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High-voltage switchgear and controlgear – Part 37-082: Standard practice for the measurement of sound pressure levels on alternating current circuit-breakers

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FOREWORD

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International Standard IEC/IEEE 62271-37-082 has been prepared by subcommittee 17A: High-voltage switchgear and controlgear, of IEC technical committee 17: Switchgear and controlgear, in cooperation with the Switchgear Committee of the IEEE Power & Energy Society[1], under the IEC/IEEE Dual Logo Agreement between IEC and IEEE.

This publication is published as an IEC/IEEE Dual Logo standard.

The text of this standard is based on the following IEC documents:

FDIS	Report on voting
17A/1014/FDIS	17A/1023/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

International standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 62271 series can be found, under the general title *High-voltage switchgear and controlgear*, on the IEC website.

The IEC Technical Committee and IEEE Technical Committee have decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this standard may be issued at a later date.

The contents of the corrigendum of January 2014 have been included in this copy.

[1] A list of IEEE participants can be found at the following URL:
http://standards.ieee.org/downloads/62271-37-082/62271-37-082-2012/62271-37-082_wg-participants.pdf

HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 37-082: Standard practice for the measurement of sound pressure levels on alternating current circuit-breakers

1 Scope

This part of International Standard 62271 provides methods for the measurement of sound pressure level produced by outdoor alternating current circuit-breakers in a free-field environment. These methods may also be used indoors or in restricted field, provided that precautions are observed in the measurement and interpretation of the results.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1
A-weighted sound level
sound level as measured on a sound level meter using a setting that emphasizes the middle frequency components similar to the frequency response of the human ear at levels typical of rural backgrounds in mid frequencies

2.2
ambient noise
all noises that exist in an area that are not related to a facility or equipment under consideration

Note 1 to entry: Ambient noise includes sound from other industrial noise, transportation sources, animals, and nature, etc.

2.3
ambient sound level
ASL
sound level that is a composite of different airborne sounds from many sources far away from and near the point of measurement

Note 1 to entry: The ASL does not include any sound from the facility or equipment under consideration and is measured without it.

Note 2 to entry: The ASL is measured under representative conditions.

Note 3 to entry: As with comprehensive sound levels, representative conditions do not constitute absolute worst-case conditions but conditions that portray typical conditions for the area

2.4
bands
octave
1/3 octave
series of electronic filters separate sound into discrete frequency bands, making it possible to know how sound energy is distributed as a function of frequency

Note 1 to entry: Each octave band has a centre frequency that is double the centre frequency of the octave band preceding it. The 1/3 octave band analysis provides a finer breakdown of sound distribution as a function of frequency.

2.5
C-weighted sound level
approximation of the sensitivity of human hearing at industrial noise levels (above about 85 dBA)

Note 1 to entry: The C-weighted sound level (i.e., measured with the C-weighting) is more sensitive to sounds at low frequencies than the A-weighted sound level and is sometimes used to assess the low-frequency content of complex sound environments.

2.6
calibration
procedure used for the adjustment of a sound level meter using a reference source of a known sound pressure level and frequency

2.7
dB
decibel
unit of measure of sound pressure that compresses a large range of numbers into a more meaningful scale

Note 1 to entry: Hearing tests indicate that the lowest audible pressure is about 2×10^{-5} Pa (0 dB), while the sensation of pain is about 2×10^{2} Pa (140 dB). Generally, an increase of 10 dB is perceived as twice as loud.

$$\text{Sound pressure level (dB)} = 10 \log\left(\frac{p^2}{p_0^2}\right) = 20 \log\left(\frac{p}{p_0}\right)$$

where

p is the root-mean-square of the sound pressure (in Pa);

p_0 is the reference root-mean-square-sound of the sound pressure, generally 2×10^{-5} Pa.

The decibel is a linear weighting and can also be used when referring to differences in weightings.

2.8
dB(A)
the decibel (dB) sound pressure level filtered through the A filtering network to approximate human hearing response at low intensities

Note 1 to entry: Also see dB and A-weighted sound level.

2.9
far field
area far enough from the noise source that the noise emissions can be treated as if they come from a single point or line source and the individual components of the noise source are not apparent as separate sources

Note 1 to entry: This is typically at a distance of at least three to five times the major dimensions of the noise source.

Note 2 to entry: The far field may consist of two parts, the free part and the reverberant part. In the free part, the sound pressure level obeys the inverse-square law (6 dB loss per doubling of distance for a point source). The reverberant part exists for enclosed or semi-enclosed situations where there are many reflected sound waves from all directions. An example of a reverberant field is industrial equipment enclosed in a room.

2.10
fast response
fast response has a time constant of 125 ms or less on a sound level meter

2.11
impulsive noise
noise characterized by brief excursions of sound pressure (acoustic impulses) which significantly exceed the ambient noise

Note 1 to entry: The duration of a single impulse is usually less than one second (see ANSI S1.13-2005).

Note 2 to entry: For the purpose of this standard, the noise produced by the closing or opening of a circuit-breaker, or their combination, is classified as impulsive noise. Other components, such as compressor unloader exhausts, may be sources of impulsive noise.

2.12
impulse r.m.s. sound level
Unit: decibel (dB, dB(A), dB(B), or dB(C))

maximum r.m.s. value reached by a sound wave, with the mean (or average) taken over a short, specified time interval

Note 1 to entry: For the purposes of this standard, the averaging time is that given by a resistance-capacitance charging circuit with a 35 ms time constant.

2.13
parallelepiped
a body "having parallel planes"; a three-dimensional figure formed by six parallelograms

2.14
peak instantaneous sound pressure level
Unit: decibel (dB)

maximum unweighted positive or negative pressure peak value reached by an impulsive sound wave at any time during the period of observation

Note 1 to entry: For the purpose of this standard, readings can be considered as peak instantaneous sound pressure level if the C-weighting is used and the response time of the instrument is 50 ms or less. Peak instantaneous sound pressure level is sometimes referred to as impact noise.

2.15
sound level
Unit: decibel (dB, dB(A), dB(B), or dB(C))
weighted sound pressure level obtained by the use of a metering characteristic and the weightings A, B, C (or other) as specified

Note 1 to entry: The weighting used is indicated. For the purpose of this standard, C weighted sound level is the same as sound pressure level (SPL).

2.16
sound pressure level
SPL
Unit: decibel (dB)
twenty times the logarithm to the base 10 of the ratio of the pressure of a sound to the reference sound pressure

Note 1 to entry: Unless otherwise specified, the effective (r.m.s.) pressure is to be used. The reference sound pressure is 2×10^{-5} Pa.

2.17
type tests
tests that are made to determine the sound level produced by a particular size, type, style, or model of circuit-breaker

Note 1 to entry: Type tests include a complete series of sound level measurements under all normal operating conditions of the circuit-breaker. These tests are usually made only on representative circuit-breakers to substantiate the values assigned to all circuit-breakers of the same design, and are not intended to be used for normal production testing.

Note 2 to entry: Applicable portions of these tests may be used to evaluate modifications of design or to verify that performance limits are being met.

2.18
field tests
tests that are made to determine the sound levels produced by circuit-breakers operating in their normal installed location

Note 1 to entry: The kind, number, and locations of measurements made in field tests are determined by the particular objectives of the tests.

Note 2 to entry: Results of field tests may not be applicable to other circuit-breakers of the same type or class.

2.19
free field
when a point source (or any source that radiates equally in all directions) radiates into free space

2.20
restricted field
when a point source (or any source that radiates equally in all directions) radiates into a non-free space where reflections will occur

3 Acoustical environment

3.1 Ambient noise

Ambient noise can sometimes be a factor for intermittent and especially continuous noise measurements, and for locations remote from the circuit-breaker. Correction for ambient sound pressure levels can be made to intermittent and continuous noise readings when the total sound measurement exceeds the ambient measurement by 4 dB to 15 dB. Impulsive noise measurements cannot be corrected satisfactorily for ambient sound pressure on the pressure-squared basis, therefore, impulsive noise measurements shall be made only when the total sound measurement is expected to exceed the ambient measurement by 15 dB or more, which is almost always the case unless significant hammering or other impulsive type noise is present in the test area.

3.2 Wind conditions

Wind conditions may result in measurement errors, especially for unweighted (flat) measurements and for low frequency components of sound. A wind screen will be useful in many cases, however, it is recommended that measurements not be made when wind speed exceeds the values listed in Table 1. (These numbers are intended as a guide only, and are based on actual measurement experience. Great care should be exercised to avoid measurement errors due to wind.)

Table 1 – Wind conditions for sound measurements

Peak instantaneous dB	**R.m.s. impulse** dB	**Maximum wind speed** m/s
< 100	< 90	2,2 (5 mph)
< 120	< 110	4,5 (10 mph)
< 140	< 130	6,7 (15 mph)

3.3 Air condition

Temperature and humidity are not significant factors in measuring sound pressure levels of circuit-breakers, however, they can have an effect on the measuring equipment, and the manufacturer's recommendations should be observed. Extremes of ambient air temperature should be avoided as should extremely humid or fog conditions.

3.4 Local topography

Local topography can affect measurements and care should be taken to avoid measurements being influenced by noise reflection, focus, or amplification from walls, buildings, or any