

Erasing LTO Tapes

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Erasing Tapes



- Destruction of data *without* destroying the media
 - ◆ Degaussing erases magnetic servo tracks and therefore destroys media
 - Tapes with magnetic servo tracks:
LTO, 3592, 9840, 9940, T10000

- Encryption limits requirement for erasing tapes
 - ◆ LTO Gen4 has encryption hardware in the tape drive
 - ◆ Erasure (or misplacement) of 256 bit key "erases" 0.8TB of data

Requirement to erase tapes



- Sale of used cartridges on open market
 - ◆ Upgrade to new generation of tape drive
 - ◆ Preventative move to avoid problems with aging tapes
 - ◆ Going out of business

- Moving cartridges between departments of a company
 - ◆ Requirement that data stay within departments

Standards



■ Governmental

◆ DoD 5220.22-M often cited

- Industrial security – little mention of magnetic tape
- Divides tapes into three types depending on coercivity
- Type III (high coercivity) ≥ 750 Oe
- All newer tapes are in this category

■ Other

◆ Prevent recovery organizations from reading data

Erasing Methods



- Writing a short file at the beginning of tape
 - ◆ Creates a new EOD (End Of Data) mark
 - ◆ LTO drive will stop reading at the EOD mark
 - ◆ Data beyond the EOD is still there
 - ◆ Data beyond EOD is accessible
 - ◆ Method is deceptive
- Method is commonly used by used cartridge resellers

Erasing Methods



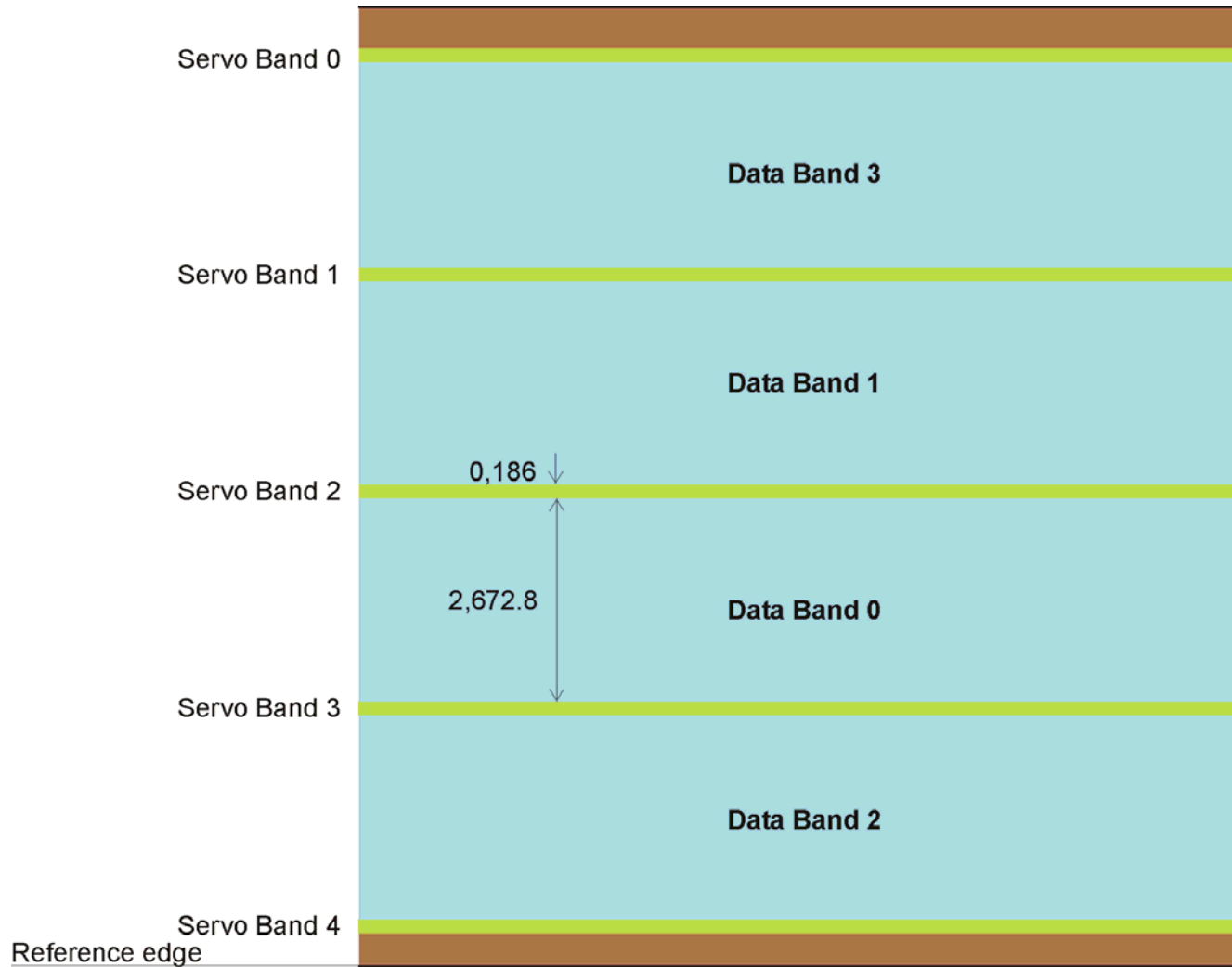
- Overwriting the entire tape
 - ◆ Tape has to be written to full capacity, not just to current EOD
 - ◆ Takes ~2 hours and is not economical
 - ◆ Not done by any reseller

- Degaussing tape and re-writing the servo tracks
 - ◆ Servo writing technology limited to media manufacturers
 - ◆ Done on pancakes, not cartridges
 - ◆ Difficult to implement

Erasing Methods



■ Erasing between the servo tracks



Tolerances

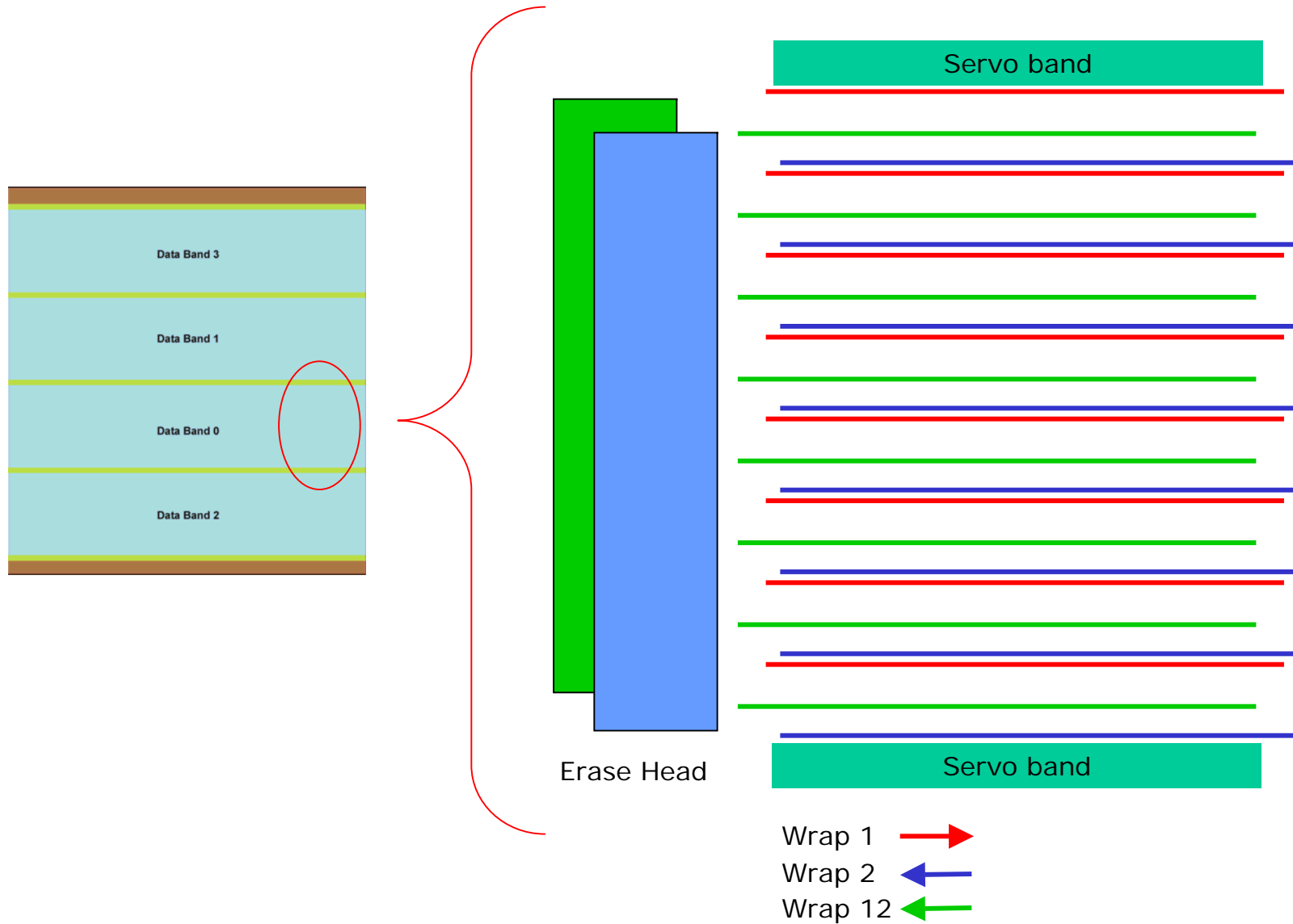


- Erasing without track-following
 - ◆ Erase heads have large mass
- Tolerances

Location of servo bands	$\pm 20 \mu\text{m}$
LTM of eraser	$\pm 10 \mu\text{m}$
Head mounting/variation	$\pm 70 \mu\text{m}$
Other	$\pm 20 \mu\text{m}$
Total	$\pm 120 \mu\text{m}$

- Erase head width $>240\mu\text{m}$ narrower than data band

Erase head location

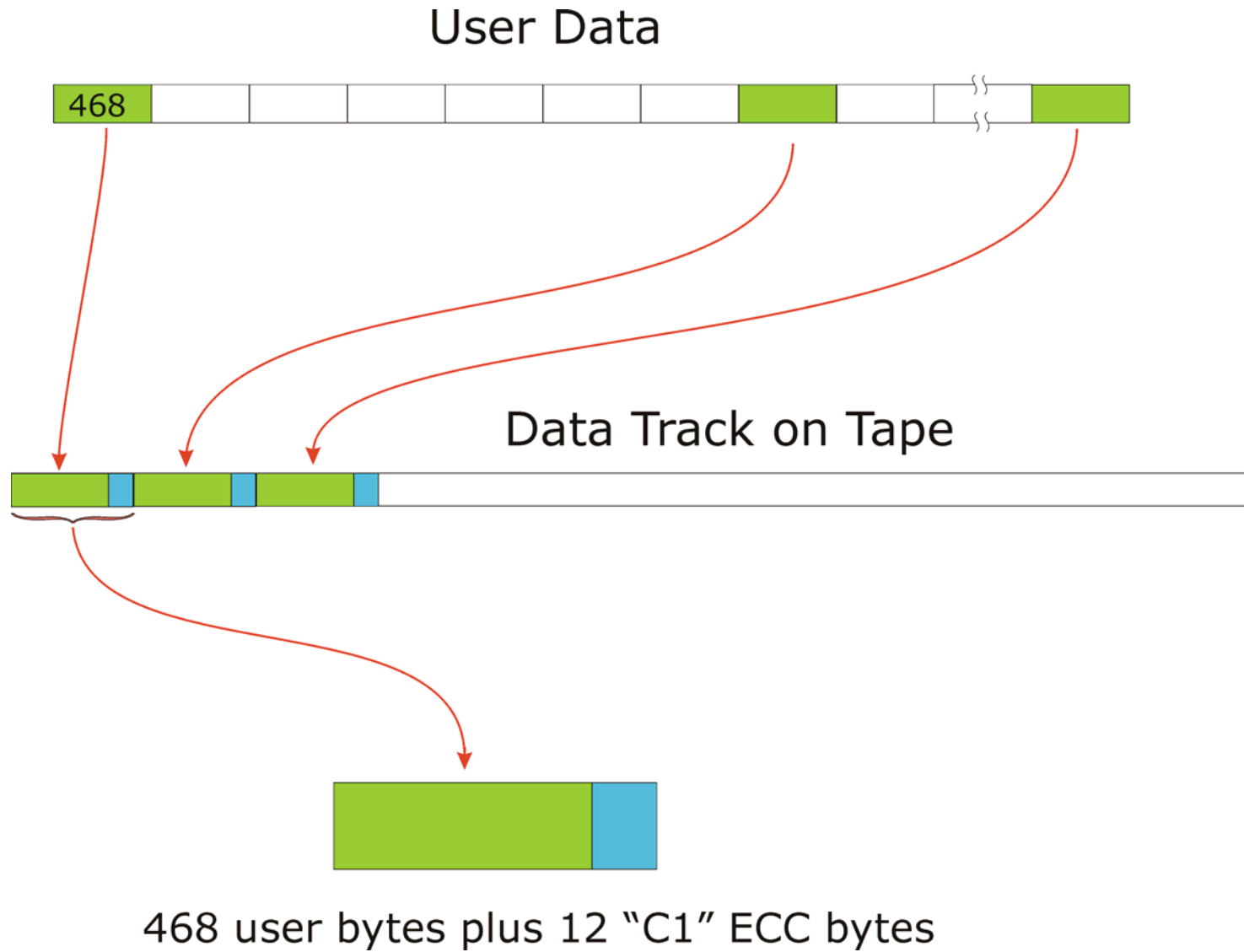


7 out of 8 good enough ?



- Erasing data between servo bands erases 7 or 8 tracks
 - ◆ OK to not erase 1 track?
 - ◆ LTO drive will not read remaining track
 - ◆ Can data be recovered from one track?

User data -> track format



User data -> track format

The logo for ME II, featuring the letters 'ME' in a bold, yellow, sans-serif font, with a Roman numeral 'II' to its right, all set against a black silhouette of a mountain range with a yellow outline.

■ Simplified model

- ◆ Ignores track rotation
- ◆ Assumes data are not compressed
- ◆ Ignores "C2" ECC byte groups
- ◆ Does not show data format
 - Randomized
 - RLL encoded
 - Addition of headers

Single track recovery



■ Equipment

- ◆ Tape transport
- ◆ Actuated LTO head
- ◆ Read electronics
- ◆ Data acquisition logic
- ◆ Software

Single track recovery



■ Procedure

◆ Hardware

- Scan tape for remaining data tracks
- Read data bits while track following

◆ Software

- Find byte groups (CQs)
- Decode RLL groups
- De randomize data
- Remove headers
- Check and correct data using "C1" ECC bytes
- Flag data groups containing errors
- Assemble recovered data

Single track recovery



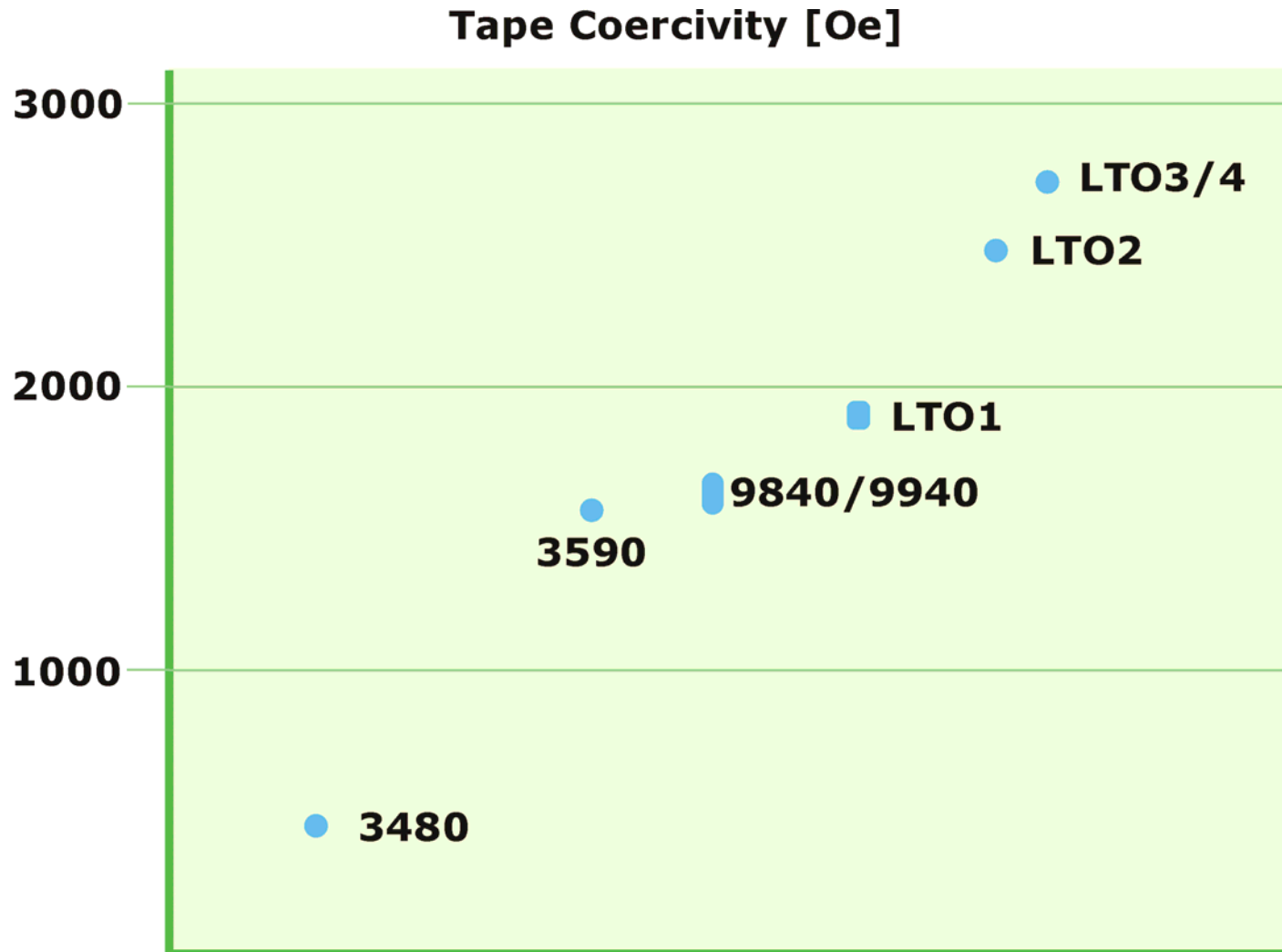
- Recoverable data
 - ◆ Strings of 468 user bytes followed by missing 3276 or more bytes
 - ◆ Reduced error correction ability without the benefit of "C2" error correction
- More data are recoverable if more tracks remain
- No commercial data recovery institution has the ability to recover single track data

Erasing data



- Magnetic layer can be saturated by erasing field
 - ◆ No recoverable remaining signal
- DC erase is possible
- Required field strength depends on coercivity

Media coercivity



Four track erase head

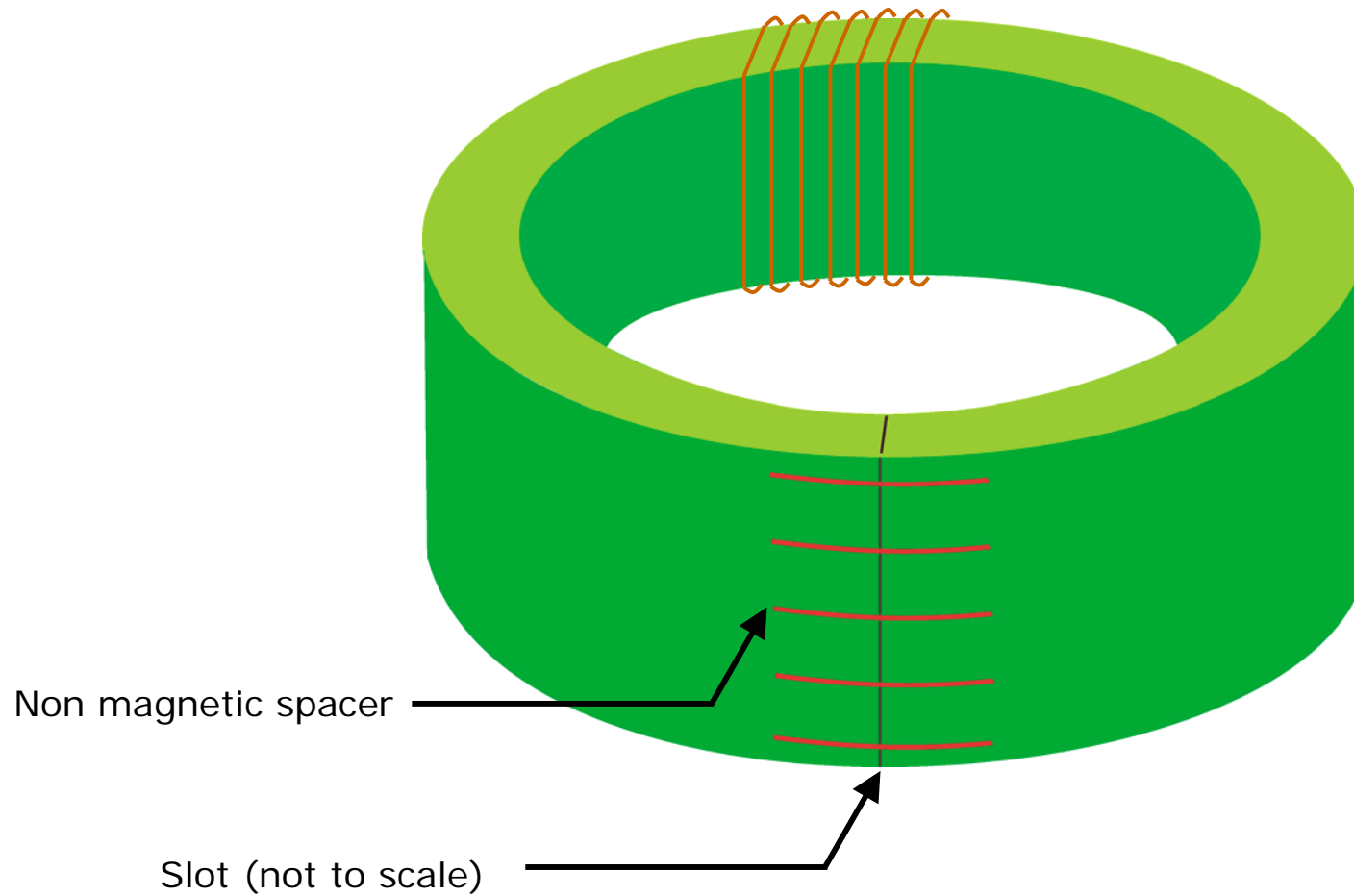


Write element

Servo band location

Erase head (not LTO)

Toroid head



Toroid head



- Non-contact head
 - ◆ No contamination of head
 - ◆ No head wear
 - ◆ No tape wear
 - ◆ Supports high tape speed
 - ◆ Low cost

Cartridge Memory



- Cartridge Memory (CM) should be updated
 - ◆ Tape directory
 - ◆ EOD location
- Statistical quality data must remain
 - ◆ Resetting statistical data is equivalent to resetting the odometer in a used car

Testing



- Erasing is a blind operation
 - ◆ Run-time monitoring of erase current

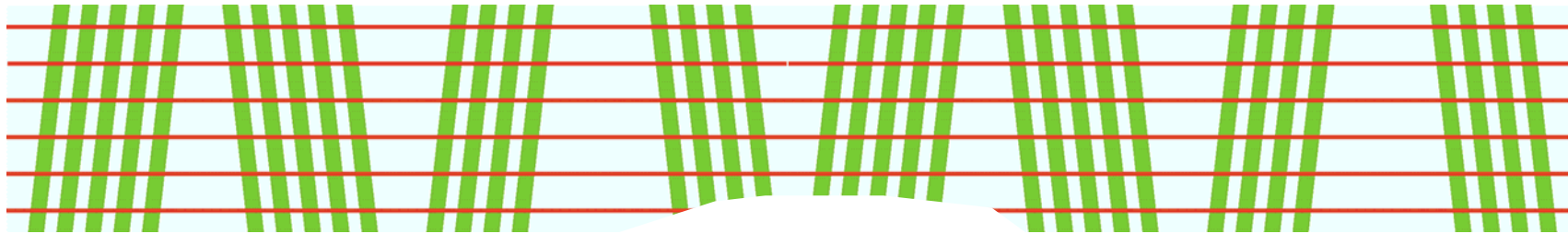
- Requirement for tests
 - ◆ Pre-shipment testing
 - ◆ Periodic tests in field

- Test objective
 - ◆ Test for integrity of servo bands
 - ◆ Test for erasure of data tracks

Testing for Servo integrity



Servo Band with 6 servo locations (red lines)



- Servo defect caused by erasure
 - ◆ Servo defect can be at the last wrap at the end of the tape
 - ◆ Not detected until writing at that location occurs
 - ◆ Permanent write failure if defect is large

Test methods



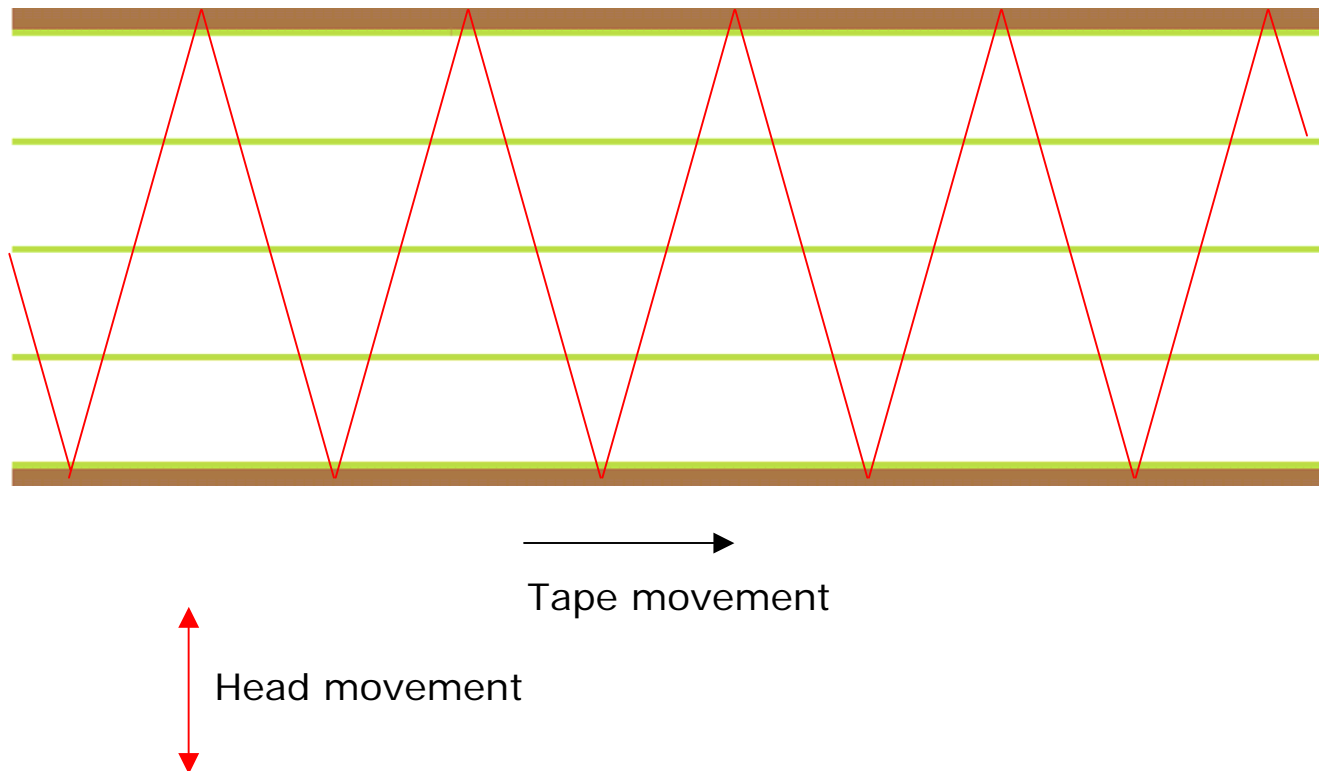
- Development of erased tape
 - ◆ Check of tape ~20 times
 - ◆ Problems may not be easily visible
 - ◆ 40m of unchecked tape between checked locations
 - ◆ Destructive to tape
 - ◆ Difficult to automate
 - ◆ Expensive
 - ◆ Performed infrequently

Test methods



■ Tape scan

- ◆ Move head over 5 servo bands and 4 data bands



Tape scan



- Check Servo Band in intervals $< \frac{1}{2}$ maximum allowed servo defect length
- Check remaining data tracks
- Check entire tape
- Generate test report
- Automated procedure

Tape scan



- Performed prior to shipment
- At customer site
 - ◆ We sent tape with test data
 - ◆ Customer erases tape and returns to us
 - ◆ We perform scan and send test report and certificate
 - ◆ Periodic test
 - After time period since shipment or last certification
 - After number of tapes erased

Erasing LTO cartridges



- Erasing data without erasing servo bands is possible
- Reliable operation
 - ◆ Frequent check of equipment
- Remaining data difficult to recover
 - ◆ In extreme situation incineration of cartridge is recommended

Commercial products



■ LTO Eraser

- ◆ Includes VeriTape
- ◆ Score of cartridge quality based on statistical data in CM
- ◆ Worn and damaged cartridges can be eliminated based on configurable minimum score value



Commercial products



■ 9940/9840

◆ 11 m/s erase speed (9940)

