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5 essential things to understand when setting up speakers

Course notes to accompany taught presentation

Rock-Tech Sound Training

www.rock-tech.co.uk | 01904 481700 | info@rock-tech.co.uk |

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Speaker Systems

5 Key Things to Learn for Setting up a Speaker System

Turn them off - Why switching my speakers off is the first thing to do

Turn them backwards - What actually comes out of my speakers

Point them sideways - Where should I point and position speakers

Go outside and shut the door - What happens to the sound, once its left my speakers

What is ‘loud enough?’ - Threshold of processing

Safety and rigging

How to measure your results scientifically

FAQ

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Why Switching off my speakers is the first thing to do

During sound check, switch off your main speakers and then LISTEN…

Apart from your speakers, what other things make noise in your venue?

- Heating and Air Conditioning
- Band
- People
- Other Nearby Venues
- Monitors

Can our speakers remove this noise?

Will it effect the finished sound?

> *"God, grant me the serenity to accept the things I cannot change, Courage to change the things I can, and wisdom to know the difference."* *Serenity Prayer, Reinhold Niebuhr*

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What actually comes out of my speakers?

Turn them around and listen to the back and the sides.

Compare two different top & sub speakers (similar size)

- What is the difference?
- How do we quantify this change?
- Very difficult to measure the sound ‘quality’ - listening and comparison is very important.

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Measuring Performance Speaker Performance

The most expensive speakers in the world can't defy the laws of physics

Lets have a look at the key 'technical parameters' that make up the 'sound' of a speaker.

- Frequency (Hz) - notes and tones, range (max and min).
- Time (mSec) - Transient response, instantaneous, phase, group delay
- Volume (dB) - continuous (or 'real life'), max peak (CF4 or +12dB)
- Direction (degrees) of the sound - polar pattern
- Generation
  - Harmonic - driver and cabinet resonance, nodes (mini room within a room)
  - Non harmonic - noise, buzz, digital conversion, etc.

Speakers are last in the chain, you can't 'fix the problem' once it's left the speaker… *Red writing means an unfixable distortion.

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Where should I point my speakers?

Note: Aiming for a worst case +/- 3dB variation throughout a room

Step 1. Decide if it's going to be a Stereo or Mono (Tops)

Narrow room: stereo

Wide room: mono

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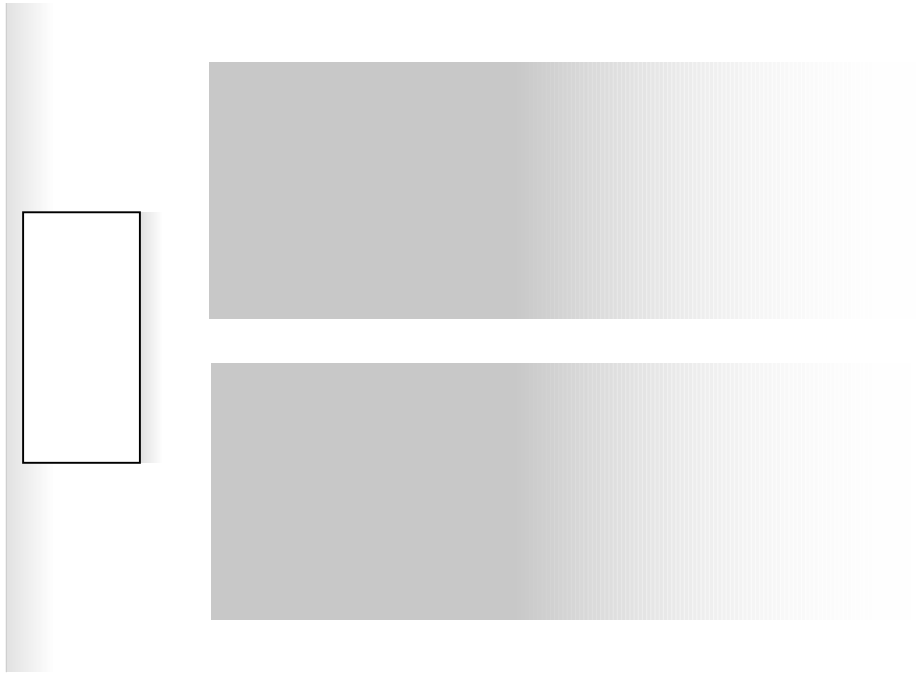

Narrow Room - Typically a Stereo System

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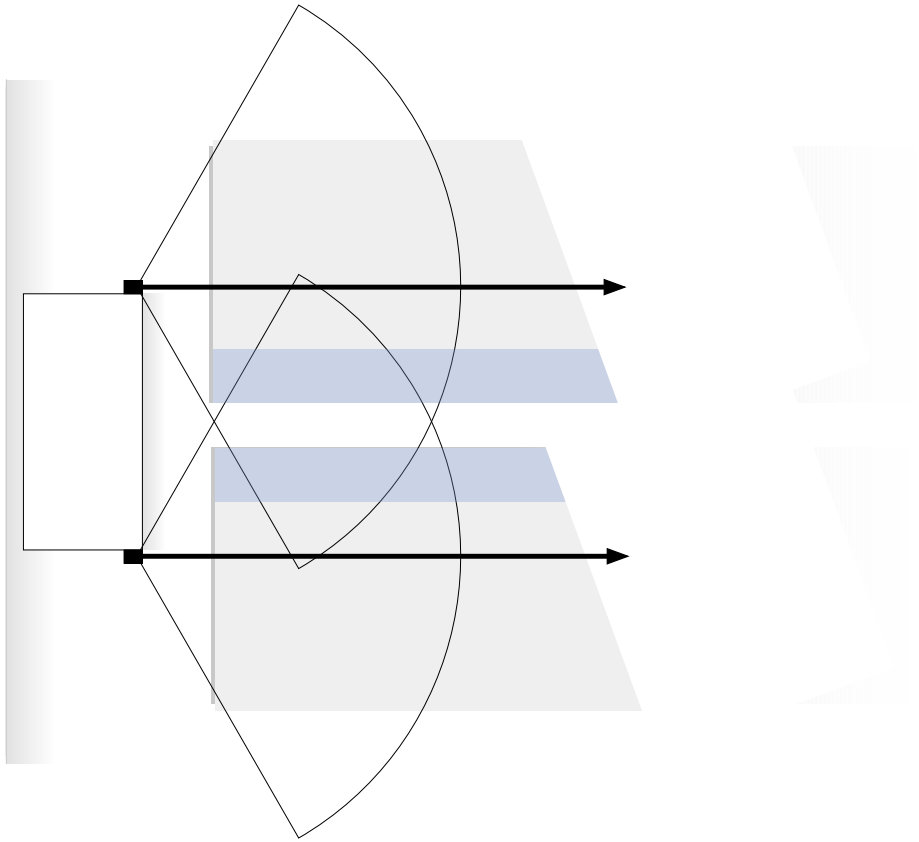

Narrow Room - Typically a Stereo System

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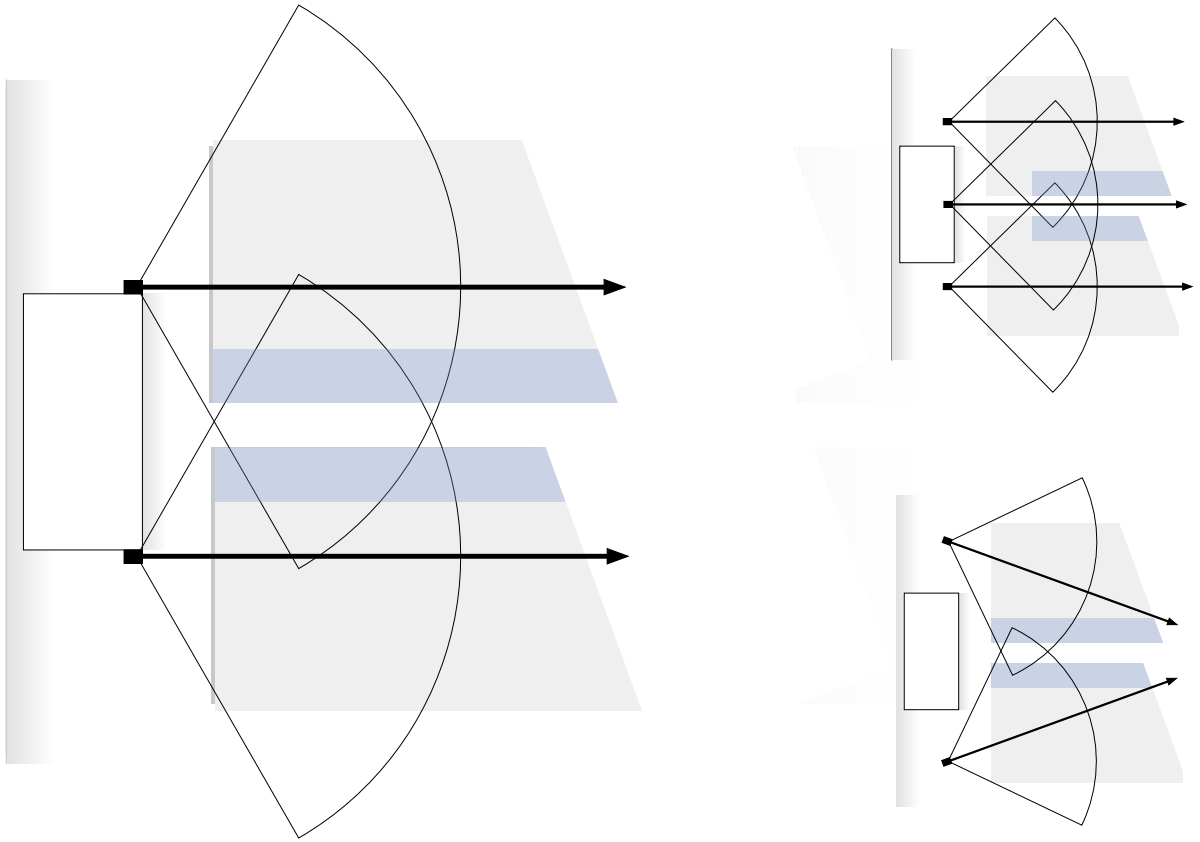

Narrow Room - Typically a Stereo System

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Wide Room - Typically a Mono System

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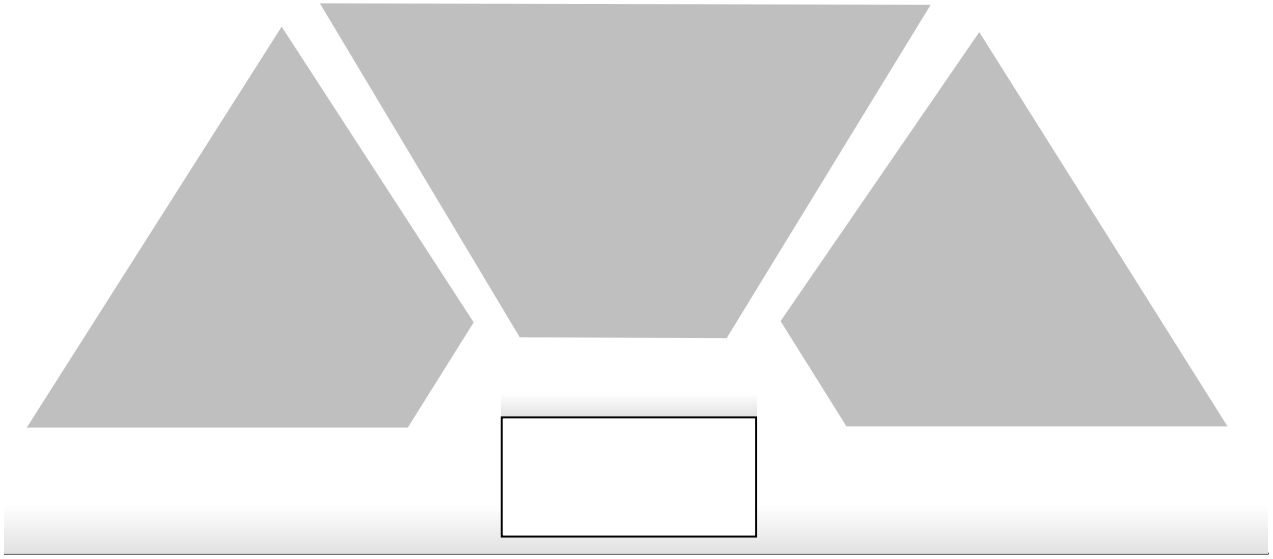

Wide Room - Typically a Mono System

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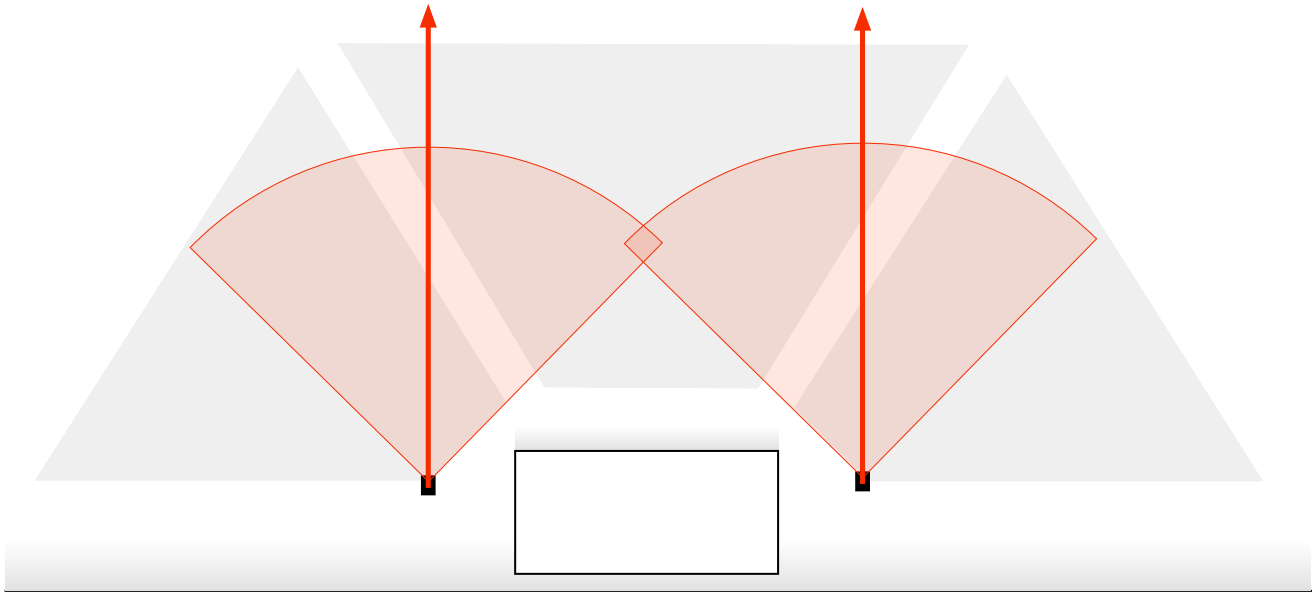

Wide Room - Typically a Mono System

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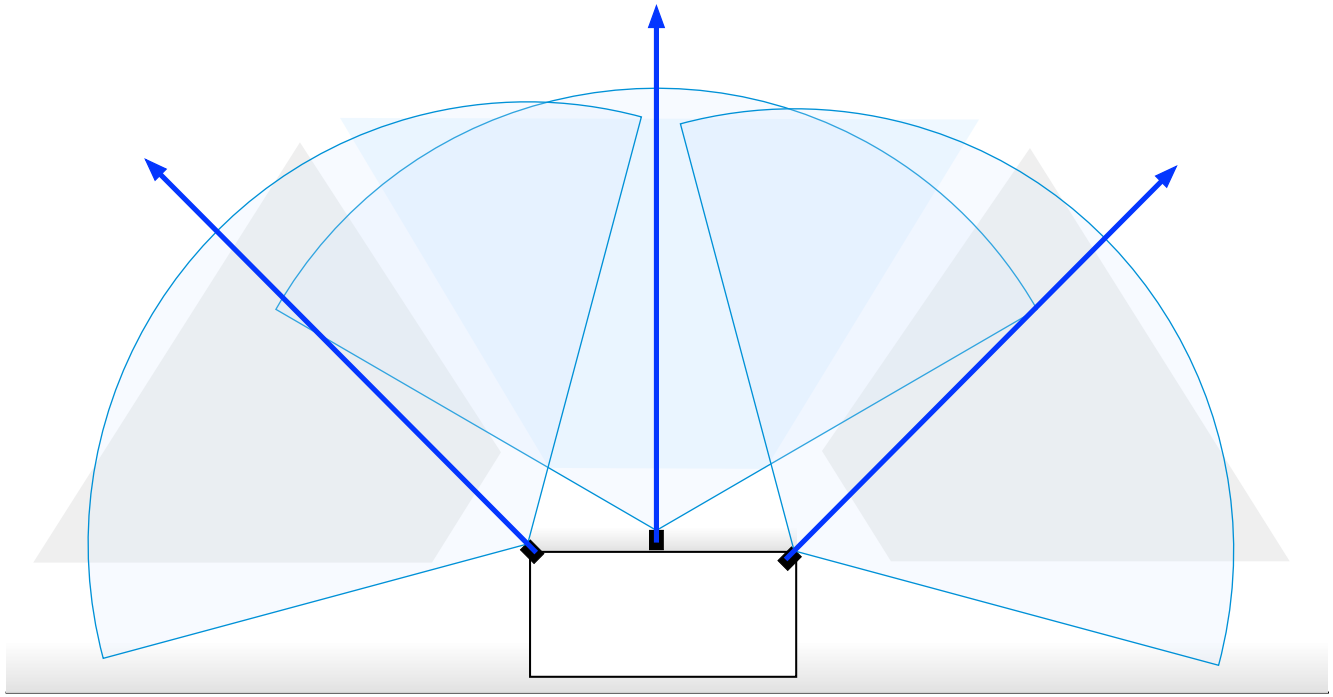

Wide Room - Typically a Mono System

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Step 2. Horizontally

- coverage across the width

A. Measure the on axis SPL (OnAx)

B. Measure the angle where the SPL is 6db quieter in the upper midrange 600-4000 (6dB Angle)

C. The ambition is to have the -6dB angle, pointing to the middle of the front row, and the on axis sound pointing to the centre of the seating zone.

D. The two overlapping speakers will then give you an reasonably even response across the room.

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Step 3. Vertically

- coverage across the Length of a space

Things to consider…

What are the main absorbers for your speaker system?

Are they even across the frequency spectrum?

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Step 3. Vertically

- coverage across the Length of a space

A. Measure the on axis SPL (OnAx)

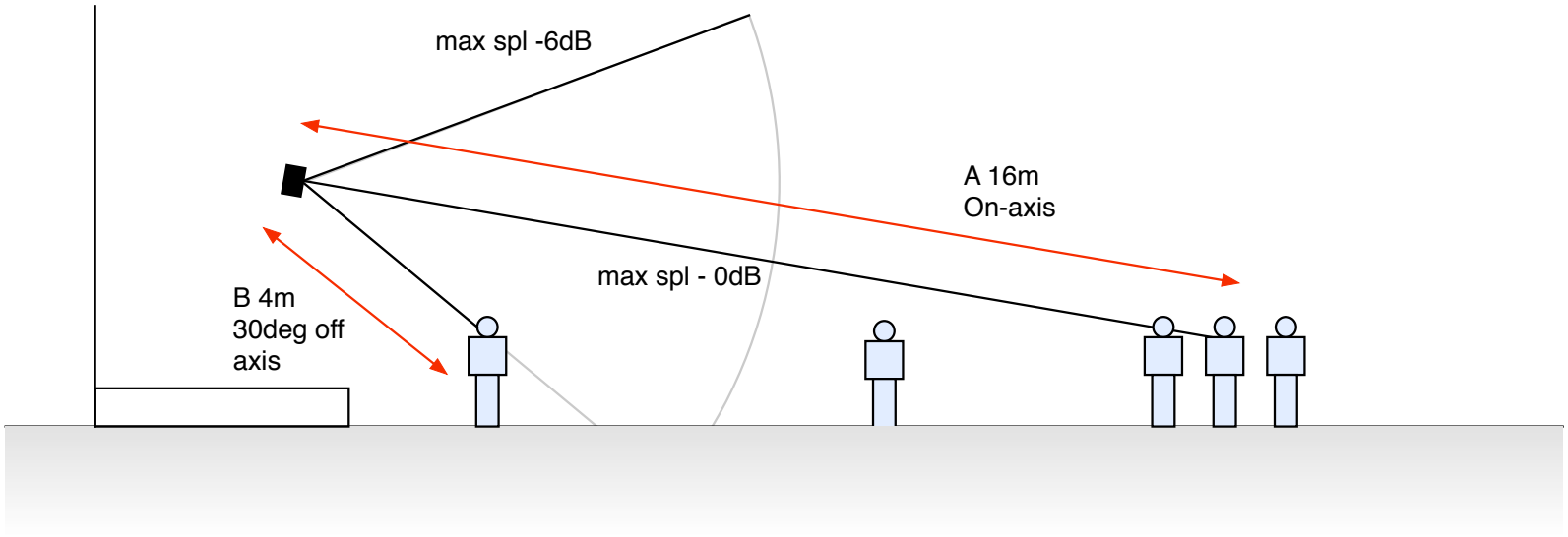
B. Measure the angle where the SPL is 6db quieter in the midrange 500-4000 (6dB Angle)

C. Point the Onaxis point of the speaker a few rows in from the back

D. Adjust the height (ensuring that it is above head height!) so that the front row receives the 6db down point, at roughly ¼ of the distance to the back.

E. This will give you a 6db difference front to back. (within our +/- 3db target)

F. If you have a much longer room then you may need additional speakers, either in an array or distributed. This will also enable you to optimise the Frequency response and average SPL.



Example placement of a speaker system
Only considering the vertical height and angle of the speaker

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Shut the door…

Overall speaker EQ can’t fix a room / instrument problem.

Example Kick Drum (instantaneous) & Bass Guitar (continuous)

Acoustic issues happen over time as well as in frequency.

If you go outside a room, open the door a crack so you can only see the speakers you will pretty much just hear the speaker system and not the reflections, the same kind of thing happens with a balcony.

This is the only bit of sound we can attempt to ‘control’ with our sound equipment.

Otherwise we need to fix our room acoustics.

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Basic Acoustic Treatments

Rear wall absorption

Stage absorption

Balanced diffusion (vocal) / absorption (bass) on ceiling and side walls

Try and remove or ‘break-up’ parallel flat surfaces

Even RT60

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We can come and give you an acoustic consultancy session

Example here - boomy bass. how to fix?

Do you have any acoustic problems?

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What is ‘loud enough’

A typical level for sound at a modern church is around 97dB A weighted.

Although there is no ‘correct’ level! and this may vary from 105dB to 85dB.

The A-Weighted, Slow setting on a normal Meter is our typical reference to measure this.

So how many speakers will we need?

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What is ‘loud enough’

Different types of dB…

Continuous

Max/Peak CF4

If we use a speaker that is under-powered what happens?

Processing automatically adjusts the sound (compression, dynamic eq (upto 20dB changes), things sound harsh)

Distortion and clipping from the amplifier and driver (things sound harsh)

We might damage the system

We need to spec a system that gives us enough headroom so that we don’t have to mix in that ‘unhelpful processing zone’.

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What is ‘loud enough’

How to calculate potential volume

we add up the ‘dBs’ for the number of speakers we have - 6dB per double the quantity if they are direct radiating and very close (i.e. Hill M10/M2 etc.) 3dB if they are seperated out

1 x Hill M10 = 136dB (at 1m)

2 x Hill M10 = 142dB (at 1m)

The 142 (dB) is the max instantaneous peak that the system can produce at its most efficient frequency.

The equivalent continuous figure (how we measure sound with a meter) is ~12dB less than that

So now we get 130dB

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What is ‘loud enough’

How to calculate potential volume

We then need to allow ourselves some headroom to ensure that no limiting or dynamic EQ affects our sound. On a Hill system we only need to allow 8dB for this (some systems need a further 18dB!!)

Then we look at our furthest distance for the speakers and reduce the volume by 6dB per doubling of the distance. So:

1m = 122dB, 2m = 116dB, 4m = 110dB, 8m = 104dB, 16m = 98dB.

So we know that 2 x M10s can deliver 98dB into a typical 16m church venue, with completely accurate, pure audio, and headroom to allow for any eventuality.

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Summary

5 Key Things to Learn for Setting up a Speaker System

Background noise - turn them off

Learn what comes out of your speakers - turn them around

Point the loudest part to the furthest away point

Optimise the room to maximise the direct sound

Use enough speakers to avoid processing - remember some systems use LOTS of processing to stop things from breaking! it doesn’t help us.