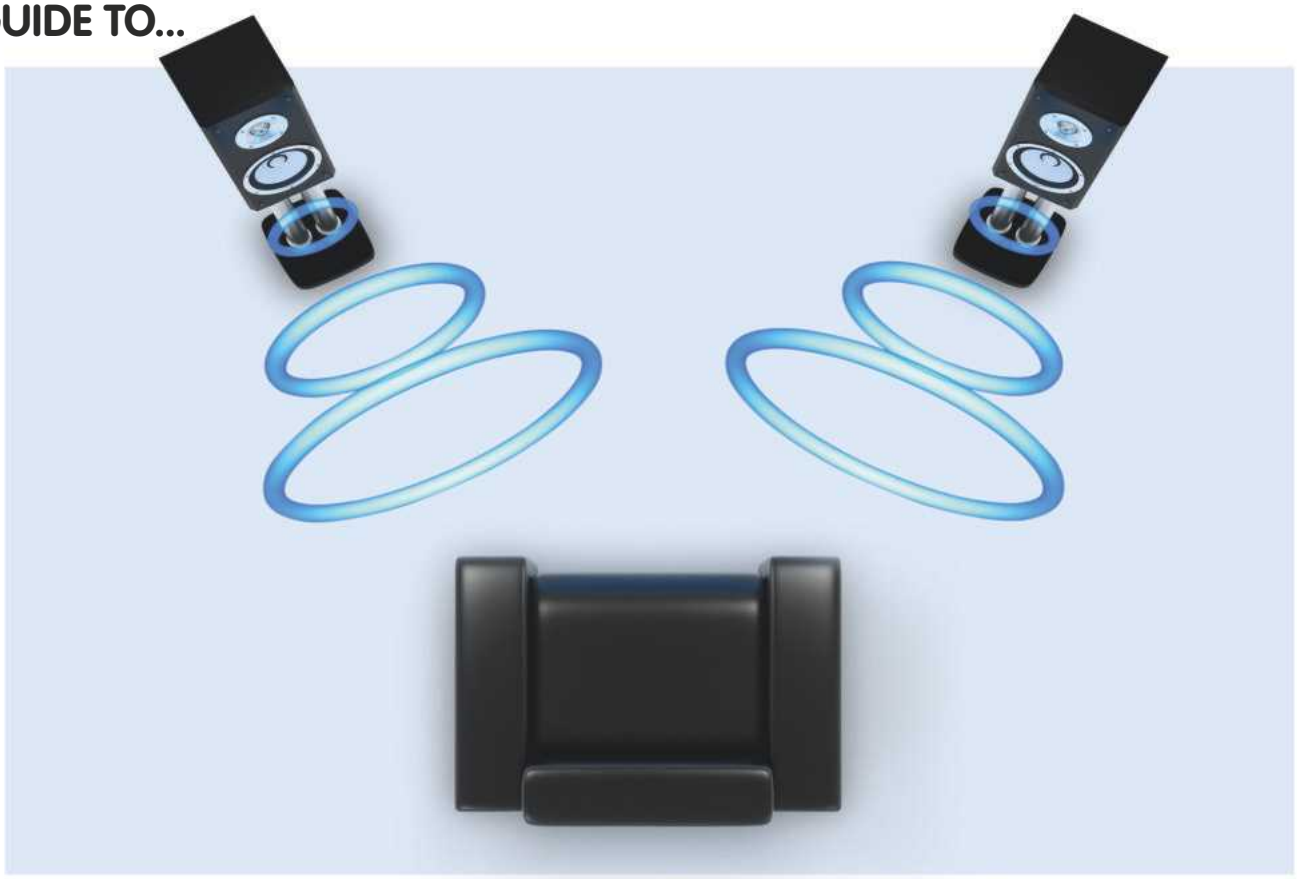


Tuning your listening room

The size, shape and construction of your room can have a big influence on the sound of your hi-fi. Here's how to get the best from it

When you have spent a lot of your hard-earned cash on your hi-fi system and paid careful attention to your mains supply, interconnect cables and loudspeakers, it is easy to overlook the last link in the audio chain terminating at your ears – the listening room!

There are, of course, many myths circulating concerning what you should do to your room to make it suitable for listening to your hi-fi. Some people say that you should aim to create what is essentially an anechoic chamber, ie a room where all sound reflections are completely absorbed by the surfaces. This does not address other issues like reverberations, rattles and other unwanted sounds. Indeed, we have also seen it written that you should consider enlarging your room as stretching the length of the walls and increasing the available space will lessen the effects of both reflections and reverberations. Clearly not a practical solution! Nor is it generally domestically acceptable to fix egg boxes to your ceiling, so that's not going to be a good idea either for diffusing resonances. What's more, they don't even do a good job of that!

Given that very few of us are likely to have a listening area the size of the Royal Albert Hall, we will limit discussions to cover issues that we consider to be both practical and suitable for the home environment. However, before we start to discuss solutions, let's first see what problems you are likely to encounter at home.

Music and movement

Let's first assume that, the signal flowing to your loudspeakers is about as perfect as possible and what you are trying to do is hear the music precisely the way that the recording engineer intended. Your loudspeakers now convert this perfect electrical signal into movements of air and this is where all the fun starts.

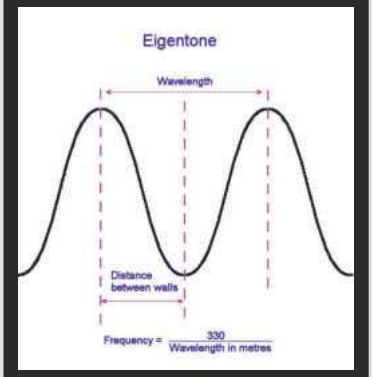
Sound waves are longitudinal waves, the result of the compression and rarefaction of air that occurs in the same direction as the direction of travel of the sound wave. The wave travels at a speed of 330m/s in air at normal temperature and pressure. This speed is an important parameter as this determines what room dimensions are likely to cause problems. The sound wave itself is transmitted by molecules of air vibrating at the audio frequencies that range from about 20Hz to 20kHz. It is, therefore, no surprise that these vibrations, apart from reaching your ears directly, can be reflected around the room and reach your ears a split second later, causing all sorts of undesirable effects. Furthermore, the vibrations can cause sympathetic rattles from the most unlikely of places. For example, listening to a splendid recording of

EIGENTONES

One of the main issues to address in any room are the natural peaks and troughs in sound caused by the room's Eigentones or standing waves.

The main frequencies amplified in rooms are those that have a wavelength that is twice that of the distance between the parallel surfaces of the walls, ceiling and floor. In a rectangular room, there are three main Eigentones, corresponding to the room's width, height and depth.

If you take a typical room with a floor-to-ceiling dimension of 2.4m and assume the speed of sound of 330m/s, the Eigentone of this is just under 70Hz, and a room of 5m in length will have an Eigentone at 33Hz. These are very much in the bass region so you can see why it is such an important



factor. This, and all the sub-harmonics will cause nasty peaks in the bass response if untamed by other factors.

If the Eigentones are causing problems, a well-designed bass trap can be the answer. Also, changing your listening position and speaker positions can help. If you are hearing a boomy bass, for example, try moving your chair forward or backwards a few tens of centimetres. You will be amazed at the difference!

Saint-Saëns' *Organ Symphony No. 3* we found that the sustained organ notes in the first movement produced a weird howling in sympathy in our listening room. Eventually we located the cause – the notes around 16Hz (we know, we measured them!) were causing sympathetic vibrations of the sash windows, even though the windows clamps had been tightened. The cure was simple – a few pieces of folded paper were wedged at strategic points in the side tracks of the windows and all was well.

Shake rattle and roll

So that brings us nicely to our first tip – check your room for rattles. Play some music that contains a good range of bass notes at a moderate level and walk around your room, listening for anything untoward. You may well be surprised by the culprits – a plate on a table, a picture on a wall or a scurrilous plant pot have all been known to jive noisily along to the music, in our experience.

Now that you've battened down the hatches, as it were, it is time to look at other issues. All rooms have naturally occurring resonances called room modes, standing waves or Eigentones. These Eigentones are one of the main causes of acoustic distortion below the fundamental frequency of the Eigentone and result in peaks and troughs in the frequency response. These can be as much as 20dB or more – but more about these later.

Some of these negative effects can be mitigated by good loudspeaker design. For example, these unwanted room resonances store energy and decay slowly compared to nearby frequencies causing audible problems such as 'one note bass' and 'boominess'. One of the many parameters involved in loudspeaker design (called Thiele-Small parameters, after Neville Thiele

Some manufacturers recommend a specific distance for speaker separation

and Richard Small from their work in the sixties and seventies) is the 'Q' factor. This is the name of the 'goodness' or 'magnification' factor by which resonance is magnified or attenuated by the loudspeaker. If the damping is too great, the system Q is low and a dead and thick sound will be the result. If there is not enough damping to control the Q resonance sufficiently, the sound will be boomy. A good loudspeaker will take the domestic environment into account and often have a Q factor of about 0.6 – 0.8. Obviously, some loudspeakers are better than others at this. Fans of transmission line speakers will know that the design is very good not only for controlling the loudspeaker's bass driver natural resonant frequency, but also for reinforcing frequency response below that resonant frequency and in a controlled manner so the room doesn't get too excited. So tip number two – choose your loudspeaker to suit your listening environment, if you can. If your supplier can offer a home trial, take full advantage of it.

OK – so you've already got your loudspeakers, but correct positioning of them is also extremely important. If you position the speakers too close to a wall, it will

One of GIK Acoutstic's free-standing acoustic panels

Q&A

Glenn Kuras
President, GIK Acoustics

HFC: Are there any simple tests you can do to identify trouble spots?
GK: There are two ways I would recommend. As we all know, rooms have mostly low-end problems and corners are the best way to deal with them. We have a pink noise file on our website (download at: gikacoustics.com/pink_noise.mp3) to test each corner to find which have the most bass problems. You play the file through your speakers and use a SPL meter to walk around the room to test each speaker. As you find areas that have the greatest build up you can place bass trapping there.

The other way to test the room is to use a program like Room EQ Wizard. This is more complicated, but will show you frequency response, decay times and so on. There is a video tutorial on our website: gikacoustics.co.uk/room-eq-wizard-tutorial/

Are there rules on where to place bass traps for maximum effect?
We always recommend trapping in all wall-to-wall corners, behind the speakers, and also corners in the back of the room. We've found that people often overlook the wall-to-floor and wall-to-ceiling corners, so we have a helpful article about all available corners: gikacoustics.co.uk/mounting-bass-traps-corners/.

What is the first thing to address when setting up your room?
The first thing is your listening spot. Whenever possible, we recommend facing the short wall in the room and sitting 38 percent from the front wall or 38 percent from the back wall. Your speakers should be equal distance from the side walls and you should try to avoid having openings on one side of your speakers and a closed area on the other. Symmetry from where you're sitting to the front wall is vital.

tend to reinforce the bass at particular frequencies – not a good thing! Obviously, having them too far away from the wall is impractical, but try to aim for at least 30cm as a starting point. Also, ensure that the distances of the speakers from the back walls and the side walls are different. If they are the same, the inevitable reflections from the back walls will tend to either reinforce or cancel the reflections from the sides, creating another potential source of peaks and troughs in frequency response. Another issue is the apparent soundstage depth. Increasing the distance from the speaker to the wall behind will increase depth, but this can have a detrimental effect on instrument focus. A trial and error approach will help determine the best positioning for your combination of room and loudspeakers.

Pay attention to your manufacturer's recommendations regarding which

Aim to have your ears at a similar height above the floor as your tweeters

speaker should be on the left and which on the right. Many designs place the tweeter off to one side in the cabinet and the speakers are often arranged so that each tweeter is on the outside edge for best image placement.

Toe-in the line

Another factor is what is termed 'toe-in' or how much the speakers are angled towards the listener. This is linked to the distance the speakers are set apart and some manufacturers recommend a specific distance for speaker separation. Use this as a starting point if your room size permits – increasing the distance between the speakers will widen the soundstage until, at some point, the centre image becomes more vague. Decreasing the separation will narrow the stage and increase centre focus. Aim for an even spread of instruments across the soundstage.

Just as important as speaker positioning, you need to be equidistant from both loudspeakers aiming to form an isosceles triangle with them. You may find that moving your position forwards or backwards will increase or decrease a particular bass response due to sound reflections and standing waves. Again, the best position will be determined by experimentation. Finally, as a general rule, aim to have your ears at a similar height above the floor as your tweeters.

Now, having got you and your speakers in the correct position, what can you do about room resonances?

A room's Eigentones are standing waves that occur between parallel surfaces as a result of the room's dimensions. These and other room resonances can be alleviated by careful positioning of furniture, like sofas and chairs. What you are trying to do is to avoid large areas of reflecting surfaces if at all possible.

Another approach that can be quite effective is to use acoustic panels from a reputable manufacturer. Such items are known as bass traps and, when used correctly, can be extremely effective at taming the most excitable of rooms and stop them from humming along to the music!

If your hi-fi is situated in the same room as your speakers, the sound can be fed back into the audio chain from your speakers. This is most obvious with record decks and it is important that these, along with your other items of audio equipment, are sited on isolation plinths to minimise this effect.

On reflection

Accurate image placement within the sound stage is compromised by reflected sounds. Direct sound from your loudspeakers is the first to arrive as it is the shortest path to your ears and, fortunately, your brain tends to use this to form a view about the positioning of an instrument. The Haas effect, also called the precedence effect, is a psychoacoustic effect described in 1949 by Helmut Haas. This states that when a sound is heard in both ears but arrives at different times, the brain localises it based upon the first arriving sound. This holds true if the subsequent (often reflected) sound arrives within 40 milliseconds of the first, even if the second sound is louder than the first. However, sound arriving later does tend to blur the image and, therefore, reflected sound should be minimised where possible. Here again, furniture and acoustic panels strategically placed can help with this – this is always a case of trial and error.

It is important to remember that room tuning is not an exact science as there are so many factors that have an effect. Of course, your listening room is likely to be one used for other purposes, such as a family or sitting room and, therefore, any changes you make to a room layout must also be domestically acceptable. The important thing to remember is that experimentation and a little common sense are the keys to success. Even an apparently small change in the speaker or listener positioning can have a huge effect and may even save you money if you are thinking of replacing your speakers to counteract a deficiency that is actually caused by your listening environment. Happy tweaking! ●

As with tuning an instrument, room tuning helps your hi-fi setup sing

ACOUSTIC TREATMENT MYTHS

As with many things in life, there are a lot of myths and 'cure-alls' out there that promise to fix all of your listening room ills. Here is a list of acoustic treatments that don't really cut the sonic mustard.

Fitting egg boxes to walls or ceilings
The origin of this myth comes from the similarity between the shape of the underside of an egg box and the pyramids and wedges that are affixed to walls of recording studios and anechoic chambers. This leads many people to think that their unused egg cartons would work in a similar fashion. In reality, they don't. The actual shapes and the material that they are made from are hugely important (for example, with the right choice of material, an anechoic chamber can be made to work for electromagnetic waves). Sadly, as an acoustic treatment, egg boxes will only absorb sounds – and they do that rather badly too!

Hanging rugs on the wall
All that a heavy wall covering will do is potentially tame high-frequency ringing and this will only be an issue if you plan to use a fully tiled bathroom as your listening area. In any case, vacuum-cleaning it will be a nightmare!

Shaped foam absorbers
There are many companies that offer acoustic foam absorbers and the like. Although foam does address some aspects of a room's acoustics, it does tend to be at the upper frequencies only and given that most people's problems will be to do with bass resonances, it's not going to be a great deal of help.

Installing and filling bookshelves
There is a view that a well-stocked bookshelf or bookcase will sort out room-induced nasties without looking out of place. In fact, the best they can do is absorb sounds generally, but they don't really address the problem frequencies. You would do far better to use proper proprietary bass traps.

NEXT MONTH: Guide to iTunes. How to get high-quality audio playback from Apple's music software.