MICROPHONE TECHNIQUE BASICS FOR MUSICAL INSTRUMENTS
by Bruce Bartlett

Suppose you're going to mike a singer, a sax, or a guitar. Which mic should you choose? Where should you place it?

Your mic technique has a powerful effect on the sound of your recordings, or the sound reproduced through a PA system. In this article we'll look at some general principles of miking that apply to all instruments.

Which Mic Should I Use?
Is there a "right" mic to use on a piano, a kick drum, or a guitar amp? No. Every microphone sounds different, and you choose the one that gives you the sound you want. Still, it helps to know about two main characteristics of mics that affect the sound: frequency response and polar pattern.

The **frequency response** of a mic is the range of frequencies it can pick up at an equal level (within a tolerance, such as +/- 3 dB).

Most condenser mics have an extended high-frequency response" they reproduce sounds up to 15 or 20kHz. This makes them great for cymbals or other instruments that need a detailed sound, such as acoustic guitar, strings, piano, and voice. Dynamic moving-coil microphones have a response good enough for drums, guitar amps, horns, and woodwinds. Loud drums and guitar amps sound dull if recorded with a flat-response mic; a mic with a presence peak (a boost around 5 kHz) gives more edge or punch.

Suppose you are choosing a microphone for a particular instrument. In general, the frequency response of the mic should cover at least the frequencies produced by that instrument. For example, an acoustic guitar produces fundamental frequencies from 82 Hz to about 1 kHz, and produces harmonics from about 1 to 15 kHz. So a mic used on an acoustic guitar should have a frequency response of at least 82 Hz to 15 kHz if you want to record the guitar accurately.

Listed below are the frequency ranges of some instruments (including fundamentals and harmonics):

Male voice: 100 to 12 kHz.
Female voice: 200 to 12 kHz.
Kick drum and bass: 40 Hz to 9 kHz.
Guitar through an amp: 82 Hz to 4 kHz.
Acoustic guitar: 82 Hz to 15 kHz.
Cymbals: 500 Hz to 20 kHz.
Toms and snare drum: 100 Hz to 12 kHz.
Fiddle: 200 Hz to 15 kHz.

A much larger list is in the book "Practical Recording Techniques 5th Edition."

The **polar pattern** of a mic is a graph of how well it picks up sounds coming from different directions.

- Omnidirectional picks up equally well in all directions.
- Bidirectional (figure-eight) picks up best in two directions - the front and back of the mic.

- Unidirectional picks up best in one direction - in front of the mic. Examples are cardioid, supercardioid and hypercardioid.

All else being equal, bidirectional and unidirectional patterns pick up less leakage, ambience and feedback than the omnidirectional pattern. Leakage is unwanted sound from instruments other than the one at which the mic is aimed. Ambience is the acoustics of the recording room– its early reflections and reverb. The more leakage and ambience you pick up, the more distant the instrument sounds.

An omnidirectional mic picks up more ambience and leakage than a directional mic when both are the same distance from an instrument. So an omni tends to sound more distant. To compensate, you have to mike closer with an omni. Some clip-on mics have an omni pattern. It can provide good isolation and good gain-before-feedback because the instrument is miked extremely close.

How Close Should I Place the Mic?
Once you've chosen a mic for an instrument, how close should the mic be? Mike a few inches away to get a tight, present sound; mike farther away for a distant, spacious sound. (Try it to hear the effect.) The farther a mic is from the instrument, the more ambience, leakage, and background noise it picks up. So mike close to reject these unwanted sounds. Mike farther away to add a live, loose, airy feel to overdubs of drums, lead-guitar solos, horns, etc.

Close miking sounds close; distant miking sounds distant. Here's why. If you put a mic close to an instrument, the sound at the mic is loud. So you need to turn up the mic gain on your mixer only a little to get a full recording level. And because the gain is low, you pick up very little reverb, leakage, and background noise (Figure 1A).

If you put a mic far from an instrument, the sound at the mic is quiet. You'll need to turn up the mic gain a lot to get a full recording level. And because the gain is high, you pick up a lot of reverb, leakage, and background noise (Figure 1B).

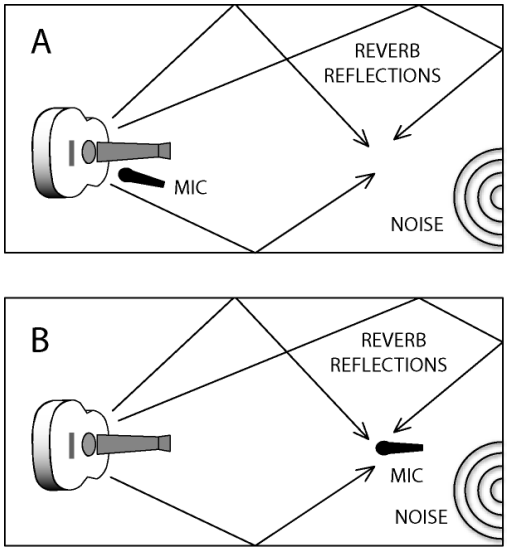

Figure 1. (A) A close microphone picks up mainly direct sound, which results in a close sound quality. (B) A distant microphone picks up mainly reflected sound, which results in a distant sound quality.

If the mic is very far away– maybe 10 feet– it's called an ambience mic or room mic. It picks up mostly room reverb. A popular mic for ambience is a boundary microphone taped to the wall. You mix it with the usual close mics to add a sense of space. Use two for stereo. When you record a live concert, you might want to place ambience mics over the audience, aiming at them from the front of the hall, to pick up the crowd reaction and the hall acoustics.

Classical music is always recorded at a distance (about 4 to 20 feet away) so that the mics will pick up reverb from the concert hall. It's a desirable part of the sound.

Leakage (Bleed or Spill)
Suppose you're close-miking a drum set and a piano at the same time (Figure 2). When you listen to the drum mics alone, you hear a close, clear sound. But when you mix in the piano mic, that nice, tight drum sound degrades into a distant, muddy sound. That's because the drum sound leaked into the piano mic, which picked up a distant drum sound from across the room.

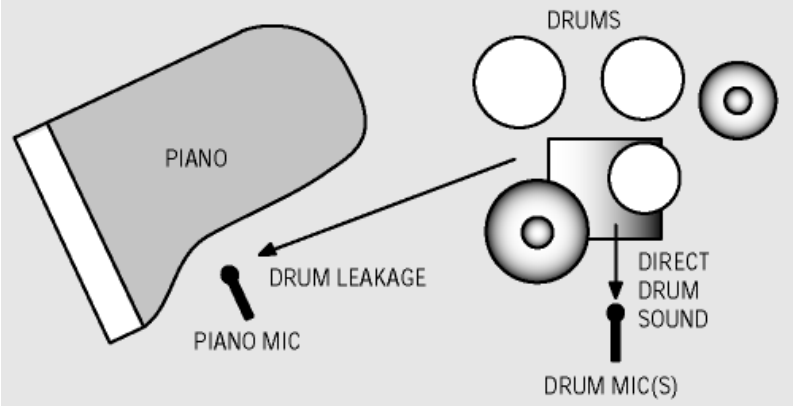

Figure 2. Example of leakage. The piano mic picks up leakage from the drums, which changes the close drum sound to distant.

There are many ways to reduce leakage:
- Mike each instrument closely. That way the sound level at each mic is high. Then you can turn down the mixer gain of each mic, which reduces leakage at the same time.
- Overdub each instrument one at a time.
- Record direct. Record an acoustic guitar off its pickup during tracking, then overdub the guitar with a mic. Record an electric guitar off its pickup during tracking, then play the guitar signal through a guitar-amp modeling plug-in during mixdown. Or record the electric guitar through a Line 6 Pod, which is a guitar-amp emulator.
- Filter out frequencies above and below the range of each instrument.
- Use directional mics (cardioid, etc.) instead of omni mics.
- Record in a large, fairly dead studio. In such a room, leakage reflected from the walls is weak.
- Put portable walls (goboes) between instruments.
- Use noise gates on drum tracks.

Don't Mike Too Close
Miking too close can color the recorded tone quality of an instrument. If you mike very close, you might hear a bassy or honky tone instead of a natural sound. Why? Most musical instruments are designed to sound best at a distance, at

least 1-1/2 feet away. The sound of an instrument needs some space to develop. A mic placed a foot or two away tends to pick up a well-balanced, natural sound. That is, it picks up a blend of all the parts of the instrument that contribute to its character or timbre.

Think of a musical instrument as a loudspeaker with a woofer, midrange, and tweeter. If you place a mic a few feet away, it will pick up the sound of the loudspeaker accurately. But if you place the mic close to the woofer, the sound will be bassy. Similarly, if you mike close to an instrument, you emphasize the part of the instrument that the microphone is near. The tone quality picked up very close may not reflect the tone quality of the entire instrument.

Suppose you place a mic next to the sound hole of an acoustic guitar, which resonates around 80 to 100Hz. A microphone placed there hears this bassy resonance, giving a boomy recorded timbre that does not exist at a greater miking distance. To make the guitar sound more natural when miked close to the sound hole, you need to roll off the excess bass on your mixer, or use a mic with a bass rolloff in its frequency response.

If you mount a clip-on mic onto the guitar's body, usually you can find a sweet spot that sounds natural and well balanced -- but it's not in the sound hole! You want the mic to pick up a good mix of the body, sound hole and strings. The same principle applies to other instruments miked with a clip-on mic.

The sax projects highs from the bell, but projects mids and lows from the tone holes. So if you mike close to the bell, you miss the warmth and body from the tone holes. All thatôs left at the bell is a harsh tone quality. You might like that sound, but if not, move the mic out and up to pick up the entire instrument. If leakage forces you to mike close, change the mic or use equalization (EQ).

Usually, you get a natural sound if you put the mic as far from the source as the source is big. That way, the mic picks up all the sound-radiating parts of the instrument about equally. For example, if the body of an acoustic guitar is 18 inches long, place the mic 18 inches away to get a natural tonal balance. If this sounds too distant or hollow, move in a little closer.

Where Should I Place the Mic?

Suppose you have a mic placed a certain distance from an instrument. If you move the mic left, right, up, or down, you change the recorded tone quality. In one spot, the instrument might sound bassy; in another spot, it might sound natural, and so on. So, to find a good mic position, simply place the mic in different locationsð and monitor the resultsð until you find one that sounds good to you.

Hereôs another way to do the same thing. Close one ear with your finger, listen to the instrument with the other ear, and move around until you find a spot that sounds good. Put the mic there. Then make a recording and see if it sounds the same as what you heard live. Donôt try this with kick drums or screaming guitar amps! You could also move a mic around while monitoring its signal with good headphones.

Why does moving the mic change the tone quality? A musical instrument radiates a different tone quality in each direction. Also, each part of the instrument produces a different tone quality. For example, Figure 3 shows the tonal balances picked up at various spots near a guitar.

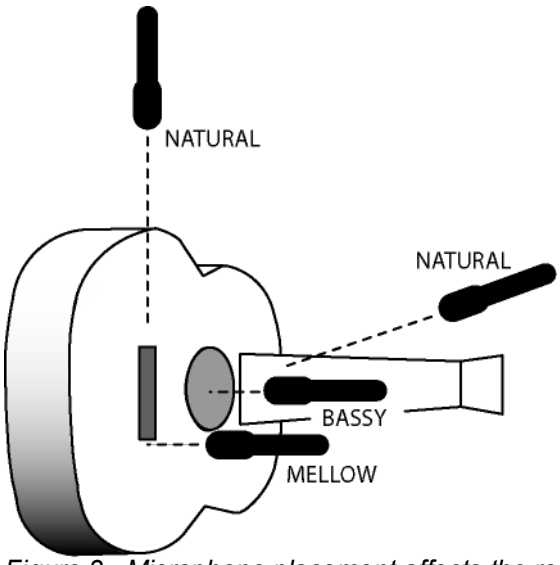

Figure 3. Microphone placement affects the recorded tonal balance.

Other instruments work the same way. A trumpet radiates strong highs directly out of the bell, but does not project them to the sides. So a trumpet sounds bright when miked on-axis to the bell and sounds more natural or mellow when miked off to one side. A grand piano miked one foot over the middle strings sounds fairly natural, under the soundboard sounds bassy and dull, and in a sound hole it sounds mid-rangey.

It pays to experiment with all sorts of mic positions until you find a sound you like. There is no one right way to place the mics because you place them to get the tonal balance you want.