www.wxyc.org
WXYC 89.3 FM Stereo
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WXYC considers its vinyl and CD archives as a (semi)permanent asset without which we would have no reason for existing. Historically we have received new material in physical format form (vinyl, CD, CD-R) and increasingly we will be receiving new material in the form of a digital file in (WAV, MP3, FLAC) format. Since SEB has not yet approved my suggestions for creating an in-house digital file archive we are currently transferring incoming files to CD-R. This can be REALLY problematic for two reasons:

1. The burners supplied with modern computers, both Mac and PC typically burn very poor-quality CD-Rs, even with high-quality blank CD-Rs.
2. The quality of CD-R blanks is increasingly very poor with two effects on usability: the error rate can be very high initially, and they will degrade rapidly over time, eventually becoming unusable.

The combination of these two factors virtually ensures sub-optimal CD-R recordings.
The Consumer Electronics industry has done a really good job deceiving consumers about CD-Rs. They say CDs are digital, and "digital is perfect," when in reality ***CD-Rs are as terribly analog and easy to damage as a vinyl LP.*** This is not an exaggeration: the data on a CD-R is a series of microscopic dark and light spots read back by a laser pickup which has to track and focus on them as the disc wobbles and spins under it…just as a needle has to track a groove in an LP. What the laser ends up seeing is an analog signal which has to be decoded back into digital to be of any use. As the laser scans the CD-R all factors affecting a vinyl LP also affect the ability to read a CD-R: fingerprints, dust, scratches, peanut butter, etc. All of these defects get in the way of the laser seeing the spots which results in an inability to see the data resulting in data errors. The one advantage a CD-R has over a vinyl LP is that the player can attempt to recalculate missing data due to disc damage, a process called ***error-correction***. Audio CD-Rs have very limited error-correction, and when it fails due to disc damage or any difficulty reading the disc the CD player literally guesses what the missing data could have been in a process called ***interpolation***. This happens a lot more often than anyone suspects, I only know this having been an optical disc engineer for 15 years using $500,000 worth of analyzers to test CD-Rs.
Why is interpolation a problem? It is a problem because it modifies the music into something other than what the artist intended. In many cases it can be unnoticeable, but it can make stuttering sounds or change timing and other nasty effects.

It is for these reasons that I strongly suggest we adopt the following guidelines for making Audio CD-Rs:

1. CD-R Creation Procedure

Since no individual has the ability to test a recorded CD-R in every possible CD drive, or operating system, the only way to ensure playability is to adhere tightly to the appropriate Sony/Philips CD-DA (Compact Disc – Digital Audio) specification. This means that CD-Rs created for archiving at WXYC need to be pre-mastered using a dedicated software program such as Roxio's Toast for Mac, Nero Burning ROM for PC, Sonic's Creator, or Gear's CD/DVD Mastering Pro. All software settings must be verified to be correct for the desired end product.
DO NOT USE THE SOFTWARE'S DEFAULT SETTINGS!
DO NOT USE DRAG-AND-DROP TO BURN THE DISC!
ALWAYS CHOOSE DISC-AT-ONCE AS THE BURNING METHOD!
A program like iTunes creates an Incremental Track disc format using packet writing that can have severe playability issues. If you are unsure if the software you are planning to use employs packet writing, please contact me before proceeding with the project.

General specification for a CD-DA CD-Rs:
Audio CD: Closed, recorded Disc-at-Once.

How can you verify a good CD-R burn?
Remember: being able to play back a completed CD-R on the recorder that made it, or any other single CD-Audio or CD-ROM drive for that matter, does not mean you have a good CD-R recording. A CD-R burn can be marginal which will show up as a compatibility issue with certain CD Players or CD-ROM drives.

How is this possible? If I don't hear any problems, doesn't it mean the disc wrote perfectly?
Error correction of digital systems has the characteristic of properly correcting small numbers of data errors until conditions degrade (expressed as the error rate increasing) to the point where the error correction fails, resulting in what is called an uncorrectable error. This means that one cannot assess the quality of a CD-R by merely playing it on a player. The CD-R may be extremely poor quality, and have a very high error rate, yet somehow escape generating an uncorrectable error on a specific player.

The following are a few general guidelines to remember when creating a CD-R for WXYC archival purposes:

2. **CD-R Blank Quality: SPARE NO EXPENSE TO USE THE BEST QUALITY, CD-R BLANK AVAILABLE, PREFERENTIALLY GOLD ARCHIVAL QUALITY ONES.**
   Cheap CD-Rs are fine for consumers, who do not have an archival requirement or any real risk with the integrity of the content. Quality in CD-R manufacturing is not inexpensive, and is most often associated with major name brands, who endeavor to protect their most important asset, their reputation.

   Testing or usability studies conducted for home use are based on different criteria than a professional use study and may not result in valid recommendations. Due to low CD-R prices and subsequent manufacturing profits, there is pressure on the premium quality manufacturers to shut down production, and subcontract to other cheaper manufacturers. Because of this, any current recommendations are to be viewed as just that.

   2.1. CD-Recorder Brands. Currently the very best archival CD-R media is made by the following two companies: Taiyo Yuden/CMC, Mitsui Advanced Media.

3. **CD-R Length:** USE **74 MINUTE CD-Rs, UNLESS YOU ABSOLUTELY NEED THE EXTRA STORAGE SPACE FOR THAT PARTICULAR ALBUM!** Errors due to all causes are additive, and the compromises made in order to achieve additional storage can cause errors. If the album length is between 74:04 and 79:40, you will need to use an 80-minute CD-R. While the inherent quality of a CD-R recording and the player will affect the actual error rate, the baseline error rate using >80-minute blanks will always be higher in any case, due to out-of-specification spiral pit track pitch and scanning velocity.

   3.1. Tech discussion: The basic problem with extended capacity CD-Rs is one of design specification centerline (as defined in the Sony/Phillips books), not CD-R quality. In order to fit more data on the same physical space, two deviations from specification centerline are made. The first is reducing the scanning velocity (rotational speed). This results in higher jitter, which contributes to the error rate of the system. The second is to squeeze the spiral pit tracks closer together. An intrinsic characteristic of a CD player optical pickup by design is that it receives 50% of it's signal from the lands between the tracks. The optical pickup also has nulls in its pickup pattern (a characteristic of the Airy pattern in the play laser beam) placed to reject the adjacent tracks. When the pit tracks are squeezed closer, the nulls fall outside the adjacent tracks, and more signals from adjacent tracks is picked up. This is called crosstalk, and it can contribute to the raw error rate. The track pitch and play laser spot size and pattern are a design pair, and one cannot be changed without affecting the other. A disc made with all of it's characteristics at the center of the Sony/Phillips specification will store approximately 74:40. If a disc is made with it's track pitch and scanning velocity at the very edge of the Sony/Phillips specification, the maximum amount of data which can be stored is 79:40. CD-R blanks longer than 74 minutes do push the limits of playability, and in order to increase the chances of success, it is inadvisable to use them unless absolutely necessary.

4. **Labeling the Source. DO NOT USE PAPER LABELS, BALL POINT PENS, OR STICKERS ON THE CD-R.** We have had many CD-R source failures for these reasons. Even if the paper label looks correctly centered, it may be off center enough to cause error inducing vibration. In other cases, the adhesive can fail, and the label can rub or jam inside the CD drive. Ball point pens will destroy the data, which is 20 microns directly underneath the top labeling surface. Use instead a CD Marker, such as the TDK CD Writer Permanent Marking Pen, which has a softer tip than a usual marker, and is specially made for labeling CD-Rs. If a CD Marker is not available, use a felt tip pen, such as a Sharpie, and be sure to use as little pressure as necessary to make a mark!

5. **CD Recorder. USE THE BEST QUALITY CD RECORDER AVAILABLE TO YOU.** The built-in optical drives supplied with Macs and PCs are uniformly terrible at creating high-quality CD-R burns. MANY problems with CD-Rs are due their being made using "the recorder that came installed in my PC/Mac". Manufacturers use the least cost CD Recorders, not the brands or models that offer the highest performance at a higher price. A recorder intended for professional CD-R recording use may have less features or a lower maximum speed than the best consumer units, but it's firmware will be more stable, and create discs which more closely follow Sony/Phillips Red Book specifications and have enhanced playability and compatibility.
   Testing or usability studies conducted for home use are based on different criteria than a professional use study and may not result in valid recommendations.

   5.1. Currently the only recorders still made which offer superior performance are made by Pioneer and Plextor.

6. **Burn at a maximum of 16x speed.** You should NEVER run the burn operation at the maximum speed, 8x or 16x is the very fastest you should choose. Speeds faster than this will result in a poorer recording as the laser cannot respond in changes to focus quickly enough with the CD-R spinning above 16x. This results in poorly burned data tracks, high error rates and reduced playability.

7. CD-R Source Creation Software Procedures

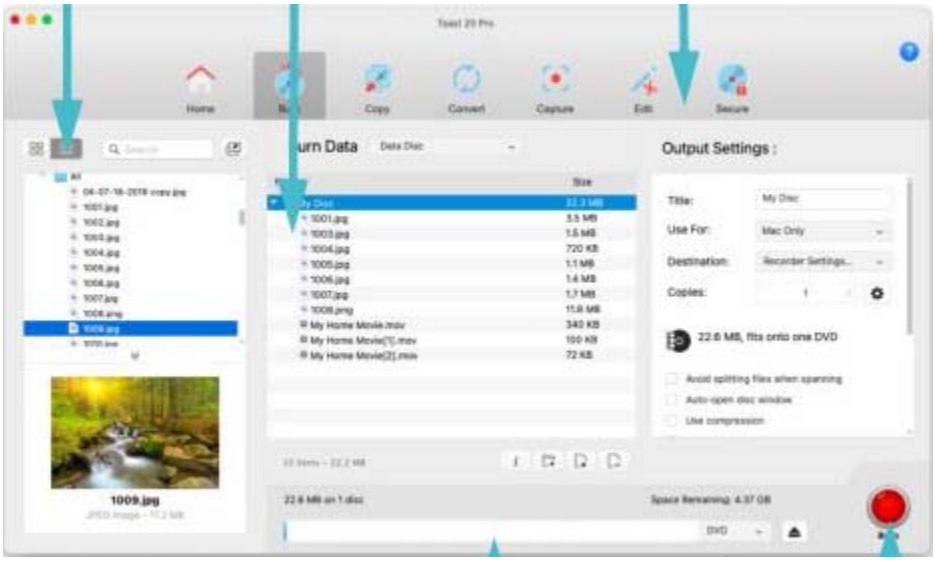
Many CD-R programs installed with Macs or PCs are not capable of making Red Book CD Audio discs as they are configured from the factory. It is possible, in most cases, to use these software packages in a way which creates a Red Book (CD Audio) Disc-At-Once CD-R by carefully selecting the proper settings and ensuring the program will create a Disc-At-Once recording, not an Incremental-Disc recording. It is easy to tell the difference: when a Disc-At-Once is finished, it can no longer be recorded or added to. Incremental-Discs remain usable for further recording, a feature making them troublesome with CD Players.

The instructions provided below are intended to be used as a guide for that purpose, and no warranty is made as to the absolute performance of the software packages referred to.

7.1. iTunes. iTunes is incapable of writing a Disc-At-Once CD-R and should **never** be used to create our archival CD-Rs.

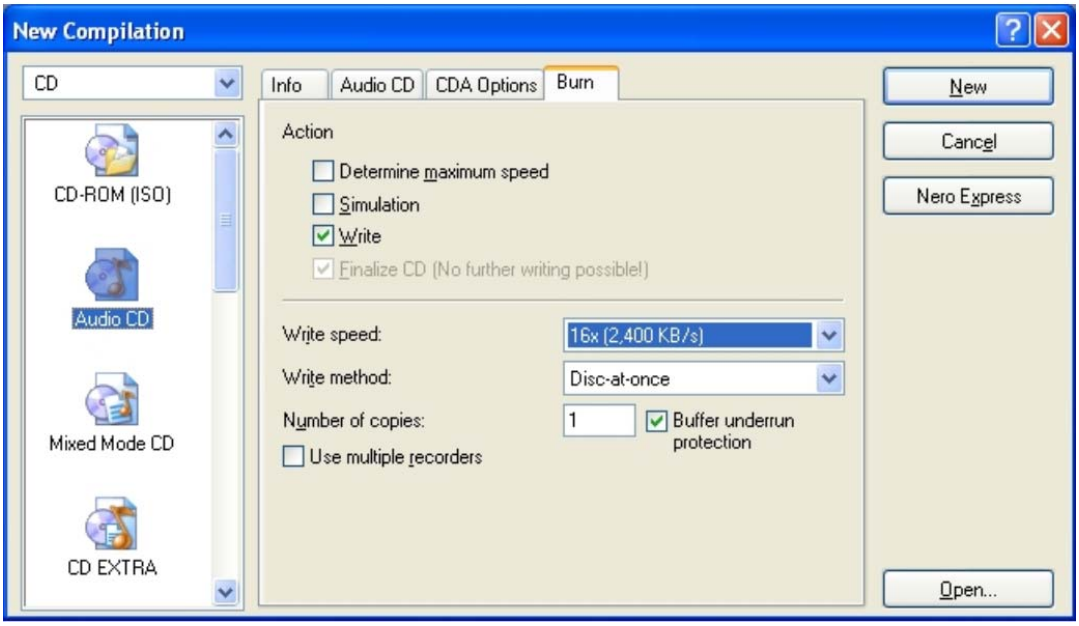
7.2. Roxio Toast. In order to create a Disc-At-Once Audio CD-R open Toast:

1. In Toast, choose Burn tab, and in the Burn Audio area, choose Audio CD.
2. In the Output Settings area, type a title, choose a format, set your destination and number of copies.
3. Enable the Add CD-TEXT check box if you want to write CD-TEXT information onto the audio CD. If your recorder can write CD-TEXT and your CD player can display CD-TEXT, you will see this information during playback.
4. Add audio files to the disc by dragging and dropping them into the Content Area from your hard disk or the Media Browser.
5. Insert a blank, recordable CD.



6. Click the red Burn button at the bottom right of the Toast window.
Toast displays a progress bar and status information as it records your disc.

7.3. Nero Burning ROM. Nero will create very compatible Red Book CD Audio discs quickly. Here is the screen shot showing how easy it is to set up to record a Disc-At-Once CD Audio:



Just choose Audio CD, ensure write method is set to Disc-At-Once and the speed is 16x max, assemble the compilation of tracks to be burned and burn.