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# Literature Review of Recorded Sound Preservation: Materials, Storage, and Access

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This paper is about how to store recorded music artifacts in their original sound carriers. While conversion preservation is optimal, it is not always feasible, and items often must be retained in their original formats until they can be converted. This paper discusses archival recorded sound collections both in terms of the environment that the items are to be stored in as well as the some specific care of the individual items. Three of the most common categories of older recorded sound carriers, wax cylinders, discs, and magnetic tape, are discussed. Each of these formats has specific requirements and it is important for librarians to be familiar with the unique challenges presented by each of them, in order to maximize their longevity with the ultimate goal of continued and renewed access to users.

Several conservators have identified concepts that apply to all preservation efforts and a consideration of these should precede a discussion of how to handle the individual materials for storage and access. A room designed to safely store fragile materials must provide stable and appropriate levels of temperature, relative humidity, light and air quality (Ogden, 1999b, 69). Sources of natural light should be avoided as well (Warren, 138**).** The quality of the air is of particular concern as it is one that is very hard to control for, being partially dictated by where the building holding the collection is sited rather than the design of the facility itself (Ogden, 1999b, 71; Warren, 132). This is an important factor, yet it is one that the librarian rarely has any control over (Warren, 132). Dust also needs to be avoided as it is hydroscopic (St. Laurent) and Warren points to a number of precautions that should be taken with regards to dust, particularly by limiting the use of textiles such as carpeting and drapery (139) and also by using cleaning equipment such as damp mops and central vacuuming systems that stir up a minimum

amount of environmental particulate matter (140). Ogden makes the point that professional conservation is often not feasible due to the cost involved, but that "adequate preventive care" is "not an unrealistic goal" (Ogden, 1999a, ix).

Warren points out that one important strategy is to store like items together (142), although he also lists over 16 different materials that were used in the manufacture and packaging of recorded sound carriers (131). While some archivists feel that the storage vessel is its own "micro-environment," (Cornell University), Warren feels that it is also useful to consider the room or rooms containing the archived materials as a "storage container" (142). St. Laurent thinks that in addition to storage in a controlled environment, recorded artifacts generally must be free of foreign contaminants, and stored in such a way as to minimize pressure, which leads to warping and other deformations. Schüller cautions against allowing anyone other than trained staff to handle master copies of materials (14).

## CYLINDERS

Cylinders of wax or tin foil were the earliest mediums carriers of recorded music. There are not too many surviving examples of the tin foil cylinders, as playback tended to destroy them (Wile 162). As they are not widely available for collection, discussion of the preservation of this format is left to another paper. The recording of sound onto wax cylinders was a "watershed day for music" (Voloshin 39) and this format, in this material, dominated the industry for 13 years, presiding over a changing industry that, in the United States, included the development of jazz and the shift to orchestral performances from band concerts (Smolian, 131). They were widely manufactured, and many

important recordings are on wax, but they are also very fragile. Heat was always an obvious concern, a patent attorney for one of the manufacturers testified in 1901 that it was widely known that the cylinders needed to be refrigerated (Wiley 163). Cold storage is not recommended today, and it is wise to consider the brittle fragility of the various types of waxes that were used and accommodate this by stabilizing the temperature of the wax cylinder against the temperature of any surfaces or materials that will touch, or are even present, in the same environment as the item. For example Shambarger recommends allowing shipping containers to reach the same temperature as the room they are in before opening, ensuring that playback equipment is the same temperature as the item being played, and that even cleaning tools such as pressurized air be kept at the same temperature as the items they are being used on in order to minimize the risk of having the cylinder crack (146). This might mean that users who want to listen to an old wax cylinder recording might need to make an appointment several days in advance to ensure that the materials are ready for playback. An additional storage concern is the role of humidity in the growth of mold, which can lead to pitting (Smolian, 132). Originally wax recordings were stored on pegs in cabinets to minimize contact with other surfaces, and Shambarger advises overseers of collections to continue to store them this way (146). Warren states that no suitable boxes are commercially available and therefore many archives use the original package to store them (152). However, Cornell University notes that special archival boxes can be used and some of these have spindles inside to stabilize the item in its container. Cornell University also advises that libraries store all archival materials in protective enclosures.

GROOVED DISCS

Volshin states that the early history of recorded music is "defined as a competition between two formats: the cylinder and the disc" (39), with the disc ultimately winning out as "the greater convenience […] tipped the scales in their favor (40). The fledgling recording industry first began experimenting with different base materials at the end of the nineteenth and beginning of the twentieth centuries. Much like the wax cylinders that preceded them, the new discs were composite items made using a proprietary blend of natural materials and chemical compounds. An early format involved vulcanized rubber, but the product reached a new level of durability when the discs were made using shellac (Voloshin, 39). The majority of pre-recorded discs that were sold were a solid, proprietary material that included minerals and shellac, the latter of which is harvested from a particular species of Asian tree beetle. There is general consensus that the format is stable, in spite of the tendency to for the shellac to become brittle. However the issue is somewhat complicated by the general inconsistency of compounds across manufacturers, and also by the practice of using recycled discs, often mixed with "soft drink bottles, litter, pieces of masonry or other unwanted material, all of which were ground up together and mixed in with the next batch of compound," (St. Laurent).

Another form of disc was the direct-cut or instantaneous discs. These carriers were generally made by overlaying a coating of acetate over a base of aluminum, glass, or even cardboard (St. Laurent). One of the major issues that these types of sound carriers face is that the core remains stable while the coating shrinks and then cracks as it pulls away from its base (St. Laurent). This means "discs still in apparently good condition

may craze at any moment" (Schüller, 4). Instantaneous discs were also sometimes made of waxed cardboard, zinc or gelatin (Schüller, 4), none of which seem particularly stable.

After World War II synthetic replacements for shellac were developed (St. Laurent). Vinyl records are considered to be "the most stable of the materials that have been used in the manufacture of sound recordings" but should not be considered permanent (St. Laurent). Although they are stable sound carriers, due to their relatively soft material, vinyl discs are prone to mechanical damage from scratching. (Schüller, 4).

Some experts feel that properly stored discs will last "centuries" (Voloshin, 32), even possibly outlasting their paper sleeves (Griffin, 11). The latter was written in 1985 and since then more attention has been paid to the effects that storage sleeves have on the materials that they are protecting, and the sole use of the original paper sleeves are generally frowned upon due to the particles that the sleeves shed as the paper deteriorates, (Warren, 150). Replacing the sleeves with other ones seems to be a widespread practice. The Library of Congress (LOC) recommends polyethylene sleeves and provides the brand name of one that can be used inside of the original paper sleeve on their web site. Warren cautions against the use of soft polyvinyl sleeves due to the "chemical similarity to vinyl discs," the resulting "migration of sleeve material to the disc surfaces" actually causes material from the sleeve to become imprinted on the item where it interferes with playback and the item can also become completely stuck to the sleeve (151).

One major storage consideration that should be taken into account is the weight of the discs. Of the three major categories of sound carriers discussed in this paper, a disc is considerably heavier than either cylinders or tape. The LOC also points out that discs, as

a physical format, tend to "concentrate weight on the centerline of a shelf" which increases the possibility of collapse. Warren provides additional information summarized in a table, which analyzes the weight of each format (135). Experts recommend storing discs in an upright fashion (Cornell, LOC) since horizontal storage increases the risk of breakage (Warren, 143). Due to their relative thinness, it is possible to store many more items per foot than the other two formats discussed here. In consideration of the overall weight and the way that the discs concentrate weight lengthwise across the middle of a shelf, the use of specialized reinforced shelving is recommended (Warren, 135). It is equally important to consider the cumulative weight-load on floors (Warren, 133).

## TAPE

Tape was the format that came after grooved discs and was the prevalent carrier for popular recorded sound until being replaced with digital compact discs in the late twentieth century. Tapes are "grouped under endangered carriers" (Schüller, 6) because unlike wine, they do not get better with age (Hess, 267). This is further complicated by the variety in manufacturing materials used, for example newer tapes actually pose more problems than their immediate predecessor (Hess, 243, Schüller, 6). Also, unlike wax and discs, tapes require a form of archival maintenance. St. Laurent recommends storing tapes with an "archival wind," which involves winding tapes slowly and evenly so that air pockets do not form, and also to rewind or "exercise" reel-to-reel tapes every few years to alleviate any stress points. Schüller (6) also points out that a well-maintained playback machine is essential, but Hess (266) states that much of this equipment is no

longer being produced which might cause tapes to become obsolete before they can be transferred to a stable digital format.

Tapes are generally comprised of two to three layers, a binder, a base and a backing, and the difference in how these materials degrade is one of the reasons that tapes are particularly prone to failure. As mentioned above various manufacturers used different formulations and Hess mentions that there are directory lists of designs by manufacturer and year (243).

In early tapes the binder layer was made from polyester polyurethane (PUR). This substance proved to be highly reactive to the magnetic iron particles used in the oxide coating and accelerated hydrolysis (St. Laurent). Several decades later from the mid 1950's to the mid 1960's polyvinyl chloride (PVC) was used as a binder and this has proved to be a fairly stable material (Schüller, 6). Later the industry shifted to polyester urethane (PEU), which has not proven to be as stable, (Hess, 243).

The base layer was initially made from acetate, although paper was also used (Hess, 242; Schüller, 4). Acetate is brittle and shrinks (Schüller, 4), while the plasticizers used to condition it "evaporate and crystalize" over time (St. Laurent). Acetate can also deform, and the edges are prone to chipping or "frilling" (Hess, 245). However, the greatest threat to acetate film is "vinegar syndrome." This occurs as the acetate decomposes causing a reaction with the iron oxide coating, and is accelerated by environmental factors such as poor ventilation, heat and humidity (Hess, 246). The process is "auto catalytic" (St. Laurent). Once started, vinegar syndrome can only be slowed down, not stopped (Hess, 246) and tapes stored nearby can also become infected (St. Laurent). Currently base layers are made from mylar (Hess, 242). This is more stable

chemically, but prone to “stretch irreparably” under stress, rather than cleanly breaking (St. Laurent). This limits the ability to repair broken tapes.

Backing materials were used less frequently, and tapes that did have some unique problems. The main issue is that the backing will interfere with the recorded surface. Some archives interleave back-coated tapes with another material to create a layer of separation between the layers (Hess, 254).

## CONCLUSION

Collections of recorded music and sound present some unique challenges that other types of archives generally do not. The variety of materials, spanning from organic and collected in the wild, to complex and proprietary chemical compounds, would be challenging enough on its own, but many of the individual pieces in a collection are amalgamations of ingredients. As a result many of the items are fragile, will deteriorate on the shelf and, as was described in the section on tapes, are sometimes prone to pernicious processes. This can limit access as some materials are too fragile to be played for any other reason but to be converted. This might mean that researchers might not have access to a body of work until it is digitized. The best response is prevention and forethought combined with a prioritized plan for converting individual items.

References

Cornell University. "Library Preservation and Conservation." *Cornell University.* 2005. https://www.library.cornell.edu/preservation/librarypreservation/meolda/preservation/stabilizationandhousing.html

*This short resource gives details on different formats and has illustrations of different types of protective carriers.*

Griffin, Marie. "Preservation of Rare and Unique Materials at the Institute of Jazz Studies." *ARSC Journal* 17, no. 1 (1985) : 11-17.

Hess, Richard L. "Tape Degradation Factors and Challenges in Predicting Tape Life." *ARSC Journal* 39, no. 2 : 240-274. http://www.richardhess.com/tape/history/HESS_Tape_Degradation_ARSC_Journal_39-2.pdf

*This is a substantial article on magnetic tape, it includes cross-cut diagrams of tape layers.*

Library of Congress. "Care, Handling and Storage of Audio Visual Materials." *Library of Congress. Preservation. Collections care. Audio Visual Materials.* Accessed Mar 21, 2015 from http://www.loc.gov/preservation/care/record.html

St. Laurent, Giles. "The Care and Handling of Recorded Sound Materials." *National Library of Canada, Music Division* (1996). Available from: http://cool.conservation-us.org/byauth/st-laurent/care.html

*This is a widely reproduced resource originally prepared for the National Library of Canada. This version was chosen because it is freely available.*

Ogden, Sherelyn. "Temperature, Relative Humidity, Light and Air Quality: Basic Guidelines for Preservation." In *Preservation of library and Archival Materials: A Manual,* edited by Sherelyn Ogden, 69-73. Andover, MA: Northeast Document Conservation Center, 1999.

Ogden, Sherelyn. Introduction to *Preservation of library and Archival Materials: A Manual,* edited by Sherelyn Ogden, 69-73. Andover, MA: Northeast Document Conservation Center, 1999.

*This book is more focused on text resources than recorded sound. However, there is some practical advice that a librarian working with a special collection will find useful.*

Schüller, Dietrich. "Audio and video carriers. Recording principles, storage and handling, maintenance of equipment, format and equipment obsolescence." *Power Point Presentation used by Albrecht Häfner and Dietrich Schüller in training workshops on audiovisual preservation organized as part of the EU Commission Project TAPE.* Retrieved Mar 21, 2015 http://www.tape-online.net/docs/audio_and_video_carriers.pdf

Shamberger, Peter. "Cylinder Records: An Overview." *ARSC Journal* 36, no. 2 (1995) 133-161.

Smolian, Steve. “Cylinder Record Research. *ARSC Journal* 26, no. 2 (1995) : 131-132.

Voloshin, Metro. “The Preservation and Storage of Historical 78 rpm Recorded Discs.” *Music References Services Quarterly* 8, no. 2 (2002) : 39-43.

Warren, Richard, Jr. “Storage of Sound Recordings.” *ARSC Journal* Fall (1993) : 131-175.

*This is a comprehensive resource for archivists. It includes numerous tables on the historic recorded sound formats including cumulative weights of items per foot.*

Wile, Raymond R. “Cylinder Record Materials.” *ARSC Journal* 26, no.2 (1995) : 162-171.

Wright, Richard. “Digital Preservation of Audio, Video and Film.” *The Journal of Information and Knowledge Management Systems* 34, no. 2 (2004) : 71-76.

Bibliography

Bigourdan, Jean-Louis; Reilly, James M.; Santoro, Karen; Salesin, Gene. "NEH Grant # Pa-50123-03. The Preservation of Magnetic Tape Collections: A Perspective." *Image Permanence Institute. Rochester Institute of Technology* (2006). https://www.imagepermanenceinstitute.org/webfm_send/303

Library of Congress. "Cylinder Records and the Library of Congress." *Library of Congress. Preservation. Collections care. Audio Visual Materials.* http://www.loc.gov/preservation/care/cyn.html

Northeast Document Conservation Center. Overview. "Preservation Leaflets." *Northeast Document Conservation Center."* Accessed Mar 21, 2015 from https://www.nedcc.org/free-resources/preservation-leaflets/overview

Nelson-Strauss, B. "Preservation Policies and Priorities for Recorded Sound Collections." *Notes: Quarterly journal of the music library association,* 42, no. 2 : 425-436.