Comparison of Rectangular vs. Circular Horns

Content

Motivation 2
Amplitude Responses 3
Dispersion 4
Horizontal 4
Vertical 5
Diagonal 6
Result 7

Motivation

Horns and waveguides are usually designed with either a circular/oval mouth or a rectangular one. It is often claimed that rectangular horns do not radiate diagonally as equally as oval horns. In the following, BEM simulations with an ideal 1" piston will be used to investigate whether this is true and whether there are fundamental differences between these designs. The amplitude response at 0° and the radiation behavior are investigated.

The horizontal and vertical contours of both horns are identical. The contours have been roughly developed in such a way that a beam angle of approx. 80° x 60° is achieved over a larger frequency range. Extensive optimization where not performed.

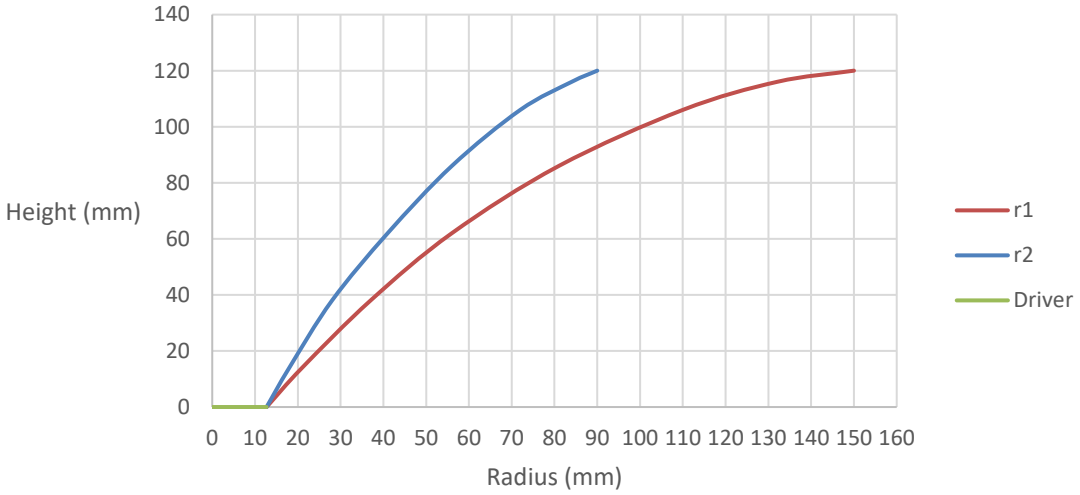


Illustration 1: Contours for Horizontal and Vertical

Dimensions:

- **Width: 30 cm**
- **Height: 18 cm**
- **Depth: 12 cm**

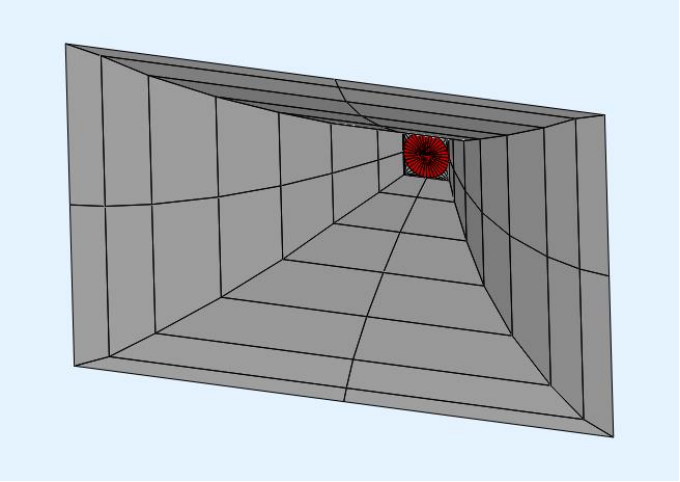


Illustration 2: Simulation of the rectangular contour

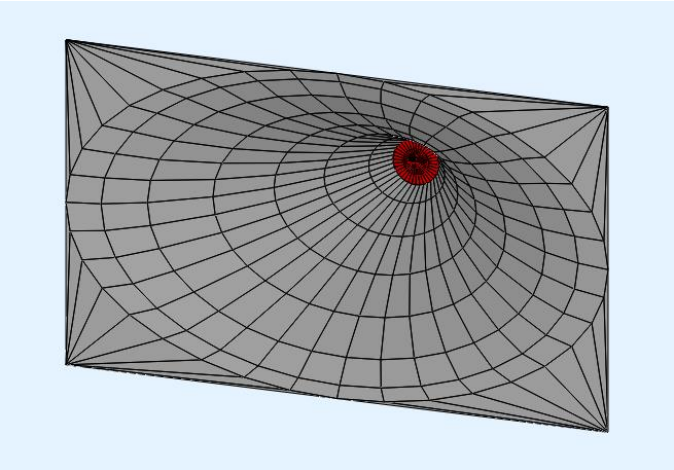
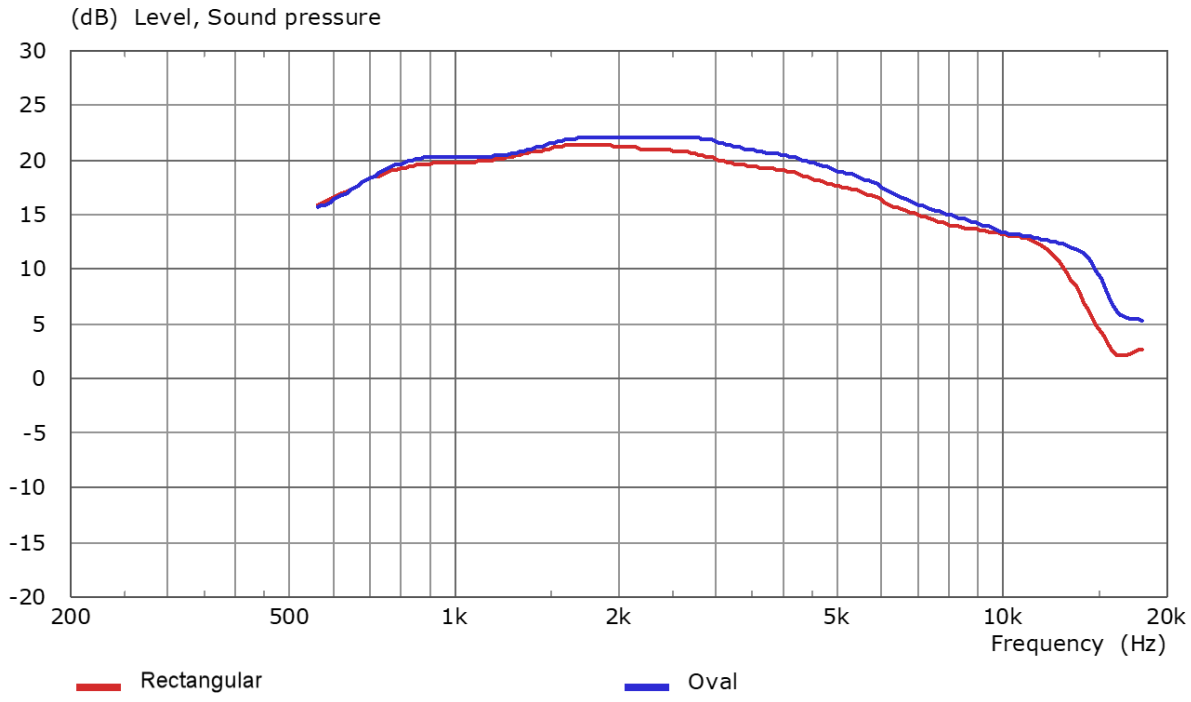


Illustration 3: Simulation of the oval contour

The simulation was performed with a resolution of 1/6 octave.

Amplitude Responses

Observation: the oval horn minimally amplifies the sound pressure level at 0° with identical contours.



Dispersion

Horizontal

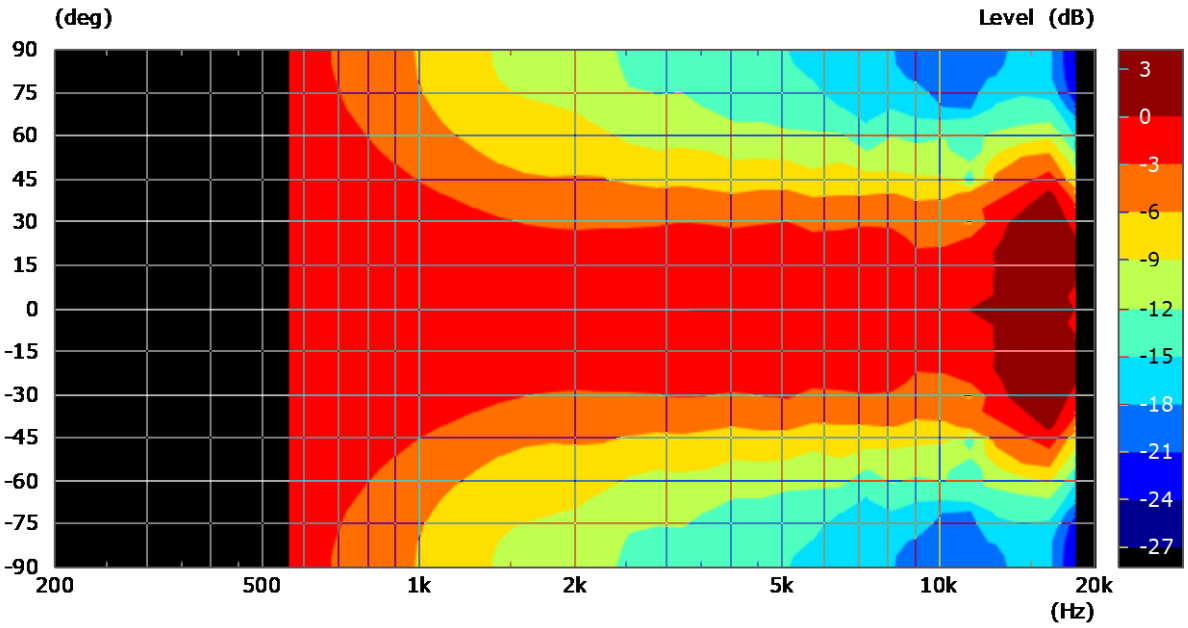


Illustration 4: Rectangular

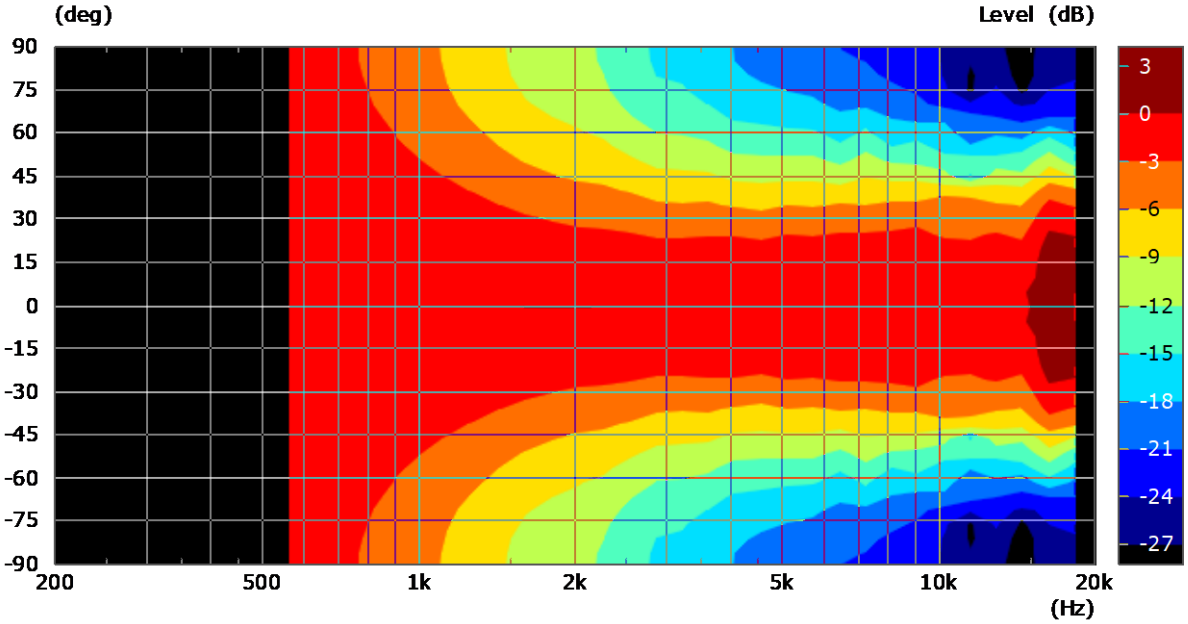


Illustration 5: Oval

Vertical

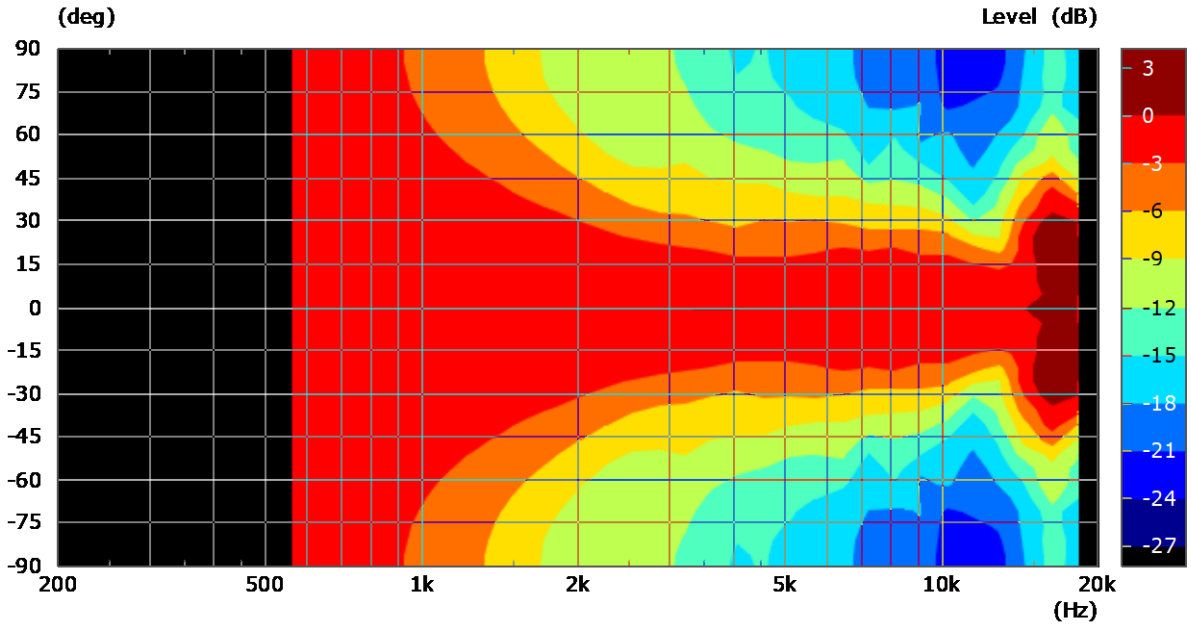


Illustration 6: Rectangular

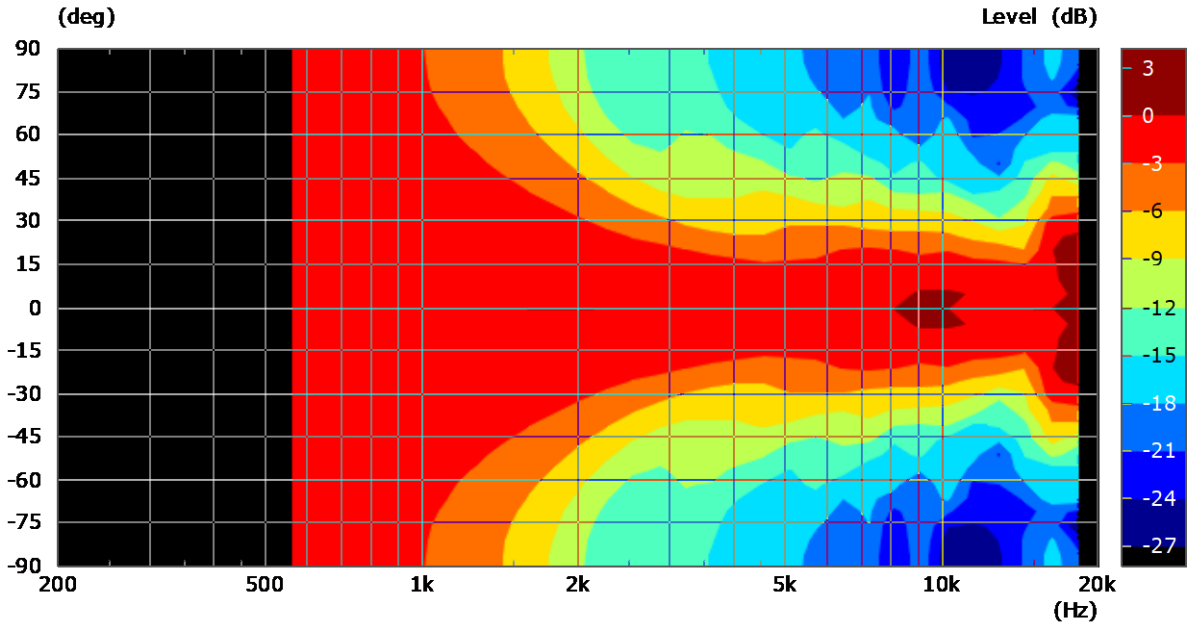


Illustration 7: Oval

Diagonal

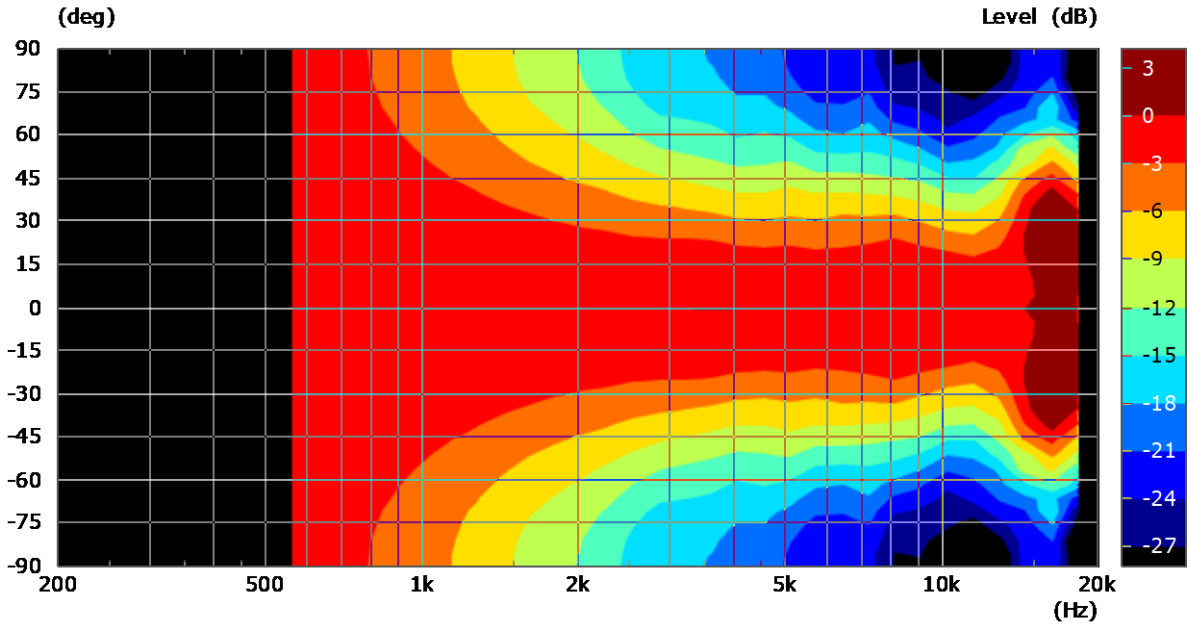


Illustration 8: Rectangular

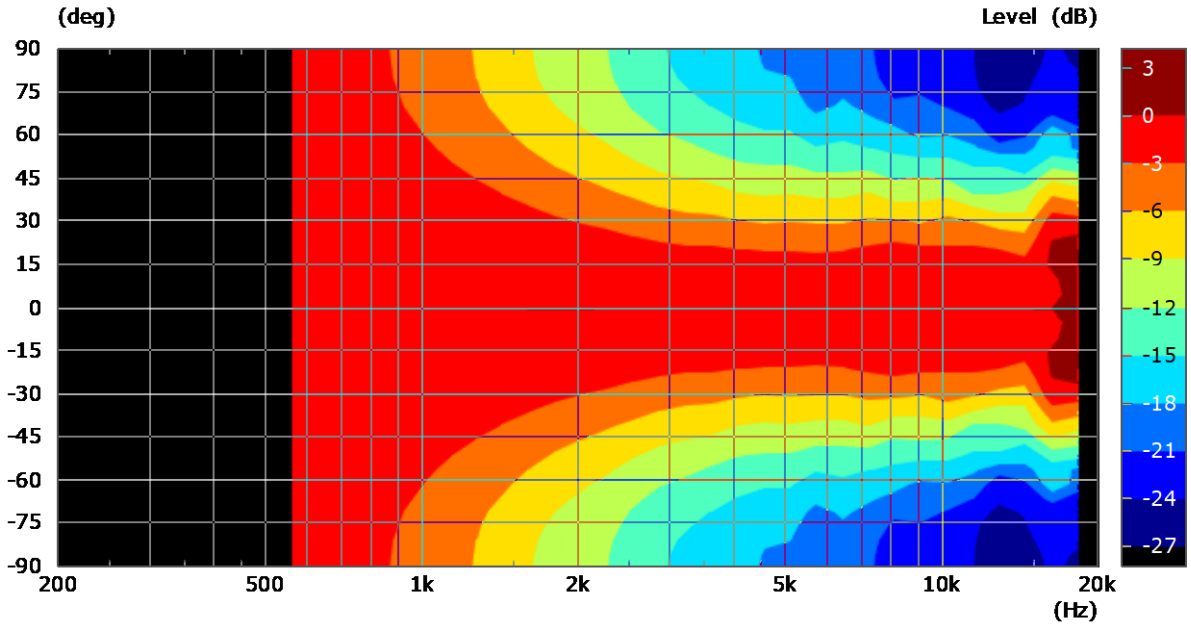


Illustration 9: Oval

Result

It was not confirmed that rectangular horns radiate unevenly diagonally. More angles between 0° (vertical) and 90° (horizontal) were also investigated, but these yielded the same result and are therefore not shown here.

Furthermore, it is noticeable that the oval horn narrows directivity somewhat more strongly in the range of about 2 – 6 kHz with identical contours for horizontal and vertical. This explains the higher sound pressure level below 0°.

Above 15 kHz, the differences become greater. Here, the rectangular horn has a stronger dip below 0°, which leads to the widening at the other angles.

In general, however, the differences are rather small and they can be further reduced by individual adjustments to the contour. The assumption that rectangular horns and waveguides in principle have disadvantages in terms of dispersion behavior is therefore unfounded.