Subject: Bass Horn with & without Rubber Throat
Posted by WithTarragon on Tue, 22 Apr 2008 16:08:58 GMT
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My current project involves building an exponential front loaded bass horn (Fc about 38 Hz). It will be bifurcated and folded and similar to the Klipsch designs. My reading has suggested that the "Rubber Throat" favored by Kipsch (initial rapid flare about 2.5 times the ultimate flare frequency) was done to reduce throat overload distortion. I have drawn out the flares of some Klipsch cabinets and I also learned that the rubber throat does NOT actually decrease the overall length/size of the cabinet (ie, the end of the initial section does NOT serve as the "throat" of the subsequent section). Although some folks may disagree with that second statement.In my application the levels will not be extreme (2-ch listening at home and the cabinets will be quite efficient to begin with). So my questions surround the issue of whether I need a rubber throat at all.1) Are there any known disadvantages to using a rubber throat?2)Has anyone actually a built front loaded cabinets with and without a rubber throat and measured any differences (esp distortion and output)?Thanks in advance

Subject: Re: Bass Horn with & without Rubber Throat
Posted by Wayne Parham on Tue, 22 Apr 2008 18:59:49 GMT
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I think those are very good questions worth studying. I would suggest trying your proposed basshorn with various throat features to see what the differences are. You can do this with computer models, making simulations of various versions of your horn and using the following program to predict response.
HornrespYou can expect very good correlation between predictions from Hornresp and actual measurements of a physical horn. I have made many Hornresp models and built physical models to test, and measurements match models very closely for basshorns.

Pay attention to response and excursion. As excursion rises, so will distortion. If you have high amplitude peaks above the passband, distortion will rise also. So watch those two things. You want a nice flat response curve with low ripple and smooth rolloff and you also want low excursion through the passband. Ideally, excursion would remain low down to the lower cutoff and then rise; However, basshorns are acoustically small so they get reactive down low and usually have an area where excurson rises in the passband. Just try to minimize this as much as possible.

You'll probably find that there are some instances where response ripple is reduced at the expense of a little bit of increased excursion. As long as excursion within the desired passband is less than driver Xmax, I would choose flatter response over lowest excursion. If the added excursion were high - say above 10% difference - then I might choose otherwise but if I can reduce ripple by 3dB and only increase excursion by 5%, I would probably choose the alignment that reduced ripple. Nice thing about Hornresp is it lets you try several conditions before building a physical model.

Model the horn you're thinking about building in Horresp and play around with different initial expansions. You can also try different front and rear chamber sizes. Once you find a model you like, you can build it with confidence that your physical horn built like your model describes will measure very close to what your predictions show.

Subject: Re: Bass Horn with & without Rubber Throat
Posted by WithTarragon on Tue, 22 Apr 2008 19:27:36 GMT
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Thanks for your thoughts. I am going through the Hornresp process, but I did not know whether it would be sensitive to rubber throat "issues". I will give it a try. When folks discuss rubber throats they usually refer to Olson's book where he offers suggested formulae for horns that are composed of multiple sections in a piece meal fashion (the end of the 1st section serves as the throat of the next section etc), but that is not actually what is going on in a rubber throat configuration. Conceptually I am wondering if the rubber throat section is acting like a chamber (after the throat) that happens to have a tapered flare). I believe that such chambers were sometimes used to effectively low pass filter the output. However I am going off-track in my speculations...Anyhow I will give it a shot.-Thanks

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Subject: Re: Bass Horn with & without Rubber Throat
Posted by Wayne Parham on Tue, 22 Apr 2008 20:10:20 GMT
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It doesn't really matter how you conceptualize the taper for Hornresp to model it accurately. As long as the horn can be described within the constraints of Hornresp, you will get a good prediction of performance. As an example, you can enter a schematic of a pipe with more flare in the first section than the second. You could even model a horn with negative flare in the first section. This would be similar to a horn with two front chambers, the one between cone and throat and a second from throat to restriction through negative flare. So there are many shapes that can be described with Hornresp beyond the usual simple shapes.

Subject: Re: Bass Horn with & without Rubber Throat
Posted by DMoore on Thu, 24 Apr 2008 03:31:01 GMT
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I think that it was Paul Klipsch who coined the phrase "rubber throat", but I could be wrong.First, all horns are simply acoustic impedance transformers by nature, even in short sections. They can

be designed to increase or decrease the impedance by flare rate and channel volume/cross-section between sections of the horn. The use of a differing flare rate (from the rest of the horn) section of horn AT THE THROAT is referred to as PWK called it a "rubber" throat, implying that it changes its impedance based on frequency, another characteristic of any horn. In this case, it is the horn throat section. Having such a throat horn section allows for greater control over the overall efficiency, distortion characteristics, and operational bandwidth of the horn, along with allowing for the desired selection of the throat cavity opening size (the main determiner of throat reactance as far as the driver is concerned). This allows for the "targeting" of a particular crossover point, a desired crossover slope, a particular driver, etc.The "rubber" throat is a method used to transfer or alter acoustic impedance. It is typically used to LESSEN the throat reactance experienced by the driver by employing a more rapid flare rate than the subsequent horn sections which usually use a less rapid flare (lower Fc) rate. I think the so-called "rubber" effect is a misnomer.The throat of rapid flare compared to the rest of the horn does not act as a chamber, it is a full-fledged horn (section) in its own right and operates exactly the way a "normal" horn does, and it will NOT effect the overall low Fc of the horn within reason, of course(that is determined by the terminal section of the horn).The goal (usually) is to provide a reduced (i.e., less acoustically restrictive) throat cavity opening/throat cross-section as compared to a single-flare rate horn of a lower Fc, yet retain the overall low Fc of the horn.Therefore, a wider operational bandpass with lower distortion is made possible by the "rubber" throat when the acoustic impedance is smoothly transfered between the differing sections. Take note that PWK typically used folds for his impedance matching, often associated with non-expanding "pipe" sections to achieve an adequate impedance match between the different flare sections. The Khorn, LaScala, and Jubilee all use different flare rates throughout. The LS is an interesting standout in that it uses a 60 Hz flare throat section and a 125 Hz terminal (mouth) section for an overall Fc of approx. 70 Hz.Not the usual configuration, and was likely done to allow the use of the same driver, throat opening, and crossover/slope as the Khorn, an economic decision, I presume.DM

Subject: Re: Bass Horn with & without Rubber Throat
Posted by WithTarragon on Thu, 24 Apr 2008 19:35:58 GMT
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Thanks for the replies. I was working with Hornresp last night and will try a fuller model tomorrow. DM: I understand the technique as a way for reducing throat overload distortion. However for home listening I am assuming the drivers are not being driven very hard to begin with. That is why I was wondering about the necessity of the initial rapid flare (rubber throat). You did mention a non-expanding pipe section. That is interesting, since such a section is found immediately after the rubber throat in the the Delgado & Klipsch article (JAES, 2000).I had always assumed that was weak point in the design (the Jubilee) since 4 parallel walls (for about 5 inches after the radius reflector) would create standing waves. I had further assumed this "convenience" was considered too short to have an appreciable decrement.

Subject: Re: Bass Horn with & without Rubber Throat

Posted by DMoore on Fri, 25 Apr 2008 02:45:52 GMT
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In the case of the LS/Belle (and Jubilee) I figure that the non-expanding column was just a device to transfer impedance 1:1 (discounting losses due to viscosity) existing so that the driver had lateral room enough to be extracted from the back chamber. The Khorn definitely DOESN'T have a non-expanding column in its pathway, and it, too, changes flare rates, so there is ample room for doubt. I just brought it up for discussion purposes. Just something to think about. The flare changes at the folds make sense though, easiest to accomplish. The parallel wall cross-section lengths of the non-expanding channels are far too short to be much of a sub-multiple of the wavelengths being produced, so standing waves are highly unlikely, rather it is just an approx. 1:1 impedance transfer conduit over a short distance for strictly practical reasons, IMO.DM

Subject: Re: Bass Horn with & without Rubber Throat
Posted by The Irishman on Mon, 28 Apr 2008 07:40:30 GMT
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If I recall correctly Bruce Edgar wrote two articles/analyses for Speaker Builder on the Rubber Throat concept. The first was substantially upset by the second in which he discussed a more advanced understanding of the implications of the math.Look at 1990 back-issues
Speaker Builder Back Issues

Subject: Re: Bass Horn with & without Rubber Throat
Posted by WithTarragon on Mon, 28 Apr 2008 18:38:49 GMT
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Thanks. The Edgar articles pertained to the throat size. The rubber throat is a confusing term since it really is not about the throat but rather the initial portion of the flare immediately after the throat. In this case a rapid flare just after the throat.