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Subject: Re: Midrange horn shape in Pi cornerhorn  
Posted by [Wayne Parham](#) on Mon, 17 Dec 2012 15:09:48 GMT  
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The midhorn flare profile is conical, which is straight-sided and is the best shape for a spherical wave. Since the midrange driver and its cone shape/features are acoustically small at the wavelengths it is used at, it acts as a point source so its radiation pattern is spherical. If it were used in free space, its radiation would be omnidirectional, but the midhorn constrains the radiation angle to a spherical section that matches the wall angle.

The midhorn is also acoustically close to the room corner at the low end of its passband, which acts something like an extension to the flare at the lowest frequencies. And of course, the corner is the waveguide for the midbass too, providing directivity control from the Schroeder frequency upwards.

Speaker placement and wavefront launch This is a little different than a compression driver, which generates a plane wave. Since the output of a compression driver is a plane wave, it needs a curved transition region to bend the plane wave into a spherical wave section. The oblate spheroidal flare profile provides this interface.

The reason a compression driver generates a plane wave is because it has a phase plug. The phase plug has a large number of small slots that direct the sound through it and maintain consistent path-length distance to provide a planar wavefront. So to work with this plane wave, the tweeter horn flare profile is oblate spheroidal. But for a spherical wave, you want conical, which is what the midhorn is.

There is a comparison of the cross-section profiles of conical and oblate spheroidal flares in the following post:

Horn/Waveguide dimensions and beamwidth Drilling down further, down into the jot and tittle level, you'll find that neither the compression driver can produce a perfect plane wave nor the direct radiator (of any shape) can produce a perfect spherical wave. But they're close.

The driver with a phase plug produces a wavefront that most closely approximates a planar wave. Of course, this is largely determined by the number and position of slots in the phase plug, because it takes equal path lengths to produce a flat isophase wavefront across the exit aperture throughout the passband. For example, circumferential slots tend to have a single pronounced resonant mode that creates a notch at some frequency whereas radial slots tend to act more like a gradual drift away from their ability to maintain phase. There are combined approaches as well, having characteristics of each phase plug type. But in general, a compression driver with a phase plug produces a plane wave at its exit.

Likewise, the direct radiator produces a wavefront that most closely approximates a spherical wave, no matter what shape the diaphragm is, as long as it (or the aperture it is playing through) is acoustically small. That's why there are so many diaphragm shapes, from flat surfaces to straight cones to curvilinear cones to domes, inverted domes and even complex shapes that don't resemble any simple geometric shape. All produce spherical waves provided they are acoustically small. Even though the shapes are different, having different path lengths across their surface, as long as the the path length difference is less than a half-wavelength, it tends to

act like a point source making a spherical wavefront.