Subject: Basshorn or Transmission Line
Posted by Wayne Parham on Thu, 26 May 2005 20:10:16 GMT
View Forum Message <> Reply to Message

Are basshorns really horns or are they tuned pipes?

I've always considered bass horns to be resonant devices because of their size. Devices that are small enough to be portable resemble tuned pipes more than horns, in my opinion. A resonator is purely resistive at resonance. So is a horn in its passband, but over a greater bandwidth and for a different set of reasons.

I'm not sure it matters, since basshorns are usually only used for an octave or an octave and a half. But I wonder whether it is more appropriate to consider basshorns to be transmission lines or tuned pipes.

Typical basshorn acoustic impedance and response

Below 100Hz, impedance shown above is highly reactive. It acts very much like a tuned pipe.

Subject: Re: Basshorn or Transmission Line
Posted by Bill Wassilak on Fri, 27 May 2005 14:15:42 GMT
View Forum Message <> Reply to Message

Man yer opening up a can of worms, My opinon like it matters is, there closer to tuned pipes than transmission lines but they have the properties of both because of the masses involved. How's that for general anser.

Subject: Re: Basshorn or Transmission Line
Posted by Wayne Parham on Fri, 27 May 2005 16:03:37 GMT
View Forum Message <> Reply to Message

I think this question only opens a can of worms if there are egos involved or people are emotionally charged, or both. But that's why I asked it here. I'd like to kick this around in the right atmosphere.It doesn't really matter if a basshorn is really a tuned pipe, because it is just a label. It's just a matter of semantics. But it might be useful when looking at one way instead of another for critical analysis.I've often said that most basshorns are too small to be true horns. I've observed that the reactance measurements show them to act like tuned pipes in the region they're used in. The mouth area is small, and the impedance curve is peaky. It just looks more like a resonator than a horn to me.Maybe this feature should be embraced. Maybe when the device must be made physically small, the best approach would be to try to align the system like a tapered pipe, where driver position in the line is used to set standing wave modes for smoothest response. Seems like a good idea to me.

Subject: Re: Basshorn or Transmission Line
Posted by Tom Danley on Sat, 28 May 2005 14:04:24 GMT
View Forum Message <> Reply to Message

Hi WayneOne way to look at this (I believe) is that all horns are based on resonant operation.If one looks at the formula's that predict the response, the difference between a pipe and a horn is in the end area's being different.It is the resistance at each end (radiation at one end, the driver source resistance at the other) sets the "Q" for the resonance, just like how the ratio of reactance's to resistance governs the "Q" of electrical resonators.If one has an ideal situation at each end, then the "Q" is low, the structure combines and the resonant structure is invisible (and just like resonant electrical impedance matchers in RF, it appears to be an impedance transformer).On the other hand, the fact that the horn is a resonator (I think) can be seen even in a "full size" horn in that even when the mouth is optimally large, one finds there is a throat reactance (negative capacitance) remaining at the low cutoff. Reactance annulling is choosing a positive capacitance (driver and back volume total compliance) that cancels the negative capacitance of the horn extending the low cutoff by making the system "resistive" for a greater range..Additionally like some wide band radio antenna's, the horn is a "flexible" resonator in that it's acoustic lengths self adjust once one is above the low cutoff. A Biconical or Conical antenna (with a ground plane) is such a device for example, it can present a very even electrical load (for an antenna) for a considerable bandwidth once above its low cutoff (also a dimension governed thing).The impedance transformation part of the horn ends (for what ever frequency) about where the horn area is about 1 wl in circumference although the portion that follows afterward does ultimately define directivity.Also, one finds the efficient range of operation for a horn is when the path length is ½ wl or more.This is because the driver sitting at one end, is at the velocity minimum at a ¼ wl resonance. The Back EMF which produces the increased resistive electrical impedance when horn loaded, requires radiator motion, when the horn is ½ wl long, it has a velocity maximum at both ends.It is interesting to note (and common practice) that when voltage driven, a horn can produce nominally flat or usable acoustic output over a much wider bandwidth than it can do so efficiently.That can be seen when one compares the acoustic power vs frequency to that dissipated in the VC due to I^2 *R heating, the ratio of which defines efficiency.Well, I should get to house cleaning, its Saturday morning.ByeTom Danley

---

Subject: Re: Basshorn or Transmission Line
Posted by Wayne Parham on Sat, 28 May 2005 15:32:03 GMT
View Forum Message <> Reply to Message

That's the way I see it too. The thing that has always hung me up on basshorns is their size. I like horns, and use them wherever I can, given size and cost constraints, etc. But basshorns always have that resonant quality because of their size.The acoustic impedance of horns becomes resistive as frequency rises, but at low frequency, they are reactive. They appear to act more like tuned pipes down low, and even more so if the mouth is undersized such as is usually the case with basshorns. That, combined with the fact that a basshorn is usually crossed over before acoustic impedance becomes uniformly resistive, brings me to the conclusion that a basshorn acts more like a tuned pipe.One possible design approach is to embrace this instead of trying to overcome it. Some liken a horn to a wide band resonator anyway. There is nothing particularly wrong with resonance, that's what bass-reflex uses, it's what transmission lines use, pipe organs, etc. Instead of expecting the device to act like a horn, maybe it's more appropriate to see it like a transmission line or tapered pipe. That's definitely what the impedance curve suggests for the first octave or two.It might be interesting to design a hybrid, a device that acts something like a horn but that is tuned like a transmission line. Basshorns, because of their size in relation to wavelength, are really just that. Martin King has a series of spreadsheets at quarter-wave.com that allow a person to model a tuned pipe, to best know where to place the driver in the line to reduce unwanted pipe modes, and to prevent notches in response from standing wave cancellations in the passband. His spreadsheets might be useful when designing such a horn/line.

Subject: Pipes, tapered pipes and Helmholtz resonators
Posted by Wayne Parham on Thu, 22 Sep 2005 17:57:19 GMT
View Forum Message <> Reply to Message

We've had some discussions here about bass-reflex, tuned pipes, tapered pipes and horns, specifically about their similarities and differences. So I've taken a moment to put together a list of references from authors other than those that normally contribute here.Acoustics and Vibration Animations, list of articles and demonstration by Dr. Daniel RussellAcoustic High-Pass, Low-Pass, and Band-Stop Filters, Daniel Russell discusses propogation of sound through ducts, transmission lines and acoustic filter chambersSuperposition of Waves, shows the interaction of standing wavesRadiation from a Baffled Piston, shows the effects of frequency on directivityEvanescent Modes in Waveguides, shows higher order modes in ducts driven above and below their cutoff frequencyMass-Spring Systems with Damping, shows how system damping affects resonance amplitude, which in turn affects responseThe Forced Harmonic Oscillator, shows systems driven below resonance, at resonance and above resonanceCoupled Oscillators, shows two mass-spring systems, like the mechanical resonance of a loudspeaker and the acoustic resonance of the cabinetThe Dynamic Vibration Absorber, shows how two tuned systems can be optimized for working together. Think speaker and box.Vibrational Modes of a Circular Membrane, shows cone flex breakup modesHyperPhysics - Resonance, several links on the subjectHyperPhysics - Air Column Resonance, online calculator of open pipe, closed pipe and tapered pipe resonant modesHyperPhysics - Cavity Resonant Frequency, online calculator of Helmholtz resonant frequencyResonance, standing waves, & Eigentones, discussion of resonance and QMusical Acoustics - Some Introductory Pages, several links about matters acoustic from the University of New South WalesPipes and Harmonics, University of New South

Wales, compares closed cylinder pipes, open cylinder pipes and closed conical pipesHelmholtz Resonance, University of New South Wales, describes Helmholtz resonanceSound Waves and Music, several online lessons from the Physics ClassromResonance and Standing Waves, Physics ClassroomStanding Waves and Resonance, describes standing waves in mechanical, electrical and acoustic transmission linesResonata, a groovy applet

---

Subject: Re: Basshorn or Transmission Line
Posted by majestik6 on Mon, 17 Oct 2005 23:05:54 GMT
View Forum Message <> Reply to Message

Wayne,I wrote a paper on that, you might find it to be an interesting read. In the paper, I examine the behaviour you are describing using Mathcad.Johnhttp://home.comcast.net/~j.vanommen/speakers/Single_Reflex_Bandpass_vs_Front_Loaded_Horn.pdf
Is a horn a bandpass?

Subject: Re: Basshorn or Transmission Line
Posted by Wayne Parham on Tue, 18 Oct 2005 02:26:55 GMT
View Forum Message <> Reply to Message

That's a very interesting study. Thanks for posting it.Martin King's spreadsheets are very useful, aren't they? They're an excellent tool for doing exactly what you did. There are some people that cannot fathom the concepts you've presented here, but I've walked the same path you have, and come to similar conclusions. I think it's safe to say that Martin has too.

Subject: Re: Basshorn or Transmission Line
Posted by Paul C. on Sat, 15 Apr 2006 19:56:56 GMT
View Forum Message <> Reply to Message

So, the old scoop, aka rear loaded horn... it's both a transmission line AND a horn.With a transmission line you will get a wavy response because at some frequencies the wave at the port is in phase with the direct wave from the woofer, reinforcing and causing a peak. At other frequencies the port wave is out of phase, causing a dip.With a transmission line the line can be stuffed with wool or other absorbing material, forming a low pass filter, and killing off the wavies at higher freqencies... leaving only the reinforcing waves in the DESIRED passband down in the bass region where it is needed. The same can be done with a "scoop" enclosure.

Subject: Re: Pipes, tapered pipes and Helmholtz resonators
Posted by Paul C. on Sat, 15 Apr 2006 20:08:09 GMT
View Forum Message <> Reply to Message

Wayne, did I send you a disk of Arthur Benade's papers? Benade was a physicist and clarinetist. He modeled the clarinet, a cylindrical pipe. All the math, graphs, the works. Some of this applies to speakers, just sub a driver for a mouthpiece/reed.http://www.vcisinc.com/acoustics.htmhttp://ccrma.stanford.edu/marl/Benade/BenadeHome.htmlhttp://ccrma.stanford.edu/marl/http://www.astro.cf.ac.uk/groups/acoucomp/TeacherUpdate.htmlhttp://www.music.mcgill.ca/~gary/papers.html

---

Subject: Re: Pipes, tapered pipes and Helmholtz resonators
Posted by Wayne Parham on Tue, 13 Mar 2007 05:28:16 GMT
View Forum Message <> Reply to Message

Here's another link with additional information. The document basically describes, among other things, the effects on standing wave nodes in a pipe of constant taper, when the taper rate is perturbed with expansions and/or contractions along its path. In other words, with this formula, you can now add growth or squish areas in a horn or transmission line to modify standing wave nodes.One can modify driver parameters, driver position, throat area and position, rate of expansion, mouth area and position and now also expansion or contraction chambers along the path as configurable parameters to optimize horn/line response. One might incorporate growth or squish areas with folds, since maintaining a constant expansion through a fold is difficult anyhow. Acoustical Klein-Gordon Equation