

METHOD OF MEASUREMENT	Symbol
<p>1 - AMPLITUDE-FREQUENCY RESPONSE CURVE : In accordance with the measuring methods of the French NF C 97-330 standard.</p> <p>BRUEL & KJÆR test Bench. —Sine-wave generator 1023. —Measuring amplifier 2121. —Power amplifier 2706. —RMS millivoltmeter 2425. —1/2" Measuring microphone 4133. —Level recorder 2305.</p> <p>The curve is traced from a 20 Hz - 20 kHz swept frequency source.</p>	
<p>2 - IMPEDANCE CURVE : In accordance with the measuring methods of the French NF C 97-330 standard.</p> <p>BRUEL & KJÆR test bench. —sine-wave generator 1023. —power amplifier 2706. —RMS millivoltmeter 2425. —Level recorder 2305.</p> <p>The impedance curve is traced from 20 Hz to 20 kHz.</p>	
<p>3 - DETERMINATION OF THE FORCE FACTOR : Obtained by the "balance" method. A known current I is applied to the coil, which results in a displacement. This displacement is then cancelled out by balancing. $\frac{mg}{I}$ This gives: $BL = \frac{mg}{I}$</p>	BL

Unit	MEASUREMENT CONDITIONS
	<p>—The speaker is mounted on a IEC baffle. The measurements are made in free-field condition.</p> <p>—The B & K type 4133 microphone is placed at a distance of 0.30 metre on axis (upper curve) and then at 30° off axis.</p> <p>—The measuring voltage, held constant, is 2.83 V, corresponding to an electrical power of 1 W across an 8 Ω impedance.</p> <p>—The published amplitude-frequency curves are presented with the sound pressure level adjusted for a distance of 1 m.</p> <p>—Measuring potentiometer setting 50 dB</p> <p>—Lower frequency limit 10 Hz</p> <p>—Writing speed 63 mm s⁻¹</p> <p>—Paper speed 10 mm s⁻¹</p> <p>—Zero level 64 dB SPL</p>
	<p>—The speaker is mounted on a IEC baffle.</p> <p>—It is supplied with a constant current through a resistance Rg of 3 Ω, by means of the compressor.</p> <p>—The measuring current is about 100 mA.</p> <p>—Measuring potentiometer ZR002 LINEAR</p> <p>—Reference level of the curves 0 Ω</p> <p>—Writing speed 63 mm s⁻¹</p> <p>—Paper speed 10 mm s⁻¹</p>
NA ⁻¹	<p>—The axis of the speaker is directed vertically.</p> <p>—The measuring current is a few tenths of an Ampere.</p> <p>—g : gravitational constant = 9.81 m s⁻²;</p> <p>—m : mass required to achieve balance.</p>

METHOD OF MEASUREMENT	Symbol
<p>4 - MEASUREMENT OF THE INDUCTION AND FLUX IN THE GAP :</p> <p>Exploration of the gap using a coil with a known wire length L. The force due to a current I applied to this coil is then balanced with a balance.</p> <p>In this case: $B = \frac{mg}{LI}$ where m is the mass required.</p> <p>The flux is then obtained from a knowledge of the surface area of the gap:</p> <p>$\Phi = B \cdot S_E$ where $S_E = \pi d \times H_E$.</p>	<p>B</p> <p>Φ</p>

<p>5 - MAGNETIC ENERGY :</p> $W = \frac{1}{8\pi \cdot 10^{-7}} B^2 V_E$	W
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6 - DETERMINATION OF THE PARAMETERS OF THE SPEAKER :

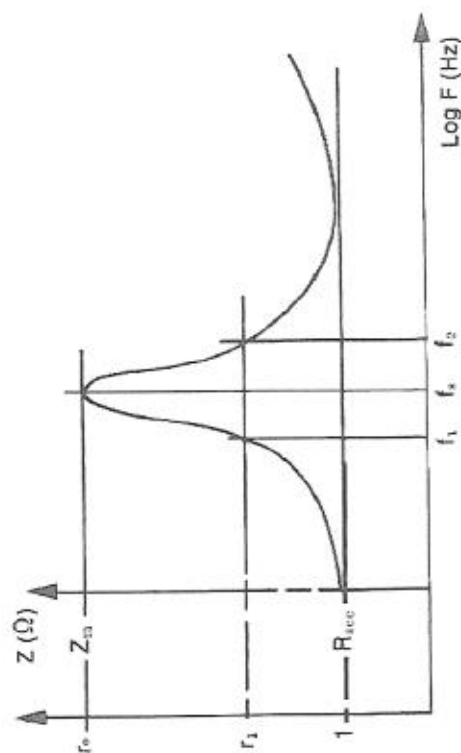


Fig. 1
Impedance change in a speaker in the region of its resonant frequency.

Unit	MEASUREMENT CONDITIONS
<p>T</p> <p>Wb</p>	<p>—The magnet system alone is tested.</p> <p>—The exploration coil is shorter than the gap.</p> <p>NOTE:</p> <p>The magnetic induction derived by this method is that which is obtained in the gap.</p>
Ws⁻¹	<p>—Magnetic induction B in Tesla.</p> <p>—V_E = volume of the gap in m³.</p>
	<p>—The speaker is mounted on a IEC baffle and run for a short break-in time at a frequency near f_0.</p> <p>—Measurements are then made on the speaker as soon as the stability of the resonant frequency has been established.</p> <p>—The speaker is fed with a constant current through a resistance $R_g = 1 \text{ k}\Omega$.</p> <p>—The voltage across its terminals is measured with a Hewlett-Packard RMS voltmeter.</p> <p>—The measuring current is chosen so that no distortion is noted on an oscilloscope connected across the speaker terminals.</p>

METHOD OF MEASUREMENT	Symbol
6a - MEASUREMENT OF THE RESONANT FREQUENCY : Sweeping of frequencies shown in Fig. 1. Noting of the frequency f_s which corresponds to the maximum value of the impedance.	f_s
6b - MEASUREMENT OF THE MECHANICAL Q FACTOR : $Z_m = \frac{Z_m}{R_{sec}}$ Determination of the ratio $r_o = \frac{Z_m}{R_{sec}}$ Then identification of the frequencies f_1 and f_2 which corresponds to an impedance satisfying the following relationship: $Z(f_1, f_2) = \sqrt{r_o \cdot R_{sec}}$ or $\Delta f = \sqrt{Z_m \cdot R_{sec}}$ where $\Delta f = f_2 - f_1$ The mechanical Q factor is then given by: $Q_{MS} = \frac{f_o \sqrt{r_o}}{f_2 - f_1}$	Q_{MS}
6c - MEASUREMENT OF THE ELECTRICAL Q FACTOR : The electrical Q factor is derived from the following relation: $Q_{ES} = \frac{Q_{MS}}{r_o - 1}$	Q_{ES}
6d - DETERMINATION OF THE TOTAL Q FACTOR : The total Q factor is then given by the expression: $Q_{TS} = \frac{Q_{MS} \cdot Q_{ES}}{Q_{MS} + Q_{ES}}$	Q_{TS}
6e - DETERMINATION OF THE MOVING MASS : A known additional mass m' is added to the moving mass M_{MD} . The new resonant frequency f_s' is then found. $M_{MD} + M_{M1} = \frac{m'}{\left(\frac{f_s'}{f_s}\right)^2 - 1}$	M_{MD}

Unit	MEASUREMENT CONDITIONS
Hz	<p>— f_s is measured using a digital frequency meter with an accuracy of one-tenth of a Hertz.</p> <p>— R_{sec} = The D.C. Resistance of the coil.</p> <p>— R_{sec} is measured with a continuous current, using an impedance bridge.</p> <p>— The measurement of f_o, f_1 and f_2 is made with as short a time interval as possible.</p>
	<p>IMPORTANT NOTE:</p> <p>The values obtained for f_1, Q_{MS}, Q_{ES} and Q_{TS} relate to a speaker mounted on a IEC baffle. They may be approximated to those obtained using an infinite baffle with reasonable accuracy.</p> <p>NOTE:</p> <p>$M_{MD} + M_{M1}$ incorporates the mass of air loading both sides of the speaker diaphragm I.E. as mounted on an infinite baffle.</p>
kg	

METHOD OF MEASUREMENT	Symbol
6f - DETERMINATION OF THE SUSPENSION COMPLIANCE : C_{NS} is obtained from f_s and M_{MD} by the relationship: $C : 1/4 \pi^2 f_s^2 M_{MD}$	C_{NS}
6g - DETERMINATION OF THE MECHANICAL RESISTANCE OF THE SYSTEM R_{NS} is deduced from the following formula, knowing Q_M , M_{MD} and f_s : $R_{NS} = \frac{2 \pi f_s M_{MD}}{Q_{NS}}$	R_{NS}
6h - MEASUREMENT OF THE INDUCTION OF THE MOVING COIL The measurement is carried out at 1 KHZ using a GENRAD 1657 measuring bridge.	L_{RM}
6i - CALCULATION OF THE ACCELERATION FACTOR $\Gamma = \frac{BL}{M_{MD}}$	Γ
7 - CHARACTERISTIC EFFICIENCY LEVEL : In accordance with the measuring methods of the French NF C 97-330 standard. Characteristic sound pressure level in dB SPL referred to 0 dB SPL = 2×10^{-5} Pa, obtained at 1 metre on reference axis of the speaker, in a free field, for an electrical power input of 1 W pink noise limited to the nominal frequency range being considered. The nominal frequency ranges are selected from the list opposite and are identified by a letter in brackets: e.g. 89 dB SPL (M).	

Unit	MEASUREMENT CONDITIONS
m N ⁻¹	
kgs ⁻¹	Although it incorporates \mathcal{R}_{MR} (the mechanical resistance corresponding to the acoustic radiation) it should be noted that $\mathcal{R}_{MR} \leq R_{NS}$ for a mounting on a IEC baffle and when the frequency is < 100 Hz. It is therefore possible to ignore the influence of \mathcal{R}_{MR} on R_{NS} .
μH	The electromagnetic drive unit is demagnetized before the test.
ms ⁻² A ⁻¹	This number quantifies the ability of a loudspeaker to respond to an impulse.
	—The speaker is mounted on a IEC baffle. The measurement is carried out under free-field condition. —The microphone is placed at 0.30 metre on reference axis of the speaker. The measurement is adjusted so as to give values for a distance of 1 metre. —The voltage at the speaker terminals is adjusted in such a way as to obtain a power of 1 W relative to the nominal impedance of the speaker. —The nominal frequency ranges are obtained by third-order active filtering, the crossover frequencies being as follows: <div style="display: flex; justify-content: space-between;"> <div> PR woofer : 250 woofer : 125 Mid-range : 0.7 k tweeter : 4 k full range : 125 </div> <div> 2 k 1 k 6 k 16 k 8 k </div> <div> (PR) (W) (M) (TW) (FR) </div> </div>