Subject: Golden ratio for loudspeaker cabinets
Posted by 3dfreak on Mon, 11 Oct 2010 04:49:12 GMT
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A source on building a speaker box mentions a "golden ratio." This ratio accordingly has been there since ancient times. It's stated as "0.62 : 1 : 1.62"

Can anyone help me understand what this means as far as audio boxes are concerned?

Subject: Re: Golden ratio for loudspeaker cabinets
Posted by Adveser on Mon, 11 Oct 2010 05:22:09 GMT
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not really, but I can tell you that the golden ratio draws an infinite spiral and therefore, I would guess that the speaker box using similar dimensions will trap a sound wave by it losing its power vs the amount of distant it has to travel (which depending on the scale and the scope could be hundreds of feet deep)

It could be amplifying or reflecting frequencies using the golden ratio just as easily.

Essentially, what the Golden Ratio represents is the fact that if you draw a box and draw another box the same dimensions inside the box, you can keep going forever. You can connect the points of the rectangles and it will draw the spiral of a seashell, which is what galaxies, DNA, sound waves and virtually everything on some level is based on.

I really don't know much about the subject as it pertains to building a speaker enclosure, but I think I see where they are going with that. I'd be interested in what they are doing with it.

Subject: Re: Golden ratio for loudspeaker cabinets
Posted by Wayne Parham on Mon, 11 Oct 2010 20:09:51 GMT
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The suggestion to use Golden Rule dimensions is intended to break up internal standing waves so a dominant mode doesn't emerge, having harmonics repeated in more than one dimension. The idea is to use approximately Golden Rule proportions for height, width and depth of a sealed or vented box. I say approximately, because I find that ratios from 1.5 to 1.7 work just as well as the exact golden rule value of 1.618-to-1.

It's a good idea in general, but it is also important to realize that the distances between internal boundaries and the driver (and port, if vented) are important too. So while it's a good place to start - an inital "blind" estimate - if the cabinet is large, it's probably safer to verify by measurements. There are some cases when Golden Ratio proportions don't work, or at least, not when the ratio is the only thing that is considered.

Note that this really only applies to full range "main" loudspeakers and isn't an issue in subwoofer

more. So if the woofer is going to pass some lower midrange and the box is large enough for standing waves to develop inside, that's when you have to be concerned about them. A subwoofer in a relatively small box (less than about 10ft3), then standing waves aren't an issue.
Standing Waves

Subject: Re: Golden ratio for loudspeaker cabinets
Posted by 3dfreak on Tue, 12 Oct 2010 15:56:29 GMT
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Thanks Wayne and Adverser for your generous replies. These sound too technical to me at this point of my learning. But I think I get the point of getting concerned about this only in main loudspeakers.

Would you mind going with me through some details a little bit so I can see how the Golden Ratio applies? If for instance I fashion a main speaker to have the dimensions of 15 in wide and 40 in tall:
1. What should the ideal depth be?
2. What should the dimensions of the back panel be?

Subject: Re: Golden ratio for loudspeaker cabinets
Posted by Wayne Parham on Tue, 12 Oct 2010 16:12:20 GMT
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Well, 15" wide and 40" tall is a ratio of 2.667-to-1, not 1.618-to-1 or even close. Not that this is necessarily bad but at 40", you'll definitely want to analyze internal standing waves. There will be pipe modes in the passband, if this is a full range speaker. Depending on what you're trying to do, that may or may not be a good thing. For instance, transmission lines depend on them. But it is something you'll need to explore for best performance.

Subject: Re: Golden ratio for loudspeaker cabinets
Posted by 3dfreak on Wed, 13 Oct 2010 09:20:02 GMT
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Alright, now I think I'm getting it. At 15" width, optimum height, based on the Golden Ratio, should be around 25-1/2".
1. How would we calculate depth at this point?
2. Would the back panel be of the same dimensions as the front?

I ask Question #2 because the article I read mentions that sides should ideally be not parallel to each other to avoid bouncing waves within the box. But it didn't discuss anything beyond that.

Subject: Re: Golden ratio for loudspeaker cabinets
Posted by Wayne Parham on Wed, 13 Oct 2010 17:49:11 GMT
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Odd shapes help breakup standing waves, yes, much the same as the Golden Ratio proportions do. Both have the same goal. Internal damping from properly placed acoustic insulation helps a lot too.

You can make the height have 1.618-to-1 ratio to the width, and width be 1.618-to-1 with respect to depth. Or you can angle a panel. Or both. Just remember, though, that these are helpful hints, suggestions to put you in the ballpark, so to speak. You may still have a standing wave node that influences response even with Golden Ratio or trapezoidal box shape. For best results, you should measure the cabinet acoustically to be sure, making adjustments as necessary.

Subject: Re: Golden ratio for loudspeaker cabinets
Posted by Thatch on Thu, 22 Dec 2011 12:28:33 GMT
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If you look at a Nautilus shell it is a natural golden ratio spiral. There is a number sequence invented by an Italian guy in the 1500s based on the golden rule. It is very simple to do on paper, but building it is something else again. BWs Nautilus is probably a Golden Ratio speaker including how the tweeters mold into the top (Mids too?) in those bullet shaped baffleless molds. I think a lot of guys use it in placing drivers when doing mirrored baffles and don't know anything about the Golden Rule, which it also is called.
The Parthenon is full of Golden Ratios in the columns, sculptures, everything. The Greeks loved it. The Nautilus just is one. Go figure.
Thatch

Subject: Re: Golden ratio for loudspeaker cabinets
Posted by Wayne Parham on Thu, 22 Dec 2011 14:14:46 GMT
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The suggestion is to make height, width and depth in the ratios of 0.62 : 1 : 1.62.

I have found this to be aesthetically attractive, but of limited actual benefit in terms of acoustics. I mean, it doesn't hurt, but the truth is that internal standing waves can set up in a golden ratio box

just as easily as they do in any other shape.

Another belief is that trapezoidal cabinets and other non-parallel shapes will help. The belief, in each case, is that these shapes will "break up" standing waves, preventing two or more dimensions from being the same or multiples of one another.

The problem is that "breaking them up" isn't usually all that helpful. It only takes one to cause a big, ugly peak. And the truth is, that's what you usually see when there are problems - one peak, one axial mode, usually from the longest dimension. So it doesn't matter all that much what the other panel surfaces, dimensions or shapes are.

Speakers are either acoustically small (in which case standing waves don't matter) or they are acoustically large, in which case they do. Standing wave modes that fall in the upper midbas and lower midrange are the hardest to deal with because they are too low in frequency for the damping material to be effective.

The good news is all the tools available to DIYers these days make finding anomalies from standing waves pretty easy. If you build a box that creates a peak from internal standing waves, you can usually move the woofer and/or port and it will go away. You just have to keep them away from pressure modes.