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Extended Play CDs

Overview

CD players are designed to correctly and optimally play CD-Rs and CD that have been manufactured with all important parameters set at the very center of each specification as spelled out in the Sony/Phillips specification books. Any and all deviations from the centerline of any specification will degrade playability. The basic problem with extended capacity CD-Rs and CDs is one of their design deviating from certain specification centerlines.

The challenge

In order to fit more data on the same physical space, extended length CDs must deviate from specification centerline in two or more parameters. A disc made with all of its characteristics at the center of the Sony/Phillips specification will store approximately 74:40 (650 Mb). The two main parameters which are compromised to extend play length are scanning velocity and track pitch. If a disc is made with its track pitch and scanning velocity set at the very outer edge of the Sony/Phillips specification, the maximum amount of data that can be stored is 79:40 (700 Mb). The scanning velocity, track pitch, and CD player laser spot size and pattern are a design system; one cannot be changed without affecting the others.

The physics behind the problem

The first parameter to be compromised in an extended play CD is reduced scanning velocity. This means that the CD is rotated more slowly, and the individual pits become smaller and more closely spaced. The effect of this is relatively higher jitter, which adds to the error rate of the system.

The second compromised parameter is track pitch. This means the individual tracks in the spiral of tracks are squeezed closer together. Due to the closer than optimum track spacing, the play laser beam now begins to actually pick up data from the adjacent tracks. An intrinsic design characteristic of a CD player optical pickup is that it receives 50% of its 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 are picked up. This is called crosstalk, and it also adds to the error rate.

Conclusions

It is a common misconception that CD replication plants make worse quality discs as the play time is increased above 74 minutes. This is not necessarily the case. By using

special players with custom play optics one can see that many 80 minute replicated discs are virtually the same replication quality as 74 minute discs.

The playability problem with extended length CDs is USUALLY the players!

They are designed for a certain size and spacing of the data pits on the CD, and they have progressively more trouble correctly reading the disc as the pits become smaller and more closely spaced. An analogy to the situation is a person taking an eye exam: as the letters on the eye chart become progressively smaller and more closely spaced, at some point the person will have trouble making them out clearly. This is not a failure in the eye chart; it is a limitation in the person viewing it!

The situation is far more complex for CD-Rs. Many CD-R blanks are poor quality to start with, and all CD-R blanks I have tested with playing time over 80 minutes have been extremely poor quality. This source of errors will compound the problem on playback.

Another problem using 80 minute CD-Rs as the master is that once a person submitting a CD master has decided to use an 80 minute blank, it is commonplace for them to figure that as long as the room exists, it should be filled up. To do so causes degradation in the field playability of the replicated disc, because when a replication plant replicates a title from a partially filled 80 minute CD-R master, they do not make a partially filled 80 minute CD. Every replicated CD is a custom length only as long as the data calls for it to be.

To summarize, there is not a specific length beyond which one can positively predict a disc playability failure in all players. The exact program length at which errors in playback arise depends on the length of the disc in conjunction with a specific player. Errors in the playback of CDs due to all causes are additive, and the design compromises inherent in extended length CD-Rs and CDs can add errors to those due to dust, scratches, and all other sources of error.

For these reasons I recommend that in all cases the length of a CD be kept to 74 minutes if at all possible. If additional CD capacity is needed, the absolute minimum increase possible above this figure will pay dividends in superior field playability, especially if the disc is to be replicated.