An American National Standard

IEEE Standard Methods for the Measurement of Sound Pressure Levels of AC Power Circuit Breakers

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of the
IEEE Power Engineering Society

Secretariat

Institute of Electrical and Electronics Engineers, Inc.
NationalElectrical Manufacturers Association

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Foreword

(This Foreword is not a part of ANSI/IEEE C37.082-1982, IEEE Standard Methods for the Measurement of Sound Pressure Levels of AC Power Circuit Breakers.)

Widespread interest in noise has prompted studies of the noise produced by power circuit breakers. In order to establish the uniformity necessary for correlation of test results, this standard describes a method of testing related specifically to power circuit breakers.

This standard deals with objective methods of measurement and reporting of sound levels. These methods are intended to provide data which can be used in evaluating the effects of circuit breaker sound on human observers, but the evaluation itself is outside the scope of this standard.

Impulsive sound caused by opening or closing operations is the major concern, but for purposes of a complete standard, the measurement of continuous and intermittent sound is included. Two major problem areas are recognized:

1) For personnel near the circuit breaker, where safety and health considerations make the impulsive sound levels of interest
2) For persons remote from the circuit breaker, where the impulsive sounds produced by operations may cause a nuisance, or where specific ordinances regulate permissible sound levels.

Methods of measurement in the near and far fields, for impulsive, continuous, and intermittent sound are given.

The Standards Committee of Power Switchgear, C37, which reviewed and approved this standard, had the following personnel at the time of approval:

C. L. Wagner, *Chair*
D. J. Polasky, *Secretary*
J. E. Beehler *(Executive Vice-Chairman of High Voltage Switchgear Standards)*
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US Department of the Interior, Bureau of Reclamation	Edward M. Tomsic
US Department of Defense, Defense Communications Agency	*Vacant*
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This standard was prepared by the Working Group on Sound Level Measurements of the Power Circuit Breaker Subcommittee. At the time this standard was approved, the working group had the following membership:

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Thomas Garrity	John G. Reckleff	E. F. Solorzano
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At the time this standard was approved, the Power Circuit Breaker Subcommittee had the following membership:

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An American National Standard

IEEE Standard Methods for the Measurement of Sound Pressure Levels of AC Power Circuit Breakers

1. Purpose and Scope

1.1 Purpose

This standard establishes uniform guidelines for measurement and reporting of sound produced by ac power circuit breakers.

This standard relates the procedures described in ANSI S1.13-1971 [4][1] to the specific requirements of measuring circuit breaker sound.

1.2 Scope

These methods are intended for use in measurement of the sound produced by outdoor circuit breakers in a free-field environment. The methods may be used indoors or in restricted field, provided that precautions are observed in measurement and interpretation of results. Three types of tests are described: design tests, conformance tests, and field tests.

1.2.1

Design tests are made to determine the sound level produced by a particular size, type, style, or model of circuit breaker. Design 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 ratings assigned to all circuit breakers of the same design, and are not intended to be used for normal production testing.

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

1.2.2

Conformance tests are performed to demonstrate that circuit breaker sound levels are within published ratings. They may include all or part of the design tests.

[1]The numbers in brackets correspond to the references listed in Section 2. of this standard.

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1.2.3

Field tests are made to determine the sound levels produced by circuit breakers operating in their normal installed location. The kind, number, and locations of measurements made in field tests are determined by the particular objectives of the tests. Results of field tests may not be applicable to other circuit breakers of the same type or class.

2. References

When the following American National Standards referred to in this standard are superseded by a revision approved by the American National Standards Institute, the revision shall apply:

[1] ANSI S1.1-1960 (R1976), American National Standard on Acoustical Terminology (Including Mechanical Shock and Vibration)[2]

[2] ANSI S1.4-1971 (R1976), American National Standard Specification for Sound Level Meters

[3] ANSI S1.10-1966 (R1976), American National Standard Method for the Calibration of Microphones

[4] ANSI S1.13-1971 (R1976), American National Standard Methods for the Measurement of Sound Pressure Levels

[5] ANSI S5.1-1971, American National Standard Test Code for the Measurement of Sound from Pneumatic Equipment

[6] IEC Pub 651 (1979), Sound Level Meters[3]

3. Definitions

Unless specifically defined below, the terms used in this standard are in accordance with ANSI S1.1-1960 (R1971) [1] or ANSI S1.13-1971 [4].

impulsive noise: A noise characterized by brief excursions of sound pressure (acoustic impulses) which significantly exceed the ambient noise. The duration of a single impulse is usually less than one second (see ANSI S1.13-1971 [4]). For the purpose of this standard, the noise produced by the closing or opening of a circuit breaker, or their combination, shall be classified as impulsive noise. Other components, such as compressor unloader exhausts, may be sources of impulsive noise.

impulse rms sound level: The maximum rms value reached by a sound wave, with the mean (or average) taken over a short, specified time interval. Unit: decibel (dB A, B, or C). For the purposes of this standard, the averaging time shall be that given by a resistance-capacitance charging circuit with a 35 ms time constant.

peak instantaneous sound pressure level: Maximum unweighted positive or negative pressure peak value reached by an impulsive sound wave at any time during the period of observation. Unit: decibel (dB). 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 μs or less. Peak instantaneous sound pressure level is sometimes referred to as impact noise.

[2]ANSI documents are available from the Sales Department, American National Standards Institute, 1430 Broadway, New York, NY 10018.
[3]IEC publications are available from the Sales Department, American National Standards Institute, 1430 Broadway, New York, NY 10018.

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sound level: Weighted sound pressure level obtained by the use of a metering characteristic and the weightings A, B, C (or other) as specified. The weighting used must be indicated. For the purpose of this standard, C weighted sound level is the same as sound pressure level (SPL). Unit: decibel (dB, A, B, or C)

sound pressure level (SPL): Twenty times the logarithm to the base 10 of the ratio of the pressure of a sound to the reference sound pressure. Unless otherwise specified, the effective (rms) pressure is to be used. The reference sound pressure is 20 μPa. Unit: decibel (dB).

4. Acoustical Environment

4.1

Ambient noise can sometimes be a factor, especially for intermittent and 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 to 15 dB (refer to ANSI S1.13-1971 [4], Section 9. and Table 4). 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.

4.2

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 exceeds the values listed in Table 1. (These numbers are intended as a guide 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	RMS Impulse	Maximum Wind Velocity
< 100 dB	< 90 dB	5 mph (2.24 m/s)
< 120 dB	< 110 dB	10 mph (4.47 m/s)
< 140 dB	< 130 dB	15 mph (6.7 m/s)

4.3

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.

4.4

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 other surfaces.

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5. Instrumentation

5.1 Sound Level Meter

In general, this will consist of a microphone, an amplifier, a calibrated attenuator, an indicating instrument, weighting networks, and an output connection to accommodate additional equipment.

5.1.1

The preferred sound level meter is the Type 1 (precision), meeting the requirements of ANSI S1.4-1971 [2] and IEC Pub 651 [6], with a response time of 50 μs or less. It shall be capable of measuring peak instantaneous sound pressure levels up to 150 dB. The sound level meter shall also be capable of measuring impulse rms sound levels as defined in Section 3. A meter decay time constant of three seconds or more is required for either measurement. A *hold* feature, which greatly increases the decay time constant, may be used if the sound level meter is so equipped.

5.1.2

A Type 2 (general purpose) sound level meter may be used if equipped with an impact noise analyzer capable of making both peak instantaneous sound pressure level readings up to 150 dB and *time average* readings.

5.2 Calibration Capability

Calibration capability shall be available for checking microphone calibration before and after each test series. Calibration shall be performed according to ANSI S1.10-1966 (R1971) [3]. Total tolerance limits for sound level meters shall be in accordance with ANSI S1.4-1971 [2].

5.3 Supplemental Instrumentation

A wide selection of additional equipment such as oscilloscopes with cameras, tape recorders, sound analyzers, etc, is generally available and, when used, can result in more complete data and permanent records.

6. Design Test Methods

6.1 Design Test

A design test consists of a complete series of tests made in a minimum of nine locations, as described in 6.4 and 6.5.1, for impulsive noise caused by circuit breaker operations, and additional tests for continuous and intermittent noise, if applicable. All or part of these tests may be specified as a conformance test.

6.2 Circuit Breaker Operating Conditions

6.2.1

Sound pressure level measurements shall be made under conditions of maximum rated pressure and rated control voltage.

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6.2.2

Measurements shall be made under no-load conditions.

6.2.3

Impulsive noise measurements shall include opening operations and closing operations.

NOTE — These conditions are intended for normal design tests. Conformance tests or special tests may be performed with unusual service conditions specified and noted in 6.6.1.

6.3 Microphone Locations

6.3.1

Microphones shall be placed 5 ft (1.5 m) above ground level.

6.3.2

The microphone shall be oriented with respect to the source so that sound strikes the diaphragm at the angle for which the microphone was calibrated to have the flattest frequency response characteristic (ANSI S1.13-1971 [4], Section 5.7.3.2.3). In most cases, for measurement of impulsive noise from a circuit breaker, the microphone can be oriented to point straight up and will give satisfactory results. It is preferable to mount the microphone on a stand or tripod with the sound level meter connected by a remote cable. The operator, if present at the microphone location, shall stand facing perpendicular to a line between the microphone and the circuit breaker, so that his body does not act as a shield or reflector for the noise.

6.4 Near-Field Measurements

6.4.1

Measurements shall be taken for each type of noise (continuous, intermittent, and impulsive) at the main control cabinet and at four locations around the circuit breaker as shown in Fig 1. Additional measurements shall be taken 3 ft (0.9 m) from other noise sources, such as compressor unloader exhausts, if located separate from the above locations.

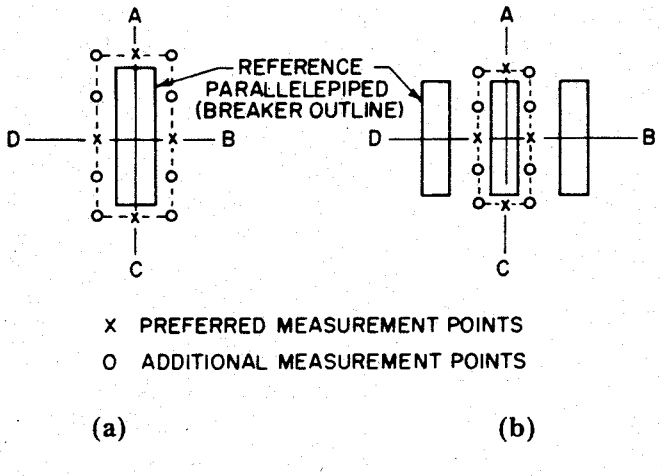
Continuous noise measurements shall be taken using the survey method of ANSI S1.13-1971 [4].

Intermittent noise produced by air compressors shall be measured as described in ANSI S5.1-1971 [5], Section 7. Data shall be taken using A-weighting or octave band, as required by objectives of the test.

Impulsive noise measurements shall be taken of the peak instantaneous sound pressure level without weighting or using C-weighting.

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NOTE: Circuit breakers in gas insulated substations may be treated as a single-frame unit because of the minimum pole spacing.

Figure 1— Location of Measurement Points with Respect to the Reference Parallelepiped for Near-Field Measurements (a) Single-Frame Circuit Breaker (b) Multiple-Frame Circuit Breaker

6.4.2

Measurements shall be taken 2 ft (0.6 m) in front of the circuit breaker control switch with the main control cabinet doors in the fully opened position.

6.4.3

Measurements of the circuit breaker shall be taken a distance of 3 ft (0.9 m) from the outline parallelepiped of the circuit breaker with cabinet doors fully closed. See Fig 1(a) for locations on single frame circuit breakers and Fig 1(b) for locations on multiple frame circuit breakers.

6.5 Far-Field Measurements

6.5.1

Measurements shall be taken for each type of noise (continuous, intermittent, and impulsive) at a minimum of four locations as shown in Fig 2.

Continuous and intermittent noise measurements shall be taken using the survey method of ANSIS1.13-1971 [4]. Data shall be taken using A-weighting or octave band as required by the objectives of the test.

Impulsive noise measurements shall be taken without weighting, or using C-weighting, as follows:

1) For a Type 1 sound level meter, record impulse rms readings per 3.5
2) For a Type 2 sound level meter and impact noise analyzer, record readings using the time average setting with 10 ms time constant. Positive pressure readings are recommended.

6.5.2

Far-field measurement distances (radius *R*) shall be a minimum of two times the maximum circuit breaker horizontal dimension. The following standard distances should be used wherever possible:

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1) Circuit breakers 362 kV and below: R = 150 ft (46 m)
2) Circuit breakers above 362 kV: R = 300 ft (91 m)

6.5.3

Circumstances such as obstructions, property boundaries, specific data requirements, etc, may make it impossible or undesirable to take measurements at the standard distances. In such cases, measurements taken at other distances can be converted to equivalent data at the standard distances specified in 6.5.2. Refer to 6.7.2 and Fig 3 for methods of converting data to the standard reference distances.

6.6 Data

The following data shall be recorded for design tests that are made according to the requirements of this standard. Standard from (Fig 4) is recommended for recording data.

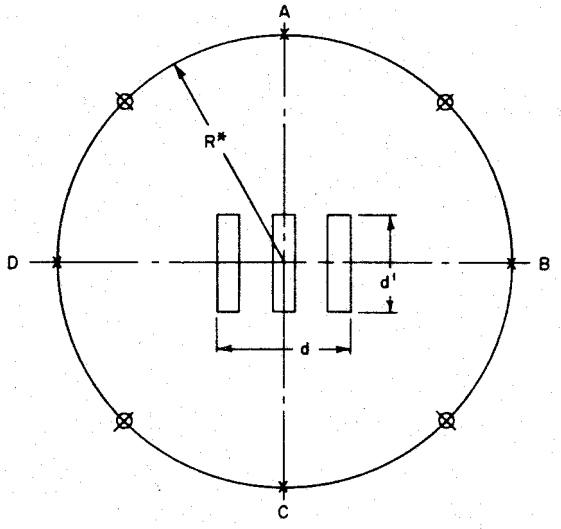


Figure 2— Location of Measurement Points with Respect to Circuit Breaker Outline for Far-Field Measurements

6.6.1

Circuit breaker being tested

1) Description (manufacturer, type, rating, serial number or identification number)
2) Operating conditions (closing or opening, plus any exceptions to 6.2)

6.6.2

Acoustic environment (use sketch if necessary)

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1) Location of circuit breaker and microphone locations
2) Location of any obstructions in the test area
3) Wind speed and direction before and after tests

6.6.3 Instrumentation

1) Equipment used (manufacturer, type, name)
2) Weighting used
3) Data on calibration

6.6.4 Acoustical data

1) Sound pressure level measurements obtained
2) Corrections applied, if any, and reason
3) Corrected sound pressure level or sound level
4) Ambient sound pressure level before and after test

6.6.5 Miscellaneous

1) Persons responsible for tests
2) Date and time of tests

6.7 Report

6.7.1

The report shall consist of the data listed in 6.6 together with such calculations, analysis, conversions, comparisons, etc, as are appropriate to the purpose of obtaining the measurements.

6.7.2

Each far-field reading, if made at other than the standard measurement distances, as per 6.5.2, shall be converted to equivalent data at the standard distances, using the following formula, or conversion curves (Fig 3):

db (to be added to reading) = 20 log D/D_s

Where D is the distance from the center of the circuit breaker to the microphone location, and D_s is the standard distance. (150 ft or 46 m for circuit breakers 362 kV and below, and 300 ft or 91 m for circuit breakers above 362 kV.)

This conversion should not be attempted for distances smaller than 35 ft (10.7 m) or greater than 1000 ft (305 m) because significant errors may result.

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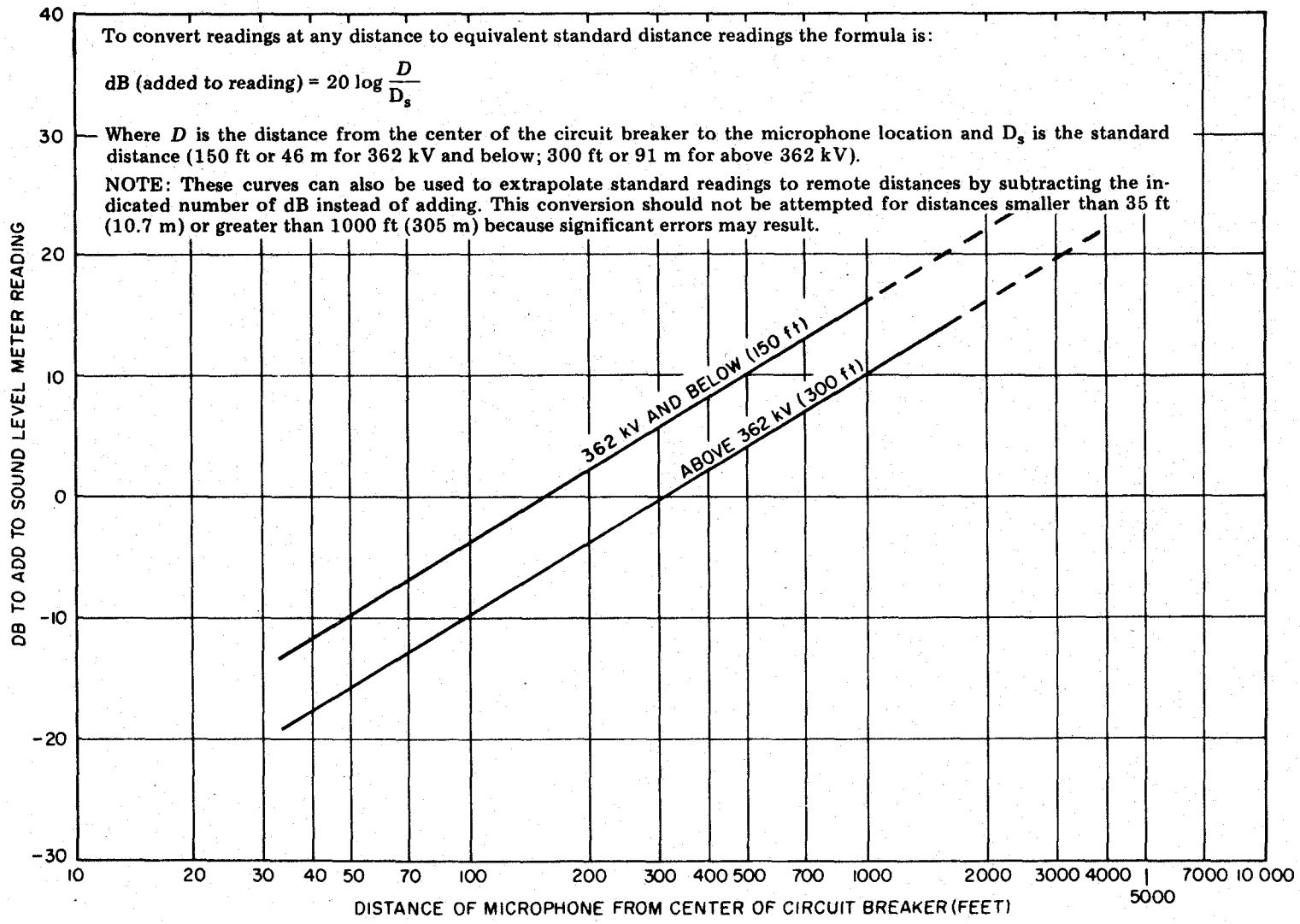


Figure 3— Conversion Curves for Nonstandard Microphone Distances

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Type of Test _____ (Design, Conformance, Field) Test Report No _____
Made by _____ Location _____ Date _____ Time _____
Circuit Breaker Nameplate
Manufacturer _____ Type _____ Serial No _____
Voltage Rating (kV) _____ Continuous Current Rating (kA) _____
Interrupting Rating (kA) _____ Time _____ Rated Operating Press _____
Mufflers — Yes/No _____
Sound Level Meter: Manufacturer _____ Type _____ S/N _____

Microphone Used _____ Calibration _____ Date _____
Calibration Method Used ____ Calibration Equipment Used ____ Mfgr ____ Type ____
S/N _____
Environment: Ambient noise, before _____ dB(A), _____ dB(C) _____
After _____ dB(A), _____ dB(C) _____ Wind Direction/Speed _____
Other Data: _____
Far Field Measurement Radii: Locations (See Sketch) _____ A _____ B _____
_____ C _____ D
Sketches & Notes (Distances to be included — Use reverse side)

SOUND, LEVEL MEASUREMENTS (dB):

	Microphone Location	Continuous	Intermittent	Impulse-As Read			Impulse-Corrected			Breaker Operating Conditions		
				Close	Open	Close Open	Close	Open	Close Open	CB Operating Pressure	Mech Operating Pressure	NOTES
NEAR FIELD	Weighting Used											
	Cont Cab											
	(A)											
	(B)											
	(C)											
	(D)											
FAR FIELD	Weighting Used											
	(A)											
	(B)											
	(C)											
	(D)											
	Average											

Figure 4— Measurement of Sound Pressure Levels of AC Power Circuit Breaker — Record Form

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6.7.3

Far-field readings, as measured or converted as described above, shall be averaged using the power-average method, and reported as a single average number along with the individual readings.

$$\overline{L_p} = 10\log\frac{1}{n}\left[\text{Antilog}\ \frac{L_p 1}{10} + \text{Antilog}\ \frac{L_p 2}{10} + \text{Antilog}\ \frac{L_p n}{10}\right]$$

where $\overline{L_p}$ is the average sound level in dB and $L_p\,1$ and $L_p n$ are the individual sound levels in dB.

7. Conformance Test Methods

All or part of the test described in Section 6, Design Test Methods, may be specified as a conformance test. The appropriate instrumentation and methods described in Sections 5 and 6 shall be used for conformance tests.

8. Field Test Methods

8.1 General

Field tests are made on circuit breakers installed in their operating environment. Data taken on a particular circuit breaker may not be applicable to other circuit breakers of the same type.

8.2 Wind Conditions

In locations where it is difficult to obtain measurements with wind velocities within limits given in 4.2, measurements may be made with due regard for the effects of wind on the readings. Measurements should not be attempted when the reading due to the combined effects of wind and ambient noise is within 10 dB of the expected sound level.

8.3 Circuit Breaker Operating Conditions

8.3.1

Measurements should be made for circuit breaker operating conditions expected to be encountered in service. Conditions may include operation while energized and carrying current within circuit breaker ratings, or unusual service conditions as specified.

8.3.2

Usually, when field test data is to be compared to data obtained in design tests, conditions specified in 6.2 should be observed. (Some field tests may be made to determine the effects on circuit breaker sound levels due to unusual service conditions.)

8.3.3

Measurements may be made on only the opening or closing operation, whichever produces the higher sound level. Measurement of CO (CLOSE-OPEN) operations may be desired.

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8.4 Microphone Locations

8.4.1

Microphones should be located 5 ft (1.5 m) above ground, and should be oriented as described in 6.3.2.

8.4.2

Microphone locations for field tests will depend upon the purpose of the test. When possible, microphones should be located at the same positions as described for design tests, per Section 6 and Figs 1 and 2, so that a direct comparison of results can be made.

8.5 Measurements to be Taken

8.5.1

When data for a particular type of noise (continuous, intermittent, or impulsive, in the near-field or far-field) will satisfy the purpose of the test, measurement of only that noise is required.

8.5.2

Measurements of impulsive noise should be made using instrumentation and methods of Sections 4., 5., and 6. for direct comparison with design test data.

8.6 Data and Report

Test data and reports should follow the applicable provisions of 6.6, 6.7, and Fig 4. The data collected and the reports given will be determined by the particular purpose of the tests.

9. Bibliography

ANSI S1.11-1966 (R1976), American National Standard Specifications for Octave, Half-Octave, and Third-Octave Band Filter Sets.

Damage Risk Criteria for Impulse Noise. Report of Working Group #57. National Research Council on Hearing, Bioacoustics, and Biomechanics (CHABA).

GARRITY, T. F. and OLIVIER, I. E. Methods for the Measurement of Sound Pressure Levels of Power Circuit Breakers. *Application of Power Circuit Breakers (IEEE Tutorial Course)*, #75 CHO 975-3-PWR.

PETERSON, A. P. G. and GROSS. E. E., Jr. Handbook of Noise Measurement. 7th ed. General Radio Company, West Concord, Mass.

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