

CD RECORDING BASICS

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OVERVIEW

This section covers some of the important topics related to CD Recording in general. Since the whole session on CD recording will be mostly practical and will show to you how to create a different sort of CDs, this material will give you just an overview of CD recording terms that are important to understand ways of recording, File systems used for recording data CDs, the most used CD Formats and most common CD-R software products. At the end you will find CD-R Glossary with basic terms repeated for easier CD-R startup in the case you are wandering for what some particular option in your CD-R software stands for. The majority of this material is taken from CD-R software Help files, so I would strongly advise you to check those files whenever you have doubts about the way you supposed to record some new CD.

CD RECORDING TERMS

Tracks and Sessions

These two terms are used frequently during CD recording, so it is necessary that you understand them:

Tracks - A CD is physically separated into individual tracks. This division is used, for example, to separate songs from one another on Audio CDs, or to separate different MPEG streams on a Video CD. An Audio CD contains one song per track, while a CD-ROM has just one track for all the computer data. A Mixed Mode CD contains one track (the first) for the computer data, and subsequently one song per track for the audio recordings.

Sessions - Each time you record to a data CD is called a session. A session is also a physical division on the CD, just as tracks are a physical division. Each session is marked by a so-called lead-in at the physical start of the session, and a lead-out at the physical end of the session. There are CD types that have to be written in one session, (i.e. Audio CDs,) and there are types of CDs that can consist of more than one session. The former are called singlesession CDs, while the latter are multisession CDs. To create a multisession CD, all sessions, even the first one, have to be recorded in the multisession mode. Each session can have several tracks, and each CD can have several sessions.

CD-R

CD-R is short for CD-Recordables. In contrast to pressed CDs, these discs contain a special layer which is burned in during the recording process.

A few older CD-ROM drives may have problems reading these CDs correctly, i.e. they may not be able to mount CD-Rs at all, or may only be able to mount the first session correctly. Should your CD-ROM drive not recognize the CD-R you have written, you should try a different brand of CD Recordable disc. In fact, since CD-R manufacturers often sell the same media under different labels, it is advisable to try a CD-R media made with a different manufacturing process altogether. The different processes product CD-Rs with different coatings. At the moment three different CD-R coatings are available: gold, green or blue.

CD-RW

CD-RW is short for CD-Rewritables. In comparison to CD-R disks, CD-RW can write but also delete and rewrite data on the disk. This way it is possible to use CD-RW disk as a high capacity data storage media that can be reused many times. It is very similar to storing a data on Zip or floppy drives. CD-RW software like Pocket CD or Direct CD is usually integrated into your Windows Explorer, what makes use of CD-RW disks very convenient. Your CD recorder must support CD-RW in order to be able to write on CD-RW disks.

CD Capacity

Recordable CDs come usually in the size of 74 minutes. The amount raw space available on a CD can be calculated in the following way:

74 minutes - (2352 bytes/sector) x (75 sectors/second) x (60 seconds/minute) x (74 minutes) =
783,216,000 bytes = 747 Mbytes

This raw space is not all available for user data. Different logical sector sizes are used on a CD, e.g. leaving only 2048 bytes/sector for computer data. In addition to this, CD formats such as ISO 9660 require various overhead information like the directory tree and volume descriptor and the CD has a different logical cluster size than the hard disk.

Since some of this overhead varies from CD to CD, it is not possible to calculate exactly how much space is available for user data. A rough estimate of the amount of space available for user data is about 680 Mbytes for 74 minute CDs.

FILE SYSTEMS

Data CDs can be recorded using two file systems: ISO 9660 and Joliet file system that is newer and supports long filenames. Here is a description of both systems:

ISO 9660

ISO 9660 is a data format, introduced in 1984 by the International Standards Organization. Since then it has succeeded in becoming a widely accepted cross-platform standard, and the most important CD data format for DOS/Windows PCs. ISO 9660 is the "lowest common denominator", and therefore has even more restrictions than the file system commonly found with DOS/Windows-based PCs. Filenames are not only limited to "8.3", but can also only contain the upper-case letters 'A' through 'Z', the numerals '0' through '9', and the underscore character '_'. Special characters like '\$' or ' ' are not allowed. Filenames without an extension must still have a dot/period.

Directory names have a maximum length of 8 characters and cannot have an extension.

The directory cannot be more than 8 levels deep. It is important to know that the file system on the harddisk of a PC-based computer differs from this file system, which is the most used system for CD-ROM. The differences are as follows: Many CDs produced today do not comply with the ISO 9660 standard, e.g. it has become quite common to allow for directories with more than 8 levels. Many CDs also contain non-ISO characters like '\$' and '-'. Creating ISO CD-Rs with non-ISO characters may cause the CDs to behave strangely, and files and directories might not be opened.

Joliet

As the restrictions of ISO 9660 are quite limiting with modern operating systems, such as Windows 95/98 or the Macintosh OS, Microsoft and Apple have each defined proprietary extensions to ISO 9660.

Of course, the advantages of these extensions can only be fully exploited by the OS they were intended for. Other systems may not even be able to read the CD at all.

The Microsoft CD-ROM recording specifications, known as "Joliet", are an extensions to ISO 9660 which allow filenames of up to 64 Unicode characters. Every Joliet CD actually contains two file systems: One complying to ISO 9660 to ensure full compatibility to all other systems, the second one Joliet, currently only readable by Windows 95/98. All other platforms will only recognize the ISO part.

RECORDING METHODS

Using CD-R software CDs can be written in two different recording methods, "Track-at-Once" or "Disc-at-Once". While all CD-Recorders work in the "Track-at-Once" mode, "Disc-at-Once" is not supported by all recorders.

Track-at-Once

The question of whether to record a CD in "Track-at-Once" or "Disc-at-Once" mode is only relevant when creating an Audio CD. It makes no difference for a data CD which mode you record in. When recording "Track-at-Once" the recording process will be interrupted after each track and can be continued immediately or sometime later. This makes "Track-at-Once" recording more flexible, as you are, for instance, able to stop the recording after each track and read out a new track from the CD recorder. However, with Track-at-Once the 2-second gap is always inserted, which may be unwanted for recording live music. The Track-at-Once mode of recording may also have little clicks between tracks when reading from ordinary CD players.

Some recorders allow to record „Track-at-once zero gap“, allowing to avoid the 2-second gap. Data CDs written as multisession CDs are recorded "Track-at-Once".

Disc-at-Once

Using the Disc-at-Once recording method, all the blocks of the CD-R are written by the recording software. This is especially useful when producing Audio CDs, as only Disc-at-Once allows the user full control over the gap between tracks and the ability to edit the PQ-channel. This might be important when mastering the CD later.

It may, however, be a problem that the entire CD has to be written at once.

"Disc-at-Once" recording allows for specifying the length of pauses between tracks as desired while the "Track-at-Once" mode only support a 2 second gap or zero gap (if „Track-at-once/zero gap,, is supported by the recorder at all).

CD FORMATS

Here are listed some standard CD formats that are commonly used to record a CD.

CD-ROM

Computer Data CD - This CD is often called CD-ROM. It contains computer data in the same way as your harddisk, and is usually recorded in the ISO-9660 format.

Audio CD

Audio CD - This is probably the type of CD people are most familiar with. This CD contains music, and can be played in CD-ROM drives on the computer, or in any CD player at home, in the car, etc.

Mixed Mode CD

Mixed Mode CD - A CD which contains both a data track and audio tracks is called a "Mixed Mode CD". The data is stored in the first track, while the audio is in subsequent tracks. Modern audio CD players will mute the first track when played.

CD-Extra

Like a Mixed Mode CD, a CD-Extra contains a data and one or more digital audio tracks. To avoid the problem of the data track being "played" on an audio CD Player (possibly damaging it), a CD-Extra contains all audio tracks in the first session and the data track in the second session. As all Audio CD players are single session drives and can only recognize the first session of a CD, they will always play what they find in the first session.

A CD-Extra capable CD-ROM drive will first look into the last session of the CD (the data part of a CD-Extra) and read this prior to doing anything with the audio first session.

The CD-R standard requires certain data that must be on a valid CD-Extra. In addition, a CD-Extra can contain standard ISO-9660 data for computers.

PhotoCD

The PhotoCD, introduced by Kodak, is a medium for storing picture information on a CD. The PhotoCD is a multisession Bridge Disc.

VideoCD

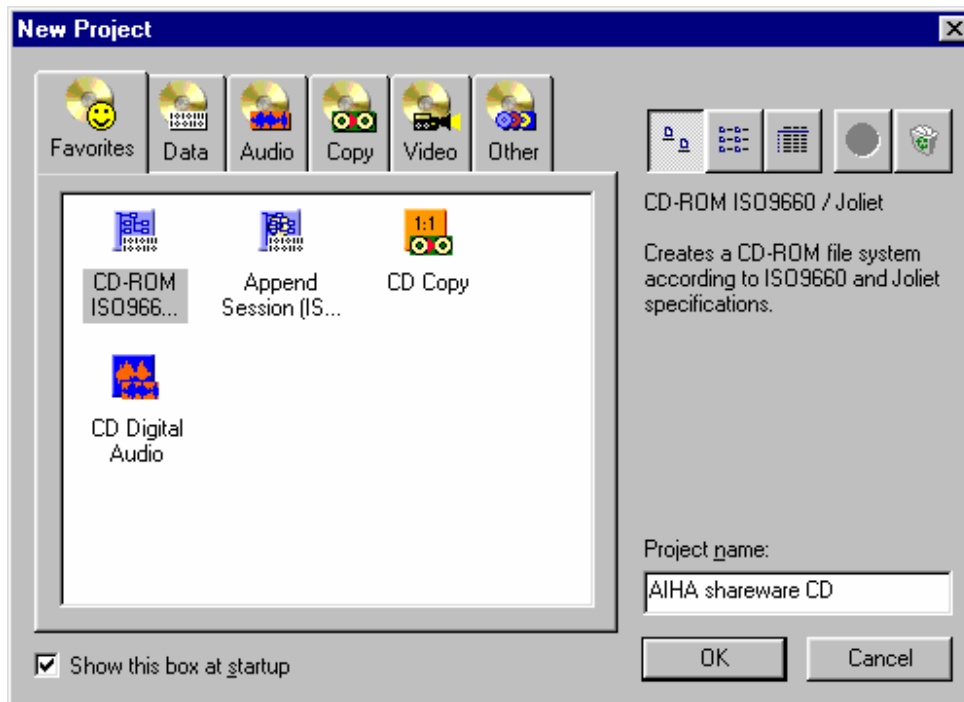
A VideoCD contains MPEG full-motion video in a special format, so that it can be played back with MPC3 computers, CD-i players or VideoCD players. More sophisticated, interactive VideoCDs including still-MPEG slide shows, MPEG files, hotspots, and menus can be created with professional VideoCD authoring tools that are available at the market.

CD-R SOFTWARE

To be able to record a new CD you must use some of CD-R software. Usually such software is provided with your CD-R device and most common ones are *Easy CD Creator*, *WinOnCD* and *Nero*. It is not much of importance which one you will use since they all are very similar and support almost all known types of CD writers and CD-R formats. They even have similar user interfaces, so if you are familiar in working with one of them switching to another one should not be a big problem.

When you wish to record a CD you will be usually prompted to choose what type of CD you want to create: Data CD (ISO9960/Joliet), Audio or Video CD or some sort of CD in Mixed Mode. *Picture 1.* shows starting screen of WinOnCD software.

After you choose the type of your CD, the interface will show something alike file Explorer. It is your only task to choose source of data you want to record, set up some options and 'burn' your CD. Explorer alike interface will allow you to choose the files you want to add to your session and you can simply drag-and-drop them on new CD layout. Space indicator will show you how much space you have left on your CD to add additional data.



Picture 1. Starting screen of WinOnCd software

Setting up the options

Before actual recording you must set up couple of options.

Close Disk -If you are recording multi session disk you will need to choose if you want to Close Disk or not. If you close disk no additional sessions can be added later. If you want to add some sessions later choose Close Session and Leave Disk Open.

Test Writing –If you want to test if your recording will be done successfully you can use this option. If you previously already recorded couple of disks and know that your system is able to record the CD with such settings you do not need to use this option since it is very time consuming like recording itself.

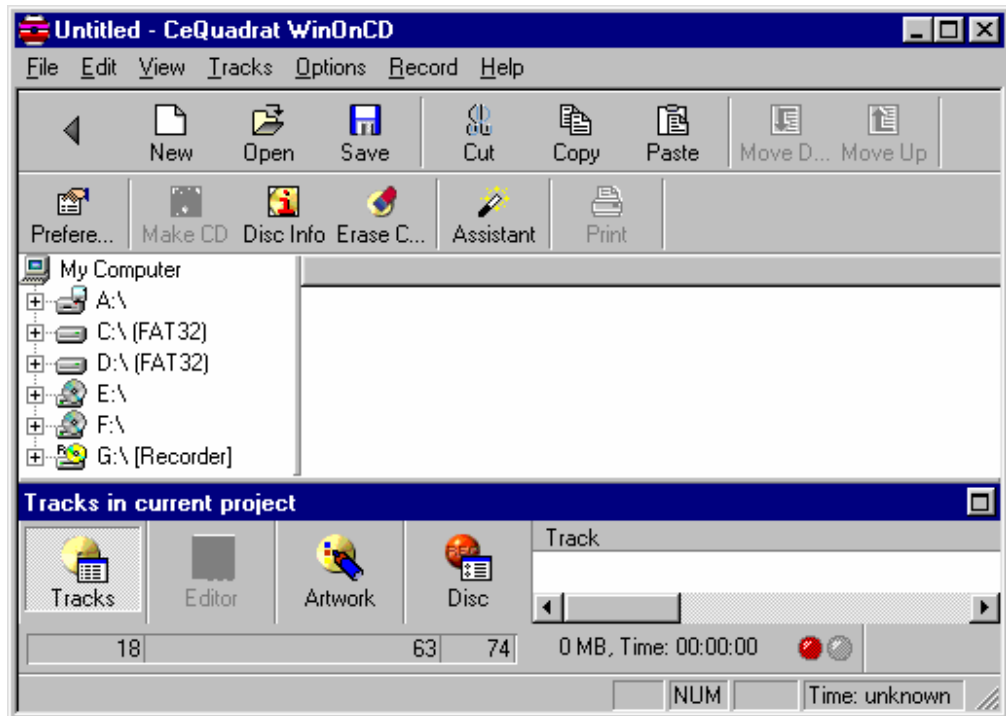
Recording Speed – You can specify a speed at which your recording will be done.

Write Mode – You can choose ‘Track-at-Once’ or ‘Disk-at-Once’ and "On-the-fly" writing if your system allows it (not recommended, can cause buffer underrun).

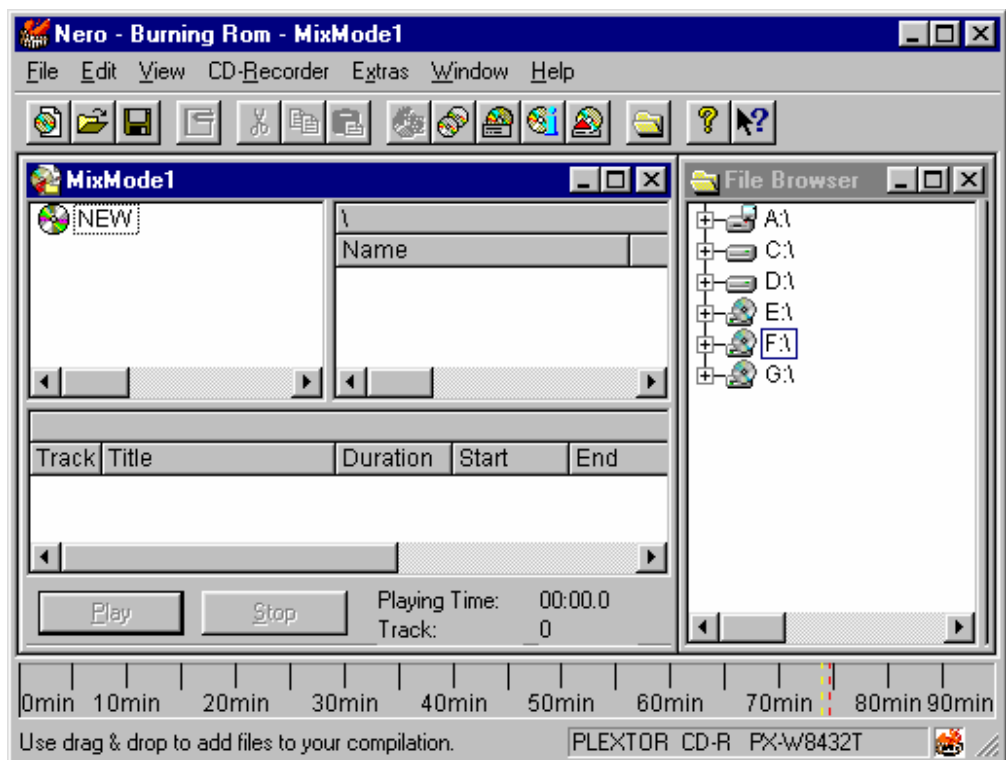
Recording

Press Record button to record your CD.

Pictures 2. and 3. show WinOnCD and Nero user interface. Other details regarding CD recording will be presented during our CD-R session.



Picture 2. WinOnCD main screen



Picture 3. Nero main screen

CD RECORDING GLOSSARY

Buffer Underrun

Each track on a CD has to be written without interruption. To achieve this, every CD recorder has a built-in buffer, to compensate for reductions in the transfer rate from the computer. If the transfer speed is too slow, the buffer is not filled fast enough and runs out of data. This is called "buffer underrun". Depending on the CD recording options, the commenced track or the entire CD-R will be unusable if this happens.

Disc-at-Once

Disc-at-Once is one of the methods of writing CDs which is not supported by all CD recorders. With this method, all the blocks of the CD-R are written by the recording software, including the track gaps. This is especially useful when producing audio CDs, as only Disc-at-Once allows full control over the gap between tracks and the PQ-channel, necessary for mastering the CD.

ISO 9660

ISO 9660 is an internationally standardized file system adapted by most operating system manufacturers. This standard is also known as ECMA 119. The use of this file system enables many systems to access files recorded conforming to this file system. The disc has to be read back on MS-DOS, Apple Macintosh, UNIX or VMS systems and must meet all the restrictions of these various file systems.

ISO 9660 is usually recorded in CD-ROM mode.

Lead-in

The lead-in contains the table of contents of a session, which holds information about the track layout of the current session. It is always written together with the lead-out at the end of a session. Each lead-in takes up 4500 sectors (about 9 Mbytes) on the CD.

Lead-out

The lead-out indicates the physical end of a session, but contains no actual data. It is always written together with the lead-in at the end of a session. The first lead-out written to a disc takes up 6750 sectors (about 13 Mbytes) on the CD, while subsequent lead-outs take up 2250 sectors (about 4 Mbytes).

Mixed Mode

A Mixed Mode CD contains one data track, and after this a number of digital audio tracks. WinOnCD can write Mixed Mode CDs.

Multisession

A multisession CD-R is a CD-R with more than one session on it. However, multisession is more commonly used in conjunction with the ISO 9660 file system, where it describes the process of adding information to an ISO 9660 CD after its initial creation.

"On-the-fly" writing

When writing CDs, a constant data rate has to be maintained. Therefore, it is sometimes advantageous to assemble the complete CD as an image file on the harddisk. When this image file is written to the recorder, it will be read linearly which guarantees an optimum read performance. This process is safe, but requires more harddisk space and is more time consuming than "On-the-fly" writing.

If the overall system speed is sufficient, the image can be assembled while the CD is being written (on-the-fly), not producing an intermediate file. Because of increased search times, this may lead to problems (Buffer underrun) on slower systems.

Session

CDs are divided into tracks and sessions. A CD can hold several sessions. Each session can hold one data track, but more than one audio or video track. Audio tracks have to be in the first session of a CD.

If you want to write a data CD in several steps, you have to write a dedicated session each time. This is what is called a multisession CD consisting of a Lead-in area, a data track, and a Lead-out area, repeated any number of times. You will need about 15 MB of CD space for each Lead-in and Lead-out overhead which does not contain any useful data. If you write an Audio CD in several steps, you will only add a track each time and close the CD after the last track. This is a so-called "Track-at-Once, single session CD".

Track-at-Once

Track-at-Once is a recording method where every track is written separately. Between the tracks the CD recorder can control the recording process. There is no difference in data CDs written "Disc-at-Once" or "Track-at-once". For Audio CDs the "Track-at-Once" recording method is significantly more flexible. An Audio CD can, for example, be recorded in several steps and with most recorders an Audio CD can be continued after a "buffer underrun" error. If, however, the CD shall be used as a master CD for mass replication, it must be written "Disc-at-Once". Also, with "Track-at-Once" CDs, clicks are sometimes heard between the tracks. This will never happen with CDs written "Disc-at-Once". For some CD recorders "Track-at-Once" is the only way to record CDs.

Source:

Nero Help Files © 1995-2000 Ahead Software gmbh

WinOnCD Help files © 1992-1998 CeQuadrat® GmbH, Germany and CeQuadrat® USA Inc.