 3 characters of the volume serial number (VOLSER) are CLN			
2. Where *xxx* equals three numerals.			

Capacities of data cartridges can be increased through data compression, with the actual compression and capacity depending upon the specific data. Write-once, read-many (WORM) cartridges are also

available in all capacities. For information, refer to "Cartridge types and characteristics" on page 19. All 3592 cartridge types can be encrypted when used with a compatible 3592 tape drive.

The 3592 tape drive is designed to support capacity scaling of individual 3592 tape cartridges over a broad range of capacities. The effect of capacity scaling is to contain data in a specified fraction of the tape, yielding faster locate and read times. Alternatively, 3592 economy tape cartridges can be used to achieve this faster performance. For information, see ."Capacity-scaling and segmentation" on page 24.

Cartridge types and characteristics

Information about the tape cartridges that are used in the 3592 tape drives.

Cartridges are distinguished by the text on the label, and by the color of the tape cartridge case and the color of the cartridge label (see **2** in Figure 9 on page 21), write-protect switch **4**, and door (see **1** in Figure 11 on page 22). The characteristics of the nine different data cartridge types and the cleaning cartridge that are used by operators with the 3592 drive are summarized in Table 6 on page 20. The main external components of the IBM 3592 tape cartridge are shown in Figure 9 on page 21.

The capacity of the 3592 tape cartridge depends on the format that is used when written from the beginning of tape (BOT). Each tape drive model has different formatting capabilities. The TS1140 Model E07/EH7 tape drive with code D3I3_5CD or later installed can read the JA, JJ, JR, JW, and similar cartridges. Drives with earlier code levels cannot read these cartridges.

The 3592 55x drive introduces two new logical formats to improve the capacity and data rate of media that support these formats. The two new formats are

- J5A or Jaguar 5 Archive logical format - unencrypted
- J5A-E or Jaguar 5 Archive logical format - encrypted

Notes:

- Non-supported media is rejected on load.
- Reformatted media is loaded (provided a prerequisite drive code level is loaded), but can be rewritten only in a supported format.
- The 3592 55x supports writing the new J5A logical formats. This format is the default write format for writes from BOT unless overridden. Append operations in supported formats default to the format of the media.
- PGA releases are provided for 3592 Ex8 previous generation drives to support the recognition and reformatting of tapes in the J5A logical format back to the J5 (10 TB) format (both encrypted or non-encrypted). Existing field microcode levels on these devices does not load cartridges in the J5A logical format and therefore must be upgraded to support media reformat interchanges.

All 3592 tape drives support cartridge reuse. The 3592 tape cartridges can be reformatted to any tape format supported by the tape drive when it writes from BOT. When reformatting, all existing data on the cartridge is erased.

All compatible 3592 tape cartridge types can be used with the encryption function of the E05, E06, E07/EH7, E08/EH8, 55F, and 60F tape drives. Encrypted cartridges use a unique format, Enterprise Encrypted Format 2 (EEFMT2), Enterprise Encrypted Format 3 (EEFMT3), Enterprise Encrypted Format 4 (EEFMT4) Enterprise Encrypted Format 5 (EEFMT5), or Enterprise Encrypted Format 6 (EEFMT6).

Table 6: 3592 capacities by density, cartridges, and products								
Format (Density Name)	**Cartridge**	**Supported by**						
		3592 J1A	**3592 E05**	**3592 E06**	**3592 E07**	**3592 E08**	**3592 55F**	**3592 60F**
J1A (3592A1)		WR	WR	RO				
	JJ/JR	60 GB	100 GB	128 GB	-	-	-	-
	JA/JW	300 GB	500 GB	640 GB	-	-	-	-
E05 (3592A2)			WR	WR	RO			
	JB/JX	-	700 GB	700 GB	700 GB	-	-	-
E06 (3592A3)				WR	WR			
	JB/JX	-	-	1 TB	1 TB	-	-	-
E07 (3592A4)					WR	WR	RO	RO
	JB/JX	-	-	-	1.6 TB	-	-	-
	JK	-	-	-	500 GB	500 GB	500 GB	500 GB
	JC/JY	-	-	-	4 TB	4 TB	4 TB	4 TB
E08 (3592A5)						WR	WR	WR
	JK	-	-	-	-	900 GB	900 GB	900 GB
	JC/JY	-	-	-	-	7 TB	7 TB	7 TB
	JL	-	-	-	-	2 TB	2 TB	2 TB
	JD/JZ	-	-	-	-	10 TB	10 TB	10 TB
55F (3592B5)							WR	WR
	JL	-	-	-	-	-	3 TB	3 TB
	JD/JZ	-	-	-	-	-	15 TB	15 TB
60F (3592A6)								WR
	JM	-	-	-	-	-	-	5 TB
	JE/JV	-	-	-	-	-	-	20 TB

Notes:

- Values are in GB and TB (10^9) no compression.
- The terms 'Extended' and 'Advanced' are used in the cartridge descriptions below to denote increased capacity.
- Devices with updated firmware might support reformatting media written with unsupported formats to a supported format based on media type.
- In addition to these cartridges, a "CE" cartridge is available for use by Service Representatives only. The VOLSER label for this cartridge begins with "CE" followed by a space and three numerals, and ending with "JA" or "JK" .

JJ	Economy Cartridge	JR	Economy WORM Cartridge
JA	Standard Cartridge	JW	Standard WORM Cartridge

Table 6: 3592 capacities by density, cartridges, and products (continued)		
Format (Density Name)	**Cartridge**	**Supported by**
JB	Extended Cartridge	JX Extended WORM Cartridge
JK	Advanced Type C Economy Cartridge	JY Advanced Type C WORM Cartridge
JC	Advanced Type C Cartridge	JZ Advanced Type D WORM Cartridge
JL	Advanced Type D Economy Cartridge	JV Advanced Type E WORM Cartridge
JD	Advanced Type D Cartridge	- Not supported
JM	Advanced Type E Economy Cartridge	WR Write and Read
JE	Advanced Type E Cartridge	RO Read Only

Cartridge external components

The main external components, common to all types of 3592 tape cartridges are shown in Figure 9 on page 21 and Figure 10 on page 22.
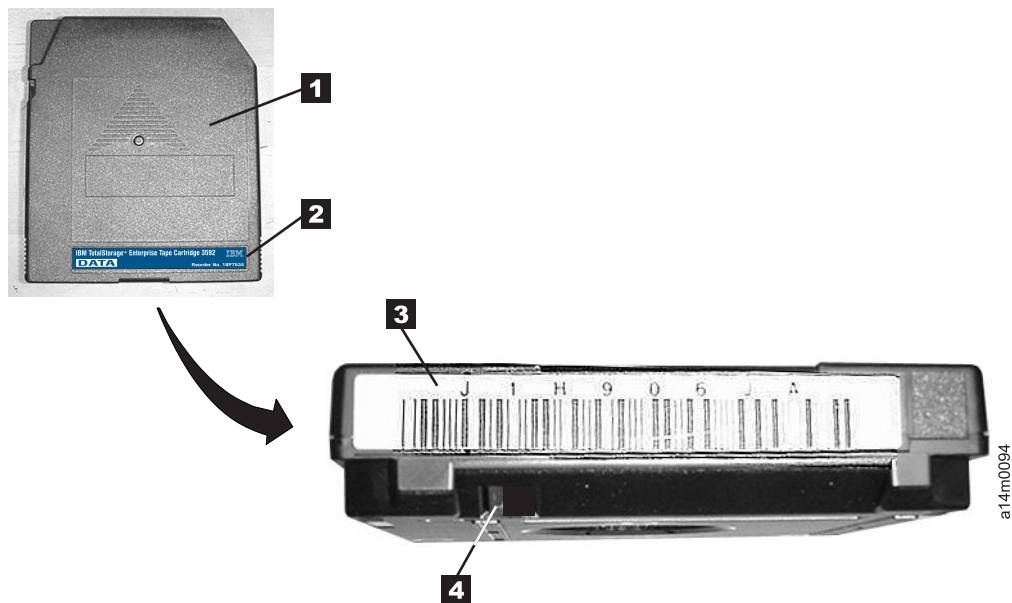
Figure 9: IBM 3592 Enterprise tape cartridge

1	Cartridge case	**3**	Cartridge bar code label
2	IBM product label	**4**	Write-protect selector

In tape libraries, the library vision system identifies the types of cartridges during an inventory operation. The vision system reads a volume serial number (VOLSER) **3**, which appears on the label on the edge of

the cartridge. The VOLSER contains 1 - 6 characters, which are left-aligned on the label. If fewer than 6 characters are used, spaces are added. The media type is indicated by seventh and eighth characters. The different cartridge type codes are shown in the "Type" column of <u>"Cartridge types and characteristics" on page 19</u>.

If you are attaching VOLSER labels to cartridges that do not have pre-attached labels, place the label entirely within the label recessed area on the cartridge. See **3** in <u>Figure 9 on page 21</u> as an example of proper placement. The label must be flat to within 0.5 mm (0.02 in.) over the length of the label and have no folds, missing pieces, tears, or any extraneous markings. Failure to follow these placement requirements results in degraded readability.

Each data cartridge includes a write-protect selector **4**, which can be set to prevent data from being over-written or erased from the tape by the tape drive. To write-enable a cartridge, slide the selector to the left (see **1** in <u>Figure 10 on page 22</u>), which exposes a square hole, to permit data to be written to and erased from the cartridge. To write-protect a cartridge, slide the selector to the right **2**, which covers the hole, preventing data to be written to or erased from the cartridge.
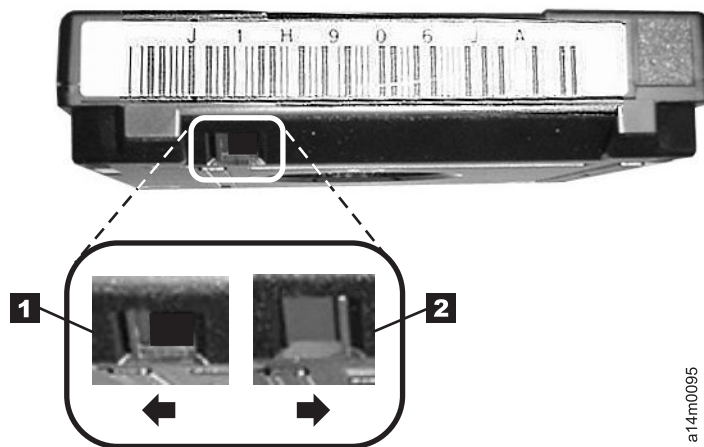
Figure 10: Write-protect selector

1 Write-enabled   **2** Write-protected

When you insert a cartridge into the drive, a threading mechanism pulls the tape leader pin and the attached tape out of the cartridge, across the drive head, and onto a non-removeable take-up reel. The cartridge door (**1** in <u>Figure 11 on page 22</u>) protects the tape from contamination when the cartridge is out of the drive. The only time that you manually retract this door is to check for proper tape pin position.

Figure 11: Data cartridge door

Cartridge Memory (CM)

Each 3592 data cartridge contains a passive, contactless, silicon storage device called cartridge memory (CM). This CM holds information about the cartridge and the media in the cartridge, and holds statistics about the media in the cartridge. The cartridge and media information is stored in a protected, read-only

area of the CM. This information is read by the CM reader in the drive, by using a contactless, radio-frequency interface, when the cartridge is loaded into the drive. The media performance statistics are stored in an unprotected, read/write area of the CM. These statistics are updated by the CM reader just before the cartridge is unloaded. The media performance statistics are maintained by the Statistical Analysis and Reporting System (SARS) portion of the drive microcode. Each cleaning cartridge also contains a CM, which tracks the number of cleaning uses.

Write-once, read-many (WORM)

These topics describe the write-once, read-many (WORM) tape cartridge and microcode controls.

Some records retention and data security applications require the Write-Once, Read-Many (WORM) function of tape data storage. The 3592 tape drives, when used with WORM media, can serve as a replacement to the IBM 3995 Optical Library where long-term records retention is required.

WORM function is accomplished on the 3592 by a combination of a special WORM tape cartridge and microcode controls in the drive. All 3592 drives with the appropriate microcode version installed can read and write WORM cartridges.

WORM tape cartridge characteristics

This topic describes the write-once, read-many (WORM) tape cartridge.

The list of characteristics of WORM cartridges are shown.

- WORM format pervades the entirety of every WORM cartridge. The WORM tape media is formatted to give every block on a WORM cartridge write-once, read-many protection. Additionally, the cartridge memory (CM) has a WORM indicator byte in the cartridge type field. Both of these conditions must be true for the drive to work with a WORM cartridge. If one condition is true and the other is false, an ATTN DRV - Invalid Cartridge message posts.
- Each WORM cartridge is identified by using a WorldWide Unique Cartridge Identifier (WWCID), which is permanent and locked, providing another level of security for data that must be maintained. This permanent locked information is stored in both the cartridge CM and on the tape itself, and can also be associated with the unique bar code volume serial (VOLSER). WORM cartridges can be audited by using the WWCID and the write mount count.
- WORM cartridges are labeled with a 'JR,' 'JV,' 'JW,' 'JX' , 'JY' , or 'JZ' and they are color-coded to distinguish them from rewritable cartridges. The color-coding is distinguishable by people with any of the three major varieties of color blindness.
- The WORM cartridge is tamper-proof (see "WORM microcode controls" on page 23).
- WORM cartridges can be read (or appended) only on WORM enabled 3592 drives. Non-WORM enabled drives are not able to take any action with a WORM cartridge other than to unload it.
- A WORM cartridge cannot be made non-WORM.
- A non-WORM cartridge cannot be made WORM.
- Written user data cannot be modified or erased. Deletion of the data requires destruction of the media and its usability, such as heat, crushing, physical shredding, or magnetic fields sufficient to delete all formatting that is required to read or write the cartridge.

WORM microcode controls

This topic describes the write-once, read-many (WORM) microcode controls.

When the drive senses that a cartridge is a WORM cartridge, the microcode prohibits the changing or altering of user data that is already written on the tape. The microcode tracks the last appendable point on the tape with an overwrite-protection pointer stored in the cartridge memory (CM). Statistical Analysis and Reporting System (SARS) data can be written and updated on WORM tapes because the SARS data is not in the user area of the tape.

Note: When a WORM cartridge is loaded and positioned at a non-appendable point on a drive that is attached to a controller, the controller gives good status to a write type command if the data that is

written is the same as what is already recorded on the media at the same location. However, the tape is not written. The tape position is after the block with the apparent overwrite and all data following is still valid on tape. When positioned at a non-appendable point on a WORM cartridge, the microcode reports overwrite errors only if attempts are made to write conflicting data. The scenario for the apparent overwrite is as follows. The host issues a write type command to the controller and the tape is at a non-appendable point. The controller attempts to write the WORM cartridge but the drive gives an overwrite error. The controller then reads the block and compares it to the block received from the host. If the block is the same, the controller gives good status to the host and leaves the tape positioned after the overwritten block. If the block varies in data or size, the controller repositions the tape in front of the read block and reports the overwrite error to the host. This process is not optimal for performance considerations.

Capacity-scaling and segmentation

This section describes how the 3592 tape drives use capacity-scaling and segmentation to place data in a designated section of tape to speed access and manage efficient capacity.

The 3592 tape drives support capacity-scaling for tape cartridges of media types JA, JB, JC, JD, and JE over a broad range of capacities. The effect of capacity-scaling is to contain data in a specified fraction of the tape, yielding faster locate and read times. Alternatively, you can purchase economy tapes (the JJ or JK media type) to achieve this faster performance.

Performance scaling limits the data that is written to the first 20% of the cartridge and when the performance segmentation option is used, the overall capacity of the cartridge is limited to 86.6% of the total capacity. The fast access segment occupies the first 20% of the cartridge, followed by the slower access segment. For example, with the E06 tape drive operating in EFMT3 format, the 3592 Extended Data tape cartridge (type JB) can be scaled to 200 GB (186.26 GiB). And using performance segmentation, the 1000 GB (931.32 GiB) Extended Data cartridge can be segmented into a 200 GB (186.26 GiB) fast access segment, and 666 GB (620.26 GiB) slower access segment. Segmentation is only available within a specified range of capacity-scaling settings.

Capacity-scaling is not supported for economy (JJ, JK, JL, JM) or write-once, read-many (WORM) tapes (JV, JW, JR, JX, JY, and JZ). For information about implementing segmentation and capacity-scaling, refer to the readme files that pertain to your device driver on the IBM Fix Central website.

Customers that use z/OS can use the capacity-scaling capability of the 3592 drive. A data class parameter determines whether a tape is to be scaled. OPEN processing scales a tape when the associated data class requests it and the tape is being written from load point (DISP=NEW, file sequence 1). On a subsequent reading of a performance scaled tape, the data is entirely contained in the first 20% of the tape, yielding fast locate and read times.

DFSMShsm and DFSMSdfp OAM can use this new feature, as well as other applications that use standard Open/Close/EOV processing. Refer to *z/OS DFSMS Software Support for IBM TS1150, TS1140, TS1130, and TS1120 Tape Drives (3592)*, SC26-7514, for information about software support for the 3592 drive.

For technical information about WORM, capacity-scaling, and segmentation, see also the *IBM Enterprise Tape System 3592 SCSI Reference*.

Cartridges pre-scaled for 60 GB (55.88 GiB) or 100 GB (93.13 GiB) capacity are also available for order with the 3599 Tape Media method. These pre-scaled cartridges can be ordered (and labeled) for a specific VOLSER range. This action allows capacity-scaling to be used by an application that allows media pools to be defined by VOLSER range.

Note: Virtual tape subsystems (TS7700 Virtualization Engine) do not support capacity-scaling or segmentation.

For information on which independent software vendors support capacity-scaling by command or with the pre-scaled cartridges with the 3592 tape drives, refer to the Independent Software Vendor (ISV) matrix for 3592 and LTO.

Chapter 4. Cartridge care and handling

This section describes the care and handling of the IBM Enterprise tape cartridge.

Handling the cartridges

Attention: Do not insert a damaged tape cartridge into your tape drive. A damaged cartridge can interfere with the reliability of a drive and can void the warranties of the drive and the cartridge. Before a tape cartridge is inserted, inspect the cartridge case, cartridge door, and write-protect switch for breaks.

Incorrect handling or an incorrect environment can damage the IBM Enterprise tape cartridge or the magnetic tape. To avoid damage to your tape cartridges and to ensure the continued high reliability of your IBM Enterprise tape drives and IBM TS1120 and later 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 is properly trained in handling and shipping procedures. This training includes operators, users, programmers, archival services, and shipping personnel.
- Ensure that any service or contract personnel who run archiving procedures 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 you ship a cartridge, ship it in its original or better packaging.
- Use shipping containers that securely hold the cartridges in place during transportation. This container can be in a well-packaged cardboard box or other container. One such container can be procured from Perm-A-Store at www.turtlecase.com.
- If you ship the cartridge in a cardboard box or a box of a sturdy material, ensure that you
  - Place the cartridge in polyethylene plastic wrap or bag 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.
- Never ship a cartridge in a commercial shipping envelope. Always place it in a box or package.

Provide proper acclimation and environmental conditions

This topic describes acclimation and environmental conditions.

- Before you use a cartridge, acclimate it to the normal operating environment for a minimum of 24 hours. If you see condensation on the cartridge, wait an extra hour.
- Ensure that all surfaces of a cartridge are dry before it is inserted.
- Do not expose the cartridge to moisture or direct sunlight.
- Do not expose recorded or blank cartridges to stray magnetic fields of greater than 350 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 28.

Perform a thorough inspection

This topic describes cartridge inspection.

After a cartridge is purchased and before it is used, complete the following steps.

- Inspect the cartridge's packaging to determine potential rough handling.
- When a cartridge is inspected, open only the cartridge door. Do not open any other part of the cartridge case. The upper and lower parts of the case are welded and held together with screws. Separating them destroys the usefulness of the cartridge.
- Inspect the cartridge for damage before it is used or stored.
- Check that the leader pin is properly seated (see Figure 19 on page 33).
- If you suspect that the cartridge was mishandled but it appears usable, copy any data onto a good cartridge immediately for possible data recovery. Discard the mishandled cartridge.

Handle the cartridge carefully

This topic describes cartridge handling.

- Do not drop the cartridge. If the cartridge drops, slide the cartridge door back and ensure that the leader pin is properly seated. If the leader pin is dislodged, go to "Repositioning a leader pin" on page 26.
- Do not handle tape that is outside the cartridge. Handling the tape can damage the tape's surface or edges, which can 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. Although 3590 tapes can be stacked with 3592 tapes, be cautious about mixing the different types of cartridges because they are not interchangeable, and can be used only with their respective drives.
- Do not degauss a cartridge that you intend to reuse. Degaussing makes the tape unusable.

Repositioning a leader pin

This topic describes repositioning a leader pin.

If the leader pin in your cartridge becomes dislodged from its pin-retaining spring clips, you must use the IBM Leader Pin Reattachment Kit (part number 18P8887) to reposition it.

Repositioning a leader pin

This topic describes repositioning a leader pin.

A leader pin that is improperly seated inside a cartridge can interfere with the operation of the drive. Figure 12 on page 27 shows a leader pin in the incorrect **1** and correct **2** positions.

To place the leader pin in its proper position, you need the following tools.

- Plastic or blunt-end tweezers
- Cartridge manual rewind tool (from the Leader Pin Reattachment Kit, part number 18P8887)
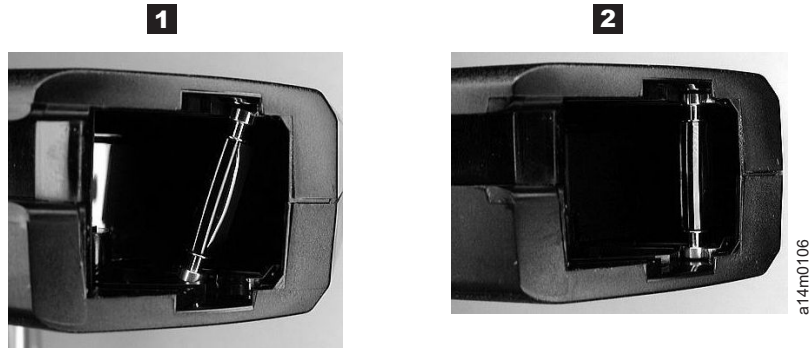
Figure 12: Leader pin in the incorrect and correct positions. The cartridge door is open and the leader pin is visible inside the cartridge.

To reposition the leader pin, complete the following steps.

1. Slide open the cartridge door (**1** in) and locate the leader pin **2**. You might 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.
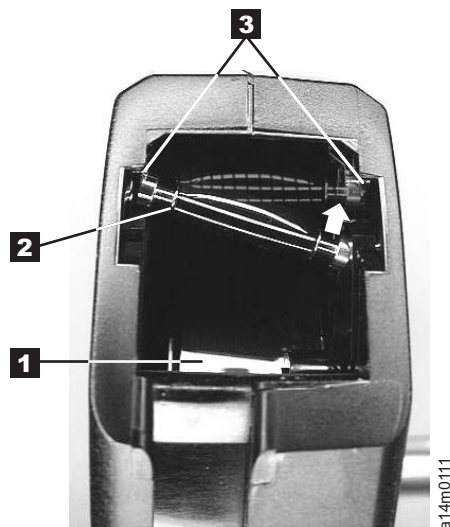
Figure 13: Placing the dislodged leader pin into the correct position. The cartridge door is open, showing the leader pin out of position.

5. To rewind the tape, insert the cartridge manual rewind tool (**1** in) into the cartridge's hub **2** and turn it clockwise until the tape becomes taut.
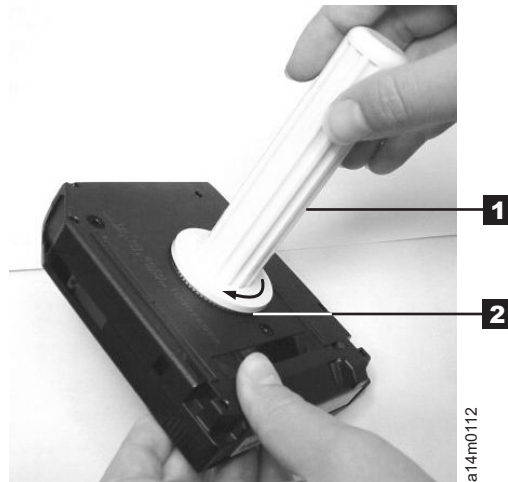
Figure 14: Rewinding the tape into the cartridge

6. Remove the rewind tool by pulling it away from the cartridge.

Environmental and shipping specifications for tape cartridges

This topic describes recommended conditions for shipping 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 varies, 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 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 7 on page 28 lists the environmental conditions for operating and storing IBM 3592 tape cartridges.

Table 7: Environment for storage and shipping the IBM 3592 tape cartridge.			
Environmental specifications			
Environmental factor	**Allowable storage**	**Recommended storage**	**Shipping**
Temperature	16 to 32°C (61 to 90°F)	16 to 25°C (61 to 77°F)	-23 to 49°C (-9 to 120°F)
Relative humidity (noncondensing)	20 to 80%	20 to 50%	5 to 80%
Maximum wet bulb temperature (does not apply to 3592 JE tape cartridges)	26°C (79°F)	26°C (79°F)	26°C (79°F)
Maximum dew point temperature (applies only to 3592 JE tape cartridges)	22°C (72°F)	22°C (72°F)	22°C (72°F)

Table 7: Environment for storage and shipping the IBM 3592 tape cartridge. (continued)			
Environmental specifications			
Environmental factor	**Allowable storage**	**Recommended storage**	**Shipping**
Magnetic field	Stray magnetic field at any point on tape not to exceed 50 oersteds (4000 ampere/meter).		

Cartridge quality and library maintenance

This topic describes cartridge quality and library maintenance.

The IBM tape cartridge provides high performance and reliability with IBM magnetic tape cartridge drives when the cartridge is properly handled and stored. Repeated handling or inadvertent mishandling can damage the physical parts of the cartridge and make it unusable.

The magnetic tape inside the cartridge is made of highly durable materials. However, the tape wears after repeated cycles in the tape system. Eventually, such wear can cause an increase in tape errors.

Track the error data available by monitoring both the cartridge and cartridge library performance. By monitoring error data, you can identify and replace cartridges that are no longer acceptable for continued use.

Proper maintenance of your cartridge library helps to keep IBM magnetic tape cartridge systems operating in a reliable and efficient manner.

⚠️ **Attention:** Do not degauss a cartridge tape. Degaussing the tape erases the servo tracks and makes the cartridge unusable. An attached host can be used to run a Data Security Erase if the data on the tape needs to be physically erased. This action physically overwrites the data on the tape without damaging the servo tracks.

Ordering media supplies

See Appendix G, "Ordering media supplies."

Chapter 5. IBM 3592 Tape Controller power procedures

J70 Tape Controller power-on procedure

To power on the J70 Controller, complete the following steps.

1. Power on the 3952 F05 frame, or the rack, housing the tape controller.
2. The controller runs a self-test when power is applied to the frame or rack. When the self-test completes, the controller's display panel (**1** in Figure 15 on page 30) displays OK, indicating that the controller is in standby mode.
3. When OK appears in the controller's display panel (**1** in Figure 15 on page 30), press the **Power ON/OFF** button (**2** in Figure 15 on page 30).

   Note: The power-on process can take up to 8 minutes to complete after **Power ON/OFF** is pressed.
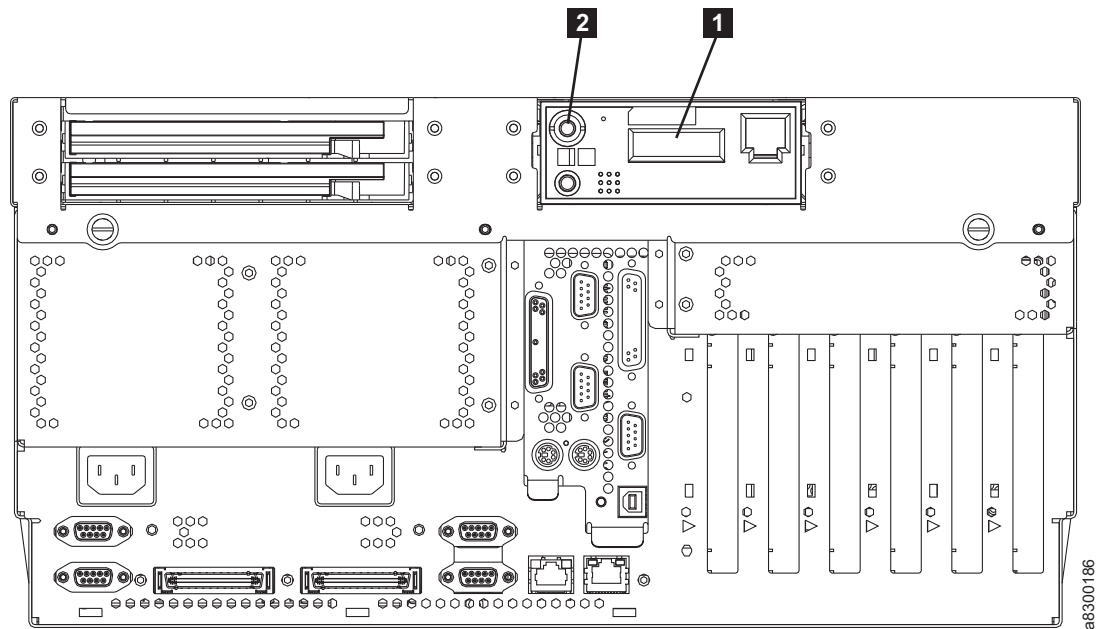
Figure 15: Rear view of J70 Controller

TS1120 Tape Controller power-on procedure

To power on the TS1120 Tape Controller, complete the following steps.

1. Power on the 3952 F05 frame, or the rack, housing the tape controller.
2. The tape controller completes a self-test when power is applied to the frame or rack. When the self-test completes, the tape controller's power LED (**1** in Figure 16 on page 31) flashes, indicating that the tape controller is in standby mode.
3. When the tape controller's power LED (**1** in Figure 16 on page 31) flashes, press the **Power ON/OFF** button (**2** in Figure 16 on page 31).

   Note: The power-on process can take up to 9 minutes to complete after **Power ON/OFF** is pressed.
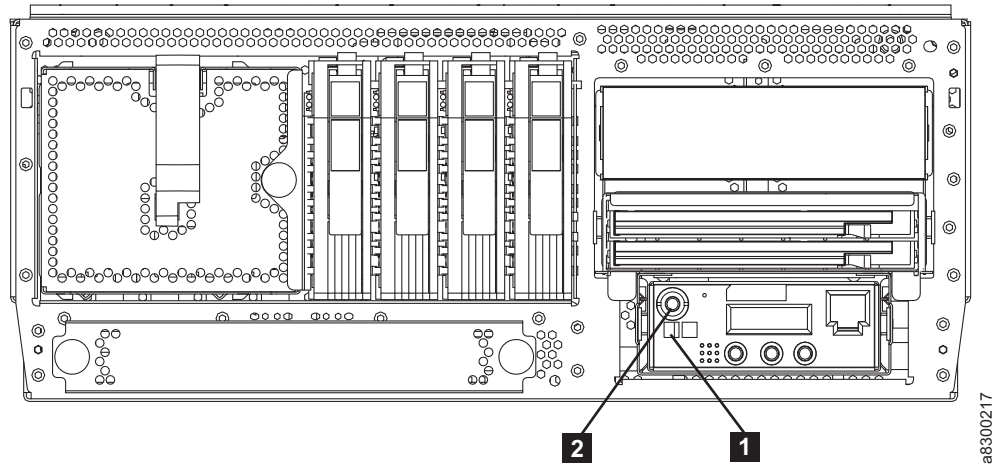
Figure 16: Rear view of TS1120 Tape Controller

J70 Tape Controller power-off procedure

To power off the J70 Controller, complete the following steps.

1. Make sure the customer is informed to vary off all operations from the J70 Controller in preparation for shutdown.
2. Press and hold down **Power ON/OFF** (**2** in Figure 15 on page 30) for approximately 2 seconds.
3. Be patient. Wait for the power-down process to reach standby mode.
4. The J70 Controller is powered down to standby mode when OK appears in the tape controller's display panel (**1** in Figure 15 on page 30).
5. Power can now be removed from the 3592 F05 frame or rack housing the tape controller, or directly from the tape controller power supplies.

TS1120 Tape Controller power-off procedure

To power off the TS1120 Tape Controller, complete the following steps.

1. Make sure that the customer is informed to vary off all operations from the TS1120 Tape Controller in preparation for shutdown.
2. Press and hold down **Power ON/OFF** (**2** in Figure 16 on page 31) for approximately 5 seconds. You see the number in the upper right corner of the operator panel decrement 4 - 1 to no number displayed. At that point, release **Power ON/OFF**.
3. Be patient. If the power down process stops before standby mode is reached, repeat step 2.
4. The TS1120 Tape Controller is powered down to standby mode when the green LED (**1** in Figure 16 on page 31) on the operator panel flashes.
5. Power can now be removed from the 3592 F05 frame or rack housing the tape controller, or directly from the TS1120 power supplies.

Chapter 6. Cleaning procedures

This topic describes the 3592 cleaning cartridges and provides information about cleaning procedures.

To help prevent errors that are caused by debris, it is important to clean the tape path, and to manually clean the outside of data cartridges, when needed. Cleaning of the tape path in each drive is an automated procedure, and rarely requires manual intervention. This procedure works automatically only if the appropriate cleaning cartridges (IBM part 18P7535) are installed in the library, and they still have remaining uses available. A 3592 cleaning cartridge is shipped with the first drive in each installation, and extra cleaning cartridges are available through IBM. The cleaning cartridge contains a cartridge memory (CM) device, which automatically tracks the number of times it is used. Cleaning cartridges need to be replaced after 50 uses. The 3592 cleaning cartridges are not interchangeable with 3590 cleaning cartridges, so you must have both types of cleaning cartridges if you have both types of drives in your library.

⚠️ **Attention:** Insert only clean and undamaged cleaning cartridges into a tape system. Do not use a china-marking (grease) pencil on the label.

The physical characteristics of the 3592 cleaning cartridge can be used to distinguish it from 3592 data cartridges. The product label on the top of the cartridge is white, with the word "cleaning" printed on it. In place of the write-protect switch, there is a non-moveable light gray block (see **1** in). If you order cleaning cartridges with pre-attached labels, the first 3 characters of the volume serial number (VOLSER) **2** are CLN. The cartridge door (see **1** in) is also light gray.

The following table lists cleaning times for the 3592 drives.

Table 8: Cleaning times for 3592 drives	
3592 drive	**Clean cycle time (start of clean to end of unload)**
J1A tape drive	3 minutes, 30 seconds
E05 tape drive	4 minutes, 35 seconds
E06/EU6 tape drive	4 minutes, 25 seconds
E07/EH7 tape drive	4 minutes, 25 seconds
E08/EH8 tape drive	4 minutes, 25 seconds
55F tape drive	4 minutes, 25 seconds
60F tape drive	4 minutes, 25 seconds
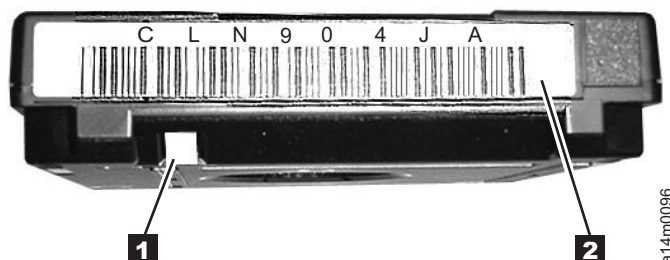
Figure 17: Cleaning cartridge - identifying characteristics

1 Light gray non-moveable block

2 Cleaning cartridge sample label
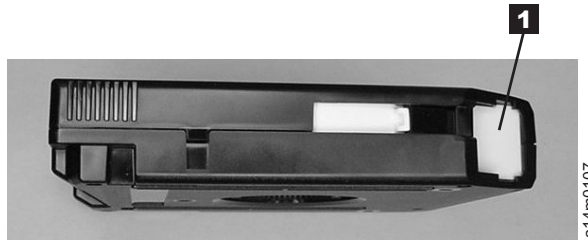
Figure 18: Cleaning cartridge door

Cleaning the tape path

This topic describes cleaning the tape path.

Tape path cleaning in the drive is an automatic procedure initiated by the drive. Changes in drive performance can generate a request for cleaning. If no cleaning cartridges are installed in the library, or if the available cleaning cartridges reached the maximum number of uses, cleaning is not completed. For information, refer to the appropriate tape library operator guide. If the library is in manual mode, a 3592 cleaning cartridge can be manually inserted into the drive to clean the tape path. The 8–character message display shows the message, CLEAN* while the cleaning is in process.

Cleaning the tape cartridge

This topic describes cleaning the tape cartridge.

Before you insert a cartridge into a drive or storage cell, inspect the cartridge for damage or debris. **Damaged or dirty cartridges can reduce system reliability and cause the loss of recorded data.** If debris appears on the cartridge, wipe the outside surfaces with a lint-free cloth lightly moistened with water. No visible water residue or droplets must be observable on the cartridge during or after the wiping effort.

⚠ **Attention:** Do not allow any liquid to contact the tape itself. Special care must be made to never allow liquid water to enter the cartridge. Water can potentially wick into the layers of the tape and cause them to adhere to each other, risking the degradation of the coating during unwind.

Ensure that all cartridge surfaces are dry and that the leader pin is in place (see **1** in Figure 19 on page 33) before you load the cartridge.
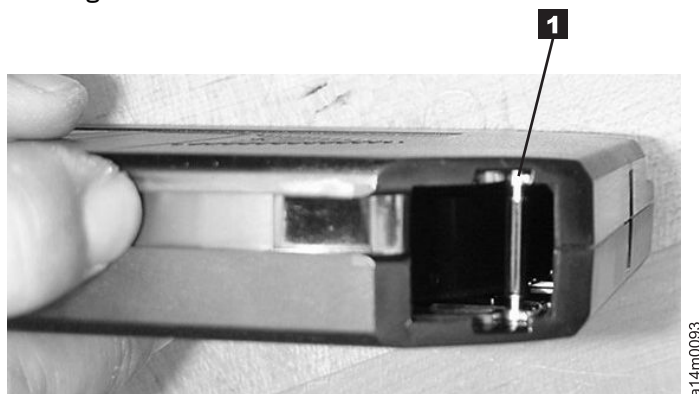
Figure 19: Tape leader pin in proper position (cartridge door manually retracted)

Chapter 7. Identifying system problems

This chapter identifies some of the problems that can occur with the system. Many problems can be resolved through the Library Manager or other host, but instances might occur when the operator needs to intervene in manual mode.

Unable to insert a tape cartridge

This topic describes the response for a tape cartridge that cannot be inserted in the drive.

If you cannot insert a tape cartridge in the drive, complete the following steps.

1. Ensure that you have the proper cartridge type, and that it is oriented correctly. Cartridges for the earlier 3590 drives are not interchangeable with cartridges for the 3592 drive.
2. Inspect the tape cartridge for damage. See "Perform a thorough inspection" on page 26.
3. Ensure that no other cartridge is already in the drive.
4. Try to load another cartridge in the tape system. Use a scratch cartridge to avoid possible damage to a data cartridge.

   If the new cartridge can be inserted in the drive, the original cartridge might be defective. Inspect the cartridge again for damage.

   If the cartridge is not damaged but it cannot be inserted, call your service representative.

FID or ATTN on the message display

This topic describes the responses to FID or ATTN on the message display.

If an error code appears on the message display, record all codes that are displayed for future reference. Some of these messages require intervention by an IBM Service Representative.

FID message
See "Failure ID messages" on page 14, or Appendix B, "FID Messages", for information.

ATTN
When the drive message displays ATTN DRV, the drive experienced either a load error (indicated by the LOAD ERR alternating message) or an unload error (indicated by the UNLOAD E alternating message). If you receive either of these messages, call your service representative.

Tape drive is not ready

This topic describes the process for a tape that is not ready.

If the tape drive is not ready at load point, complete the following steps.

1. If the cartridge is not inserted correctly, remove the cartridge and insert it again. If the cartridge fails to load in the tape system, remove the cartridge and inspect it for correct type or damage. See "Perform a thorough inspection" on page 26.
2. If a FID or ATTN message appears on the message display, record the code, press **Unload** (see **4** in Figure 7 on page 13), and try the operation again.
3. If the drive does not become ready, and no messages are displayed, call your service representative. If a FID or ATTN message appears on the message display, record the code message and see "FID or ATTN on the message display" on page 34.

Unloading a tape cartridge after a power failure

This topic describes unloading a tape cartridge after a power failure.

If a power failure occurs, the normal tape system process unloads a tape cartridge when power is restored to the device. The time that is required to complete the unload can vary, but might take up to 15 minutes. If the device fails to unload a tape cartridge after this period, you can attempt to unload the cartridge by pressing **Unload** on the front of the drive (see **4** in Figure 7 on page 13).

- If the drive unloads the cartridge, remove it by grasping the cartridge, and pulling it towards you.
- If, within 15 minutes, the drive does not unload the cartridge or a FID or ATTN message appears on the display, report the problem to your service representative. See "FID or ATTN on the message display" on page 34.

Tape fails to unload

This topic describes the response for a tape that fails to unload.

If the tape fails to unload from the drive, complete the following steps.

1. Press **Unload** (see **4** in Figure 7 on page 13).
2. If an error code or a FID message appears on the message display, record the error code or FID message and press **Unload** again.
3. If the drive does not rewind or unload, call your service representative. If a FID or ATTN message appears on the message display, record the code and see "FID or ATTN on the message display" on page 34.

Message display is blank

This topic describes the situations where the message display is blank.

If the message display on the front of the drive is blank, two possibilities exist.

- The drive has no power
- The drive is ready

Complete the following steps to resolve the problem.

1. Verify that the drive is receiving power. The power LED (see **6** in Figure 6 on page 13 or **5** in Figure 7 on page 13) must be a steady green.
2. If the drive power light is off, call your service representative.
3. If the power light is on, verify that a cartridge is in the drive. If not, insert a scratch cartridge. Verify that the message display becomes active. If the panel still does not display a message, contact your service representative.

Tape/drive read or write problems

See Appendix A, "Media/hardware problem isolation."

Encryption Key Manager-reported errors

This section defines error messages that are reported by the IBM Security Key Lifecycle Manager and are related to the TS1120 and later tape drives. The table includes the error number, a short description of

the failure, and corrective actions. Refer to *IBM Security Key Lifecycle Manager Knowledge Center* for information on the EKM debug tool.

Table 9: Errors that are reported by the encryption key manager		
Error Number	**Description**	**Action**
EE02	Encryption Read Message Failure: DriverErrorNotifyParameterError: "Bad ASC & ASCQ received. ASC & ASCQ does not match with either of Key Creation/Key Translation/Key Acquisition operation."	The request is for an unsupported action. Ensure that you are running the current version of the Encryption Key Manager (refer to *IBM Security Key Lifecycle Manager Knowledge Center* to determine the current version). Check the versions of drive or proxy server firmware and update the firmware to the current release, if needed. Enable debug tracing on the key manager server. Try to re-create the problem and gather debug logs. If the problem persists, contact IBM for support. See "Who do I contact for Encryption Key Manager support?" on page 40.
EE0F	Encryption logic error: Internal error: "Unexpected error. Internal programming error in EKM."	Ensure that you are running the current version of the Encryption Key Manager (refer to *IBM Security Key Lifecycle Manager Knowledge Center* to determine the current version). Check the versions of drive or proxy server firmware and update them to the current release, if needed. Enable debug tracing on the key manager server. Try to re-create the problem and gather debug logs. If the problem persists, contact IBM for support. See "Who do I contact for Encryption Key Manager support?" on page 40.
	Error: Hardware error from call CSNDDSV returnCode 12 reasonCode 0.	If using hardware cryptography, ensure that ICSF is started.
EE23	Encryption Read Message Failure: Internal error: "Unexpected error........"	The message received from the drive or proxy server was not parsed because of general error. Ensure that you are running the current version of the Encryption Key Manager (refer to *IBM Security Key Lifecycle Manager Knowledge Center* to determine the current version). Enable debug on the key manager server. Try to re-create the problem and gather debug logs. If the problem persists, contact IBM for support. See "Who do I contact for Encryption Key Manager support?" on page 40.

Error Number	Description	Action
Table 9: Errors that are reported by the encryption key manager (continued)		
EE25	Encryption Configuration Problem: Errors that are related to the drive table occurred.	Ensure that the `config.drivetable.file.url` is correct in the `KeyManagerConfig.properties` file, if that parameter is supplied. Run the `listdrives -drivename <drivename>` command on the Encryption Key Manager server to verify whether the drive is correctly configured (for example, the drive serial number, alias, and certificates are correct). Ensure that you are running the current version of the Encryption Key Manager (refer to *IBM Security Key Lifecycle Manager Knowledge Center* to determine the current version). Check the versions of drive or proxy server firmware and update them to the current release, if needed. Enable debug tracing and retry the operation. If the problem persists, contact IBM for support. See "Who do I contact for Encryption Key Manager support?" on page 40.
EE29	Encryption Read Message Failure: Invalid signature	The message that is received from the drive or proxy server does not match the signature on it. Ensure that you are running the current version of the Encryption Key Manager (refer to *IBM Security Key Lifecycle Manager Knowledge Center* to determine the current version). Enable debug on the key manager server. Try to re-create the problem and gather debug logs. If the problem persists, contact IBM for support. See "Who do I contact for Encryption Key Manager support?" on page 40.
EE2B	Encryption Read Message Failure: Internal error: "Either no signature in DSK or signature in DSK cannot be verified."	Ensure that you are running the current version of the Encryption Key Manager (refer to *IBM Security Key Lifecycle Manager Knowledge Center* to determine the current version). Check the versions of drive or proxy server firmware and update them to the current release, if needed. Enable debug tracing on the key manager server. Try to re-create the problem and gather debug logs. If the problem persists, "Who do I contact for Encryption Key Manager support?" on page 40

Error Number	Description	Action
EE2C	Encryption Read Message Failure: QueryDSKParameterError: "Error parsing a QueryDSKMessage from a device. Unexpected dsk count or unexpected payload."	The request to the Encryption Key Manager is an unsupported function. Ensure that you are running the current version of the Encryption Key Manager (refer to *IBM Security Key Lifecycle Manager Knowledge Center* to determine the current version). Check the versions of drive or proxy server firmware and update them to the current release, if needed. Enable debug tracing on the key manager server. Try to re-create the problem and gather debug logs. If the problem persists, "Who do I contact for Encryption Key Manager support?" on page 40
EE2D	Encryption Read Message Failure: Invalid Message Type	The Encryption Key Manager received a message out of sequence or received a message that it does not know how to handle. Ensure that you are running the current version of the Encryption Key Manager (refer to *IBM Security Key Lifecycle Manager Knowledge Center* to determine the current version). Enable debug on the key manager server. Try to re-create the problem and gather debug logs. If the problem persists, contact IBM for support. See "Who do I contact for Encryption Key Manager support?" on page 40.
EE2E	Encryption Read Message Failure: Internal error: Invalid signature type	The message that is received from the drive or proxy server does not have a valid signature type. Ensure that you are running the current version of the Encryption Key Manager (refer to *IBM Security Key Lifecycle Manager Knowledge Center* to determine the current version). Enable debug on the key manager server. Try to re-create the problem and gather debug logs. If the problem persists, contact IBM for support. See "Who do I contact for Encryption Key Manager support?" on page 40.
EE30	Prohibited request.	The request to the tape drive is an unsupported function. Enter the correct, supported command for the target tape drive.

Table 9: Errors that are reported by the encryption key manager (continued)

Table 9: Errors that are reported by the encryption key manager (continued)		
Error Number	**Description**	**Action**
EE31	Encryption Configuration Problem: Errors that are related to the keystore occurred.	Check the key labels that you are trying to use or configured for the defaults. You can list the certificates that are available to the Encryption Key Manager by using the `listcerts` command. If you know that you are trying to use the defaults, run the `listdrives -drivename drivename` command on the Encryption Key Manager server to verify whether the drive is correctly configured. For example, the drive serial number, and associated aliases/key labels are correct. If the drive in question has no aliases/key labels that are associated with it, then check the values of **default.drive.alias1** and **default.drive.alias2**. If this action does not help or the alias/key label exists, then collect debug logs and contact IBM for support. See "Who do I contact for Encryption Key Manager support?" on page 40.
EE32	Keystore-related problem.	Most likely cause is either that tape was encrypted with a different Encryption Key Manager with different keys or the key that was used to encrypt this tape was renamed or deleted from the keystore. Issue `list -keysym` and ensure that the request alias is in the keystore.
EEE1	Encryption logic error: Internal error: "Unexpected error: EK/EEDK flags conflict with subpage."	Ensure that you are running the current version of the Encryption Key Manager (refer to *IBM Security Key Lifecycle Manager Knowledge Center* to determine the current version). Check the versions of drive or proxy server firmware and update them to the current release, if needed. Enable debug on the key manager server. Try to re-create the problem and gather debug logs. If the problem persists, contact IBM for support. See "Who do I contact for Encryption Key Manager support?" on page 40.

Error Number	Description	Action
EF01	Encryption Configuration Problem: "Drive not configured."	The drive that is trying to communicate with the Encryption Key Manager is not present in the drive table. Ensure that the `config.drivetable.file.url` is correct in the `KeyManagerConfig.properties` file, if that parameter is supplied. Run the `listdrives` command to check whether the drive is in the list. If not, configure the drive manually by using the `adddrive` command with the correct drive information or set the drive.acceptUnknownDrives property to true by using the `modconfig` command. Enable debug tracing and retry the operation. If the problem persists, contact IBM for support. See "Who do I contact for Encryption Key Manager support?" on page 40.

Table 9: Errors that are reported by the encryption key manager (continued)

Who do I contact for Encryption Key Manager support?

The entitlement for software support varies depending on the operating system on which the key manager is running, and depending on whether the support requirement is defect-related or implementation-related.

Table 10: IBM Encryption Key Manager support contacts

Type of support	IBM Operating Systems: zOS, AIX, i5OS Linux		Non-IBM Operating Systems: Windows, Solaris, HP/UX
Defect Support	Contact IBM Service with IBM operating system's name or identifier and customer number.	Contact IBM Service with IBM Tape Library's machine type/model and serial number.	Contact IBM Service with TPC/BE name or identifier and customer number.
Implementation Support [1]	Contact SupportLine IBM Service.	Contact SupportLine IBM Service.	Contact SupportLine IBM Service.

[1] An IBM Supportline contract offers the best Encryption Key Manager implementation assistance. Some basic implementation assistance can be obtained by contacting IBM Service. Use the same machine type-model that would be used to report a defect. Should your customer require more extensive implementation assistance, billable onsite services are available from IGS and Lab Services. Contact IGS Inside Sales (888-426-4343 option 3) to obtain a Statement of Work (SOW).

If a defect occurs, IBM Service is always the first point of contact. The method to engage IBM Software Service varies depending on the operating system on which Encryption Key Manager is being run.

For the following IBM operating systems: z/OS, AIX, and i5/OS, contact IBM Service (For US customers call 800-IBM-SERV). Select the software option, then identify the operating system and the same customer number that was used to order the operating system.

For Linux, select the hardware option, and use the **Machtype-Model** of the tape library to report the defect.

For the non-IBM operating systems; Windows, Solaris, and HP/UX, select the software option, then identify the software as TPC/BE and supply the same customer number that was used to order TPC/BE.

Note: The relevant operating system here is the operating system on which the key manager is running, not the operating system that is generating the encrypted IOs.

To search the *IBM Tivoli Key Lifecycle Manager Knowledge Center*, go to the web at Tivoli Key Lifecycle Manager

To search the *IBM Security Key Lifecycle Manager Knowledge Center*, go to the web at IBM Security Key Lifecycle Manager for z/OS

Appendix A. Media/hardware problem isolation

An error code (FID 86 or FE) is generated when the drive experiences an error and cannot determine whether the error was caused by the tape cartridge or by a problem in the drive hardware. The FID 86 or FE is not displayed on the drive, but is logged in the sense information that is returned to the host system. Follow this procedure if you receive an error when reading or writing to the drive and no FID is displayed.

Media and drives can affect each other and the indications can be confusing. You must record the symptoms for the drive and the tape to make problem isolation possible. The failing component or tape must be isolated or you continue to experience problems. Problems can be intermittent so careful record keeping is necessary. Keeping careful records of transient problems enable problem isolation and resolution.

To determine the cause of the read or write errors, follow these steps.

- Ensure that the tape drive is not overdue for cleaning. If the drive is installed in a library with automatic cleaning, ensure that the automatic clean function is enabled, and a cleaner cartridge is installed in the library. Some libraries track cleaner cartridges and *expire* them after a number of mounts. Ensure that the cleaner cartridge in the library is available.
- Determine which volume serial numbers (VOLSERs) or cartridges are potential problems.

  - Note which cartridges VOLSERs fail during the operation. (It is possible to have multiple bad cartridges.)
  - Record the MIM message code at the host and associated VOLSERs, if the host supports MIM messages.
  - If you receive SIM messages at the host, get the VOLSERs from the message and record them in your Tape Serial Log. (See as an example of how to establish a log and what it includes.)

- Determine whether the cartridges are bad.

  - Examine the cartridge for damage. Open the door to observe if the pin is in its proper place, and examine the cartridge for cracks. If damaged, either repair or replace the cartridge.

    Note: A repaired cartridge might be used long enough to recover data on that cartridge. When the data is recovered, the cartridge must then be taken out of service and discarded or returned to the place of purchase.

  - If the cartridges look OK, and you have access to another 3592 drive, try the operation with the suspect cartridges in the other drive. If your cartridges fail in the other drive, replace the media.

- Determine whether the drive is bad.

  - Try a new tape on the suspect drive. Log all failure data on your Drive Log (see as an example of how to establish a log and what it includes), and try one more tape. If it also fails, call for service.
  - If only one tape fails, then log the information on both the and the for future reference.
  - If tapes show evidence of damage, do not put any more tapes into the drive until a service representative examines the drive.

Table 11: Tape Log example							
Failure Date	**Drive**	**Failure Code Unknown**	**Failure Code FE**	**Failure Code 85**	**Failure Code 86**	**Failure Code 87**	**Failure Code (other)**
10/11/2010	Drive 1	1	1	1			

Table 11: Tape Log example (continued)							
Failure Date	**Drive**	**Failure Code Unknown**	**Failure Code FE**	**Failure Code 85**	**Failure Code 86**	**Failure Code 87**	**Failure Code (other)**
10/16/2 010	Drive 2	1	1			1	B3

Table 12: Drive Log example		
Log Item	**Drive 1**	**Drive 2**
8A Error 4 tapes	11/9/2010 call for service	
85 Error 1 tape	11/14/2010 record tape serial	
Load failure		serial 123456 8/18/2010

Appendix B. Failure ID messages

describes Failure ID (FID) messages and customer action for the FID. An FID can be displayed on the drive message display panel (an 8–character display on the front of the drive) or obtained from host software or error logs.

	Table 13: FID messages	
FID	**Description**	**Customer Action**
50	Encryption Configuration 100% Drive Canister	Encryption configuration that is installed during manufacturing is incorrect. Drive canister must be replaced.
51	Encryption Self-Test (POST HW) 100% Drive Canister	Encryption hardware power-on self-test failed. Drive canister must be replaced.
52	Encryption Self-Test (POST FW)	Encryption firmware power-on self-test failed. See FID E6 in this table.
53	Encryption Self-Test (Invoked) 50% Drive Canister: 50% Microcode	An explicitly started encryption self-test failed. See FID E6 in this table.
54	Encryption Self-Test (Automatic) 80% Drive Canister: 20% Microcode	An automatically started encryption diagnostic failed.
55	Encryption Module Failure 80% Drive Canister: 20% Microcode	An unexpected failure of hardware function occurred.
58	:	An error was detected during the encryption of data.
59	Decryption Error 25% Drive Canister: 25% Microcode 25% EKS: 25% Cartridge	An error was detected during the decryption of data.
5A	EKS Failure	An unexpected status was returned by the encryption key server (EKS). Check library/proxy interface, check EKS log. Not a drive or microcode problem. Requires investigation by customer.
5B	Encryption PROXY Failure	A failure or timeout occurred on the proxy interface. Check library/proxy interface, check EKS log. Not a drive or microcode problem. Requires investigation by customer.

FID	Description	Customer Action
5F	Security Prohibited Function	A function was attempted which is prohibited due to the current security settings.
81–84, 85	Drive Problem	Call for service
86	Cartridge or Drive Problem	1. Isolate between media and hardware. See Appendix A, "Media/hardware problem isolation," on page 42. 2. Call for service if problem remains.
87	Cartridge Problem	1. Isolate between media and hardware. See Appendix A, "Media/hardware problem isolation," on page 42. 2. This failure can be caused by a damaged cartridge. Inspect the cartridge that was being used when the error occurred for physical defects. Replace the cartridge if it is damaged. 3. Call for service if problem remains.
8A	Drive Performance Problem	Call for service
90	Drive Problem	Call for service
9C	Hardware or configuration problem	Call for service
AA, AB, AC, AD	Configuration Problem	Call for service
AE, AF	Hardware Problem	Call for service
BF	Hardware Problem	Call for service
C1	Drive Problem	Call for service
D8	Drive Problem	Call for service
E4	Drive Problem	Call for service
E5, E6	Drive or microcode problem	Call for service
ED	Informational Message	Microcode dump exists in flash memory. The flash dump can be cleared by the service representative only.
F2, F4	Cartridge or Drive Problem	Call for service
F5	Fibre Channel error	See "Fibre Channel problem determination" on page 52. If problem persists, call for service.
F6	Cleaning needed for performance reasons.	Clean the tape drive (run cleaning tape). If this FID continues to be posted, call for service.
F7	Fibre wrap test failure.	If this FID continues to be posted, call for service.

Table 13: FID messages (continued)

FID	Description	Customer Action
FE	Cartridge or Drive Problem	1. Isolate between media and hardware. See Appendix A, "Media/hardware problem isolation," on page 42. 2. This failure can be caused by a damaged cartridge. Inspect the cartridge that was being used when the error occurred for physical defects. Replace the cartridge if it is damaged. 3. Call for service if problem remains.
FF	Operator Procedure or Host Problem	FID FF is always presented to the host in SCSI Request Sense Data. Some types of problems also present this FID on the message display and service panel. 1. **FID FF Displayed on Drive Message Display** (It also went to the host.) • FID FF is automatically displayed when the service representative selects **Force Error Dump** from the **Services** menu. • **Action:** Remove the dump icon and the FID message by pressing **Reset**. • The service representative can remove the FID message, without removing the dump icon, by selecting **Reset Drive** on the **Services** menu. 2. **FID FF Displayed at Host Only - Not on Drive Panel** (Message went to the host only.) • The host receives this FID, but it is not presented on the drive message display or service panel. If FID FF was reported in host error log with a SIM message, complete the action indicated in SIM message codes (such as clean drive). • This FID is presented for an invalid and unsupported SCSI command or parameter, which is a SCSI application program software problem. Sense data exists at the host.

Table 13: FID messages (continued)

Appendix C. TapeAlert error reporting

TapeAlert error reporting is an industry standard that provides a status monitoring and problem detection capability for tape devices with the fibre interface in an Open Systems environment. The TapeAlert interface is implemented with up to 64 alert flags that are read by the host from the device by using log sense page 0x2e. Some of the flags are mandatory and must be supported by the tape drive. The remainder are non-mandatory flags and can be unsupported. Tape Alerts are presented in decimal format. All flags at the drive are cleared at Power On Reset (POR).

The 3592 drive supports the TapeAlert flags in that were developed for tape drive/ autoloader devices:

Table 14: Supported TapeAlert Flags			
No.	Flag	Description	Customer Action
1	Read warning	The tape drive is having problems with reading data. No data was lost, but a reduction in the performance of the tape is detected.	See Appendix A, "Media/ hardware problem isolation," on page 42 to isolate fault between drive and media.
2	Write warning	The tape drive is having problems with writing data. No data was lost, but a reduction in the capacity of the tape is detected.	See Appendix A, "Media/ hardware problem isolation," on page 42 to isolate fault between drive and media.
3	Hard error	This flag is set for any unrecoverable read/write/ positioning error, and is cleared when the cartridge is removed from the drive (this flag is set with flags 4, 5, or 6).	Determine whether flag 4, 5, or 6 exists; follow actions for those flags.
4	Media	This flag is set for any unrecoverable read/write/ positioning error that is because of faulty media, and is cleared when the cartridge is removed from the drive.	If possible, copy any data you require from the tape, then discard media. If failure persists, call for service.
5	Read failure	This flag is set for any unrecoverable read error where the isolation is uncertain and the failure might be either faulty media or faulty drive hardware. It is cleared when the cartridge is removed from the drive.	See Appendix A, "Media/ hardware problem isolation," on page 42 to isolate the problem. Discard media if identified as faulty. If failure persists, call for service.
6	Write failure	This flag is set for any unrecoverable write/positioning error where the isolation is uncertain and the failure might be either faulty media or faulty drive hardware. It is cleared when the cartridge is removed from the drive.	See Appendix A, "Media/ hardware problem isolation," on page 42 to isolate the problem. Discard media if identified as faulty. If failure persists, call for service.

No.	Flag	Description	Customer Action
		Table 14: Supported TapeAlert Flags (continued)	
7	Media life	The tape cartridge reached the end of its calculated, useful life (EOL).	1. Copy data to another tape cartridge 2. Discard old (EOL) tape.
8	Not data grade	The tape cartridge is not data-grade. Any data that you back up to the tape is at risk. The flag is set when severe servo problems are detected when a cartridge is loaded.	Discard media. If failure persists, call for service.
9	Write protect	This flag is set when the tape drive detects that the tape cartridge is physically write-protected and device driver sees a write command. It is cleared when the cartridge is removed from the drive.	Set write-protect selector on cartridge to write-enable. Ensure that cartridge is not logically protected. If problem persists, call for service.
10	No removal	This flag is set when an Unload is attempted and SCSI Prevent Media Removal is set to ON. This flag is cleared when the cartridge is removed from the drive.	Operator procedure error or customer software error.
11	Cleaning media	This flag is set when a cleaning tape is loaded into the drive. It is cleared when the cleaning cartridge is removed from the drive.	None. Status message only.
12	Unsupported format	This flag is set when a non-supported cartridge type is loaded into the drive. It is cleared when the cartridge is removed from the drive. Can also be caused by FMR tape that is loaded for read/write.	Remove invalid cartridge. If problem persists call for service.
14	Unrecoverable snapped tape	The operation failed because the tape in the drive snapped. The operator cannot remove the tape and must call for service.	Call for service.
15	Memory chip in cartridge	The memory in the tape cartridge failed.	Do not use the cartridge for further backup operation.
16	Forced eject	This flag is set when a tape cartridge was manually removed.	None. Status message only.
17	Read-only format	This flag is set when a read-only formatted tape is loaded into the drive. It is cleared when the cartridge is removed from the drive.	None. Status message only.

No.	Flag	Description	Customer Action
		Table 14: Supported TapeAlert Flags (continued)	
18	Tape directory corrupted on load	This flag is set when the tape drive detects that the directory is corrupted and results in longer file-search times. The flag is cleared when the cartridge is removed from the drive.	Customer action optional. The drive automatically rebuilds the directory as data is read or the operator can reread all data from the tape to rebuild the directory. To allow the tape drive to quickly rebuild, issue a Space or Locate to EOD (End of Data) request. The cartridge contains redundant versions of the tape directory. This operation typically completes in a few minutes. But if the Cartridge Memory (CM) directory is invalid and the tape is full, this operation can take up to 2 hours to allow for the linear processing of all records on tapes.
19	Nearing media life	Tape cartridge is nearing its specified end of life.	1. Copy data to another cartridge. 2. Replace the tape cartridge.
20	Clean now	This flag is set when the tape drive detects it needs cleaning (performance problem) and is cleared when the drive is successfully cleaned.	Clean the drive at the earliest convenience if not done automatically (done automatically with library manager).
21	Clean periodic	This flag is set when the tape drive detects it needs routine cleaning (based on usage) and is cleared when the drive is successfully cleaned.	Clean the drive between jobs if not done automatically (done automatically with library manager).
22	Expired cleaning media	Replace the cleaning cartridge with a new one. This condition is set after an unsuccessful clean cycle. It is cleared when the next cleaning is attempted.	Replace the cleaning cartridge.
23	Invalid cleaning cartridge	The drive expects a cleaning cartridge to be loaded, and the loaded cartridge is not a valid cleaning cartridge.	Use a valid cleaning cartridge.
25	Dual-port interface error	A redundant Fibre interface port on the tape drive failed.	Call for service.
26	Cooling fan failure	A tape drive or power supply-cooling fan failed.	Call for service.

No.	Flag	Description	Customer Action
		Table 14: Supported TapeAlert Flags (continued)	
27	Power supply	Power supply failed	Call for service.
30	Hardware A	Hardware fault when reading or writing. Reset drive and retry job.	Call for service.
31	Hardware B	This flag is set when the tape drive fails its internal Power-On-Self-Tests (POST), and is not cleared until the drive is powered OFF.	Call for service.
32	Interface	This flag is set when the tape drive detects a problem with the Fibre interface. It is cleared when the drive is powered OFF.	Call for service.
33	Eject media	This flag is set when a failure occurs that requires the tape cartridge to be ejected from the drive and retried. The flag is cleared when the cartridge is removed from the drive.	Try different media. If problem persists, call for service.
34	Download fail	This flag is set when an FMR image is unsuccessfully downloaded to the tape drive with the SCSI, Fibre, or RS-422 interface. It is cleared when the drive is powered off or a successful microcode update is completed.	Call for service.
36	Drive temperature	Drive temperature sensor indicates that the drive is too hot.	Call for service.
37	Drive voltage	This flag is set when the drive detects power supply voltages outside of the specified voltage limits. It is cleared when the drive is powered off.	Call for service.
38	Predictive failure	A hardware failure of the tape drive is predicted.	When it is convenient, call for service.
39	Diagnostics required	This flag is set when a tape cartridge or drive FID or ATTN DRV message is posted and some further isolation for media or hardware is needed. It is cleared when the drive is powered off.	Call for service.
50	Lost statistics	Media statistics were lost at some time in the past.	None. Status message only.
51	Tape directory invalid at unload	The tape directory on the tape cartridge just unloaded was corrupted. File search performance is degraded.	Customer action optional. The drive automatically rebuilds the directory as data is read or the operator can reread all data from the tape to rebuild the directory.
52	Tape system area write failure	The unloaded tape cannot write its volume control region (VCR) successfully.	Try another tape.
53	Tape system area read failure	The tape VCR cannot be read successfully at load time.	Try another tape.
54	No start of data	The start of data cannot be found on the tape.	Try another tape.

Table 14: Supported TapeAlert Flags (continued)			
No.	Flag	Description	Customer Action
55	Load failure	Operation failed because the media cannot be loaded and threaded.	Remove tape, try another tape. If problem persists, call for service.
57	Interface	This flag is set when the tape drive detects a problem with the RS-422 (LDI) interface. It is cleared when the drive is powered OFF, or a successful microcode update is completed.	Call for service.
58	Firmware failure	Operation failed because of microcode problem.	Call for service.

Appendix D. Problem determination

Host environment connections

Verify that the drive power is ON. Then, refer to the *IBM Tape Device Drivers Installation and User 's Guide*, GC27-2130, for information about open system attachments. To access the current device driver installation and user guides online, go to the IBM Fix Central website.

iSeries / AS400 environment attachment check

Verify that a 3592 is properly attached to an AS/400 with the following procedure:

1. Type `WRKCFGSTS *DEV *TAP ASTLVL(*BASIC)` at the prompt.
2. Type VFYTAP on the AS/400 command line.
3. Type the device that is associated with the 3592, such as TAP13.
4. Select the **Basic read/write test** option on the **Tape Device Test** menu and follow the instructions that are provided.
5. When the **Tape Device Test** menu is displayed, select **Exit test menu**.

Fibre Channel problem determination

1. Verify that the drive is receiving power. The LED on the front of the drive and the Power LED (**5** in Figure 20 on page 53 or **1** in Figure 21 on page 53) on the rear of the drive are a steady green.
2. Check the Fibre Channel connections. Verify that the fibre cables are properly connected to the two pairs of ports at the rear of the drive canister (see **6** in Figure 22 on page 55, Figure 23 on page 56, and Figure 24 on page 57).
3. Use the two LEDs on the rear of the drive that is labeled Port 0 and Port 1. See **1** and **2** in Figure 20 on page 53 or **5** and **6** in Figure 21 on page 53 to determine whether a problem exists between the drive, the cable, and the device to which it is attached. See Table 15 on page 54 for the meaning of the LED activity. Use switch, hub, or other fibre product tools and documentation to further diagnose the problem.
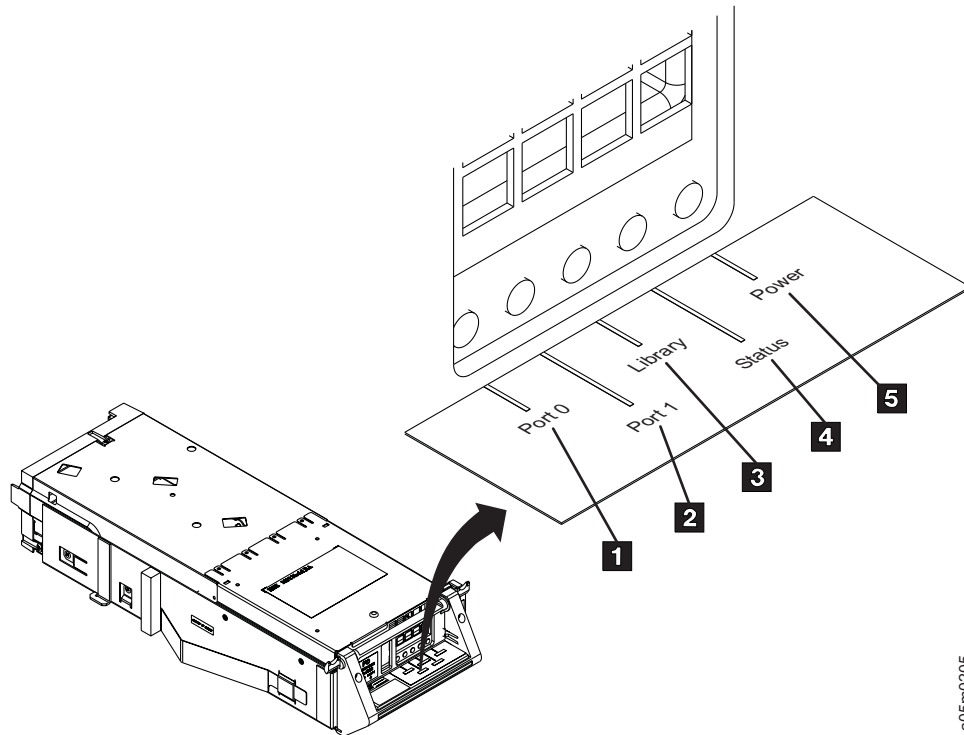
Figure 20: Drive rear panel LED (all models except EH7/EH8)

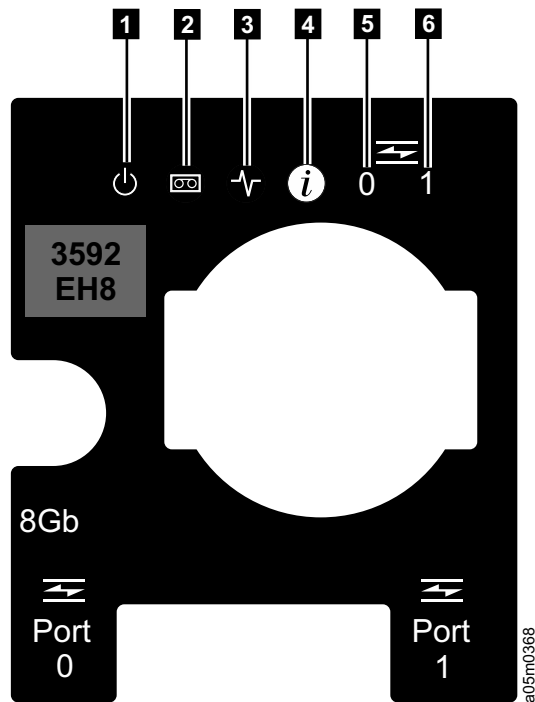Figure 21: Drive rear panel LED (EH7/EH8/55F/60F)

Table 15: Fibre Channel LED color and activity meaning		
LED color	**LED activity**	**Meaning**
Green	Steady	Fibre Channel connection is good. No data is transmitted. Drive might be offline to the control unit or host.
Green	Flashing, 0.5 s intervals	Fibre Channel connection is good, and data is transmitted.
Yellow	Flashing, 1.0 s intervals	Fibre Channel connection is detected but is not fully initialized and not ready to process commands.
<none>	<none>	No light detected through Fibre Channel.

If the problems are because of the drive or the fibre cable that is connected to the drive,

1. Check the Fibre Channel Attachment in its environments. For tape device attachment test information, refer to the *IBM Tape Device Drivers Installation and User's Guide*, GC27-2130, and the appendix that describes how to verify the correct attachment of your device. To access the guide online, go to the IBM Fix Central website.

2. Verify software levels and topology. Use the links in "IBM online access" on page xiii to view the current supported software and hardware. Verify that the wanted topology is supported.

3. If the problem remains, call your IBM Service Representative.

Appendix E. Rack-mount problem determination

This section is for drives that are installed in rack-mounts only, and does not apply for drives that are installed in automated environments. In addition to the front panel components described in "Drive front panel components" on page 12, rear panel components can also be visible and accessible in a rack-mount installation. Some of these components can be used alone, or in combination with the front panel displays to retrieve basic drive status information. This information can, in turn, be used by service technicians in isolating and correcting drive problems.

Note: The components that are described are not accessible or visible to an operator in IBM Enterprise Automated Tape Library installations. Access to the rear panel of a 3592 drive in library installations are for qualified IBM service technicians only.

Drive rear panel components (for E08, E07, E06/EU6, E05, and J1A models)

The rear panel of the 3592 tape drive is the same on the E08, E07, E06, EU6, E05, and J1A tape drives except for the model marking **2** on the right, the RS-232 serial port **5** on the E05, EU6, and J1A (see Figure 22 on page 55) tape drives, and the ethernet port **7** on the E06, E07, and E08 tape drives (Figure 23 on page 56). An Encryption Capable label **3** appears on some E05 tape drives.

The rear panel on all models has five LEDs **1** to display different statuses. The first two LEDs on the left, labeled **Port 0** and **Port 1**, indicate Fibre Channel activity. The middle (third from the left) LED, labeled **Library**, indicates communications from the library. The fourth LED from the left, labeled **Status** (except on the E07 and E08 tape drives), displays drive status. On the E07 and E08 tape drives, the fourth LED is labeled **Cartridge Present**, and indicates cartridge present and drive status. The LED on the far right, labeled **Power**, indicates the status of power to the drive. If the drive status LED (fourth from the left) is flashing, a status message can be viewed on the 8-character front panel message display. An IBM Service Support Representative can also plug the service panel (see Figure 26 on page 60) into the connector **4** to view the message. The dual port Fibre Channel connectors **6** are also on the rear of the drive canister. The shaded area that is labeled **8** is a handle for use when cables are installed.
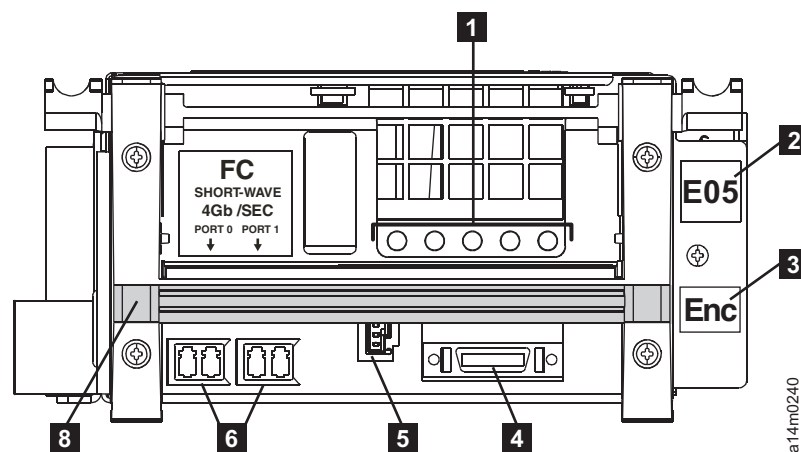

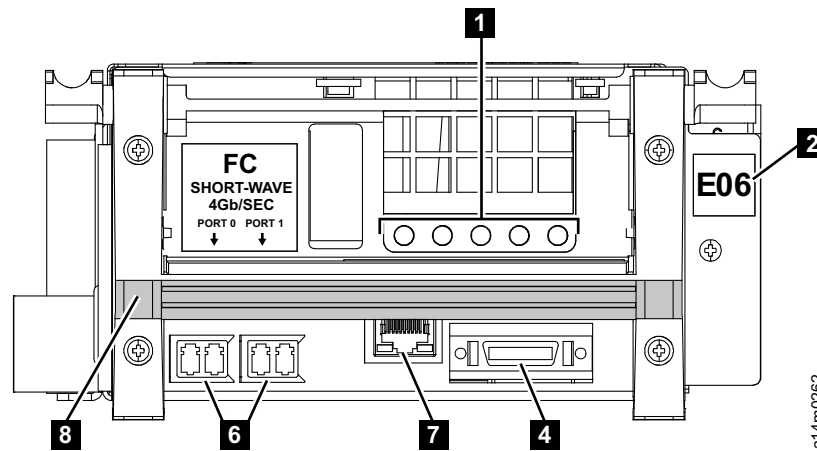*Figure 22: E05, EU6, and J1A tape drive rear panel components*

Figure 23: E08, E07, and E06 tape drive rear panel components

LED status indicators

The five LEDs on the rear of the drive can provide basic information about the status of the drive and its communication connections. In addition to the two Fibre Channel LEDs described in "Fibre Channel problem determination" on page 52, there are three extra LEDs. The **Library** (**3** in Figure 20 on page 53), **Status** **4** (**Cartridge Present** **4** on the E07 and E08 tape drives), and **Power** **5** LEDs can provide basic drive status information. When a problem is identified, record this information to report to your service representative. The LEDs can display steady on, flashing, or off in either green or yellow. See Table 16 on page 56 for the meaning of the LED activity. If a color or mode is not listed, it is not used as a status indicator.

Table 16: Drive rear panel LED indications

LED number	Name/Purpose	Color	Light on indicates:	Flashing light indicates:	No light indicates:
3	**Library** - Library communications (all drives)	Green	At least one message received since POST	Library communication activity	No communications since last POST of drive
4	**Cartridge present** - Cartridge status (E07 and E08 tape drives only)	Green	Cartridge present, no message, or error, POST diagnostic completed	Cartridge present, message, or error available, POST diagnostic completed	No cartridge present, no message, or error, POST diagnostic completed
4	**Status** - Drive status (all drives)	Yellow	Power on started or microcode soft reset begun	Status message is available at service panel	POST diagnostic completed
5	**Power** - Drive power status (all drives)	Green	+5 V dc or +12 V dc is present at drive	—	+5 V dc or +12 V dc is missing

Drive rear panel components (for 60F, 55F, EH8, and EH7 models)

The rear panels on the EH7/EH8/55F/60F models have six LEDs **1** to display different statuses. The first two LEDs on the right, **0** and **1**, indicate Fibre Channel activity. The third from the right LED is **Information**. The fourth LED from the right, **Ethernet communication**, displays Ethernet communications. The second LED from the left, **Drive Status**, displays the status of the drive. The LED on the far left, **Power**, indicates the status of power to the drive. If the drive status LED (second from the left) is flashing, a status message

can be viewed on the 8-character front panel message display. An IBM Service Support Representative can also plug into the virtual service panel by using the Ethernet port on the front of the enclosure to view the message. See Figure 27 on page 61. The dual port Fibre Channel connectors **6** are also on the rear of the drive canister. The area that is labeled **7** is a handle for use when cables are installed.
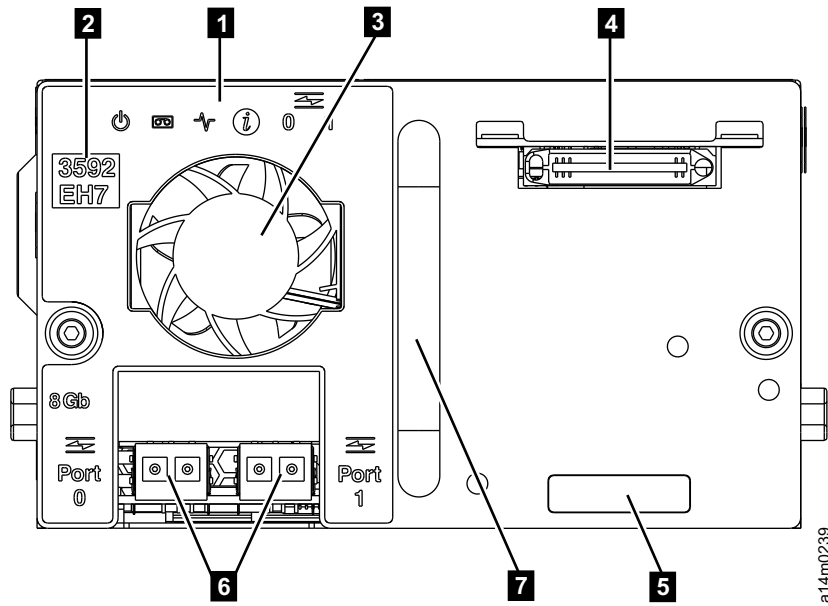

Figure 24: EH7/EH8/55F/60F tape drive rear panel components

Table 17: Drive rear layout	
Item number	**Item name and details**
1	LED array (described from left to right) • Power • Drive status • Library communications • Information (error messages) • Port 0 Fibre • Port 1 Fibre Green LEDs flash at half-second intervals. Yellow LEDs flash at 1-second intervals.
2	Model number label (EH7, EH8, 55F, 60F)
3	Fan
4	Canister cable port The cable from this port connects to the Ethernet port and power supply on the front enclosure behind the enclosure bezel.
5	MTM/Serial number label
6	Dual port Fibre Channel ports
7	Handle

LED status indicators

The LED status indicators are identified in Figure 25 on page 58 and their functions and meanings are listed in Table 18 on page 58.

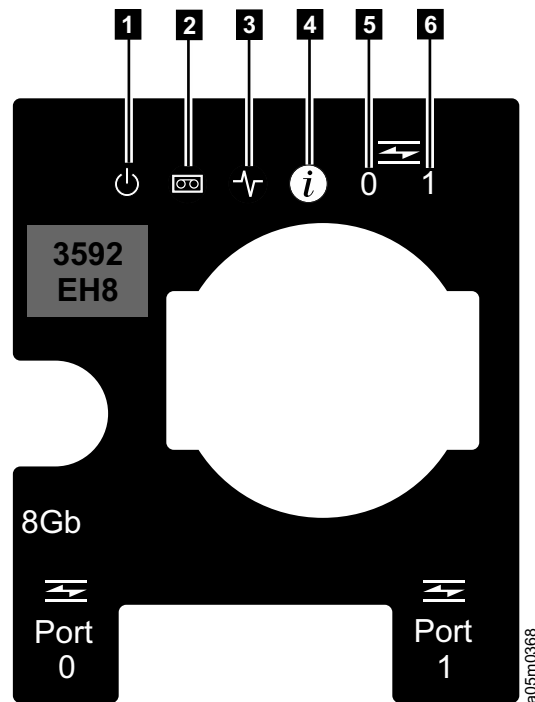*Figure 25: LEDs - Locations for EH7/EH8/55F/60F*

LED	LED name	LED color	LED-on indicates:	Flashing LED indicates:	No LED indicates:
1	**Drive power**	Yellow	N/A	N/A	+5 V dc or +12 V dc is missing at drive.
		Green	+5 V dc or +12 V dc is present at drive.	During reset, LED might flash, indicating drive is attempting to unload cartridge before actual reset process.	
2	**Drive status**	Yellow	• Cartridge status not indicated • No message or error • POR diagnostic in progress	• Cartridge not present • Message or error • POR diagnostic is completed.	• Cartridge not present • No message or error • POR diagnostic is completed.
		Green	• Cartridge present • No message or error • POR diagnostic is completed.	• Cartridge present • Message or error • POR diagnostic is completed.	

Table 18: LEDs - Function and meaning

Table 18: LEDs - Function and meaning (continued)					
3	**Ethernet communi-cation**[1]	Yellow	N/A	N/A	No communications since last POST of drive
		Green	N/A	Ethernet communication activity	
4	**Information**[2]	Blue	N/A	N/A	N/A
5	**Port 0** - Fibre Channel activity	Yellow	N/A	Fibre Channel connections are good; not ready to transmit.	• No light is detected through Fibre Channels.
		Green	Fibre Channel connections are detecting light, but no data is being transferred. Wrap tools are installed or drive canister is offline to host.	Fibre Channel connections are good; data is being transferred.	• Fibre Channel cable is disconnected. • Port is not in use. • Fibre wrap plug is installed on the port.
6	**Port 1** - Fibre Channel activity	Yellow	N/A	Fibre Channel connections are good; not ready to transmit.	• Drive was not returned to operator mode (is still in CE offline mode or CE online mode).
		Green	Fibre Channel connections are detecting light, but no data is being transferred. Wrap tools are installed or drive canister is offline to host.	Fibre Channel connections are good; data is being transferred.	

Notes:

1. The **Ethernet Communication** LED is always off unless the CE or the customer is connected to the Ethernet port at the front of the enclosure.

2. The **Information** LED is not lit. However, even if it is, it is not a cause to replace the drive. If it is on, the fan is probably running at full speed.

Service panel and virtual service panel

For all drive models except EH7, EH8, 55F, and 60F, qualified IBM service representatives can attach the cable of a service panel (see Figure 26 on page 60) to a connector on the rear of the drive. See **2** in Figure 22 on page 55, , and Figure 23 on page 56 to complete extra functions.

- **This service panel is not intended for use by operators.**

- **This service panel is not to be used to support the 3592 installed in an IBM TS3500 tape library and is not shipped with the TS3500 tape library. Functional problems can be encountered if this panel is used on drives that are installed in a TS3500 tape library. See the *IBM TS3500 tape library Introduction and Planning Guide, GA32-0559* for details on the 3592 installed in a TS3500 tape library.**
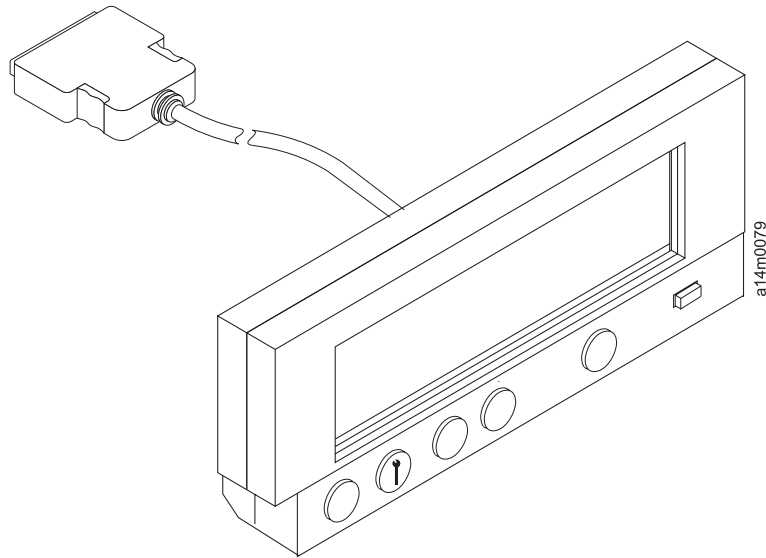
Figure 26: Service panel (To be used by qualified IBM service personnel only)

For EH7/EH8/55F/60F drives installed in a Rack Mount configuration, the IBM service representative accesses a virtual service panel, which is a laptop that is connected to the drive with an Ethernet cable. See "Ethernet connection for rack mount EH7/EH8/55F/60F drives" on page 60.

Important: The virtual service panel is not intended for use by operators.

Ethernet connection for rack mount EH7/EH8/55F/60F drives

For EH7, EH8, 55F, and 60F tape drives, the Ethernet ports are behind a bezel on the front of the enclosure. The left Ethernet port goes to the left drive, and the right Ethernet port goes to the right drive. In Figure 27 on page 61, the enclosure bezel is removed and the Ethernet ports are circled.
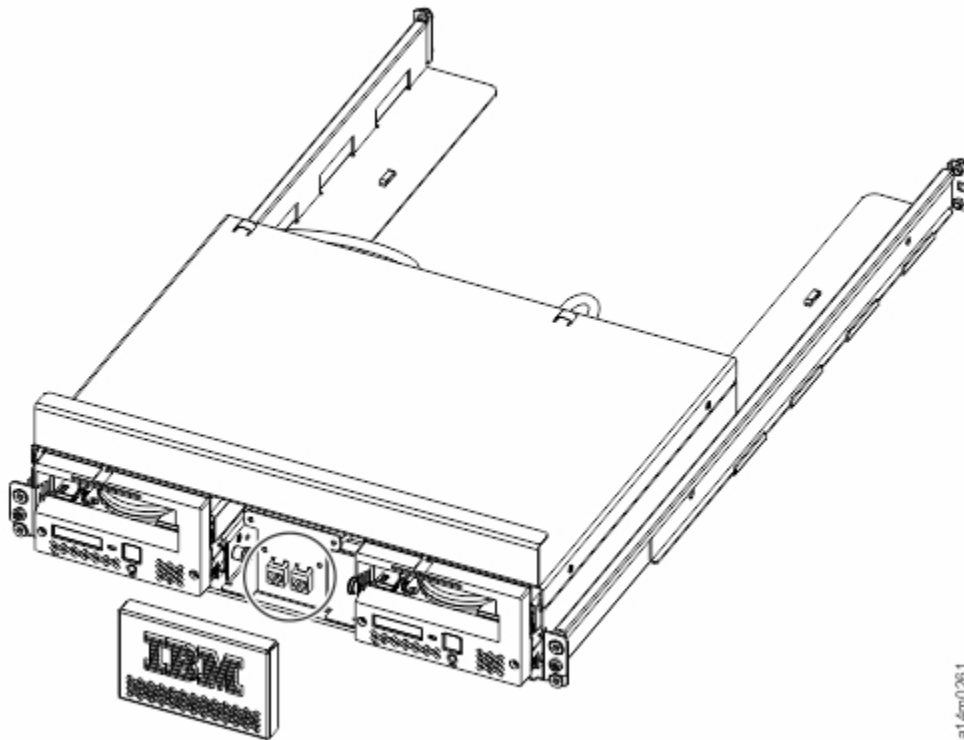
Figure 27: Ethernet ports, rack mount EH7/EH8/55F/60F tape drive

Appendix F. Host reporting

Statistical Analysis and Reporting System (SARS)

The Statistical Analysis and Reporting System (SARS) helps determine whether read and write errors are caused by the media (tape) or the hardware in the drive. The 3592 microcode contains a Volume SARS (VSARS) algorithm and a Hardware SARS (HSARS) algorithm to analyze errors. SARS algorithms report messages through SIMs and MIMs.

Algorithms are run in the 3592 just before a tape is unloaded. To distinguish error patterns and trends, the SARS *volume* algorithms require the tape to be mounted on different drives while the SARS *hardware* algorithms require different volumes to be mounted on one drive. As degraded hardware passes through predefined error thresholds, cleaning and service repair messages or error codes are presented. Similarly, if tape volumes continue to process poorly on different drives, rewrite or discard-media messages are presented.

The SARS reporting of Service Information Message (SIM) and Media Information Message (MIM) functions can be disabled if host software does not support SIMs and MIMs.

Service and Media Information Messages (SIMs and MIMs)

SIM and MIM functions are primary factors for improved product availability.

- A SIM alerts you when an abnormal operational condition in the 3592 requires service attention. Information in the SIM identifies the affected drive, the failing component, and severity of its fault condition, and the expected operational impact of the pending service action. This information helps the user to initiate and expedite appropriate recovery and service procedures so normal operation is restored with maximum efficiency and minimal disruption.

  A SIM contains the machine type, machine serial number, and Field Replaceable Unit (FRU). This information allows the dispatch of the appropriate service personnel and the replacement parts that are required to correct the machine fault. This procedure helps improve service response time and helps reduce the time that is required for machine repair.

- A MIM identifies problems with the media (tape) and the volume number of the bad cartridge. This identification allows the customer to do maintenance within the tape library and to prevent unnecessary service calls when the fault is media.

You can select, depending on your software, the severities you want to see. For example, you might want to see only the acute SIM/MIM, or prefer to see all SIMs and MIMs sent to the host. SIM/MIM filtering by severity can be done through configuration options. The four severity codes are listed here.

- Severity 0 (FID4) code - The device requires service, but normal drive function is not affected.
- Severity 1 (FID3) code - Moderate severity.
- Severity 2 (FID2) code - Serious severity.
- Severity 3 (FID1) code - Acute severity.

A MIM specifies what is wrong with the cartridge that is indicated. The three MIM severity codes are listed here.

- Severity 1 - Moderate severity.
- Severity 2 - Serious severity.
- Severity 3 - Acute severity.

SIMs and MIMs can be reported multiple times. A configuration option allows reporting the same SIM/MIM more than once. The time between repeat SIMs/MIMs is 8 hours. For example, if the

configuration option is set to two, a SIM is reported when an error occurs, it is repeated 8 hours later, and, then again, 8 hours after that message. The default is to not repeat SIMs/MIMs.

SIM/MIM presentation

SIMs and MIMs reporting varies for different systems. Refer to the *Statistical Analysis and Reporting System User Guide* that can be accessed on the IBM URL http://www.ibm.com/systems/storage/tape/library.html. This book is available only online, and cannot be ordered as a printed version.

Specific SIM and MIM presentations are shown for these systems.

System
> **Presentation**

System z (zSeries, S/390®)
> IEA480E and IEA486E messages, and also EREP reports.

z/VM® (VM/ESA)
> HCP6359I and HCP6357I messages, and also EREP reports.

z/VSE® (VSE/ESA)
> OP64I, OP65I, and OP20 messages, and also EREP reports.

TPF
> CEFR0354I, CEFR0355W, CEFR0356W, CEFR0357E, CEFR0347W, CDFR0348W, and CDFR0349E messages, and also EREP reports.

TSM (formerly ADSM)
> ANR8972E, ANR8830E, and ANR8831W messages.

AIX
> SIM/MIM messages are logged to EREP reports.

HP
> When enabled, SIM/MIM messages are logged to `/var/adm/atdd/atdd_d.log`.

SUN
> When enabled, SIM/MIM messages are logged to `/var/adm/messages`.

Linux
> With taped DAEMON, SIM/MIM messages are logged to `/var/log` with file names of the form **<drive serial #>.<time stamp>.simmim**.

Appendix G. Ordering media supplies

This appendix provides information on different ways of ordering media supplies, including feature codes and part numbers for ordering media supplies for 3592 tape drives. Selected media supplies can be ordered by using feature codes when a 3592 drive is purchased. This method of ordering is called "pack-in", and the media is shipped with the hardware order. Not all media types are available with this method. The 3599 Tape Media method is available for ordering all types of data and cleaning cartridges. This method is typically used for ordering larger quantities, and for ordering initialized or pre-labeled cartridges. Media supplies can also be ordered by using part numbers, through IBM-authorized distributors.

Feature Code descriptions ("pack-in")

Note: FC 8802, FC 8820, FC 9590 are longer marketed by IBM beginning in January 2005. See "3599 media supplies" on page 64 to order 3592 media.

Table 19 on page 64 lists the media features, which can be used to order media when a 3592 drive is ordered. Only the 300 GB (279.39 GiB) Data cartridges and the Cleaning cartridges can be ordered with this method. For all other media types, you must use the 3599 Tape Media method, or order by part number through an IBM-authorized distributor.

Table 19: Media features ("pack-in")	
Feature Code	**Description**
8802	One IBM Enterprise Tape 3592 Cleaning cartridge
8820	Twenty IBM Enterprise Tape 3592 Data cartridges 300 GB (279.39 GiB) only
9590	No data cartridges

Feature Code definitions

Cleaner Cartridge (FC 8802)

Note: FC 8802 is longer marketed by IBM beginning in January 2005.

This feature provides a 3592 cleaning cartridge for 3592 tape drives. Maximum: five. Plant or field installation.

Twenty 3592 Data Cartridges (FC 8820)

Note: FC 8820 is longer marketed by IBM beginning in January 2005.

This feature provides twenty 300 GB Data cartridges for 3592 tape drives. Maximum: five. Plant installation only.

3599 media supplies

3599 media supplies.

Customers can order media with the 3599 Tape Media method. With this method, you can order unlabeled, pre-labeled, initialized, and bulk-packaged tape data cartridges in various combinations and

cleaning cartridges for the 3592 tape drive. Orders can be placed by calling IBM Americas at 1-800-IBM-CALL (1-800-426-2255). The following cartridge types are available.

- Standard Data cartridges (JA)

  – 300 GB (279.39 GiB) EFMT1 format
  – 500 GB (465.66 GiB) EFMT2 format
  – 640 GB (596.04 GiB) EFMT3 format

- Extended Data cartridges (JB)

  – 700 GB (651.93 GiB) EFMT2 format
  – 1000 GB (931.32 GiB) EFMT3 format
  – 1600 GB (1490.12 GiB) EFMT4 format

- Advanced Type C Data cartridges (JC)

  – 4000 GB (3725.29 GiB) EFMT4 format
  – 7 TB (6.37 TiB) EFMT5 format

- Advanced Type D Data cartridges (JD)

  – 10 TB (9.09 TiB) EFMT5 format
  – 15 TB (13.64 TiB) EFMT5 formatted for 55x drives

- Advanced Type E Data cartridges (JE)

  – 20 TB (18.2 TiB) EFMT6 format

- Economy Data cartridges (JJ)

  – 60 GB (55.88 GiB) EFMT1 format
  – 100 GB (93.13 GiB) EFMT2 format
  – 128 GB (119.21 GiB) EFMT3 format
  – Read only for EFMT4 format

- Advanced Type C Economy Data cartridges (JK)

  – 500 GB (465.66 GiB) EFMT4 format
  – 900 GB (838.18 GiB) EFMT5 format

- Advanced Type D Economy Data cartridges (JL)

  – 2 TB (1.82 TiB) EFMT5 format
  – 3 TB (2.73 TiB) EFMT5 formatted for 55x drives

- Advanced Type E Economy Data cartridges (JM)

  – 5 TB (4.55 TiB) EFMT6 format

- Economy WORM (write-once, read-many) cartridges (JR)

  – 60 GB (55.88 GiB) EFMT1 format
  – 100 GB (93.13 GiB) EFMT2 format
  – 128 GB (119.21 GiB) EFMT3 format

- Standard WORM cartridges (JW)

  – 300 GB (279.39 GiB) EFMT1 format
  – 500 GB (465.66 GiB) EFMT2 format
  – 640 GB (596.04 GiB) EFMT3 format

- Extended WORM cartridges (JX)

  – 700 GB (651.93 GiB) EFMT2 format
  – 1000 GB (931.32 GiB) EFMT3 format

- 1600 GB (1490.12 GiB) EFMT4 format
- Advanced Type C WORM cartridges (JY)
    - 4000 GB (3725.29 GiB) EFMT4 format
    - 7 TB (6.37 TiB) EFMT5 format
- Advanced Type D WORM cartridges (JZ)
    - 10 TB (9.09 TiB) EFMT5 format
    - 15 TB (13.64 TiB) EFMT5 formatted for 55x drives
- Advanced Type E WORM cartridges (JV)
    - 20 TB (18.2 TiB) EFMT6 format

With the 3599 Tape Media method of ordering, model numbers are used to identify the cartridge types, and feature code combinations are used to specify the quantities, labeling, and initialization options. Table 20 on page 66 shows a few examples of ordering options for each cartridge type. More feature codes are required to completely specify all wanted characteristics of the cartridges.

3599 media feature descriptions

This topic describes the 3599 media features.

Table 20: Descriptions of 3599 tape media features

3599 Model	Media ID/ Feature Code	Feature Code for Labeling, Initialization, and Quantity		Format	Individual Cartridge Capacity[2, 5]	Description
		Regular	RFID[1]			
011	JA/9030	1020	1021	9082	640 GB (596.05 GiB)	20-pack 3592 Data cartridges, labeled and initialized
				9081	500 GB (465.66 GiB)	
				9080	300 GB (279.39 GiB)	
012	JA/9030	2020	2021	N/A[3]	500 GB (465.66 GiB)	20-pack 3592 Data cartridges, labeled, not initialized
					300 GB (279.39 GiB)	
013	JA/9030	3020	N/A	N/A	500 GB (465.66 GiB)	20-pack 3592 Data cartridges, not labeled and not initialized
					300 GB (279.39 GiB)	

3599 Model	Media ID/ Feature Code	Feature Code for Labeling, Initialization, and Quantity		Format	Individual Cartridge Capacity[2, 5]	Description
		Regular	RFID[1]			
014	JB/9032	4020	4021	9084	1600 GB (1490.12 GiB)	20-pack 3592 Extended Data cartridges, labeled and initialized
				9082	1000 GB (931.32 GiB)	
				9081	700 GB (651.93 GiB)	
015	JB/9032	5020	5021	N/A	700 GB (651.93 GiB)	20-pack 3592 Extended Data cartridges, labeled, not initialized
016	JB/9032	6020	N/A	N/A	700 GB (651.93 GiB)	20-pack 3592 Extended Data cartridges, not labeled and not initialized
420	JC/9035	4211	4221	9084	4 TB (3.64 TiB)	20-pack 3592 Advanced Data cartridges, labeled and initialized
520	JC/9035	5221	5231	N/A	4 TB (3.64 TiB)	20-pack 3592 Advanced Data cartridges, labeled, not initialized
620	JC/9035	6200	N/A	N/A	4 TB (3.64 TiB)	20-pack 3592 Advanced Data cartridges, not labeled and not initialized
425	JD/9036	4251	4261	9085	10 TB (9.1TiB)	20-pack 3592 Advanced Data cartridges, labeled and initialized
525	JD/9036	5251	5261	N/A	10 TB (9.1TiB)	20-pack 3592 Advanced Data cartridges, labeled, not initialized
625	JD/9036	6250	N/A	N/A	10 TB (9.1TiB)	20-pack 3592 Advanced Data cartridges, not labeled and not initialized
426	JE/9037	4262	N/A	N/A	20 TB (18.2 TiB)	20-pack 3592 Advanced Data cartridges, labeled and initialized
526	JE/9037	5262	N/A	N/A	20 TB (18.2 TiB)	20-pack 3592 Advanced Data cartridges, labeled, not initialized
626	JE/9037	6262	N/A	N/A	20 TB (18.2 TiB)	20-pack 3592 Advanced Data cartridges, not labeled and not initialized

Table 20: Descriptions of 3599 tape media features (continued)

3599 Model	Media ID/ Feature Code	Feature Code for Labeling, Initialization, and Quantity		Format	Individual Cartridge Capacity[2, 5]	Description
		Regular	RFID[1]			
E11	JJ/9050	1120	1121	9082	128 GB (119.21 GiB)	20-pack 3592 Economy cartridges, labeled and initialized
				9081	100 GB (93.13 GiB)	
				9080	60 GB (58.88 GiB)	
E12	JJ/9050	1220	1221	N/A	60 GB (58.88 GiB)	20-pack 3592 Economy cartridges, labeled, not initialized
E13	JJ/9050	1320	N/A	N/A	60 GB (58.88 GiB)	20-pack 3592 Economy cartridges, not labeled and not initialized
430	JK/9052	4300	4310	9084	500 GB (465.66 GiB)	20-pack 3592 Advanced Economy cartridges, labeled and initialized
530	JK/9052	5300	5310	N/A	500 GB (465.66 GiB)	20-pack 3592 Advanced Economy cartridges, labeled, not initialized
630	JK/9052	6300	N/A	N/A	500 GB (465.66 GiB)	20-pack 3592 Advanced Economy cartridges, not labeled and not initialized
435	JL/9054	4351	4361	9085	2 TB (1.8 TiB)	20-pack 3592 Advanced Economy cartridges, labeled and initialized
535	JL/9054	5351	5361	N/A	2 TB (1.8 TiB)	20-pack 3592 Advanced Economy cartridges, labeled, not initialized
635	JL/9054	6350	N/A	N/A	2 TB (1.8 TiB)	20-pack 3592 Advanced Economy cartridges, not labeled and not initialized
436	JM/9055	4362	N/A	N/A	5 TB (4.55 TiB)	20-pack 3592 Advanced Economy cartridges, labeled and initialized
536	JM/9055	5362	N/A	N/A	5 TB (4.55 TiB)	20-pack 3592 Advanced Economy cartridges, labeled, not initialized
636	JM/9055	6362	N/A	N/A	5 TB (4.55 TiB)	20-pack 3592 Advanced Economy cartridges, not labeled and not initialized

Table 20: Descriptions of 3599 tape media features (continued)

3599 Model	Media ID/ Feature Code	Feature Code for Labeling, Initialization, and Quantity		Format	Individual Cartridge Capacity[2, 5]	Description
		Regular	RFID[1]			
021[4]	JW/9040	2120	2121	9082	640 GB (596.05 GiB)	20-pack 3592 WORM cartridges, labeled and initialized
				9081	500 GB (465.66 GiB)	
				9080	300 GB (279.39 GiB)	
022[4]	JW/9040	2220	2221	N/A	500 GB (465.66 GiB)	20-pack 3592 WORM cartridges, labeled, not initialized
					300 GB (279.39 GiB)	
023[4]	JW/9040	2320	N/A	N/A	500 GB (465.66 GiB)	20-pack 3592 WORM cartridges, not labeled and not initialized
					300 GB (279.39 GiB)	
024[4]	JX/9044	2420	2421	9082	1000 GB (931.32 GiB)	20-pack 3592 Extended WORM cartridges, labeled and initialized
				9081	700 GB (651.93 GiB)	
025[4]	JX/9044	2520	2521	N/A	700 GB (651.93 GiB)	20-pack 3592 Extended WORM cartridges, labeled, not initialized
026[4]	JX/9044	2620	N/A	N/A	700 GB (651.93 GiB)	20-pack 3592 Extended WORM cartridges, not labeled and not initialized
440	JY/9046	4400	4410	9084	4 TB (3.64 TiB)	20-pack 3592 Advanced WORM cartridges, labeled and initialized
540	JY/9046	5400	5410	N/A	4 TB (3.64 TiB)	20-pack 3592 Advanced WORM cartridges, labeled, not initialized
640	JY/9046	6400	N/A	N/A	4 TB (3.64 TiB)	20-pack 3592 Advanced WORM cartridges, not labeled and not initialized

Table 20: Descriptions of 3599 tape media features (continued)

Table 20: Descriptions of 3599 tape media features (continued)

3599 Model	Media ID/ Feature Code	Feature Code for Labeling, Initialization, and Quantity		Format	Individual Cartridge Capacity[2, 5]	Description
		Regular	RFID[1]			
445	JZ/9049	4455	4465	9085	10 TB (9.1 TiB)	20-pack 3592 WORM cartridges, labeled and initialized
545	JZ/9049	5451	5461	N/A	10 TB (9.1 TiB)	20-pack 3592 WORM cartridges, labeled, not initialized
645	JZ/9049	6450	N/A	N/A	10 TB (9.1 TiB)	20-pack 3592 WORM cartridges, not labeled and not initialized
E21[4]	JR/9042	3120	3121	9082	128 GB (119.21 GiB)	20-pack 3592 Economy WORM cartridges, labeled and initialized
				9081	100 GB (93.13 GiB)	
				9080	60 GB (58.88 GiB)	
E22[4]	JR/9042	3220	3221	N/A	100 GB (93.13 GiB)	20-pack 3592 Economy WORM cartridges, labeled, not initialized
					60 GB (58.88 GiB)	
E23[4]	JR/9042	3320	N/A	N/A	100 GB (93.13 GiB)	20-pack 3592 Economy WORM cartridges, not labeled and not initialized
					60 GB (58.88 GiB)	
017	JA	7005	N/A	N/A	cleaning, 50 uses	5-pack 3592 Cleaning Cartridges, with media identification labels
017	JA	7006	N/A	N/A	cleaning, 50 uses	5-pack 3592 Cleaning Cartridges without media identification labels

Notes:

1. Radio frequency identification labels

2. For more details about individual cartridge capacities, see "Cartridge types and characteristics" on page 19.

3. N/A = Not applicable

4. This product is no longer available for order by this method. Refer to "Ordering media supplies by part number" on page 71 to order this media type.

5. For cartridges that are not initialized, the actual cartridge capacity is dependent on the format used to write the cartridge.

Ordering media supplies by part number

This topic describes ordering media supplies by part number.

Table 21 on page 71 and Table 22 on page 72 list the data cartridges and media supplies that you can order for the 3592 tape drives.

You can use one of the following methods to order the cartridges and media supplies shown in Table 21 on page 71 and Table 22 on page 72 by part number:

- Order online or through an IBM-authorized distributor (for the closest distributor or to order online, see the IBM Storage Media website)
- If you do not have Internet access, order from any authorized IBM Business Partner or your IBM sales representative.
- Call 1-888-IBM-MEDIA

Table 21: 3592 media supplies for the 3592 tape drive		
Supply Item[1]	Capacity[2]	Part Number
IBM Tape Cartridge 3592 Data (JA)	E06 format: 640 GB (596.04 GiB) E05 format: 500 GB (465.66 GiB) J1A format: 300 GB (279.39 GiB)	18P7534
IBM Tape Cartridge 3592 Extended Data (JB)	E07 format: 1600 GB (1490.12 GiB) E06 format: 1000 GB (931.32 GiB) E05 format: 700 GB (651.93 GiB)	23R9830
IBM Tape Cartridge 3592 Advanced Type C Data (JC)	E08 format: 7 TB (6.37 TiB) E07 format: 4000 GB (3725.29 GiB)	46X7452
IBM Tape Cartridge 3592 Advanced Type D Read/Write (JD)	55F format: 15 TB (13.64 TiB) E08 format: 10 TB (9.09 TiB)	2727263
IBM Tape Cartridge 3592 Advanced Type E Read/Write (JE)	60F format: 20 TB (18.2 TiB)	02CE960
IBM Tape Cartridge 3592 Economy (JJ)	E06 format: 128 GB (119.21 GiB) E05 format: 100 GB (93.13 GiB) J1A format: 60 GB (58.88 GiB)	24R0316
IBM Tape Cartridge 3592 Advanced Type C Economy (JK)	E08 format: 900 GB (838.19 GiB) E07 format: 500 GB (465.66 GiB)	46X7453
IBM Tape Cartridge 3592 Advanced Type D Economy (JL)	55F format: 3 TB (2.73 TiB) E08 format: 2 TB (1.82 TiB)	2727264
IBM Tape Cartridge 3592 Advanced Type E Economy (JM)	60F format: 5 TB (4.55 TiB)	02CE961

Table 21: 3592 media supplies for the 3592 tape drive (continued)		
Supply Item[1]	Capacity[2]	Part Number
IBM Tape Cartridge 3592 Economy WORM (write-once, read-many) (JR)	E06 format: 128 GB (119.21 GiB) E05 format: 100 GB (93.13 GiB) J1A format: 60 GB (58.88 GiB)	24R0317
IBM Tape Cartridge 3592 WORM (JW)	E06 format: 640 GB (596.04 GiB) E05 format: 500 GB (465.66 GiB) J1A format: 300 GB (279.39 GiB)	18P7538
IBM Tape Cartridge 3592 Extended WORM (JX)	E07 format: 1600 GB (1490.12 GiB) E06 format: 1000 GB (931.32 GiB) E05 format: 700 GB (651.93 GiB)	23R9831
IBM Tape Cartridge 3592 Advanced WORM (JY)	E08 format: 7 TB (6.37 TiB) E07 format: 4000 GB (3725.29 GiB)	46X7454
IBM Tape Cartridge 3592 Advanced Type D WORM (JZ)	55F format: 15 TB (13.64 TiB) E08 format: 10 TB (9.09 TiB)	2727265
IBM Tape Cartridge 3592 Cleaning	Cleaning, 50 uses	18P7535

Notes:

1. Be sure to order bar code labels for all cleaning and data cartridges. Order volume serial (VOLSER) labels separately.
2. Cartridge capacities vary depending on tape drive and format.

Keep a lint-free cloth for wiping the outside of cartridges, and the item listed in to maintain your cartridges.

Table 22: Supplies for 3592 cartridge maintenance	
Description	Part number
Leader Pin Reattachment Kit. This kit is for 3592 cartridges only. It contains the necessary tools to reattach the leader pin to the tape. It includes the rewind tool, which can be used to add tension to a tape if the leader pin is displaced.	18P8887

Ordering bar code labels

This topic describes ordering bar code labels.

Bar code labels with VOLSERS are required for cartridges that are used within a library. You can order these labels separately from the IBM data cartridges and cleaning cartridges.

⚠️ **Attention:** The IBM TS3400, TS3500, and TS4500 tape libraries and the IBM 3494 tape library are designed to work with bar code labels that meet the specifications and requirements set forth in the Barcode Label Specification for use with 3592 Tape Media. The label providers that are listed in demonstrated the ability to produce finished bar code labels that meet the foregoing specifications and requirements. This information is provided for the convenience of IBM tape library users only, and is not an endorsement or recommendation of such providers. IBM

is not responsible for the quality of bar code labels procured from sources other than IBM. This information is applicable to bar code labels that are printed by the listed companies. IBM did not review the quality of any labels that are produced by software or services that are offered by such companies that allow users to print labels on their own printing equipment.

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

Table 23: Authorized suppliers of custom bar code labels	
In the Americas	**In Europe and Asia**
EDP/Tri-Optic 6800 West 117th Avenue Broomfield, CO 80020 US Telephone: 888-438-8362 or 303-464-3547 Fax: 888-438-8363 or 303-666-2166 http://www.tri-optic.com	
Netc, L.L.C.[1] 100 Corporate Drive Trumbull, CT 06611 US Telephone: 203-372-6382 Fax: 203-372-0676 http://www.netclabels.com	Netc Europe[1] Telephone.: +49-2151-970-900 Fax: +49-2151-970-908 Email: Vertrieb@netclabels.de http://www.netclabels.de
	Netc Asia Pacific Pty. Ltd.[1] 7 Cordwood Drive Cooroy QLD 4563 Australia Telephone: +61 (0)7 5442 6263 Fax: +61 (0)7 5442 6522 http://www.netclabels.com.au
[1]Netc is the only authorized supplier of radio frequency identification (RFID) labels. Orders for RFID labels must be placed through the U.S. office. Orders are shipped worldwide.	

Appendix H. Accessibility

Accessibility features help users who have a disability, such as restricted mobility or limited vision, to use information technology products successfully.

Accessibility features

The major accessibility features associated with the IBM 3592 tape drives and TS1120 Controller documentation is listed here.

- You can use screen-reader software and a digital speech synthesizer to hear what is displayed on the screen. PDF documents are tested with Adobe Reader version 7.0. HTML documents are tested with JAWS version 9.0
- This product uses standard Windows navigation keys

Keyboard navigation

You can use keys or key combinations to complete operations and initiate menu actions that can also be done through mouse actions. You can navigate the IBM 3592 tape drives and TS1150 Controller information from the keyboard by using the keyboard shortcuts for your browser or screen-reader software. See your browser or screen-reader software Help for a list of keyboard shortcuts that it supports.

IBM and accessibility

See the IBM Human Ability and Accessibility Center for information about the commitment that IBM has to accessibility.

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Feature Code 4804 must be installed in an equipment rack with metal front, rear, and side covers or doors to be in compliance with all applicable national regulations concerning electromagnetic compatibility (EMC), including the following and their successors:

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- ICES-003 (Canada)
- Directive 2014/30/EU (European Union EMC Directive)
- Agreement of Voluntary Control Council for Interference by Information Technology Equipment (Japan VCCI)
- Act No. 8867 (Republic of Korea Radio Waves Act)
- New Zealand Radiocommunications Regulations 2001
- Australia Radiocommunications Act 1992
- CNS 14348-2006 (Taiwan BSMI regulation for EMC)
- Regulation 2004/108/AT (Turkey Electromagnetic Compatibility Regulation)
- EMC Regulations of the Eurasian Economic Union

If a cable is attached to one of the RJ45 service ports on Feature Code 4804, a shielded cable must be used.

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RISC/6000	RISC System/6000	RS/6000	Series i
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zSystem			

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Symbols

The following symbols are used in this manual:

Symbol
   description

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Displays on the service panel to indicate that trace data is stored in the device. Also printed in text as an *Attention* notice.

Displays on the service panel when flash dump trace data is available in flash memory.

Printed in text and in figures to indicate an ESD-sensitive part.

Printed in text and in figures to indicate that a Class I Laser device is installed.

Displays on the service panel to indicate that the slide bar on the cartridge is set to the file-protected position.

Displays on the service panel to indicate that the host file-protected the volume.

Displays on the service panel to indicate that the slide bar on the cartridge is set to the **not** file-protected position.

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CAN ICES-3 (A)/NMB-3(A)

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European community contact:

IBM Deutschland GmbH
Technical Regulations, Department M372
IBM-Allee 1, 71139 Ehningen, Germany
Tele: +49 (0) 800 225 5423 or +49 (0) 180 331 3233
Email: halloibm@de.ibm.com

Germany Electromagnetic Compatibility Directive

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rusemi

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

Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. IBM is not responsible for any radio or television interference caused by using other than recommended cables and connectors, or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) this device might not cause harmful interference, and (2) this device must accept any interference received, including interference that might cause undesired operation.

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 and workstations

State of New Jersey: For information about recycling covered electronic devices in the State of New Jersey, go to the New Jersey Department of Environmental Protection website at http://www.state.nj.us/dep/dshw/recycle/Electronic_Waste/index.html.

State of Oregon: For information about recycling covered electronic devices in the state of Oregon, go to the Oregon Department of Environmental Quality site at http://www.deq.state.or.us/lq/electronics.htm.

State of Washington: For information about recycling covered electronic devices in the State of Washington, go to the Department of Ecology website at https://fortress.wa.gov/ecy/recycle/. Or, telephone the Washington State Department of Ecology at 1-800-Recycle.

IBM cryptographic coprocessor card return program

This machine might contain an optional feature, the cryptographic coprocessor card, which includes a polyurethane material that contains mercury. Follow local ordinances or regulations for disposal of this card. IBM established a return program for certain IBM cryptographic coprocessor cards. More information can be found at http://www.ibm.com/ibm/environment/products/recycling.shtml.

Système Internationale d'unités (SI)

A system of abbreviations for terms such as mega and giga is used in this publication. This universally used international system of units is equivalent to a familiar term "the metric system." For **disk** storage capacity, volumes, transmission rates, and other physical measurements, the system is the same; K = 1 000. For terms that apply to processor storage capacity, the SI system prevails. For example, for **disk** storage capacity and other physical and theoretical measurements, the actual value of the base number "K" is 1 000. For **processor** storage capacity, the actual value of the base number is 1 024.

Glossary

This glossary defines the special terms, abbreviations, and acronyms used in this publication and other related publications. If you do not find the term you are looking for, see the *IBM Glossary of Computing Terms* located at the IBM Terminology website.

A

access method
A technique for moving data between processor storage and input/output devices.

ACF
See *Automated Cartridge Facility*

ACS
Automatic Cartridge System

ADSM
See *TSM*

AES
Advanced Encryption Standard. A block cipher adopted as an encryption standard by the US government.

Advanced Interactive Executive
IBM's implementation of the UNIX operating system. The RS/6000 and pSeries, among others, run the AIX operating system.

AEN
Asynchronous event notification is the ability of a device to initiate communications with attached hosts.

AIX
See *Advanced Interactive Executive*

ALPA
Arbitrated Loop Physical Address

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

APAR
authorized program analysis report

archiving
The storage of backup files and associated journals, usually for a given period.

arbitrated loop
see *Fibre Channel arbitrated loop (FC-AL)*

archiving application
The retention of records, in machine-readable form, for historical purposes.

automatic cartridge facility (ACF)
An optional feature for the 3590 tape drive. It allows both the automatic loading and unloading of tape cartridges.

automatic mode
A mode of operation that can be selected on the ACF cartridge loader. This mode allows the automatic feeding and loading of tape cartridges requiring no operator action.

B

BVPD
Backup Vital Product Data

backhitch
Magnetic tape that makes a slight backward motion just prior to moving forward.

backup and recovery application
The short-term retention of records used for restoring essential business and system files when vital data has been lost because of program or system errors or malfunctions.

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

bar code label
A specially coded label that can be affixed to a tape cartridge and which enables a device to identify the cartridge and its volume serial number. The bar code label must be affixed to a tape cartridge to enable the library to identify the cartridge and its volume serial number.

beginning of tape (BOT)
The location on a magnetic tape that indicates the beginning of the permissible recording area.

bit
A binary digit that may have the value of either 0 or 1.

block
A collection of contiguous records recorded as a unit. Blocks are separated by inter-block gaps, and each block may contain one or more records.

BOT
beginning of tape

BOV
beginning of volume

BRMS
Backup Recovery and Media Services

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

BTLS
Basic Tape Library Support

buffer
A routine or temporary storage location 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.

byte
A binary number containing exactly eight bits.

C

capacity
See *media capacity*.

capacity scaling
A logical method of reducing the overall length of media available for write and read operations, providing faster data-access times.

cartridge loader
A standard function for the tape drive. It allows the automatic loading of tape cartridges.

certificate
A digital document that binds a public key to the identity of the certificate owner, thereby enabling the certificate owner to be authenticated.

channel
A device to device connection between the processing unit and the I/O control unit.

channel command

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

channel path

The physical path between the channel and the control unit. Synonymous with channel.

cleaning cartridge

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

CM

Cartridge Memory

command

A control signal that initiates an action or the beginning of a sequence of actions. See also *channel command*.

control unit (CU)

A device that controls input and output operations of one or more devices.

control unit function

A device that contains the functional logic for controlling the input and output operations at one or more devices.

conversion

The process of changing from one method of data processing to another or from one data-processing system to another.

CPU

central processing unit

D

data

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

database

A set of data, consisting of at least one file, sufficient for a given purpose or for a given data-processing system.

data cartridge

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

data channel

A device that connects a processor and main storage with the I/O control unit. Synonymous with input/output channel and I/O channel.

data compression

An algorithmic data-reduction technique that encodes data from the host and stores it in less space than un-encoded data. The original data is recovered by an inverse process called decompression.

data-compression ratio

The number of host data bytes divided by the number of encoded bytes. It is variable depending on the characteristics of the data being processed. The more random the data stream, the lower the opportunity to achieve compression.

data transfer rate

The average number of bits, characters, or blocks per unit time passing between corresponding equipment in a data transmission system. The rate is expressed in bits, characters, or blocks per second, minute, or hour.

dataset

The major unit of data storage and retrieval, consisting of a collection of data in one of several prescribed arrangements and described by control information to which the system has access.

DDR

Dynamic device reconfiguration

degauss

To make a magnetic tape nonmagnetic by means of electrical coils carrying currents that neutralize the magnetism of the tape.

DFSMS

Data Facility Storage Management Subsystem

DK

Data Key. An alphanumeric string used to encrypt data.

drive head

The component of a drive that records an electrical signal onto magnetic tape, or reads a signal from tape into an electrical signal.

drive loaded

A condition of a tape drive in which a tape cartridge has been inserted in the drive, and the tape has been threaded to the beginning-of-tape position. Also known as a mount.

dump

To write the contents of storage, or of a part of storage, usually from an internal storage to an external medium, for a specific purpose such as to allow other use of storage, as a safeguard against faults or errors, or with debugging.

E

ECC

Error-correction code

EEDK

Externally Encrypted Data Key. A Data Key that has been encrypted (wrapped) by a Key Encryption Key prior to being stored in the data cartridge. See *KEK*.

effective data rate

The average number of bits, bytes, characters, or blocks per unit time transferred from a data source to a data sink and accepted as valid. The rate is expressed in bits, bytes, characters, or blocks per second, minute, or hour.

EEFMT2

Enterprise Encryption Format 2 recording technology. AES 256-bit encrypted data written recorded at the performance and capacity format used by the native E05 tape drive.

EEFMT3

Enterprise Encryption Format 3recording technology. AES 256-bit encrypted data written recorded at the performance and capacity format used by the native E06 tape drive.

EEFMT4

Enterprise Encryption Format 4 recording technology. AES 256-bit encrypted data written recorded at the performance and capacity format used by the native E07 tape drive.

EEFMT5

Enterprise Encryption Format 5 recording technology. AES 256-bit encrypted data written recorded at the performance and capacity format used by the native E08 tape drive.

EEFMT6

Enterprise Encryption Format 6 recording technology. AES 256-bit encrypted data written recorded at the performance and capacity format used by the native 60F tape drive.

EFMT1

Enterprise Format 1 recording technology. The performance and capacity format used by the J1A tape drive and the E05 tape drive when emulating J1A tape drive to record at increased density.

EFMT2

Enterprise Format 2 recording technology. The performance and capacity format used by the native E05 tape drive to record at increased density.

EFMT3

Enterprise Format 3 recording technology. The performance and capacity format used by the native E06 tape drive to record at increased density.

EFMT4

Enterprise Format 4 recording technology. The performance and capacity format used by the native E07 tape drive to record at increased density.

EFMT5

Enterprise Format 5 recording technology. The performance and capacity format used by the native E08 tape drive to record at increased density.

EFMT6

Enterprise Format 6 recording technology. The performance and capacity format used by the native 60F tape drive to record at increased density.

EIA

A unit of measure established by the Electronic Industries Alliance, equal to 44.45 mm (1.75 in).

EHPCT

extended high-performance cartridge tape

emulation

imitation of another device

enable

To provide the means or opportunity. The modification of system, control unit, or device action through the change of a software module or a hardware switch (circuit jumper) position.

encryption capable

A TS1120 and later tape drive that is functionally able, but not yet set up by IBM, to encrypt and decrypt data. All TS1150, TS1140, and TS1130 tape drives are encryption-capable. All TS1120 tape drives with Feature Code 5592 or 9592 are encryption-capable.

encryption enabled

An encryption-capable TS1120 and later tape drive that has been set up by IBM to encrypt and decrypt data.

encryption key manager (EKM)

A software program that assists encrypting tape drives in generating, protecting, storing, and maintaining encryption keys that encrypt information that is written to and decrypt information that is read from tape media.

encryption key server (EKS)

A software application supplying public and private keys and certificates for use in encrypting and decrypting data on the TS1120 and later tape drives.

Environmental Record Editing and Printing (EREP)

The program that formats and prepares reports from the data contained in the error recording data set.

EOD

end-of-data

EOV

end-of-volume

The point on a tape volume beyond which writing of logical blocks or tape marks is not allowed.

error-recovery procedures (ERP)

Procedures designed to help isolate and, where possible, to recover from errors in equipment. The procedures are often used with programs that record the statistics of machine malfunctions.

ESA

expanded storage array

ESCON

Enterprise System Connection architecture

F

Fabric, Fibre Channel
An interconnection that receives addressed information which, in turn, routes the information to its appropriate destination.

FC
feature code

Fibre Channel
A technology for transmitting data between computer devices at a data rate of up to 8 Gbps. It is especially suited for attaching computer servers to shared storage devices and for interconnecting storage controllers and drives. Often the term is used to refer to an optics cable utilizing filaments to transmit data.

Fibre Channel arbitrated loop (FC-AL)
In this topology, two or more Fibre Channel end points are interconnected through a looped interface. Information is routed through the loop to its destination.

Fibre Channel hub
In this topology, the hub provides ports similar to switch ports and uses a Fibre Channel arbitrated loop structure.

Fibre Channel switch (switched fabric)
In this topology, two or more end points are interconnected through one or more switches.

Fibre Channel topologies
Shared loop host and storage controllers

Fiber Connectivity (FICON)
A high-speed input/output (I/O) interface for mainframe computer connections to storage devices.

FICON
See *Fiber Connectivity*

FID
Failure ID

field replaceable unit (FRU)
An assembly that is replaced in its entirety when any one of its components fails. In some cases a field replaceable unit may contain other field replaceable units; for example, a brush and a brush block that can be replaced individually or as a single unit.

file
A set of related records, treated as a unit, for example, in stock control, a file could consist of a set of invoices.

file protected
Pertaining to a tape volume from which data can be read only. Data cannot be written on or erased from the tape. See *write-protect.*

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

formatted tape volume
A tape volume that has been initialized with certain formatting information (such as servo tracks), which is required to exist for the recording technique used on the volume before any data can be recorded. Depending on the format and medium, formatting may or may not be required to use the medium for data recording purposes.

FRU
Field replaceable unit

FTP
File transfer protocol

FTP site
Any electronic repository of information that uses the File Transfer Protocol (FTP) for transferring files to and from servers. Use of an FTP site generally requires a user ID and possibly a password.

G

GB
Gigabyte; 1,000,000,000 bytes

GBIC
See *gigabit interface converter*

gigabit interface converter (GBIC)
A device that converts data from electrical signals to optical signals.

GiB
One gibibyte (GiB) = 2^{30} bytes = 1,073,741,824 bytes.

H

HBA
Host Bus Adapter

HCD
hardware configuration definition

High Performance Tape Subsystem
An IBM tape subsystem using 3592 tape drives and, in some configurations, a 3592 tape controller.

host
The controlling or highest-level system in a data communication configuration. Synonymous with *server*.

host system
A data-processing system that is used to prepare programs and the operating environments for use on another computer or controller.

HPCT
high-performance cartridge tape

HSC
host software component

I

immediate mode
In tape-write-immediate mode, channel end and device end are presented separately.

index
A function performed by the cartridge loader that moves cartridges down the input or output stack one cartridge position. A cartridge loader can perform multiple consecutive indexes.

initiator
A device that requests an I/O process to be performed by another device (a target). In many cases, an initiator can also be a target. processing unit, that handles the transfer of data between main storage

input/output channel
In a data-processing system, a functional unit, controlled by the processing unit, that handles the transfer of data between main storage and peripheral equipment.

install
To set up for use or service. The act of adding a product, feature, or function to a system or device either by a singular change or by the addition of multiple components or devices.

interchange
The ability to process (read or write) a given tape volume on any one of a set of tape devices that support the form factor and recording format on the tape volume.

interchange application
The preparation of tapes for use on other systems or devices, either local or remote, or the use of tape data prepared by another system.

interposer

An interposer is used to connect two dissimilar cable or device connectors.

invoke

To petition for help or support. The request for a feature or function to be utilized in future processing activities by using software or hardware commands.

I/O

input/output

IODF

input/output definition file

IPRs

Installation Planning Representatives

ISP

independent service provider

ISV

independent software vendors

J

job control language (JCL)

Problem-oriented language designed to express statements in a job that are used to identify the job or describe its requirements to an operating system.

K

KB

Kilobyte; 1,000 bytes

KEK

Key Encrypting Key. An alphanumeric string used to encrypt the Data Key. See *EEDK*.

KiB

One kibibyte (KiB) = 2^{10} bytes = 1,024 bytes.

keystore

A database of private keys and their associated X.509 digital certificate chains used to authenticate the corresponding public keys.

L

label

A label is a control file that is associated with a data file which provides volume and file identification information. The label is a software construct that appears as any other file to the I/O subsystem.

LC

Lucent connector. A type of fibre cable connector. See also SC, Standard Connector.

LCD

See *liquid crystal display*

leader pin

A small metal rod attached to the end of the magnetic tape. During tape processing, the leader pin is grasped by a threading mechanism, which pulls the pin and the tape out of the cartridge, across the drive head, and onto a take-up reel. The head can then read or write data from or to the tape.

LED

Common abbreviation for light-emitting diode.

liquid crystal display (LCD)

A low-power display technology used in computers and other I/O devices.

loader

See *cartridge loader*

load point
  The beginning of the recording area on magnetic tape.

logical-backward direction
  Tape movement is in the logical backward direction when the tape position is moving away from EOV and toward BOV. Logical backwards is defined independently of the physical forward or physical backward directions.

logical block
  A logical block is an independently accessible unit of information created by the program within a file. A logical block may be either a data-logical block or a mark-logical block.

logical end of tape
  A point on the tape where written data normally ends.

logical-forward direction
  Tape movement is in the logical forward direction when the tape position is moving away from BOV and toward EOV. Logical forward is defined independently of the physical forward or physical backward directions.

logical record
  A logical record is a string of concatenated data bytes that is passed between an application program and a control program or access method as the result of an I/O request.

LUN
  Logical Unit Number

logical-write protection
  Logical-write protection is a function provided by the device that allows a program to write-protect a tape volume through some device command. Logical-write protection persists for the duration of a tape mount or until deactivated by the program.

long wave
  A Fibre Channel cable that has a 1400 nm wave length.

M

magnetic recording
  A technique of storing data by selectively magnetizing portions of a magnetizable material.

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

manual mode
  A mode of operation that can be selected on the cartridge loader. This mode allows a single tape cartridge feed, performed by the operator.

MB
  Megabyte (often expressed as a data rate in MB/s or MB/second, for megabytes per second).

MB/s
  One megabyte per second = 10^6 bytes per second = 1,000,000 bytes per second.

Mb
  Megabit. One Megabit = 10^6 bits = 1,000,000 bits.

Mb/s
  One megabit per second (Mb/s) = 10^6 bits per second = 1,048,576 bits per second.

mebi
  Binary prefix for 2^{20}.

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

mega
  Prefix for 'million' (10^6).

megabyte (MB)
  One million bytes.

megabytes per second (MB/s or MBps)
A measure of bandwidth on a data transmission medium, where 1 MBps = 1,000,000 bytes per second.

MES
Miscellaneous equipment specification.

metric system
Deprecated term for the *SI* system.

MI
Maintenance information.

MiB
Mebibyte. One mebibyte (MiB) = 2^{20} bytes = 1,048,576 bytes.

Mib
Mebibit. One mebibit (Mib) = 2^{20} bits = 1,048,576 bits.

Mib/s
One mebibit per second (Mib/s) = 2^{20} bits per second = 1,048,576 bits per second.

microcode
A code, representing the instructions of an instruction set, that is implemented in a part of storage that is not program-addressable.

microprocessor
An integrated circuit that accepts coded instructions for operation; the instructions may be entered, integrated, or stored internally.

microprogram
A sequence of elementary instructions that correspond to a specific computer operation, that is maintained in special storage, and whose execution is initiated by the introduction of a computer instruction into the instruction register of a computer.

A group of micro instructions that when executed perform a preplanned function.

migration
See *conversion*

MIM
Media information message

missing interrupt handler (MIH)
An MVS™ and MVS/XA facility that keeps track of I/O interrupts, informing the operator and keeping a record whenever an expected interrupt fails to occur in a preset time interval.

mount
The act of making a tape volume available for processing by a specific tape device.

mounted
The state of a tape volume while it is available for processing by a specific tape device.

multiplexer channel
A channel designed to operate with a number of I/O devices simultaneously.

N

native data capacity
The amount of data that can be stored without data compression on a cartridge.

nonremovable media
Recording media that cannot be added to or removed from a recording device.

O

Oe
Oersted. The unit of magnetic intensity in the centimeter-gram-second system.

OEM
Original equipment manufacturer

operating environment
The temperature, relative humidity, and wet bulb temperature of the room in which the tape library routinely conducts processing.

output stack
The part of the cartridge loader that receives and holds processed cartridges.

P

partitions
One or more non-overlapped mini-volumes, each with its own beginning and ending points, contained within a single physical tape volume.

physical-backward direction
Tape movement is in the physical backward direction when the physical tape is moving in the direction that is defined as backward for the device processing tape. Physical backward is defined independently of the logical forward or logical backward directions.

physical end of tape
A point on the tape beyond which the tape is not permitted to move.

physical-forward direction
Tape movement is in the physical forward direction when the physical tape is moving in the direction that is defined as forward for the device processing tape. Physical forward is defined independently of the logical forward or logical backward directions.

physical-write protection
A facility provided by the mechanical housing of the tape volume that allows a human being or robotics device to write-protect a tape volume. Physical-write protection persists until the state of the facility on the tape volume is changed.

POST
Power On Self-Test. A series of diagnostic tests which are run automatically each time power is provided to the device.

PostScript
A standard specified by Adobe Systems, Incorporated, that defines how text and graphics are presented on printers and display devices.

processing application
The execution of a systematic sequence of operations performed on data to accomplish a specific purpose.

PSP
product service planning

PTF
Program temporary fix

public/private keys
A cryptography system that uses two keys: a public key known to everyone and a private or secret key known only to the recipient of the message. The public and private keys are related in such a way that only the public key can be used to encrypt messages and only the corresponding private key can be used to decrypt them. Also known as asymmetric keys.

Q

queuing
The ability of a device to accept multiple commands; implementation is either tagged or untagged. Tagged queuing allows a device to accept multiple commands from a host. Untagged queuing allows a device to accept only a single command that must be completed before accepting another command from the same host.

quiesce
　　To bring a device or system to a halt by a rejection of new requests for work.

R

random access
　　Random access refers to the processing of information on a volume in a manner that requires the device to access nonconsecutive storage locations on the medium.

read-type commands
　　Any commands that cause data to be read from tape.

record
　　A collection of related data or words, treated as a unit; for example, in stock control, each invoice could constitute one record.

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

rekey
　　The process of changing the asymmetric Key Encrypting Key (KEK) that protects the Data Key (DK) stored on an already encrypted tape, thereby allowing different entities access to the data.

relative humidity
　　The ratio of the amount of water vapor actually present in the air to the greatest amount possible at the same temperature.

removable media
　　Recording media that can be added to or removed from a recording device.

RSA
　　Rivest-Shamir-Adleman algorithm. A system for asymmetric, public-key cryptography used for encryption and authentication. It was invented in 1977 by Ron Rivest, Adi Shamir, and Leonard Adleman. The security of the system depends on the difficulty of factoring the product of two large prime numbers.

S

SAN
　　Storage Area Network

SAPR
　　Solutions Assurance Product Review

SARS
　　Statistical Analysis and Reporting System

SC
　　Standard connector used for fibre cables. See also LC, Lucent Connector.

SCSI
　　Small computer system interface

SCSI device
　　A host adapter or a target controller that can be attached to the SCSI bus.

SEK
　　Session Encrypted Key. A Data Key that has been encrypted (wrapped) for secure transfer between the encryption key server and the TS1120 and later tape drives. See *SK*.

server
　　A functional unit that provides services to one or more clients over a network. Examples include a file server, a print server, and a mail server. The pSeries, iSeries, HP, and Sun are servers. Synonymous with *host*.

sequential access
　　Refers to the processing of information on a volume in a manner that requires the device to access consecutive storage locations (for example, logical blocks) on the medium.

SK

Session Key. An alphanumeric string used to encrypt the Data Key for secure transfer between the encryption key server and the TS1120 and later tape drives. See *SEK*.

ship group

The group of supplies, cables, or documentation that is shipped with the machine.

shipping environment

The temperature, relative humidity rate, and wet bulb temperature of the environment to which the tape library is exposed when being transferred from one location to another.

short wave

A Fibre Channel cable that has an 850 nm wave length.

SIM

Service information message

SKLM (IBM Security Key Lifecycle Manager)

IBM's EKM application that assists encrypting tape drives in generating, protecting, storing, and maintaining encryption keys that encrypt information that is written to and decrypt information that is read from tape media.

SPE

Small programming enhancement

special feature

A specific design addition to an IBM product that is quoted in the IBM Sales Manual and ordered separately.

SSR

IBM service support representative

standard function

The significant design elements of an IBM product that are included as part of the basic standard product.

subsystem

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

system mode

A mode of operation that can be selected on the cartridge loader. This mode allows the automatic feeding and loading of premounted blank or scratch tape cartridges in response to nonspecific volume requests, while specific volume requests require operator insertion of the requested tape cartridge.

T

TapeAlert

A patented technology from Hewlett-Packard that monitors the status of a tape device and media, and detects problems as they occur.

TapeAlert flags

Status and error messages that are generated by the TapeAlert utility and display on the host console. The messages indicate the type of problem and tell how to resolve it.

tape cartridge

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

tape device

A computer peripheral device that supports reading or writing of a removable recording medium called a tape volume. A tape device has a model number.

tape drive

A device that is used for moving magnetic tape and includes the mechanisms for writing and reading data to and from the tape.

tape format

The tape format defines the way that information is physical recorded and arranged on a tape volume. It includes the physical representation for all constructs associated with the tape data model as well as other constructs that are format dependent.

tape library

A structure that provides for the storage of tape volumes and facilitates the movement of tape volumes between the storage structure and the tape device.

tape mark

A tape mark is a mark logical block that can be recorded on the medium under program direction. Tape marks are used by the program to delineate collections of data logical blocks on a given volume.

tape mount

The operation associated with mounting a tape volume on a tape device.

tape synchronous mode

The tape-synchronous mode transfers records whose length is greater than the limits defined for buffered records. The device operates in the tape synchronous mode, if the format being processed is supported.

tape unit

A device that contains tape drives and their associated power supplies and electronics.

tape volume

The recording medium and associated mechanical package that houses the media used by a tape device. See also *volume*.

target

A SCSI device that performs an operation requested by the initiator. In many cases, a target can also be an initiator.

TB

Terabyte. One terabyte = 1,000,000,000,000 bytes.

terminator

A part used to end a channel or connection on a computer system.

TPF

transaction processing facility.

TSM

Tivoli Storage Manager.

TSMC

TotalStorage Master Console.

U

Ultra

The ANSI SCSI standard allowing up to 40 MB/s transfers on a SCSI bus.

unformatted tape volume

A tape volume that has not been initialized with certain formatting information (for example, servo tracks), which is required to exist for the recording technique used on the volume before any data can be recorded. Depending on the format and medium, formatting may be required to use the medium for data recording purposes.

uniform resource locator (URL)

The address of an item on the World Wide Web. It includes the protocol followed by the fully qualified domain name (sometimes called the host name) and the request. The web server typically maps the request portion of the URL to a path and file name. For example, if the URL is http://www.storage.ibm.com/tape/index.html, the protocol is http; the fully qualified domain name is www.storage.ibm.com; and the request is /tape/index.html.

unique cartridge identifier (UCID)

See *WWCID*.

URL

See *Uniform resource locator*.

V

VOLSER

Volume serial number. The serial number of the specific tape cartridge.

volume

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

A data carrier that is mounted and demounted as a unit, for example, a reel of magnetic tape, a disk pack.

volume identifier (volid)

An identifier that uniquely identifies a tape volume within an installation. The volume identifier might be shown on an external label on the tape volume and could also be recorded on an internal label of the media itself. On some devices, the same volid might be associated with multiple units of media or the different volids might be associated with the same unit of medium.

VPD

Vital Product Data

W

World-wide Unique Cartridge Identifier

See *WWCID*

write-once, read-many (WORM)

A technology to allow data to be written once to storage media. After that, data is permanent and cannot be altered, but can be read any number of times.

write protected

A tape volume is write protected if some logical or physical mechanism causes the device processing the tape volume to prevent the program from writing on the volume.

write-type commands

Any commands that cause data to be written on tape or affect buffered write data.

WWID

An identifier that uniquely identifies a hardware component, such as the port and node of a drive.

WWCID

An identifier that uniquely identifies a cartridge.

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