

Welcome back,
pburrows

LOG-OUT

PROFILE

CASE STUDIES

ARCHIVE

SEARCH

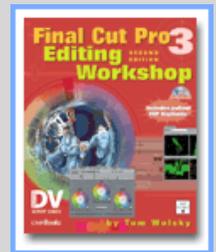
Search

GO!



DV MEDIA GROUP

- Media Kit
- Store
- DV Certified



[Printer friendly version.](#)

Ralph LaBarge

DVD Compatibility Test

For many years, I have been a devoted fan of recordable DVD technology, and I've built my business around it as a DVD developer. It's crucial that I understand how I can author discs that can be read by the widest number of viewers so I can avoid returns, excess technical support, and general end-user frustration. But there are many variables in the DVD world.

In my studio, I have first-, second-, and third-generation DVD-R burners from Pioneer; first- and second-generation DVD-RAM drives from Panasonic; and first-generation DVD+RW drives from HP and Sony. When DVD+R drives become available later this year, I'll be the first one on my block to buy one.

I use recordable DVD extensively in developing and testing titles before I send them out for replication. Other DVD producers circumvent replication and release recordable DVDs they've burned themselves.

With the release of set-top DVD recorders from Panasonic, Pioneer, and others, recordable DVD is rapidly becoming a mass-market product.

Computer-based DVD burners are readily available for less than \$400, and set-top units can be bought for less than \$1000. Combined with inexpensive DVD authoring tools from companies such as Apple, Pinnacle Systems, Sonic Solutions, Ulead, and others, affordable systems for making your own DVD discs are becoming a reality for many consumers. But compatibility issues are growing exponentially.

Unfortunately, there is trouble in recordable DVD paradise. As with most new technologies, recordable DVD has a compatibility problem. This compatibility problem has three main factors—the DVD formats (e.g., DVD-R, DVD+RW, DVD-RW), the DVD blank media manufacturers (e.g., Maxell and Verbatim), and the DVD players (e.g., Pioneer and Sony)—that have complex permutations.

The purpose of this article is to make DVD producers, vendors, and consumers aware of the compatibility issues for recordable DVD. The compatibility of replicated DVDs, burned from glass masters in high volumes at large DVD replication houses, is outside the scope of this story. I will explore the issues that affect DVD producers who burn smaller runs themselves.

I'll provide recommendations on how to avoid problems when you record DVD discs and how to attain the widest compatibility so your DVD can be watched by as many people as possible. Then I'll wrap up with a few general guidelines to help you get the most out of recordable DVD.

A brief overview of recordable DVD technology

Let's start by taking a look at the different technologies used to make a recordable DVD. There are currently five different types of recordable DVD products on the market. These products are DVD-R for Authoring, DVD-R for General, DVD-RW, DVD+RW, and DVD-RAM. A sixth product, DVD+R, should be widely available within the next few months. Each of these recordable DVD technologies has its own strengths and weaknesses.

DVD-R for Authoring, DVD-R for General, and DVD+R all use organic dyes that are sensitive to an infrared laser. DVD-R for General and DVD+R discs are recorded using a 650nm (nanometer) laser, while DVD-R for Authoring discs are recorded using a 635nm laser. When the organic dye is exposed to a low-power infrared laser, it is permanently changed and the data is recorded onto the disc. The rewritable formats-DVD-RW, DVD+RW, and DVD-RAM-use phase-change materials. There are two different power levels used for writing and erasing data on a phase-change disc. The highest power level causes the surface of the material to become less reflective, and a lower power level causes the material to become more reflective. Phase-change-based recordable DVD media can be rewritten more than 1000 times, but the organic dye material used in DVD-R and DVD+R media can only be written once.

Potential compatibility problems

Several different compatibility problems can occur between a recorded DVD disc and a consumer DVD player. These problems include physical, logical, and application incompatibilities. The DVD specification states that single-layer discs should have a reflectivity between 45 percent and 85 percent, and dual-layer discs should have a reflectivity between 18 percent and 30 percent. The first potential problem with recordable DVD media is if their reflectivity falls outside the specified ranges.

The DVD specification also defines several logical parameters that are important for recordable DVD media. These parameters are stored in the header area of each data sector on the disc, and they include sector type format, tracking method, reflectivity, layers, and data type information. Each logical parameter must be set correctly for a recordable DVD disc to work properly.

Application-level compatibility problems are generally related to the average and burst data rates of the content stored on the disc. In theory, any recorded DVD disc that complies with the DVD specification should work fine on all consumer DVD-Video players. However, in practice, recorded DVD discs with high average or burst data rates, or with data stored at or near the outer edge of the disc, are more likely to exhibit playback compatibility problems.

Physical, logical, and application compatibility problems can manifest themselves in a number of different ways. Many consumer DVD-Video players will fail to mount a recorded DVD disc. When this happens, the player usually displays an error message indicating that the disc is damaged, has the wrong region code, or, in some cases, a diagnostic code. Other typical problems include video artifacts, audio dropouts, and navigation problems that prevent portions of the disc from being accessed. In some cases, a DVD-Video player may lock up while playing a recorded DVD disc.

What is compatible?

One of the most frustrating things that can happen to a DVD developer is to send recorded discs to clients, friends, or relatives, and the discs fail to play properly on their systems. Many developers know enough about potential compatibility problems that they tell their clients or friends to use a compatible player in order to use the disc they send them, but what compatible means isn't always clear.

A number of Web sites-such as www.vcdhelp.com/dvdplayers.php, www.apple.com/dvd/compatibility, and www.DVDMadeEasy.com-provide information about compatible players. Unfortunately, the data found on some of these DVD compatibility Web sites is based on anecdotal information and relies on individual end users to report their experiences with how a single brand of recordable DVD media works on a specific make and model DVD player. Because there are no common standards to define what compatibility is, the information found on these sites must be taken with a grain of salt.

I have a rather simple definition of compatibility as it relates to recordable DVD: A recordable DVD disc is compatible with a consumer DVD-Video player if it works identically to a replicated disc created from the same disc image. In other words, end users should expect that recorded DVD discs will work as well as replicated discs purchased from a retail store.

The ultimate recordable DVD compatibility test

For many years, I have been telling anyone who would listen that we need a more rigorous method of determining the compatibility of recordable DVD discs on consumer DVD-Video players. I know many of the DVD-Video player manufacturers and recordable media vendors have internal compatibility testing programs. However, the results of these internal testing programs are rarely disclosed to the general public, or even the DVD development community. After discussing this problem with the DV editors, we decided to undertake a rigorous compatibility testing effort and publicize the results. This article is an attempt to bring sanity to how compatibility is reported for recordable DVD media on consumer DVD-Video players.

I have an engineering background. More than 20 years ago, I graduated with a bachelor's degree in electrical engineering and went to work for a Department of Defense contractor designing digital signal processing equipment. An integral part of designing electronic equipment is to develop a test plan and procedure to make sure that every unit that comes off the production line works as well as, or better than, the first prototype unit.

Developing a test plan to determine the compatibility of recordable DVD media is actually quite simple. You need to test every possible combination of DVD format, blank media brand, player brand, player model, and player revision. Then you must repeat those tests with multiple copies of each DVD format and brand on multiple copies of each player make and model to eliminate any random variables that might have influenced the test results (like a scratch on one of the test discs or a bad integrated circuit in a player).

I discovered there were more than 50 different combinations of recordable DVD formats and media brands, and over 400 different makes, models, and revisions of DVD-Video players. This adds up to over 20,000 different tests that would have to be run for only a single instance of media on one copy of every player! If the test were expanded to include multiple media copies tested on multiple players, the total number of tests would quickly exceed 100,000.

Figure 1 - Brands of Recordable DVD Media Tested, by DVD Format

| DVD-R for Authoring (3.95GB) | DVD-R for Authoring (4.7GB) | DVD-R for General (4.7GB) | DVD-RW (4.7GB) | DVD+RW (4.7GB) |
|--|--|--|---|-----------------------------------|
| Mitsui Pioneer Ridata TDK Verbatim | Maxell Mitsui Pioneer Ridata Ritek Taiyo Yuden TDK Verbatim | Apple CD-Recordable.com Imation Maxell Memorex Mitsui Panasonic Pioneer Ridata Ritek Sony TDK Verbatim Vivastar | JVC Memorex Pioneer Ridata Ritek Sony TDK Verbatim | HP Memorex Sony Verbatim |

A realistic recordable DVD compatibility test

Then reality set in, and I realized I had to approach the problem in a more feasible manner. I wrote a test plan and procedure that I could actually implement given time, budget, and labor constraints, yet was still a good, thorough (not to mention unprecedented) test to determine compatibility. I set a \$1000 budget to cover the cost of acquiring blank recordable DVD media and shipping all of it to various test facilities. The biggest problem was labor, which was solved through the generous contribution of staff time by five different compatibility testing companies in the DVD industry, none of whom make or sell recordable DVD media or DVD players.

The test's source material came from two DVD-Video disc images I authored using Sonic Scenarist NT 2.5. One disc image was used for full-capacity (4,700,000,000-bytes) media, and a second disc image was used for limited-capacity (3,950,000,000-byte) media. The full-capacity disc image is the Naxos Musical Journey Saint-Saens & Bizet. The limited-capacity disc image is The Call. Both titles were released during 2001 by DVD International and replicated by Panasonic Disc Services Corporation.

I arranged for the discs to be tested in five internal compatibility labs, including two major

DVD replication houses because they have the widest range of DVD players and independent positions in the industry. See the "Testing Facilities" sidebar for more information about some of the test sites. They followed detailed test procedures I wrote for each of the two disc images to test content from every area of the disc. The full-capacity (4.7GB) disc test procedure included 28 unique steps, and the limited-capacity (3.95GB) disc image had 16 unique steps.

The test DVD titles were chosen as source material because both titles had high-bitrate content, utilized over 97 percent of the disc's capacity, and had been released as a replicated title. Using high-bitrate content and discs that were close to full capacity meant it would be easy to spot errors caused by a recordable DVD compatibility issue. If a DVD player has to reread data on the disc, the video is visibly paused as it rereads, and an audio dropout may occur. Replicated copies of each disc image were also tested on every player to ensure that any detected problems were a result of their storage on recordable DVD media rather than a flaw in the encoding, authoring, or layout of the test disc image.

In order to pass the test, a recorded disc had to display the video, audio, and graphics at the same level of quality as the replicated version of the title. Each test facility looked for skipped frames, pauses, stuttering, or digital artifacts in the video as they listened for noise, pops, or dropouts. The test facilities also tested menu navigation. The recorded disc had to navigate correctly through the title's menu system to pass the test.

Figure 2 - DVD-Video Players Tested

| | |
|-----------|--|
| Akai | DVP1000 (1998) |
| Apex | AD500W (2001), AD600A (2001), AD660 (2000) |
| Denon | DVD1000 (1998) |
| GE | GE1105P (2000) |
| Hitachi | DVP305U (2000), DVP315U (2000) |
| JVC | XV511BK (1999), XV523GD (2000), XVD723GD (2001) |
| Kenwood | DVD404 (2001) |
| KLH | DVD221 (2000) |
| Magnavox | DVD611 (2001) |
| Microsoft | XBox (2001) |
| Oritron | DVD100 (1999), DVD200 (2000) |
| Panasonic | DVDA100 (1998), DVDA300 (1999), DVDA350 (1998), DVDRP56 (2001), DVDRV20 (2001), DVDRV31 (2001) |
| Philips | DVD621 (2002), DVD711 (2000) |
| Pioneer | DV333 (1999), DV341 (2001), DV414 (1998), DV434 (2000), DV500 (1997), DV505 (1998), DVC302D (1999), DVS9 (1998), DVDV7400 (2000), PDVLC10 (2000) |
| Proscan | PS8680Z (1999) |
| RCA | RC5200P (1997), RC5215P (2000), RC5220P(2000), RC5400P (2002) |
| Samsung | DVDM301 (2001), DVD511 (2000), DVD611 (2000), DVD709 (2000) |
| SMC | DVD3308 (1999) |
| Sony | DVPNC600 (2001), DVPS315 (1998), DVPS330 (1999), DVPS345 (2000), DVPS360 (2001), DVPNS400 (2002), DVPS550 (1999), DVPNS700P (2001), DVPS7000 (1997), DVPS7700 (1999), Playstation 2 (2001) |
| Thompson | DTH1000 (1998) |
| Toshiba | SD1700 (2001), SD2300 (2000), SD2700 (2001), SD3000 (1996), SD3006 (1997), SD4700 (2002), SD6109C (2000), SD6200 (2000) |
| Zenith | DVD2100 (1999), DVD2200 (1999) |

Media types and brands

Figure 1 shows a list of the recordable DVD formats and brands that were included in this test. I would like to thank many of the listed vendors who provided samples of each media type. In addition to media samples provided by vendors, we purchased approximately \$1500's worth of blank media.

I chose not to include DVD-RAM media in the test because an extreme minority of consumer DVD players and DVD-ROM drives are capable of reading this format. My testing was a bit too early to include DVD+R, but stay tuned to DV and DV.com for future updates on that format.

DVD-Video players

Figure 2 shows a list of the makes and models of DVD-Video players we tested. Over 2400 unique tests were performed, requiring well over 400 hours of testing labor.

Only players that were designed to handle at least one of the recordable DVD formats listed in Figure 1 were included in the test matrix. Every effort was made to include current models from each vendor, although we were constrained by the specific player makes and models available at each test facility. The acquisition date of each player is listed in parentheses next to the model number.

| | Player 1 | Player 2 | Player 3 | Player 4 | Player 5 | Player 6 | Player 7 |
|------------------------|----------|----------|----------|----------|----------|----------|----------|
| 4.7GB DVD-R (G) | | | | | | | |
| 1 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 2 | ✗ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 3 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 4 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 5 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 6 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 7 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 8 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 9 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 10 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 11 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 12 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 13 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 14 | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ |
| 3.9GB DVD-R (A) | | | | | | | |
| 1 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 2 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 3 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 4 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 5 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 4.7GB DVD-R (A) | | | | | | | |
| 1 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 2 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 3 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 4 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 5 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 6 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 7 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 8 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 4.7GB DVD-Rw | | | | | | | |
| 1 | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✗ |
| 2 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ |
| 3 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ |
| 4 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ |
| 5 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ |
| 6 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ |
| 7 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ |
| 8 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ |
| 4.7GB DVD+Rw | | | | | | | |
| 1 | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✗ |
| 2 | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✗ |
| 3 | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✗ |
| 4 | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✗ |
| Prepared Discs | | | | | | | |
| Sony'Sense | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| The Call | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Legend | | | | | | | |
| Passes All Tests | ✓ | | | | | | |
| Fails Some Tests | ✗ | | | | | | |
| Fails All Tests | ✗ | | | | | | |

A small sample of the test results matrix, which shows the inconsistencies of recordable DVD. We don't list the names of the DVD players because the purpose of this test is to draw general conclusions about recordable DVD compatibility, not specific conclusions about the performance of a particular player.

Making the test discs

The first step in making the test discs was to record five copies of each unique DVD format and manufacturer brand. In order to eliminate as many variables as possible, I recorded at conservative speeds. DVD-R and DVD-RW discs were recorded at 1x speed, and DVD+RW media were recorded at 2.4x speed-the lowest speed settings for each drive type.

DVD-R for General media were recorded on a Pioneer DVR-A03 using B's Recorder Gold software. DVD-R for Authoring media were recorded on a Pioneer DVR-S201 using Prassi DVD Rep 2.0 software. DVD+RW media were recorded on a Sony DRU110A drive using B's Recorder Gold software.

After each disc was burned, I tested it on both a Pioneer DVDV7400 and Sony DVPS400 player to verify that the recording was completed successfully. If the test disc passed all tests on each player, the disc was numbered and set aside for shipping to one of the five test facilities. If the test disc failed any test, it was destroyed so it couldn't be used.

I burned a total of 209 discs for the test. One hundred ninety-five were used to create five sets of 39 test discs. I had 14 discs that either failed during the burning process or didn't

work properly in the initial test. I sent a set of 39 test discs and one copy of each replicated disc to each of the five test facilities, along with the detailed test procedures. Running all 41 discs through a single player took approximately five hours.

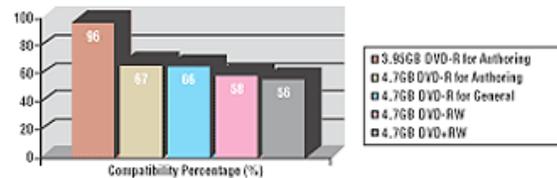


Figure 4 - Compatibility by Media Type (Passes All Tests) Looking only at the test cases that had a "Passes All Tests" result, the 3.95GB DVD-R for Authoring format is the most compatible, and DVD-RW and DVD+RW are the least compatible of the DVD format types.

The test results

Three possible results were recorded for each test: Passes All Tests, Fails Some Tests, and Fails All Tests. Test data sheets were completed by each facility for every combination of DVD format, media brand, and player make and model. All test results were forwarded to me, and then I compiled them into an extensive test results matrix. Figure 3 (above) shows a very small sample of the matrix.

When the results were displayed in this fashion, the results clearly show the inconsistencies of recordable DVD.

It was common to have one disc work flawlessly on one player, work marginally on a second player, and fail to work at all on a third player. It was also common for a single player to play some but not all brands of the same type of media.

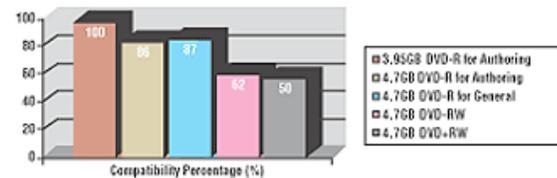


Figure 5 - Compatibility by Media Type (Passes ALL Tests and Fails Some Tests) If we loosen the definition of compatible and look at test cases that had a "Passes All Tests" and "Fails Some Tests" results, 3.95GB DVD-R for Authoring is still the most compatible, and DVD-RW and DVD+RW are still the least compatible.

Draw the right conclusions

If I had the time, money, and staff to do a more complete test that included multiple copies of each media format and brand, as well as multiple units of each player make and model, I would consider publicizing the raw data-but as the raw data stands, it's prone to misinterpretation. The samples in this test are large enough to draw general conclusions about recordable DVD compatibility, but not large enough to draw specific conclusions about the performance of a specific player model or vendor manufacturer.

The potential for misinterpretation, as well as the sheer size required, is why we're not printing the raw data in this article. I'm also not going to give out test results for a specific brand of media or make and model player. However, with over 2400 test results, I can draw accurate conclusions about the compatibility of different types of recordable DVD formats and media brands.

Conclusion #1: DVD format matters

The first conclusion that can be drawn from the test results is that the format of recordable DVD media is important in determining compatibility between a recorded disc and a DVD player. The data in Figure 4 (below) includes only the test cases that had a "Passes All Tests" result, indicating that the test disc was compatible with the test player.

As you can see from Figure 4, the 3.95GB DVD-R for Authoring format is the most compatible, followed by 4.7GB DVD-R for Authoring and 4.7GB DVD-R for General, whose test results are essentially the same given the margin of error in our test sample. DVD-RW

and DVD+RW are the least compatible of the media types.

It is possible to use a less-strict definition of compatibility, which includes results for discs that failed some, but not all, tests. Figure 5 shows the results if we include all test cases that had a "Passes All Tests" and "Fails Some Tests" result in the compatibility percentage. This is equivalent to saying that a recordable DVD disc is compatible if the player mounts the disc and starts to play it back. The quality of playback is ignored in this definition of compatibility.

As you can see from Figure 5—even using a less-strict definition—the 3.95GB DVD-R for Authoring format is the most compatible, followed by 4.7GB DVD-R for General. DVD-RW and DVD+RW are still the least compatible of the media types.

Conclusion #2: Media brand matters

The brand of media is also important in determining compatibility. Figure 6 (below) shows the lowest, average, and highest compatibility rating for each media type by brand. As you can see, there are wide variations in compatibility within a specific format of media based on the media vendor.

Perhaps the best example of this is in the DVD-R for General category, where the worst brand of media had a compatibility rating of only 45 percent while the best brand had a compatibility rating of 80 percent. Because DVD-R for General media is by far the most popular form of recordable DVD, the data illustrates a very important point for most DVD developers: media brand matters! Another interesting point is that DVD-RW and DVD+RW media have much better consistency across brands than DVD-R. In general, if a DVD player could play one brand of DVD-RW or DVD+RW media, it could play all of the brands of the same media format.

Conclusion #3: Player make and model matters

The test results clearly reveal that the make and model of a DVD player is just as important as the format and brand of recordable media. As you can see from Figure 3, some players support one type of recordable media, but not another. In addition, many players exhibit inconsistencies within a media format by playing some brands of media flawlessly, having marginal playback on other brands, and failing to mount other brands at all.

The test results demonstrate the danger of using anecdotal evidence or end-user testimonials to determine recordable DVD compatibility. It is quite likely that end users will have a positive experience with one format and brand of media on their players, but another end-user will have a negative experience using a different format or brand of media on the same make and model player.

Only 10 percent of the players we tested played all 39 different format and brands of recordable media correctly. None of the players we tested failed to read all 39 test discs correctly. This means that 90 percent of the players tested had inconsistent results, playing some formats or brands of media well but playing back marginally on other formats and brands of media.

Conclusion #4: DVD-RW and DVD+RW are very similar

If you look at the data in Figures 5, 6, and 7, you can see that the overall compatibility of DVD-RW and DVD+RW is very similar, and probably within the margin of error of the test. The compatibility ratings of DVD-RW and DVD+RW are lower than DVD-R because many older DVD players won't read rewritable formats at all. Some older players detect that a DVD-RW or DVD+RW disc has the reflectivity of a dual-layer disc (between 18 and 30 percent), but they won't play the disc when parameters stored in the sector header indicate that it is a single-layer disc or has a data type that is not supported by the player. These logical compatibility problems are the primary reasons why DVD-RW and DVD+RW have lower compatibility ratings than DVD-R.

Conclusion #5: Things are getting better

With compatibility ratings of less than 50 percent for certain brands of media, recordable DVD upsets some developers. However, a careful review of the test data offers hope. If we look only at DVD players acquired during 2001 and 2002, the test results improve dramatically. Figure 7 (page 28) shows the results for the 2001 and 2002 models of DVD players that we tested. As you can see, the results for all media types are dramatically improved when we eliminate older players.

Analyzing the test results shows that the overall level of recordable DVD compatibility has improved every year since DVD was initially released in 1996. A few words of caution: There are still a few models on the market that won't play anything but the 3.95GB DVD-R for Authoring media, and there are also some models that can't play DVD-RW or DVD+RW

media. If you are considering buying a new DVD player and compatibility with recordable DVD media is important, you should do some homework to determine if the unit you want to buy can play the type of media you generally use.

Conclusion #6: Some media brands work better.

It is clear from the test data that some brands of media have better compatibility than others, and that some makes and models of players work better than others. Figure 8 (below, left) lists the compatibility test results for all media brands in the tests. The players listed in Figure 9 (below, right) correctly played all 39 recordable DVD discs in the test. Keep in mind that we only tested a subset of DVD players in the market. I am sure there are many other players that can play all 39 discs in our test perfectly, but they're not listed in Figure 9 because we didn't have access to those players during our test effort.

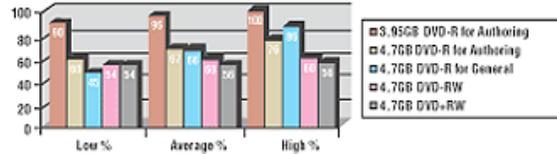


Figure 6 - Compatibility Ranges According to Media Brand
There are wide compatibility permutations within a specific format of media due to varying quality of blank media. DVD-R for General media format is by far the most popular form of recordable DVD, and has a compatibility range from 45 percent to 86 percent. Conversely, DVD-RW and DVD+RW media have much better consistency across brands than DVD-R. Media brand matters!

A few general guidelines

Let me wrap up with a few general guidelines to help you get the most out of recordable DVD. These suggestions are based on the results of the testing and my experiences working with recordable DVD drives and media for the past five years.

1. Use DVD-RW or DVD+RW for internal testing. Find a DVD player that supports either DVD-RW or DVD+RW (or both) and use it for internal testing. Because you can rewrite these discs, you will save money over using a write-once format such as DVD-R for Authoring, DVD-R for General, or DVD+R.
2. Use DVD-R for external testing or final product delivery. Because you probably can't control what type of DVD player the end users have, it's best to send them DVD-R discs. DVD-RW and DVD+RW are still significantly less compatible than DVD-R, so it is better to be safe than sorry. Also, DVD-R media are much cheaper than either DVD-RW or DVD+RW.
3. Use low to moderate bitrate encoding for video if the final product will be delivered on a recordable DVD. Although most DVD players and DVD-ROM drives can read recordable DVD discs, these discs often have a higher error rate during playback than replicated discs do, causing the player to reread some data sectors. Using a low to moderate (less than 7Mbps) data rate for video encoding will make the recorded disc a little easier to reread without a visible pause in the video playback, or audio dropout.
4. Use brand-name media and players whenever possible. Brand-name media are generally more expensive than off-brand media, but your clients, friends, and family will have fewer problems, which means you won't be spending time and money on problem solving.
5. If you choose to use off-brand media, record them at the lowest speed possible-1x for DVD-R and DVD-RW, and 2.4x for DVD+RW. Using slower recording speeds increases the overall compatibility rating of off-brand media.
6. The best value in recordable DVD media right now, in my opinion, is from Apple Computer. Apple sells DVD-R for General media on its own Web site (www.apple.com) for \$24.95 for a five-pack. This is by far the cheapest price I have seen for any of the media brands on my recommended list.





Figure 7 - Compatibility by DVD Format (New DVD Players Only) Results for all media types are dramatically improved when we eliminate older players and only look at the results for 2001 and 2002 models of DVD players.

| Figure 1 - Brands of Recordable DVD Media Tested, by DVD Format | | | | |
|--|--|--|---|---|
| DVD-R for Authoring (3.95GB) | DVD-R for Authoring (4.7GB) | DVD-R for General (4.7GB) | DVD-RW (4.7GB) | DVD+RW (4.7GB) |
| Mitsui (98%) Pioneer (98%) Ridata (98%) TDK (96%) Verbatim (90%) | Maxell (76%) Mitsui (69%) Pioneer (65%) Ridata (69%) Ritek (71%) Taiyo Yuden (63%) TDK (67%) Verbatim (59%) | Apple (73%) CD-Recordable.com (45%) Imation (71%) Maxell (80%) Memorex (59%) Mitsui (73%) Panasonic (69%) Pioneer (58%) Ridata (69%) Ritek (51%) Sony (76%) TDK (76%) Verbatim (69%) Vivastar (63%) | JVC (59%) Memorex (55%) Pioneer (61%) Ridata (55%) Ritek (59%) Sony (61%) TDK (61%) Verbatim (61%) | HP (57%) Memorex (57%) Sony (57%) Verbatim (55%) |

Summary and conclusions

If you have gotten this far in the article, you now understand why the issue of recordable DVD compatibility is so important-and so complex.

Those of you who were around during the launch of recordable CD will remember that we had to solve a number of compatibility problems before recordable CD became as popular as it is today. I have no doubt that the recordable DVD drive and media vendors will continue to improve their products and, within a few years, recordable DVD will be as popular and compatible as recordable CD is today. Stay tuned to DV magazine and DV.com for updates on recordable DVD compatibility. Our future testing effort will be expanded to include more DVD formats, media brands, and players.

Recordable DVD compatibility issues are related to the format, media brand, and the make and model of DVD player. It is important to understand there are no perfect recordable DVD formats, perfect media brands, or even perfect DVD players available today.

But if you follow the guidelines in this story, you will be able to minimize the effects of recordable DVD compatibility issues on your DVD projects.

| Figure 9 - Player Performance: Perfect Players |
|---|
| Apex AD660 |
| Microsoft Xbox |
| Pioneer DV333 |
| Pioneer DVDV7400 |
| Pioneer PDVLC10 |
| Sony DVPS330 |
| Sony DVPS360 |
| Toshiba SD4700 |

Conclusions

- DVD format, media brand, and player interact to determine compatibility.
- DVD-RW and DVD+RW are very similar.
- The most compatible format is 3.95GB DVD-R for Authoring.
- Name-brand media are more compatible than off-brand media.

- Of the DVD players we tested, 90 percent show some incompatibility.
- DVD players manufactured since 2001 are more compatible.

Testing Facilities

Five different companies participated in our testing: Still in Motion, Testronic Laboratories, Alpha DVD, and two companies that requested to remain anonymous.

Still In Motion

Still In Motion, a Technicolor Company, is a leading DVD authoring service bureau serving the Hollywood studio market and specializing in Class A titles. Recent projects include domestic and international releases of Snow White and the Seven Dwarfs, Platinum Edition; Atlantis: The Lost Empire; Unbreakable; and the award-winning DVD Cosmos, the late Dr. Carl Sagan's PBS science series. Still In Motion prides itself on its ability to consistently offer the most advanced and innovative features in the DVD industry.

www.stillinmotion.com

Testronic Laboratories

Testronic Laboratories offers professional, confidential product verification services, tailored to meet the needs of the home entertainment industry, from facilities in Pinewood Studios, London, and Burbank, CA. Both sites operate to identical standards, guaranteeing the uniformity of approach essential to multinational content owners and distributors.

Established in 1998, Testronic Laboratories is staffed by QA professionals with over 70 years of combined experience in related industries. www.testroniclaboratories.com

Ralph LaBarge has a background in electrical engineering and the design of digital signal processing equipment for a Department of Defense contractor. He is also an award-winning DVD title developer, and author of the book DVD Authoring & Production (CMP Books, 2001). LaBarge has completed over 200 DVD projects to date.

Ralph LaBarge and DV magazine would like to extend our thanks and appreciation to the companies who volunteered their facilities and staff time for the tests. Two test facilities have chosen to remain anonymous, but they still have our thanks for a job well done.