

Fixing it in the Mix

A primer on the recording process.

Preparation

Before you even think about bringing in a band you must:

1. Know the console and recorder -- read all of the material from Yamaha, Radar and PQE, and practice by recording yourself.
2. Know compression and limiting, both with the board and the outboard gear. Again, read and practice.
3. Know the microphones -- the best way is to practice recording yourself with each one. Figure out how directional each is, and exactly what the switches do.

Before you bring in a band:

- Listen to them perform outside of the studio.
- Talk to them about what they want recorded.
- Talk about what kind of sound they want - jazz, rock, country, faith, blues, and classical all require differences in recording and mixing.
- Listen to other examples of the genre.

Setting up

You and your assistant should be there an hour before the band. Things to do:

- Find all the cables and mic stands.
 - Test the cables.
 - Check that the stand hardware tightens up and so on.
 - Find enough headphones and check operation. Figure out how the headphone mixes are going to be set up. Make sure you have talkback working.
 - Plan where to put each musician and place stands and cable (put mics out after the band loads in).
 - Make sure there's enough room on the drive.
 - Make a new Radar project for each song.
 - Make a new session on the board.
 - Set up the mixer with each microphone assigned directly to a track.
 - Patch any insert processing you may need and test the connections.
 - Set the processor controls to neutral.
 - Start your log - date and time, who the musicians are (and how you can find them later), names of songs, equipment you plan to use.
- Use the traffic cone or brick to prop open the studio door and the bungee cord to hold the 189 door open so you don't have to do the combination all the time. Don't forget to shut the studio door when the session starts. Post a note to keep tourists out.

Setting levels

Have your assistant place mics as the band warms up. You should work out a set of hand signals to direct the assistant in precise placement - closer, further, left, right, up, down.

When all the mics are roughly placed, have the band run through their numbers. For each mic:

- Set basic level with trim
- Solo and listen for sound character
- Solo and listen for bleed from other instruments
- Ask the player to play alone and mute his mic to double check for bleed

Move mics if needed to clear these up, but don't fuss too long. Any delay at this point will affect the band's playing. You want to get first takes while the band is fresh and energetic.

About bleed

You worry about bleed because phasing will affect the character of the instruments and because it may conflict with overdubs. The rule of thumb is that a mic on an instrument should provide a signal that is at least 6db stronger than the same sound from any other mic. That's in the final mix, so if there is some bleed in a mic you may have to turn up, there could be trouble. Make sure you have good levels from soft instruments like flute and harmonica. If you have bleed, move the musicians further apart and use the directionality of the mic to reduce the unwanted sound. Some bleed is inevitable. It is impossible to contain the drums, for instance. Luckily, the sound of kick and snare drum is somewhat immune to phasing. Make sure there's no cymbal bleed, however.

About character

Everybody knows how their instrument should sound. Since there are many sounds for each instrument, the approval of the final sound should be up to the performer or producer. The job of the engineer is to know how to get different sounds when required. This is done with mic choice, mic placement, and as a last resort, eq on the board. Here are some tips:

Vocals

There are two fundamental vocal sounds, close miked and distant. The difference is that with a close technique, the singer uses the mic to mouth position and distance as part of the performance, controlling sound and volume with the mic as much as the lungs. The SM58 is usually best for this; put it on a stand even if the performer holds it to sing.

A distant mic is usually about forehead high, 6 to 24 inches away. At that distance, movement of the singer has less effect. This is appropriate for strong singers with good control. Use the Neuman or other large diaphragm type with a pop screen. One of the external preamps may be the best choice.

In both cases the singer must be able to hear themselves very clearly in the headphones. Give them a mix from aux 5 or 6 with a lot of voice and some reverb. If you are compressing the voice, make sure the uncompressed sound is what they hear. (If you compress voice, lay down an uncompressed track too. Use an external preamp and split the signal off at the patch bay.)

Guitar

For electric guitar, mic the amp as carefully as you would an acoustic instrument. Most amps don't sound right until they are turned up, so don't try to keep it soft. Sometimes it helps to turn an amp to the wall. A e604 mic about 8 inches from the cone and halfway between the center and edge is a good place to start. If the amp has multiple speakers, start with the mic in between them, but a little further back.

Most engineers use two mics on an acoustic, one on the body, one on the fingerboard. These are about 8" back. Slightly panning these in the final mix gives a rich sound. The SM81s are first choice, but may be a bit fretty.

Bass

On an electric, you also mic the amp. The e604 mics may work well here. Start with the mic about 16" back.

On an acoustic, use a large diaphragm mic (but not the Neumann). Aim just above the bridge or at the f hole from about 24" back. You often have to use gentle compression on bass. Do this if the open strings boom out too much.

Piano

For a classical sound, use an X-Y pair of SM81s about 12 feet away. The typical jazz sound is produced by putting one mic over the hammers on the treble side and another down toward the end of the bass strings. Mix these with only a little separation, or you'll get a 10 foot wide piano. For an upright, open the lid and place one mic a little above the opening. For a honky-tonk sound, take the front board off and place two mics near the hammers. (Note: on a piano, the sound comes from the strings and sound board. Any holes in the metal framing are only there to save weight and have nothing to do with sound.)

Strings

For violin and viola use an SM-81 about 3 feet above the instrument. For cello, a large diaphragm 24" from the f hole. A quartet may be recorded with an X-Y pair or with one mic per instrument. For string ensembles, the "studio string" sound uses about one mic for every 4 instruments, but at least two.

Winds

The sound on close miked woodwinds varies noticeably from the mouthpiece to the bell. The sound at the bell will change suddenly when the lowest note is played. The best place to start is between the hands, about 12" away. (Further if the performer moves a lot.) Move toward the mouthpiece to get an edgier sound.

If you get too close to the mouth, you'll get too much breath. Use an SM81, BG 4.1 or Sennheiser 441.

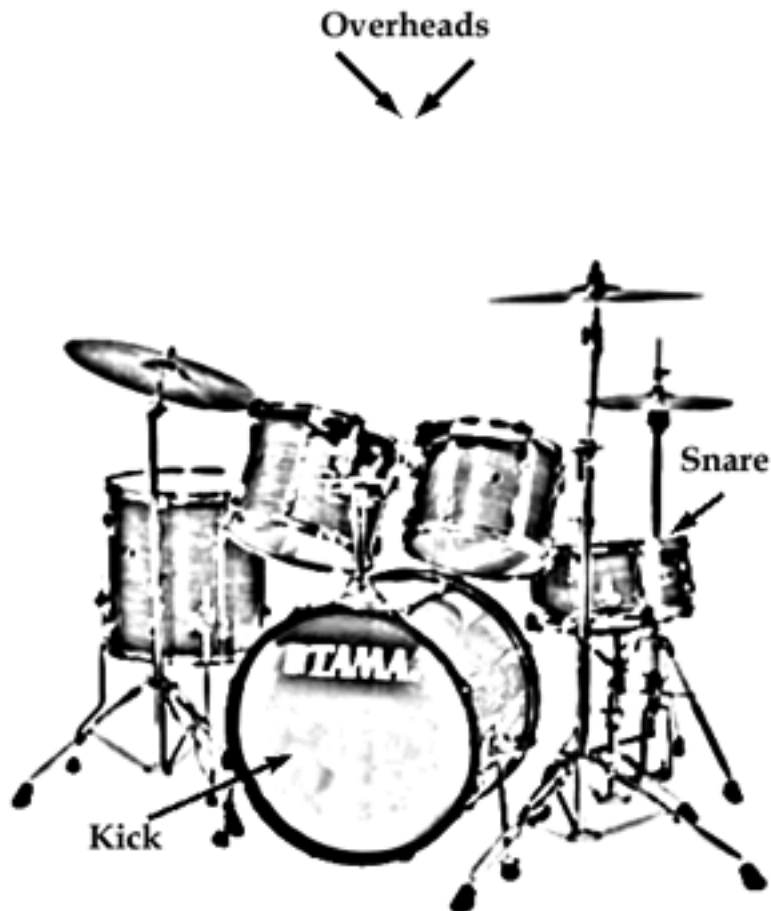
Brass

Mic near the bell, but not centered. You want to avoid the rush of air that comes out. Use a pop screen if the trumpeter insists on playing straight into the mic. Also BG 4.1 or Sennheiser 441.

Percussion

Always mic percussion from above. The favorite spot for most drums is just beyond the rim and 4" up. It takes two mics to cover a xylophone- place these so all notes are the same volume. In a pinch you can put a cardioid at the bass end and pointed at the high end, about 40" up. For hand held gadgets, put a mic over the music stand and let the performer position them as he plays. The Sennheiser 441 mics work well on percussion (set the attenuator switch). Be prepared to use a limiter. (Patch a Dominator into the insert.)

Mics on the Drum Set.



Recording a drum set is not too different from recording an acoustic ensemble. You start with a stereo pair placed to get the overall sound, and add spot mics to emphasize the important instruments. The basic setup uses four mics.

The overheads provide the full sound of the set. They can be hung on two tall stands about 30" apart, or on a single stand as an angled pair. They will generally be 7 or 8 feet up, depending on how much ceiling room there is. (You need at least a 10 foot ceiling.) These should be wide range mics with built in attenuators. The SM 81s work well. Fiddle with the placement to get a nice stereo image out of the toms and cymbals.

The SM57 is the universally acclaimed snare mic. That's probably as much for the shape and ability to withstand high sound level as anything else. It should be placed where it looks just over the edge of the drum, and angled to reject high hat.

The AKG D112 is a good kick drum mic - you need a large diaphragm mic with high sound level ability. It can have an internal high end rolloff (as the D112 does) or you can roll it off at the board. The placement is quite variable and really depends on the drum. Start halfway between the center and rim about 8" back. Move it until you hear a good balance of thump and ring. This is not a gradual change as you move in any direction - there are null and hot spots scattered all over.

Adjust your levels with the drummer playing one drum at a time. Be conservative-- when a drummer gets going, the levels will go up 10 db. Once recording starts, watch for clips. Ideally, you can lay each mic to a track-- if not, you will have to spend extra time to balance the sound.

Mixing the set.

The overheads are the base sound. Pan them left and right, and adjust the relative levels to get a good image on cymbals and toms. Bring in kick slowly to get a sound that fits the genre. The purpose of the kick mic is not to make louder kicks- it's to tighten the timing. The kick sound should establish the rhythm. Once the kick is right, bring in snare to match. Again, it's a timing issue, you want the snare and kick relationship to be right. Snare and kick should be centered.

Putting Down Tracks

It's OK to push record a little early - dead space can always be removed. Every time you hit record, you should make a log entry. Track time and name of song at the least. When a take ends, log the time and what was memorable about the take. ("Hey, can we hear the one where Jimmy tripped on the snare drum?")

You should be listening to a rough mix of the RADAR output. (Don't let any input channels get assigned to the main mix.) Watch the track levels, and make any adjustments necessary at the trims. (Remember, the trims stay the trims no matter what layer is up on the console.) Pay attention to the performance so you

know when to dump a take. Until you get really good, there should be no one but you and your assistant in the control room while you are tracking.

After the Session

Back up your tracks to the Archive drive. While the backup is working:

- Put all of the microphones away. If you've brought any from the other rooms, put them back. (Make sure no microphones leave with the band!)
- Coil and hang the cables.
- Move the mic stands to the back of the room.
- Take any trash out to the main hallway (It's OK to pull the bag out and leave it in the hall. There are spare bags underneath.)
- If it's Saturday, put the chairs back (four rows of 7).
- Bring your log up to date.

Overdubs

Miking overdubs is easy, because you usually only have one instrument. The tricky part is getting a headphone mix the performer is comfortable with. As with a singer, adding reverb to their part (but not the recorded tracks) often helps a lot. Use a new track for overdubs, don't try to punch into the existing track.

Comping

Comping is making a composite track with the best verses from several takes. If the project requires a lot of this, you may want to move to pro tools in order to use the playlist features. Comping on Radar is not too hard, but the playlists make it a breeze.

Stems

An instrumental mix is not necessarily stereo. More likely it will be five tracks: two for drums, one for bass, and two for the instrumentals. You can make these on spare tracks of the Radar or by patching the board busses directly to ProTools.

Mixing down

The aim of the mix down is to provide a convincing impression of a real band in action. Keynotes of a good mix;

1. Ensemble balance -- The important parts are forward, the drums are right for the style, nothing is hidden.
2. Ensemble blend -- supporting parts (like strings or backup vocals) should match in level and sound.
3. Transparency -- a listener should always be able to pick out any part.
4. Tonal balance -- the bass, midrange and treble should have about the same energy.
5. Image -- there should be a sense of location for each instrument. Some are centered, some left or right, but they are somewhere, and stay there.

The path to the best mix is repeated trials experimenting with all of the possible combinations. The tools for mixing are levels, compression, and EQ.

EQ

The original point of EQ was to correct for unnatural sounding microphones. That's not much of a problem these days, but EQ is also a good way to keep tracks separate. The idea is that if two instruments play the same note at the same time, it may be difficult to hear them as separate lines. It is also true that an instrument that covers a lot of spectral real estate tends to mask instruments with a simpler tone.

The Bump

The first EQ technique is to simply boost an important part of the instrument's range. This is very common with vocals. Almost every piece of gear from microphones to speakers has the capability of emphasizing the 2khz to 4khz range, where the vocal formants are found. Formants give voice its identity, and convey the vowel sounds. The result of a boost here is to bring the voice out relative to other instruments and make the lyrics easier to understand.

Many other instruments can benefit from a slight bump like this, but if you bump them all you'll get a tinny sound. If the mixer has a parametric eq, you can put bumps at different frequencies for each instrument.

The Window

Some instruments like electric guitar are vocal maskers. If the guitar covers the voice, it can help to cut the guitar at the same frequency the voice is bumped. This opens a bit of a window in the dense guitar sound. It will still be loud, but won't cover the voice as much. Also, a combination of a bump and a window leaves each instrument closer to its natural sound.

The Rolloff

Some instruments don't fill the entire audio spectrum, but may have bleed from other instruments on their track. A kick drum or bass doesn't really need high frequency (to some extent) and a flute doesn't need bass. If you dial out the unused spectrum, the background of the mix becomes clearer.

Exciters

Bumping only works if there is sound energy at the area bumped. Exciters add signal to a part of the spectrum that doesn't have any. The most common example is the guitar fuzz, that adds many partials to the naturally clean guitar sound. The Aphex Aural Exciter can be set to add energy to the formant region of the voice, or put a lower octave on a bass ("Big Bottom"). Any sound with a full spectrum comes across as louder than a pure one, even if the meter reads exactly the same.

Compression

Compression makes a track louder by keeping any part of it from getting too soft¹. Since compression works on individual words and notes, it will tend to even the sound out, so a combination of a boomy bass note and a dropped syllable don't result in a missed word. Each kind of instrument requires a different approach to compression.

Voice

Compression on the lead should be as gentle as possible. If too much is used, the phrase shape is lost. The rowdier the song, the more compression is appropriate. On the other hand, backup vocals are usually compressed a lot. Attacks can be on the slow side, but if the sound gets breathy, attack is too slow. Some compressors have the ability to key only on high frequency, which can be used to remove sibilance (deEssing).

Guitar

Compression on guitar will tend to extend the sustain. It will also bring out the noise of the amp. If you compress a guitar, you should probably also gate it.

Bass

Compression is common on bass because you generally want a very even sound. Attack should be pretty fast and the release slow, and gate is required if the amp is noisy.

Kick Drum

If you compress a kick drum, you shorten the note. The initial punch of the kick will get through before the attack lets the compression start. The attack setting will determine just how long the meat of the sound is. Since the kick mic is added to the sound of the kick in the overheads, the net effect is to emphasize the leading edge of the beat.

Other Instruments

Compression is rare on winds and strings. Sometimes simple limiting is in order, especially on brass attacks and general percussion. That should be done in the initial recording.

Levels

With a perfect performance, the levels can be set once to give the right overall balance and left alone. In most cases, the engineer's job is not over just yet. With heavy compression, phrasing may become lost. If parts trade the lead, the listener's attention must be guided to the important track. Mistakes happen, and need to be glossed over.

¹ Loudness is the effect of the average signal level. What actually happens, of course, is the loud parts are turned down, and then the whole thing is turned up.

The Push

Probably most mix moves are to bring up the lead line. An increase of 3dB is more than enough to do this². This needs to be done in an unobtrusive manner, giving the effect of the performer taking one step forward. The move must usually be made before the line begins to play, and will drop back with the final phrase³. Be sure you get back to the correct mark.

The Duck

Along with pushing the lead, you may need to drop a secondary part. Be careful doing this, as it can really stick out. Don't routinely shut off parts that aren't playing - this makes noticeable changes in the ambience of the room, although sometimes there's an accidental sound that needs to be muted briefly. (It's easiest to edit these out of the track on Radar.

Phrasing

Phrasing should come from the performance, but sometimes compression flattens out an arc. This can be delicately put back in, but a fader doesn't do the same thing a voice does. If the singer didn't get it right in the first place, you can't make it up.

Panning

Panning can literally separate instruments in the mix. As a general rule, drums and vocal are centered, others are placed in an arc around the stage. if you have a pair of stereo tracks (such as drum overheads) panning controls the separation as well as the placement. If you pan both left and right to center, there is no stereo (and some phasing may occur) but it's often effective to soften the stereo effect by panning to the 9:00 and 3:00 positions.

Reverb

Each instrument gets enough reverb to establish a sense of depth. Set the reverb to flatter the vocal, then give balanced amounts to the other instruments. Pick a reverb that's natural sounding -- it's better to have a moderate amount of short reverb than tiny amounts of long reverb. If the reverb doesn't have a high cut built in, EQ it at the effect return.

Mastering

Mastering is a catch-all term for whatever is done to move the project from the studio into the real world. Once this meant preparing tapes for the brutal process of cutting vinyl. Now, it means getting a sound that makes the listeners happy. The key to effective mastering is to be able to hear exactly what needs to be done to each track- actually doing it is usually quite simple. It's hard to judge the initial effect of tracks if you have been working intensely on them, so it's routine

² Depending on what's actually on the track of course. Some players over play their solos and need to be reined in.

³ fader moves should always go in the direction the music is going anyway.

to bring in someone new to do the final mastering. Some folks make their living as mastering engineers, and many swap mastering and mixing chores.

Before you master a project, you should have a good idea of the sound you are aiming for, especially if you are trying to fit into an established genre. You get this by listening to lots of examples. It's important to listen to everything both in the studio and at home because you are going to find the most difficult issue is getting a sound that works on various systems.

These are the tasks encountered in mastering:

- Cleaning up artifacts like pops at the end of tracks
- Matching the perceived loudness of the tracks
- Getting the right sound for the genre.
- Surviving home playback.

Artifacts

Artifact cleaning is just attention to detail. Do the fades at the end of songs really go to silence? Is there a cough in a quiet spot? Any amp hum? To find this stuff, you have to listen around and behind the music.

The best way to deal with artifacts is not to record them in the first place. That means slowing down in the middle of frantic sessions and listening. Here are some very common sources of noise to watch for:

- Guitar amps. They all hum-- you can reduce it with careful mic placement and attention to the gain settings. In general, you want the knobs on the guitar cranked and the amp output turned back.
- Motorized instruments like vibraphones.
- Drum pedals and chairs (They squeak). Unattended drums may ring with other instruments. A guitar in an open case may ring a bit.
- People.

Reduce background noise with gating on the channels. You have to adjust threshold just above the noise level and set the attack and release to fit the instrument on the track.

Casual noise can sometimes be faded out with the board automation, but in the worst cases, you will have to pull a track over to the Mac and edit it.

You also have to avoid any artifacts in the mixdown. These can be:

1. Clips: watch those levels! When tracks combine, the buss can overload.
2. Compression breathing: pay attention to the attack and release settings.
3. EQ changes during the mix: not usually a good idea.
4. FX changes during the mix.

The cure is to do it over.

Loudness

Loudness is not shown on meters. Loudness is what you hear - what's on the meters is electrical power. The frequency of the sound has nearly as much effect on loudness as the amplitude, especially if the amplitude is fairly low. The only way to match loudness is to listen to the whole thing in one sitting, and note when you have an urge to turn it up, and when you need to turn it down. Pay attention to the typical levels for the genre. Rock is louder than classical, country is in between.

Be sure to compare the first and last tracks- it's common to have each track almost match, but wind up with gradual increase or decrease in volume.

Sometimes you have to return to the mix to adjust compression settings. Compressed tracks are louder, and if some of your tracks are heavily compressed and others aren't, they will never match. In some genres, particularly rock, it is appropriate to further tighten the tracks with multi-band compression. A pass through the Ultradyne may work here.

You may find a track that shows overs and still sounds wimpy. This often comes from snare hits that may be 20 dB above the rest of the mix. Compression won't catch this, because the hits get through before the compressor kicks in. One thing to try is boosting the track and copying it to another track. This will deliberately clip the hits (they won't sound any different), and when you bring the new track back to the mix things will be under better control.

Equalization

Some styles of music imply certain overall frequency curves. A cover band may want a 50's sound with rolled off bass and highs, for instance. Generally, this is produced in the mix, but you may find some tracks have bright or bassy sounds that can be simply adjusted with overall equalization. Again, you need to listen to the whole project, but this time it's best to jump around, from the middle of one track to another.

In general, commercial releases have a high frequency response that drops about 3 db per octave above 3 khz.

What home stereos do to your careful work

The monitors you have been working with are very expensive, and are built to have a consistent, generally flat sound. Their main characteristic is clarity, so you can hear every little flaw and detail. Home stereos are designed to sound good in a stereo store. They hide things, and accentuate popular parts of the spectrum such as the mid bass and the vocal formant range. Home stereo systems are usually limited by the speakers. These fall into one of three categories:

Audiophile systems have extended range and a "sweet" sound. Perfect for Enya and the BSO, they are closest to the sound of monitors. Multiple driver systems are currently popular, so there are often strange phasing artifacts, especially

when heard at an angle. The deepest part of the bass is reproduced, and sometimes exaggerated a bit. Vocal peaks are uncommon, since that makes strings strident, but there may be peaks in the very high range.

Rock and roll systems are built for "punch". This usually is produced by using very efficient woofers that resonate around 80 - 150 hz. These systems also have a vocal bump, because that brings out the lyrics in noisy stores like Circuit City. Usually, they don't sound right unless they are played loud enough for the midrange to match the boomy bass.

Junk systems can be anything. Usually there is no real bass at all, just a bit of 100 hz resonance. These generally come in small boxes, so extra resonances caused by the box are common. There's no high frequency to speak of. The two speakers of a pair seldom match, so the image dances around.

You should try to listen to your work on examples of each.

The most common problem is muddy bass. This happens when your material has extreme low frequency (the open E on a bass is 42 hz), and the speaker resonates about an octave higher. Unfortunately, the resonance⁴ is not in tune, and will clash with the actual second harmonic of the note. The cure is to roll off everything below 75 or 80 hz This doesn't eliminate the deep bass-- a proper speaker will still bring it out, but the cheap ones won't be pushed over the edge by it any more. You won't miss the fundamentals because our ears are very good at putting them back in. In fact, most of the super low frequency sound is inaudible anyway. Based on that reasoning, many engineers use a more extreme shelving filter at 45 hz.

The other common problem is strident vocals. If you have used an eq boost at 2-4 khz to bring vocals out, and the speakers do too, the combination boost is likely way too much. If you have used the technique of putting gentle boost on the vocals and a complementary cut in the other tracks you won't be as likely to encounter the problem.

Household speakers sound quite different when played loud and soft. You have to think about the audience for the genre. Most people tend to listen at 75 to 85 dB, which is a little loud but not painful, but the young male demographic likes to hit 95, enough to drown conversation and hurt ears. All speakers gain bass when cranked up, so rock mixes need paradoxically, a little less bass.

Car speakers are something else again. Since they are small, the bass generally can't keep up with the midrange as they are boosted to drown out the road noise. Car mixes have to be crunched to about 10 dB of dynamic range with a multi-band compressor. Radio stations do this routinely.

⁴ Sometimes the resonance actually comes from the acoustics of the room, rather than the speaker. Same difference to us, though.

If you mix for a dance club, you'll find there's plenty of deep bass, and the problem is to get the tenor range to come out. Usually anyone who adds sub woofers to a system sets them too loud.

TVs are also surprisingly resonant in the mid bass. If you are mixing a sound track, you have to deliberately back off the mid range to avoid masking dialog.

CD Production Considerations

The CD manufacturing process does have a few quirks of its own:

- Overs -- if a CD master hits digital 0 for two or three successive samples, a duplicating house may reject it. To prevent this, bring up the normalize dialog and see how much headroom each track has. If it says 0, reduce the level by 0.1 dB.
- Block errors -- a recorded CD is never perfect. There are always spots where the error correction has to kick in for proper playback. If there are too many of these, the duplication house will reject the CD. To avoid this, use good CDs and optimize the burning process according to the burning software instructions. You should back up your audio file in data format as well as audio format.
- Data continuity -- some CD burning programs don't handle the track spacing properly, leaving blank spots in the data path that will pop. If you must use toast or the like, burn from a disk image. Jam is better, because it will put the p and q ids in the right place.