

FUJIFILM

FUJIFILM Recording Media U.S.A., Inc.

LTO Tape Technology Care & Handling



LTO Tape Technology Overview

LTO Technology LTO (Linear Tape-Open)

LTO Ultrium high-capacity Tape Drive Format developed by LTO Drive Technology Provider Companies (TPC) – IBM, HP and Quantum.

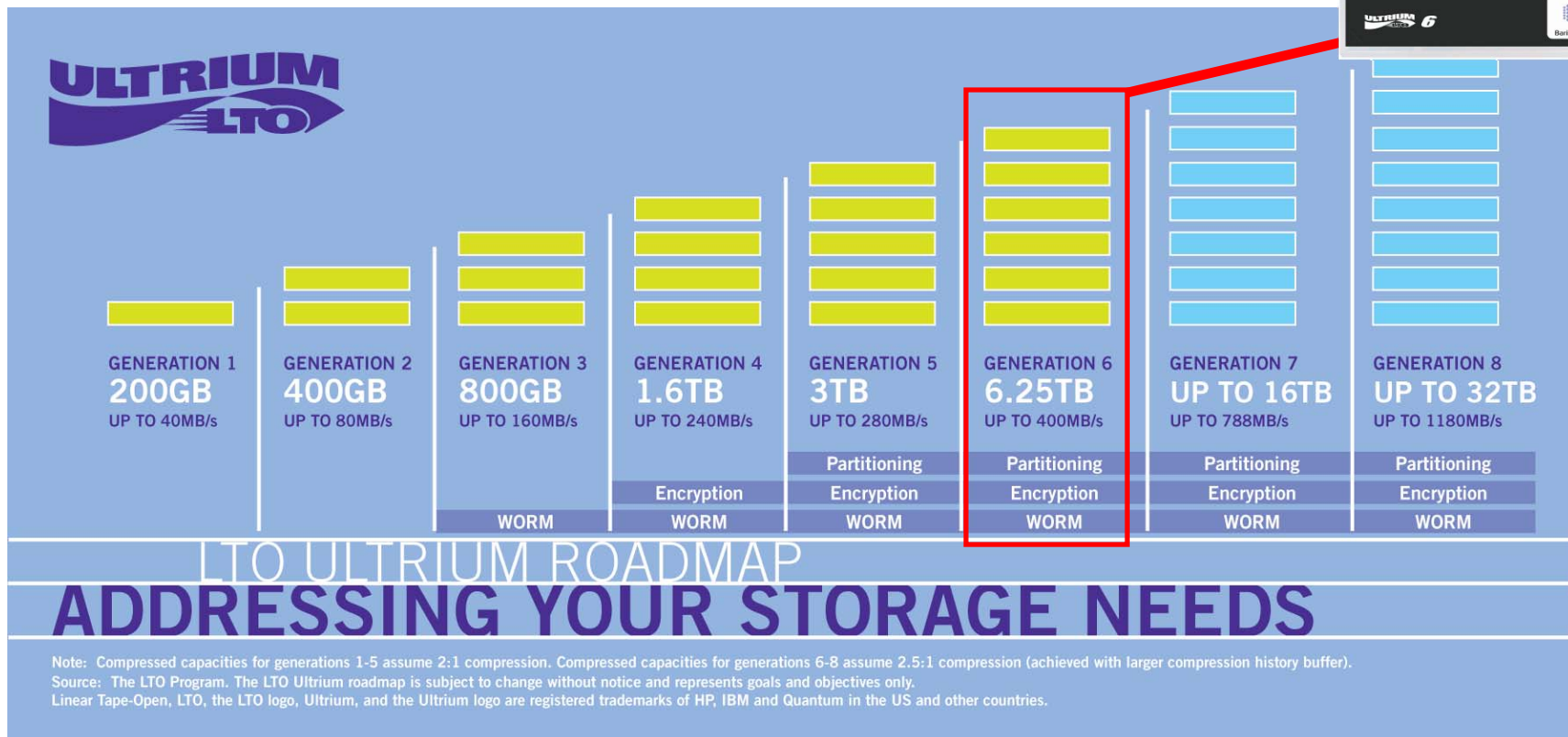
- **LTO Ultrium Data Cartridge**
 - Single-reel; High-capacity Tape
- **Ten-generation Roadmap**
 - 200 GB up to 120 TB with compression

* Quantum acquired Certance (Seagate's former Removable Storage Solutions Division) 12/2004.

• Linear Tape-Open, LTO, the LTO logo, Ultrium, and the Ultrium logo are trademarks of HP, IBM and Quantum in the US and other countries.

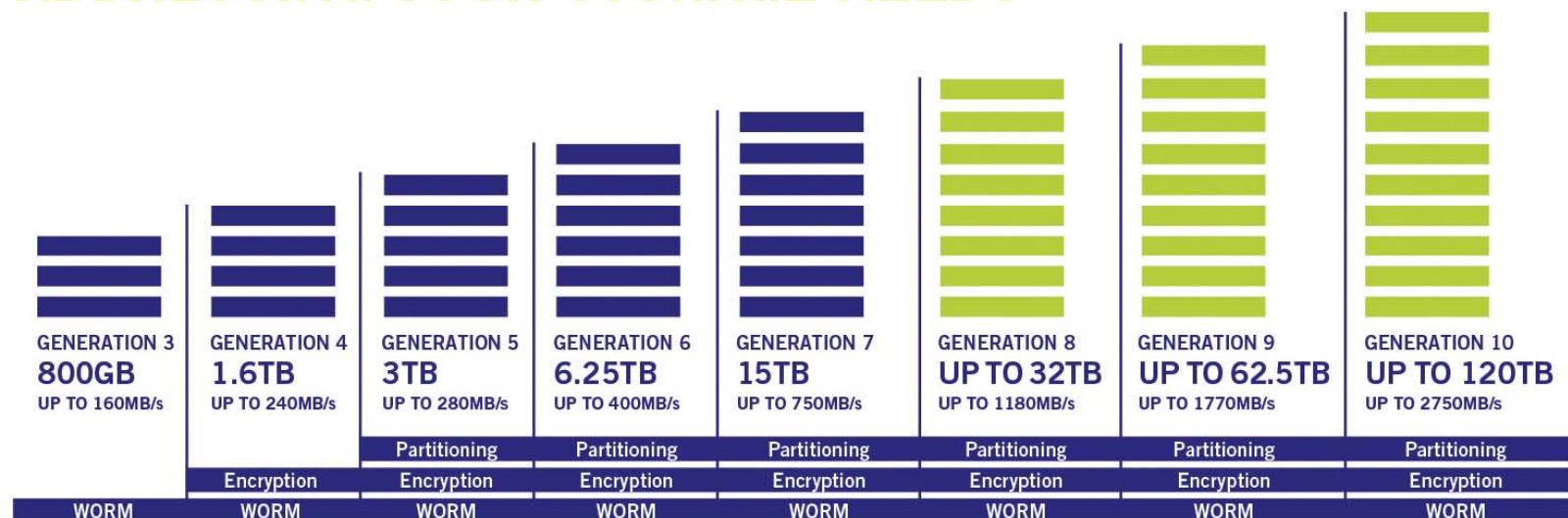


LTO roadmap



LTO roadmap – Generations 3-10

LTO ULTRIUM ROADMAP ADDRESSING YOUR STORAGE NEEDS



Note: Compressed capacities for generations 1-5 assume 2:1 compression. Compressed capacities for generations 6-10 assume 2.5:1 compression (achieved with larger compression history buffer).
Source: The LTO Program. The LTO Ultrium roadmap is subject to change without notice and represents goals and objectives only.
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LTO Ultrium Generations/Specifications



LTO 1: introduced in 2000, 100/200 GB native/compressed capacity, 20/40 MB/s native/compressed transfer rate

LTO 2: introduced in 2002, 200/400 GB native/compressed capacity, 40/80 MB/s native/compressed transfer rate

LTO 3: introduced in 2004, 400/800 GB native/compressed capacity, 80/160 MB/s native/compressed transfer rate

LTO 4: introduced in 2007, 800/1600 GB native/compressed capacity, 120/240 MB/s native/compressed transfer rate

LTO 5: introduced in 2010, 1.5/3.0 TB native/compressed capacity, 140/280 MB/s native/compressed transfer rate

LTO 6: introduced in 2012, 2.5/6.25 TB native/compressed capacity, 160/400 MB/s native/compressed transfer rate

LTO UCC (Universal Cleaning Cartridge): compatible with all 6 generations of LTO drives-up to 50 cleanings per cartridge

Fujifilm LTO Ultrium Cartridge Color

Unique shell color for each generation of Fujifilm LTO Ultrium data cartridges:



Black LTO 1



Purple LTO 2



Slate-Blue LTO 3 (grayish green)



Green LTO 4



Red LTO 5

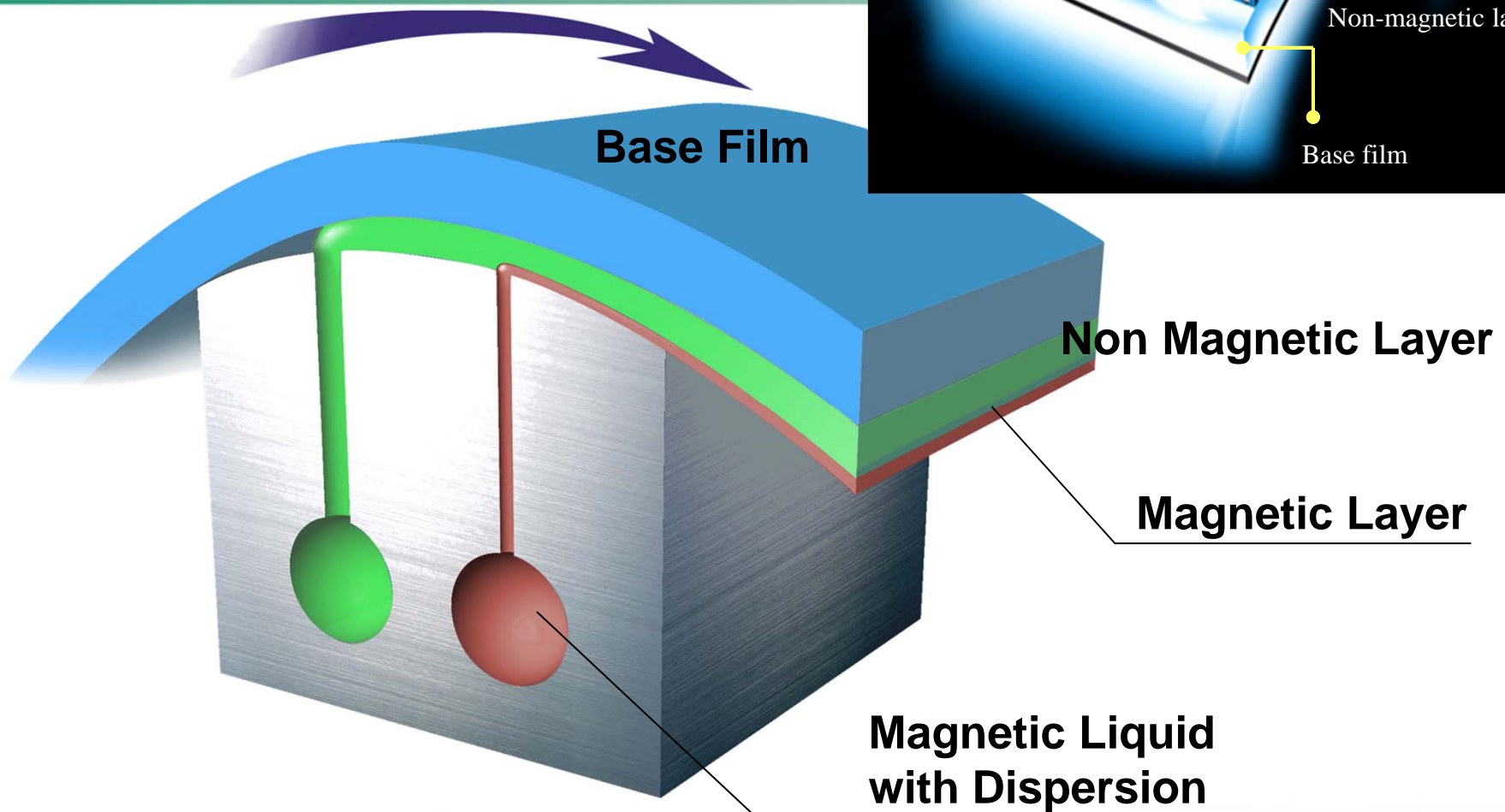


Black w/ BaFe Logo LTO6

(WORM: two-tone Slate-Blue / Platinum Ultrium 3 WORM, two-tone Green / Platinum Ultrium 4 WORM, two-tone Red/Platinum Ultrium 5 WORM, two-tone Black Platinum Ultrium 6 WORM)

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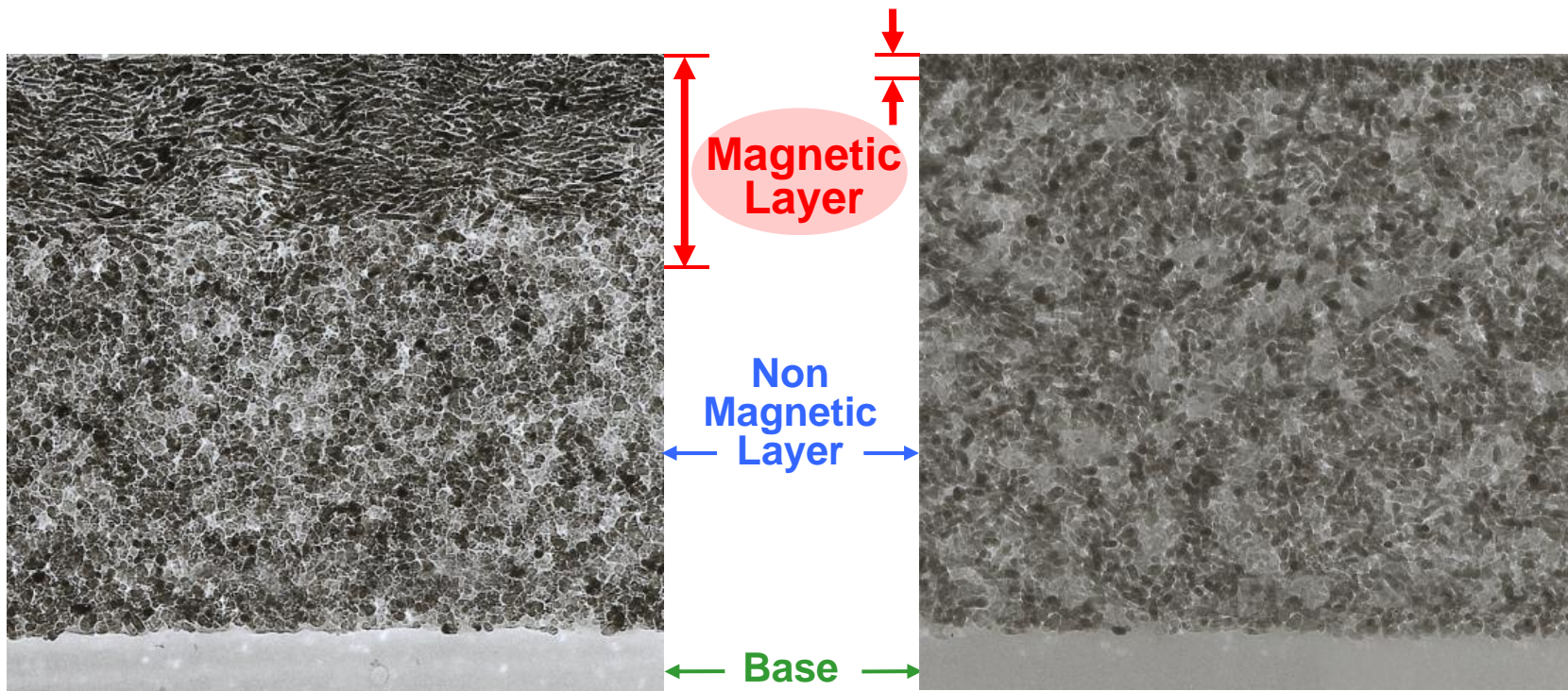
Dual layer Simultaneous Coating Technology



Magnetic Tape Cross-Section

ATOMM Technology

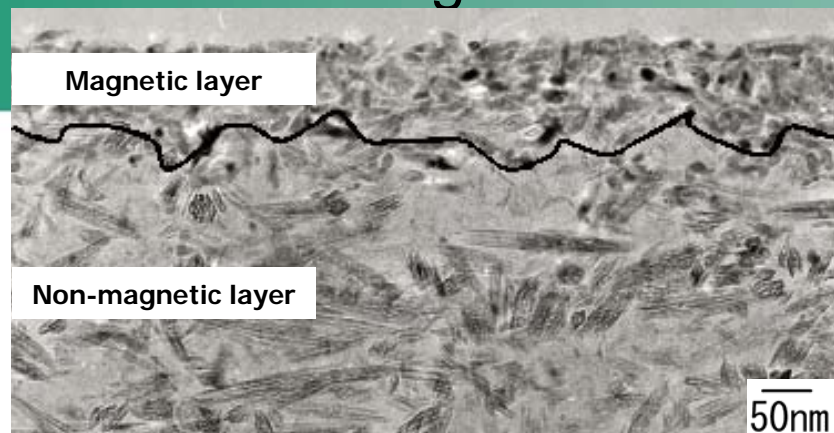
NANO3 (NANOCUBIC)
Technology



LTO 1, 2, 3

LTO 4 & 5, 3592

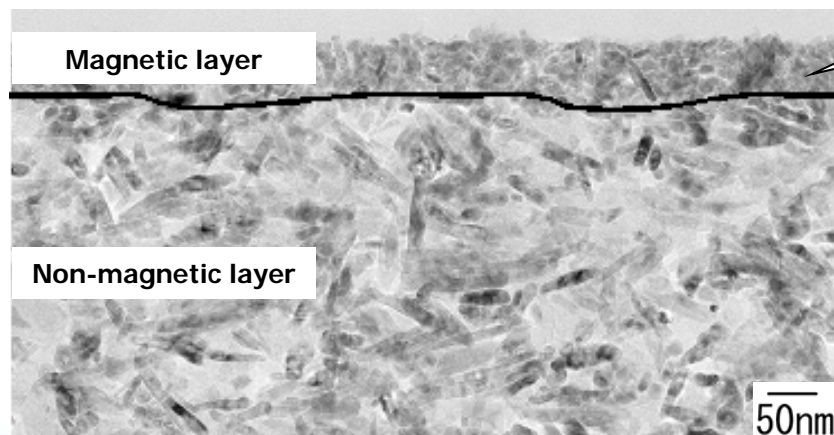
Current coating with MP



LTO 6 BaFe technology

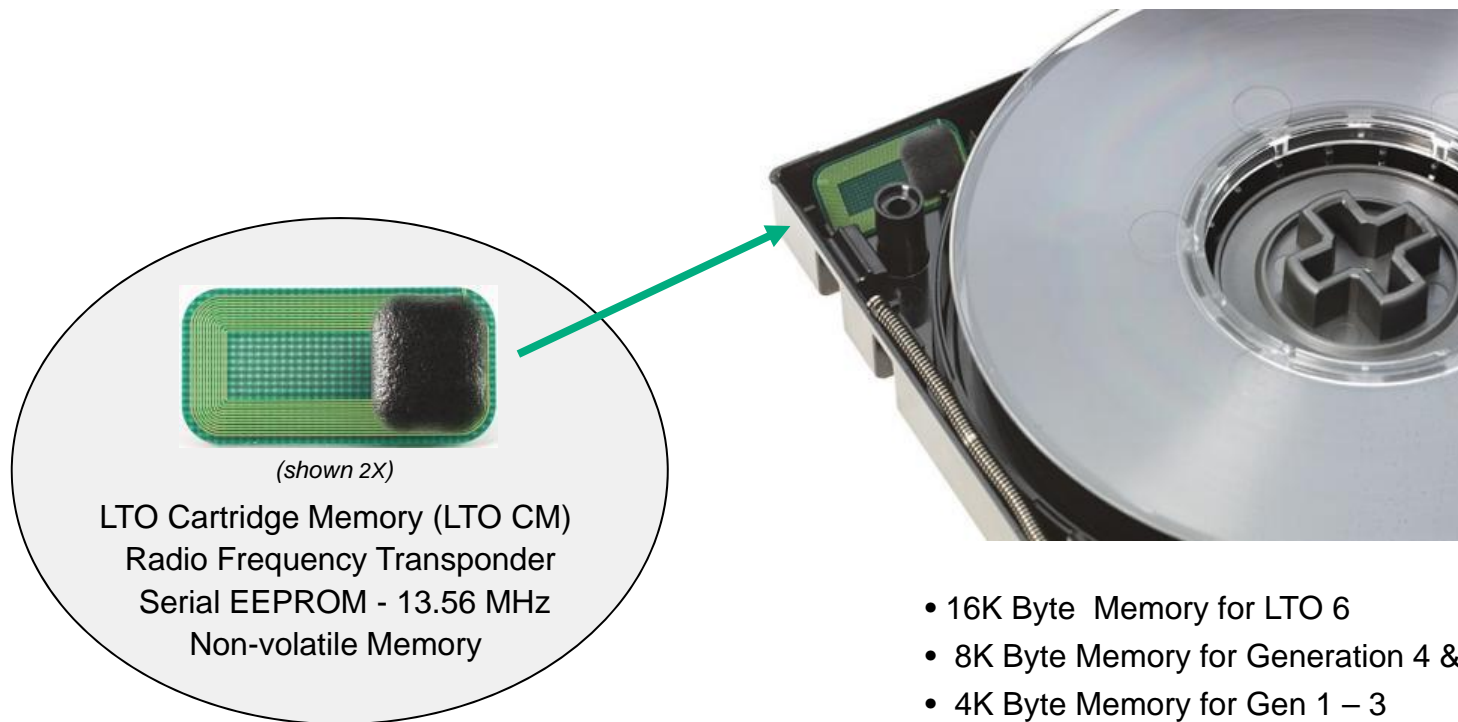
Thinner and more uniform magnetic layer enables stable output & recording, with less noise

New coating technology for Barium Ferrite



LTO-CM

Cartridge Memory: Stores usage history & other information on a Non-contact Passive RF Interface Memory Chip



LTO Ultrium Servo-Tracking

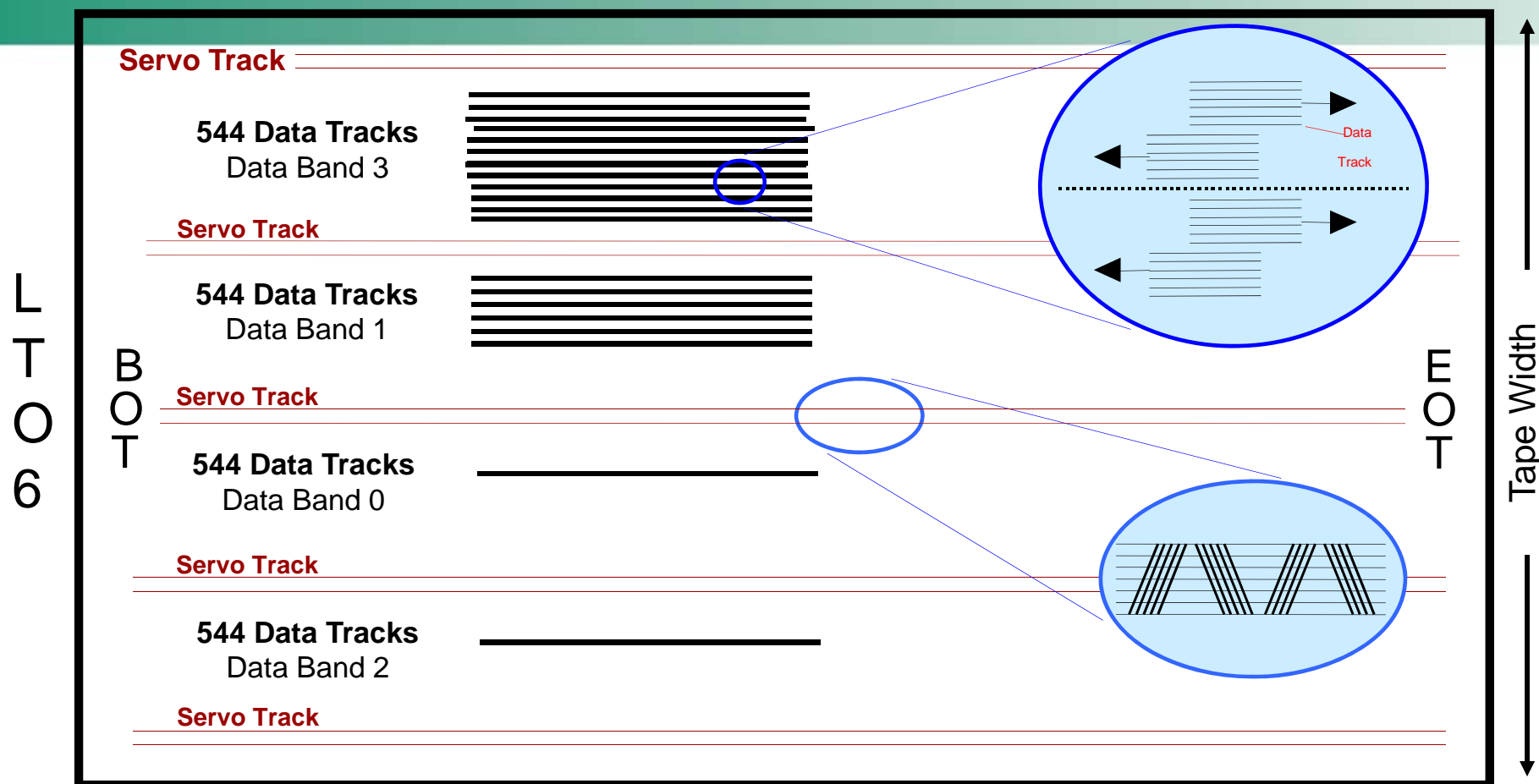
Pre-written Magnetic Servo Tracks –

Magnetic servo tracks for positioning the drive's read/write head are factory written.

Do not degauss (bulk erase) LTO Ultrium data cartridges that you intend to reuse.

Degaussing makes the tape unusable!

Ultrium 1: 8-element Read/Write Head writes 12 sets of 8 tracks in each of 4 data bands = 384 tracks;
Ultrium 2: 8-element, 512 tracks; Ultrium 3: 16-element, 704 tracks. Ultrium 4: 16-element, 896 tracks



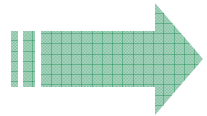
Ultrium 6: 16-element, 2176 tracks Ultrium 5: 16-element, 1280 tracks

Diagram not to scale. Five factory recorded servo bands occupy < 8% of recording surface area. Servo Tracks are scalable and do not change for LTO 1, 2, 3, 4, 5, & 6 (unique code for each and for WORM media).¹³

LTO ULTRIUM MEDIA AND DRIVE COMPATIBILITY

Tape Media Capacity, Length	LTO-1 Tape Drive	LTO-2 Tape Drive	LTO-3 Tape Drive	LTO-4 Tape Drive	LTO-5 Tape Drive	LTO-6 Tape Drive
LTO Ultrium 1 100/200 GB, 609m	Full Read/Write Compatibility	Full Read/Write Compatibility	Read-Only	NOT COMPATIBLE	NOT COMPATIBLE	NOT COMPATIBLE
LTO Ultrium 2 200/400 GB, 609m	NOT COMPATIBLE	Full Read/Write Compatibility	Full Read/Write Compatibility	Read-Only	NOT COMPATIBLE	NOT COMPATIBLE
LTO Ultrium 3 400/800 GB, 680m	NOT COMPATIBLE	NOT COMPATIBLE	Full Read/Write Compatibility	Full Read/Write Compatibility	Read-Only	NOT COMPATIBLE
LTO Ultrium 4 800/1600 GB, 820m	NOT COMPATIBLE	NOT COMPATIBLE	NOT COMPATIBLE	Full Read/Write Compatibility	Full Read/Write Compatibility	Read-Only
LTO Ultrium 5 1.5/3.0TB, 846 m	NOT COMPATIBLE	NOT COMPATIBLE	NOT COMPATIBLE	NOT COMPATIBLE	Full Read/Write Compatibility	Full Read/Write Compatibility
LTO Ultrium 6 2.5/6.25TB, 846 m	NOT COMPATIBLE	NOT COMPATIBLE	NOT COMPATIBLE	NOT COMPATIBLE	NOT COMPATIBLE	Full Read/Write Compatibility

• Ultrium 6 drives are backward read & write compatible with Ultrium 5 Data Cartridges. When using an Ultrium 5 Data Cartridge, the Ultrium 6 Drive will write or read 1600 GB (3200 GB assuming 2:1 compression), same as an Ultrium 5 Drive.



Care and handling

Cartridge System Tape Care & Handling

Tape requires four elements (software, hardware, media & *people*) to function properly.

- Tape cartridges must be managed, handled and stored properly
- Good care and handling will maximize tape media longevity
- The real *value* of tape media is in the data - proper care safeguards your data

Cartridge System Tape Care & Handling

Hardware-Tape drive Cleaning

- Today's data tape drives require no (user) preventive maintenance beyond use of cleaning cartridges
- Cleaning cartridges should be used as soon as possible (and only) when requested by the drive, or as recommended by the drive manufacturer
- Do not exceed the number of uses specified by the cleaning cartridge

Cartridge System Tape Care & Handling

LTO Universal Cleaning cartridges

- **LTO UCC:** 50 uses max
(Early HP LTO 1 drives 15 cleanings)
- All LTO drives: Generations 1, 2, 3, 4, 5, & 6
- Cartridge Memory tracks usage & number of cleanings
- Drive will immediately eject when full number of uses are achieved with “Expired Cleaning Media” Message



Cartridge System Tape Care & Handling

Data tape cartridge media requires...

- proper operating environments
- proper storage environments
- proper operator handling
- proper shipping

Cartridge System Tape Care & Handling

Dust/Debris/Contaminants



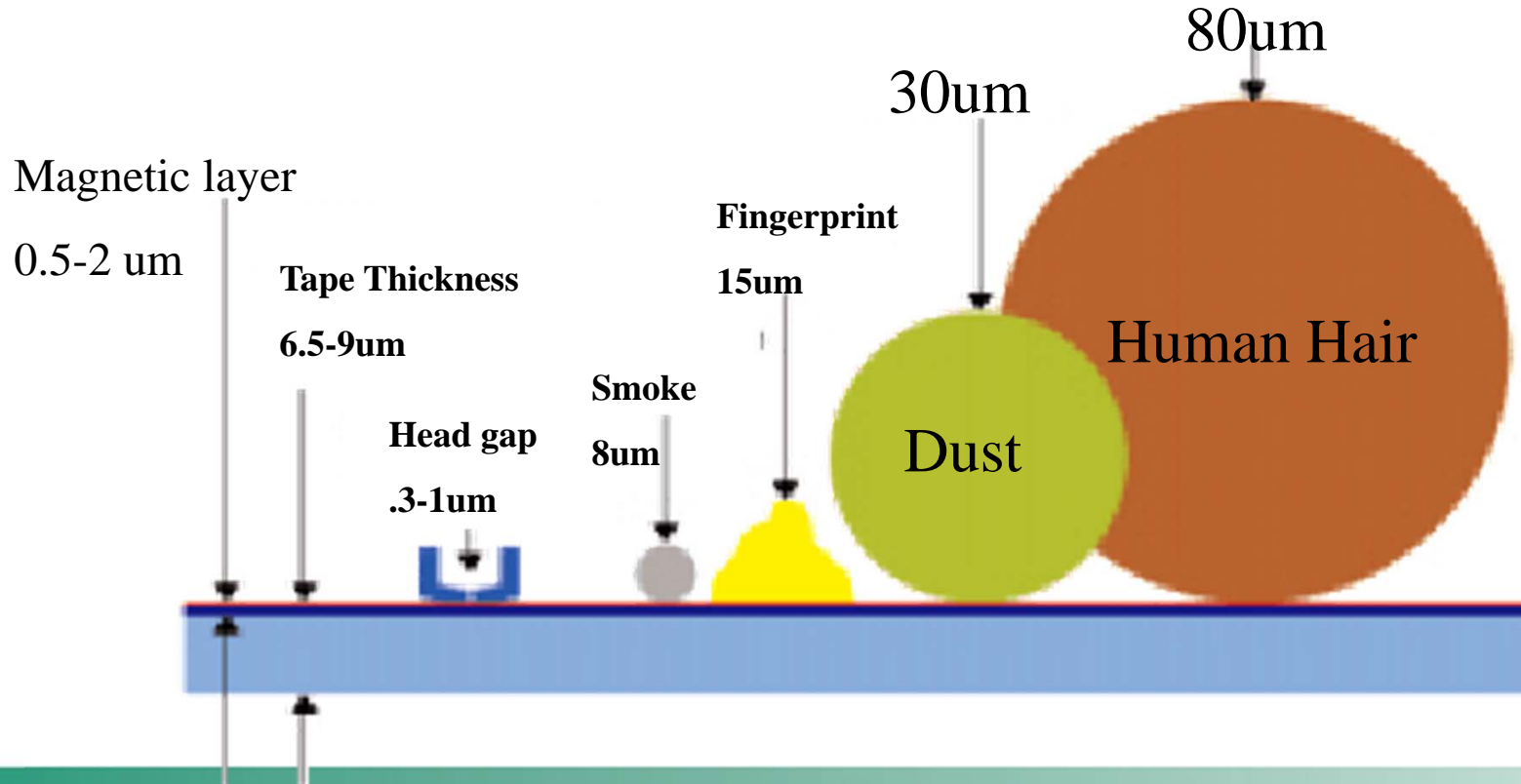
Cartridge System Tape Care & Handling

Proper tape drive operating environments

- Do not allow ***airborne dust*** or other **contaminants**, especially while drives are operating, but also during storage and shipping
- Typical contaminant sources: packing/storage materials (paper dust, cardboard particles, low quality foam debris), fingerprints, hair, dust, smoke, poor room filtration, etc...
- Any airborne dust or contaminants will get wound into the tape-pack and damage media
- Contaminants can also interfere with the head media interface, resulting in head clogs, R/W errors

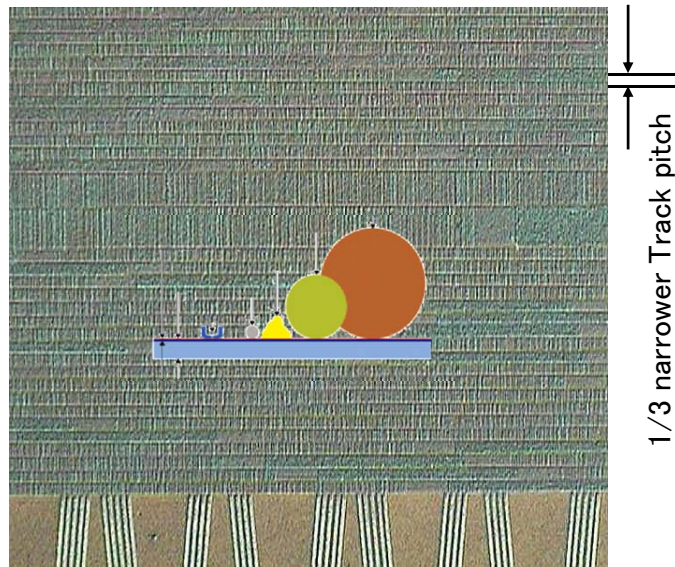
Proper tape drive operating environments

Typical Contaminants & Size Comparison

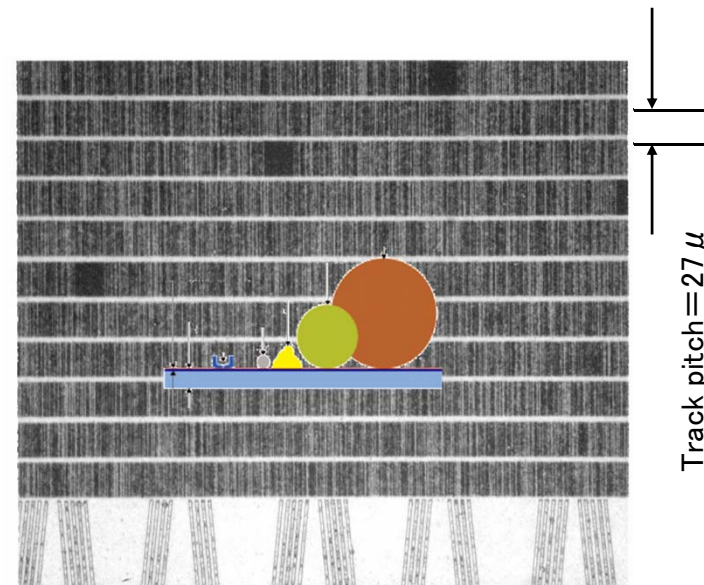


Proper tape drive operating environments

- Data tracks and contaminant particles-size comparison
- Dust/Debris can cause head clogs
- Decreased signal/Spacing loss
- Interfere/block servo tracks



LTO-5



LTO-1

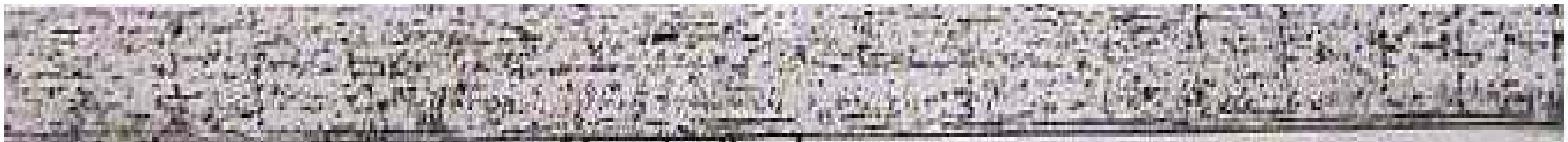
Cartridge System Tape Care & Handling

Tape cleaning machines are not recommended

- Can potentially damage media
- Beware of used or 're-certified' media



Magnetic layer severely damaged



Proper Tape Drive Operating Environment

- Do not allow ***excessive heat*** while drives are operating
- Temp at drive head is usually several degrees higher than ambient
- Insufficient cooling ventilation for the drive, due to a lapse in room cooling, can quickly cause excessive heat inside the drive at the tape head interface and damage media

Proper Tape Storage & Usage Environment

- Avoid uncontrolled temperature/humidity conditions for both intermediate and long-term storage
- Avoid harsh environments whenever possible; however, when extreme environments are unavoidable, plan for **acclimation** time
 - Cartridges should be acclimated to the drive-operating environment before use; Acclimate cartridges for at least as long as they were exposed to the uncontrolled environment, and/or up to 24 hours

Usage & Storage environments for LTO/3592

Condition	Temperature	Humidity	Magnetic Field
Usage – Drive Environment	10°- 45° C (50° - 113° F)	10 - 80% RH (max wet-bulb temp – 26° C)	
Short & Medium Term Storage	16°-35° C (61° -95° F) ± 2° C	20 – 80% RH ± 5% RH (max wet-bulb temp – 26° C)	4000 A/m (50 Oe) or less *
Long-term Storage	Ideal 18° C (65° F) ± 2° C 16-27C (61 -80F)	20 – 50% RH ± 5% RH (max wet-bulb temp – 26° C)	4000 A/m (50 Oe) or less *

* As magnetic fields dissipate quickly, ensuring tapes are at least 10cm (4") from any possible magnetic source will minimize the chance of any accidental tape erasure.

Cartridge System Tape Care & Handling

Proper tape media **storage** environments...

Use recommended containers: P-case, 'Vaulting' case, in a climate controlled area

- inert storage materials and pollution free environment
- free from dust, debris & contaminants
- Store cartridges vertically (reel axis horizontal)



Proper environmental conditions for operation and storage will maximize media longevity.

Cartridge System Tape Care & Handling

Proper operator handling

- Avoid rough handling and dropping tape cartridges...
- However, when the unavoidable happens – and it will – perform a thorough inspection for any damage
- A good policy is to retire any “scratch” tape that has received strong physical shock due to being dropped
- Think similar handling for HDD and Tape
 - *if you wouldn't do it to a hard disk drive...*

Cartridge System Tape Care & Handling

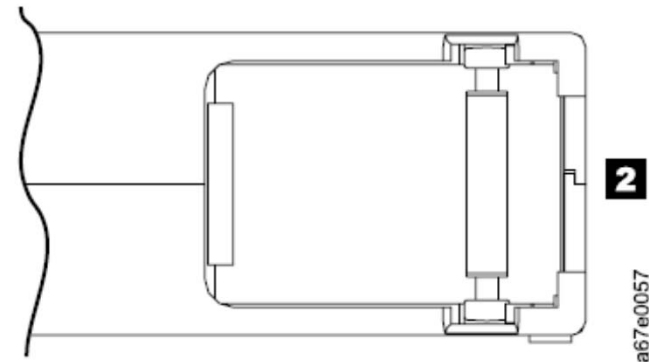
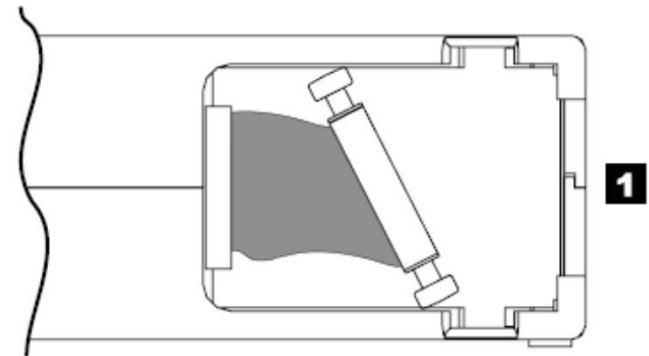
Proper Operator Handling- **Cartridge Drop/Impact**

- Leader pin could get dislodged
- Tape pack shift
- Tape Edge Damage
- Potential damage to internal parts
- Potential cartridge shell damage

Cartridge System Tape Care & Handling

Cartridge Impact –Leader pin

- Improperly Seated leader Pin may result
- Leader pin must be reseated prior to use
- Always inspect a dropped cartridge (damage, leader pin)



Normal Position

Cartridge System Tape Care & Handling

Cartridge Impact

Normal tape pack



Dropped Cartridge:

- Tape pack shift
- Popped out strands
- Edge damage

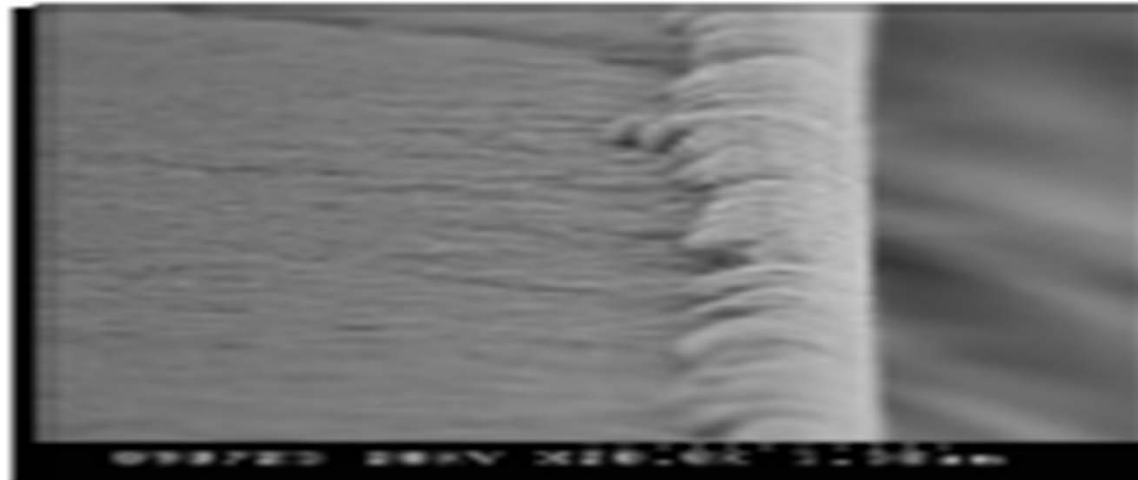


Cartridge System Tape Care & Handling

Cartridge Impact

Edge Damage

- Debris generation
- Loss of servo tracks and/or data



Software/Hardware Optimization

- Data path to tape should meet **drive streaming** rates
- Streaming rates affected by:
 - System Architecture (VTL in use?)
 - Software/Application/Hardware configuration & settings
- Non-streaming drive operation:
 - "Shoe shinning" - wear and tear on media and drives
 - Longer back-up times
- Balance drive and media usage
 - Spread the workload evenly across all drives & tapes
- Media management
 - Media rotation to balance usage across tapes

Causes of Backup Failure

➤ Human/Natural

- Lack of automation
- Lack of repeatable process

➤ Drives

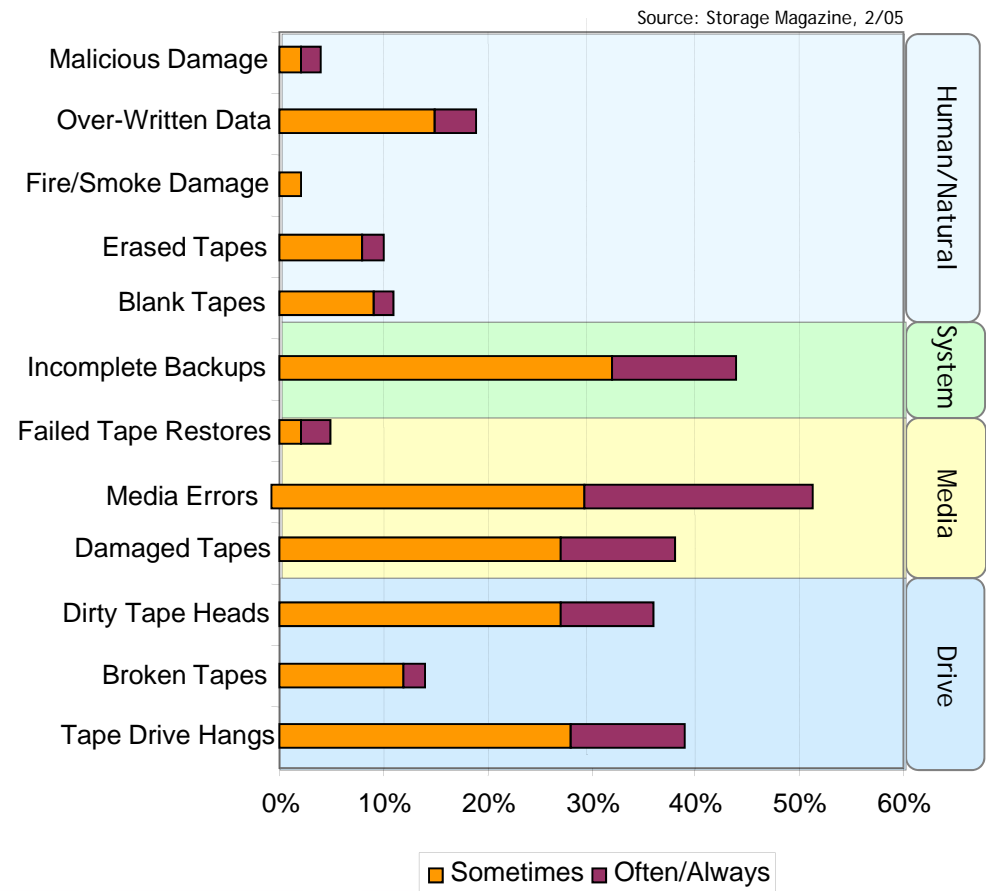
- Mechanical errors
- Dirty heads (write or read)
- Firmware errors

➤ System

- Drive utilization imbalance
- Underperforming drives
- Backup software errors/configuration
- Network capacity
- Network errors

➤ Media

- Damaged (scratch, shoeshine, creased, etc.)
- Degraded (worn, magnetic properties, etc.)



System Management Facility/Utility

- Monitor tape usage history
 - Track number of uses
 - Track error growth
 - Tape retirement guideline
 - ID overused tapes
 - ID possible problem drive(s)

- Options for monitoring
 - IBM EREP
 - SUN/STK PM2, STA
 - Fujifilm Read Verify Appliance (RVA)
 - Fujifilm Dternity
 - Fujifilm DC Analyzer

Fujifilm Data Cartridge Analyzer

**Diagnostic tool to assist with ID of media,
drive, & back-up problems**

- Simultaneous CM and barcode reader
- Software analyzes results, interprets error codes, grades media
- Historical tracking of cartridges
- Easy to understand graphical results
- Recommends solutions to common problems & errors

Fujifilm Data Cartridge Analyzer

● LTO : Cartridge Memory (CM)

1. What is CM ? CM is...

- an intelligent memory chip inserted in the cartridge.
- a non-contact passive RF interface memory chip.

2. What is its function? CM can...

- store information on tape usage, number of loads/unloads, cleaning, and error logs.

No need for physical connection between the drive & cartridge

➔ Reduce head wear & Raise Reliability !!



Shown 2X

LTO Cartridge Memory (LTO CM)
Radio Frequency Transponder
Serial EEPROM(*)

*EEPROM=
An embedded **E**lectronically **E**rasable
Programmable **R**ead **O**nly **M**emory module



DC-Analyser

Media pool: MediaPool33

Generation: [v] Condition: [v]

Manufacturer: [v] Drive Serial No.: [v]

14

OK MODERATE NG

ANALYSIS CAPACITY ANALYSIS Total Cartridge:26 Barcode No. Serial No.

Serial No.	Scanning Date	Thread Count	Capacity(GB)	Status
EODE0206	2008-05-02 18:07:06	9	38.562	NG
EODE0207	2008-05-02 18:07:06	9	38.562	NG
FRMW0201	2008-05-02 18:07:06	10	38.562	NG
GOOD0100	2008-05-02 18:07:06	9	38.562	OK
PSSY0205	2008-05-02 18:07:06	9	38.562	OK
TDSR0204	2008-05-02 18:07:06	9	0	OK

QUIT

ReadVerify Appliance (RVA) for Library w/ 10+ drives

ReadVerify Appliance



Fujifilm's ReadVerify Appliance (RVA) provides a proactive method for monitoring and validating the integrity of tape media, tracking the performance and utilization of tape devices to provide comprehensive reports on the health of the overall backup environment.

— Maximize Tape Library Assets

Complete view into the performance, utilization, and health of the tape library environment, providing visibility into the root cause of incomplete backups, unbalanced drive usage, and low performing assets.

— Minimize Data Risk

By monitoring the health and integrity of tape drives and media, RVA provides a proactive indication of data at risk. Errors are tracked over the productive life of the component to provide clear metrics for corrective action to minimize data risk.

— Real-time Notification

Enables proactive management and corrective action before failures occur.

— Data Recoverability Assurance

The optional ArchiveVerify (AV) feature reduces the risk of data recovery failure through scheduled, automated data validation, thus minimizing data risk and assuring regulatory compliance.

— Seamless, Heterogeneous Integration

RVA plugs directly into the SAN and begins monitoring immediately. Installation is agent-less, application agnostic, and heterogeneous.

Care and Handling- Barcode Labels

Starts with Quality Label Materials & Manufacturing

- Long lasting, stable adhesive
- Stable, fade resistant inks
- Protective overlay
- Optical characteristics optimized for barcode readers



Proper Application

- Orientation (barcode towards hub)
- Proper placement within cartridge label area
- Avoid creases, bubbles

Care and Handling

- Avoid scratches
- Dirt/debris may interfere with reading
- Avoid Temp/RH extremes & Cycling
- Proper storage (same as media)



EDP Tri-Optic In-house Label Printer

- **Fujifilm Exclusive!**

Tri-Optic® labels are *manufactured* (under license) at Fujifilm's USA factory

- Label of choice for major library OEMs
- A special design laminate overlay protects the label and optimally scatters light
- Applied in a clean room environment
- Technical support
- Quick order process time as labels are printed in-house
 - Drop ship direct to end-user
- Custom Logo Barcode Labeling



Cartridge System Tape Care & Handling

Proper shipping ...

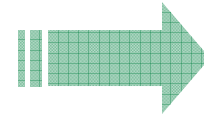
- Cartridges should be packed snugly in a rigid shipping box with adequate impact protection,
 - surrounded by adequate shock-absorbent material for protection and...
 - adequately supported to prevent any movement within the box
 - debris and particle free packing material
- Or, use one of the professional accessories, designed to meet the appropriate packaging requirements for the shipping circumstances

Cartridge System Tape Care & Handling

Cartridge Disposal

- Data tapes can potentially pose a serious data security concern for organizations because sensitive data can be accessible after disposal
- Any data retention policy that causes a company to fall out of regulatory compliance can result in very severe penalties that include fines, ceasing of operations and/or criminal charges.
- Fujifilm suggests that organizations immediately review their media management policies from purchase to end-of-life and make sure they:
 - Enact policies that ensure control of archived data before, during and after it leaves your organization;
 - Prohibit the selling of used media to protect against potential breach of confidentiality or violation of government regulations. Used media resellers routinely repackage and resell tapes with customers' data, potentially exposing data to unknown third parties.
- Develop guidelines for confirming appropriate data deletion and destruction of retired media, or utilize third party companies that provide proper certification of destruction
- A Certified Destruction service can guarantee cartridges are demagnetized, physically destroyed, and recycled –making your data impossible to access
- Specify “new, factory fresh” media when purchasing new media through a reseller. This will ensure that the media you receive is not merely initialized or repackaged to appear as new.

Fujifilm Tape Accessory Products
Protection and Storage



Data Tape Courier Pro Cases



- Reusable Vault/Shipping Containers w/tray system to fit all Mid Range & Enterprise tapes with or without p-case
- Holds between 14 – 40 DLT, LTO and Enterprise tapes
- Reliable compression clips, lockable, moisture seal
- Tested and Certified by Fujifilm



Data Tape Courier – Pro LTO Soft

Pro LTO Soft

- 14 LTO tapes without their plastic protective cases
- Made of super shock absorbent “Croc” material
- Particle and debris free



FUJIFILM Data Tape Tracker-GPS tracking during transit

Complete Surveillance Solution



User defined location
based security policy



Custom tracking
cartridges

24/7 Communications
Command Center



Data Tape Carousel



- This carousel is exclusive to Fujifilm, manufactured by Russ Bassett
- The unit rotates 360 degrees
- Each carousel unit is compact and equipped with 4 full-swivel casters allowing for easy relocation
- Dimensions- 76"H x 28"W x 28" D
- Shipping weight empty: 286 lbs.
- Cartridge Capacity:
 - 672 DLT per unit (26060000)
 - **768 LTO per unit (26060001)**
 - 336 DLT and 384 LTO (26060002)
 - 768 Enterprise (26060003)

Fujifilm Gemtrac

- Supports all data media formats ½ inch, DLT and LTO
- Fujifilm branded
- Can store up to 4,060 LTO cartridges in their plastic cases in 70% less space
- Need to register opportunities with Fujifilm to unlock discount





Tape Media Care & Handling



Questions?

FUJIFILM
RECORDING MEDIA