

# Instrumentation corner

Richard Wright and Guillaume Goulamhousen. Effects of weather on outdoor microphone windshields

## Introduction

Microphone systems used for long-term outdoor noise monitoring are exposed to constant risk of damage from rain, corrosion and mechanical damage. Such systems are generally required to fulfil the specifications in IEC 61672-1 and are periodically verified to IEC 61672-3. However, owing to the practical limitations of test laboratories, such periodic verification does not typically include free-field testing of the entire microphone system including the windshield. Instead, a standard procedure is to inspect the components and replace any that show clear signs of wear. Conditions encountered by outdoor systems in their everyday use affect measurements in ways that may not be appreciated by users. In particular, temporary conditions such as rain and ice would probably not be observed during periodic verification.

## Test methods

Tests were carried out in a simulated free field system developed by Cirrus Research to carry out automated directional response tests to IEC 61672.

Conclusions were drawn about two standard styles of windshield:

- Type A: 'conventional' cylindrical type, consisting of 40 dpi foam in an open cavity shape with a wall thickness of 7mm (Figure 1);
- Type B: spherical type of diameter 80mm, consisting of solid 80 dpi foam with ultra-violet resistant and hydrophobic (water-repellent) treatments (Figure 2).



Figure 1:  
Type A windshield: conventional  
cylindrical type



Figure 2:  
Type B windshield: spherical  
type of diameter 80mm

Rainfall was approximated by spraying water from above, while ‘damp’ conditions were simulated by leaving the wet windshields to drain naturally at room temperature for several hours. The frozen state was achieved using a climate chamber to cool wet windshields rapidly to -30°C immediately prior to testing.

**Effects of water**

When sprayed with water to simulate rain, type A absorbed up to 70g of water, whereas the hydrophobically treated type B absorbed only 4g. Frequency responses for windshield A are shown in Figure 3. It can be seen that the wet and damp effects are similar up to 10kHz, but at higher frequencies they are markedly different.

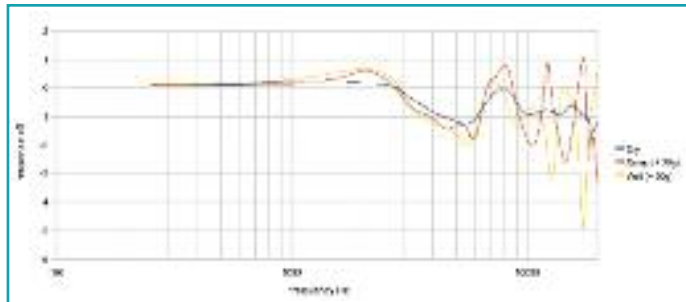


Figure 3: Influence of rainwater on windshield A

Frequency responses for windshield B are shown in Figure 4. It can be seen that this type shows a steadily increasing attenuation at higher frequencies when dry, but this characteristic could easily be corrected using a digital filter in the sound level meter. The deviations due to rain are within approximately 3dB in the worst cases, at frequencies above 10kHz.

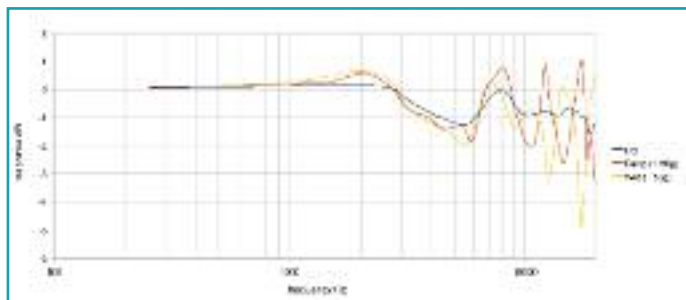


Figure 4: Influence of rainwater on windshield B

**Effects of ice**

Two weather scenarios were considered: firstly, when the windshield is soaked in rain, then frozen — a situation common in rainy climates where the night-time temperature drops below 0°C; and secondly when the side of the windshield builds up a coating of hard snow due to deposition in blizzards with strong winds.



Figure 5: Cold weather problems

The frequency response for the horizontal plane (90° incidence) with ice on top is shown in Figure 6. Even after correction of the dry response of the windshield, the effect of ice is to exceed the tolerances in IEC 61672-1, particularly at around 4kHz.

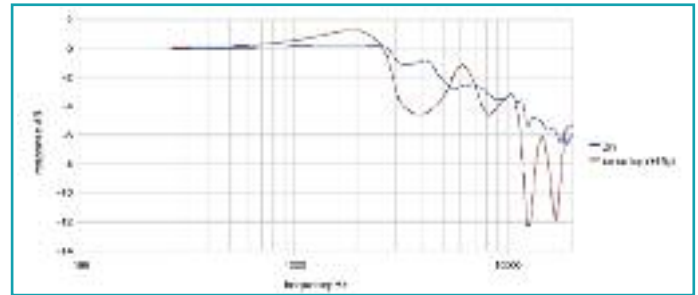


Figure 6: Influence of ice on top, windshield B

The effects of a build-up of snow and ice proved greater, as would be expected, with deviations of up to +5dB and greater than -20dB from a flat frequency response.

The polar response at selected frequencies in the ‘packed snow’ scenario is shown in Figure 7. Note that the ice patch was oriented so that it was directly facing the loudspeaker near the 180° position.

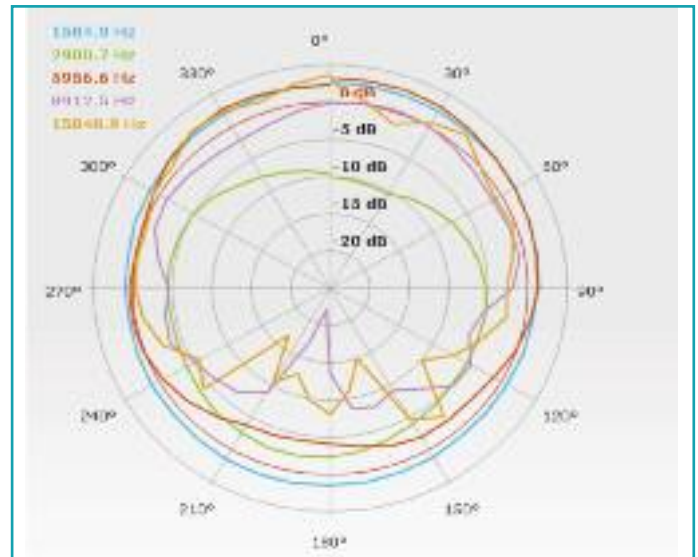


Figure 7: Type B, ice on side

Deviations of more than 10dB occur at different angles, not simply when the ice patch is facing the direction of incident sound. The differences between 0° and 360° results are due to changes between the start and end condition of the ice, as it melted slightly during the test.

**Mechanical damage**

Damage to outdoor windshields is often encountered, for example from birds and small animals picking pieces of foam from the windshield, presumably to use for nesting material. Such damage was simulated by cutting a conical section from a windshield of type B. This resulted in deviations of the magnitude of +2.5dB and -2.0dB compared with the reference level.

**Conclusions**

Rain soaking into the windshield has a complex effect on the frequency and directional responses, with the potential to move the system

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response outside acceptable limits. These effects are less pronounced on hydrophobically treated spherical windshields than on non-treated open-cavity windshields. Ice crusts on windshields have marked effects on the responses.

Sufficient care should be taken to record meteorological conditions and to interpret measurements accordingly in locations prone to heavy rainfall and freezing. The windshield may exhibit significant response deviations that vary over time during the drying process for several

hours after rain has stopped.

Physical damage to the foam also affects the responses, but to a lesser degree than rain and ice.

The tests also concluded that wind-induced noise tends to decrease as windshield diameter increases. It is possible that weather, damage and ageing effects are also lower on larger devices.

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