



REVIEW

BY DAVID MOULTON

Ribbon microphones have legendary status in the industry. Back in the '40s, '50s, and even '60s, they were quite popular. Since that time they've fallen into disuse because many of their virtues were acquired by the dual large-diaphragm condenser microphones, which have comparatively few of the operational problems that ribbon microphones presented.

Naturally, such mics are steeped in an aura of retro superiority, and there is a cult of users who swear by (a) ribbon microphones in general and (b) old ribbon microphones in particular, such as the RCA 77DX mic and/or the Bang & Olufsen 200 stereo ribbon mic. Such mics are alleged to have extraordinarily "natural" sound quality, which is to say that some engineers really like the way they capture the timbre of instruments and voices in the studio.

Ribbon mics in general

It's useful, in light of this, to consider how ribbon mics actually work. To quote from my new book *Total Recording* (ah, to be able to quote someone without asking permission):

"The ribbon microphone lies somewhere between the condenser and the dynamic microphone in terms of attributes. It also has a specific and particular directional behavior that makes it special.

Royer R-121 Ribbon Microphone



What went around has come around again

"The ribbon microphone consists of a comparatively large, compliant metallic diaphragm suspended in a strong magnetic field. As the diaphragm moves in response to the motion (velocity, actually) of the air, its passage through the magnetic field causes an electrical current to be generated, creating the audio signal.

"By the nature of the design, the ribbon diaphragm is open to air on both sides. As a result, sound artifacts arriving from the sides of the microphone diaphragm exert equal pressure on both sides of the diaphragm, so that it doesn't move. The result is that the electrical output of the microphone varies as a function of the angle of arrival of any given sound artifact. More

specifically, sounds arriving from the side are not picked up, while sound from the front is picked up strongly and sound from the back is picked up equally strongly, but with the polarity of the electrical output from the microphone reversed.

"This bi-directional, or "Figure 8," directional behavior is of great importance to understanding general microphone usage, a variety of stereo microphone techniques, and the derivation of the so-called "cardioid" directional behavior of microphones."

One of the virtues of the ribbon microphone is that the ribbon itself, being so compliant and low in mass, floating in space as it were, has really excellent transient response to the velocity (and direction) of the

REVIEW ROYER R-121



air molecules. Because the ribbon is essentially free-floating, it can really provide quite an accurate rendition of the changing state of air velocity at the mic.

This is also, of course, an operational hazard. The ribbon is extremely vulnerable to air motion (you never blow into a ribbon to see if it's working) and suffers from an extreme case of proximity effect. I suspect that these are some of the reasons ribbons have fallen into disuse: they have been a little too fragile for the rigors of rock and roll life."

Royer R-121 in particular

With all that said, I was pleased to find that Royer Labs has come out with a new ribbon mic, using some updated technology for both the ribbon itself (a 2.5 micron thick aluminum ribbon) and for the magnets (there are two neodymium magnets in each R-121, one on each side of the ribbon).

You've gotta be careful around magnetic tapes and the like—the permanent magnets in a ribbon mic are quite strong, and they will partially or fully gauss and/or degauss DATs, credit cards, cassettes, etc.

Royer also offers a stereo ribbon microphone, the Royer/Speiden SF-12. The SF-12 is not simply a stereo version of the R-121, it's an altogether different microphone with some common tonal characteristics. Such a pair of ribbon elements in a coincident array constitute the so-called "Blumlein Pair" and can be used in either XY or MS configurations for immense fun and profit. Really tasty.

Royer sent two R-121s for evaluation. The mic is really nice looking. It is a carefully fabricated metal structure that has excellent build quality,

with the magnet mounting frame visible as a pair of small "ears" sticking outside the cylindrical mic housing. Note: you've gotta be careful around magnetic tapes and the like—the permanent magnets in a ribbon mic are quite strong, and they will partially or fully gauss and/or degauss DATs, credit cards, cassettes, etc.

Each mic comes in a rugged wooden case, and a spring-loaded mic clip is provided. In the options department, you can get a really nifty windscreen with it, as well as a shock mount. Both accessories are highly recommended. At \$995 this mic is not cheap, but it's not outrageous either.

Like all ribbon mics, the Royer is bi-directional in pickup pattern (the so-called "figure-8" pattern). Happily, my measurements confirmed that the pattern is pretty much constant across the audio spectrum. Royer claims a frequency response of 30–15,000 Hz, and the mic easily does that (see the sidebar about measurements, however, for an interesting tale). Sensitivity was rated at -54 dBV for a 94 dB SPL input, which is typical for any reasonable unpowered microphone.

Royer recommends that you operate the microphone into a load of greater than 1k . Not a problem most of the time. The maximum level that the mic is rated to endure is "> 135 dB SPL." I probably wouldn't stick the Royer into a kick drum or right in front of a stack of Marshalls playing Goth. [Royer states that many users do record extremely loud guitar, bass, drums, etc., all with no mic damage.—MM] Royer doesn't publish an Equivalent Input Noise (E.I.N.) spec, but I measured it informally to be around 23 dBA SPL. Decent.

Interestingly, Royer offers a lifetime warranty to the original owner, and in a nice gesture to users who might be new to handling ribbon mics (or who have shied away from them because of fears about damage), if you ever do blow the ribbon on your R-121 they'll do your first rereibboning for free. Nice touches.

Sound

This is where we head off into the ozone. My experience with ribbons has been limited, and I was really curious to try a modern one. So after going through my usual measure-

ment stuff, I made a bunch of comparison recordings using my trusty B&K 4007 reference mic, an AKG 414 in bi-directional setting, and the Royer. Source material included voice(s), including mine, guitar, trumpet, cello, and some percussion.

I recorded everything to multitrack so I could switch back and forth between mics as needed for study. I didn't really plumb the depths of the proximity effect, and was pretty conservative with placements, so that acoustic sources were typically 24 to 30 inches away from the mics.

Like all ribbon mics, the Royer is bi-directional in pickup pattern (the so-called "figure-8" pattern).

For reasons that I can't directly explain, I often preferred (slightly, but nonetheless preferred) the sound of the Royer ribbon played back through my loudspeakers in comparison with the original source itself! How do you like them apples? Definitely I liked the recorded reiteration of my voice better, and I felt moderately strongly about the trumpet and the cello. So much for accuracy!

The word I would use to describe the sound is "natural." There was a kind of easy smoothness and lower midrange something-or-other that was just plain nice, and that made the original sound feel a little pinched and/or tubby in comparison. Now, to me it is truly weird to be saying that maybe a recording of a cello might actually sound better than the cello itself, but in fact something close to that happened, although the difference isn't big. So for a number of situations I might be inclined to grab the Royer first, and that includes when recording my own voice.

Any quibbles? See the measurement sidebar, and note that in any case there is a smooth rolloff starting about 7 kHz. This "cool" sort of top end response may actually be a virtue and a significant part of the microphone's sound, differentiating it from the more conventional 8 kHz peak that shows up in so many modern microphones.

Royers for fun and profit

Because the Royer is bidirectional, it tends to de-emphasize lateral ener-



REVIEW ROYER R-121



gy arriving at the mic. This results in quite a different sound quality from either omnidirectional or cardioid mics used in most reverberant spaces such as studios, particularly small ones. Further, because the bi-directional behavior is constant down into low

a particular and distinctive kind of timbral and acoustical truth. Expect warmth, richness and a je ne sais quoi that makes the Royer different—and perhaps just a little better than many other mics.

Price: \$995

More from: Royer Labs, 821 North Ford St., Burbank, CA 91505. 818/760-8472, fax 818/760-8864, www.royerlabs.com.

Dave Moulton is hard at work measuring CODECsmicrophones, and loudspeakers. He's also busy recording, teaching and writing. It's a tough life! Write to him at moulton@recordingmag.com.



Excerpted from the July edition of RECORDING magazine. ©1999 Music Maker Publications, Inc. Reprinted with permission. 5412 Idylwild Trail, Suite 100, Boulder, CO80301 Tel: (303) 516-9118 Fax: (303) 516-9119

I often preferred the sound of the Royer ribbon played back through my loudspeakers in comparison with the original source itself! How do you like them apples?

frequencies, there is a distinct smoothness to the reverberant bass response compared to cardioids. Meanwhile, the mic tends to de-emphasize the room nicely, compared to omnis.

Again, Blumlein Pairs are a wonderful (I said wonderful) way to go to record stereo tracks, and the Royers should do this extremely well. My two mics were very closely matched in terms of both level and response (about 0.5 dB).

I would be very happy using the Royer for voice (spoken and sung) and for a variety of overdub applications. Royer's sales VP, John Jennings, notes that a number of users are really tickled by how well it records guitar amps, and encounter no problems with high levels. This doesn't surprise me. A Blumlein Pair for drum overheads would be killer. Also, I expect using such a pair about five feet above and in front of the harp of a grand piano with the lid off might be similarly stellar.

For much classical and acoustic recording, the Royer should prove to be excellent. Overall, this is a really nice, quite distinctive microphone. It may not be as "accurate" as some others (whatever "accuracy" means), but the Royer mic tells



The joy of measurements

When I measured the Royer mics for frequency response, I ran into a problem: my measurements didn't quite match the factory published response curve. Specifically, I found a deep notch in the response around 14 kHz.

After *much* head-scratching and trying to figure out how I'd screwed up the testing once again, I finally satisfied myself that the notch was probably really there, so I called up Royer to talk about it. They were friendly, helpful, open and concerned. Seems they had jobbed the formal measurement out to a lab with an anechoic chamber, and were perfectly happy with the results they got back (which they should have been).

Then I spent a lot *more* time trying to figure out what was really going on, including some reading, research and consulting with my personal favorite audio guru Neil Muncy.

My final conclusion is that there is a frequency (ca. 14 kHz) whose half-wavelength (.48 inches) makes it around to the back side of the ribbon and causes a very narrow null at that frequency (the response comes right up again, so that the output is almost as high at 17 kHz as it is at 12 kHz).

Now, this looks awful on a response plot. In fact, the audible effect is negligible for several reasons, and you shouldn't worry about it. First, we humans are comparatively insensitive to narrow resonances and notches due to the nature of the critical bands in our hearing. Second, the frequency involved is extremely high, and comparatively little energy is present there in most cases.

Third, because it is an interference effect occurring at the ribbon, the notch begins to go away as the angle of arrival of the sound goes off-axis. In actual production the notch is less critical than the on-axis measurement would make it appear.

What about the lab's anechoic measurement? I wasn't there, don't know how they set things up. I'm convinced the notch is there in anechoic space. Neil and I speculated that the sweep speed of the test oscillator, the writing speed of the chart recorder, and/or an octave smoothing function may have taken the notch out.

To test my thesis about the notch being inaudible (er, not significantly audible might be a better way of putting it), I dialed in a complementary peak on the Yamaha O2R eq and managed to pretty much smooth the notch out. Then I compared the sound of the mic with and without the notch. To my ears, listening to a variety of program sources, the notch just wasn't an issue.

So here's yet another case where we need to think through the meaning of what we are trying to measure. Ain't audio fun?

The joy of accuracy? Not!

How can it be that a mic sounds "better" than the source it is trying to record? If we think about recording in terms of accuracy of reproduction, such a concept is nonsensical. However, when we *carefully* think through what we're trying to accomplish, it makes a bit more sense.

Think of it this way: we're trying to coax music out of loudspeakers. An essential ingredient of music is tonal quality, and it is a very subjective ingredient. In the final analysis we really have to ask ourselves how "musical," how "beautiful," something sounds. Doesn't matter where it comes from. Doesn't matter how accurate it is. Just "how beautiful."

So in this case the Royer plus my loudspeakers combined to yield a subjective tonal quality that I preferred, slightly and unscientifically, in comparison with the original sound sources I studied. This is pretty fuzzy, of course, and you might not find the same thing to be true (you aren't me, of course, and you aren't using my loudspeakers).

Nonetheless, the observation suggests that there is something pretty special going on with these microphones. They manage to yield a very beautiful and convincing tonal quality that is distinctly (if subtly) different than what other microphones yield. And it is entirely possible that you may find it as attractive as I do. Time will tell.