

A background image showing rows of tape storage racks in a data center. The racks are filled with tape cartridges, and the scene is lit with a cool blue light. The image is partially obscured by a dark blue semi-transparent overlay.

LTO Tape Handling Guide

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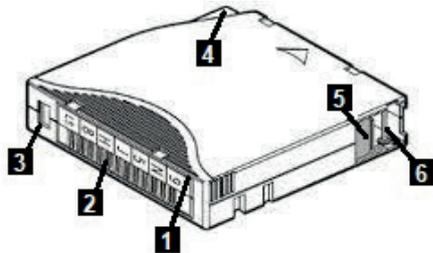
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0 - Preface

Welcome to the **LTO Tape Handling Guide!**

This guide provides information on proper treatment of magnetic tape cartridges to avoid data loss from inadvertent damage.



LTO tape cartridge components

1. LTO Cartridge Memory
2. Label Area
3. Write-Protection Switch
4. Insertion Guide
5. Cartridge Door
6. Leader Pin

Topics in this guide:

- **Cartridge Receiving/Unpacking**
- **General Cartridge Handling Procedures**
- **Cartridge Lifetime Guidelines**
- **Archive requirements for Long Term Retention**
- **Tape Cartridge Care & Handling Quick-Tips**
- **About Cleaning**
- **Best Practices Summary**

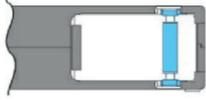
1 - Cartridge Receiving/Unpacking

- Inventory and inspect the delivery. Incomplete shipments or visible carton damage that may affect the contents should be immediately noted on all copies of the carrier's delivery receipt.
- If the shipment was not properly packaged to protect the cartridges against damage, inform your vendor.
- Do not immediately unpack the shipment if acclimation is required. Acclimation means allowing data cartridges to slowly adjust to the drive-operating environment for up to 24 hours prior to use.
 - Keep tape cartridges in the shipment packaging for the first 8 hours.
 - Unpack the cartridges for the second 8 hours. By doing this, inspect for damage. If cartridge damage is discovered, keep all packaging material as evidence for filing a claim.
 - Remove the cartridges from their protective cases for the third 8 hours.

2 - General Cartridge Handling Procedures

- Inspect cartridges prior to inserting into a drive to make sure that they are clean and undamaged.
- If a cartridge is damaged or dirty and there is no other source for this information and the cartridge must be mounted, mount the cartridge once by copying the data to a new cartridge.
- Do not drop the cartridge. If it is dropped, copy the data from the dropped cartridge to another cartridge, and retire or destroy the dropped cartridge.

- Assure that the leader pin is seated properly.



- Keep cartridges away from dust and debris. Do not store them near copier or printers or shipping and receiving areas.
- Keep cartridges at least 8-12 cm away from high current power cables, power supplies, motor generators because recorded media can be erased if exposed to a large magnetic field.
- Operating temperature should be between 10°C to 45°C (50°F to 113°F).
- Relative humidity while operating should be between 10% and 80%
- Do not degauss as servo-tracks will be erased and the cartridge would be unusable.
- Tape surfaces should never be touched as residue from a fingerprint can create greater head-to-tape separation and result in loss of signal

3 - Cartridge Lifetime Guidelines

- If a cartridge experiences a permanent error on more than one drive, copy the data to another cartridge.
- A general rule of thumb criteria for cartridge replacement is if an unrecoverable error occurs more than twice on one device, or on two or more devices, the cartridge should be retired.
- Cartridges should be retired at least after 350 read/write cycles (if no full capacity reads/writes are performed).
- See table* below for estimated lifetime.

LTO Generation	Total End to End Passes	# Passes for full Capacity	Number of full Capacity Read/Writes	Years of Life at 1 full capacity write/week
LTO-6	20.000	136	147	~3
LTO-7	20.000	112	178	~3.5
LTO-8	20.000	168	119	~2
LTO-9	20.000	208	96	~2

- For daily utilisation, exchange cartridges at least every 1 to 2 years.

* source: Wikipedia

4 - Archive requirements for Long Term Retention

- As datasheet talk about an archival life of 30 years, environmental prerequisites have to be considered.
- Studies have shown that the operating and storage environments have a strong effect on the generation of debris.
- Friction is increased under high temperature and humidity conditions, and usually results in increased debris generation.
- Media stored and operated in environments where the humidity is very low (dry condition) also show a propensity for generating debris
- Storage areas for the archiving of media should be clean and free of dust and contaminants.
- Media should be stored vertically.
- Archive temperature should be between 16°C and 25°C (61°F to 77 °F) (35°C (95°F) if archiving < 6 months).
- Archive humidity should be between 20% and 50% (80% if archiving < 6 months) non-condensing.
- Maximum wet bulb temperature should be max. 26°C (79°F) regarding to the whole system. Possible temperature/humidity combinations (in green) can be taken from the table below.

wet bulb temp [°C]		environmental temperature [°C]							
		35	32	29	27	24	21	18	16
relative humidity [%]	20	19	17	16	13	12	10	8	6
	30	22	19	18	16	14	12	10	8
	40	24	22	20	18	16	13	11	9
	50	26	24	22	19	17	14	12	10
	60	28	26	23	21	19	16	14	11
	70	31	28	26	23	20	17	14	
	80	32	29	27	24	22	19		

5 - Tape Cartridge Care & Handling Quick-Tips

Environmental Issues

- Allow cartridges to acclimate for at least 24 hours prior to use
- Use cartridges in a clean environment
- Maintain relative humidity between 30% and 50% in the environment where the cartridges will be used, and a temperature between 16°C and 32°C
- Keep cartridges away from moisture, dirt, and direct sunlight

Transporting Cartridges

- Use cases that prevent the cartridges from getting bumped against each other or any other hard surface
- Tapes have to be accommodated in a way to prevent any movement inside
- Manually carry minimum amounts of tapes to avoid accidental drops
- Avoid rapid temperature or humidity changes
- Avoid large magnetic fields such as those in large motors or high voltage lines
- Always ship data cartridges in original manufacturer or better packaging
 - surrounded by adequate shock-absorbent material for protection and
 - adequately supported to prevent any movement within the box and
 - oriented on edge (tape reel axis horizontal) inside the final box
- Do not drop cartridges



Storage Issues

- Keep cartridges boxed until ready for use
- Keep cartridges away from known generators of dust and debris such as printers, copiers, and cardboard unpacking areas
- Keep recorded and unrecorded cartridges away from high current cables, power supplies, motors, and generators. Recorded information could be lost if the magnetic field is greater than 40 gauss in air

Handling Issues

- The deep recessed label area on the cover of the cartridge allows users to stack the cartridges. However, only stack the cartridges up to 6 high
- Use the write protect feature available on all cartridges to protect data which is not to be overwritten, check if writing should be re-established
- Do not load a damaged or dirty cartridge into a drive, since it could result in damage to the drive. Consult the hardware service engineer before placing any questionable cartridge into the drive
- When moving cartridges around in the library, use a carrier that isolates the cartridges from each other and limits movement
- Do not open the cartridge for any reason

6 - About Cleaning

The necessity of a clean environment

The LTO cartridge itself consists of between 846m and 1.035m of tape media wound on a hub, and enclosed in a hard plastic shell. Any dust particle or contaminant can enter the tape pack via this opening, especially during the period of time when it is loaded into the drive. This can present a problem both to the tape and to the drive. Anything that the LTO tape cartridge comes in contact with needs to be free of dust and contaminants. This includes the tape drive, the cartridge handling automation, cartridge carriers, cartridge transport containers, and operating and storage environments.

Cleaning Cartridges

Internally, the primary mode of maintaining cleanliness is the utilization of cleaning cartridges. All drives require the use of cleaning cartridges as part of the routine operation.

Cleaning Cartridges do not last forever. You should use a new one at least after 50 usages.

Cleaning indication

LTO drives automatically request cleaning requirement based on utilisation and read/write errors. Standalone tape drives, autoloaders and tape libraries will display an indicator (i.e. led or display a "C") when cleaning is required. You should only clean the drive, when these indicators show up.

Cleaning and tape automation

Most autoloaders and tape libraries provide a dedicated cartridge slot for cleaning cartridges. So a tape automation system is able to perform an automated cleaning on drive request. This slot can mostly also be configured as an additional slot for data cartridges. If there is no capacity problem, this slot should be kept as a cleaning cartridge slot to benefit from fully automation convenience.

Software vs. hardware based cleaning

If cleaning is requested by a tape drive, tape automation systems will perform the cleaning process by themselves. If operated by backup or archival software, which include media management and often cleaning handling, cleaning can also be initiated by software, as an autoloader or tape library is able to send a command to the backup or archiving software. We recommend the software based cleaning, as it will be recorded into the regular event log of the software which is more convenient as getting the information out of the library, which might not be easy accessible.

Cleaning Guidelines

- Only clean if indicated by drive
- Keep a cleaning cartridge in an autoloader or tape library
- If supported, use software based cleaning
- Replace cleaning cartridge after 50 cleaning cycles
- Keep the environment clean
 - Any carrier, rack, or shipper that comes in contact with cartridges should be free of dust or any other type of contaminant
 - Periodic schedules for cleaning carriers, racks, and shippers should be implemented.
 - Data centres that house LTO media and drives should isolate copiers, printers, food, and drinks away from the media and drives.
 - Operations that are heavily dependent on packaging or unpacking cardboard boxes, or other debris-generating materials, should keep this activity outside of the data centre.
 - All cartridges being loaded into a drive or automated cartridge handling equipment should be inspected prior to loading to make sure that they are free of debris.

7 - Best Practices Summary

- It is best to protect cartridges from extreme conditions by avoiding uncontrolled environments! However, when harsh environments are unavoidable, plan for acclimation time. Always inspect the tape before inserting into the drive or robot.
- During an inspection, never touch fingers in the media. This can cause data loss and also transfer dirt into the unit.
- Never apply labels out of the marked area. If the label is in the correct position but has damage, it must be replaced. Important: Never apply a label over another even if applied in the appropriate area. If you need to replace, remove an old one and apply the new one.
- If the tape is dropped accidentally, it should be inspected. A fall might cause the release of the Leader Pin or damage the teeth of the lower gear.
- Always pack the tape inside the case when not in use, always in an upright position and never stack them.
- Never open the tape, because removing the screws and exposing it can damage it, and the assembly process is not simple.
- Don't store tapes near magnetic fields, ex: x-ray, Electric power board, Transmission network, no breaks, etc.
- Use only suitable cases with individual accommodation during transport, avoiding contamination by dust or debris. Never pack the tapes next to printers or copiers.
- Allow a 24-hour for the tape to acomodate to the operating temperature and humidity before using new or stored cartridges.
- Make sure all sides of the tape are dry before inserting it into the drive.
- Never expose the tape directly to sunlight or humidity.
- Eject media before turning off the drive.
- Use PEPS / FIFO process to better balance the use of tapes, minimizing wear.

