

Format Preservation Fact Sheet

1. Format name:

Compact disc

2. Brief history of format

The compact disc has not been around very long, but many scientific and technological developments since the mid-nineteenth century have contributed to its development. The idea of recording sound was realized when Thomas Edison invented the phonograph in 1877, and the CD's physical form was established Emile Berliner invented the audio disc in 1887. At the same time, the fields of electricity, electronics, and computing developed. In 1949 the first 45 rpm records were introduced. In 1950 Richard W. Hamming published work on error detection and error correction codes; without error correction, CDs would be impossible. In 1958 C. H. Townes and A. L. Schawlow invented the laser, and in the same year stereo LPs hit the market.

In 1969 a Dutch physicist named Klaas Compaan had the idea that a certain technique for manufacturing holograms could be used to record images to glass discs. Over the next twelve or so years, Sony and Philips researched the capabilities of this new format and developed standards for CD audio. Audio CDs were introduced in Europe and Japan in the fall of 1982 and in the United States in 1983. CD-ROMs followed shortly thereafter. By 1990, worldwide CD sales were approaching 1 billion.¹

3. Life expectancy of the format

A compact disc consists of several layers. In the middle is a very thin, reflective, usually metal layer. This reflective layer, whose function is to reflect the laser beam, is encased on both sides with clear layers; one of these is the playing side, and on the other side is the label. This is a construction which can be made from many different combinations of materials, each of which has its own advantages and disadvantages.

Mass-market CDs are made from a thin film of aluminum with a covering of polycarbonate. The advantages of these materials are that they are inexpensive and easy to make. The disadvantages are that CDs can become damaged fairly easily, and that production errors which lead to early deterioration are hard or impossible to detect before the damage is already done.

A phenomenon called "CD rot" is caused by the oxidation of the aluminum coating inside the CD. Air, water, or other foreign matter can be trapped inside the CD during the pressing process, the inks used for labeling could eat away the thin plastic and expose the aluminum, or the pressing process could cause cracks in the plastic layers. These problems do not become evident until the aluminum has already begun to oxidize,

¹ Ken C. Pohlmann, *The Compact Disc Handbook*, The Computer Music and Digital Audio Series, vol. 5 (Madison, Wisconsin: A-R Editions, 1992), 9-12.

and there is nothing that can be done to treat them. The CD will eventually become unplayable and the data irretrievable.²

Sometimes problems occur with the discs produced by a specific manufacturer. In the late 1980's and early 1990's a British CD manufacturer called Philips & Du Pont Optical UK Limited (PDO) produced several hundred titles using a plastic lacquer which could not resist the long-term corrosive effects of the sulphur in the paper used for CD booklets and inserts. Over a period of years, the lacquer will corrode, and the aluminum will oxidize, taking on a bronze tint.³

Excluding manufacturer error, there is no agreement on how long compact discs can be expected to last. CD manufacturers assert that they are virtually permanent; archival experts estimate a useful life of ten to thirty years. The only data available is from accelerated-aging tests, which cannot substitute for field data. Everyone but the CD manufacturers agrees that polycarbonate and aluminum compact discs are nowhere near permanent.⁴

A French company called Digipress has developed an optical disk they call the "Century Disc," a compact disc made of tempered glass and a reflective layer of gold. These discs are made to be archival-quality and to last at least a century. Therefore the construction of these discs uses no organic or unstable materials. These discs are surely more durable than polycarbonate CDs, but with the price at least \$500 per Century Disc, it is more cost-effective merely to purchase multiple plastic discs and to hope.⁵

4. Storage requirements

CDs should be stored at 50-68F and 40-50% RH, away from fluctuations in temperature and relative humidity. Poor temperature and humidity can cause CDs to warp; warped CDs don't track. CDs should also be kept in dark storage, because UV light can cause the aluminum substrate or the coating to darken, leading to misreading and mistracking.

CDs should be stored in their jewel cases, upright, with an internal tray and hub to keep them from sliding around. Certifiably acid-free paper or board housing is acceptable, as long as it is boxed vertically in archival boxes. For long-term storage, any booklets, notes, or unadhered labels should be removed from the jewel case in case they are acidic.⁶

5. Other preservation and access issues relevant to the format

Use of CDs is dependent on proper hardware and software. As ubiquitous as they now are, they will inevitably suffer the fate of the LP, which was once so popular but for

² Alan King, "The Care and Feeding of Your CD-ROM Disk," *Database* 14, no. 6 (1991): 106.

³ L. David Lampson, "CD Bronzing," [cited 23 January 2003]; available from <http://classical.net/music/guide/society/krs/excerpt3.html>.

⁴ King, 106.

⁵ Denis Oudard, "The Evolution of Century Disc Archival Technology," *CD-ROM Professional* 4, no. 6 (1991): 42, 44.

⁶ Diane Vogt-O'Connor, "Care of Archival Compact Discs," [cited 23 January 2003]; available from <http://www.archives.state.co.us/cpa/articles/audiovisual/careofcds.htm>.

which a player is now almost impossible to find. Any person or institution intending to preserve CD media for future use must also preserve the tools for accessing that information.

6. Strategies to preserve (other than storage requirements)

It is very easy to scratch, crack, or otherwise damage compact discs through careless handling. One way to reduce handling of CDs while still making them available for use is to place them in caddies such as CD player auto-changers. That way a CD only needs to be handled twice, once to put it into the caddy and another time to take it out, with many periods of use in between.

Only handle a CD by its edges, and never flex, bend, or place pressure on it. Don't take risks with the original CD or the only copy. Hand-deliver instead of mailing it, and don't use the only copy for long-term data use.

Don't mark, label, or emboss a CD. Inks on a CD can erode the protective plastic layer.

Clean CDs only when absolutely necessary. First use compressed air; if that doesn't work, dampen a cloth with distilled water and wipe from the center to the outside edge. Never wipe in circles, and never use solvents.

Develop a schedule for migrating or remastering CD data, and monitor CD condition regularly in order to know when to implement the plan. Inspect copies before paying for the work.⁷

⁷ Ibid.

7. Annotated bibliography

- King, Alan. "The Care and Feeding of Your CD-ROM Disk." *Database* 14, no. 6 (1991): 105-107.
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