



**Relazione di Prova n° 03/99**  
costituita di n. 11 pagine

Parma, 20 marzo 1999

**Richiedente:** Sound Corporation S.a.s  
Via Giardini, 109  
41043 Formigine (MO)  
P. IVA 00721540367

**Oggetto della Prova:** Determinazione delle curve di direttività e della dispersione laterale di un diffusore sonoro multi-via Peecker Sound **Double Array Series** mod. **AS 120 CrossFire**

## 0. Premessa

Su domanda del richiedente, in data 5/3/1999 sono stati eseguiti rilievi acustici su un diffusore prodotto dal richiedente, denominato **peecker sound Double Array Series** mod. **AS 120 CrossFire**.

Si tratta di un diffusore sonoro speciale, costituito da due tweeter a tromba e da un woofer quadrato dotato di 64 diffusori, disposti in matrice quadrata. Esso è progettato per essere installato orizzontalmente, rivolto verso il basso, in modo da produrre elevati livelli sonori al di sotto dello stesso, limitando contemporaneamente le emissioni sonore verso le zone laterali.

I rilievi sono stati eseguiti con due diverse metodologie:

- misura dei diagrammi di dispersione polare (“curve di direttività”) in campo libero simulato, facendo impiego di una tavola rotante e del sistema di analisi MLSSA.
- misura dello spettro del livello sonoro prodotto a m 1.5 dal suolo dal diffusore sonoro installato in posizione operativa (appeso a m 3.2 dal suolo riflettente, rivolto in basso) lungo due direttrici ortogonali.

La prima misura consente di quantificare le proprietà di emissione direttiva del diffusore: tali dati sono richiesti, ad esempio, per l’impiego di programmi di simulazione dell’acustica delle sale. La seconda misura ha viceversa consentito di verificare sperimentalmente il comportamento del diffusore in condizioni effettive di impiego, tenendo in considerazione anche la riflessione sul pavimento, che influenza in modo significativo la dispersione del suono nello spazio vista la particolare modalità di impiego del diffusore.

Impiegando il programma di calcolo RAMSETE, è stato infine effettuato il calcolo dei “balloon” di direttività tridimensionale, indispensabili per poter compiere simulazioni della propagazione sonora in ambienti chiusi con programmi di simulazione.

## 1. Strumentazione utilizzata.

Sono state impiegate le seguenti apparecchiature, preventivamente verificate presso il Laboratorio di questo Dipartimento:

- Personal computer Epson PC-AX3S con scheda di acquisizione dati MLSSA.
- Analizzatore di spettro in tempo reale Larson Davis modello 2900 con microfono per campo libero Larson Davis da 1/2".

Tutta la strumentazione suddetta era stata preventivamente verificata e calibrata presso il laboratorio di questo Dipartimento, utilizzando strumentazione di riferimento con classe 0 di precisione (analizzatore di spettro Bruel & Kjaer tipo 2133 e sorgente campione B&K tipo 4230).

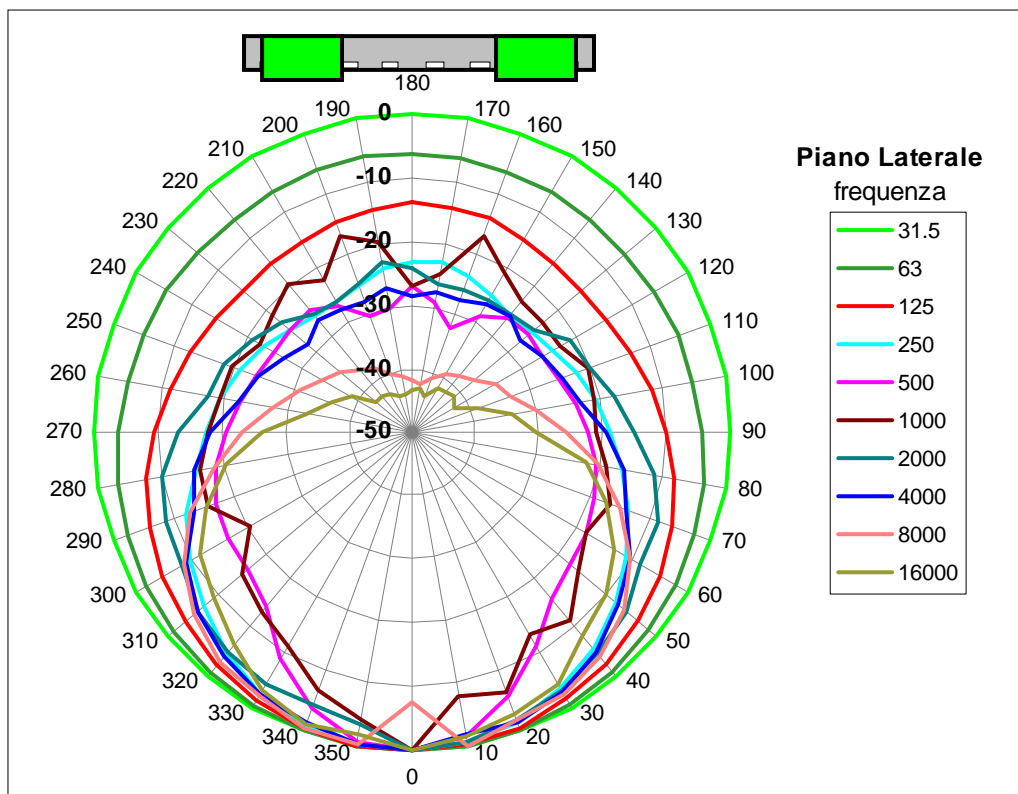
## 2. Rilievi eseguiti

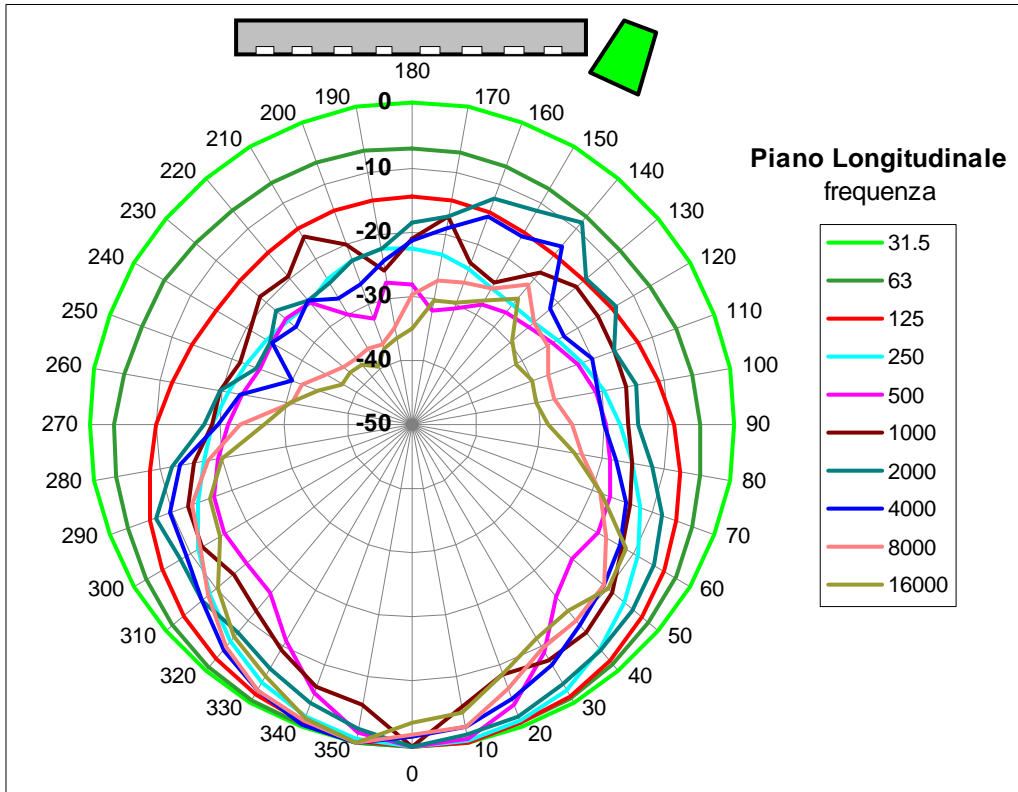
### 2.1 Diagrammi di dispersione polare

I diagrammi di dispersione polare sono stati ottenuti collocando la sorgente sonora sulla tavola rotante, sincronizzata con la scheda MLSSA che ne comandava la rotazione a passi di 10°. Il microfono è stato collocato sul pavimento, in modo che la riflessione sullo stesso risultasse ininfluenza sulla misura. Le riflessioni sulle altre pareti di prova del laboratorio sono state rese ininfluenti mediante l'adozione di una idonea finestra temporale, applicata alla risposta all'impulso misurata prima della sua analisi FFT.

Dagli spettri sonori in banda stretta (FFT di 16384 punti) sono stati calcolati i livelli in banda d'ottava e di terzo d'ottava, dai quali sono stati ricavati i diagrammi di dispersione polare, normalizzando a 0 dB i livelli sonori nella direzione di massima emissione.

Le seguenti 2 figure riportano sovrapposte le curve di direttività in bande d'ottava.





Le seguenti tabelle riportano invece i dati di direttività in bande di 1/3 d'ottava:

**Piano Laterale**

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	-33.7	-30.4	-23.7	-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	

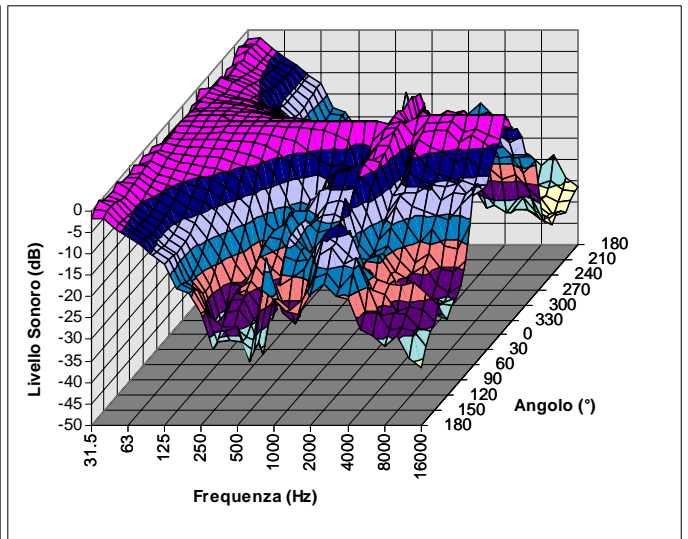
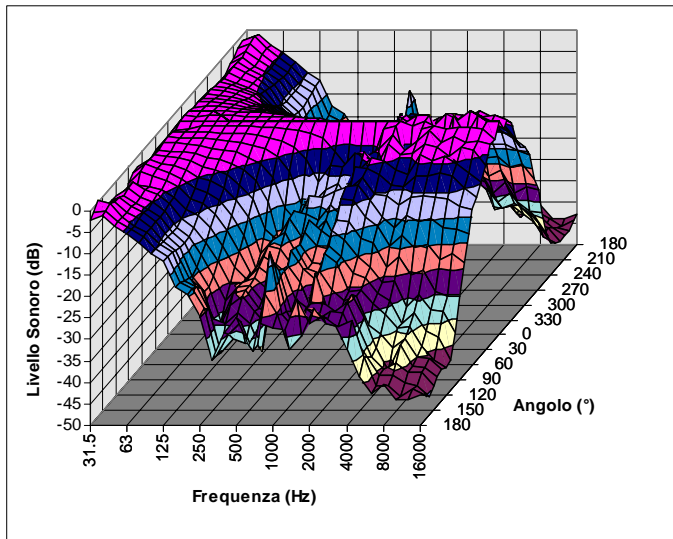
### Piano Longitudinale

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	-29.2	-31.8	-32.8	-18.8	-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	-19.9	-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	-37.5	-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	-21.1	-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	-23.9	-21.1	-25.2	-29.9	-28.5	-33.3	-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	-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	-17.3	-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
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

Le seguenti due figure riportano tali dati in forma grafica tridimensionale:

**Piano Laterale**

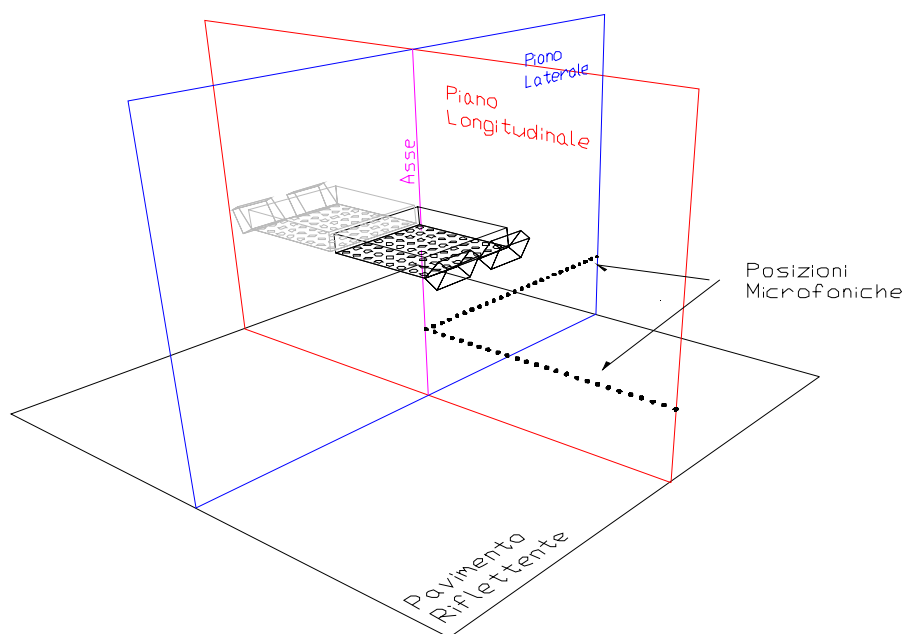
**Piano Longitudinale**



## 2.2 Misura dei livelli sonori in posizione operativa

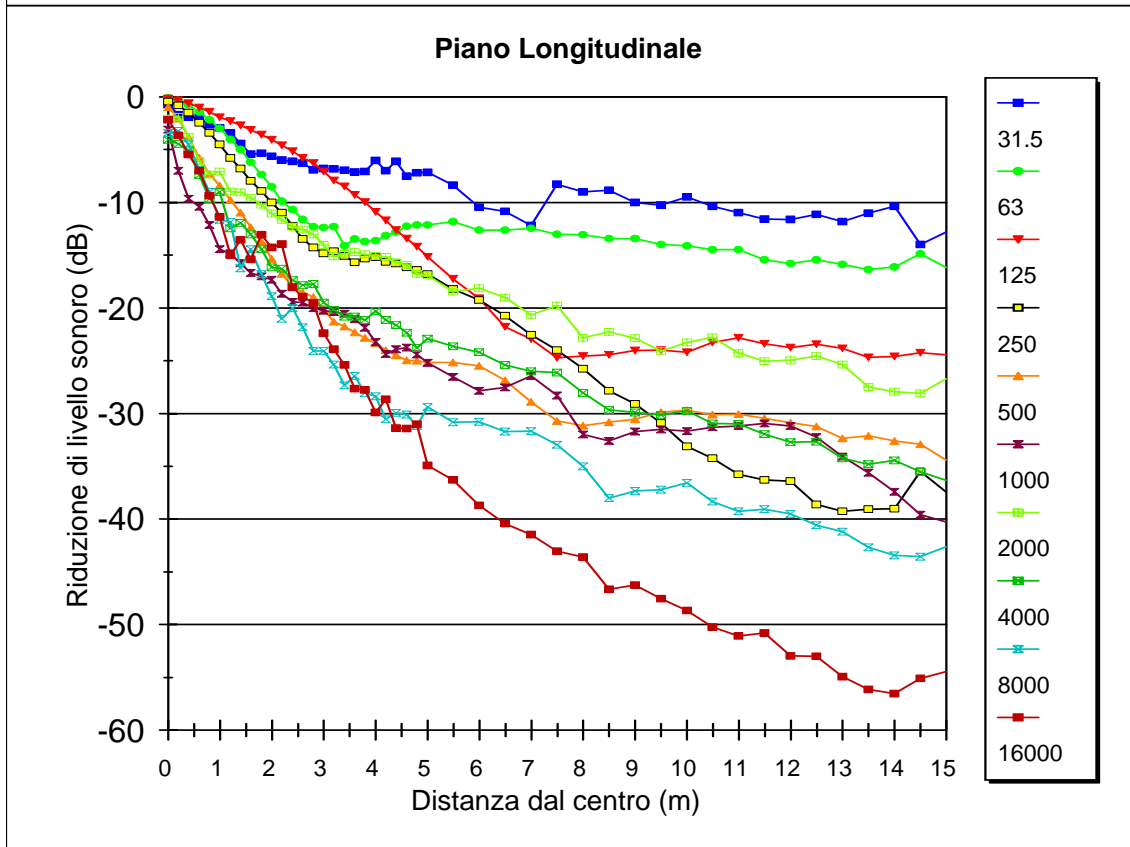
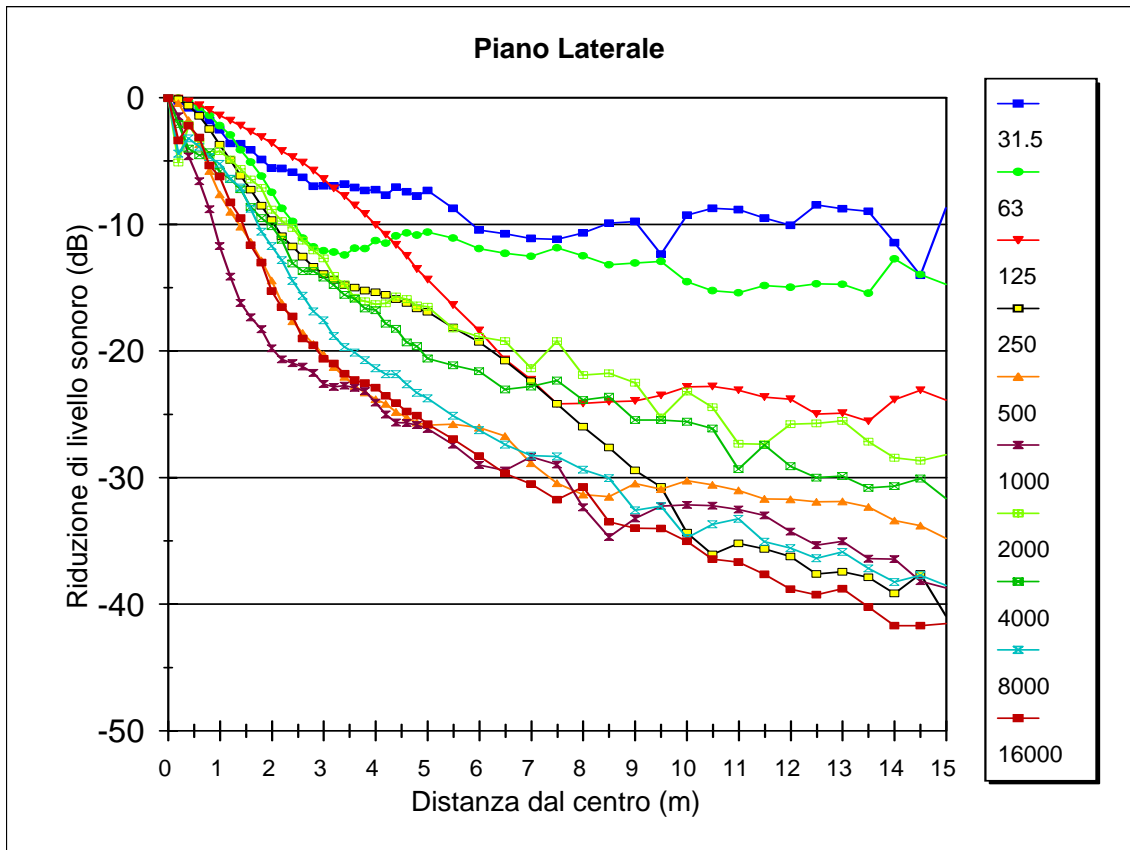
L'altoparlante è stato installato con il suo piano di emissione rivolto verso il pavimento riflettente del laboratorio, ad una altezza di m 3.20 dallo stesso. Il microfono è stato collocato su un treppiede, ad una altezza di m 1.50 dal pavimento.

Partendo dalla posizione collocata esattamente sotto il centro del diffusore, sono stati misurati gli spettri sonori in banda di 1/3 d'ottava lungo due direttrici ortogonali (laterale e longitudinale), corrispondenti ai due piani in cui precedentemente erano state determinate le curve di direttività. Il microfono è stato spostato lungo le direttrici con un passo di 0.2 m fino alla distanza di m 5 dall'asse del diffusore, indi con passo di 0.5 m fino alla distanza di m 15 dall'asse del diffusore. La seguente figura mostra schematicamente la geometria adottata per la prova, fino alla distanza di m 5 dall'asse del diffusore. Sebbene la configurazione degli altoparlanti costituenti il diffusore non sia simmetrica sul piano longitudinale, la determinazione dei livelli sonori è stata effettuata solo sul lato indicato: questo perché nell'utilizzo reale il diffusore viene installato affiancato ad un altro elemento identico, come mostrato dalla figura, e pertanto l'emissione sonora fuori-asse va determinata solo sul lato ove sono collocati i tweeter a tromba.



L'altoparlante è stato alimentato con rumore bianco MLS, ma gli spettri sonori misurati in ciascun punto sono stati normalizzati rispetto allo spettro rilevato nel punto "0" (asse del diffusore).

Le seguenti due figure riportano i profili spaziali dei livelli sonori in bande di ottava, lungo le due direttrici laterale e longitudinale.



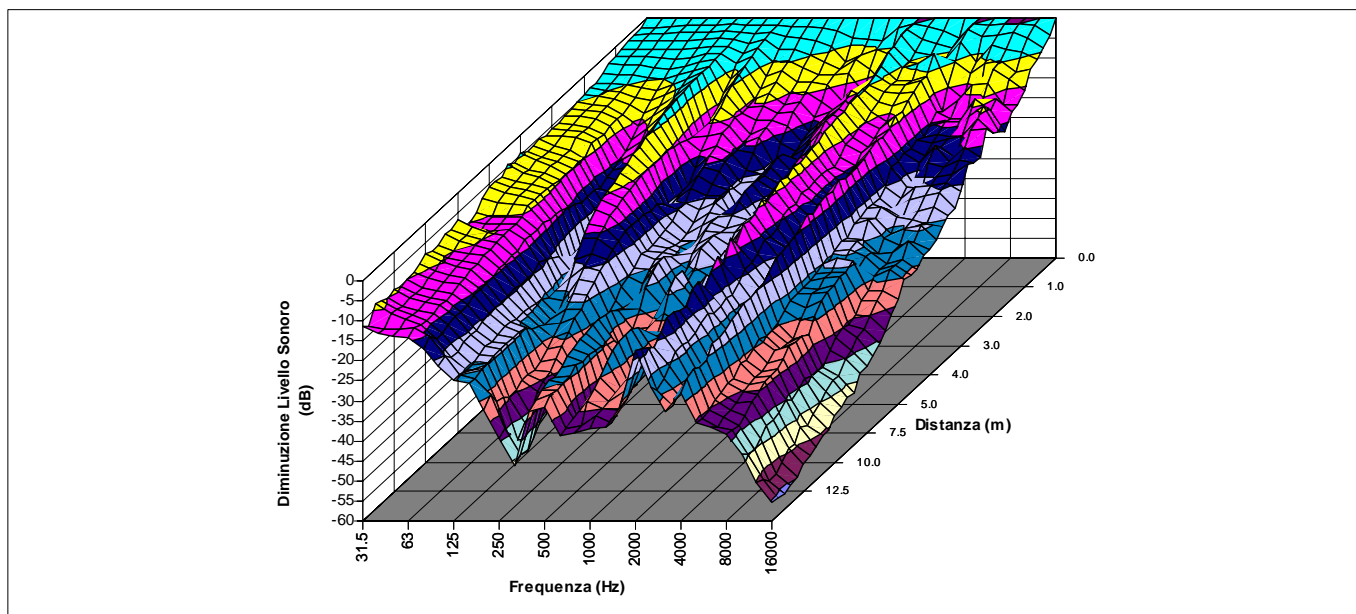
Nelle due pagine seguenti sono riportati gli stessi dati in bande di 1/3 d'ottava, sia in forma tabellare che mediante rappresentazione grafica tridimensionale:

### Direzione Laterale

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	-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	-3.0
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	-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	-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	-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	-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	-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	-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	-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	-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	-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	-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	-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	-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	-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	-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	-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	-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	-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	-22.6	-23.6	-22.0	-25.6	-25.4	-18.5	-15.3	-16.2	-14.5	-17.9	-19.5	-19.2	-19.8	-24.1	-21.5	-26.2	-26.2
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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	-27.4
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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	-28.0
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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	-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	-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	-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	-32.6
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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	-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	-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	-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	-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	-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	-34.8	-32.4	-34.8	-32.4	-26.7	-26.6	-25.1	-28.4	-30.6	-34.5	-32.8	-37.0	-36.8	-39.2	-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	-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	-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	-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	-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	-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	-44.2
15.0	-7.6	-10.2	-11.8</																										

### Direzione Longitudinale

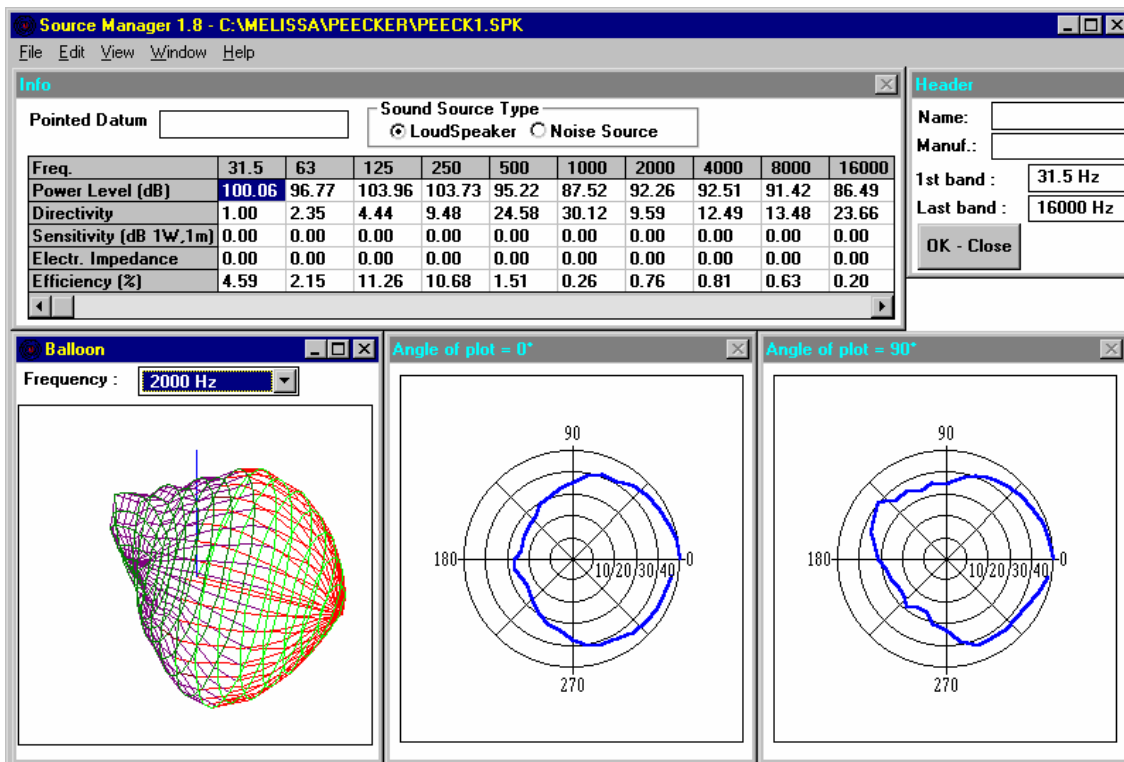
Dist. (m)	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10K	12.5k	16k	
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.2	-1.1	-0.9	-0.7	-0.3	-0.2	-0.2	-0.1	-0.2	-0.2	-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	-14.5	-10.9	-12.9	-4.6	-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	-19.0	-11.9	-11.7	
2.4	-5.3	-5.4	-5.8	-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	-23.1	-17.0	-22.9	-15.8	-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	-18.9	-18.5	-8.1	-13.3	-16.4	-11.2	-22.4	-21.4	-25.8	-27.7	-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	-22.7	-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	-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	
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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	





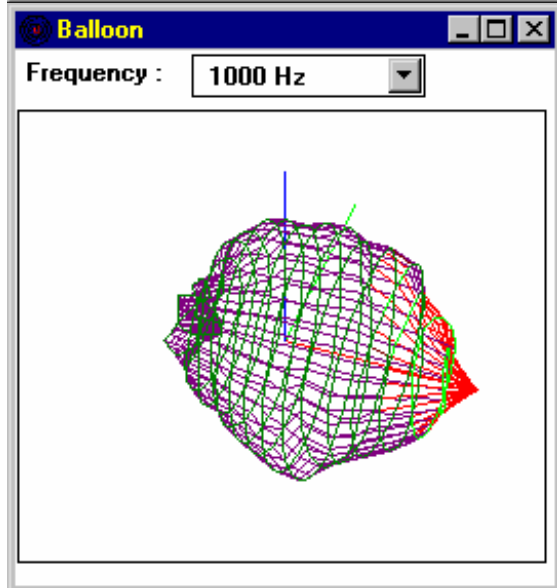
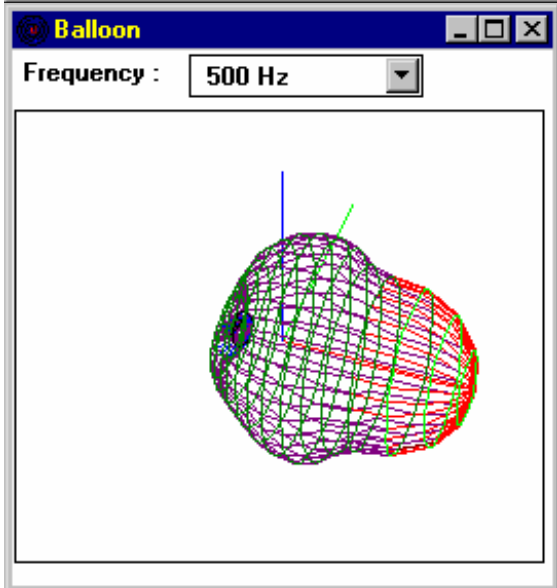
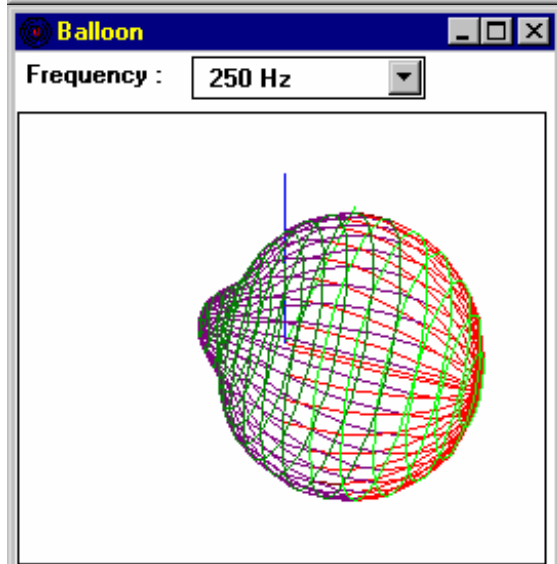
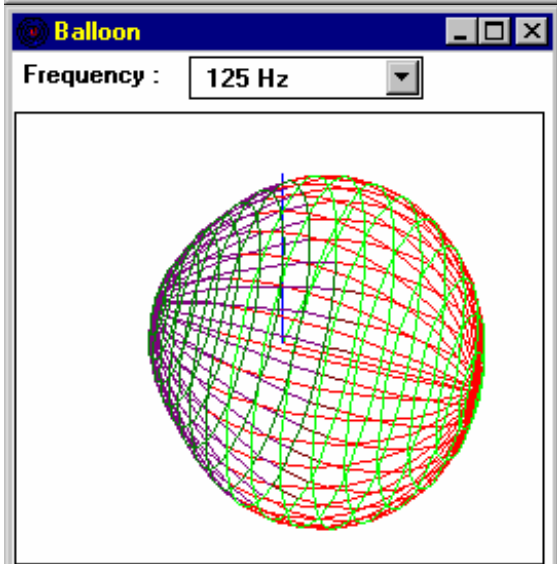
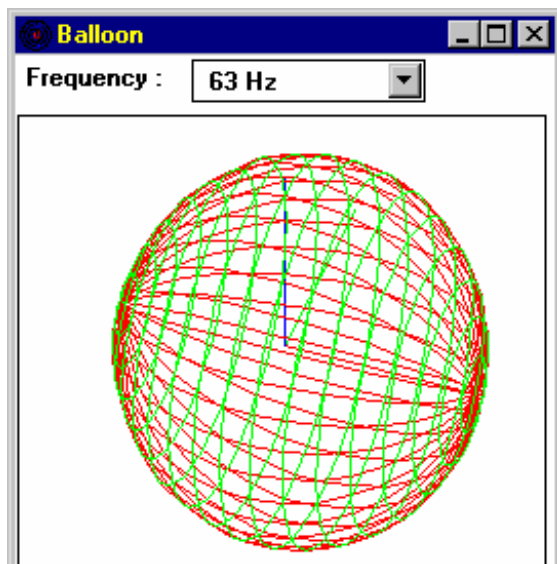
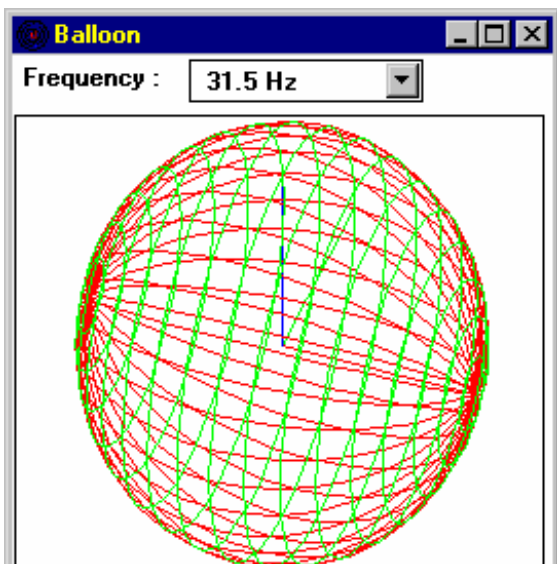
### 3. Estrapolazione dei “balloon” di direttività sulla base delle curve di direttività

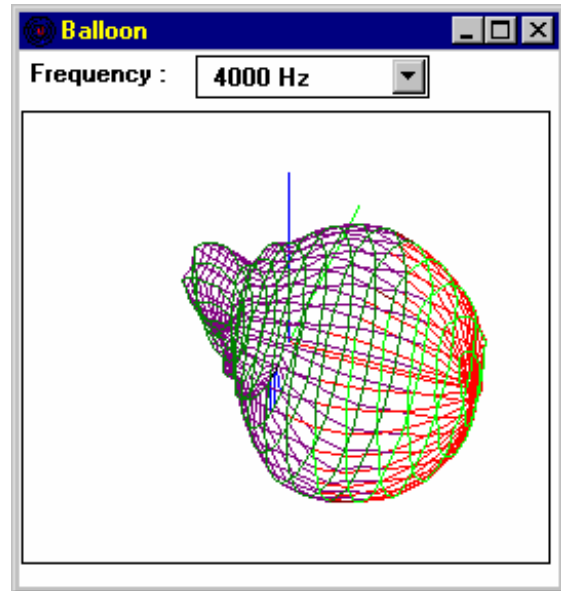
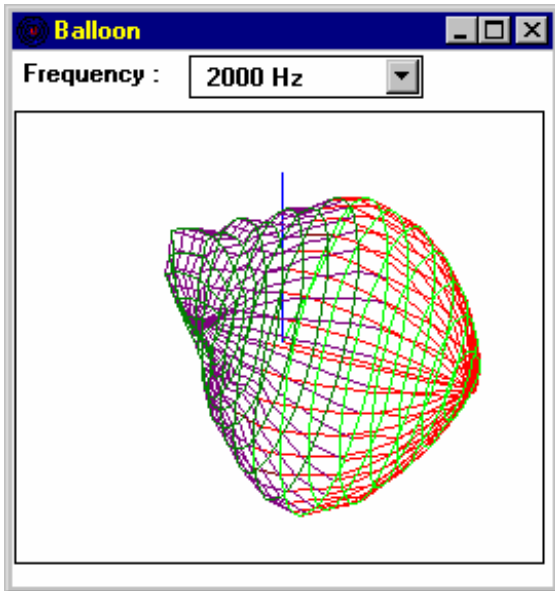
I dati di direttività ottenuti sperimentalmente sono stati impiegati per definire completamente l'emissione tridimensionale della sorgente sonora, utilizzando il programma di calcolo Ramsete. In particolare è stato impiegato il modulo Source Manager per trasformare, tramite interpolazione, le curve di direttività sui due piani ortogonali in “balloon” completi; la seguente figura mostra il risultato di tale operazione relativamente alla frequenza di 2000 Hz, nonché i livelli di potenza sonora ottenuti dal calcolo (si noti che gli stessi derivano dalla particolare valore della potenza elettrica utilizzata nel corso delle prove, e pertanto non costituiscono il valore limite ottenibile dal diffusore in prova).



Il calcolo è stato eseguito per tutte le bande d'ottava da 31.5 a 16000 Hz, ed in tal modo sono stati ricostruiti i diagrammi tridimensionali (“balloon”) di direttività a tutte le frequenze. Il file di descrizione della sorgente ottenuto (PEECK1.SPK), allegato su dischetto alla presente relazione, consente dunque di operare il calcolo previsionale dei livelli sonori e di altri parametri acustici (rapporto campo diretto/campo riverberante, indice di chiarezza, Speech Transmission Index) in ambienti di forma arbitraria, tenendo conto delle effettive proprietà acustiche dei materiali e dell'esatto posizionamento delle sorgenti sonore.

Le seguenti figure riportano tali 10 balloons:





Va osservato che nei diagrammi suddetti l'asse principale (rosso) dell'altoparlante è rivolto orizzontalmente, mentre esso è stato progettato per venire collocato con l'asse principale rivolto verso il basso. Di conseguenza il lato dell'altoparlante su cui sono collocati i tweeter risulta corrispondere al lato superiore dei balloon (asse blu).

Lo Sperimentatore  
(Ing. *Angelo Farina*)

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Il Direttore del Dipartimento  
(Prof. Ing. *Gino Ferretti*)

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