OUTDOOR MICROPHONE PERFORMANCE.

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INTRODUCTION

The first outdoor microphones were developed in 1962. Until then outdoor microphones were traditional hydrophones with a strong response to heat variations as caused by the weather conditions especially sunshine, clouds and rain.

Outdoor microphones meeting class 1 and even class 0 specifications have been developed and are today available for S.P.L. measurements in many variations. Outdoor microphones are available for accurate measurements of aircraft flyovers at vertical incidence as well as for community noise measurements at horizontal incidence.

The most advanced outdoor microphone systems are built for permanent outdoor use under all weather conditions over many years in high winds and heavy rain and meant to suffer only short times of performance loss. This of course requires built-in reliable calibration which is readily available within ±0.2 dB even if the microphone is mounted on a roof or a 10m high mast.

For less demanding measurement conditions well protected microphones are available – still allowing measurements to be made within the IEC Standard requirements. Microphones for outdoor measurements in multiple locations and rain-protected are also available as low price solutions.
The use of intensity microphones for more effective discrimination of background noise as well as for reduction of wind noise and for more reliable data under reactive conditions based on the intensity vector quantity is proposed.

OUTDOOR MICROPHONE PERFORMANCE

The outdoor microphones used in the fifties were hydrophones like the LC10 or BBN379. They were very sensitive to vibration and heat transients. When clouds passed the sun they would respond with an output signal equivalent to several hundred Pascal. The frequency response would only fulfill the ANSI S1.4-1971 type 2 requirements. They would only enable measurements down to 50 dBA (see Fig. 1).

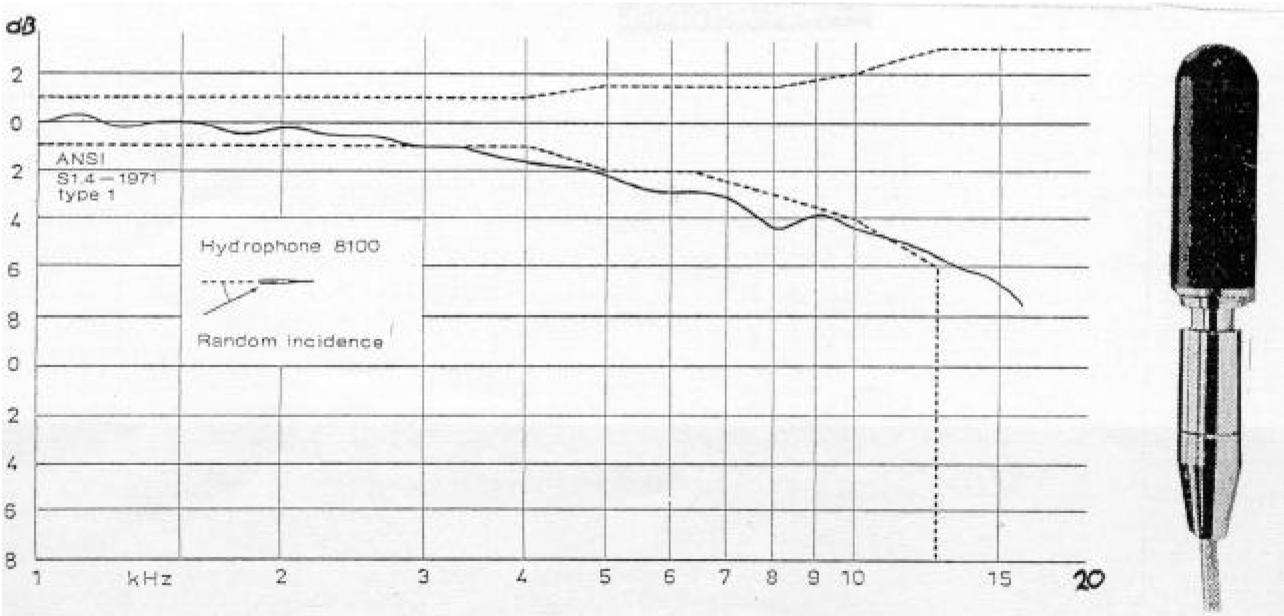


Fig. 1. Frequency response of hydrophone used for monitoring in Air.

The demand for more accurate noise measurements increased in the 1960’s promoted by the awareness of noise as an important environmental factor.

Aircraft flyovers and traffic as well as industrial noise caused legislative measures and thereby more requirements for accurate assessment of the noise. All-weather measurement stations enabling measurements to be made at 30 dBA were requested.

This led to monitors using condenser microphones of measurement quality. One such unit is seen in Fig. 2. An important feature was the built-in electrostatic actuator which enables in-situ calibration of the complete system without having to dismount the microphone. It was built into the rain protection cap on top of the microphone. A 500 Hz signal was supplied to the actuator, producing a 1,000 Hz reference signal on the output terminal and providing an excellent stable calibration level for testing the whole system.

The use of windscreens with a layer of thin nylon net led to wave motions inside the windscreen. The change in acoustic impedance at the surface of the net caused variations in the microphone frequency response of up to 13 dB (see Fig. 2.). Using narrow-band random noise for calibration to some extent made the calibration curve look smooth.

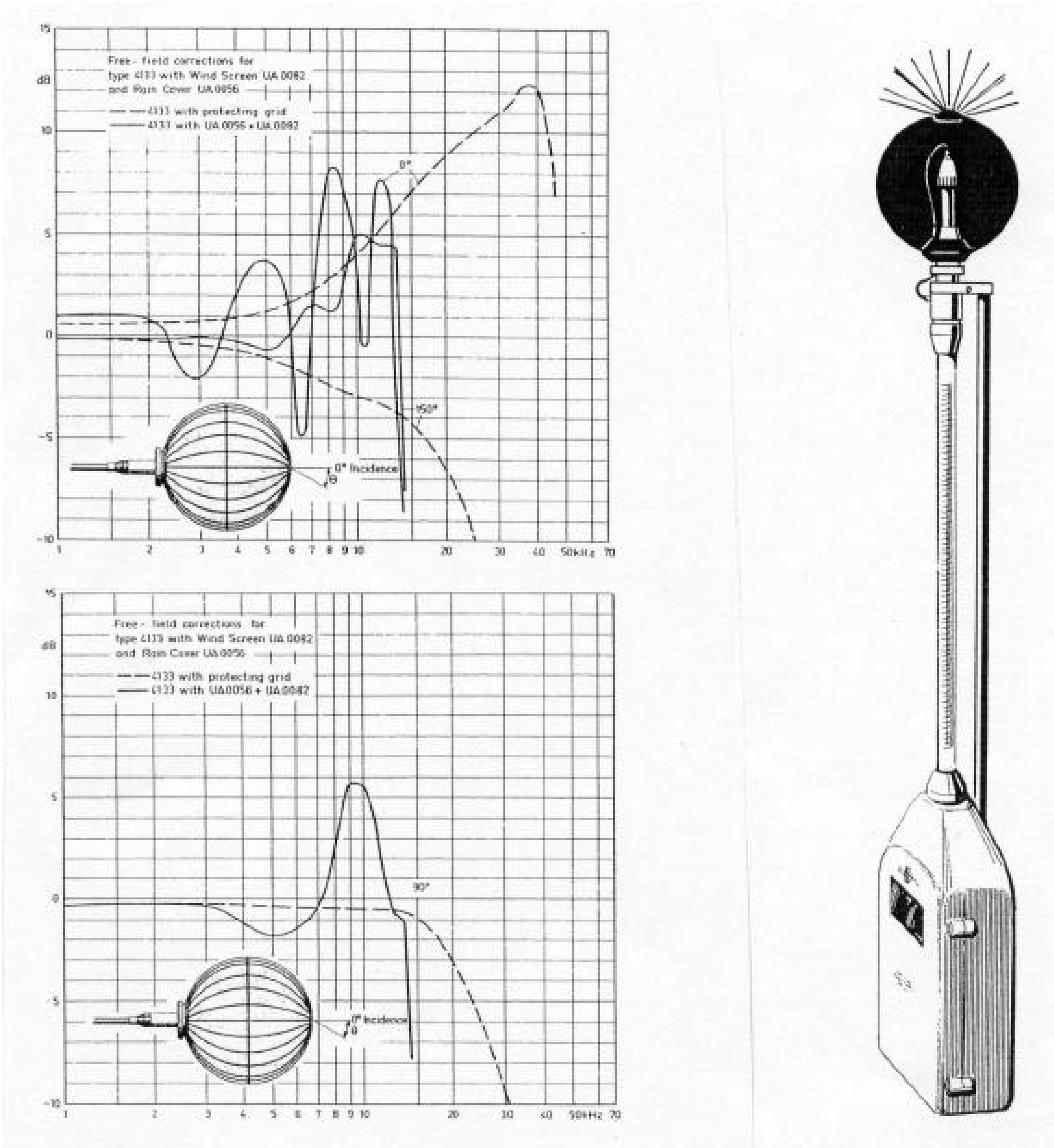


Fig. 2. Outdoor microphone with windscreen, raincover and electrostatic actuator calibration.

The open cell polyurethane foam appeared on the market. It was proposed to me by Alfred L. DiMattia of CBS Laboratories for wind screen purposes. This particular material has an opening which can be controlled in the blowing process and the pores per square inch defined within a well defined range. This led to a new design of windscreens with much better free field 0° incidence response for aircraft flyovers (see Fig. 3.).

The condenser microphone design was based on the use of a thin 2-5µm thick nickel diaphragm. This is a problem when the air is contaminated with pollutants containing acid. The diaphragm might be damaged within a few months.

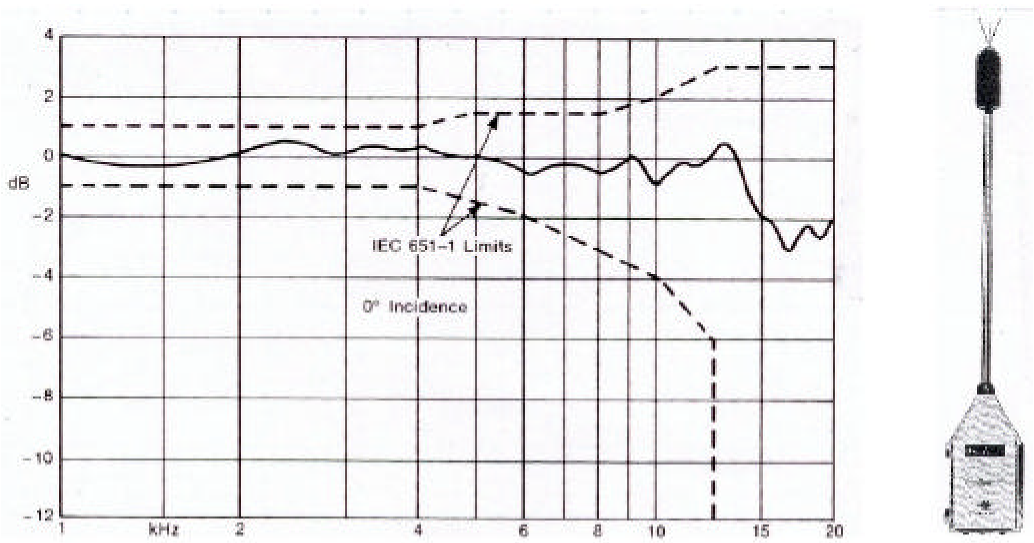
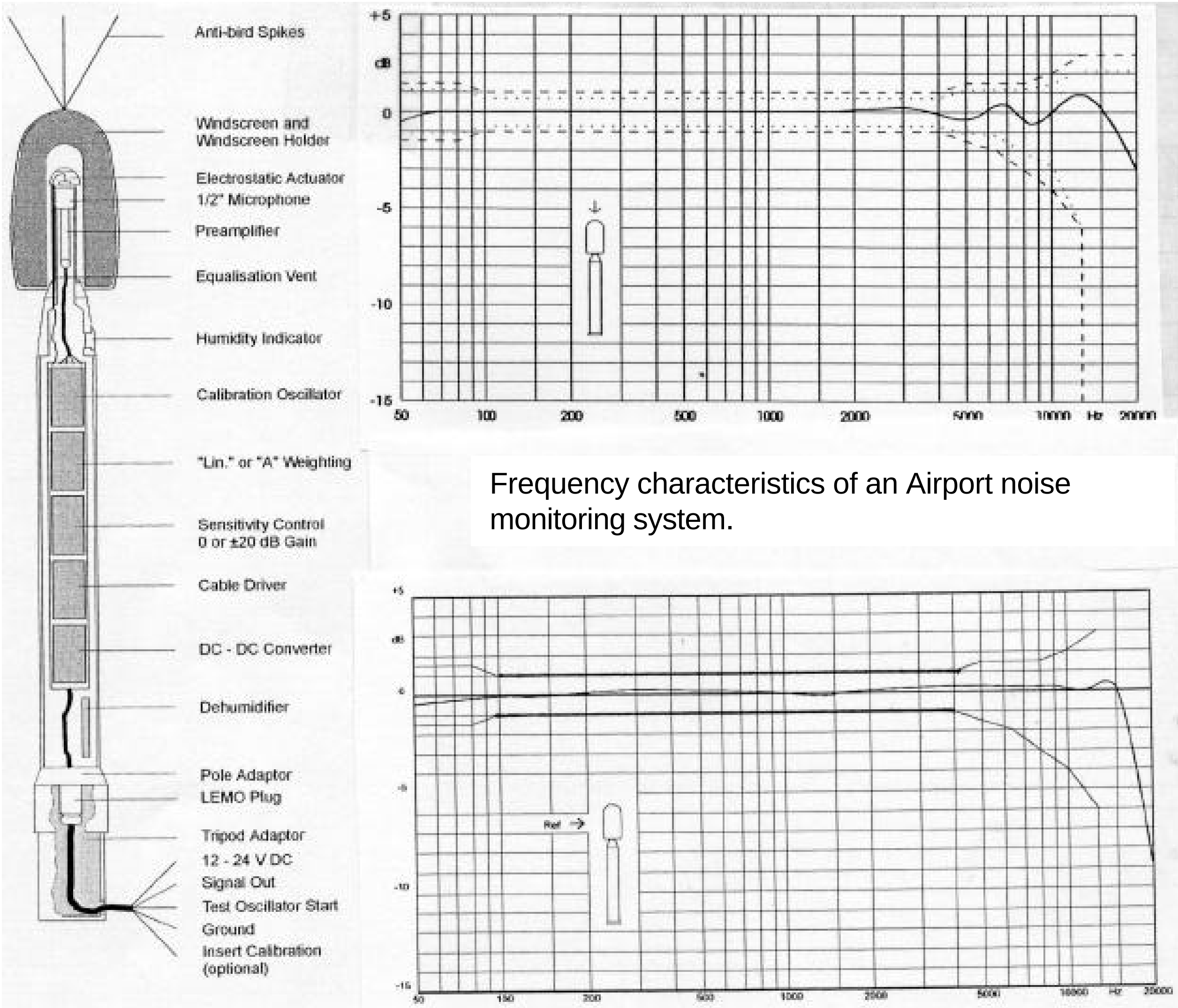


Fig. 3. Outdoor microphone with foam windscreen and anti-bird spikes.

Modern outdoor microphones are much smaller and still contain all the features of the earlier models and have proven their ability to withstand the weather for many years. They measure A-weighted sound pressure levels well below 20 dBA. They can be accurately tested for changes in calibration level to within 0.2 dB e.g. caused by changes in static pressure or temperature variations.

Use of virtually non-corrosive alloy diaphragms make it possible to produce microphones which can be guaranteed to withstand weather and pollution for many years with no visible effects. They can be made for 0° or 90° incidence for aircraft flyovers or community noise (see Fig. 4.).

For permanent outdoor monitoring it is an advantage to include the front-end electronics with calibration in the field unit. The heat dissipated by the electronics keeps the unit warm and free from moisture and condensation.



Frequency characteristics of an Airport noise monitoring system.

Frequency characteristics of a Community noise monitoring system.

Fig. 4. Permanent noise monitoring system with tolerance curves as required by IEC 651 type 1 and 0.

For intermittent outdoor use, units without proper calibration facilities may also be used. This type of outdoor microphone should be checked with a pistonphone at regular intervals.

The use of the intensity technique would greatly improve the reliability of aircraft flyover measurements. Using a two microphone probe with spacer will, for a dual channel system, remove problems with reflection from the ground or surrounding walls or roofs. It will remove extraneous signals from the horizontal plane and clearly separate sound coming from below and from above.

The system would be less sensitive to wind and turbulence. An improvement of up to 20 dB can be expected. The sound pressure level will be available along with the intensity level. Such a system would be more expensive but also much more reliable (see Fig. 5.)

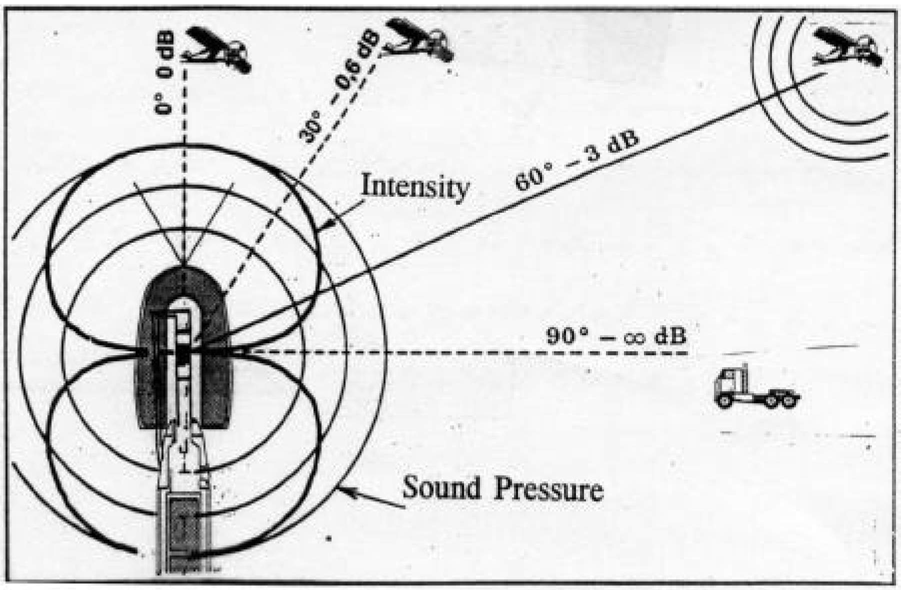


Fig. 5. Sound intensity system for Aircraft monitoring.

The measurement of sound emission and imission under most weather conditions is not a technical problem. It could be an economical problem to reach a desired level accuracy.