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# The Preservation of Recorded Sound Materials

## Preservation of Sound Recordings

A good definition of preservation put forward by the International Institute for Conservation--Canadian Group and the Canadian Association of Professional Conservators is that preservation encompasses "all actions taken to retard deterioration of, or to prevent damage to, cultural property. Preservation involves controlling the environment and conditions of use, and may include treatment in order to maintain a cultural property, as nearly as possible, in an unchanging state."<sup>11</sup>

There are essentially only three concerns to consider when handling and storing sound recordings:

- 1) that they be kept free of any foreign matter deposits
- 2) that they be kept free of any pressure that might cause deformations
- 3) that they be stored in a stable, controlled environment

### 1. Foreign Matter Deposits

#### General

Dirt can be classified into two categories:

- 1) **Foreign matter deposits** which are not part of the original object, such as grease from fingerprints, soot, stains, adhesives, etc. and
- 2) **alterations of original object material** through chemical reactions (whether internal reactions or reactions with environmental agents). Metal corrosion products, palmitic acid from acetate discs, or a gummy substance on tapes are examples of alteration in the state of the original.<sup>12</sup>

Dust is commonly a mixture of fragments of human skin, minute particles of mineral or plant material, textile fibres, industrial smoke, grease from fingerprints, and other organic and inorganic materials. There are often salts such as sodium chloride (carried in from sea spray or on skin fragments), and sharp gritty silica crystals. In this chemical mixture are the spore of countless moulds, fungi and micro-organisms which live on the organic material in the dust (fingerprints,

for example, serve as good culture media). Much of the dirt is hygroscopic (water-attracting) and this tendency can encourage the growth of moulds, as well as increase the corrosiveness of salts, hydrolysis and the release of acids.<sup>13</sup>

Dust (including fingerprints) will negatively affect sound recording preservation in a number of ways:

### **Discs**

Dust is abrasive, and combined with the pressure exerted on the groove walls by the stylus, can permanently etch the walls worse, dust can also be imbedded permanently into thermoplastic substances. Only a small point of the stylus is actually making contact with the groove walls. One and a half grams of stylus pressure on such a minute surface translates to several tons of pressure per square inch. The resulting drag generates enough heat that the plastic partially melts (though not enough to deform), causing a microscopic flow around the stylus into which dust can be embedded permanently.

### **Tapes**

Dust attracts and traps moisture and will precipitate hydrolysis, a common and serious cause of long-term magnetic tape degradation. Also, dust may cause permanent damage to the tape when the abrasiveness of the dust along with the pressure exerted between the tape surface and the tape recorder heads will scratch the oxide layer and the tape recorder heads.

### **CDs**

Since there is no physical contact at playback, there is virtually no chance of physical damage occurring during playback due to dust deposits. Nevertheless, dust will impede proper playback by obstructing the reading of the information, while it may also affect the long-term preservation. At present, the precise, long-term degradation mechanisms for the CD are still physical damage will occur owing to the scratching of the protective layer.

### **To minimize foreign matter deposits:**

#### **General:**

- Never touch the surface of a recording. Use clean, white lintless cotton gloves and handle by the edges.
- Recordings should not, unnecessarily, be left exposed to open air. Return items to their containers when not in use and never leave storage containers open.
- Do not place recordings near sources of dust including paper or cardboard dust.
- Keep the surrounding area clean. Do not consume food or beverages in the area in which recordings are handled.
- Keep storage facilities as clean and dust-free as possible.

- The air conditioning system should be equipped with dust filtering equipment.
- Keep labelling to a minimum, but limit the placement of labels, especially pressure sensitive labels, to the container using conservation ink.
- Keep equipment clean, well adjusted and in good working condition.

### **Grooved discs**

- Do not use paper or cardboard inner sleeves and do not store records without inner sleeves.
- Use soft polyethylene inner sleeves. Do not use record sleeves made of PVC.
- Remove grooved discs from the jacket (with the inner sleeve) by bowing the jacket open by holding it against the body and applying a slight pressure with a hand. Pull the disc out by holding a corner of the inner sleeve. Avoid pressing down onto the disc with the fingers as any dust caught between the sleeve and the disc will be pressed into the grooves.
- Remove grooved discs from the inner sleeve by bowing the inner sleeve and letting it slip gradually into an open hand so that the edge falls on the inside of the thumb knuckle. The middle finger should reach for the centre label. Never reach into the sleeve.
- To hold a disc, place the thumb on the edge of the disc, and the rest of the fingers of the same hand on the centre label for balance. Use both hands on the edge to place disc on turntable.

### **Tapes**

- Do not store paper inside reel-to-reel tape box.
- After removing the end tab from the virgin reel-to-reel tape, cut off one-and-one-half wraps of the tape. This is to avoid any adhesive, left by the end tab, from being transferred to the machine or causing layer-to-layer adhesion of the tape.

### **CD**

- Remove CDs from their case by pressing thumb and third finger on edge of the disc near the top and bottom of the case and pressing on the plastic clasp in the center with the other hand.

### **Cleaning<sup>14</sup>**

Since dust is usually held in place by electrostatic attraction, dry wiping on its own does not work effectively. The added friction created by the duster will cause the dust to jump back to the charged surface.

Distilled water is used for cleaning records and CDs for many reasons. Its precise chemical makeup is known, it will not leave any residue behind, is safe to use, and is inexpensive. Water disperses static charges and counteracts the increase in conductivity from the pick-up of salt deposits from finger prints. However, water alone cannot

dissolve grease, thus surfactants are used as additives to enable water to be a grease solvent. Surfactants break grease surface bonds and allow water to penetrate grease solids, causing swelling and then random dispersion.

### General

- The Canadian Conservation Institute (CCI) recommends the use of nonionic, ethylene oxide condensates surfactants to clean sound recordings. The CCI does not foresee long-term problems associated with the use of nonionic surfactants such as Tergitol. Tergitol 15-S-3 is an oil soluble surfactant and 15-S-9 is a water soluble surfactant. Combined they remove a wide range of dirt and greases and can safely be used on sound recordings. Use 0.25 part of Tergitol 15-S-3 and 0.25 parts of Tergitol 15-S-9 per 100 parts of distilled water. (These products are available in small quantities from TALAS (Division of Technical Library Service Inc) 213 West 35th Street, New York, N.Y. 212-465-8722.) The recording must then be rinsed thoroughly with distilled water to eliminate any trace of detergent residue.
- Keep an airgun handy to blow off light surface dust.

### Grooved discs

- Grooved discs are best cleaned using a record cleaning machine such as the Keith Monks, VPI, Nitty Gritty using 0.25 part of Tergitol 15-S-3 and 0.25 parts of Tergitol 15-S-9 per 100 parts of distilled water. These machines allow for an even dispersion of fluid and can then vacuum the liquid leaving a clean, dry surface. The discs must then be rinsed thoroughly with distilled water and vacuumed dry to eliminate any trace of detergent residue. Records should be cleaned before each playback.
- Clean Vulcanite discs showing signs of acid build up using 0.25 part of Tergitol 15-S-3 and 0.25 parts of Tergitol 15-S-9 per 100 parts of distilled water and rinse thoroughly.
- Clean acetate discs showing signs of palmitic acid deposits (white greasy substance on acetate disc surface) as if cleaning LPs, except add 1 part ammonia per 100 to the Tergitol cleaning solution. Do not use ammonia on shellac based discs.

### Tapes

- Vacuum reel-to-reel tape pack if dusty. Use a vacuum which has a hose, and keep the motor away from the tape in order to reduce the risk of magnetizing the tapes.
- Clean tape surfaces using a product such as 3M "Tape Cleaning Fabric" (610-1-150). This soft fabric product will pick-up loose debris commonly found on tape surfaces after being dislodged by the fabric fibers.

### CDs

- An air gun should be used to blow off any light surface dust.

- If fingerprints or other stains must be removed, 0.25 part of Tergitol 15-S-3 and 0.25 parts of Tergitol 15-S-9 per 100 parts of distilled water can be utilized safely. Carefully blot the area of the disc needing washing with a soft cloth (preferably a soft cotton that has been washed several times) imbued with a concentration of Tergitol and distilled water. Rinse well using a second cloth soaked in distilled water. Blot dry using a soft cotton cloth. Use an airgun to blow off any lint left over.
- Avoid rubbing in any direction.

## 2. Surface Deformations

Since the surface of a sound recording is the information carrier, it is critical that the surface be well cared for. Physical deformations such as warping of discs, stretching of tape or shock from dropping them, will directly affect sound information integrity. One must develop a respect for the integrity of the artifact.

### To minimize deformations

#### General

- Never leave recordings near sources of heat or light (especially ultraviolet light) as plastics are adversely affected by both.
- Do not place heavy objects on top of recordings. Recordings should never be placed on top of each other.
- Shelf recordings vertically; do not stack "off vertical" or horizontally.
- Do not use shelving units where supports put more pressure on one area of the recording or where supports are more than four to six inches apart.
- Do not interfile recordings of different sizes as smaller items may get lost or damaged, while larger items may be subjected to uneven pressure.

#### Discs

- Remove shrink-wrap on LPs completely. Shrink-wrap can continue to shrink, thus warping the disc.

#### Tapes

- Do not drop tapes. The shock could partially rearrange the ferromagnetic particles, effectively attenuating high frequencies.
- Store tapes away from any sources of magnetic fields.
- Do not store reel-to-reel tapes in a plastic bag within tape box. The plastic bag will trap moisture.
- Handle reel-to-reel tapes by the hub rather than the flanges as the pressure on the flanges will damage them and ultimately damage the tape edges.
- Ten-inch reels should have supports in their boxes so that the hub bears the weight of the tapes rather than the flanges.
- Rewind (exercise) reel-to-reel tapes every 3½ years to work out

stresses which may have crept in through linear expansions and contractions..

- Store reel-to-reel tapes with an "archival wind". Wind tapes slowly so that air pockets between layers do not form causing successive layers to be placed unevenly on top of each other. The unevenness will cause stress, expose binder to air and exposes edges to possible physical damage by the flanges.
- A reel-to-reel tape deck with the heads removed can be used to rewind tape in the regular play mode. The tape tension might have to be readjusted to compensate for the removal of the heads.

### **3. Environment**

A proper environment for the storage of sound recording is essential to retard degradation mechanisms. Elevated temperature and humidity can affect certain chemical properties of the plastics that make up recording media and can also create an environment that encourages the growth of fungus. Wide or rapid fluctuations of the environment are equally detrimental to the long term preservation of sound artifacts.

#### **Acetate discs**

Shrinkage of the lacquer coating due to the loss of plasticizer is the primary destructive force of these discs. Excess moisture will accelerate plasticizer loss. Acetate discs decompose continuously, and over time react with water vapour or oxygen to produce acids that in turn act as catalysts for several other chemical reactions. One of these is the release of palmitic acid, a white waxy substance. Acetate discs are very susceptible to fungus growth. Excess heat will probably accelerate the loss of the coating adhesion.

#### **Vulcanite discs**

Vulcanite discs are adversely affected by elevated levels of light, heat and humidity. In response to light and heat, Vulcanite loses sulfur. Light induces oxidation and form oxides of sulfur and sulfuric acid in the presence of humidity. The acidity builds up to a level at which the degrading material is attacked and eventually decomposed.<sup>15</sup>

#### **Shellac discs**

High humidity levels accelerate the embrittlement of shellac discs. This embrittlement causes a fine powder to be shed from the disc after each playback, effectively scraping away groove information. The severity of the embrittlement is unpredictable, due to the wide combinations and variety of materials (and of material quality) that were used during their production. The average shellac content in a shellac disc is approximately 15 % with the remaining 85% composed of aggregates. Organic materials in the aggregates are susceptible to fungus attack, while shellac itself is said to be fungus-resistant.

#### **Vinyl discs**

Vinyl discs are adversely affected by ultraviolet light and thermal cycling (heat fluctuation). The consequence of thermal cycling is that each cycle of temperature results in a small irreversible deformation, and these deformations are cumulative.<sup>16</sup> Vinyl discs are resistant to fungal growth and are unaffected by high humidity levels.

## **Tapes**

Hydrolysis is the chemical reaction whereby the binder resin "consumes" water drawn from humidity in the air to liberate carboxylic acid and alcohol. Hydrolysis in magnetic tape results in the binder shedding a gummy and tacky material which causes tape layers to stick together and inhibits playback when it is deposited onto the tape recorder heads. Hydrolysis also causes a weakening in the bond holding the binder to the backing, which results in shedding or possible detachment.

Cellulose acetate backed tapes are very susceptible to linear expansion in humid and/or warm conditions. Because of the different properties of the binder and the base, the absorption of humidity and heat result in tape curling and edge fluttering. Repeated dimensional changes due to environmental fluctuations grossly affect winding tension (hence the need for periodic rewinding) and can promote binder fatigue, cracking, and finally, the irreversible loss of sound information (known as catastrophic failure). Tape binder is somewhat susceptible to fungi growth though less so with modern tapes as fungicides are presently incorporated into the binder.

The process of the break-down of acetate backed tape is exhibited by the release of acetic acid. It is accelerated by the presence of moisture and iron ferromagnetic particles in the tapes. When the acetate is degrading --giving off acetic acid odour-- it starts to take up more moisture. The process of self-destruction is autocatalytic.

## **CDs**

The compact disc is a laminate of 4 different materials. The bottom of the disc is made of polycarbonate onto which the pits containing the digitized sound information are stamped. A thin layer of aluminum is then applied, covering the pits. A thin lacquer coating (which becomes the top of the disc) is then applied to cover the aluminum layer, and finally the ink for the labeling.

As with any laminated products, one must wonder how the aging characteristics of each material will interact with, and affect adjacent layers.

## **Proper storage environment**

- Store recordings at a maintained temperature of between no more than 15-20°C. Fluctuation of temperature should not vary more than 2°C in a 24-hour period.
- Maintain a relative humidity of 25-45%. Fluctuation of relative

- humidity should not vary more than 5% in a 24-hour period.<sup>17</sup>
- Maintain proper ventilation and air circulation of stacks at all times to avoid any micro climates.
- Keep sound recordings in dark storage when not being consulted. Fit light fixtures with fluorescent tubes which do not produce ultraviolet radiation in excess of 75 µw/lm (microwatts per lumen).
- Separate and isolate from tape vault acetate tapes exhibiting an acetic acid odour. Copy the tapes promptly.

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## Conclusion

Over the past century, recorded sound has become an intrinsic part of our culture. Upon hearing an early sound recording device in 1888, Sir Arthur Sullivan stated that he was "astonished and somewhat terrified at the result of this evening's experiments--astonished at the wonderful power you have developed, and terrified at the thought that so much hideous and bad music may be put on record forever." Unfortunately, sound recordings are not "forever".<sup>18</sup> These are ephemeral documents, both in their physical composition and consequently in the means by which the sound is ultimately retained. They can have their life span shortened considerably by both internal and external forces. By undertaking certain precautionary measures, custodians of the heritage of sound can lengthen considerably their collection's life span thus preserving a rich, invaluable world of sound.

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