

OPTICAL DISC TYPES

Types of optical disc

CD-ROMs/DVD-ROMs (read-only-memory) are commercial grade discs and use a metallic data layer. This layer is created using a molding machine that stamps pits (depressions) and lands (flat surfaces) into a polycarbonate substrate base. The metal layer is then applied to the base, creating the data layer. While aluminium is most frequently used, it can potentially oxidize and lose data. This process of oxidization is sometimes referred to as “disk rot”. For archival discs, silver or gold layers are preferred because of longer life expectancies and better reflectivity.

DVD-ROMs can also support a double layer of data, using two metal layers, one semi-reflective and the other of fully-reflective. Laser light beams can read each layer of data separately. If both sides of a DVD are used, this double layer can be doubled again, creating four data layers.

CD-Rs/DVD-Rs (recordable) are recordable, write-once discs which use photosensitive organic dye just below of the reflective layer. This dye undergoes a chemical change when exposed to specific laser light beams; creating bits (marks) containing data.

Some dyes used in DVD-Rs and CD-Rs include Phthalocyanine (greenish) Cyanine (blue) and Azo (dark blue). Silver, silver alloys and gold are used as reflective layers on recordable CDs and DVDs. Both gold and silver will outlast the organic dyes, which will decay over time. Aluminium is not used because it may cause reactions with the dyes.

CD-RW/DVD-RWs (rewritable) are recordable, erasable and re-recordable discs that use a phase changing film data layer that reacts to heat. Laser light beams melt bits into the film to create data. These bits can be erased and re-recorded by adjusting the temperature of the laser. Rewritable CDs and DVDs usually use aluminium reflective layers, because the phase changing film degrades at a faster rate than aluminium oxidizes.

Blu-ray Discs/HD DVDs represent a new generation of optical media. Both disc types use unique blue-violet laser beams to read data, requiring the purchase of new equipment to be read. Blu-ray Discs and HD DVDs are incompatible formats, and were engaged in a format war, up until Toshiba officially announced its discontinuation of the HD DVD format on February 19, 2008.

The structure of HD DVDs is similar to traditional DVDs, with the data layer protected by layers of substrate of each side. The structure of Blu-ray discs is more similar to CDs, with the information stored directly beneath the surface. Early Blu-ray discs were easily damaged, but a protective layer was developed and made Blu-ray discs more reliable.

Handling and care of optical discs

The information recorded on an optical disc cannot be read without the intervention of a machine. Therefore, care and handling are important. Since optical discs are read using a laser they do not suffer from wear due to repeated use, as no stylus ever comes into contact with the disc. However discs are susceptible to scratches from everyday handling. Optical discs should be handled only by their edges or the center hole or hub.

The machine required to play and read the disc must also be kept and maintained.

Scratches

Scratches on the laser reading side of an optical disc

The depth and width of scratches as well as the direction in which the scratches run all determine whether or not the data on the optical disc will be readable. Small scratches on the substrate generally have no effect on the readability of a disc as the laser is reading through the substrate to the data layer. If a scratch is deep or wide enough to affect laser focus, error detection and correction can usually recover the data. However some scratches are too deep and wide or too bunched together for error correction to occur. Similarly, if a scratch runs along a track or is deep enough to scratch the data layer itself data is usually unable to be recovered.

Scratches on the label side of an optical disc

Because a CD's reflective metal layer and data layer are both found directly beneath the thin lacquer surface of the label, great care should be used to prevent scratching on the label side of a CD. Even a small scratch can damage the metal reflective layer making the data unreadable. The instrument used to label CDs should be seriously considered.

Pens or markers with hard tips that could scratch the label should not be used nor those with a strong solvent content that could degrade the protective lacquer of the label. The best choice would be a water-based felt tip marker. Scratches on the label side of a DVD are not as damaging, as the data layer of a DVD is found in the middle of the disc surrounded by the substrate on both sides.

Environmental considerations

In general optical discs should not be exposed to extreme temperatures or direct sunlight that may cause heat build up in the disc or damage the data layer with UV rays. However due to the different composition of data and metal layers, exposure to heat and light have different effects on certain optical discs. In all optical discs high temperatures can cause the substrate to soften and the disc to warp, discs should not be exposed to extreme heat for this reason. Ambient heat or heat build up in a ROM disc does little to damage the data layer as it is made up of aluminum. Light also has little effect on ROM discs. The only known problem occurring with the exposure of ROM discs to light is evidenced over an extended period of time when the polycarbonate substrate begins “clouding” or “coloring”.

CD-R, DVD-R and DVD+R discs along with CD-RW, DVD-RW, DVD+RW and DVD-RAM discs are all affected by exposure to ambient heat as well as heat build up generated by direct sunlight. CD-R's data layer is made up of dye that degrades at high temperatures. Degradation of the dye makes it less transparent and bits and lands are read incorrectly making the data unreadable. UV rays in sunlight also carry enough energy to produce a photochemical reaction that changes the optical properties of the dye. RW and RAM discs' data layer is composed of a phase changing film that is even more sensitive to heat than the dye found in R discs. For this reason degradation due to ambient heat or heat generated by direct sunlight is even faster in RW and RAM discs than R discs. The phase changing film in RW and RAM discs are not light sensitive and UV rays do not affect the optical properties of the film. After being exposed to freezing temperatures a disc's separate layers may warm at different speeds causing separation of the layers. In either situation a disc should be allowed to return to room temperature before it is used.

The polycarbonate substrate of discs exposed to high humidity or immersion may absorb some water and should be allowed to dry out in a less humid environment before being used. Most discs should be usable after being able to dry out for 24 hours; however, occasionally minerals may be left behind from the water and could react with the components of the disc and damaging the layers thus rendering it unreadable.

Cleaning of optical discs

Preventative or regular cleaning is not recommended for optical media discs, as the cleaning process may create scratches on the substrate surface. Surface dust and fingerprints do not typically impede the laser's ability to shine through the substrate to read the data layer. This, along with error detection and correction technology means that fingerprints and dust rarely affect playback of the disc. If cleaning is necessary it is advised to use a dry soft lint-free cloth. Holding the disc by the edges or by the center hole wipe the disc outward from the center hub to the outer edges of the disc. Wiping in a circular motion may create scratches parallel to the pit track and will impede error correction. For stubborn fingerprints and dirt wipe the disc with a soft lint free cloth moistened with water or use a cleaner specified for the cleaning of discs. It is advisable to blow any excess dust off an optical disc before using it in a player to avoid build up of dust in the player and

accumulation of dust on the laser reader.

Storage of optical discs

Optical discs should be stored in individual storage containers. These containers protect them from scratches and dust and also help protect them from temperature shifts that may cause stress to the disc. Discs should be stored vertically and if possible in a cabinet or drawer where it can be further protected from environmental shifts. If long term storage is necessary it is advisable to remove the liner booklet from inside the individual storage case in order to avoid the collection and retention of moisture inside the case.

Repair and reclamation of data from optical discs

If the scratches on the laser reading side of an optical disc are preventing it from playing it is most economical to attempt to transfer the data to a new disc. If this is not possible it may be worthwhile to try and repair it with a commercially available fluid based CD scratch repair kit. If neither of these methods work there are companies that offer CD restoration services. There are also software packages available that diagnose disc problems and help recover inaccessible information.

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