

## CD Manufacturing Process

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### **What is the production process for CD-R?**

CD-R manufacturing is similar to pressed CD injection molding, with a few differences. The glass master used to make the stamper for the injection molding machine contains a wobbled pre-groove defined in the Orange Book. The molded substrates are spin coated with a proprietary dye that each manufacturer has developed. On top of this, a gold or silver reflective coat is added by means of vacuum deposition, and this is followed by a spin coat of lacquer protection. Some CD-R manufacturers then add extra scratch protection to increase durability and a printability coating for use in ink jet printers.

### **Is there really any difference among blank discs from different manufacturers?**

Obviously, there are going to be some differences, simply because the discs have been manufactured in different factories using different equipment. However, all discs conform to the recording specifications of the Orange Book, Part II. All blank discs should work in your recorder. You should check with your recorder manufacturer for specific recommendations.

### **Why are different manufacturer's discs different colors?**

The color of the CD-R disc is related to the color of the specific dye that was used in the recording layer. This base dye color is modified when the reflective coating (gold or silver) is added. Some of the dye-reflective coating combinations appear green, some appear blue and others appear yellow. Visual differences between various media types are irrelevant from the standpoint of their actual operation. At 780 nm, where CD-R recorders and CD-ROM readers function, the media are, for all intents and purposes, indistinguishable from an optical recording standpoint. They all "look" the same to the devices.

### **What are the differences/benefits between cyanine, phthalocyanine and azo dyes?**

There are a number of important recording characteristics associated with each dye and reflectivity coating combination, as well as some longevity issues. Each media manufacturer strives to balance the engineering characteristics of the dye to insure greater compatibility with recorders and readers and long archive life. In addition to cyanine and phthalocyanine, there is also azo dye. Cyanine dye and its metal-stabilized derivatives were originally used to make CD-R media, and the Orange Book, Part II, referred to the recording characteristics of cyanine-based dyes in establishing CD-Recordable standards. The phthalocyanine dye is a newer dye that appears to be less sensitive to exposure to light after recording, so that longevity has been improved. Azo dye has been used in other optical recording media and is now being used in CD-R. The media manufacturers use these different dyes in combination with dye thickness, reflectivity thickness and material and groove structure to fine tune their recording characteristics for a wide range of recording speeds, recording power and media longevity. Over time, there has been a steady convergence in the properties of the various dyes used for CD-R.

## **Premastering**

### **What's a better platform for burning my own CDs — a Mac or a PC?**

Either platform is suitable. In defining "better" for you, you need to examine where your data is coming from and whether you are adding any indexing, linking or authoring to the data before creating your CD-R. Likewise, you need to consider the specific CD recorder that you have or are planning to buy, because a number of recorder software products are specifically enabled for a specific platform and may not cover both platforms.

### **Do I really need to worry about formats and standards if I'm burning my own discs? Why can't writing a CD be as easy as writing to a hard disk?**

One of the salient characteristics of compact disc is the transportability and compatibility of the media, which is insured by agreement to the standards and formats. CD is such a versatile media that several different industries are using it to carry specific types of digital data. You are right in not wanting to worry about formats and standards. They should be and are increasingly becoming transparent to the user. For the most part, all of the formats and standards have been agreed to by the appropriate industry groups. Still, you do need to specify which type of CD you wish to create because the recorder manufacturers and software vendors allow you to choose between audio formats, data formats (ROM) and photo or video formats. By using those standards, you guarantee interoperability for yourself, because later you may wish to read back the data on a different CD reader. The really good news here is that the emergence of CD-Recordable with incremental packet writing has become just as easy as writing to a hard disk.

### **Why do I need a formatter to record a CD-R when my hard disk or MO drive only needs a software driver?**

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The technology of CD-R recording is evolving. A formatter gives you a great deal of control over your entire disc structure. Newer software, on the other hand, acts like a driver by allowing you to assign a drive letter to the CD recorder and then to copy information to that drive. A formatter is required whenever you are writing the disc in "disc at once" mode rather than the newer multisession or incremental packet recording modes.

### **What is a buffer underrun, and why is it a problem with CD-R?**

When you record to CD, one of the technical happenings behind the scenes is that pieces of the data are interleaved between blocks. This data interleaving is done to make the media more robust and protect the data from large surface scratches. When the CD recorder begins to write a data stream, it cannot stop at some arbitrary point before the interleaving is completed. If your computer system cannot feed data to the recorder fast enough, the buffer memory of the recorder empties. This "buffer underrun" condition cuts off data from the recorder and interrupts the writing process. The resulting disc will be unplayable in most CD-ROM players. Some CD recorders allow the user to recover the disc and record to the unused portion.

### **Why does multisession have so much overhead?**

Multisession requires about 13.5 MB or 6,750 blocks between sessions. The lead-out area at the end of the session acts as a "landing zone" for the read laser. The lead-in area at the beginning of the session allows for a complete Table of Contents (TOC) to be written for the most recently recorded session.

### **What's a "hybrid" disc?**

The word "hybrid" has several different meanings as it applies to CD. One category of hybrid is a CD that contains two separate file systems: ISO 9660 and Macintosh HFS. The disc can be inserted into either an IBM-type PC or an Apple Macintosh or any other computer system that supports the ISO 9660 file structure. Another category of hybrid is a disc that is designed to interact with the Internet. This implies a hybrid publishing model where part of the information resides on CD and another part resides within the Internet. These "Internet CDs" are also called "Connected CDs." Still another version of hybrid refers to the Orange Book definition of a disc that contains pre-recorded information on it and allows the user to record information as well.

### **How do I make a "customized" hybrid disc that shows only PC information for PC users and Mac information for Mac users?**

Several software providers offer software systems that allow you to do this. As you shop for premastering or CD-R formatting software, just ask the vendor if they can provide support for a PC/Mac hybrid CD, and obtain their instructions on how to proceed. In addition, the rapid acceptance and use of the new UDF (Universal Disk Format) provides another means of allowing access to the same disc from separate operating system platforms.

### **I want to use the same data resources for three operating systems on one disc. How does that work?**

This is a true hybrid disc which probably combines ISO 9660 (level 1), Rock Ridge Extensions (for UNIX) and Macintosh HFS. Premastering software for this combination is available from several software vendors. Please refer to the Resource Listing in the appendix.

### **Can I make a hybrid (Mac plus PC) disc on my PC?**

Most, if not all, of the hybrid software commercially available, is Macintosh-based for the simple reason that Apple has made tremendous efforts to allow importing and conversion of PC data into the Macintosh environment. Also, the Macintosh disc formatting software recognizes both native Mac/HFS as well as PC formats. For the latest information on this topic, check with the software vendors listed in the Resource Listing. Note that Creative Digital Research's HyCD package does make a hybrid-Mac CD under a Windows environment.

### **Does the location of files on a disc have any effect on playback performance?**

Yes, but to a very minor degree. The fastest retrieval is for those data placed on the inside tracks (near the start of the CD). This is because it takes longer to seek data from the outer (or end) of the CD and the lag time for the disc to rotate faster in those outer regions. Therefore, if your CD is written in "disc at once" mode and you therefore have some control over critical indexing information, that information should be copied to the CD before other data files. For a multimedia type disc, the location of files can be extremely important so that files that are likely to be accessed together are physically close to one another on the disc.

### **Can I record directly from DAT to CD-R?**

The DAT formats for audio and data are different on tape than on CD-R. You need first to convert the format using a

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disk-based PC system, next make the appropriate PQ edits, and then write the information to CD-R using a mastering software package. If your DAT is pre-edited with PQ information, the Alea System (see Resource Listings) can copy the audio DAT to CD-R. If your audio DAT is unedited, you can use a combination of Red Roaster software and a Digital Audio Lab 'D' card in your PC to read in your DAT tape, sample convert it from 32, 44.1 or 48 KHz, edit in the PQ codes and premaster to CD-R. (Red Roaster is available from Microboards). Also MediaFORM's CD2CD/Pro series duplicator can interface directly to an audio DAT player via an SPDIF port on the duplicator.

### **Why can't I use long filenames on my discs if my operating system can use them?**

Short filenames of the 8.3 variety are part of the ISO 9660 file structure. If you require longer filenames and want to stay within the ISO 9660 boundaries, you should use the "Rock Ridge" extensions to ISO 9660 provided by Young Minds (Redlands, CA, Tel: 909-335-0581) or Creative Digital Research (San Jose, CA, Tel: 408-255-0999). Newer Windows 95 recording software will typically include an option for you to use the Joliet file name conventions for 32 bit operating system access. As an example, Adaptec's EasyCD Pro (San Jose, CA, Tel: 408-774-6228) can write Win 95 long filenames.

### **What mastering software can run under WindowsNT? Win 95? OS/2?**

Please refer to the Resource listing that follows for an indication of which operating systems are supported by the various mastering software vendors.

### **What's a "mixed mode" disc?**

A mixed mode disc combines data and audio tracks on the same disc. Data recording and audio recording require different "modes," so that the reader can interpret the information correctly. A mixed mode disc allows you to record a data track followed by one or more audio tracks. Contrast this to the new CD Plus or Enhanced CD standard that lets you do the same thing, only in the reverse order, i.e. the audio tracks come first.

### **Can I record audio onto CD-R?**

Yes, you can. In fact, it was the heavy use by audio studios to create "check" discs or "reference discs" for recording artists that started the CD-R industry. An estimated 25% to 30% of current CD-R discs are used for audio applications. The first CD-R recorders processed audio only and had to be modified to handle the data or CD-ROM format. Great progress has been made by hardware and software manufacturers to allow you to capture audio and then record it to CD-R.

### **Why aren't there inexpensive audio CD recorders that are as easy to operate as a cassette deck?**

There have been a few attempts to make the CD recording process as easy to operate as a cassette deck, and others will surely follow. As for "inexpensive," CD recorder prices have fallen dramatically over the past two years, and they are expected to continue dropping. When first introduced in 1989, a CD recorder cost over \$60,000. The current generation of CD recorders cost less than \$1,000.

### **Can CD-R discs be used as masters for stamping?**

Yes, they can. If you are planning to do this, then you should discuss the use of CD-R as input transfer media with the mastering facility you have selected. The mastering facility will require you to verify that there are no "uncorrectable" or E32 errors on the CD-R that you provide. This is because the software used in the glass mastering process to drive the laser beam recorder is often set up to abort the glass mastering process if an E32 error is encountered.

### **Do discs have to be created in "disc at once" mode to be used in a mastering facility?**

The mastering facilities have traditionally preferred "disc at once" mode, because their mastering software did not know how to correctly interpret other recording modes used by newer generations of CD recorders. Now, however, several of the mastering facilities have upgraded their mastering software to interpret multisession recording modes. This opens the door for you to record in "track at once" or "multisession" mode. However, you need to verify that your selected mastering facility can handle the specific mode that you would like to use. Most important, if you use a multisession or incremental packet writing mode, then you must "finalize" or close the disc so that it complies with the ISO 9660 reading conventions.