



Making a Great Master

ESSENTIAL INFORMATION FOR MUSICIANS,
ENGINEERS, AND PRODUCERS

Contents

Preface	The audio recording and manufacturing process
Chapter 1	Format options for your audio master
Chapter 2	Digital audio workstations
Chapter 3	Digital master preparation
Chapter 4	CD master preparation
Chapter 5	Analog tape preparation
Chapter 6	Handling your master
Chapter 7	Creating a CD master
Chapter 8	Post-production mastering
Chapter 9	If problems occur
Resources	



Preface

At Disc Makers, scores of masters come through our doors for audio manufacturing every month. This gives us a particular expertise when it comes to the best methods for preparing your master – as well as the pitfalls to avoid. This guide, the result of our decades of experience, is intended to clarify and simplify your transition from the artistic (i.e., writing and recording) stage of your project to the manufacturing stage. Use this as a guide to answer questions and help you produce a product with superior quality with confidence and ease.

The audio recording and manufacturing process

The process of transforming your musical ideas into a finished product you can share and sell begins with your recording sessions and continues through to the delivery of your packaged CDs or vinyl records. The choices you make at each step affect the quality of your final product, so familiarizing yourself with this process at the earliest stages will help you produce the best possible results. In general, the process runs as follows:

Recording. Recording involves capturing instrumental and vocal sounds, using microphones or direct inputs, and storing them on a stand-alone or computer-based digital audio workstation (DAW) – or in some cases, on digital or analog tape. Some recordings are made direct to stereo, but the vast majority are recorded “multi-track,” meaning that the sounds of the different instruments are

recorded and stored individually.

Mixing. Mixing is the art of blending individually recorded sounds through a console or on a DAW, controlling the level, EQ, and pan (stereo speaker placement) of each sound to create a final “mix” of your musical selections, or songs. These mixes are typically two-track stereo and are recorded to disc, tape, or stored on the hard drive of a DAW.

Master assembly. Master assembly means editing a collection of individual song mixes into a complete master that flows from start to finish in the desired order and with the desired amount of space between selections. Due to the ease and control offered by digital waveform editing, digitally recorded songs are typically compiled on a DAW, with the material then transferred in assembled form to a recordable CD (CD-R), DDP 2.0 (Disc Description Protocol) master, or individual audio files like WAV or AIFF.

Post-production mastering. Mastering is the final step in the recording process, which takes place after the mixing process (post-production) to optimize and add the final sonic touches to your recordings. When you send your master to a professional mastering studio like [The SoundLab™](#) at Disc Makers, your overall program level is set, as well as the song-to-song (AKA relative) levels. EQ, compression, and other digital processing is also used to make your recorded material sound as good as possible when played in the various listening environments of the customers who buy the end product. Once optimized through mastering, the resulting program is transferred to a “production master” for the manufacturing plant that will make the actual copies. Production masters are typically:

- a CD-R or DDP 2.0 master for the CD plant; or
- a “master lacquer” for the vinyl record pressing plant.

Manufacturing. Manufacturing is the process of producing and packaging copies of the production master for distribution and sale.

- Replicating CDs (typically for quantities over 300) is a process in which the production master is transferred to a “glass master.” Molds are made from the glass master, and from there discs are replicated, a multi-step process involving injection molding, stamping, and lacquering.
- Duplicating CDs (typically for quantities under 300) is a process in which the master is used to record or “burn” CDs in duplication towers using lasers to etch information on a recordable CD, or CD-R.
- For vinyl records, the master lacquer is used to make molds that are used to press the records.

When deciding how to prepare and submit your master, there are several format options to choose from. A complete body of work on a CD-R, individual audio files such as WAV or AIFF (with any variety of bit-depths and sample rates), and DDP 2.0 file sets are the most popular formats. An analog reel-to-reel master or DAT (digital audio tape) also provides high quality, though used less frequently with the advent of newer digital options. A vinyl LP, or even a cassette tape, can be supplied as a master if one of the higher quality formats is not available – though these options should be a last resort as the audio quality will not be as good.

Digital vs. analog

In the age of computer recording and DAWs, analog is less commonly used, though still regarded by many as the superior choice. In some cases, analog can produce the highest quality sound detectable by the human ear, but it suffers from generation losses and tape hiss. In most cases, digital recording offers sonic and economic advantages over analog.

An analog recording captures an entire sound wave, but it also adds all the idiosyncrasies of the medium, including tape hiss, phase errors, distortion, wow and flutter, and dropouts. Digital boasts a perfectly clean representation of sound, but some aficionados aren't fully satisfied with the standard CD sampling rate and word length of 44.1 kHz/16 bit because it is actually an incomplete representation of the original sound wave.

A number of audio equipment manufacturers have addressed this concern by increasing the resolution of their professional systems, making the representation of the sound wave more complete. Some of these systems also support higher sample rates, up to 88.2 or 96 kHz, though the complex sample rate conversion required to go from 96 kHz to the 44.1 kHz required for CD release can introduce its own sonic artifacts.

How does all of this affect you? If you decide to use an analog master, make sure you do all you can to eliminate all the problems that can be associated with analog. If you decide to use a digital master, record at the highest word length you can. If you are planning on recording at a high sample rate (88.2 or 96 kHz), keep in mind that if you are releasing your music on a CD, your music would have to be converted to the CD spec of 44.1 kHz, which would negate the effect of recording at 88.2 or 96 kHz.

Digital

Digital recording is achieved by transforming audio signals into the language of computers. Electrical impulses are translated into signals that are either on or off (in binary terms, 1 or 0), with nothing in between. The major advantage of digital sound recording is that there is no perceivable generation loss and no tape hiss. It is possible, in theory, to make a 100th-generation copy that is bit-for-bit indistinguishable from the original master.

Analog signals are represented by a continuous, uninterrupted waveform. Digital technology takes the analog signal and cuts it up into many little slices, taking a sample of the analog signal at every cut. A sample taken with higher frequency means the digital curve more closely reflects the actual analog wave signal, and will therefore sound more like the analog original. A CD plays back at a sampling rate of 44.1 kHz (kiloHertz), which means that a sample of the analog signal is taken 44,100 times per second.

Digital recording comes in a variety of formats, including tape-based recorders, stand-alone hard-disk recorders, and computer-hosted DAWs. For professional and home studio multi-track recording, DAWs are typically used. For professional stereo masters, audio files such as WAV or AIFF are frequently used, as are DDP 2.0 masters, though these are most often created by a professional mastering engineer. Audio CDs on CD-Rs are also still widely used.

CD-R

In our experience at [The SoundLab](#), the recordable CD (CD-R) is the most common digital format used. Studio workstations can generate master CD-Rs, and CD-Rs can also be made on standalone decks and computer-based DAWs equipped with recording software and CD drives. (The SoundLab uses CD-Rs for our Proof Positive Reference CDs for clients using our mastering services.)

Individual audio files: (WAV, AIFF, etc.)

Since the majority of recordings today occur in a DAW, and every DAW has the ability to output high-quality stereo audio files after mixdown and mastering, individual audio files are one of the most popular format choices to submit for manufacturing.

The two most frequently used file types are WAV and AIFF. They are identical in audio fidelity and both are almost universally supported by any audio software package. Both WAV and AIFF files can be created in various levels of quality. At minimum these files should be 16-bits, with a sample rate of 44.1K. This is the industry standard "CD-quality" audio.

DAT

DAT, or Digital Audio Tape, was originally intended as a consumer format when introduced in 1987, but it became the format of choice for mixdown and/or safety copies in many recording and project studios before the CD-R became the standard. Because physical editing of DAT tape is impossible, individual DAT mixes are often transferred digitally to a computer-based DAW for editing and assembly, then re-transferred to DAT or CD-R to be sent out for mastering or manufacturing.

Analog

Analog recording had been the traditional method of storing signals on various media since Edison developed the cylinder phonograph in the late 1800s. The signal is continuous and variable (analog), just like natural sound. The stored signal correlates directly to the source captured by the microphone.

The two most common analog storage media are magnetic, usually tape; and mechanical, usually disks, such as vinyl records. While analog systems can create high-quality master recordings, the various media have some inherent flaws that can introduce variations in the recorded signal, thus altering the original to some degree. By contrast, digital chops up the signal into small pieces, assigns each a value, and stores the values numerically, making it immune to minor anomalies of the storage medium.

Tape speed

There are three common analog tape speeds used when recording a final stereo mix. (Note that in audio recording, tape speed is quoted in ips, or inches per second).

- 7 1/2 ips: used in non-critical professional recording.
- 15 ips: the most commonly used professional speed.
- 30 ips: universally accepted as the highest quality analog commonly available. This was a very popular speed three to four decades ago that fell into disuse, although it has made a comeback in recent years.

Generation loss

Each time an analog copy is made, the quality is degraded by a certain amount – some degree of distortion and noise (electronic circuit noise and tape hiss) are added to the program. By the time a consumer hears a top-quality, mass-produced program, it is at best a fifth-generation copy. Even starting with the very best program source, the final market product quality has deteriorated.

Dropouts and tape hiss

Magnetic tape suffers from several maladies. One of these, dropouts, are areas of tape that simply cannot be magnetized and therefore cannot hold the signal. As the tape is played back, the dropout does not reproduce the signal. For a very brief instant (usually), there is no sound. Every tape suffers from dropouts, although they may be too brief to be detectable by the human ear.

For any given dropout, a wider track width and/or a faster tape speed will reduce the audible effect. Thus, a stereo master running at 30 ips on 1/2" tape will provide excellent protection against dropouts. At the other end of the spectrum, a cassette running at 1 7/8 ips is far more vulnerable to dropouts in normal use, though it still can give surprisingly good results.

Higher speeds also improve many other qualities of a recorded signal. Extended high frequency response, signal-to-noise ratio, and phase shift problems are all improved with increased tape speed and, to some degree, track width.

Another of analog tape's inherent maladies is tape hiss. This background noise basic to all analog tape recording is also, in varying degrees, a function of tape speed and track width. Tape noise is also accumulated from generation to generation, so care must be used to minimize the number of tape generations used from tracking to production master.

Choosing a format

If you wish to record in analog, choosing 30 ips and 1/2" two-track (or 15 ips with Dolby SR encoding), will provide you the best results when it comes to audio fidelity. With digital, your options are more plentiful. You'll probably want to go with CD-R or DDP for your final 2-track master, mixed down from a DAW or digital multi-track.

Chapter 2

DIGITAL AUDIO WORKSTATIONS

Most modern recordings are recorded and mixed entirely digitally, without ever hitting tape, on a digital audio workstation (DAW). A DAW is an integrated device for recording, mixing, editing, and mastering audio. A DAW may be an all-in-one studio workstation device, or may be computer-based, using one or more software programs and additional installed hardware. DAWs are usually a cost-effective way of producing a high-quality recording, and can function as stand-alone, tapeless configurations.

A computer-based DAW is a standard personal computer with an added audio input/output interface, a hard disk for storing audio data, and a recording/mixing/editing software package. Like most anything involving computers, DAWs have become both far more powerful and affordable in recent years.

With a high-quality interface and analog-to-digital converters, DAWs can record digital audio with the same fidelity as the best stand-alone digital recorders. But a DAW is more than just a recorder. Once your tracks are recorded, DAWs offer a single working environment for all your subsequent production tasks, including:

- enhancing individual tracks with reverb, EQ, compression, and other effects; or digital signal processing using either built-in or third-party software tools.
- editing tracks with great precision and control while looking at a display of the actual waveform on screen, cutting and pasting individual pieces of music to create the exact arrangement you want.
- mixing the tracks into a final stereo version using a virtual on-screen mixer that, in some cases, allows automation of nearly every level and effects process.
- pre-mastering your mixes, optimizing the final overall program level of a group of songs, adjusting the "relative" (song-to-song) levels, and enhancing the sound of the mixes with EQ, compression, and/or other built-in or third-party processing.
- creating a playlist of the mixed masters that you want on your album, including fade-ins, fade-outs and the duration of the spacing between songs.

- recording your playlist to CD-R, or output a DDP 2.0 master.

The ease and control with which DAWs can perform these steps makes them particularly well-suited for preparing a master that conforms with the guidelines laid out in the following chapter on master preparation.

It's worth noting that, while DAWs and recording software are powerful tools, there are other factors that go into a great audio recording and master, including microphone choice and quality, the acoustic environment in which the recording was made, and the engineer and producer's expertise. Recording is both art and science, and having the best equipment doesn't automatically translate to professional results. You can expect a digital workstation to provide excellent reproduction of the sounds being created in a recording environment, but know-how and experience go a long way toward producing a high-quality music recording.

Chapter 3

DIGITAL MASTER PREPARATION

To the recording engineer, digital recording can reveal faults and problems in the studio that were undetectable using analog. If your goal is to produce a killer CD, there are certain steps that must be taken in the preparation of your master.

First, your mix should come out of – and go back into – total silence. To do this, record for at least 15 seconds at the beginning and end of the song (for individual tracks) or audio program, with levels set at minimum. Check each track for clicks, bumps, thumps, and other strange sounds that sneak into almost every recording. Make sure your mixer's output is as clean and quiet as possible by listening to each track open all the way on headphones. Is there a hum or hiss that could be reduced or removed with proper grounding or a cleaner power supply? Experiment to find the optimal output level for your mixer.

If you have experience mixing to analog tape, you know how to take advantage of well-known tape effects. For example, lower frequencies sometimes slightly increase on playback and a pleasant type of distortion eases in when the tape is driven into saturation. This addition of even-numbered harmonics and bass boost is especially noticeable on drums, bass, and vocals, and is featured on many great rock and pop recordings. For better or worse, digital recording does none of this. If you need analog warmth and crunch, you'll have to add it with tube equalizers and pre-amps or compressors.

Dynamic range

The dynamic range (the difference between the quietest and loudest sounds on the tape) of a digital recorder is in excess of 90 dB, but that's not true for all music formats, so make sure the dynamic range of your mix is not greater than that of your planned release format, such as vinyl LPs.

What to provide on a digital master

Before you submit a final master to Disc Makers, take time to sit down and listen it from beginning to end. Hear for yourself what is on the master and make sure you know what to expect when you receive your manufactured copies. If, at this point, there is anything you want to change, go back to the studio and fix it. Understand that whatever is on your master will be on your finished product.

Make sure that all songs are in the proper order with the correct spacing between them. Decide now whether you are satisfied with the way the master sounds, taking into account the acoustics of the room in which you are listening. Any unexpected post production required at the mastering and manufacturing stage will add to the cost of your project and the time required to complete it. Post production (AKA mastering) is the process of adjusting, sequencing, equalizing and compressing your program, and eliminating unwanted sounds or noises. [The SoundLab](#) at Disc Makers offers professional post-production that includes all of the above.

Editing

If you need to resequence a group of individual songs (selections that have complete silence between them), assemble them as desired in your DAW. A DAW can provide powerful editing capabilities and options, especially when a project calls for precise control over the lengths of the silence between tunes, for crossfades or segues, or for making edits within the program (e.g., a radio edit).

Note that it is crucial to get the tones and mix you want during the recording process, before you get to the mastering stage. In mastering, the engineer usually has the entire, finished mix on two tracks, and while the mastering process can take a good mix and make it brilliant, it is not the forum for fixing individual tracks and mistakes that occurred during the recording process.



Frequently asked questions about digital masters

My engineer just gave me this CD. I don't know what's on it besides the order and length of the songs. Should I send it in anyway?

No, listen to it first! We strongly discourage sending in a master if you do not know exactly what's on it. Most problems in mastering are easily avoided by spending a little time in the studio listening to the entire program one last time.

At what level should I digitally record my material?

It depends on where you're going next. If you are not mastering the project, then have your peaks go up to zero. Remember, it'll be exactly the same on the replicated disc. If you are having your project mastered, leave some headroom for the mastering engineer, anywhere near the -6 dB range should be adequate.

Can I compile my master from MP3, AAC, or WMA files?

Technically, you can, but it is not recommended. These file types are heavily compressed, which lowers the audio fidelity, and are intended for transferring over the Internet. Use WAV (.wav) or AIFF (.aif) files to avoid a loss in audio quality.

Can I upload my master to Disc Makers?

Yes. Individual audio files are accepted as AIFF, WAV, FLAC (all preferred) or MP3 files. All individual audio files should be encoded with a sample rate of 44.1 kHz and in 2-channel (stereo). The bit rate for AIFF, WAV, and FLAC should be 16-bit. MP3, AAC, or WMA file bit rates should be between 128 kb/s and 320 kb/s. We can also accept a DDP 2.0 file set as an upload, and we recommend it be compressed in a zipped folder. If you're having your CD mastered by [The SoundLab](#), we can accept any of these file formats.

One song is a little louder than the others. Can you make sure that one gets lowered a little bit?

Sure, just be aware that any changes to the master you submit will incur a charge. Even minor edits require time to listen, make a judgment, and edit. [The SoundLab](#) at Disc Makers provides all of our post production services affordably.

Everything's fine, it just needs a little compression. Can you do that?

Yes, please refer to the answer above.

Should I have a safety copy of my digital master CD made?

Definitely. A CD can get damaged or lost in shipping, and if it's the only copy you have, you've just lost the only copy of your master. You may also consider uploading your CD master using our Master Uploader App software instead of shipping us a physical version.

I have a cassette master. Should I make a CD or DAT copy to send to Disc Makers?

Definitely. It simplifies the mastering process. However, due to the quality limitations inherent in cassettes, we recommend you stay away entirely from that as a master tape format.

Chapter 4

CD MASTER PREPARATION

When you submit a CD master to Disc Makers, you want to submit an audio CD that sounds just like you want the final CD to sound. All of the songs must be in the proper order, with the desired spacing between them.

It's important to note that you'll need to provide an audio or music CD for manufacture, not a data CD. Sending individual audio files, such as .wav or .aiff, on a CD will require [The SoundLab](#) to convert these files to a suitable audio master format for manufacture, which can delay your order. Make sure that your CD master is an audio CD that can be played on any standard audio CD player. If you

test it and it doesn't, consider uploading those individual audio files instead of sending a CD.

Most DAWs allow you to control the level of each selection in an assembled project. As you prepare your master, try to ensure each song flows naturally into the next in terms of volume, so that each track starts at a pleasing volume relative to the song before it.

Be sure to place a CD track or "index" marker at the start of each selection on your CD. These index markers will be transferred to your CDs and will make it easy for listeners of your CD to jump to each selection as desired, including songs that fade into one another or have no discernible break.

To help ensure compatibility, create your CD master on a CD-R disc, not a CD-RW. While Disc Makers can successfully work with either medium, not all production facilities can.

All computer-based DAWs give you the option of mixing down (or "bouncing") your mix to various digital formats. When preparing your master, be sure that this setting (adjusted within the native audio program) is set to an uncompressed audio format, usually a WAV (.wav) or AIFF (.aif) file. Along with this setting make sure the files you are creating are not split stereo files. Make sure you select the option for "interleaved stereo" files. WAV and AIFF files can contain stereo (two track, left and right) information in a single file.

Along with the options for setting the audio format, you will find settings for bit rates and sampling rates. Audio CDs can only play back at a sampling rate of 44.1 kHz and a bit rate of 16 bits. If you are outputting audio files that will be submitted to [The SoundLab](#) for mastering, we recommend you send higher resolution files. 24-bit, at the same sample rate your multi-track project was recorded, is ideal. Adjust these settings accordingly.

Be very careful to not bounce your songs to a compressed audio format because significant loss of audio quality will occur. In other words, do not compile your audio master from MP3, AAC, or WMA files. These file formats are great for Internet file transfers, but not for your audio CDs.

Summary

If you're submitting an assembled master CD:

- Listen to the CD carefully. It should sound exactly the way you want your finished product to sound.
- Make sure the disc surface is clean and scratch free. Use only a soft-tipped marker to label the CD, never a ball point pen.
- Place a CD track marker at the start of each selection.



Frequently asked questions about CD masters

What should I do if my songs are on different CDs?

If at all possible, consolidate your sources on your DAW before you submit your project to Disc Makers. Any post-production editing adds to the cost of the project and the time required to complete it.

What brand of CD do you recommend?

Check to see what brand the manufacturer of your burner recommends, or if the machine was calibrated with a certain brand or at a certain speed. Disc Makers offers a selection of [pro audio media](#).

Does it matter what speed I use to burn my master?

Typically, no. While it used to be recommended that a CD master be created at the slowest speed possible, new dye formulations used in CD-Rs allow for low error recording even at faster speeds. The only way to know for sure how fast you can safely burn a master is to burn test CDs at various speed with different brands of media, then have the CDs error-checked to see the if the error rate is acceptable.

Chapter 5

ANALOG TAPE PREPARATION

Leadering

It is necessary to “leader” analog tape. Leader is a length of paper or plastic tape spliced onto the very beginning and end of each selection. Leaders eliminate the possibility of print-through, and make it easy to find selections.

Splicing

All splices should be tight and professional. If any portion of the splicing tape is hanging over the edge of the tape, it may get caught in the tape guides of certain machines, causing unwanted variations in tape speed. Make sure that no portion of the splice is visible when looking at it from the oxide, or dull, side of the tape. The life of a splice is approximately 10 years, so be prepared for re-splicing when reproducing from older analog tapes.

Calibration tones

All analog tapes should have the following calibration tones at either the head or the end of the tape: A 1 kHz tone, a 10 kHz tone, and a 100 Hz (not kHz) tone, in that order, all at 0 dB operating level. If the tape is Dolby encoded, either with Dolby A or Dolby SR, it must also have the appropriate Dolby tone, or there is no way to decode it properly. The reason? The tones will verify that the equipment is functioning properly. They also offer a means of compensating for a machine that is slightly out of spec.

All of these tones should be recorded just before the session begins, on the same machine on which

the recording will be made, and the machine should be warmed up for at least 30 minutes. Warming up the machine keeps it stable throughout the recording session. If the tones are put on at a later time or by another machine, they will not function as an accurate reference and can do more harm than good.

Ordinarily, the tones are “printed” on the tape with a signal generator (AKA oscillator, tone generator, audio generator). If you have no signal generator, CDs with test and calibration tones are currently available through mail order companies like [Music Books Plus](#). Buy one and use it. You can also use these test CDs to calibrate your studio equipment, just be sure to use the sine wave mode.

Here is the correct procedure for adding calibration tones, whether you are using a signal generator or a calibration CD.

- Switch any noise reduction system out, whether or not you will be encoding the tape. Feed a 1 kHz tone into the console. Adjust the console for 0 VU out of both channels to your two-channel recorder. Then adjust the recorder for 0 VU record level. Record this tone for about 15 seconds.
- Switch the signal generator to 10 kHz. Adjust the console for 0 VU out as you did before, but – this is important – do not adjust the recorder. Record about 15 seconds of this tone, regardless of what the VU meter on the recorder indicates.
- Next, set the signal generator to 100 Hz and again adjust the console for 0 VU (but not the recorder) and record 15 seconds of this tone.
- If you intend to encode your tape with Dolby A or Dolby SR, record about 15 seconds of the appropriate Dolby tone at this point.

You now have a meaningful set of calibration tones and you can begin mixing.

If the tones do not come out right, leave them as they were recorded. That way if the recording machine is misaligned in any way, our playback machine at Disc Makers can be adjusted to match. This is one of the few times two wrongs do make a right. Be sure to indicate the tape machine’s operating record level on the tape log and the tape box (see FAQs in this chapter).

Noise reduction

Whether or not to use noise reduction depends on the type of music you are recording, the machinery used to reproduce it, and individual taste. Professional studios typically use Dolby A, Dolby SR, or dbx noise reduction for analog recording.

Take sheet/tape log

If your master tape is analog, be sure it has a take sheet indicating everything on the tape (including tones), and what order it is in. This is important because some things are not as obvious to the engineer as they are to you.

Leave space at the beginning and end of each tape. Don't start the recording two inches from the front of the tape. It takes several feet of tape just to thread a professional deck. That's a bar or two of music on some songs. If your recording ends at the last foot of tape, the deck will shut down before the end of the song. Without enough of a pad the tape cannot be started at the beginning and will not play to the end. You also run the risk of destroying your valuable master by damaging the tape at the beginning or end of the program. Avoid extra charges and delays by providing ample leadering.

Other analog master tape concerns

Reels should have head and tail leaders of at least five seconds. Albums should have head and tail leaders of at least ten seconds per reel, and each selection on the album should be separated with about two to four seconds of leader.

The master tape should be supplied tails out, slow wound, in a proper box. All necessary information, such as times, titles, any noise reduction that was used, and any instructions or special problems you may want the mastering engineer to consider should be included with the tape.

For all of the forms you need and more information, go to the "[Preparing your master for replication](#)" page of Disc Makers' website.



Frequently asked questions about analog masters

At what level should I record my program on my analog tape deck?

As long as you know the level and tell us what it is, we can deal with your master. It is helpful if the recording level is noted on the master tape box (i.e., 180 nW/m, 250 nW/m), and whether the engineer recorded a certain number of dB above or below this operating level (i.e., +3/180 nW/m).

What should I do if my songs are on different tapes?

If possible, consolidate your sources before you submit your project to Disc Makers. Any post-production editing done by Disc Makers adds to the cost of the project and the time required to complete it.

Can I put my tones on after my recording is complete?

Tones should be recorded just before the session begins or immediately afterwards, on the same machine on which the recording is made, without any changes in its calibration. The tape machine should be warmed up and calibrated before the recording session begins.

What if I don't have a tone generator?

We recommend you **include** tones on your master, especially if you are planning to make an analog recording. Most studios should have a generator, but if yours does not, you can buy a

CD with tones that can get the job done. They can be purchased through mail-order houses like [Music Books Plus](#).

Chapter 6

HANDLING YOUR MASTER

A finished master is the result of months of hard work and many dollars spent. It also represents an irreplaceable artistic expression that cannot be described in monetary terms. The care of this master deserves as much consideration as was given the creation of the entire project.

Safety copy

It is absolutely critical that a safety copy be made of your master before you ship or deliver it anywhere. CDs and tapes can easily be damaged or lost during shipping and handling. A safety copy is a small price to pay to preserve your irreplaceable performances. If you are working on a DAW, you can also protect your work by backing up your entire session for each song on a removable medium such as a data CD or DVD, or on a backup hard drive.

Keep the safety in a safe place and send the master to be mastered. This may seem obvious, but it's especially important with analog master tapes. Often a producer will keep his master analog tape and send a copy or safety to be mastered. Unfortunately, sometimes the second machine is out of alignment and the safety does not match the original exactly. After spending money and effort to create the best product you know how, why start the manufacturing process off at a disadvantage with a second-generation tape?

Storing master CDs and tapes

Precautions for storing CD-Rs are often marked on the packaging of blank CD-R media. CD-Rs should never be left in direct sunlight or for long periods of time in hot, humid locations.

Analog or digital tapes should be clearly marked and boxed whenever they are not on or in a tape deck.

- When storing tapes, the conditions are simple to remember. If you are comfortable, so is the tape: 65 to 75 degrees (Fahrenheit) and 40 to 60% relative humidity. (Professional media storage facilities often use lower temperature and humidity for long-term storage: 45 degrees at 25% humidity, for instance.) Make any necessary climatic adjustments where the tape is stored, or move it elsewhere to ensure its safety.
- Store tapes in a clean, dry environment with stable temperature and humidity in the ranges indicated above.
- Store tapes in acid-free cardboard or plastic library boxes. Tape boxes and tapes should stand on

end so that the wound tape is supported by the hub of the tape reel.

- Keep master tapes away from smoke and dust as much as humanly possible. Hair, dust, and smoke particles are major contributors to dropouts in the digital world.

Winding analog masters

After use and before being placed in its box, every master tape should be slow-wound and left tails out. That is, it should be played through from beginning to end at play or shuttle speed, not fast forward or rewind. This ensures the tape is wound under constant and proper tension, allowing it to pack smoothly, which protects the tape edges and minimizes tape stretching. The tails-out position forces you to rewind the tape before playing, which reduces print-through. It also frees up any mechanical problems such as sticky splices. Also, after the duplication facility's mastering department has processed your tape for CD or LP, it will already be in its slow-wound, tails-out state, and ready for storage.

Transporting analog master tapes

Caring for master tapes during transportation is as important as caring for them in your tape library. There are many physical and environmental factors you should consider when shipping a master.

Keep tapes away from magnetic fields: motors, magnets, cables carrying heavy current, vacuum cleaners, etc. If you are traveling by plane, hand-carry the tape. Don't leave it in your baggage and let it run through the x-ray machine and don't walk through the metal detector with it. Hand it to the security person for inspection. When shipping tapes, clearly mark them with a message such as: **MAGNETIC MEDIA. KEEP AWAY FROM ELECTROMAGNETIC FIELDS!**

When shipping your master via courier, double box the tape(s). Place the tape box inside another larger box with plenty of insulating or shock absorbing material between the two containers. If you can't use double containers, use a plastic library shipping case designed for the medium you are shipping. Use a reputable shipper and insure the tape for the reasonable replacement value of the recordings it contains.

Chapter 7

CREATING A CD MASTER

With the popularity of DAWs, many clients today prepare CD masters on their own studio workstations, using a CD-R drive and built-in pre-mastering software. [The SoundLab](#) at Disc Makers also gives you the option of having your master professionally prepared by our experienced staff. Our mastering engineers use the best available media and equipment, and digital masters are loaded into our Sequoia digital editing and pre-mastering environment entirely in the digital domain with no generation loss.

Analog masters are immediately converted into digital files and loaded into the system without any interim tape copies. We load the data into a computer, add the digital subcoding (commonly known as P and Q codes), create a frame-accurate time log, and create a DDP 2.0 master for manufacture.

Chapter 8

POST-PRODUCTION MASTERING

Many people don't understand the mastering process and see it as an unnecessary expense. Having committed months of devoted work to a project, and having taken advantage of the pre-mastering tools at your disposal, it is often difficult to understand how a total stranger could improve the final product. After all, if your mix didn't sound right, you wouldn't have left the studio.

As explained in the Preface, this step occurs after your recording is mixed, and before CD and vinyl LP manufacturing are done. It is the last creative process in the making of an album and the first step in the manufacturing process. Every major-label release is mastered to prepare it for radio play and retail sale. The reason? A good mastering engineer puts the whole album in perspective, subtly enhancing and balancing the connection between songs and the focus of the project as a whole.

In the studio, you record one song at a time, resulting in songs that all peak at different levels (volume) and have different EQs, etc. A mastering engineer attempts to unify the album with skillful use of EQ, gain, and compression to give it a consistent sound from track to track, and to make sure that it will translate the way you want it to on consumer stereo systems. This mastering process also allows the engineer to raise the overall level so your album is as hot as it can be, if that is your desire.

Mastering can also be helpful for fixing problems such as "pops," out-of-phase tracks, and overall noise reduction.

One advantage of using a third-party audio post-production facility is that an unbiased sound professional has the opportunity to evaluate your master and determine how to get the most out of your production in an acoustic environment created for the specific purpose of mastering music. After you've spent weeks or even months in the same recording studio listening to your CD over and over again, a fresh pair of ears can put the project into perspective and make your music sound its best.

Our SoundLab mastering engineers typically use a set of processors that include:

- Compressors, limiters, and expanders. These processors adjust the dynamics of a mix.
- Equalizers. EQs will help the mastering engineer target specific frequencies within a track, or over your entire program, in an effort to adjust and enhance the tonal balance of your mix and recording.

To improve your recording, a mastering engineer can:

- Raise the overall level.
- Even out song levels and EQ individual tracks for cohesion.
- Correct minor mix deficiencies with equalization.
- Enhance flow by changing the space between tracks.
- Eliminate noises between tracks.
- Make your music sound great on any sound system.
- Add your [ISRC codes](#)
- Add [CD-Text information](#) (artist, title, and track names that can be displayed by some CD players).

Your master is the template for thousands of your CDs to be produced for commercial release. If you are not mastering your audio recording, you are skipping what could be a crucial step in making your CD the best it can be.

[The SoundLab](#) at Disc Makers previews masters at no charge to determine what benefits can be achieved, and offers affordable packages that include signal processing, equalization, limiting, and compression to raise your master to optimal commercial industry standards.

Chapter 9

IF PROBLEMS OCCUR

Unfortunately, problems do occasionally arise during the manufacturing process. What do you do when your finished product does not match your supplied master or your approved test after SoundLab mastering?

First, don't panic. Play your disc on several different pieces of equipment. Ask your friends for their unbiased opinions – without coaching them. You may find that what sounds like a disaster to you is really quite acceptable to everyone else. Don't forget, you lived with this project for a long time; it's your baby. Above all, try to keep things in perspective – it is impossible for you to hear your own work with total objectivity and clarity.

If there is a clear defect or you believe there is a real problem, call the manufacturer and explain the situation. Be calm and explain the problem as clearly and objectively as possible. Any reputable firm will appreciate the opportunity to correct a true problem.

Should you be unfortunate enough to wind up with a whole shipment of defective CDs, you will have to do some detective work together with your rep at the manufacturing plant to figure out what went wrong. If your finished product doesn't match your master or the mastered test you approved, within commercial standards, the plant should re-do your product.

Remember, though, facilities will manufacture product to match the test you approved. If the glitch on your finished CDs was on your master or approved reference CD, you may be out of luck. Therefore, we can't stress enough that you must listen carefully to each test you receive before approving it! It may sound obvious, but listen to the whole test without interruptions. Otherwise, minor glitches or dropouts could go unnoticed and you'll have to live with the consequences.

A-B Test

When a problem occurs on a test or finished product, there is only one valid listening test to accurately compare one source against another: the A-B test. Very simply, you first listen to the master and then instantly switch to the reference or final product that you want to appraise. You must be playing both formats simultaneously, on similar players, using the same amp and speakers (or headphones). It is absolutely essential that both playback machines, the CD player or turntable, be perfectly calibrated and aligned for the A-B test to be valid. This means that not only must their frequency response be flat to professional standards, but their output levels must match each other. A-B tests can be quite difficult to set up for people inexperienced with their use, so ask an engineer to assist you.



Common problems

My reference CD doesn't sound as hot as other CDs I own.

Normalizing a CD's level and making your record as "hot" as it can be is one thing [The SoundLab](#) does when mastering a project. We search for the hottest spot on the master and maximize that to 0 dB (the maximum allowable level on a CD). This peak determines your overall level. Without sound processing (such as EQ, compression, or limiting) your levels cannot be raised any more. [The SoundLab](#) at Disc Makers offers affordable sound processing including equalization, limiting, and compression that may help. If you are not using our mastering services, remember that your finished product will match your supplied master exactly. If the levels on your supplied master are low, your finished product will be as well.

Remember, most of the CDs you own were probably recorded with top budgets, in top studios, with top engineers and producers. If your master has a very wide dynamic range, the apparent recording level may be low, even though the actual level still peaks at 0 dB. Only through compression or limiting can your apparent level be raised. Disc Makers' engineers generally do not recommend a lot of compression during the mastering stage. Some studios choose to start compressing tracks as early as in the multi-track stage, to give the finished recording that nice, fat sound.

One song sounds hotter (or quieter) than the others.

Disc Makers' mastering engineers set the overall recording levels when mastering. They do not match levels on every song unless it is specifically requested. If the recording levels are not consistent on your master, they won't be consistent on your finished product. Please be sure to fill out the master questionnaire on the back of the Disc Makers order form if you need any editing or sound processing done.



Resources

The SoundLab at Disc Makers

The mastering facility at Disc Makers. This site offers our packages, prices, equipment, and more.

www.discmakers.com/soundlab

More guides from Disc Makers

Our catalog and complimentary guides are full of tips and expert advice written by industry professionals.

www.discmakers.com/request

Disc Makers Partner Program

Are you a studio owner? Join the Disc Makers Partner Program and earn cash for referring your clients.

<http://www.discmakers.com/community/partnerprogram/>

Echoes, Disc Makers blog

Dig in to interviews with great music producers, tips on how to build your home studio, gear tutorials, and recording insights from the pros.

<http://blog.discmakers.com/2012/03/home-studio-posts/>