How do I protect and handle optical disks?

Types of optical disks

The term 'optical disk' describes a range of disk types where the stored information is read optically, ie by a laser.

There are three main types of optical disk:

- ROM disks contain information that cannot be changed or added to by the user (ROM stands for 'read-only memory'). CD-ROM and DVD-ROM are the most common types of ROM disk.
- WORM disks are also known as read-write optical disks (WORM stands for 'write once, read many'). The most common form of WORM disk is CD-R (recordable). CD-Rs are blank when sold. Users can record information on them, but it cannot be deleted or changed. Recording onto the disks requires dedicated hardware.
- Rewritable optical disks – also known as EO (erasable optical) disks – allow the user to record information on a disk, erase it, and replace it with new data. The most common forms of rewritable disks are CD-RW and DVD-RW. They are used when information is being regularly revised, edited or updated. As with WORM disks, recording onto rewritable disks requires dedicated hardware.

Composition of optical disks

Optical disks are comprised of between three and five layers of plastic and metal. Depending on their construction, they are more or less susceptible to damage.

Optical disks all have a stable polycarbonate plastic base on their reading side. The base layer strengthens the disk and maintains the depth between the data and the laser that reads it. As the laser must read through the base layer, any damage – such as scratches, dirt, oil from fingers – can interfere with retrieving data from the disk.

Data is stored on the disk in the form of marks or pits that either absorb or reflect the light from the laser beam.

On ROM disks, data is moulded as pits in the polycarbonate layer. A metal layer is on top to reflect the laser. It is usually aluminium, but can be silicon, silver or gold.

Recordable (WORM) disks use a photosensitive dye layer sandwiched between the polycarbonate and metal layers to capture and store data.

Rewritable disks have a phase-changing film between the polycarbonate and metal layers. To erase and rewrite data, the laser beam heats the film, changing its light transmission properties.

On DVDs, above the data and metal layers, there is another polycarbonate layer. The data is thus stored in the centre of the disk.

CDs have only a thin lacquer layer on the label side to protect the metal layer. Because the metal is very close to the surface of the CD, it is very susceptible to damage on this side.

Deterioration of optical disks

The critical portion of an optical disk is the data layer. Although in theory it is well protected, in fact it can be damaged. In addition, because optical disks are a very dense form of information storage, small amounts of degradation can cause significant information loss. There are many sources of potential damage to disks.

- Solvents can affect the lacquer layer and subsequently the metal layer on a CD.
- Damage to the polycarbonate plastic layer is a common cause of optical disk failure. Because they are read optically, any marking that interferes with the light path, eg scratches or surface deposits, can cause problems such as skipping or repetition of tracks. Some deposits, such as fingerprints, may cause etching of the plastic surface and can lead to irreversible damage.
- The polycarbonate plastic layer has a tendency to 'flow' over time. This means that the plastic layers may slowly lose their shape, making them difficult to read.
- Inks used to print information on the label surface may corrode the plastic or lacquer layer and subsequently the metal layer.
- CDs are particularly prone to damage to the 'label' side from writing implements. Sharp points can easily damage the lacquer and metal layers, making the disk unreadable.
- As with all record media, temperature and humidity – particularly dramatic and sudden changes – can cause degradation.
- Corrosion of the metal layer can result in a disk becoming unreadable. Certain metals, such as gold, are more resistant to corrosion than others

Handling and care of optical disks

- Handle disks by the outer edge or the centre hole only, do not touch the surface of the disk.
- Disks should not be bent or flexed.
- Do not write or mark in the data area of the disk (the area the laser reads). Write on the clear 'hub' area of the disk or, preferably, on the packaging that contains the disk.
- If you must label the disk itself, use a water-based felt-tip permanent marker to mark the label side of the disk. Do not use adhesive labels as the adhesive can damage the disk.
- Keep dirt or other foreign matter from the disk.

If an optical disk becomes dusty, dirty or fingerprinted, it may be possible to clean it before permanent damage occurs. Take great care. Gently remove loose dust using a non-abrasive photographic lens tissue, or very soft brush. Oily dirt deposits and finger marks can be removed

using CD/DVD-cleaning detergent, isopropyl alcohol, or methanol. The solution should be applied sparingly to the disk surface and wiped off with a tissue. **The cleaning motion should never be circular (along the tracks). Always brush from the centre of the disk outwards.** If a scratch is created while cleaning, it will do less damage cutting across the tracks than along them.

On the label side of a CD, the data layer is very close to the surface. The following points are therefore important.

- Do not scratch the label side of the disk.
- Do not use a pen, pencil, or fine-tip marker to write on the disk.
- Do not write on the disk with markers that contain solvents.
- Do not try to peel off or reposition a label.

Protective packaging

Optical disks usually come with their own rigid plastic case, known as a jewel case. These cases are reasonably dustproof and are suitable for long-term storage as they are usually constructed of an inert plastic. Disks that do not have a jewel case should be individually enclosed in a sleeve, bag or envelope made of an inert plastic such as polyethylene, polypropylene or Tyvek®.

Store disks in their packaging (or cases) to minimise the effects of environmental changes. Remove a disk from its protective packaging only for use and return it immediately after use.

CDs should not be stacked or packaged in groups so that they lean against each other. The pressure may lead to warping or deformation. Jewel cases are the ideal enclosure because they support each disk at the hub and deflect any impact from other items. Store disks upright (book style) in plastic cases designed for CDs and DVDs. Disks stored horizontally for a long time (years) can warp.

Open a recordable disk package only when you are ready to record data onto it. Check the disk surface before recording to make sure that it is clean and in good condition.

Environment

Optical disks should be stored at temperatures between 4°C and 20°C and relative humidity (RH) 20 to 50%. For long-term storage, 18°C and 40% RH is suitable. But for archival storage, temperature and RH should be lower. In these conditions the natural deterioration of the items can be slowed. It is important that these environmental levels are stable. Fluctuations will increase the speed of media degradation.

Do not expose disks – especially recordable ones – to prolonged sunlight or other sources of ultraviolet light. Fluorescent tubes are low in ultraviolet light, so use them wherever possible in storage areas. Storage areas should not have windows, but if they do, they should be covered with curtains or blinds.

Reformatting and migration

Two major factors threaten long-term preservation of optical disks: the instability of the media, and the likelihood of technological obsolescence. CDs made today may be in excellent condition in 30 years. But if the machines to play them or the software to interpret them have been superseded, the data may be inaccessible. The cost of recovering data from obsolete media and data formats can be high. It is essential to have a strategy to migrate data from the optical disk media onto newer media before it becomes obsolete.

The best prospect for long-term retention of information on optical disks seems to be regular copying or data migration. This entails copying the information on the disk to a fresh WORM or rewritable disk or to another format such as digital tape (or another new technology format that may be developed). If this is done regularly, the information should survive indefinitely.

Ensuring that the data on the disk is readable is more problematic. As computer programs are upgraded, older formats become unreadable. This is especially the case with proprietary data formats. The best response to this problem will depend on your resources and software environment. However, two solutions are to:

- upgrade the data to newer formats when you migrate the data to new media or
- use open or International Standard data formats

Further advice

Please contact the Agency Service Centre <http://www.naa.gov.au/records-management/help/index.aspx> if you require further advice on protecting and handling optical disks.