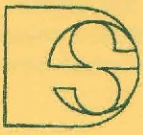

The

DALESFORD SPEAKER BOOK

by

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The loudspeaker designs in this book enable the home constructor to take advantage of the benefits offered by the use of bextrene-coned bass drive units coupled with the extended response and wide dispersion available from the latest generation of dome treble units.

The cone of a loudspeaker needs to (1) be as light as possible to respond quickly and accurately to the signal fed to it (good transient response), (2) be as rigid as possible so that the whole cone acts like a piston and does not deform under load and (3) be as acoustically dense as possible.

Number (1) is obviously at variance with numbers (2) and (3)! Number (3) is necessary (in acoustic suspension, infinite baffle and bass reflex designs) because a speaker drive unit generates sound from the back of the cone as well as from the front – but 180° out of phase. This sound from the rear of the cone is reflected between the internal surfaces of the speaker enclosure and inevitably strikes the rear of the cone again. Some sound penetrates the cone ("echo effect") and adds an unwanted component to the sound produced.

Bextrene effectively absorbs this sound energy and prevents the out of phase sound penetrating the cone. Bextrene is also light in weight and does not deform easily. All of which makes Bextrene an excellent cone material.

In bass-reflex designs the sound from the rear of the cone is used to augment the low frequency output of the speaker to improve the bass response. This is done by designing the cabinet and reflex port so that the sound output from the port is in phase with the sound generated from the front of the cone at low frequencies where the natural output of the speaker is falling off, thereby giving a more extended response than one would expect from a cabinet of that size.

The difference between, say, one amplifier and another in your chosen price bracket will be, generally speaking, subtle. The difference between speaker systems is much more obvious and this is an area where a wide choice is available to the home constructor and where considerable financial savings are possible. Alternatively, "Building your own" could give you a much better pair of speakers than you thought you could afford!

The loudspeaker probably has a greater influence on the enjoyment obtained from your HiFi system than any other single component.

Virtually all domestic HiFi requirements are covered by the loudspeaker designs in this book, with designs suitable for amplifiers of 10 – 100 watts per channel.

Cabinet construction is kept as simple as possible so that the DIY constructor can achieve optimum results with the simplest of tools.

Crossover network circuits are provided for the electronically minded. For the constructor whose interest is largely in the woodworking side of the project, completely assembled crossover networks are available.

The designed performance will only be achieved if the specified cabinet dimensions are adhered to and only the recommended acoustic absorbents used.

All the designs employ high density 18 mm chipboard which can be veneered or covered in plastic laminate to suit individual tastes.

Sufficient glue should be used to ensure that all cabinet joints are airtight.

The speaker drive units should not be fitted until the glue used in the cabinet construction is thoroughly dry – the fumes from some adhesives can adversely affect speaker cones.

Two of the designs have the drive units offset in the cabinet and can be made as "mirror-image" pairs. Normally, these will be positioned so that the treble units are towards the outside which widens the stereo image and also gives the treble sounds a greater distance to travel than the bass notes (this compensates for the fact that higher frequencies travel faster than lower ones). However, where domestic considerations dictate that the speakers are positioned too far apart for optimum results, it can be an advantage to have the treble units offset towards the *inside* to narrow the angle and give a more acceptable stereo image.

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Due to considerations of decor, and domestic harmony, the installation of most HiFi speakers is, at best, a compromise.

Some understanding of room acoustics can be a great help in obtaining the best results from your chosen speakers.

The listening environment has a profound influence on the sound quality apparent to the listener. Room size and shape, furnishing materials, siting of furniture etc. are all important.

Sound reverberates in any enclosed space, that is to say, it persists for a time after leaving the loudspeaker due to wall to wall and floor to ceiling reflections. Some energy is lost at each encounter with the reflecting surfaces until the sound becomes inaudible. However, at certain frequencies the sound will arrive back at the loudspeaker just at the right time to reinforce the loudspeaker output. This will happen when the total "there and back" path of the reflected sound is equal to one wavelength of the sound (or a multiple thereof). The sound arriving at the speaker will then be *in phase* with the speaker output. A *Standing wave* is then set up which persists as long as the speaker is producing that particular frequency.

The path followed by the reflected sound is determined by the room dimensions and there will be resonant frequencies for the length, height and width of the room. To find the lowest frequency resonance of any dimension we divide half the speed of sound in feet per second by the dimension in feet.

The speed of sound in air is affected by temperature and humidity. However, it will be accurate enough for our purpose to take this figure as 1120 feet per second. If your room is, say, 20 feet long, dividing this figure into 560 (half of 1120) will give a fundamental resonance of 28 Hz.

Acoustic problems occur when room dimensions are equal to, or are exact multiples of, one another. For example, a room 20 feet long × 10 feet wide × 10 feet high would have resonances on the 20 feet length of 28 Hz, 56 Hz, 84 Hz, 112 Hz etc. and on the width and height of 56, 112, 168, 224 etc. This means that, say, a 112 Hz note would be reinforced by reflections end to end, side to side and floor to ceiling in that room. The result would be an annoying emphasis on sounds close to that frequency and also, of course, on sounds close to 56 Hz and 224 Hz.

Above these low frequencies the resonances are not so widely spaced and therefore the sound reinforcement applies, for all practical purposes, to all frequencies and there is no unwanted reinforcement of particular notes. The room 20 feet × 10 feet × 10 feet is, of course, an extreme case.

Ideally, the resonant frequencies should be as evenly spaced as possible. This would be achieved if the ratios of height/width/length were 1/1.6/2.5 (3 metres × 4.8 metres × 7.5 metres).

The question is – if one has a room which produces an annoying acoustic effect, what can be done about it?

Problem resonances can be controlled to some degree by careful siting of the speakers.

If a speaker is situated near a point where the standing wave resonance has its maximum pressure, the speaker will excite that resonance most strongly. If the speaker is positioned where the standing wave resonance is at its minimum pressure the speaker will excite that resonance least effectively.

Moving a speaker quite a small distance will often have a marked effect on the apparent sound quality.

In a room with a fitted carpet which covers the entire floor and which is laid on underfelt or rubber underlay, there will be few problems from resonances in the floor/ceiling mode.

The sound absorption of the carpet will be high enough, even at low frequencies, to effectively damp the standing waves in this mode. Resonances in wall to wall modes are likely to be the troublesome ones and can be modified by use of heavy curtaining, room divider units, bookshelves, irregular surfaces of cork etc.

One particularly difficult problem arises when (a) the amplifier (or tape deck or turntable) produces mains hum *(50 Hz), (b) the speakers have good bass response and can reproduce 50 Hz sounds easily and (c) the room has a strong resonance around 50 Hz. Given this combination of circumstances, the hum must be cured at source! (Due to the pattern of the standing waves the hum will be very noticeable in some parts of the room and very much quieter in others.)

The size of the listening room inhibits the reproduction of sounds lower than the rooms lowest resonant frequency – it is no good expecting proper reproduction of a 32 foot organ pipe in a room 11 feet × 9 feet!

Where a loudspeaker is floor-standing, the output of bass notes is reinforced by sound reflected from the floor. Similarly, a further lift in bass response comes from the wall if the speaker is placed close to a side wall.

If optimum results are required it is worth while spending some time in experimenting with different loudspeaker positions. Sound quality is subjective – the final rule must be – if it sounds right – it is right.

*50Hz in Great Britain — 60Hz in certain other countries.