Erasing LTO Tapes

Peter Groel
Mountain Engineering II, Inc.
1233 Sherman Drive, Longmont CO 80501-6133
Phone: +1-303-651-0277   FAX: +1-303-651-6371
E-mail: peterg@MountainEngineering.com

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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) \( \geq 750 \text{ Oe} \)
    - 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

<table>
<thead>
<tr>
<th>Description</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location of servo bands</td>
<td>± 20 µm</td>
</tr>
<tr>
<td>LTM of eraser</td>
<td>± 10 µm</td>
</tr>
<tr>
<td>Head mounting/variation</td>
<td>± 70 µm</td>
</tr>
<tr>
<td>Other</td>
<td>± 20 µm</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>± 120 µm</strong></td>
</tr>
</tbody>
</table>

- Erase head width >240µm 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

468 user bytes plus 12 “C1” ECC bytes
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

Tape Coercivity [Oe]

- LTO3/4
- LTO2
- LTO1
- 3590
- 9840/9940
- 3480
Four track erase head

Erase head (not LTO)
Toroid head

Non magnetic spacer

Slot (not to scale)
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

![Diagram of tape movement and head movement]
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)