THE CURRENT STATE OF AMERICAN TELEVISION AND VIDEO PRESERVATION

SPECS BROS., LLC

INTRODUCTION

SPECS BROS. is a magnetic tape decontamination and restoration facility. We specialize in disaster recovery and the rejuvenation of archival tapes suffering from material breakdown. Since 1983 we have been examining, testing, cleaning, repairing and restoring tapes that would not play back at all or exhibited signal retrieval problems. Our extensive hands-on experience and focus on physical restoration prior to playback give us a unique perspective on video preservation.

We are pleased to have been asked to share our experience with this body as we sincerely agree that the community as a whole needs to take an in-depth look at the problems of preservation. We need to communicate what is being done now, envision what may be done better in the future and reevaluate some of the assumptions we have labored under in the past. Since we deal with the practical realities of video preservation on a daily basis, we have identified a number of actions and biases that have far-reaching effects.

PERCEPTUAL BIAS

Initially, two preconceptions one encounters repeatedly must be addressed if any current video preservation initiative is to be successful. The first is "print and film are physical media but video is an electronic medium". While video may be recorded, manipulated and transmitted electronically, the medium on which the information actually exists *is* physical. With videotape, the potential for preservation is greatly enhanced by the fact that the signal itself is fairly hard to destroy. However, retention of the signal becomes academic if the physical tape has been so abused or degraded that the signal cannot be retrieved.

A perceptual bias effectively disassociates the physical tape from the program or image it contains and makes tapes vulnerable to mistreatment. Humans are, by nature, visually and task oriented. A videotape containing images of "President Nixon" physically looks like a disk or a small plastic box. Its physical appearance recalls neither the President nor the many hours of shooting and editing required to create the program. Experience shows that personnel do not intuitively make the connection. Once a program has been recorded or viewed, the tape itself becomes an object, divorced from the image it contains and emotionally devoid of value.

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While people are excited by the image on a monitor, and by the costly hardware used to manipulate the image, they fail to be excited by the reel or cassette that actually ***contains*** the image. So, while personnel and machinery are maintained in relatively clean, climate controlled environments, there is a tendency to stick the tapes away in whatever space for which an organization can't find another use. After spending large sums of money to produce or acquire video programs, these same programs are frequently stored in rooms that are under construction, full of debris, too hot for human habitation, perpetually damp or subject to flooding. Certainly, it is difficult to believe that professionals who recognize tape as a repository of valuable information would consciously treat materials in this manner. People simply fail to equate putting ***tapes*** in an unsuitable environment with putting ***programs*** in an unsuitable environment.

Even when an organization provides climate controlled storage for their tapes, abuse is likely to continue within other areas of the operation. Simply consider the difference between the care used in moving machinery around a facility and the way tapes are handled. Machinery is moved slowly, is not intentionally thrown, bumped, or dropped and is always placed "right side up". Conversely, tapes are improperly stacked on their sides and the most common motion used to move tapes is a swing of the arm followed by a distinct drop of anywhere from a few inches to several feet.

This widespread, unintentional abuse of videotape brings us to the second preconception we would like to address. Namely, "since videotape was not originally designed as a long term storage medium, a lot of recorded materials are now being lost and there is little we can do about it". We handle large volumes of older tapes. The primary reason these tapes are sent to us for restoration should not be attributed to design flaws or inherent material instability but to the fact that ***tapes have been subjected to extremely hostile environments under conditions we would not expect other materials to survive***. To date, the industry should consider itself lucky. Whatever the initial design intent, most professional videotapes have been fairly durable and are capable of surviving tremendous abuse before they are permanently destroyed.

From a physical viewpoint, magnetic tape is a <u>good</u> long-term storage medium. A substantial body of research illustrates that the life expectancy of tape can be extended significantly. If tapes are properly handled and stored, they will outlast the availability of the playback machinery necessary to reproduce the images they contain. Furthermore, restoration techniques exist that can reverse or sufficiently reduce the effects of aging that otherwise render tapes unusable.

PREMATURE AGING

The premature aging of videotape we see today is primarily caused by excessive exposure to common environmental factors. It is not surprising that three elements responsible for the degradation and decay of most things in the world also pose a threat to videotape. They are dirt, moisture and heat.

Dirt is all-pervasive. There is sufficient debris on every tape we examine to cause some signal loss. Virtually anything that comes between the tape surface and the playback heads can interfere with signal retrieval, including something as small as a speck of dust or the oil from a fingerprint! Often, there is enough debris to cause damage to both tape and machinery if playback is attempted.

Unfortunately, many people believe that "tape stored in a protective case is safe from dust and dirt". While storage and shipping cases do offer some protection from contamination, no standard storage case is air tight. If cases are exposed to even marginally varying temperatures, the air inside expands and contracts. When the air contracts, dust, debris and airborne contaminants from the surrounding area are sucked into the case. Tapes are routinely stored in areas so filthy that you can write your name in the dirt on the cases. Invariably, the tapes inside suffer from contamination.

It has been stated in at least one paper on recommended handling practices that "most tapes do not need to be cleaned". While it is possible to get a signal off many tapes without cleaning, every study we have seen clearly shows that cleaning is beneficial. Laboratory testing and field experience agree that, ideally, every tape should be cleaned before remastering. Making a new master off a tape that has not been cleaned permanently preserves signal defects that are a result of dirt and debris, not of defects in the original recording. Additionally, cleaning is an excellent method for identifying more serious tape problems that can cause permanent damage if playback is attempted.

Basic tape cleaning, which is used to remove loose particulate debris from the surface of the tape, is usually performed on machinery specifically designed for the task. Most models employ both wiping tissues and some type of burnishing "post" or "blade". It is important to note that these modern tungsten carbide or sapphire "blades" bear no relationship to the razor blade that gave early cleaning machines such a bad reputation. Of course, it is important that the cleaning machinery itself be used properly. Equipment that is operated by untrained personnel and allowed to become filthy or misaligned may cause more problems than it solves.

While damage to tapes from dirt and dust is often overlooked unless it is severe, the damage done by moisture is so noticeable that it eclipses any other form of chemical decomposition. Binder hydrolysis occurs when water, often absorbed from moisture in the air, breaks down the long chain molecules (polymers) in the recording or backcoat layers of a tape into low molecular weight oligomers. Since long chain molecules are vital to maintaining the tape's strength, the structure is weakened and the tape loses integrity. The oligomer residue rises to the surface of the tape, making it tacky. The adhesive characteristics of the residue actually exceed the internal adhesive characteristics of the tape. If enough residue migrates to the surface it will bind the tape wraps together. Attempts to run such tapes on either playback or cleaning machinery can literally rip the tape apart!

All videotapes are subject to hydrolysis. The severity of hydrolysis that develops is directly related to the temperature and corresponding percentage of relative humidity (Rh) the tapes are stored in over time. The threat of hydrolysis can be reduced by lowering either factor. While reducing temperature is usually stressed, we believe this emphasis is misleading. Hydrolysis is caused by the presence of moisture, not heat. Cool is "better" because cool air holds less moisture. Storing tapes in a cool environment that is noticeably wet or damp will encourage, not retard, hydrolysis. Additionally, such tapes are susceptible to the growth of fungus. While cleaning machinery can be used to remove spores from the tape surface, chemical treatment or irradiation is needed to kill the fungus. The spores pose a health hazard and can contaminate both machinery and people, so protective gear should always be worn when handling fungus-infected tapes.

The most obvious effect of hydrolysis is a condition called "sticky tape syndrome" or "sticky shed". A procedure developed by Ampex, often referred to as "baking", is considered the "cure" for this problem. When properly applied, this procedure melts the hydrolyzed residue on the surface of the tape and causes it to be reabsorbed into the binder. This allows the tape to be played back without sticking or shedding. Baking is not a panacea. It can do serious damage if applied to problems other than hydrolysis.

Keeping tapes cool extends life. High temperatures accelerate many reactions associated with decay, including the loss of the recorded signal. Extremely low temperatures can cause lubricant loss. However, the most common temperature-related problems are the result of uncontrolled temperature *variation*. Exposing cold tapes to warmer air allows condensation to form on the tape surface and encourages hydrolysis. Extreme temperature fluctuation causes tape to expand and contract, leading to creasing and deformation. Because various elements of the tape expand and contract at different rates, layer separation can occur. In the worst-case scenario, whole sections or sheets of oxide strip off a tape during playback.

While moisture and temperature extremes cause a great deal of damage, their judicious controlled application is often used to restore damaged tapes to playable condition. Creases can be removed and tape "resized" to its original shape with careful application of heat. SPECS BROS. has also had success readhering loose oxide layers by combining temperature manipulation with extremely low humidity.

DISASTER

Another problem that seriously affects videotape preservation is disaster: exposure to floods, fires, quakes etc. Long term decay often goes unnoticed until playback is attempted, so badly deteriorated tapes have often been assumed to be OK. Conversely, in disaster scenarios, people usually assume that the tape is destroyed. In truth, most damage that occurs to tapes in disasters is similar to the damage that occurs over time. It is simply more sudden, intense and obvious. Some effects are greater.Tapes become fragile, and it is important to handle them with extra care. Other forms of apparent damage have little impact if restoration is done promptly.

Most tapes affected by disaster are recoverable. Highly effective restoration techniques have been developed, tested and applied. We have salvaged reels submerged in sewage and fire damaged cassettes with melted hubs and shells. One important aspect of tape recovery that is often ignored are the shippers, reels and cassette housings themselves. A shipper exposed to fire conditions will collect smoke residue under its flanges. Many reels have hollow spaces where water can collect during exposure to a flood. If this water is not removed, it will reemerge during playback, wetting both tape and machine. It also does little good to clean a tape and then spool it back into a filthy shell. Consider that a standard D-2 cassette has thirty nine parts in addition to the tape itself: thirty four parts move, fourteen of which are metal. There is plenty of opportunity for recontamination, corrosion and breakage to occur.

The most common disaster we encounter is flood damage. Videotapes are so subject to flood damage primarily because of the way they are stored. Tapes housed in the basement of a commercial facility are often placed directly under the building's main steam, water and sewage lines. Tapes in temperature controlled archives or libraries are still stored under sprinkler systems. Many storage facilities are located on flood plains or in maritime areas. When a natural disaster (hurricane, tornado, flood, etc.) occurs, the river, bay or ocean inundates the facility. Finally, certain conditions that are merely annoying to humans (e.g. an overflowing toilet; leaky soda machine or dysfunctional sump pump) can be life-threatening to tapes. ***The most important aspects of flood reclamation are controlled dehumidification and contaminant removal.*** All water carries dissolved contaminants. Therefore, many tapes require additional treatment (such as chemical decontamination or rewashing with distilled water) prior to dehumidification.

Disasters involving particulate debris are usually less damaging than those involving liquid contamination. Plaster dust is particularly invasive and affects tapes in situations ranging from building collapse to office renovation. Powdered mortar dust is another common contaminant. It often contains lime and can become corrosive if exposed to moisture. Particulate contamination is easily removed with cleaning machines. However, extra care must be taken when cleaning reels and shippers and contaminated cassette shells should be replaced.

Fire poses a less frequent but more volatile threat to videotape. In fire scenarios, tapes are not only exposed to intense heat but to water, smoke, fire suppression chemicals and debris as well. Fire damage is treatable, but the restoration process often requires multiple steps. The most important aspect of fire recovery is proper handling of the materials at the beginning. Once the smoke clears, a bevy of professional restorers and cleaners are usually brought in to assess the damage. Some take affected machinery off premises for cleaning and repair, others clean walls, carpets and furniture. Too often in this situation, videotapes are treated like the carpet, not the machinery. Companies will frequently allow cleaning service personnel to attack tapes with caustic detergents, water, and ammonia!!!

RECOMMENDATIONS AND CONCLUSION

As has been obvious from this entire presentation, we are concerned by the manner in which videotapes are treated industry-wide. Unfortunately, we do not perceive an easy way to alter the prevailing attitudes. Videotapes simply don't look as interesting or valuable as the latest piece of high tech machinery so they will continue to be destroyed by benign neglect.

For decades we have had general guidelines for the handling and storage of magnetic tapes. If these guidelines had simply been followed, we would not be experiencing many of the problems we are encountering today. Still, the current state of television and video preservation is surprisingly good: large volumes of magnetic recordings are playable despite mishandling; the majority of tapes that have deteriorated can be restored and sufficient obsolete machinery exists to guarantee that virtually any format can be played back. However, if we do not initiate a comprehensive preservation program now, we are likely to encounter serious problems in the future.

Ultimately, video preservation is like a three legged stool: the tape itself; the machinery to play it back on and the knowledge of how to use them together. If one "leg" is missing, the "stool" will not stand. Fortunately, we have a substantial window of opportunity in which to deal with all three factors. Tapes that are badly decayed can be restored before the programs are lost. Those in hostile environments can be moved to better locations to extend their life expectancy. Repositories for machinery can also be established while the hardware is still available. These repositories should include machines (both obsolete and new), spare parts, operating manuals and schematics.

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With rapid changes in technology, certain aspects of preservation will become more difficult in the future. Using the old transistor technology, a competent engineer can replace or "recreate" a missing part. Twenty years from now it may be much more difficult to replace a specific computer chip. Similarly, most obsolete formats are fairly rugged. While manufacturers are improving tape formulations, new tapes are smaller, thinner and more delicate. These tapes may not survive under the conditions tapes have been subjected to in the past. SPECS BROS. is already observing new patterns of decay on D-1, D-2 and Beta SP tapes that were not present in older formats. We have labeled the two most common problems "Spot Hydrolysis" and "Accelerated Contact Hydrolysis".

Spot Hydrolysis is caused by condensation, and can render tapes unplayable within a matter of days. When tapes are exposed to flood conditions, high humidity or extreme temperature variations, water condenses in droplets on the edge of the tape. Hydrolysis occurs rapidly at those spots. As the binder under the droplet decays, it adheres the tape wraps together and leaves a crystalline residue. Because the wraps are bonded together, any attempt to play a tape with spot hydrolysis causes the tape to tear.

Accelerated Contact Hydrolysis is caused by the interaction of the tape backcoat and the polished metal guideposts used in new cassette formats. In the presence of moisture, the metal posts act as a catalyst, and affect chemical breakdown of the binder backcoat. Deterioration is rapid. The tape sticks to the posts and may break if playback is attempted. If the tape is wet (from flood exposure), the reaction can occur within 24 hours. If the tape is exposed to high humidity, the process is slower but will still occur within a matter of weeks, rather than years.

These new patterns of decay highlight the need for continuing research. Theory indicates that tape should last over a century if properly handled. The additional quantitative data necessary to convert theory into practice requires highly sophisticated equipment not readily available outside of government laboratories. It would be beneficial to the industry if a government agency could collect research recommendations and requests for future testing from a broad range of video users. These could then be submitted to the various labs capable of handling them.

Finally, we would like to make a plea concerning "experts" in the field of video preservation and restoration. Expert advise is often essential, but one should be prudent when applying or relaying such information. Much of the information that is passed around is opinion, which may or may not be supported by data and experience. Other information is garbled by inaccurate repetition. Like the old children's game of telephone, the message three or four steps down the line may bear little resemblance to the original.

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Conversely, experts should not attempt to inhibit the flow of information by hiding behind the term "proprietary". Few techniques are truly exclusive and an expert's real advantage is the length and breadth of his experience. While no one would expect an expert to provide a complete blueprint of his methods, a brief explanation of the procedures employed and a willingness to discuss the theory that supports them is essential. Otherwise, an organization has no idea of what will be done to their material. Quite simply, ask questions and make certain the answers are clear.

In conclusion, we believe that ***communication*** is the key to success. We must encourage open dialogue between the public and private sectors, scientists and engineers, archivists and commercial producers...and apply what we learn! Ultimately, the more the community as a whole cooperates, the more effective our preservation and restoration efforts will be.

Respectfully submitted,

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