

8 FORMAT POINTS AND COMPARISONS

[Review the preservation ranking scale in Appendix 1 before examining the scores below]

8.1 Summary of Format Base Scores

Note that the format scores below are misleading if taken out of context. They must be understood within the context of format characteristics and preservation problems. For example, polyester open reel tape appears to be very stable given its low base score. However, certain types of polyester tape that typically exhibit problems such as Sticky Shed Syndrome, will score near the top of the scale.

Format	Base Score
PVC open reel tape	2.5
Polyester open reel tape	2.5
Paper open reel tape	2.75
Wire recordings	2.75
Audio cassette	2.75
Aluminum disc	3.0
Acetate open reel tape	3.0
DAT	4.0
Lacquer disc	4.25

Summary of rationale—selected points from the discussions of each format above

- DAT receives a high base score because of the near obsolescence of the format and reported widespread playback problems
- Paper based open reel tape appears to be relatively stable in our experience and according to an article by Dr. John W.C. Van Bogart, National Media Laboratory
- Audio cassette receives a relatively lower base score despite its inclusion on the IASA priority list because the format appears to be relatively more stable than others in the practical experience of most archivists and engineers
- Aluminum discs appear relatively stable, except for oxidation. There are mixed reports as to the seriousness of this problem, particularly whether it becomes worse over time
- Wire recordings, most of which are made of stainless steel, are very stable chemically. They are not actively deteriorating. The format is obsolete which places it at some risk, however, there are still machines and expertise available to transfer them, for the next decade at least
- Lacquer discs are the format most at risk due to their relative instability and the process by which they rapidly deteriorate chemically (plasticizer exudation leading to delamination)

8.2.2 Polyester Open Reel Tape

Characteristic/Problem	Points added
Format base score	2.5
Age—add 0.005 points for each year of life	0.005–0.27
Long play (1 mil base)	0.5
Double play (0.5 mil base)	1.0
Triple play (0.5 mil base or thinner)	1.2
Unknown if double or triple play (0.5 mil base or thinner)	1.1
Off-brand	0.75
Tracks	0.006–1.0
Sound field—stereo	0.15
Noise reduction	0.5
SBS—SSS	2.0
SBS—UP	2.0
Fungus	1.5
Visible tape pack problems—minor	0.25
Visible tape pack problems—moderate	0.5
Visible tape pack problems—severe	0.75
Other serious documented problems (not any of above)	1.5

8.2.5 Analog Audio Cassette Tape

Characteristic/Problem	Points added
Format base score	2.75
Age—add 0.005 points for each year of life	0.005–0.22
120/180 minute	0.75
Off-brand	0.75
Type II or Type IV	0.5
Type III	1.15
Dolby B	0.25
Dolby C, Dolby S, or dbx	0.5
Sound field—stereo	0.15
SBS—UP	2.0
Fungus	1.5
Other serious documented problems (not any of above)	1.5

8.2.6 Digital Audio Tape (DAT)

Characteristic/Problem	Points added
Format base score	4.0
Age—add 0.005 points for each year of life	0.005–0.1
Age—1993 or earlier	0.5
Thin tape—over 60 meters	0.75
Long play format or other 32K sampling rate	0.5
Data-grade tape	0.5
Recorded on portable	0.25
Fungus	1.5
Other serious documented problems	1.5

Appendix 1: Preservation Ranking Scale

0.0—1.9 = Collection is in very good shape and there is little or no risk to its content at the present time.

This collection is relatively stable and safe and is considered to be at little risk. The recordings in this collection are carried on formats that are considered relatively stable at the current time. None of them exhibit problems with deterioration and copies of collection originals have been made. There is at least one copy for every original.

There are no compelling reasons relating to preservation condition to take preservation action with this collection.

2.0—2.9 = Collection is in good shape but there is a small risk to its content at the present time.

This collection is relatively stable and safe but has some minor to moderate risk factors present. Collections in this category may also be in somewhat poorer condition but have multiple, high-quality copies.

There are few compelling reasons to take preservation action with this collection. The collection must have multiple important outside factors present (such as potential or actual use or very high research value) to justify preservation action.

3.0—3.9 = Collection is in decent shape but its content is at some risk.

This collection is carried on formats that are known to be somewhat unstable. The recordings in this collection are *not* exhibiting signs of severe deterioration but may have some minor to moderate problems. They may also have the potential for severe problems that may or may not develop but are currently not manifest.

This collection is at some risk and could be a candidate for preservation action depending on other priorities as well as outside factors such as potential use or research value.

4.0—4.9 = Collection is in deteriorating or poor shape and/or is carried on a format that is nearly or completely obsolete. Its content is at moderate to severe risk.

This collection is carried on formats known to be unstable and/or its recordings are known to be actively deteriorating. Collections may also be placed in this category if carried on a format with serious obsolescence issues. The recordings in this collection are exhibiting signs of moderate to severe deterioration or have other serious problems.

This collection is at moderate to severe risk and is a solid candidate for preservation action.

5+ = Collection is in very poor shape or is rapidly deteriorating, has extensive damage and/or significant deteriorative forces at work. Its content is at serious risk and requires attention soon.

This collection is carried on formats known to be highly unstable and obsolete and/or its recordings are known to be in very poor shape or rapidly deteriorating.

This collection is in serious trouble and is a prime candidate for preservation action. If the content of the collection is to survive with the highest quality possible, preservation action must be taken soon.

Here is another set of categories that might be used to interpret collection scores:

Safe Zone = 0—2.4

Caution Zone = 2.5—3.99

Danger Zone = 4 and up

Appendix 4: Off-Brand Cassettes in the Collections at the Archives of Traditional Music

AC	Hi-Fi	Profi Sound
AIWA	Hitachi	Radio Shack
Akai	IMA	Realistic
ALME	IMT	Rezound
Arista	International Recotape	Ross
ATNT	Corporation (IRC)	Sanyo
Audio Magnetics Corporation	Jaf	Seiko
Audiomaster	JVC	Sentry
Audiopak	KDK	Shanghai
Audiovox	Lafayette	Sharp
Audition	Lebotone	SKC
Baba	Loewe	Smat
Bell & Howell	Lucky	Sonotech
Bestron	Magnet	Soundcraft
Boots Audio	Mallory	Superscope
Capitol	Mark	Superphonic
Capitol 1 (Same as Capitol?)	Maxwell (NOT Maxell)	(Zayre Corporation)
Century	Mei-Ya	Super-sound von Focitron
Century Sound	Melodie 2000	Supertape
(Same as Century?)	Melody	TapeMaster
Certron	Meltrack	TEAC
Combo	Metro	TEAM
Concertape (Radio Shack)	MS 600	Tips
Contek	Music 2000	Tony
Crystal	National Panasonic	Toshiba
Dak Enterprises	Nivico	T-Series
Denon	Norelco	TSIC
Dindy Super	Nulec	Union 3000
EDU-Cassette (BASF)	Okhai	Unitape
Emitape	Passport	Universal
Fujisan	(Manufactured by 3M)	Webcor
GE	Pfatone	
General	Pilipe (NOT Philips)	
Gold	Pioneer	
Golden	Planet	
Goldstar	POP	
	Prinzsound	

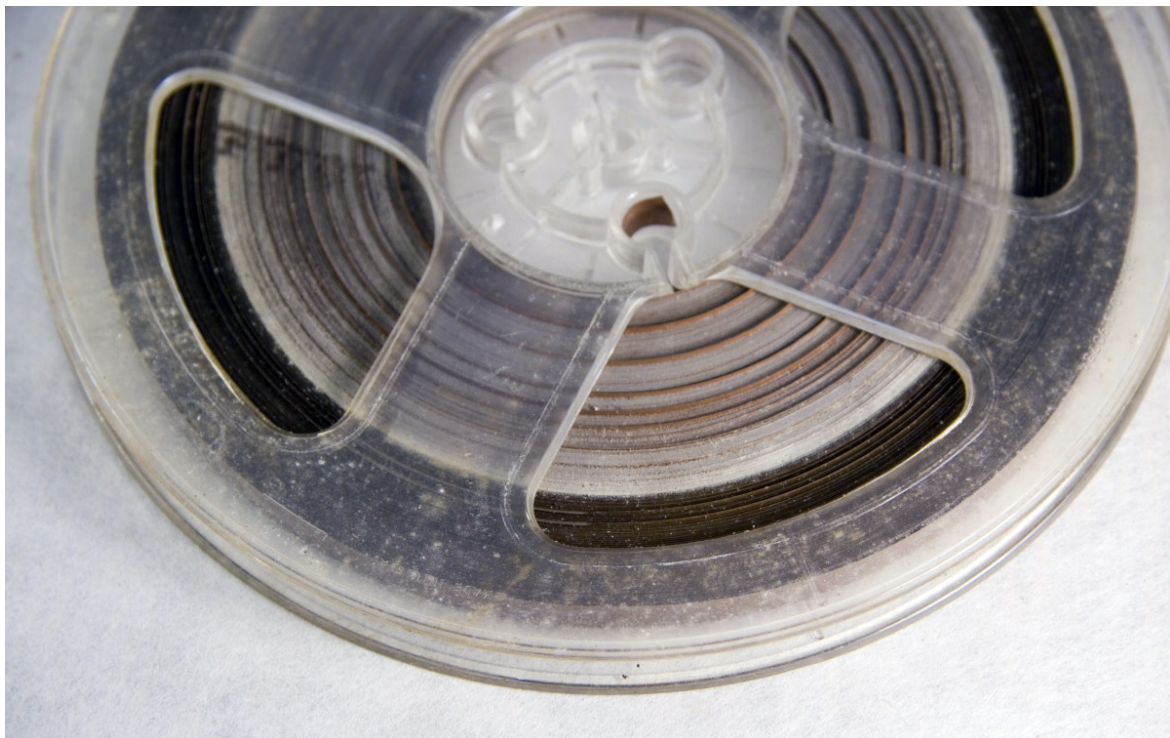


FIGURE 25: FUNGUS ON TAPE

Identification

Look for patterned, fuzzy, thread-like, or hairy-looking growths on the surface of the tape pack. Typically, these growths are white in color on open reel tape although they may also be black, brown, or mustard-colored. Try to distinguish mold from other types of visible contamination such as dirt, which may look similar but usually does not appear as fuzzy or patterned.

Points and Risk

The presence of fungus is considered a serious risk factor by FACET, which adds 1.5 points for this condition. Although active mold is a more serious problem as it continues to damage the tape, FACET does not differentiate between active and dormant. Testing for dormancy is usually best done by an expert and not something that we want to encourage. It is enough to know that mold is present, whether active or dormant.

2.3.3 Soft Binder Syndrome—Sticky Shed Syndrome (SBS-SSS)

Overview

Soft Binder Syndrome (SBS) is a new term coined by Richard Hess for all polyester-backed tapes that exhibit sticking, squealing, and abnormal shedding.²⁶ This includes tapes identified as failing due to the two degradation modes defined until now, Sticky Shed Syndrome (SSS) and Loss of Lubricant (LoL). Hess' work in consultation with a group of scientists, audio engineers, and tape specialists, has demonstrated that what has been termed LoL is not truly loss of lubricant but deterioration caused by a number of factors not yet completely understood. His work also suggests that the mechanism by which baking (also called incubation) renders a SSS tape playable has also been misunderstood.

²⁶ Hess, "Tape Degradation," 8.

In the 1970s, most audio tape manufacturers switched from either an acetate or PVC binder to a polyester urethane binder for performance reasons related to changes in the oxide (magnetic pigment) coating. Note that by this time all tape base (the substrate or base film) material was polyester. Back coating—a usually black coating on the back of the tape—was added to many tape brands at the time, resulting in a premium mastering-quality tape. Polyester urethane binders are particularly susceptible to degradation via a process called hydrolysis, a chemical reaction caused by water in the form of humidity in the air that is accelerated at high temperatures. The result—a tape that sticks to the guides and heads of the tape machine, squeals, and often exhibits massive oxide and backing shed—is known as Sticky Shed Syndrome. SSS, as defined, appears to occur only on back-coated tapes. For many years it has been treated through baking, which renders the tape temporarily playable. A small number of tapes with SSS reportedly have deteriorated to the point that they do not respond to baking.²⁷ There are also reports that increasingly longer baking times are needed for SSS tapes to be playable, suggesting that this type of deterioration is continuing and becoming worse.²⁸

Identification

Audio engineers and sound archivists have over twenty years of experience identifying SSS tapes and treating them through baking. There are a small number of tape brands that are known to be afflicted with SSS in almost all cases. It is not only safe, but prudent, to assume that these brands have SSS as playback of sticky shed tapes will usually damage them. Below is a list of known SSS tape brands. All of them are polyester-based, back coated, mastering-quality tape stock. PVC, paper, and acetate-based tape do not experience SSS. This list is probably incomplete.

Ampex 406, 407, 456, 457

Capitol Q15

Scotch 226, 227, 806, 807, 808, 809

Points and Risk

Because some SSS tapes have deteriorated to the point that they do not respond to baking, because baking times are reportedly increasing, and because baking is an invasive procedure that is not fully understood, FACET considers this an extremely serious problem, adding 2.0 points for this condition.

²⁷ Reports from various people on the ARSC listserv. See UNESCO's *Safeguarding Our Documentary Heritage*, edited by George Boston at: http://webworld.unesco.org/safeguarding/en/txt_magn.htm, which states that baking "cannot restore the most severely affected tapes." Also see Otto Hinterhofer et al., "The Chemical Deterioration of Magnetic Tape and Its Assessment by Physical and Chemical Testing" (paper presented at the 104th convention, Amsterdam, The Netherlands, May 16-19, 1998. Preprint 4701). On page 1, the authors state that "with further deterioration...the rate of successful re-conditioning may drop significantly in the future."

²⁸ Hess, "Tape Degradation," 11.

2.3.4 Soft Binder Syndrome—Unidentified Problems (SBS-UP)

Overview

In addition to SSS, there is another class of polyester-based tapes that are also severely degraded and exhibit some similar and some different symptoms. Typically, these tapes squeal and stick but show little or no oxide shedding, do not have a back coating, and do not respond to baking. These tapes have generally been diagnosed as losing lubricant although, as discussed above, this is no longer considered accurate. There is much yet to learn about how these tapes deteriorate, so FACET classifies them as SBS—following terminology in Richard Hess’ paper—adding the term unidentified problems.²⁹ SBS-UP tapes are often unplayable due to the sticking and un-recordable due to the squealing, which makes its way through the signal chain into the digital file. Restoration strategies include applying lubricant, using rolling tape guides, working with tape tension, and playing in a cold environment, all with either mixed or preliminary results so far.

Identification

SBS-UP is identified through playback by assessing the symptoms that are presented. There are a few tape brands—particularly Sony PR-150 and Scotch 175—that are known to have SBS-UP. Our experience at the ATM with Scotch 175 is that some of it exhibits SBS-UP symptoms while some does not. These tape brands should be considered suspect until proven otherwise. The FACET user must identify these tape brands, which are included in the list of problematic major manufacturer tapes above.

Points and Risk

FACET identifies SBS-UP as a very serious problem, equivalent to SBS-SSS, and adds 2.0 points if diagnosed through playback. Tape brands in which SBS-UP is known to be a problem some of the time, but which have not been diagnosed through playback, receive 0.75 points through the assessment of major manufacturers, problem tapes from major manufacturers, and off-brands.

2.3.5 Vinegar Syndrome (VS)

Overview

Vinegar Syndrome is a major degradation mode for acetate-based tape. According to a UNESCO report, “cellulose acetate has a tendency to become brittle through hydrolysis caused by the moisture contained in the atmosphere. This brittleness generally causes serious problems when playing old audio tapes. Tapes with severe cases of hydrolysis can suffer from the so-called ‘Vinegar Syndrome’, an auto-catalytic process whereby acetic acid is set free in ever increasing quantities and thus creates an accelerating effect on the decay process. This has been particularly experienced in film archives, especially in hot and humid climatic areas. Affected films become soft and limp, ending up as powder or slime. While, in theory, this may also happen to acetate audio tapes, no disastrous losses similar to those in the film world have been reported.”³⁰

²⁹ Hess, “Tape Degradation,” 8.

³⁰ From the section titled “Typology and History” in UNESCO, “Magnetic Carriers,” available online at http://webworld.unesco.org/safeguarding/en/txt_magn.htm.

There is no evidence that Vinegar Syndrome in audio tape will result in an unplayable tape. The few reports of Vinegar Syndrome so far indicate, with one exception, little or no problems with playback and transfer.³¹ It is quite possible that not enough time has elapsed for the serious problems seen with film to manifest in audio tape, but there is also no evidence that this problem will develop in the same way with tape. Richard Hess presents in his paper some factors that support the theory that serious deterioration of audio tape as a result of Vinegar Syndrome is inevitable.³²

Identification

Vinegar Syndrome affects acetate-based tape only—polyester, PVC, and paper tape do not suffer from this problem. The presence of acetic acid as part of the degradation process gives a definite vinegar smell to tapes with this problem, although the ability to differentiate by smell is highly individual and somewhat subjective. In some cases there is no doubt: if you notice a strong vinegar smell immediately after opening a tape box, it is likely that VS is present. When the box has been open for a few seconds the acetic acid dissipates and the smell is no longer as perceivable. Note that VS is infectious, and tapes with this condition must be kept away from the rest of the collection.

The film community uses acid-detection strips such as those manufactured by the Image Permanence Institute to diagnose and assess VS.³³ These strips have been tested on film and there is uncertainty about their accuracy in detecting threshold danger levels for audio tape, which has much less mass than film.³⁴ Still, it may be possible to diagnose the presence of VS and gain insight into the general condition of an acetate tape collection using the strips.

Points and Risk

FACET considers VS a serious problem, although not as serious as SBS-SSS and SBS-UP which nearly always result in unplayable tapes. 1.5 points are added for collections with Vinegar Syndrome.

2.3.6 Other Documented Problems

Overview

Problems may exist that are not part of the conditions described above or are found on tapes that have simply not yet been diagnosed with one of the “syndromes.” The section below presents a few to look out for, most of which are diagnosed through playback. This category, however, can also be used for any other problems that are encountered or observed.

³¹ The exception was reported by the Cutting Corporation in an article that is apparently no longer available online. They reported brittle and buckling open reel tape along with a strong vinegar smell.

³² Hess, “Tape Degradation,” 5.

³³ Information available through Image Permanence Institute, “A-D Strips,” (Rochester, N.Y.: Image Permanence Institute, Rochester Institute of Technology, 2006), http://www.imagepermanenceinstitute.org/shtml_sub/cat_adstrips.asp. A-D strips are dye-coated paper strips that detect and measure the severity of acetate film deterioration.

³⁴ Hess, “Tape Degradation,” 20.