

All you ever wanted to know about CD-R's

So you thought picking up some CD-R media on the way home from work was going to be easy. Dreamer! Instead, you're standing in the store, confronted by a dizzying array of choices: discs that are gold, silver, red, blue, or even purple; speed ratings; pricier certified discs and less expensive noncertified ones; and brands ranging from household names to house labels. Are any of these differences worth worrying about, or can you just grab the color that suits your fancy and get on with your life?

Chokhani.net checked the info available on the net, studied the reports of the experts who have tested the actual media from four common brands: CompUSA, Imation, Sony, and Yamaha.

We found that while CD-R media in general are pretty reliable, there are definite differences in quality and some easy ways to avoid bad experiences.

Media hype

The most obvious differences between CD-R's, such as color, capacity, and speed, have a good amount of impact on the buying decision of many. But dig deeper--literally--into the disc, and you'll find the heart of the matter.

Color, size, and speed

Designer colors such as red, blue, purple, and black have become popular recently and are purely cosmetic, having no affect at all on the quality or compatibility of a disc. There's another, more subtle color issue involving the reflective layer of the disc and archival life, but we'll get to that later.

The capacity of a disc is a no-brainer: 80-minute/700MB discs hold more than 74-minute/650MB discs; if you want to write more data or music per disc, get the 80-minute discs. Just be aware that some older drives and CD players may not be able to read 80-minute discs, although this problem is becoming increasingly rare.

The *speed rating* of a disc--indicating the top speed at which you can reliably write data to it--is also pretty straightforward. The rule of thumb is to use discs that match the top speed of your drive, such as 24X media for a 24X/10X/40X drive or 12X media for a 12X/10X/32X drive. You can always use higher-rated media for a slower-rated drive, but trying to use slower-rated media in a higher-rated drive could lead to problems.

Quality control

The less obvious differences in discs--the materials used and the grade of quality control--are what really make or break them. We'll get to the materials later, but now for the bad news about quality control: There's no accounting for it. According to some experts, so many different companies manufacture CD-R media in so many different places that it's almost impossible to track or test it all.

Media quality varies for other reasons, too; vendors are constantly switching sources, good manufacturers can have bad days, and the quality of basic materials can vary. Other factors, including the quality of the laser, the firmware, and the mechanics of the drive reading and writing to the disc, can also affect the outcome.

The good news is that the overall quality of discs is quite good. Manufacturing CD-R media is a well-developed and understood process; where we once routinely saw 5 or so bad discs on every spindle of 50, we now get some spindles with no faulty platters at all. Of course, we may simply be lucky--it's that much of a crapshoot.

Another way to buy reliable media is to stick with a major company that manufactures its own--such as Fuji, Kodak, Maxell, Mitsui, Taiyo Yuden, TDK, or Verbatim. These companies exercise direct control over the materials and processes that go into making the discs, ensuring a more consistent level of quality. House-brand media, such as CompUSA's, and even some big-name brands buy their discs from a variety of companies, so quality may not be as consistent from batch to batch.

Because media quality can be so unpredictable, it should be only one part of a larger data-safety program. To safeguard vital data, you should also employ your software's Verify function and make two or more copies in case of an emergency.

Cheap or good?

If you're strapped for cash, don't worry. While certified media will buy you some peace of mind, not all data-storage needs justify the media's higher price. If you're producing nonarchival music CDs, disseminating data for the short haul, or simply making quick one-offs to send to friends, cheapies on a spindle may be more economical, even if you get a few bad discs per batch. Of course, you risk wasting time by writing to the bad discs--but you get what you pay for.

A CD test-spin

Beyond buying certified or noncertified discs, determining the true quality of CD-R media literally involves an in-depth analysis of the number of errors that occur when data is read from it.

Every CD-R you write will produce errors, which are measured in terms of block-error rate, or BLER. BLER is the number of errors per *block* (a block is 2,024 to 2,352 bytes of data, depending on the write mode).

BLER has a variety of causes. "BLER...can be caused by anything from improper writing to inferior CD-R quality: dye, metallization, or plastic discrepancies (by that I mean particles in the plastic or stress of the plastic)."

Discs, like humans, are allowed a certain amount of fallibility. "Up to 220BLER is acceptable, according to the Yellow Book (CD-ROM) specification, after which the disc is officially considered to have failed." Newer drives are also more tolerant of a disc's failings. Many modern readers can correct errors at a higher BLER than 220, since error-correction technology has been advanced since the spec was written.

Taking a test-spin

To determine the BLER of some commonly available CD-R media, Chokhani.net studied the test results arranged for the use of CD Associates' CDA 3000 analysis computer to check discs for write errors.

The performance charts show three pieces of data for each disc: the overall quality rating based on the CDA 3000's analysis, the average BLER, and a picture of what the BLER looked like on a sample disc from each brand.

Three of the four brands passed with flying colors. However, Sony's discs couldn't pass muster at 40X read speeds, even though they were supposed to do so; the machine had to decelerate to 24X to make the disc readable. CD Associates reported that the laser's signal level from the Sony discs was too low for the faster speed. In other words, the variation between the burn marks and the rest of the disc was not distinct enough to be read at that rate.

Most users might never realize that their discs were being read at 24X instead of 40X, but exacting multimedia mavens should check Sony discs to see if they experience the same problem.

Reports on some tests on important brands are as follows:

Brand : Yamaha
Price per spindle : \$35
Speedrating : 20X
Certified? : Yes

Performance : The Yamaha media showed the lowest error rate of all the CD media types. As a result, it got the highest quality rating from the CDA 3000 Analyzer: 97 percent.

Brand : CompUSA
Price per spindle : \$20
Speed rating : 16X
Certified? : No

Performance : CompUSA's media ranked second in our trials, with a quality rating of 94 percent when tested at 40X. Its error rate was three times that of the Yamaha's. The CompUSA media is uncertified, but it is also inexpensive.

Brand : Imation
Price per spindle : \$25
Speed rating : 16X
Certified? : No

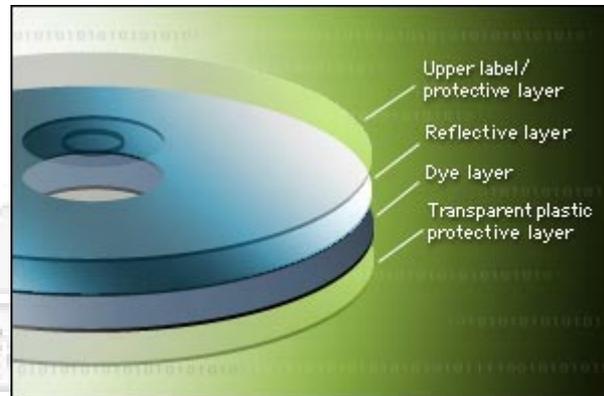
Performance : Imation's 16X, uncertified media ranked third in the trials. Its average BLER was about 75 percent higher than that of the CompUSA media and more than 5 times higher than the Yamaha's. Nevertheless, it still was ranked as excellent by the CDA 3000 analyzer

Brand : Sony
Price per spindle : \$30
Speed rating : 16X
Certified? : No

Performance : Sony's discs placed last in trials, because at 40X, the discs returned too many errors and failed the BLER tests. The signal the discs returned was not strong enough for adequate error correction at this speed, resulting in an average BLER 33.5 times that of the Yamaha media. However, the discs could be read just fine at 24X and had a much lower average BLER at that speed.

Disc anatomy

To understand why variations in CD-R compatibility and reliability exist, it helps to know a bit about the makeup of the media.



CD-R media has four layers: an upper label/protective layer, a reflective layer, a photoreactive-dye layer, and a transparent plastic (polycarbonate) bottom layer, which protects the two middle layers. Your CD-R/RW drive writes data to these discs by firing a laser in a short burst to burn a hole in the dye layer. This hole is filled in by the metal in the reflective layer above it, which creates a bright spot that's read like a pit in a commercial CD (commercial CDs are pressed much like LPs used to be).

Silver and gold.

The reflective and dye layers are the most important layers in the equation. The reflective layer can be gold, silver, or a combination of both. Gold is generally thought of as the most stable in the long run since it's the least reactive with dyes and, therefore, less prone to corrosion. However, there's also a good argument for silver, which was specified in the original standard because it's more reflective and, therefore, more easily read by players.

Manufacturers also claim that dye formulas have been improved to the point where reactions with the reflective layer are no longer an issue.

Fool's gold

Buying a disc with real gold in it can be a challenge because you can't go simply on product labeling or even the color of the disc. The packaging on some generic discs may use the word *gold* strictly as an advertising ploy. And disc colors can be deceptive. The upper layer can be any color of the rainbow, and manufacturers have also recently taken to coloring the transparent bottom layer. Some discs, for instance, have a gold-colored upper protective layer, yet they actually use a silver reflective layer.

How can you tell fool's gold from the real thing? If store personnel cannot confirm the truth for you, ask them if you can open a package and look at the disc. If you look very closely at the bottom layer, even through a color, you should be able to see a warm glow to the disc that signals true gold inside.

Comparing a gold disc to a silver disc makes it easier to see the difference. If you cannot perform any of these checks, your best bet is to research company Web sites for the

specification, or you can just learn from experience by buying different brands and comparing them.

The dyes used in a CD

The photoreactive-dye layer comes in more variations than the reflective layer does. The original official CD standard called for TDK's Azo dye, which is dark blue. However, a number of other dyes, such as the lighter blue cyanine, have been developed and employed since--basically so that vendors don't have to pay each other royalties.

Some dyes, such as phthalocyanine, are lighter than others and don't produce as distinct a variation in color between burn marks and the unburned areas. This has been the traditional knock on common reflective/dye combinations such as gold/phthalocyanine.

By and large, try not to worry. Unless you're having real problems with discs that can't be read in other drives, the dye/metal controversy will probably not affect you much.

That said, we recommend discs with a gold reflective layer for archiving because under adverse conditions, the more stable nature of gold could be the difference between retaining your data and suffering corrosive heartbreak. But for the best compatibility with the widest variety of drives and players, use discs with a silver reflective layer--their higher reflectivity may make them more readable in older players with weak lasers.

Care and feeding of CD-Rs

In order for your CD-Rs to stand the test of time, you must care for them properly. This means placing them in jewel cases whenever you're not using them, not subjecting them to direct sunlight or other extreme weather conditions, and keeping them away from the hands of small children and klutzy adults.

The storage story

If you're short of jewel cases, paper or plastic sleeves are better than nothing. However, where a jewel case suspends a disc in midair, a paper sleeve is in direct contact with the surface of a disc. Dust can accumulate inside a sleeve, turning it into sandpaper, slowly yet inexorably ruining the surface of your disc.

Downside up

If you're not 100 percent diligent about keeping your discs safely tucked away (who is?), then you should always place them *clear* side down. *The labelled/printed face of a disc is actually more delicate than the bottom, clear, polycarbonate layer*, and major damage to the label side will ruin the reflective and dye layers as well. This is not to say that you can scar the clear bottom layer with impunity, but minor scratches to polycarbonate are survivable, and even major ones can often be buffed out or filled.

Label issues

Labels are handy for categorizing your discs, but they can also affect performance and damage your discs. A poorly attached label can cause a disc to wobble too much for high-speed reading. If you must use labels, use only those formulated for use on CDs. These have milder adhesives than general-purpose labels and shouldn't react badly with the top layer. Another caveat: If peeled off a label has both the reflective and dye layers come off with it. It makes for great art, but the disc will be completely useless after that.

CD markup

Marking a disc with a pen is probably OK if you use a specially formulated CD marker. But the ink formulations in some general-purpose pens can react badly with the upper layer and leak through to harm the reflective and dye layers below. If you want to be completely safe, either mark your discs on the clear inner circle where no data is stored, or better yet, leave the disc unmarked and use the paper jewel case insert to list the disc's contents.

Follow these few simple rules, and you can expect years of service from your CD media.

Chokhani.net's bottom line for CD-R media

1. When the data or music's important, use certified media from a major manufacturer that makes its own discs. Otherwise, go with the cheapies to save money.
2. Designer colors are fine, but make sure the media is rated to match the top speed of your recorder.
3. Buy discs with a gold reflective layer if you're archiving. There's a debate as to whether gold is actually superior, but better safe than sorry. Use discs with a silver reflective layer for the best compatibility with older drives and players.
4. Use jewel cases to store your CD-Rs, forgo labels when possible, use only specially formulated CD markers to label your CD-Rs, and keep your CD-Rs out of the sun and extreme temperatures.

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