The Care and Feeding of Magnetic Tapes

Patricia A. Reslock
Center for Naval Analyses
Alexandria, Virginia

There are many obstacles to successfully acquiring machine-readable data. Difficulties usually occur during the physical transfer of the data from one site to another, the most common method being magnetic tape. Yet, even with higher quality tape and more efficient tape drives, tape processing is still plagued with problems. Parity errors, incompatible tape labels, multiple encoding schemes, and poor quality media have all contributed to tape users' frustration. In an attempt to educate the nontechnical professional, this paper will give an overview of the technical aspects of magnetic tapes and their use. Topics include the physical aspects of magnetic tape, how data is stored on tape, recording modes, tape errors, and their prevention.

A data archivist faces two main tasks: data acquisition and data maintenance. To acquire data you must know how data is stored on tape and what your installation can handle. The information necessary to successfully transfer data between sites will be covered below, as will housekeeping measures essential to keeping magnetic tapes readable.

Data Acquisition

The physical aspects of magnetic tape. A standard magnetic tape has a 10½-inch hub filled with ½-inch wide tape. The tape should be 2400 feet +50 feet, -0 feet. It is important to bear this in mind when purchasing new tapes, as tapes of less than 2400 feet are indicative of poor quality control.

A magnetic tape is composed of three layers. The first layer is made of oxide; this is where the magnetized data is stored. This layer must be smooth and of uniform thickness (0.00045 of an inch). The second layer (the binder) is a glue used to make the oxide adhere to the backing. The binder must be flexible enough to reduce oxide chipping, yet, not too sticky, or the tape will stick to itself. The last layer is the backing, and it is usually made of mylar. Creating a magnetic tape is a complex task; hence it is important to have rigid quality control standards.

There are three important points to be aware of when exchanging data on tape: 1) Is the tape labeled or unlabeled? 2) How many data files are on the tape? and 3) How many tape reels does the data span?

Tapes can come with or without labels, and files can come as a single file on a single tape reel, multiple files on a reel, a single file on multiple reels, or multiple files on multiple reels (reference (1),(2)). You must know what types of tapes your installation can handle and what types of utilities are available at your site for processing these types of tapes. Check to see if one form is easier to handle than another. If so, see if you can receive the data from the sending organization in that form.

Here is a list of the other items you need to know when receiving a tape:

1. Is the tape 9-track or 7-track (7-track is fairly old technology, but does still exist)?

2. How large is the blocksize of the data? Some systems cannot handle blocked data.

3. At what density was the data recorded (6250 BPI, 1600 BPI, 800 BPI)?

4. At what parity was the data recorded (even or odd)?

5. What is the character set in which the data was recorded?

Some character set possibilities include:

ASCII American National Standard Code for Information Interchange. Most commonly found on Digital Equipment Corporation systems;

EBCDIC Extended Binary Coded Decimal Interchange Code. IBM, Amdahl, Burroughs;

BCD Binary Coded Decimal Character Code. CDC6600, Honeywell;

FIELDATA Standarized Military Data Transmission Code. Univac.

The main point to all this is: Know what your system has and what it can handle. Your Computing Services department should have a handout telling the easiest way to receive data. This information is imperative for a successful transfer of data.

I have found the government form "Transmittal Form for Describing Computer Magnetic Tape File Properties" to be an invaluable reference when receiving or sending data (reference (3)). You can use this form in one of two ways. When receiving data, fill it out the way you need to receive the tape, and send the form along with your data request. When sending data, send the form filled out with the specifications of the way the tape was created.

Tape Maintenance

How to minimize, correct, and prevent errors. Most tape errors are due to contamination of the tape, physical mishandling, or problems with tape drives and/or tape cleaning equipment. Here are some items that you want to consider to keep your tapes readable (reference (4)).

Reduce contamination. Most tape contamination comes from the tapes themselves. Oxide chips off the surface of the tape each time the tape is used. One way to reduce this chipping is to buy high quality tapes made with good binder. Other contamination comes from carelessness in handling tapes or a dirty computer room. Some ways to reduce contamination are:

1. Reguarly clean tape drives. (At CNA we clean the drives at the start of every shift and before tape intensive jobs.)

2. Maintain the proper recommended temperature and humidity--this helps to reduce the oxide chipping.

3. When cleaning the floors around tapes, clean the entire floor with a damp mop--DO NOT sweep, dry mop, or dust.

4. Minimize floor waxing--if you must wax, machine buff to remove the excess wax, damp mop with cold water to harden the surface, and buff again when dry. NEVER use steel wool or other metal abrasives for buffing.

Another way to reduce contamination is to regularly clean tapes (once every eight uses). Be very careful if you decide to do this, as some tape cleaners do more harm than good. I would not recommend using a tape cleaner on a tape that is error free.

Tape drives can also produce tape errors. Your organization should have a regular tape-drive maintenance program where a field engineer does routine cleaning and alignment of the drives. This preventive maintenance is invaluable.

Long-term storage. Once a tape has been hanging on a rack for about six months, it starts to deteriorate. Pieces of dirt and chipped oxide start to cause dents in the backing of the tape. The tape may become unreadable because the dent is causing the tape to be too far away from the read head of the tape drive. The best way to prevent this type of problem is to spin tapes every six months. The preferred method is to have a program that scans the data on the tape to be sure the tape can be read. If there are problems, you will know it early and will be able to copy the data to another reel. If you wait for a long period of time to spin a tape, the damage could be permanent. The concept is the same as walking with a rock in your shoe. If you walk a block and take it out, you probably will not suffer any long-term damage. If you walk a mile with a rock in your shoe, you will have a hole in your foot.

Tape handling. Tips for tape handling include:

1. Keep tapes in the computer room.
2. Tapes should not be laid on top of the tape unit.
3. External tape labels should be sticky labels that peel off and leave no residue.
4. Never allow the beginning of the tape to trail on the floor.
5. Smoking should not be permitted around tapes.

Tape storage. Tapes should be stored in an upright position in a cabinet or shelf elevated from the floor, and as far away from sources of paper and card dust (line printers and card reader/punch) as possible.

Backups of valuable data sets should be kept off site. To save money, look for a sister institution to swap tapes with instad of paying for vault storage.

Tape Transmittal. Very often tapes are damaged in the mail or while being hand carried. Tapes sent through the mail should be clearly marked MAGNETIC TAPE--KEEP AWAY FROM ELECTRIC MOTORS, SCANNING DEVICES AND MAGNETS--DO NOT X-RAY. Be sure to give the above adivce to the courier for tapes being hand carried.

Conclusions and Recommendations

To ease data transfer, know the answers to all of the questions on a form like "Transmittal Form for Describing Computer Magnetic Tape File Properties" (reference (3)). Be sure to ask for some type of a dump or map of the tape being created. This makes the sending installation look at the tape after it is written--that is, it forces them to be sure something was written to the tape. Finally, be sure to get documentation on the data. These items include record layout, descriptions of all the variables and how they were derived, and the count of the total number of records in each file.

To insure in-house data reliability, scan data tapes every six months to a year to be sure they are readable. At first sign of trouble, recopy the data. Recopy vauable data sets to NEW tapes every three or four years. Try to maintain cleanliness at your sit. DO NOT use a cheap tape cleaner. It will do more damage than good. Most important of all: buy the best quality tapes you can afford.

References

(1) VAX/VMS Magnetic Tape User's Guide, VAX/VMS Version 3.0. Digital Equipment Corp, Maynard, MA; Chapter 2. May, 1982.

(2) U.S. Department of Commerce. National Bureau of Standards. Magnetic Tape Labels and File Structure for Information Interchange. Federal Information Processing Standards Publication 79. 1980.

(3) U.S. Department of Commerce. National Bureau of Standards. Transmittal Form for Describing

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