**Section 910.106 Protocols for Determination of Sound Levels**

a) The raw data collection procedures to determine equivalent continuous sound pressure level (Leq) are described in this Section using as an example the determination of a 1-hour Leq corrected for ambient. The following procedures must be used:

1) Using Small Blocks

A) Divide the 1-hour interval into many small blocks of time so that corruption of the data from short-term background, transient sound and loss of data can be limited to the corrupted or bad blocks. The block duration measured in seconds is fixed for any measurement hour. The duration must be neither less than 10 seconds nor greater than 100 seconds. For example, if the block duration is chosen to be 60 seconds (1 minute), then the data collection proceeds for 60, 1-minute periods of measurement.

B) The collected data for each block represents a block duration Leq (or sound exposure level (SEL)) in octave-bands (or ⅓ octave‑bands if prominent discrete tones may be present).

C) Delete data for any block corrupted by one or more short-term background transient sounds.

D) After deleting corrupted data blocks, there will be a fixed number of "good" data blocks remaining. This number is designated as NPLNS, where PLNS stands for Property-Line Noise Source. These remaining "good" blocks are numbered consecutively. The subscript "i" is used to denote the numbering of the blocks in time order after corrupted data blocks have been deleted.

E) The data for the NPLNS remaining blocks are time averaged on an energy basis by octave (or ⅓ octave-band) using Equation 1 below. In this equation, two subscripts are used, i to designate time and j to designate the specific frequency, either an octave-band or ⅓ octave-band. The raw, 1-hour Leq in the *j*th frequency band is given by:

 [Equation 1]

where Leq is the Leq in the *j*th frequency band for the *i*th non-deleted data block.

F) In terms of SEL, the raw SEL in the *j*th frequency band is given by:

 [Equation 2]

G) The raw, 1-hour Leq in the *j*th frequency band is given in terms of the corresponding SELj by:

 [Equation 3]

Where T is the block duration in seconds, NPLNS is the number of non-discarded data blocks, and 3600 is the number of seconds in an hour.

2) Continuous Data Collection

A) Adjust the measuring instrument to continuously measure sound pressure and accumulate Leq for each block of time. For convenience, the hour may be split into several smaller blocks such as 10, 6-minute blocks or 4, 15-minute blocks, etc.

B) A switch on the measuring instrument must be available to inhibit data collection whenever a short-term background transient sound occurs. Use this switch to prevent short-term background ambient sounds from corrupting the data.

C) Data collection must proceed for one hour. The energy average of the several measured Leqij each weighted by the number of seconds actually accumulated during the *i*th block results in the raw, 1-hour Leq in each frequency band given by:

 [Equation 4]

Where Leqij is the Leq in the jth frequency band for the *i*th large block. Ti is the actual number of seconds of "good" data accumulated in the *i*th block of time (e.g., 6 to 15 minutes); and

 [Equation 5]

3) Minimum Data Collection Requirements

A) Initial Measurement Duration. Measure the property-line noise source initially for one hour. Because of correction for short-term background transient sounds, actual reported data collection time T, in seconds, may be less than 3600 seconds (one hour).

i) If small blocks of data are used for data collection, then the total measurement duration in seconds, TPLNS, is given by NPLNS T, where T is the length of each block in seconds and NPLNS is the number of non-discarded blocks. If data inhibition is used for data collection, then TPLNS is the number of non-inhibited seconds during the measurement hour. In either case, TPLNS must be at least 900 seconds.

ii) If very few blocks were used for data collection, then the duration of each block, T, may be too long and must be reduced.

iii) For either data collection method, sounds considered to be short-term transient may actually be part of the long-term background ambient and must be so redefined.

B) Extended Measurement Duration. If TPLNS is less than 900 seconds during the first hour of measurements, modify the raw data collection procedures appropriately and take new measurements for an additional hour. If TPLNS after combining the first and the second hour of measurements is also less than 900 seconds, then collect additional raw data using the data inhibition method or method employed during the second hour until TPLNS is greater than or equal to 900 seconds.

4) Correction for Long-Term Background Ambient Sound

A) The raw 1-hour Leq must be corrected for long-term background ambient sound. Subsection (b) describes methods to obtain the long-term background ambient sound level in the jth frequency band. The correction is dependent on the difference (in decibels) between the raw, 1-hour, jth band property-line noise source (Leqj)and corresponding jth band long-term background ambient sound level. The correction to be applied is as follows:

i) If the difference between the raw 1-hour Leq and the long-term background ambient sound is larger than 10 decibels, then the correction is set to 0.

ii) If the difference between the raw 1-hour Leq and the long-term background ambient sound difference is less than 3 decibels, then the *j*th frequency-band level, Leqj, is set to 0.

iii) If the difference between the raw 1-hour Leq and the long-term background ambient sound is between 3 and 10 decibels, then the correction given in Table 1 is subtracted from the raw, 1-hour property-line noise source Leqj.

Table 1

Corrections in dB for long-term

background ambient sound

|  |  |  |
| --- | --- | --- |
|  | Difference | Correction |
|  | (dB) | (dB) |
|  | 3 | 3 |
|  | 4 | 2.3 |
|  | 5 | 1.7 |
|  | 6 | 1.3 |
|  | 7 | 1.0 |
|  | 8 | 0.7 |
|  | 9 | 0.6 |
|  | 10 | 0.5 |

B) The long-term background ambient corrected level is the property-line noise source Leqj reported for the jth frequency band.

b) Obtaining the Background Ambient Sound Level

1) Measure the background ambient during a 10-minute interval.

2) Long-term background ambient measurement procedures are similar to procedures to measure the property-line noise source itself. Eliminating short-term background ambient transient sounds from the measurement of average long-term background ambient sound level, proceeds in a manner similar to the measurement of the property-line noise source emissions themselves. The two methods for measurement are:

A) to divide the 10-minute measurement into short blocks of data; or

B) inhibit data collection when short-term background transient sounds occur. The same method must be used for gathering both the property-line noise source data and the corresponding long-term background ambient data. The measurement procedures for each method are given in subsections (b)(3), (b)(4) and (b)(5).

3) Using Small Blocks of Data

A) Divide the 10-minute measurement of long-term background ambient into short measurement blocks. The duration of these blocks in seconds (T) must:

i) remain constant during the entire measurement, both when measuring the long-term background ambient and when measuring the property-line noise source; and

ii) divide exactly (without remainder) into 600 and must be neither greater than 100 seconds nor less than 10 seconds.

B) Discard data for any measurement block corrupted by one or more short-term ambient transient sounds. The number of remaining, non-discarded measurement blocks is designated NBA, where *BA* stands for background ambient.

C) The Leq for each octave-band (or ⅓ octave-band) are time-averaged on an energy basis over the NBA remaining measurement blocks to obtain average long-term background ambient Leq per band. Equation 1 (see subsection (a)(1)(E)) is used for this calculation with NBA replacing NPLNS as the number of elemental blocks to be summed. The total duration of the measurement in seconds, TBA, is given by NBA multiplied by T.

4) Continuous Data Collection

A) Adjust the measuring instrument according to manufacturer's instructions to continuously measure sound pressure and accumulate (i.e. record) Leq. A switch must be available to inhibit data collection whenever a short-term background transient sound occurs, (and on some instruments, a button may be available to delete the most recent, previous data).

B) Use the switches or buttons to prevent short-term background ambient sounds from corrupting the data.

C) Data collection must proceed for 10 minutes. The result is the 10-minute, long-term background ambient Leq in each band.

D) TBA is the number of non-inhibited measurement seconds during the 10-minute measurement period.

5) The minimum duration, for either method, TBA  must be at least 150 seconds. If TBA is less than 150 seconds, then continue to measure the long-term background ambient beyond the original 10 minutes and until TBA for the total long-term background ambient measurement is greater than or equal to 150 seconds.

6) Measurement Alternatives. The long-term background ambient noise should ideally be measured at the potential violation site just before measurement of the property-line noise source emissions. However, turning off the property-line noise source may not always be possible. The following are a hierarchical order of five procedures for obtaining the long-term background ambient noise. The first four procedures involve direct measurement; the fifth procedure provides for use of tables of values obtained from extensive measurements. These are not equivalent procedures but are ordered from what is considered to be the most accurate to what is considered to be the least accurate procedure.

A) Direct Measurement Procedure-1: With the property-line noise source (PLNS) turned off, measure the long-term background ambient noise within the hour before or within the hour after measurement of the PLNS emissions at the location where the PLNS measurements are being taken and with the measurement equipment used for the PLNS measurements.

B) Direct Measurement Procedure-2: With the PLNS turned off, measure the long-term background ambient noise during a similar time period in terms of background ambient sound level, within one to 24 hours before, or within one to 24 hours after measurement of the PLNS emissions at the location where the PLNS measurements are being taken and with the measurement equipment used for the PLNS.

C) Direct Measurement Procedure-3: With the PLNS turned off, measure the long-term background ambient during some other acoustically similar period within one to 30 days before, or within one to 30 days after measurement of the PLNS emissions. This alternate long-term background ambient measurement time might be a Saturday night or anytime during a Sunday or holiday. The measurements would be made at the location where the PLNS measurements are being taken and with the measurement equipment (or like equipment) used for the PLNS measurement.

D) Direct Measurement Procedure-4: With the PLNS turned off, measure the long-term background ambient noise during some other acoustically similar period within 30 to 90 days before, or within 30 to 90 days after measurement of the PLNS emissions. These measurements would be made at the location where the PLNS measurements are being taken and with the measurement equipment (or like equipment) used for the property-line noise source measurements.

E) Measurement Procedure-5: Tables of Long-Term Background Ambient Noise. If none of the alternatives can be used, use the applicable long-term background ambient data taken from Tables A through D in Appendix A. These tables are organized by predominant land use and time of day (daytime or nighttime). There are separate tables for octave- and ⅓ octave-bands. The background environments presented in the table are based on extensive measurements conducted in the Chicago area and are divided into the five categories listed in this subsection (b)(6) compliant with G.L. Bonvallet, "Levels and Spectra of Traffic, Industrial, and Residential Area Noise", Journal of the Acoustical Society of America, 23 (4), pp 435-439, July 1951; and Dwight E. Bishop and Paul D. Schomer, Handbook of Acoustical Measurements and Noise Control, Chapter 50, Community Noise Measurements, 3rd Edition, Cyril M Harris, Editor, McGraw-Hill Book Co., New York (1991).

i) Category 1: Noisy Commercial and Industrial Areas. Very heavy traffic conditions, such as in busy downtown commercial areas, at intersections of mass transportation and other vehicles, including the Chicago Transit Authority trains, heavy motor trucks and other heavy traffic, and street corners where motor buses and heavy trucks accelerate.

ii) Category 2: Moderate Commercial and Industrial Areas, and Noisy Residential Areas. Heavy traffic areas with conditions similar to Category 1 but with somewhat less traffic, routes of relatively heavy or fast automobile traffic but where heavy truck traffic is not extremely dense, and motor bus routes.

iii) Category 3: Quiet Commercial and Industrial Areas, and Moderate Residential Areas. Light traffic conditions where no mass transportation vehicles and relatively few automobiles and trucks pass, and where these vehicles generally travel at low speeds. Residential areas and commercial streets and intersections with little traffic comprise this category.

iv) Category 4: Quiet Residential Areas. These areas are similar to Category 3 but, for this group, the background is either distant traffic or is unidentifiable.

v) Category 5: Very Quiet, Sparse Suburban or Rural Areas. These areas are similar to Category 4 but are usually in unincorporated areas and, for this group, there are few if any near neighbors.

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