



Test Report n° 03/99
Consisting of 11 pages

Parma, 20 March 1999

Claimant: Sound Corporation s.a.s
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P.IVA 00721540367

Subject of the Test: Determination of the curves of directivity and lateral scattering of the multi-channel sound loudspeaker, Peecker Sound Double Array Series mod. Cross Fire AS/120

0. Introduction

At the request of the claimant, dated 5/3/1999, acoustic tests have been carried out on a loudspeaker produced by the claimant, called **Peecker Sound** Double Array Series mod. Cross Fire AS/120. This is a special sound loudspeaker, consisting of two horn tweeters and a square woofer equipped with 64 speakers, set out in a square matrix. It is intended for horizontal installation, facing downwards, in such a way as to produce high volumes below it, but, at the same time, limiting sound emissions laterally.

The tests were carried out following two methods:

- Measuring the polar dispersion diagrams ("directivity curves") in a simulated free field, using a rotating table and the MLSSA system of analysis.
- Measuring the sound level spectrum produced at 1.5m from the ground by the sound loudspeaker when installed in its operating position (suspended at 3.2m from a reflecting floor, facing downwards) along two orthogonal directrices.

The first measurement quantifies the properties of the loudspeaker's directive emission: these data are required, for example, for use in simulation programs of hall acoustics. The second measurement, meanwhile, tests experimentally the behaviour of the loudspeaker under effective working conditions, taking into consideration the floor reflection, too, which has a significant influence on sound scattering, given the particular use required of the speaker.

The RAMSETE calculation program has been used to carry out the calculation of the three-dimensional directivity "balloons", which are indispensable for simulating the sound propagation in closed environments with simulation programs.

1. Instrumentation used.

The following equipment was used, after checks carried out in the Laboratory of this Department:

- Epson PC-AX3S Personal computer with MLSSA data acquisition board
- Larson Davis Spectrum analyser in real time, model 2900, with Larson Davis ½" microphone for free field.

All these instruments were checked and calibrated first in the department laboratory, using reference instruments with O class precision (Bruel & Kjaer spectrum analyser, type 2133, and a B&K sample source, type 4230).

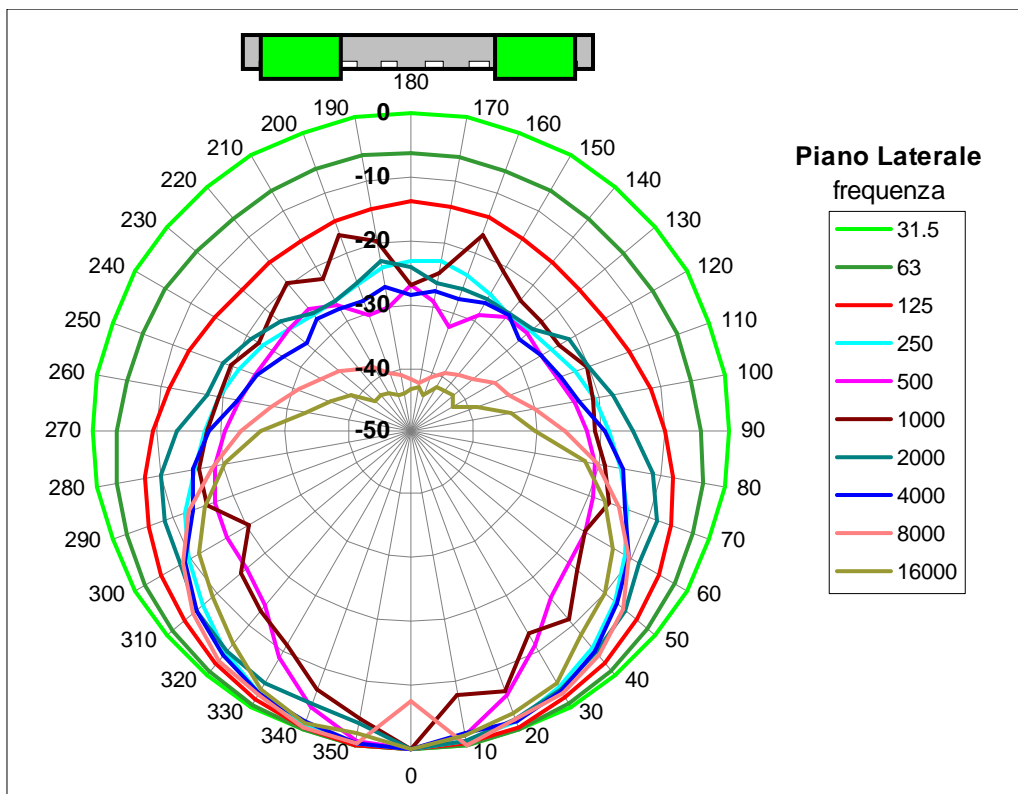
2. Tests carried out

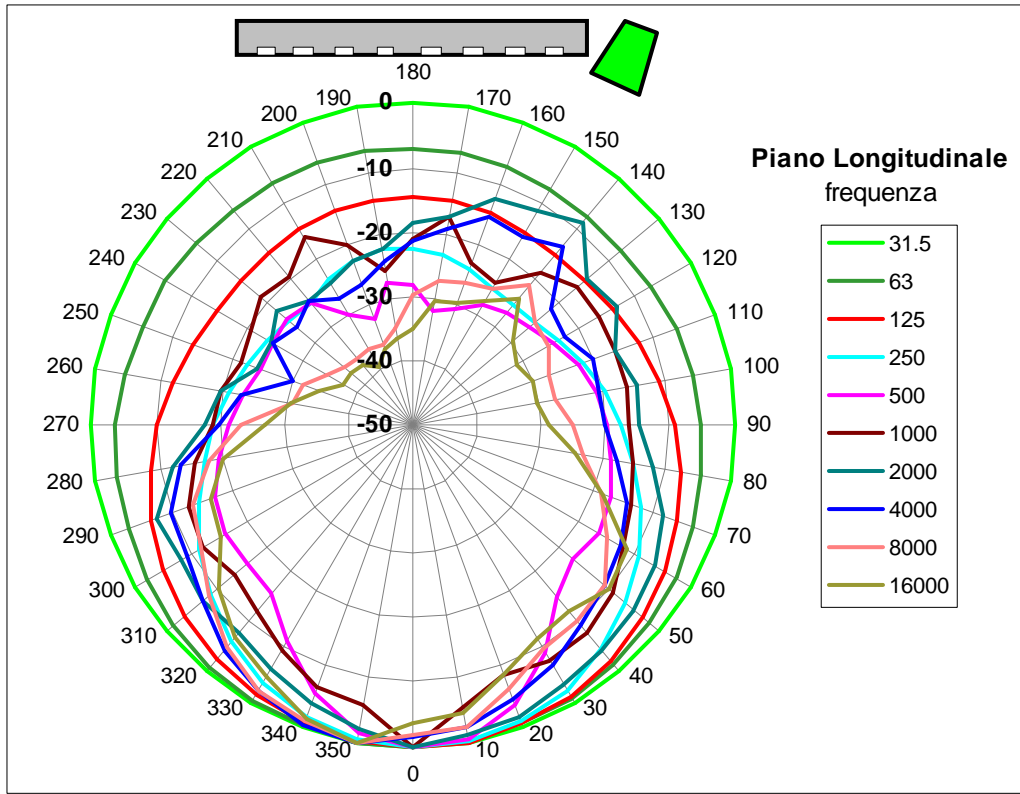
2.1 Polar scattering diagrams

The polar scattering diagrams were obtained by placing the sound source on the rotating table, synchronised with the MLSSA board, which commands the rotation in 10° steps. The microphone was placed on the floor, in such a way that the floor reflection was not influential for the measurement. Reflections off the other test walls of the laboratory were made non-influential by use of an appropriate time window, applied to the impulse response measured before the FFT analysis.

The sound spectra in narrow band (FFT of 16384 points) were used to calculate the levels in octave band and "third-octave", which gave the polar scattering diagrams, normalising at 0 dB the sound levels in the direction of greatest emission.

The two figures below report the overlapping directivity curves in octave bands.





The following tables show the directivity data in “third-octave” bands:

Lateral plane

Angle	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10k	12.5k	16k
0°	-3.6	-0.2	-0.3	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.0	-0.2	-1.5	-8.3	-13.1	-6.0	0.0	0.0
10°	-6.2	-1.2	-0.6	-0.2	-0.1	-0.1	-0.2	-0.2	-0.3	-0.4	-0.7	-1.1	-1.8	-3.0	-6.3	-9.6	-8.2	-8.6	-0.6	-0.1	-11.4	-0.9	-0.2	-0.8	-0.4	-0.5	-0.7	-3.1
20°	-5.1	-0.4	-0.2	-0.1	-0.3	-0.5	-0.7	-0.8	-1.1	-1.5	-2.4	-4.0	-6.7	-12.1	-7.9	-8.7	-5.2	-6.1	-4.2	-0.9	-4.5	-2.6	0.0	-2.7	-1.5	-2.7	-2.6	-3.3
30°	-3.5	-0.2	-0.4	-0.5	-0.7	-1.0	-1.3	-1.6	-2.2	-3.2	-4.9	-8.7	-16.6	-15.5	-12.6	-11.2	-16.1	-3.9	-7.4	-2.1	-4.6	-4.0	-2.1	-2.7	-4.6	-2.6	-3.4	-6.9
40°	-4.0	-0.3	-0.5	-0.7	-1.2	-1.8	-2.2	-2.7	-3.8	-5.4	-8.6	-16.1	-18.7	-12.9	-13.4	-11.8	-10.5	-7.2	-3.8	-4.8	-6.6	-8.0	-3.3	-4.5	-3.6	-5.3	-7.4	-9.7
50°	-4.1	-1.0	-1.2	-1.4	-2.0	-2.7	-3.3	-4.1	-5.6	-8.0	-13.0	-23.8	-15.1	-15.7	-17.2	-13.8	-16.7	-5.1	-5.3	-6.7	-9.1	-9.5	-7.2	-7.0	-6.4	-7.1	-9.8	-12.2
60°	-4.4	-1.1	-1.5	-1.8	-2.7	-3.7	-4.7	-5.6	-7.7	-11.1	-18.5	-20.6	-15.6	-20.5	-19.1	-16.0	-21.4	-8.7	-6.4	-10.1	-10.5	-12.6	-11.0	-10.4	-10.9	-11.1	-12.9	-13.7
70°	-2.5	-0.7	-1.8	-2.4	-3.5	-4.9	-6.1	-7.4	-9.9	-14.4	-23.5	-19.4	-18.0	-23.6	-14.8	-17.2	-19.2	-7.5	-7.1	-10.3	-14.2	-16.7	-14.1	-15.3	-14.7	-16.8	-17.2	-18.2
80°	-3.0	-0.7	-1.9	-2.8	-4.5	-6.2	-7.8	-9.2	-12.3	-17.3	-25.8	-19.9	-20.8	-24.7	-16.5	-19.6	-20.2	-9.1	-9.3	-13.1	-15.1	-19.9	-17.5	-20.2	-19.7	-23.0	-21.7	-23.7
90°	-4.2	-1.4	-2.5	-3.5	-5.4	-7.4	-9.5	-11.3	-14.8	-20.2	-25.8	-21.1	-23.2	-25.5	-18.1	-22.4	-22.7	-12.7	-13.3	-17.0	-18.1	-23.9	-21.3	-25.6	-24.5	-29.3	-30.4	-30.4
100°	-6.8	-3.2	-3.9	-4.6	-6.4	-8.6	-11.1	-13.1	-17.1	-22.7	-25.4	-22.5	-24.9	-26.6	-17.6	-22.5	-23.7	-14.1	-16.3	-20.1	-22.4	-25.9	-25.7	-31.7	-28.8	-32.5	-32.9	-37.7
110°	-4.1	-1.6	-3.1	-4.4	-6.9	-9.6	-13.0	-15.4	-19.6	-25.1	-24.8	-23.6	-26.4	-30.5	-17.0	-21.5	-23.7	-16.5	-18.9	-22.8	-23.7	-27.3	-29.2	-34.6	-32.0	-36.4	-37.7	-43.0
120°	-3.3	-1.9	-3.7	-5.1	-7.5	-10.4	-14.4	-17.4	-21.9	-28.0	-24.6	-24.4	-28.2	-32.2	-19.7	-23.4	-29.5	-17.2	-19.0	-25.9	-25.3	-28.8	-31.2	-34.3	-34.0	-38.7	-41.8	-43.7
130°	-3.5	-2.2	-4.2	-5.5	-7.6	-10.4	-14.8	-19.0	-22.9	-31.8	-24.9	-24.0	-28.4	-29.4	-18.9	-26.3	-28.0	-20.3	-24.4	-26.9	-25.7	-32.6	-34.5	-37.8	-35.8	-40.0	-40.3	-42.7
140°	-3.1	-1.4	-3.5	-5.2	-7.7	-10.5	-14.6	-19.6	-22.6	-34.0	-26.5	-24.4	-27.8	-31.0	-18.2	-27.8	-32.2	-19.4	-27.8	-29.0	-24.3	-29.6	-36.5	-41.9	-35.9	-40.9	-41.3	-43.5
150°	-2.0	-1.3	-3.7	-5.5	-7.9	-10.2	-13.9	-19.0	-20.9	-29.5	-29.7	-27.1	-29.6	-36.6	-15.5	-26.7	-32.0	-25.0	-24.8	-26.9	-24.6	-31.2	-37.6	-40.4	-39.2	-41.3	-41.1	-44.4
160°	0.0	-0.7	-3.9	-5.7	-7.8	-9.7	-13.0	-18.2	-19.5	-25.9	-35.6	-32.1	-33.4	-33.6	-11.6	-26.1	-29.6	-25.0	-27.6	-25.9	-26.0	-32.1	-36.5	-40.6	-40.7	-42.5	-43.2	-45.7
170°	-1.6	-1.2	-3.8	-5.5	-7.7	-9.7	-12.9	-17.7	-18.6	-24.3	-35.5	-29.9	-27.0	-33.7	-20.6	-25.0	-33.7	-30.4	-23.7	-27.5	-28.0	-26.7	-35.2	-42.0	-42.1	-44.5	-42.7	-44.0
180°	-2.2	-1.1	-3.5	-5.4	-7.7	-9.7	-12.7	-17.3	-18.9	-24.9	-35.5	-28.3	-24.6	-31.1	-26.1	-27.5	-27.6	-20.8	-26.3	-24.5	-26.5	-32.4	-38.9	-42.6	-40.6	-43.9	-43.9	-42.8
190°	-1.2	-0.3	-3.0	-5.1	-7.8	-10.0	-13.1	-18.2	-19.4	-25.7	-36.8	-30.3	-28.6	-34.0	-14.3	-26.1	-30.7	-24.4	-25.7	-21.9	-25.7	-28.4	-37.8	-41.7	-40.9	-42.7	-44.5	-43.1
200°	-1.8	-0.9	-3.4	-5.3	-7.8	-10.0	-13.4	-19.0	-21.0	-28.6	-33.6	-29.3	-31.3	-33.1	-11.5	-29.3	-31.6	-25.0	-29.7	-24.1	-27.4	-28.8	-37.8	-41.3	-38.4	-43.8	-43.6	-44.5
210°	-3.2	-1.5	-3.6	-5.3	-7.7	-10.2	-14.1	-20.2	-22.7	-32.9	-27.9	-25.3	-27.6	-35.4	-17.0	-30.7	-31.2	-22.3	-27.6	-27.1	-25.6	-31.2	-35.3	-38.9	-38.0	-40.0	-42.6	-44.3
220°	-3.1	-1.6	-3.6	-5.2	-7.6	-10.3	-14.7	-20.3	-24.0	-32.5	-24.9	-23.3	-26.8	-30.8	-14.3	-30.6	-29.8	-21.6	-22.8	-32.9	-24.9	-31.4	-33.9	-36.1	-38.3	-40.4	-41.5	-44.6
230°	-4.3	-1.6	-3.3	-4.8	-7.3	-10.3	-14.8	-19.3	-23.2	-28.5	-23.8	-23.2	-26.9	-30.1	-16.1	-27.6	-27.4	-19.0	-22.0	-26.6	-27.8	-29.2	-36.0	-35.3	-34.8	-37.8	-42.2	-43.9
240°	-4.7	-1.6	-3.0	-4.3	-6.9	-9.9	-14.1	-17.4	-20.9	-25.4	-23.7	-22.8	-26.7	-31.8	-18.1	-24.8	-27.0	-16.6	-20.1	-24.1	-26.1	-28.3	-31.0	-34.4	-33.4	-34.6	-37.8	-42.6
250°	-4.6	-1.7	-3.0	-4.1	-6.4	-9.0	-12.5	-15.3	-18.4	-22.9	-24.1	-22.0	-25.6	-28.9	-15.8	-24.1	-23.0	-14.2	-17.4	-21.1	-23.6	-25.9	-27.4	-31.9	-29.8	-33.3	-35.2	-39.5
260°	-4.5	-2.0	-3.1	-3.9	-5.8	-8.0	-10.6	-12.9	-16.0	-20.7	-24.0	-20.8	-24.0	-25.9	-14.5	-26.7	-23.9	-13.7	-16.4	-18.9	-21.2	-26.0	-24.1	-28.6	-26.1	-30.8	-32.9	-33.0
270°	-5.1	-1.5	-2.3	-3.1	-4.6	-6.4	-8.6	-10.9	-14.1	-18.6	-23.8	-20.5	-19.7	-23.3	-13.1	-25.1	-22.9	-10.9	-11.7	-15.3	-17.3	-22.3	-19.6	-23.5	-22.0	-27.3	-26.0	-26.7
280°	-5.5	-1.3	-1.8	-2.5	-3.8	-5.3	-6.9	-8.9	-11.9	-15.7	-23.9	-19.5	-17.2	-20.1	-11.8	-21.6	-19.1	-7.9	-8.3	-11.8	-14.7	-18.2	-15.8	-18.0	-17.8	-20.2	-19.6	-22.9
290°	-3.7	-0.7	-1.4	-2.0	-3.1	-4.3	-5.7	-7.0	-8.9	-12.5	-21.4	-19.4	-15.3	-18.4	-12.2	-18.8	-18.1	-8.0	-7.1	-10.3	-14.2	-15.5	-13.1	-13.2	-13.8	-13.7	-15.1	-16.3
300°	-5.1	-0.8	-1.0	-1.4	-2.2	-3.1	-4.2	-5.4	-6.9	-9.3	-15.8	-21.2	-14.3	-16.4	-18.3	-19.1	-25.3	-7.5	-6.1	-9.4	-9.9	-10.6	-9.6	-9.2	-9.0	-9.3	-10.9	-13.4
310°	-4.4	-0.5	-0.7	-0.9	-1.6	-2.3	-3.0	-3.8	-4.9	-6.7	-11.0	-22.1	-15.2	-12.9	-16.7	-14.5	-14.5	-5.0	-6.3	-6.2	-7.1	-7.5	-5.6	-6.9	-4.8	-6.5	-8.5	-12.0
320°	-4.1	-0.1	-0.3	-0.5	-0.9	-1.4	-2.0	-2.5	-3.2	-4.3	-6.9	-12.8	-21.0	-12.2	-16.5	-14.3	-11.7	-6.6	-3.4	-6.0	-5.7	-5.2	-3.2	-4.0	-2.5	-3.8	-5.4	-9.0
330°	-4.7	-0.4	-0.3	-0.3	-0.5	-0.8	-1.1	-1.3	-1.7	-2.3	-3.6	-6.3	-11.3	-17.0	-8.5	-11.6	-14.1	-9.7	-2.8	-4.8	-4.5	-3.1	-2.0	-2.2	-3.2	-2.9	-2.6	-4.2
340°	-4.0	0.0	0.0	0.0	-0.2	-0.4	-0.6	-0.5	-0.7	-1.0	-1.5	-2.6	-4.2	-7.1	-8.5	-11.1	-5.0	-4.8	-9.3	-3.1	-2.7	-3.6	-0.9	-2.2	0.0	-1.3	-1.0	-2.2
350°	-3.4	-0.1	-0.2	-0.1	0.0	-0.1	-0.1	-0.2	-0.1	-0.2	-0.3	-0.5	-0.8	-1.2	-2.4	-3.4	-6.1	-9.3	-7.1	-1.8	0.0	0.0	-8.8	0.0	-4.9	0.0	-1.2	-3.0

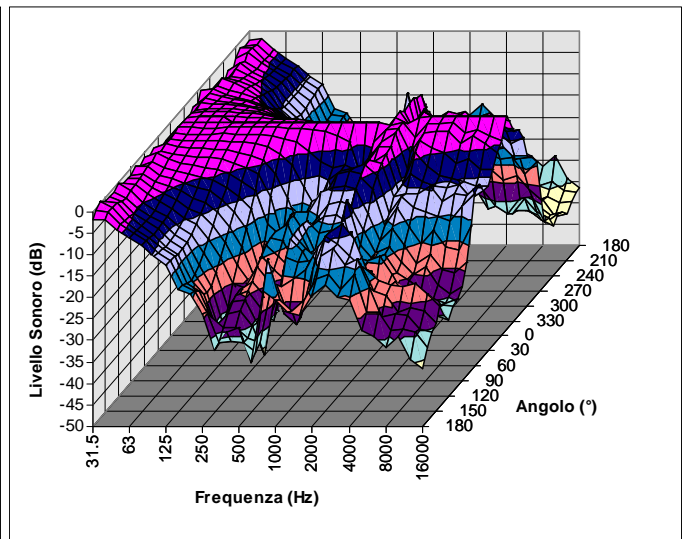
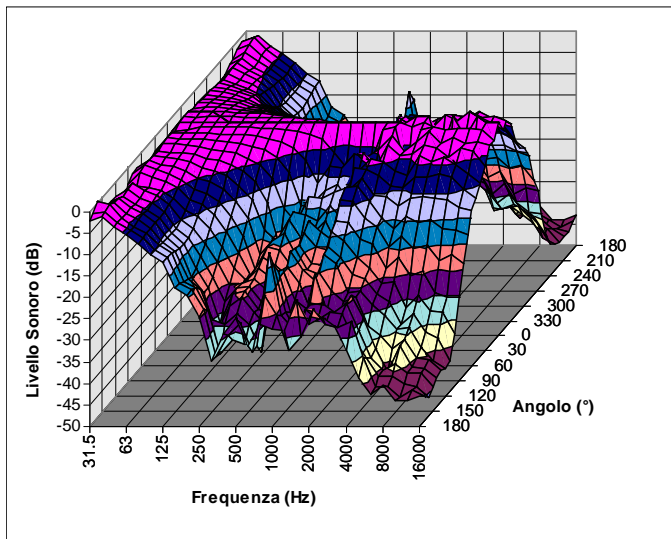
Longitudinal plane

Angle	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10k	125.k	16k	
0	-4.2	-0.2	-0.1	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.8	0.0	-3.6	-0.4	-0.5	-0.3	-2.6	-2.0	-3.5	-4.4	
10	-3.1	0.0	-0.2	-0.3	-0.2	-0.1	-0.1	-0.1	-0.1	-0.2	-0.3	-0.5	-0.9	-1.2	-2.1	-3.7	-12.0	-3.6	-0.7	-0.5	-6.1	-1.5	-1.1	-1.1	-3.8	-2.0	-4.1	-6.2	
20	-3.2	-0.4	-0.6	-0.6	-0.5	-0.5	-0.5	-0.5	-0.6	-0.9	-1.7	-2.6	-4.4	-7.0	-8.3	-7.9	-9.1	-5.8	-2.4	-0.3	-8.7	-2.2	-3.9	-5.0	-7.5	-6.2	-8.9	-8.7	
30	-3.4	-0.5	-0.8	-1.0	-1.0	-1.0	-1.1	-1.3	-1.7	-2.3	-4.0	-6.7	-11.9	-16.9	-10.0	-8.0	-7.3	-6.1	-2.2	-2.4	-10.9	-3.7	-6.9	-9.1	-9.6	-10.4	-11.5	-11.5	
40	-1.5	-0.4	-1.3	-1.6	-1.7	-1.7	-1.9	-2.4	-3.1	-4.2	-7.4	-13.3	-19.8	-14.0	-12.2	-7.4	-6.7	-7.6	-4.6	-3.0	-11.6	-7.4	-9.2	-10.4	-10.7	-9.9	-13.3	-11.6	
50	-2.5	-1.0	-1.8	-2.2	-2.3	-2.6	-2.9	-3.7	-4.9	-6.5	-11.6	-21.5	-15.3	-15.3	-10.7	-9.5	-9.2	-10.0	-3.3	-3.9	-11.8	-11.1	-10.8	-9.1	-12.9	-11.0	-11.4	-8.7	
60	-1.2	-0.4	-1.8	-2.6	-3.1	-3.7	-4.1	-5.3	-6.9	-9.2	-16.7	-19.3	-14.5	-18.7	-15.8	-12.5	-11.7	-12.6	-3.2	-5.6	-14.3	-10.5	-13.1	-14.2	-15.0	-16.0	-12.6	-10.0	
70	-2.2	-1.2	-2.6	-3.4	-4.0	-4.8	-5.4	-7.1	-9.2	-12.2	-21.9	-17.6	-15.9	-22.0	-16.1	-13.8	-13.6	-15.3	-4.7	-7.7	-16.2	-11.8	-16.4	-20.4	-17.1	-21.0	-21.8	-16.2	
80	-1.0	-1.2	-3.1	-4.1	-4.9	-6.1	-6.8	-8.9	-11.6	-15.5	-24.8	-17.7	-18.4	-23.4	-13.8	-16.5	-15.8	-17.4	-6.5	-12.0	-18.6	-15.6	-19.4	-23.6	-21.6	-25.3	-25.8	-23.4	
90	-2.1	-1.6	-3.4	-4.6	-5.7	-7.4	-8.3	-10.7	-14.0	-18.6	-25.4	-18.4	-20.8	-23.8	-13.5	-19.9	-18.4	-19.9	-9.6	-14.9	-20.1	-18.6	-22.3	-25.2	-23.4	-27.6	-29.7	-27.9	
100	-1.5	-1.4	-3.7	-5.1	-6.6	-8.6	-9.8	-12.6	-16.4	-21.9	-25.6	-19.5	-22.9	-25.2	-13.3	-19.1	-17.3	-19.3	-6.6	-17.4	-20.2	-19.3	-23.6	-25.4	-27.6	-29.6	-30.8	-29.7	
110	-1.3	-1.7	-4.1	-5.7	-7.3	-9.7	-11.2	-14.6	-18.7	-24.9	-25.8	-21.0	-24.4	-27.7	-13.4	-16.6	-19.2	-20.2	-9.4	-18.8	-19.6	-18.7	-22.8	-27.6	-26.1	-29.5	-29.9	-30.3	
120	-0.3	-1.9	-4.9	-6.6	-8.1	-10.6	-12.3	-16.4	-21.1	-29.3	-25.1	-23.3	-26.6	-30.3	-13.5	-16.1	-21.3	-20.8	-11.9	-11.6	-20.9	-25.1	-24.2	-24.6	-25.7	-26.7	-31.0	-32.1	
130	-1.3	-2.5	-5.3	-7.0	-8.5	-11.2	-13.1	-18.2	-23.3	-32.4	-25.3	-24.5	-28.7	-31.0	-16.5	-17.7	-17.1	-14.2	-10.7	-16.8	-22.7	-19.7	-24.6	-22.1	-25.8	-27.9	-29.9	-30.0	
140	-1.2	-2.3	-5.1	-6.9	-8.6	-11.4	-13.4	-19.2	-23.5	-32.0	-25.7	-25.3	-30.6	-29.5	-22.0	-20.2	-18.2	-12.9	-9.1	-7.6	-11.1	-18.1	-20.6	-21.7	-22.0	-21.4	-23.8	-26.7	
150	-1.2	-1.5	-4.5	-6.7	-8.7	-11.5	-13.5	-19.4	-22.6	-30.2	-27.4	-26.5	-30.1	-36.7	-20.7	-27.5	-28.1	-16.8	-9.3	-10.8	-14.0	-16.5	-21.9	-23.1	-26.9	-25.9	-26.8	-29.4	
160	0.0	-1.2	-4.4	-6.5	-8.3	-10.9	-12.8	-18.9	-21.0	-26.7	-29.2	-31.8	-32.8	-32.8	-26.0	-28.6	-22.7	-12.5	-10.9	-14.9	-13.5	-20.0	-26.8	-26.1	-26.6	-29.6	-30.5		
170	-1.0	-1.1	-3.9	-6.1	-8.0	-10.7	-12.5	-18.3	-19.6	-24.6	-31.7	-31.2	-31.5	-33.9	-12.2	-21.7	-24.4	-21.6	-16.9	-15.7	-19.4	-15.8	-24.7	-24.5	-29.0	-28.4	-29.3	-32.9	
180	-1.9	-1.7	-4.3	-6.2	-7.9	-10.4	-12.3	-18.2	-19.0	-23.7	-32.3	-28.0	-26.9	-35.3	-18.5	-20.6	-23.3	-24.2	-19.4	-17.0	-19.9	-20.4	-27.7	-28.9	-31.6	-29.0	-34.3	-36.4	
190	-2.2	-1.8	-4.3	-6.1	-7.8	-10.4	-12.3	-18.3	-18.8	-23.6	-32.0	-27.0	-26.6	-36.6	-23.7	-26.0	-27.6	-27.1	-19.3	-21.4	-21.9	-25.0	-32.8	-36.2	-34.9	-33.8	-36.1	-36.4	
200	-1.5	-1.7	-4.4	-6.2	-7.7	-10.4	-12.4	-18.5	-19.1	-24.7	-34.2	-31.8	-31.8	-36.1	-15.2	-23.3	-30.4	-28.2	-18.9	-22.4	-23.9	-28.9	-35.1	-36.0	-37.5	-36.3	-37.6	-37.5	
210	-2.8	-1.5	-3.7	-5.5	-7.4	-10.6	-12.9	-18.8	-20.1	-27.2	-33.9	-28.9	-30.2	-36.2	-11.1	-22.6	-32.3	-25.5	-20.7	-25.3	-25.3	-27.5	-34.8	-36.3	-37.0	-35.8	-39.8	-39.0	
220	-4.3	-2.2	-4.0	-5.5	-7.3	-10.7	-13.2	-19.2	-21.7	-30.4	-27.9	-23.3	-28.1	-33.2	-15.0	-25.2	-30.0	-25.2	-19.6	-26.8	-22.4	-27.2	-30.6	-36.4	-37.3	-36.1	-38.3	-37.6	
230	-3.4	-1.5	-3.5	-5.1	-7.1	-10.8	-13.5	-18.9	-23.3	-30.5	-24.5	-22.0	-29.0	-31.7	-14.2	-26.2	-28.1	-22.3	-16.0	-26.0	-24.1	-26.9	-32.5	-36.4	-35.3	-36.8	-38.8	-36.5	
240	-5.3	-1.9	-3.2	-4.6	-6.7	-10.6	-13.2	-17.7	-23.1	-26.6	-22.9	-22.5	-28.7	-31.2	-16.4	-23.4	-28.1	-25.8	-19.9	-25.4	-21.9	-27.7	-32.5	-33.6	-34.6	-34.8	-37.1	-38.3	
250	-8.0	-2.3	-2.9	-4.1	-6.1	-9.9	-12.2	-16.1	-21.2	-24.1	-22.7	-23.1	-26.7	-27.7	-18.9	-20.8	-25.9	-21.1	-25.2	-29.9	-21.1	-25.2	-29.9	-28.5	-32.0	-34.5	-30.7	-34.0	-35.5
260	-6.8	-1.7	-2.4	-3.5	-5.4	-8.8	-10.6	-14.2	-18.7	-22.0	-22.5	-22.0	-24.6	-25.0	-16.4	-20.5	-23.9	-21.0	-14.5	-21.3	-21.0	-23.7	-28.0	-31.5	-33.2	-29.7	-29.4	-34.8	
270	-3.6	-0.4	-1.5	-2.7	-4.6	-7.9	-9.6	-11.6	-15.9	-21.3	-22.3	-20.5	-22.2	-23.9	-15.0	-21.6	-23.2	-16.9	-11.3	-22.6	-17.7	-20.9	-26.3	-28.1	-21.6	-24.3	-23.3	-26.2	-28.9
280	-3.5	-0.9	-1.9	-2.8	-4.0	-6.0	-7.2	-10.4	-13.8	-17.9	-22.9	-19.1	-19.4	-20.5	-12.0	-18.0	-18.7	-12.2	-6.0	-15.3	-11.4	-13.7	-19.1	-16.5	-18.0	-17.8	-21.4	-18.8	
290	-1.0	-0.7	-2.1	-2.8	-3.3	-4.5	-5.5	-8.6	-11.3	-15.0	-22.5	-18.2	-16.6	-17.5	-10.5	-13.5	-15.1	-7.6	-2.0	-11.0	-7.5	-12.0	-14.8	-15.2	-13.9	-12.7	-16.4	-16.6	
300	-2.9	-0.6	-1.3	-1.8	-2.3	-3.4	-4.1	-6.4	-8.9	-11.8	-19.1	-19.0	-14.3	-16.7	-12.8	-11.4	-12.9	-7.8	-1.7	-13.5	-8.3	-11.6	-10.9	-9.6	-13.2	-13.0	-15.5	-15.2	
310	-2.4	-0.4	-1.0	-1.3	-1.6	-2.3	-2.9	-4.6	-6.6	-8.7	-14.0	-21.5	-13.8	-15.3	-13.2	-13.0	-7.8	-0.2	-12.3	-6.8	-9.9	-7.3	-6.8	-10.7	-8.5	-11.1	-9.7	-9.7	
320	-4.0	-0.3	-0.5	-0.7	-1.0	-1.4	-1.8	-3.1	-4.4	-5.8	-9.1	-16.0	-16.8	-13.7	-17.1	-9.7	-12.7	-8.8	-0.7	-10.7	-4.0	-8.8	-3.5	-3.6	-6.7	-4.7	-7.0	-6.6	
330	-4.5	-0.8	-0.6	-0.6	-0.5	-0.8	-1.0	-1.8	-2.7	-3.4	-5.3	-8.6	-15.6	-17.3	-8.5	-13.9	-9.3	-9.4	-1.0	-6.5	-1.3	-5.0	-1.7	-1.2	-4.0	-1.4	-4.4	-5.7	
340	-5.2	-0.5	-0.2	-0.2	-0.2	-0.3	-0.4	-0.9	-1.4	-1.7	-2.5	-3.9	-6.3	-10.6	-5.8	-4.4	-8.6	-6.8	0.0	-4.0	0.0	-1.8	0.0	-0.6	-2.0	-0.7	-1.3	-2.0	
350	-5.7	-0.4	0.0	0.0	0.0	0.0	-0.1	-0.3	-0.4	-0.5	-0.7	-1.1	-1.6	-2.8	-4.5	-7.1	-6.3	-3.8	-0.2	-1.7	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

The following two figures show these data in three-dimensional graphic form:

Lateral plane

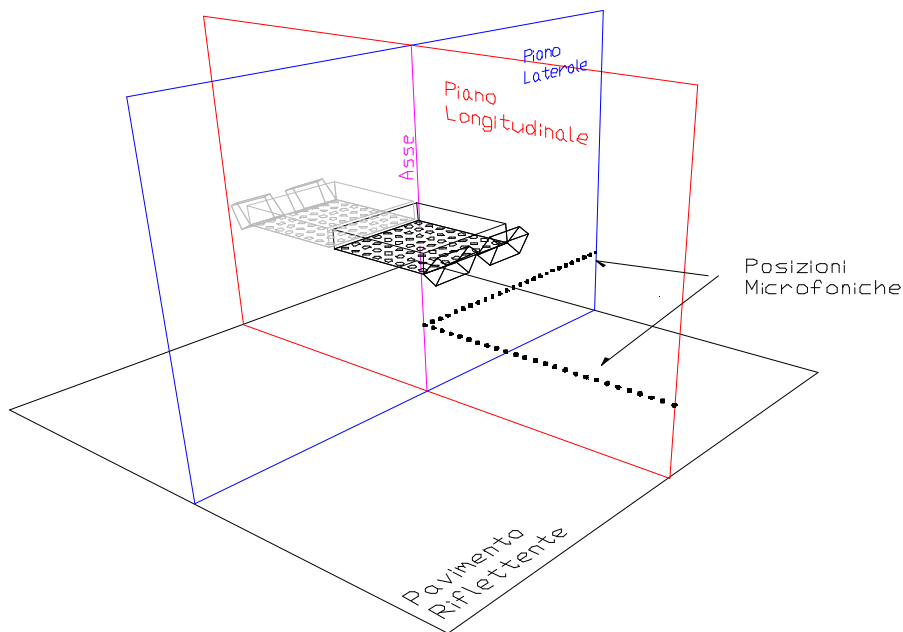
Longitudinal plane



2.2 Measuring sound levels in operating position

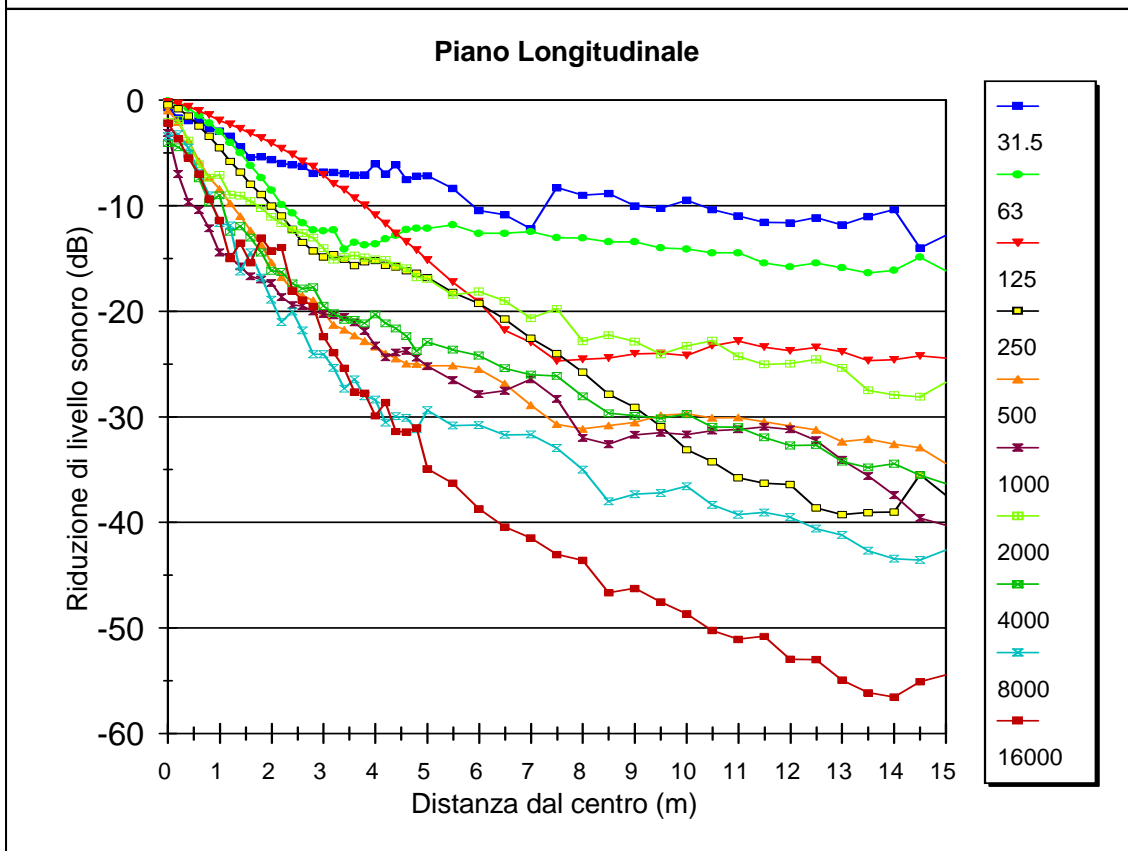
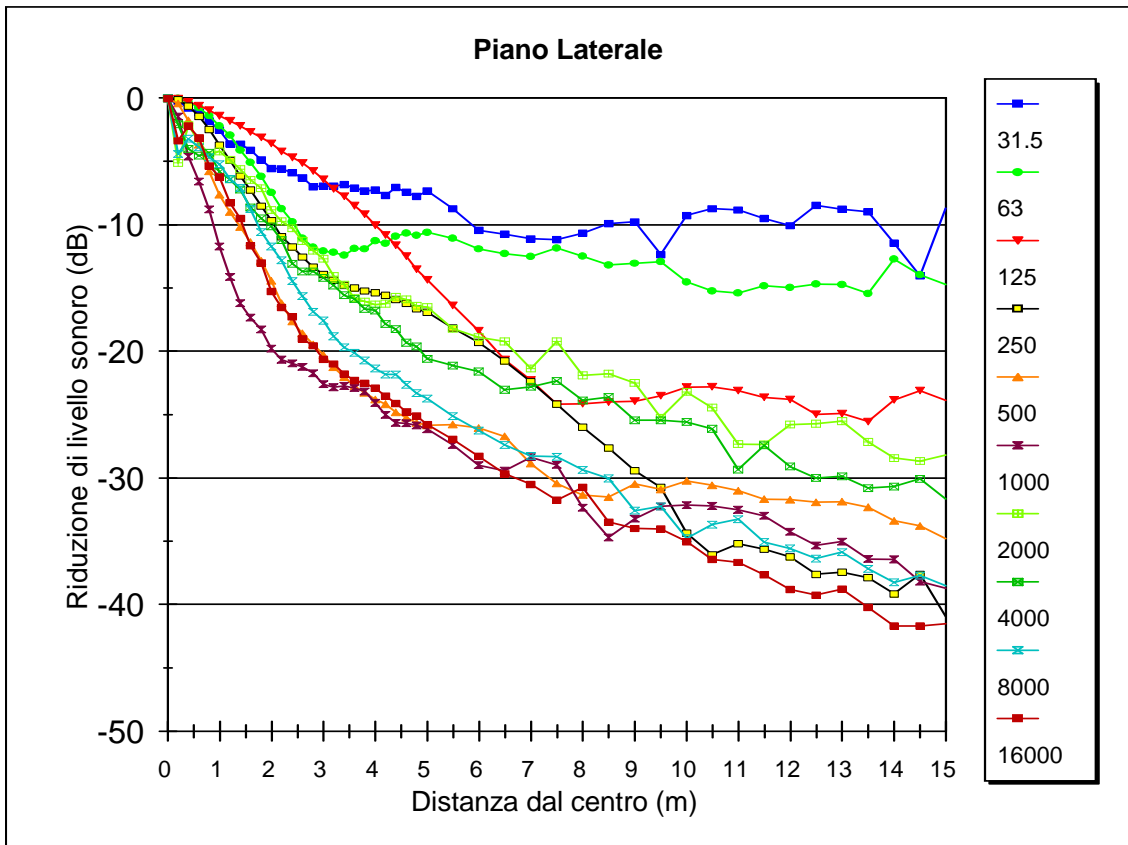
The loudspeaker was installed with the emission plane facing downwards towards the reflecting floor of the laboratory, at a height of 3.20m above the same. The microphone was set on a tripod, at a height of 1.50m above the floor.

Starting from a position exactly below the centre of the diffuser, the sound spectra were measured in “third-octave” bands along two orthogonal directrices (lateral and longitudinal), corresponding to the two planes in which the directivity curves were calculated previously. The microphone was moved along the directrices in steps of 0.2 m, up to a distance of 5m from the speaker axis, then in steps of 0.5 m up to a distance of 15m from the speaker axis. The next figure shows an outline of the geometry used for the test, up to the distance of 5m from the speaker axis. Although the configuration of the loudspeakers comprising the speaker is not symmetrical on the longitudinal plane, the sound levels were determined only on the side indicated: this was because, for its real use, the diffuser will be installed alongside another identical element, as shown in the figure, and, therefore, the sound emission off-axis is calculated only for the side with the horn tweeters.



The loudspeaker is driven by MLS white noise, but the sound spectra measured in each point were normalised with respect to the spectrum recorded at point “0” (speaker axis).

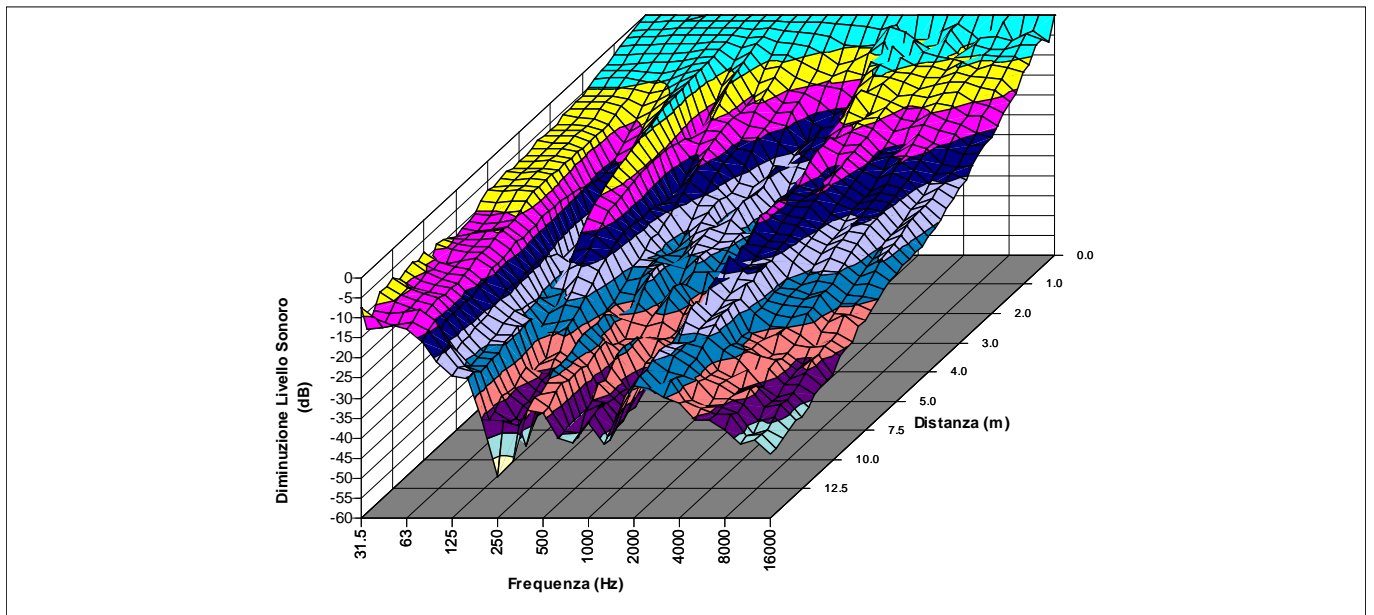
The following two figures show the spatial profiles for the sound levels in octave bands, along the two lateral and longitudinal directrices.



The following two pages show the same data in “third-octave” bands, both in table form and in three-dimensional graphic form:

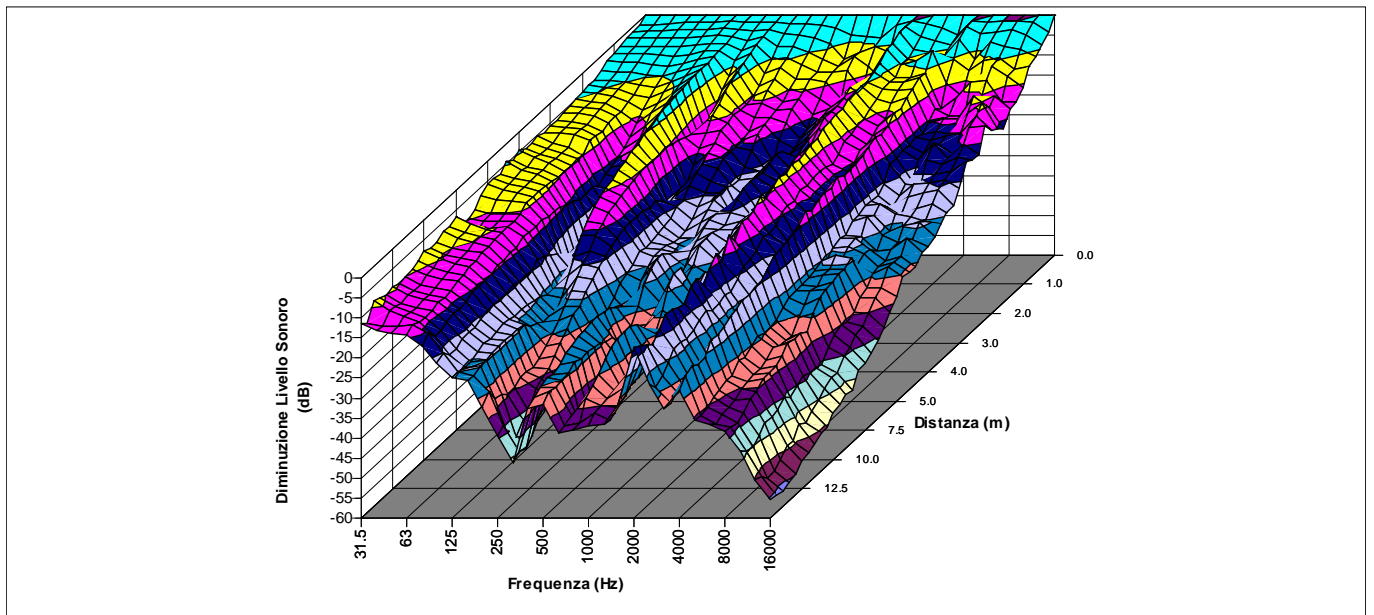
Lateral Direction

Dist. (m)	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10k	12.5k	16k	
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.2	-0.3	-0.2	-0.1	0.0	0.0	-0.1	0.0	-0.1	-0.1	-0.1	-0.2	-0.3	-0.4	-0.6	-1.1	-1.4	-1.9	-1.2	-8.2	-6.7	-2.5	-0.5	-3.1	-6.7	-0.5	-7.2	-2.4	-5.1	
0.4	-0.9	-0.7	-0.5	-0.3	-0.3	-0.3	-0.2	-0.3	-0.5	-0.4	-0.9	-1.2	-1.6	-2.4	-4.4	-4.9	-4.5	0.0	-1.3	-4.1	-6.3	-0.7	-6.0	-2.9	-2.6	-3.6	-1.6	-3.2	
0.6	-1.2	-1.1	-0.9	-0.8	-0.7	-0.7	-0.5	-0.6	-1.4	-0.8	-2.2	-2.6	-3.5	-5.2	-8.1	-7.0	-5.2	-2.5	-9.8	-2.2	-6.5	-2.0	-5.5	-3.1	-4.2	-4.2	-3.2	-3.0	
0.8	-1.8	-1.8	-1.6	-1.4	-1.4	-1.2	-0.9	-0.9	-2.4	-1.4	-3.9	-4.2	-5.8	-8.0	-9.6	-8.0	-9.1	-8.9	-1.9	-5.5	-3.4	-4.5	-5.2	-6.1	-4.2	-4.4	-4.6	-6.6	
1.0	-2.6	-2.5	-2.3	-2.2	-2.2	-2.0	-1.3	-1.2	-4.0	-2.1	-6.2	-5.7	-8.2	-9.7	-10.6	-11.1	-14.1	-4.6	-5.8	-3.4	-5.5	-5.4	-6.5	-4.3	-6.2	-5.3	-5.7	-7.0	
1.2	-3.7	-3.6	-3.4	-3.0	-2.9	-2.7	-1.9	-1.4	-5.5	-2.9	-8.3	-7.0	-10.1	-10.7	-12.8	-16.1	-13.8	-6.2	-3.5	-5.3	-5.8	-6.8	-6.9	-5.4	-6.5	-6.8	-7.0	-10.9	
1.4	-3.7	-3.5	-3.5	-3.8	-4.3	-3.5	-2.4	-1.6	-7.6	-3.7	-10.3	-8.1	-11.7	-11.4	-16.6	-18.5	-14.4	-8.0	-4.6	-5.5	-6.5	-8.1	-7.3	-6.4	-6.4	-7.8	-8.5	-11.4	
1.6	-4.2	-4.0	-4.0	-4.6	-5.3	-4.4	-3.0	-1.7	-9.9	-4.6	-11.1	-9.4	-12.8	-12.6	-20.3	-16.8	-16.1	-9.4	-7.5	-5.2	-8.6	-8.3	-8.9	-8.0	-7.6	-9.8	-11.0	-12.6	
1.8	-4.9	-4.9	-4.9	-5.5	-6.5	-5.5	-3.7	-1.9	-11.9	-6.1	-11.3	-11.1	-13.4	-14.5	-20.1	-17.6	-17.7	-10.8	-5.7	-7.1	-8.4	-10.5	-10.1	-8.7	-9.7	-12.2	-12.2	-14.6	
2.0	-5.5	-5.5	-5.6	-6.4	-8.0	-6.6	-4.4	-2.0	-13.4	-7.6	-11.0	-13.0	-13.7	-17.3	-20.6	-18.7	-20.4	-13.9	-5.7	-10.4	-8.4	-11.2	-11.9	-10.0	-11.6	-12.8	-14.8	-15.9	
2.2	-5.6	-5.5	-5.6	-6.8	-9.9	-8.0	-5.3	-2.4	-14.0	-9.7	-11.0	-14.9	-14.6	-21.5	-22.1	-18.9	-21.9	-13.8	-8.0	-9.9	-9.6	-13.2	-12.1	-11.2	-12.6	-13.8	-16.7	-16.3	
2.4	-5.9	-5.8	-6.0	-7.3	-11.5	-9.3	-6.1	-2.6	-13.3	-11.3	-11.5	-15.7	-16.4	-24.4	-20.9	-20.5	-21.5	-12.9	-10.5	-9.4	-11.0	-13.9	-15.7	-12.3	-14.3	-16.0	-17.4	-17.1	
2.6	-6.0	-6.5	-6.9	-8.4	-13.1	-10.8	-7.1	-2.7	-11.9	-13.5	-12.1	-16.0	-18.7	-23.2	-19.1	-23.4	-22.1	-14.3	-12.0	-10.2	-11.6	-15.6	-15.4	-13.2	-14.5	-18.3	-19.1	-18.8	
2.8	-6.9	-7.0	-7.2	-8.4	-14.5	-12.4	-8.0	-3.1	-11.5	-16.0	-12.8	-16.5	-21.5	-22.5	-19.6	-26.4	-21.3	-16.1	-10.1	-12.4	-11.8	-15.5	-15.1	-14.6	-15.8	-19.2	-19.0	-20.6	
3.0	-6.9	-7.0	-7.0	-8.3	-15.7	-14.2	-9.0	-3.7	-10.7	-18.1	-14.0	-17.1	-22.5	-23.8	-21.2	-25.8	-21.8	-17.2	-10.6	-13.1	-12.1	-15.0	-16.9	-14.7	-16.7	-20.5	-20.1	-21.5	
3.2	-6.9	-7.0	-7.0	-8.2	-16.2	-16.1	-10.1	-4.3	-10.4	-19.8	-15.4	-18.2	-22.0	-26.6	-21.3	-24.8	-22.8	-17.6	-10.5	-16.8	-12.6	-15.5	-17.6	-16.2	-17.8	-21.6	-20.1	-22.5	
3.4	-6.6	-7.0	-7.2	-8.5	-16.4	-17.8	-11.1	-4.7	-10.3	-21.2	-16.6	-19.7	-21.2	-28.8	-20.5	-25.7	-23.3	-19.9	-11.8	-16.1	-13.3	-16.3	-19.1	-17.4	-18.4	-22.3	-20.8	-23.6	
3.6	-7.1	-7.0	-7.0	-7.9	-15.6	-19.5	-12.0	-5.4	-10.3	-20.1	-18.0	-21.4	-21.2	-28.3	-20.2	-27.2	-23.5	-18.8	-13.1	-17.3	-13.5	-16.7	-19.2	-17.9	-18.8	-22.5	-21.1	-24.7	
3.8	-7.2	-7.4	-7.3	-8.1	-15.2	-21.8	-13.1	-5.9	-10.4	-19.7	-19.0	-23.3	-21.5	-25.8	-20.5	-27.6	-23.7	-17.6	-14.8	-16.4	-14.5	-17.3	-19.5	-18.4	-19.0	-23.8	-21.2	-25.4	
4.0	-7.3	-7.3	-7.1	-7.7	-14.1	-23.9	-14.3	-6.7	-10.5	-18.9	-20.6	-25.9	-22.2	-23.6	-22.0	-25.6	-25.4	-18.5	-15.3	-16.2	-14.5	-17.9	-19.5	-19.8	-24.1	-21.5	-26.2		
4.2	-7.6	-7.8	-7.7	-8.1	-13.9	-25.8	-15.6	-7.3	-10.8	-18.0	-21.7	-27.3	-24.2	-22.5	-23.9	-24.1	-28.4	-18.4	-15.5	-16.0	-15.5	-19.1	-20.7	-19.9	-20.1	-24.5	-22.1	-27.2	
4.4	-7.0	-7.1	-7.0	-7.5	-13.4	-26.0	-16.5	-8.1	-11.1	-18.6	-22.4	-27.3	-25.8	-22.8	-24.7	-24.4	-29.5	-17.7	-14.4	-15.9	-15.7	-19.6	-21.9	-19.6	-20.6	-24.4	-22.7	-27.3	
4.6	-7.4	-7.5	-7.2	-7.5	-12.8	-25.6	-17.8	-9.0	-11.8	-17.8	-22.3	-26.3	-26.7	-23.6	-24.6	-25.5	-27.3	-18.9	-14.0	-16.4	-17.0	-20.0	-22.7	-20.4	-21.1	-25.4	-23.6	-27.4	
4.8	-7.8	-7.7	-7.5	-7.7	-12.8	-25.2	-19.4	-10.0	-12.3	-18.0	-23.7	-25.4	-27.0	-24.9	-24.1	-27.2	-26.7	-21.0	-14.3	-16.8	-17.4	-20.8	-22.4	-21.0	-22.0	-26.0	-23.9	-27.6	
5.0	-7.2	-7.4	-7.3	-7.6	-12.5	-24.3	-20.5	-10.8	-12.6	-18.0	-24.7	-24.8	-25.8	-27.0	-24.0	-27.7	-27.7	-21.4	-13.4	-18.0	-18.7	-21.1	-23.0	-21.3	-22.6	-26.3	-24.7	-28.0	
5.5	-8.6	-8.9	-8.6	-8.4	-12.5	-21.8	-24.0	-12.8	-14.3	-18.5	-25.0	-24.9	-24.1	-30.1	-26.4	-26.4	-30.6	-24.1	-16.2	-18.4	-18.8	-21.8	-24.6	-22.8	-24.0	-27.5	-26.1	-28.6	
6.0	-10.3	-10.6	-10.1	-9.6	-13.0	-20.8	-27.1	-14.9	-15.7	-19.1	-27.0	-26.4	-23.5	-30.9	-28.1	-30.6	-28.4	-24.9	-17.7	-18.4	-19.1	-22.4	-25.5	-24.6	-24.9	-28.2	-27.8	-29.0	
6.5	-10.4	-11.2	-10.9	-10.3	-13.1	-19.6	-27.7	-18.0	-17.5	-20.2	-28.2	-29.2	-23.8	-29.7	-26.2	-32.2	-33.1	-26.0	-16.9	-19.6	-20.4	-24.9	-26.5	-25.6	-26.4	-29.1	-29.4	-30.0	
7.0	-10.8	-11.5	-11.2	-10.6	-13.3	-19.2	-26.4	-21.1	-19.5	-21.6	-29.4	-33.0	-26.0	-30.7	-25.5	-30.0	-31.7	-25.7	-21.8	-20.2	-19.9	-25.7	-26.3	-27.4	-26.6	-29.8	-29.8	-31.7	
7.5	-11.4	-11.0	-10.3	-9.7	-12.8	-19.3	-26.8	-25.9	-21.6	-23.4	-29.6	-32.5	-28.4	-31.5	-26.8	-31.1	-29.8	-26.8	-16.6	-19.8	-19.3	-25.6	-26.4	-27.1	-26.3	-30.6	-31.2	-32.6	
8.0	-10.4	-10.9	-10.8	-10.5	-13.4	-19.2	-25.4	-28.0	-23.8	-24.9	-31.1	-30.3	-31.3	-32.6	-31.6	-33.9	-31.8	-26.1	-22.3	-20.7	-21.2	-25.9	-27.2	-27.6	-28.0	-31.4	-29.8	-32.5	
8.5	-9.2	-10.6	-11.1	-11.2	-14.1	-19.5	-24.6	-28.0	-25.6	-26.3	-33.2	-28.4	-34.3	-34.3	-35.6	-34.0	-34.7	-27.4	-18.8	-23.0	-20.5	-26.4	-28.2	-28.8	-27.7	-32.6	-32.7	-34.8	
9.0	-9.1	-10.5	-11.0	-11.1	-14.0	-19.4	-24.3	-29.0	-28.5	-27.6	-34.3	-26.7	-33.9	-35.3	-32.4	-32.6	-35.1	-29.4	-19.9	-23.1	-23.0	-26.3	-29.4	-30.0	-31.8	-35.1	-33.3	-35.1	
9.5	-12.3	-12.4	-11.9	-11.2	-13.6	-18.8	-23.8	-29.5	-30.7	-28.5	-35.9	-27.5	-32.8	-36.2	-31.2	-31.7	-34.5	-28.9	-26.1	-24.0	-21.9	-29.7	-31.4	-29.9	-32.7	-33.6	-33.1	-35.6	
10.0	-8.2	-10.5	-11.9	-12.6	-15.6	-20.0	-22.9	-24.8	-34.9	-33.1	-35.6	-27.1	-30.5	-38.3	-29.4	-34.4	-34.4	-28.9	-20.5	-24.1	-22.2	-29.2	-30.9	-33.8	-33.3	-36.2	-33.6	-38.6	
10.5	-9.0	-11.0	-12.0	-12.4	-15.2	-19.8	-23.1	-25.2	-34.6	-33.5	-35.4	-27.1	-30.4	-38.4	-29.4	-34.4	-34.4	-28.9	-20.6	-24.1	-22.3	-29.3	-30.9	-33.8	-33.3	-36.3	-33.6	-38.6	
11.0	-7.6	-10.2	-11.9	-13.2	-16.6	-20.8	-23.0	-23.7	-34.9	-35.9	-37.2	-27.4	-30.8	-39.3	-28.7	-37.0	-35.1	-29.1	-22.7	-24.4	-23.3	-28.3	-29.8	-31.3	-32.1	-36.9	-35.3	-38.6	
11.5	-8.5	-10.8	-12.0	-12.7	-16.0	-21.1	-24.4	-24.3	-32.7	-35.6	-39.4	-28.5	-32.1	-39.3	-29.5	-39.3	-34.8	-32.4	-26.7	-26.6	-25.1	-28.4	-30.6	-34.5	-32.8	-37.0	-36.8	-39.2	
12.0	-9.1	-11.3	-12.4	-12.9	-16.1	-21.1	-24.5	-24.6	-33.4	-36.9	-38.7	-29.0	-31.0	-42.9	-31.2	-36.5	-37.9	-32.9	-25.0	-24.9	-26.0	-31.9	-33.7	-32.0	-36.1	-38.5	-37.7	-41.1	
12.5	-7.4	-9.8	-11.3	-12.4	-16.2	-21.9	-25.8	-26.1	-34.7	-38.0	-40.5	-29.0	-31.5	-42.1	-32.8	-36.0	-39.6	-31.8	-24.2	-25.4	-27.7	-31.4	-32.7	-35.4	-34.4	-38.2	-38.0	-42.0	
13.0	-7.8	-9.9	-11.4	-12.4	-16.2	-21.9	-25.7	-25.9	-34.4	-37.9	-40.3	-29.0	-31.4	-42.2	-32.3	-36.0	-39.3	-31.7	-23.8	-25.4	-27.7	-30.9	-32.4	-34.8	-33.7	-38.1	-37.6	-41.4	
13.5	-7.9	-10.3	-11.9	-13.1	-17.0	-22.6	-26.4	-26.5	-33.7	-39.7	-42.1	-30.6	-30.5	-42.0	-35.0	-35.6	-40.2	-31.8	-25.0	-27.6	-29.0	-30.1	-34.6	-34.5	-35.9	-40.3	-39.1	-42.4	
14.0	-11.1	-11.9	-11.5	-10.8	-13.5	-19.5	-25.0	-26.2	-36.2	-38.6	-44.7	-32.0	-31.5	-41.4	-36.4	-34.5	-40.3	-30.9	-25.9	-29.8	-27.7	-33.3	-35.1	-35.3	-36.8	-42.1	-40.9	-43.0	
14.5	-14.2	-14.0	-13.2	-12.3	-14.6	-19.7	-23.7	-24.9	-36.9	-37.4	-38.3	-31.2	-33.6	-39.9	-40.0	-35.6	-41.8	-31.0	-26.1	-30.1	-27.2	-32.4	-34.1	-35.6	-35.6	-41.0	-40.5	-44.2	
15.0	-7.6	-10.2	-11.8	-12.6	-15.9	-21.0	-24.4	-25.1	-35.4	-49.6	-45.9	-33.1	-33.6	-40.2	-41.2	-36.1	-41.6	-33.6	-26.9	-27.8	-29.7	-31.1	-35.6	-35.4	-38.0	-41.5	-40.4	-43.9	



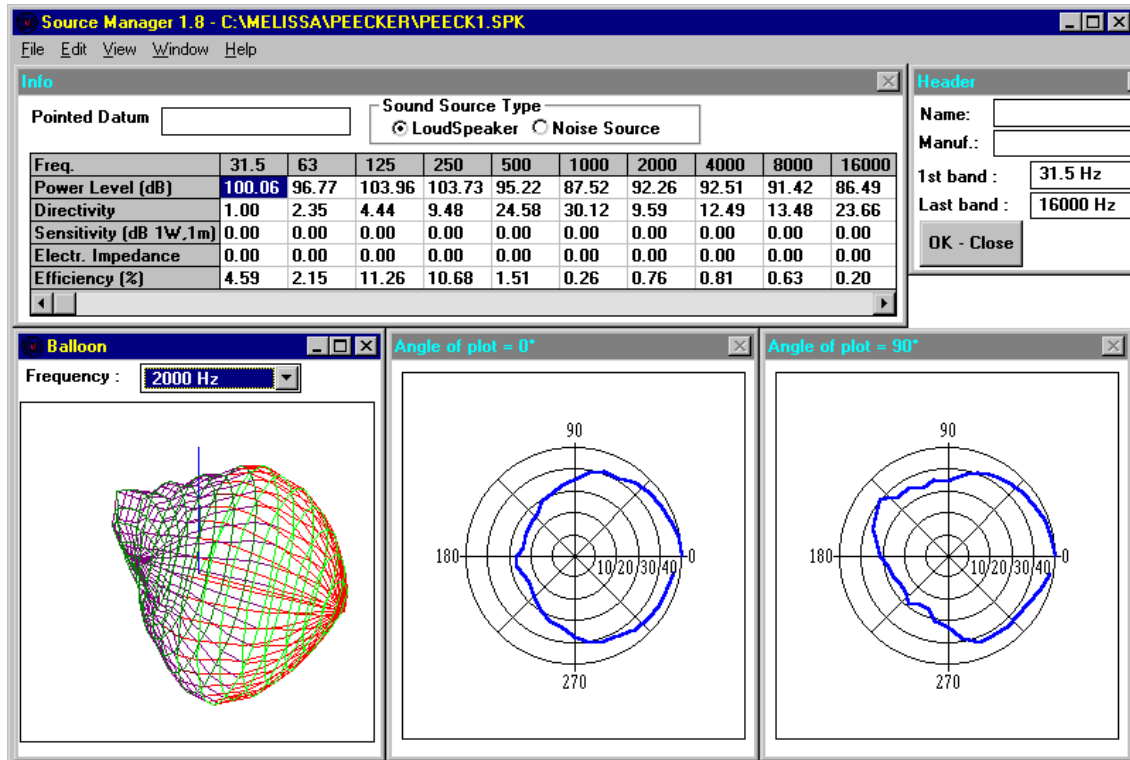
Longitudinal Direction

Dist. (m)	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10K	12.5k	16k	
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.2	-1.1	-0.9	-0.7	-0.3	-0.2	-0.2	-0.1	-0.2	-0.2	-0.2	-0.6	-0.6	-1.0	-1.6	-3.5	-4.0	-4.2	-0.9	4.2	-0.6	-1.6	-3.5	1.1	-0.2	0.6	0.0	-0.5	-2.8	
0.4	-1.3	-1.1	-0.9	-0.6	-0.6	-0.6	-0.4	-0.5	-0.9	-0.5	-1.8	-1.9	-2.8	-4.2	-8.3	-6.5	-5.0	-6.4	3.4	-2.3	-3.6	-4.5	1.2	-1.9	-1.4	-0.5	-2.2	-4.7	
0.6	-1.2	-1.2	-1.2	-1.2	-1.4	-1.1	-0.7	-0.9	-1.9	-1.0	-3.5	-3.4	-4.9	-6.7	-8.3	-6.0	-8.2	-12.4	0.7	-4.0	-4.9	-5.7	-1.7	-6.7	-2.5	-3.4	-4.0	-5.9	
0.8	-1.9	-2.0	-1.9	-2.0	-2.1	-1.7	-1.1	-1.2	-3.2	-1.6	-5.3	-4.8	-6.7	-8.3	-8.2	-8.1	-13.1	-9.5	-1.3	-5.3	-6.0	-6.4	-5.1	-7.8	-5.6	-4.8	-7.6	-6.8	
1.0	-2.2	-2.2	-2.3	-2.6	-3.0	-2.5	-1.7	-1.7	-4.2	-2.3	-7.4	-5.8	-8.5	-8.6	-9.4	-13.8	-12.1	-7.8	-1.2	-5.3	-4.0	-1.5	-9.9	-12.9	-12.8	-5.5	-7.9	-11.0	
1.2	-2.6	-2.8	-3.0	-3.6	-4.1	-3.3	-2.2	-1.6	-6.7	-3.2	-8.9	-7.2	-10.1	-9.7	-12.1	-14.6	-9.2	-11.4	-3.4	-6.7	-6.8	-5.7	-14.5	-11.9	-8.1	-7.7	-12.9	-12.8	
1.4	-3.6	-3.8	-4.0	-4.6	-5.1	-4.1	-2.8	-1.7	-8.5	-3.9	-10.2	-8.4	-11.5	-10.6	-14.7	-13.1	-10.4	-14.9	-3.9	-6.3	-6.3	-5.5	-13.2	-14.9	-14.9	-11.0	-10.1	-13.2	
1.6	-4.6	-4.8	-5.0	-5.7	-6.3	-5.1	-3.5	-1.8	-10.6	-5.1	-10.6	-10.3	-12.1	-11.9	-16.6	-13.8	-11.1	-12.9	-4.9	-6.9	-7.1	-6.7	-15.4	-14.4	-14.2	-8.7	-11.3	-16.8	
1.8	-4.3	-4.9	-5.4	-6.6	-7.6	-6.2	-4.3	-1.9	-12.3	-6.2	-10.7	-12.4	-12.3	-13.7	-17.6	-17.9	-14.4	-16.7	-6.0	-7.9	-8.8	-7.6	-16.6	-15.9	-16.6	-11.2	-8.7	-15.2	
2.0	-4.7	-5.1	-5.6	-7.2	-9.2	-7.3	-5.0	-2.2	-13.4	-7.9	-10.3	-14.5	-12.9	-16.7	-18.9	-15.2	-10.8	-16.0	-4.7	-8.8	-11.4	-8.8	-15.9	-16.6	-15.6	-14.9	-10.7	-14.2	
2.2	-5.0	-5.5	-6.1	-7.9	-11.0	-8.6	-5.9	-2.5	-12.6	-9.3	-11.1	-15.2	-13.9	-20.9	-19.1	-16.4	-12.4	-16.2	-4.7	-9.7	-11.6	-8.5	-16.6	-18.2	-16.2	-16.2	-11.9	-11.7	
2.4	-5.3	-5.4	-6.8	-7.7	-12.9	-10.0	-6.6	-2.8	-12.2	-11.9	-11.4	-15.5	-16.0	-21.7	-16.7	-17.9	-14.4	-16.7	-6.0	-10.1	-12.7	-10.3	-16.3	-18.8	-14.5	-18.3	-14.8	-17.2	
2.6	-5.4	-5.7	-6.2	-8.1	-14.4	-11.9	-7.7	-3.2	-11.7	-14.4	-12.8	-15.1	-19.1	-20.2	-15.7	-19.5	-14.6	-15.3	-5.7	-10.8	-13.3	-10.7	-16.7	-22.7	-17.3	-18.2	-16.4	-17.1	
2.8	-6.0	-6.3	-6.8	-8.6	-15.4	-13.4	-8.6	-3.5	-10.9	-17.1	-14.0	-15.2	-20.7	-20.5	-16.7	-20.8	-14.4	-16.2	-6.3	-11.2	-13.4	-9.9	-17.0	-21.9	-22.1	-19.3	-18.8	-16.3	
3.0	-6.0	-6.2	-6.5	-8.3	-16.3	-15.4	-9.8	-4.1	-10.3	-20.3	-15.4	-16.3	-20.6	-23.7	-17.5	-19.7	-14.8	-15.3	-6.5	-12.9	-15.1	-11.1	-20.4	-23.3	-20.5	-20.0	-19.2	-21.6	
3.2	-6.1	-6.2	-6.4	-8.1	-16.4	-17.6	-11.0	-4.8	-9.8	-19.8	-16.1	-18.2	-19.7	-27.1	-17.0	-19.5	-15.6	-17.5	-7.6	-13.8	-15.6	-11.9	-21.7	-24.5	-22.0	-21.1	-20.2	-24.2	
3.4	-5.5	-7.0	-8.2	-10.2	-17.8	-19.2	-12.2	-5.2	-9.8	-20.5	-17.7	-19.5	-19.5	-26.3	-16.6	-20.6	-15.9	-17.7	-7.9	-13.2	-16.6	-12.3	-21.6	-23.0	-25.2	-23.5	-22.3	-24.4	
3.6	-5.7	-7.1	-8.0	-9.7	-16.7	-22.0	-13.5	-5.9	-10.2	-21.0	-19.8	-21.7	-19.9	-33.7	-17.0	-22.9	-18.8	-17.2	-8.3	-12.8	-16.8	-12.2	-21.3	-20.9	-23.5	-24.2	-25.1	-25.8	
3.8	-5.6	-7.2	-8.3	-9.9	-16.8	-23.3	-14.5	-6.5	-10.0	-18.8	-20.1	-23.5	-20.8	-21.7	-18.2	-23.1	-16.5	-18.0	-8.5	-13.0	-17.0	-12.4	-22.5	-22.4	-26.2	-24.9	-24.1	-27.7	
4.0	-4.4	-6.4	-7.9	-9.9	-17.0	-25.3	-15.9	-7.3	-10.0	-17.4	-21.5	-24.9	-22.7	-20.6	-20.1	-21.3	-18.8	-18.5	-8.1	-13.3	-16.4	-11.2	-22.4	-21.4	-25.8	-27.2	-26.9	-28.7	
4.2	-5.5	-7.2	-8.2	-9.6	-15.7	-27.3	-17.3	-8.0	-10.5	-17.5	-22.2	-25.0	-25.1	-20.5	-22.0	-20.8	-20.9	-17.5	-9.3	-13.0	-16.4	-12.6	-24.3	-24.7	-28.4	-27.9	-25.0	-28.7	
4.4	-4.5	-6.4	-7.7	-9.4	-15.4	-27.9	-18.7	-8.9	-10.9	-17.0	-22.6	-24.6	-26.1	-21.3	-21.5	-21.4	-19.4	-17.5	-8.4	-14.3	-18.0	-12.3	-23.8	-23.5	-26.6	-29.3	-28.1	-30.6	
4.6	-6.2	-7.4	-8.0	-9.0	-14.3	-26.4	-19.7	-9.7	-11.6	-16.7	-23.3	-23.8	-25.8	-22.7	-20.8	-23.1	-18.5	-19.7	-9.5	-13.9	-19.4	-12.5	-24.8	-24.3	-26.2	-29.4	-28.2	-30.7	
4.8	-5.8	-7.2	-7.9	-9.0	-14.1	-25.5	-21.0	-10.4	-12.0	-16.7	-23.1	-23.7	-24.4	-24.1	-20.5	-24.6	-19.6	-21.2	-10.7	-14.5	-21.1	-13.9	-26.1	-25.7	-27.6	-29.5	-27.8	-30.2	
5.0	-5.8	-7.2	-8.0	-9.1	-14.0	-24.5	-22.7	-11.3	-12.7	-16.9	-22.5	-24.0	-23.0	-26.2	-20.9	-24.6	-21.5	-19.9	-8.9	-16.0	-20.9	-12.7	-25.0	-23.6	-24.4	-31.6	-31.8	-33.9	
5.5	-7.2	-8.2	-8.5	-9.1	-13.2	-21.7	-25.9	-13.5	-14.3	-17.9	-24.5	-25.0	-21.6	-28.5	-24.5	-26.8	-20.3	-22.6	-11.1	-16.9	-19.6	-14.6	-25.8	-25.5	-25.6	-32.9	-32.7	-36.1	
6.0	-9.3	-10.2	-10.2	-10.2	-13.6	-20.7	-27.6	-15.6	-15.7	-18.6	-25.1	-27.1	-21.5	-28.2	-26.4	-33.2	-20.5	-23.2	-11.3	-16.1	-20.1	-15.3	-26.2	-25.5	-25.2	-34.7	-35.2	-38.5	
6.5	-9.7	-10.6	-10.5	-10.4	-13.5	-19.7	-27.5	-19.5	-18.0	-19.4	-26.2	-30.7	-27.2	-28.3	-22.4	-28.6	-24.3	-25.2	-10.6	-18.0	-22.5	-15.7	-26.7	-26.8	-25.9	-35.9	-36.8	-40.4	
7.0	-11.5	-11.5	-10.9	-10.5	-13.2	-18.8	-26.0	-22.8	-19.9	-21.0	-28.3	-31.8	-25.2	-29.5	-22.1	-26.9	-22.0	-23.1	-14.1	-18.8	-23.8	-16.1	-26.4	-26.5	-26.1	-35.1	-37.5	-42.3	
7.5	-6.7	-8.6	-9.6	-10.6	-14.3	-20.0	-26.1	-26.7	-21.5	-22.3	-30.2	-29.0	-29.1	-31.5	-23.9	-28.6	-24.1	-24.1	-11.2	-19.1	-24.1	-16.2	-26.7	-28.8	-27.0	-35.9	-39.4	-43.1	
8.0	-7.5	-9.1	-10.0	-10.7	-14.1	-19.6	-25.1	-28.8	-23.8	-23.9	-31.0	-27.8	-32.4	-32.0	-28.5	-30.8	-27.5	-25.6	-16.4	-20.9	-25.9	-18.3	-28.0	-30.3	-29.3	-37.7	-40.0	-43.6	
8.5	-7.3	-9.1	-10.2	-11.1	-14.6	-19.9	-24.7	-28.5	-25.9	-26.1	-32.3	-26.5	-34.9	-32.8	-32.9	-30.6	-26.3	-25.4	-13.1	-22.5	-28.0	-19.7	-29.7	-33.4	-32.3	-40.8	-42.8	-47.2	
9.0	-8.6	-10.0	-10.7	-11.3	-14.4	-19.4	-24.1	-28.6	-28.0	-26.8	-34.2	-26.1	-33.7	-33.4	-30.8	-30.2	-25.6	-25.3	-15.2	-21.7	-28.2	-19.9	-30.0	-33.3	-31.4	-39.9	-42.4	-46.7	
9.5	-8.7	-10.4	-11.2	-11.8	-15.0	-19.8	-24.0	-27.5	-30.1	-28.9	-33.8	-25.6	-31.1	-34.4	-28.5	-30.3	-26.6	-25.6	-17.8	-22.3	-28.1	-20.4	-30.0	-33.1	-31.3	-40.0	-43.9	-47.7	
10.0	-7.9	-9.7	-10.9	-11.8	-15.2	-20.3	-24.3	-26.8	-31.5	-31.0	-38.0	-25.4	-30.7	-35.7	-26.3	-31.8	-29.8	-26.0	-14.9	-22.6	-27.6	-20.1	-29.2	-32.0	-30.9	-39.0	-45.3	-48.2	
10.5	-8.8	-10.7	-11.7	-12.4	-15.4	-20.0	-23.4	-25.0	-33.4	-32.6	-36.2	-26.2	-29.5	-38.2	-25.4	-31.7	-31.4	-26.0	-15.3	-21.4	-29.6	-21.1	-30.2	-33.8	-32.7	-40.2	-46.6	-50.3	
11.0	-9.5	-11.1	-11.9	-12.4	-15.3	-19.7	-23.0	-24.3	-34.1	-34.5	-37.8	-26.2	-29.2	-39.3	-25.1	-35.5	-29.3	-27.3	-18.1	-22.2	-28.2	-21.4	-31.5	-34.3	-33.8	-41.5	-47.8	-50.3	
11.5	-10.0	-11.8	-12.8	-13.4	-16.3	-20.6	-23.6	-24.3	-33.7	-35.3	-39.5	-27.1	-28.8	-41.0	-25.5	-33.8	-27.7	-29.2	-17.6	-23.5	-29.8	-22.6	-30.9	-34.3	-33.8	-40.0	-46.8	-51.6	
12.0	-10.0	-12.0	-13.1	-13.7	-16.7	-21.1	-24.1	-24.4	-33.4	-36.4	-38.4	-27.6	-29.0	-42.8	-26.1	-34.3	-27.2	-29.6	-16.4	-24.1	-30.8	-22.8	-33.1	-34.6	-34.0	-41.7	-49.6	-52.5	
12.5	-9.5	-11.6	-12.7	-13.4	-16.3	-20.7	-23.7	-24.2	-34.5	-40.7	-40.5	-28.9	-28.4	-42.0	-27.5	-34.2	-27.8	-29.6	-16.7	-23.2	-30.3	-23.0	-32.7	-35.1	-35.6	-42.0	-49.3	-53.0	
13.0	-10.2	-12.2	-13.2	-13.8	-16.8	-21.1	-24.2	-24.6	-35.0	-41.3	-41.6	-29.9	-29.7	-42.5	-30.1	-34.0	-29.5	-29.3	-18.5	-23.5	-30.6	-25.6	-33.9	-36.2	-36.0	-42.2	-51.4	-54.8	
13.5	-9.3	-11.6	-13.0	-14.1	-17.5	-22.2	-25.2	-25.0	-33.5	-44.3	-43.8	-29.3	-30.0	-39.0	-31.2	-34.7	-32.2	-29.3	-21.0	-25.7	-31.4	-26.0	-34.3	-36.8	-38.0	-43.8	-52.8	-55.5	
14.0	-8.6	-11.1	-12.7	-13.8	-17.3	-22.1	-25.2	-24.8	-33.2	-44.1	-45.5	-30.1	-30.4	-37.5	-33.2	-35.0	-35.4	-29.4	-19.6	-27.4	-31.4	-25.0	-35.3	-36.9	-39.1	-45.2	-53.1	-56.2	
14.5	-13.0	-13.7	-13.5	-13.1	-15.5	-20.2	-24.9	-26.1	-29.9	-38.3	-44.9	-31.3	-29.9	-38.5	-37.7	-35.2	-37.1	-31.0	-18.6	-28.7	-32.9	-26.0	-35.8	-37.9	-38.7	-44.8	-51.3	-55.7	
15.0	-11.3	-13.0	-13.8	-14.2	-16.9	-21.4	-24.8	-25.5	-32.2	-39.3	-46.0	-32.6	-31.7	-38.8	-37.9	-36.9	-36.7	-31.6	-17.5	-26.7	-32.6	-28.1	-35.5	-36.5	-38.3	-43.4	-50.5	-55.4	



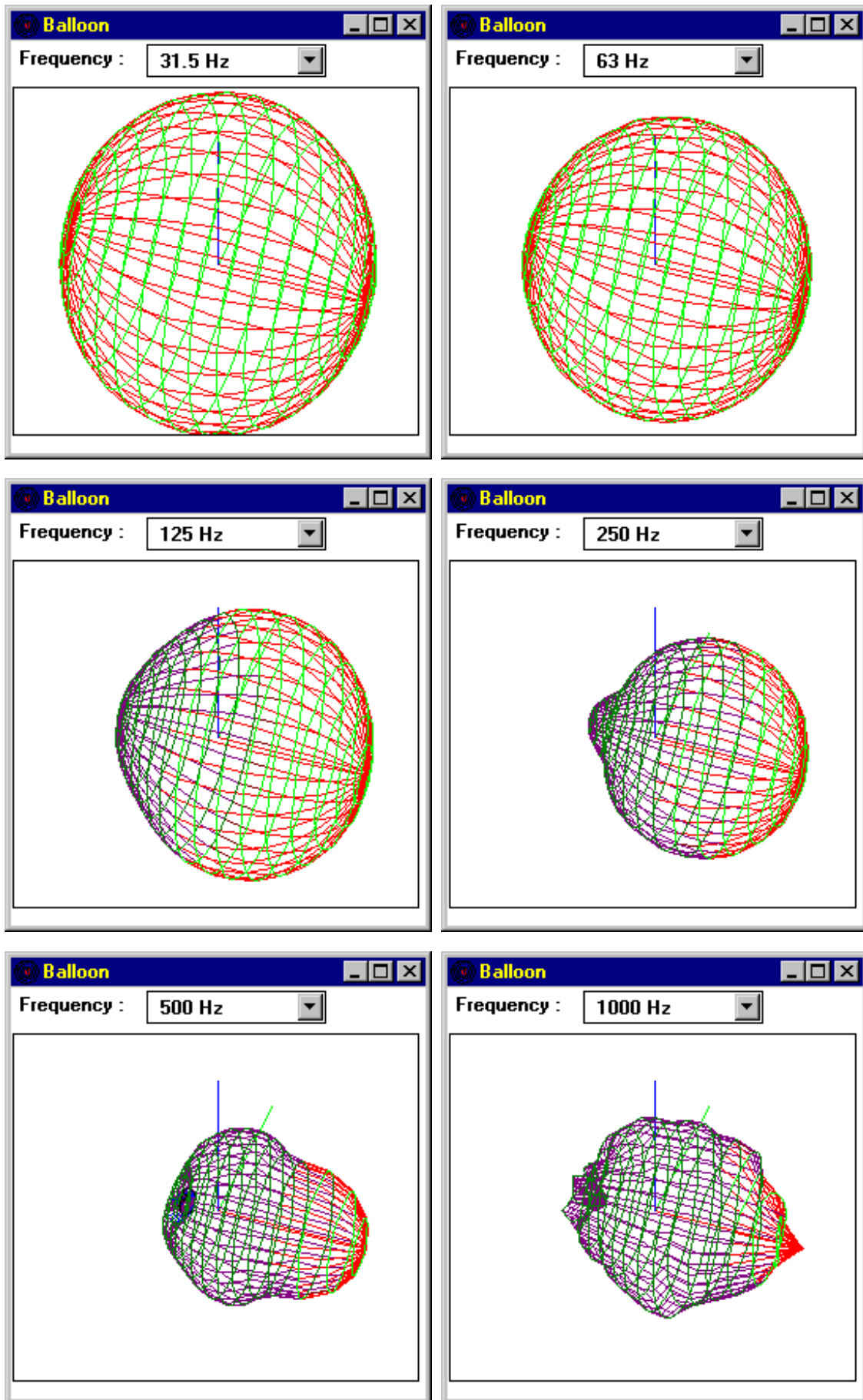
3. Extrapolation of the directivity “balloons” on the basis of the directivity curves

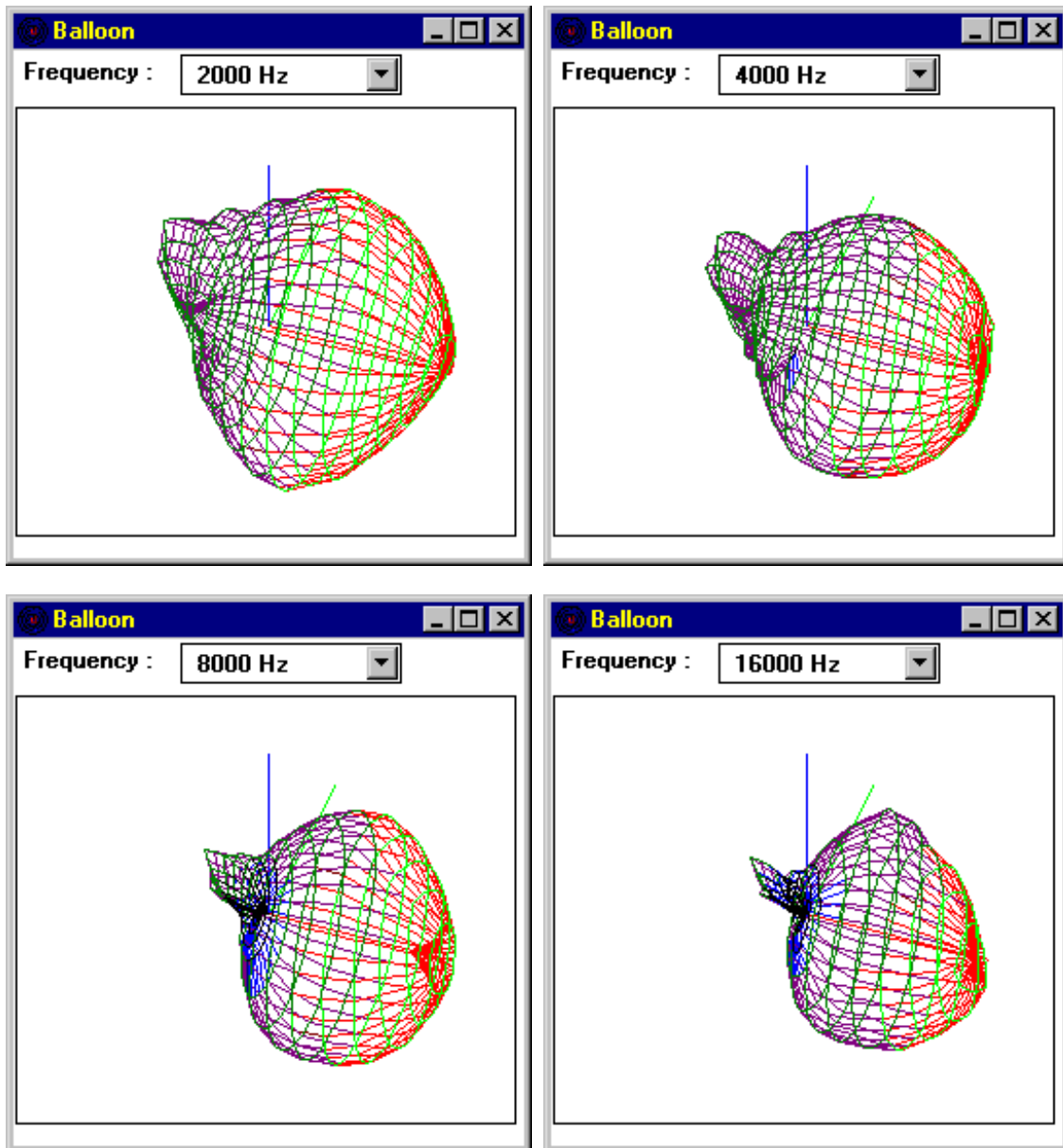
The directivity data obtained experimentally were used to define completely the three-dimensional emission of the sound source, using the Ramsete calculation program. In particular, the Source Manager module was used to transform, by means of interpolation, the directivity curves on the two orthogonal planes into complete “balloons”; the figure below shows the result of that operation for the frequency of 2000 Hz, as well as the volume levels obtained from the calculation (it should be noted that these derive from the particular value of the power supply used during the course of the test and, therefore, they do not represent the maximum capacity obtainable from the speaker being tested).



The calculation was made for all the octave bands from 31.5 to 16000 Hz, and, in this way, the three-dimensional diagrams (“balloons”) of directivity have been built up for all the frequencies. The source description file obtained (PEECK1.SPK), enclosed on floppy disk with this report, makes it possible to apply the anticipatory calculation of the sound levels and other acoustic parameters (ratio direct field/reverberation field, clarity index, Speech Transmission Index) in environments of arbitrary shape, taking into account the effective acoustic properties of the materials and the exact position of the sound sources.

The following figures report 10 such balloons:





It should be noted that the principal axis (red) of the loudspeaker in the diagrams above faces horizontally, but it has been designed for use with the main axis facing downwards. Consequently, the side of the loudspeaker with the tweeters corresponds to the upper side of the balloons (blue axis).

The Tester
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