MICROPHONE WIND NOISE

Microphone Wind Noise performance typically depends on wind velocity, the acoustic overload limit of the microphone element, and system housing design. The design around the microphone sound port in particular affects turbulence. The purpose of this document is to outline some common guidelines used to mitigate wind noise.

OVERVIEW

Wind noise can cause problems with any outdoor microphone application. The cause of wind noise is always the same: air turbulence at the sound port of the microphone. This note suggests methods to mitigate the effects of wind noise on sound quality. Available wind noise reduction methods may be restricted or enhanced depending on design and performance requirements of the application.

WHAT IS WIND NOISE

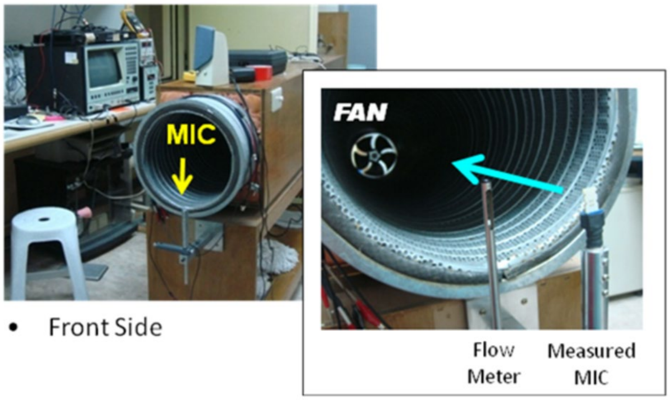
Microphone wind noise results from turbulence at the sound port of the microphone element.

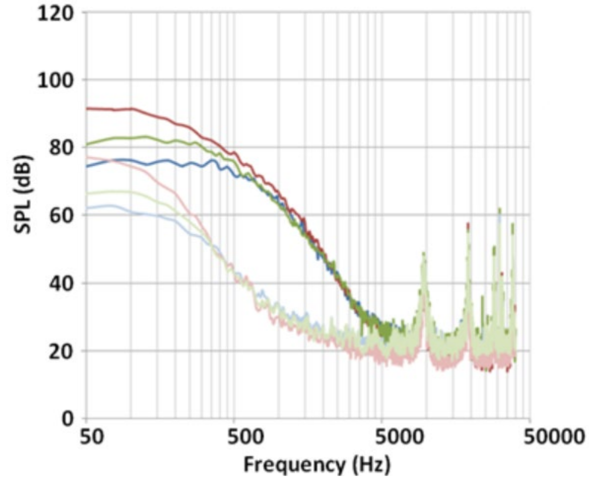
Turbulence is random and rapidly changing pressure and velocity. Turbulence varies with size of obstacle(s) and viscosity of fluid (or gas). Surface properties (friction, shape) affect transition from laminar to turbulent flow.

Microphone wind noise may be reduced by reducing turbulence at the sound port of the microphone element or reducing the microphone's audible response to turbulence.

WIND NOISE MEASUREMENT SETUP

Wind-Tunnel setup pictured below is 2m long. The wind channel ID is 30cm. The measurement sample is located 10cm from tunnel opening. The long tunnel produces repeatable steady laminar flow while turbulence is introduced by the structure of the sample or housing.





• Back Side

Measurement is relative to background acoustic noise floor (measured with the test sample removed from the air flow). Typical wind velocity settings are 2.5m/s and 5.0m/s.The orientation of the test sample against airflow affects the resulting wind noise, so measurements are typically taken at two or more orientations.

Data from the wind noise test is down in the graph as sound pressure level (in dBSPL) vs. frequency. Notice that the highest SPL levels for wind noise Occur at low frequencies.

REDUCING WIND NOISE

Methods that can be used to reduce the wind noise captured by the microphone are discussed below.

1. Use a microphone element with high pass response

The size of the pierce hole or vent that bypasses the microphone diaphragm typically sets the low frequency roll-off for a microphone. The charts below show the comparative frequency response and wind noise. For applications that limit the microphone bandwidth to the typical telephony bandwidth of 300Hz to 4kHz, or for applications where voice intelligibility is more important than voice quality, the designer may wish to exchange increased low frequency roll-off for reduced microphone wind noise. This method does nothing to reduce turbulence and may be combined with other methods.

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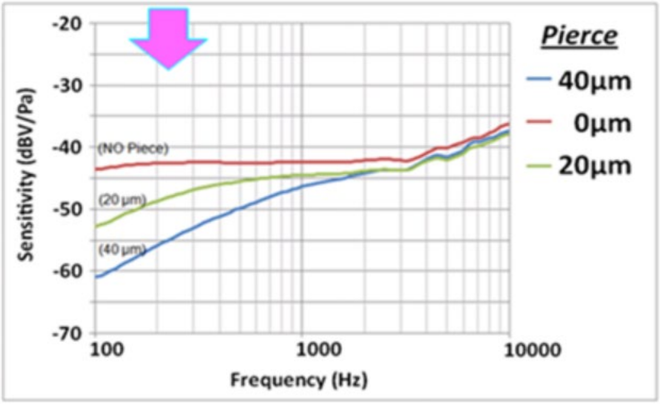
Model/Reference Number:
AN-21 MICROPHONE WIND NOISE

Form 0529-01

- Frequency Response Curves



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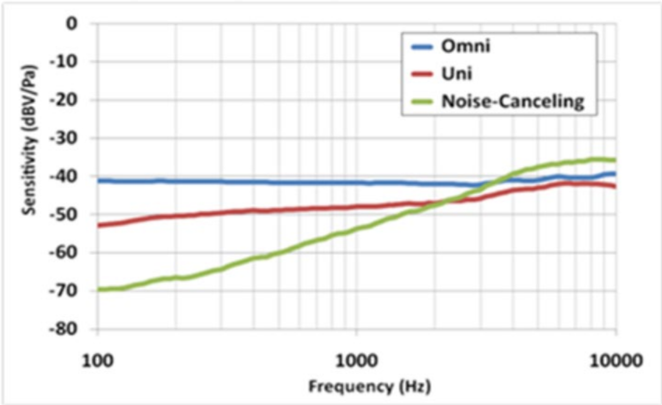
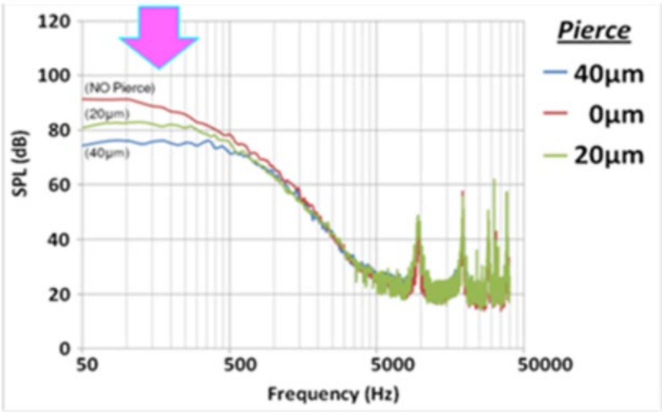


- Noise spectrums



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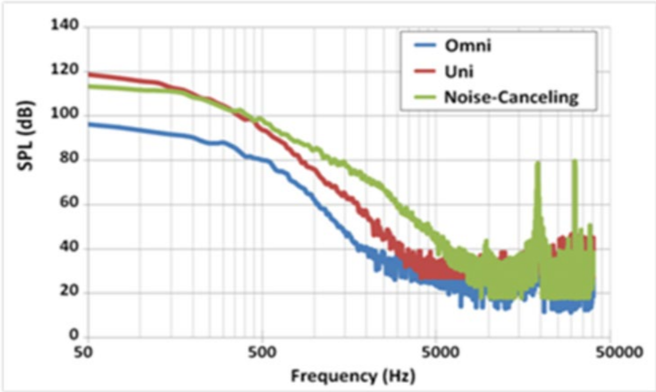

2. Use an Omni-directional microphone instead of Uni-directional

Unidirectional or noise cancelling microphones have 2 sound ports; omni-directional microphones have only one. A second sound port is a second avenue for wind noise to reach the diaphragm of the microphone. Because wind noise is inherently random, noise from the front and rear ports will add and increase the total wind noise.

Notice in the graphs below, although the sensitivity of uni and N/C microphones in chart is lower, wind noise SPL is substantially higher.

3. Optimize Mechanical Design of Device Housing

The tendency of an object to disturb laminar airflow increases with the size of the object and with the degree to which it forces abrupt changes in the airflow path. For purposes of wind noise, a product housing may be thought of as an obstruction to wind flow that produces turbulence.

Streamlining and reducing the size of the product housing, especially in the area of the microphone sound port(s) helps to reduce wind noise. All edges exposed to wind should have radii >2mm, preferably 4mm.

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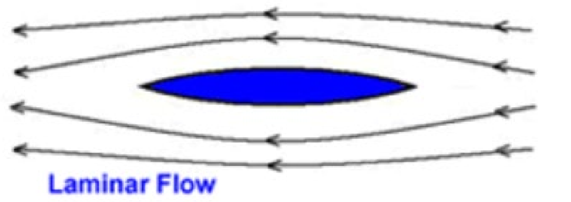
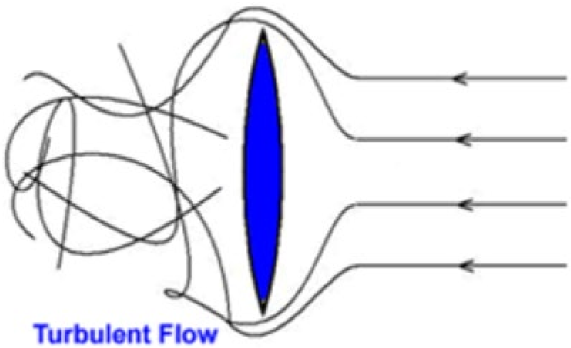




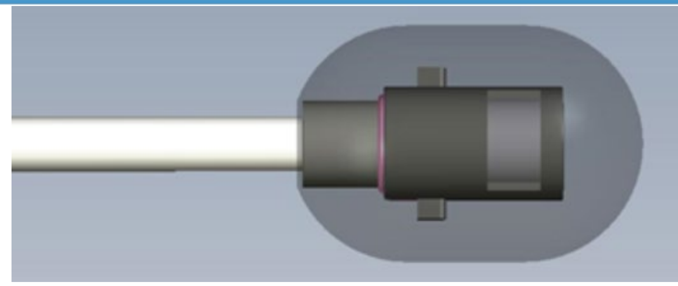
In addition, the leading edge of the turbulence-protected zone should be at least 2mm upstream of mic port (4mm would be better). This is because the thickness of the wind shear layer increases along the direction of air flow.

4. Use damping material in a microphone's external sound path

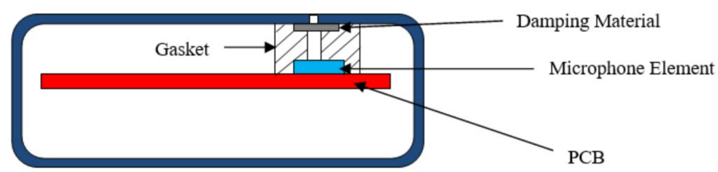
The purpose of adding a damper is to slow or stop the turbulent air from reaching the microphone sound port, thereby reducing wind noise.

Choices for damping material include screen, cloth, non-woven material such as felt, sintered material such as metal or plastic particles compressed and foam (open cell type).

The type, location and size choice for damping material varies by application and design objective. For example as shown in illustration below, boom microphones typically use foam windscreens to reduce wind noise. For high velocity wind, a larger and higher density foam windscreen would be needed.



Mobile phones and some headsets cannot use a foam windscreen. For an omni-directional microphone in a housing, a smaller and less fragile method is needed to reduce wind noise. Microphones require a gasket to couple the sound port(s) to the outside of the housing or bezel. The gasket is frequently a convenient place to mount damping material to reduce wind noise. For best reduction of wind noise, position the damping material toward the sound outlet of the housing, not on the transducer. Example as showed in illustration below.



Fragile damping material such as cloth or non-woven should be located behind the sound port of the housing. More robust material such as metal screen, sintered metal, or sintered plastic, may be located in or over the sound port of the housing.

5. Optimize microphone sound path design

The design along the microphone sound path (from the mic port opening to the external surface of the device housing) is also important in reducing the wind noise.

The variation of microphone port shape usually has limited or no effect on wind noise but the shape feature along the sound path may affect wind noise going into the microphone port. It is recommended to design a smooth sound path and not create an

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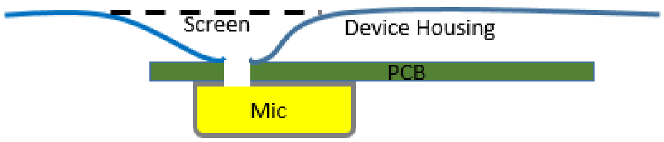
air cavity larger than the opening in the housing or bezel.

One practical shape is a large shallow depression on a surface as shown in illustration below.



The length of the sound path is also important in a thin housing design. 6dB noise reduction can be achieved for each doubling of the distance up to around 4mm. Beyond this, other factors tend to reduce the effectiveness of increased distance.

Multiple openings on a single housing with one microphone can also reduce wind noise provided the ports are spaced at least 3mm apart. This is because the noise at each opening is uncorrelated, so the combined pressure of the openings will provide spatial averaging.

SUMMARY

The table below summarizes the important points of each wind noise reduction method.

Methods of Reducing Wind Noise	Summary
Microphone Low Frequency Roll-off	Application must tolerate (or benefit from) reduction in acoustic bandwidth
Microphone Type	Choose omni-directional microphone if it works for the application
Size/Streamline	Reduce the size of the housing and use rounded edges where possible to reduce turbulence.
Damping Material	Damping material in sound path slows turbulent airflow.
Microphone Sound Path Design	Avoid the creation of an air cavity behind the external sound port opening.

The type of microphone chosen may help in reducing the wind noise at system level. Sound path and housing optimization further reduces wind noise. If a DSP is available at the system level it is possible to design algorithms to reduce wind noise further.

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