ASA/ANSI S12.9-2016/Part 7

Reaffirmed by ANSI June 19, 2020

AMERICAN NATIONAL STANDARD

Quantities and Procedures for Description and Measurement of Environmental Sound, Part 7: Measurement of Low-frequency Noise and Infrasound Outdoors and in the Presence of Wind and Indoors in Occupied Spaces

Secretariat:

Acoustical Society of America

Approved on April 25, 2016:

American National Standards Institute, Inc.

Abstract

Part 7 of the ANSI/ASA S12.9 series describes cautions and unique techniques for measuring low-frequency noise (LFN) outdoors in the presence of wind. It is necessary to measure in wind for wind turbine projects and for countless other industrial power and facilities where environmental wind speed cannot be controlled or levels are specified under downwind conditions. The standard also describes a uniform and repeatable methodology for documenting LFN levels and spectra indoors in occupied spaces where modal considerations are important. The principal concern outdoors is wind-induced noise (WIN) created by wind sources alone. The best estimates for WIN versus wind speed are presented herein based on the literature and special testing conducted by the working group for this standard. The standard is intended to define methods for routinely observed or monitored measurements of infrasound and LFN (ILFN) with standard off-the-shelf instrumentation, commercially available or special windscreens, and microphones appropriate to the task at hand. Following the standard methods should promote uniform, repeatable, and comparable data from site to site.

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ANSI/ASA S12.9-2016/Part 7

Accredited Standards Committee S12, Noise

Standards Secretariat
Acoustical Society of America
1305 Walt Whitman Road, Suite 300
Melville, NY 11747

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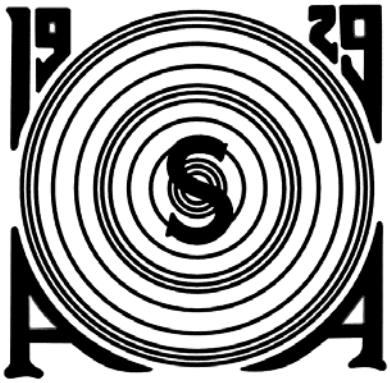

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Foreword

[*This Foreword is for information only, and is not a part of the American National Standard* ANSI/ASA S12.9-2016/Part 7 American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound, Part 7: Measurement of Low-frequency Noise and Infrasound Outdoors in the Presence of Wind and Indoors in Occupied Spaces. *As such, this Foreword may contain material that has not been subjected to public review or a consensus process. In addition, it does not contain requirements necessary for conformance to the standard.*]

This standard comprises a part of a group of definitions, standards, and specifications for use in noise. It was developed and approved by Accredited Standards Committee S12 Noise, under its approved operating procedures. Those procedures have been accredited by the American National Standards Institute (ANSI). The Scope of Accredited Standards Committee S12 is as follows:

> *Standards, specifications, and terminology in the field of acoustical noise pertaining to methods of measurement, evaluation, and control, including biological safety, tolerance, and comfort, and physical acoustics as related to environmental and occupational noise.*

This standard is a new part of the ANSI/ASA S12.9 series *American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound*.

This standard is not comparable to any existing ISO Standard.

At the time this Standard was submitted to Accredited Standards Committee S12 - Noise for approval, the membership was as follows:

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D.F. Winker, *Vice-Chair*

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	R.J. Peppin	

Suggestions for improvements to this standard will be welcomed. They should be sent to Accredited Standards Committee S12, Noise, in care of the Standards Secretariat of the Acoustical Society of America, 1305 Walt Whitman Road, Suite 300, Melville, New York 11747-4300. Telephone: 631-390-0215; FAX: 631-923-2875; E-mail: asastds@acousticalsociety.org.

Introduction

Measuring outdoor sound pressure levels and spectra can be difficult in the presence of wind, even at very low wind speeds often defined as “acceptable” in many measurement standards. Wind-induced noise (WIN) is the principal problem and can produce a false indicator of sound pressure at low frequencies mistaken for actual low-frequency noise when in fact no such low-frequency noise is present. WIN is the sound that can be measured in remote quiet environments essentially free of all anthropogenic and natural sources of sound, except for wind-generated noise such as leaf noise and pseudo microphone noise. Experience shows that accurate outdoor measurements down to conventional frequency range limits (i.e., the 16 Hz or 31.5 Hz octave band) can only be made under nearly ideal “calm and still” conditions when using standard relatively small windscreens. Conditions are calm and still when there is no measurable wind speed at microphone height and no observable grass or tree leaf movement or audible sound.

Note that this experience and statement applies to precision type 1 instrumentation while using the windscreen (60 to 90 mm diameter) furnished by the instrument supplier. Measuring the overall A-weighted outdoor level is much less of a problem due to the severe weighting of the A scale filter, but measuring the C- or G-weighted levels usually requires calm and still conditions or improved wind protection. The A-weighting filter may not be appropriate for evaluating low-frequency noise (LFN) or infrasonic-plus-low-frequency noise (ILFN).

The procedures contained herein allow WIN to be estimated yielding the lowest levels for valid measurements in each frequency band in the presence of low to high wind speeds. WIN for seven improved windscreen designs have been measured and are tabulated herein. Using these data, one can separate true acoustic ILFN from wind-induced noise. This information is also informative to instrumentation suppliers in the development of commercial products.

Measurement of indoor sound at low frequencies is addressed, and a standard test measurement methodology is developed that should yield repeatable data from site to site and from one investigator to another.

Acknowledgement

The working group of volunteers for this standard has expended much time and effort in designing, fabricating, and testing improved windscreen devices to lower the valid frequency for which sound can be measured in the presence of wind. The results are contained in the standard and annexes. The chair would like to especially acknowledge the contribution of Dr. Bruce Walker of Channel Islands Acoustics for an extraordinary effort that far surpassed the considerable efforts of other members.

American National Standard

Quantities and Procedures for Description and Measurement of Environmental Sound, Part 7: Measurement of Low-frequency Noise and Infrasound Outdoors In the Presence of Wind and Indoors in Occupied Spaces

1 Scope

This standard provides requirements and methods for measuring low-frequency sound and noise levels outdoors in the presence of wind and indoors in occupied spaces. The most common application anticipated is the measurement of outdoor immission levels either near or far from sound emission sources or emission levels near a source.

A repeatable method for measuring low-frequency levels and spectra indoors is given so that results can be compared from site to site or for repeated measurements at the same site under differing operating scenarios or time periods.

The value of this method to indoor measurements is that wind effects on the microphone are eliminated. However, two new variables are introduced: wind impinging on a structure creates significant low-frequency noise that is difficult to quantify, and measuring indoors with room sizes comparable to or smaller than low-frequency wavelengths requires an accounting of room resonance modes. Nevertheless, following the prescribed measurement technique in low-wind conditions should give a uniform repeatable method of measurement that accounts for differing room modes from space to space.

The standard does not address all factors to be considered when measuring the emissions of sources or background sound levels in the environment that are covered in other standards. Such factors may be measurement metrics, duration of measurements, background corrections, time of day, and countless others. Usually, wind speeds in these specific standards are limited to low values (about 2 m/s or 5 mph) to minimize wind-induced noise effects. Measured data in the annexes show clearly that wind, even at these low wind speeds, significantly affects the measurements at very low frequencies. This standard is limited to measurement techniques, principally microphone wind-mitigation measures that can be used to quantify such wind effects. Hence, the wind-mitigation techniques for microphone protection described herein are supplemental to existing measurement standards.

Advanced signal processing techniques in the time domain that can detect ILFN signals in the presence of wind are discussed briefly and referenced.

2 Normative references

The following referenced documents are indispensable for the application of this standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ANSI/ASA S1.1-2013 *American National Standard Acoustical Terminology*

ANSI/ASA S1.4-2014/Part 1 / IEC 61672-1:2013 *American National Standard Electroacoustics – Sound Level Meters – Part 1: Specifications*