Publication NPC-101

Technical Definitions

1. Technical Terminology and Standards

The following terminology and standards shall be used for the purposes of any Noise Control By-Law enacted pursuant to The Environmental Protection Act and all Publications of the Noise Pollution Control Section of the Pollution Control Branch of the Ministry of the Environment. The definition of any technical word used in such By-Law or this or any such Publication and not herein defined shall be the definition appearing in the applicable Publication of the Canadian Standards Association (CSA), the American National Standards Institute (ANSI), the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), the Society of Automotive Engineers (SAE), or the Machinery and Equipment Manufacturers Association of Canada (MEMAC):

(1) Acoustic Calibrator

An "Acoustic Calibrator" is an electro-mechanical or mechanical device intended for the calibration of sound level meters and meeting the specifications of Publication NPC-102 - Instrumentation, for Acoustic Calibrators.

(2) A-Weighting

"A-weighting" is the frequency weighting characteristic as specified in IEC 123 or IEC 179 and intended to approximate the relative sensitivity of the normal human ear to different frequencies (pitches) of sound.

(3) A-weighted Sound Pressure Level

The "A-weighted sound pressure level" is the sound pressure level modified by application of the A-weighting. It is measured in decibels, A-weighted, and denoted dBA.

(4) Beating

"Beating" is the characteristic of a sound which has an audible cyclically varying sound level, caused by the interaction of two sounds of almost the same frequency.

(5) Buzzing Sounds

A "buzzing sound" is a sound which is characterized by the presence of a large number of related discrete harmonics in its frequency spectrum. These harmonics together with the fundamental frequency produce a sound which subjectively is termed a "buzz". Examples are sounds from a buzzer or a chain saw.

(6) Decibel

The "decibel" is a dimensionless measure of sound level or sound pressure level; see sound pressure level.

(7) Effective Sound Pressure

The "effective sound pressure" at a point is the root-mean square value of the instantaneous sound pressure, over a time interval, at the point under consideration as detected with a sound level meter meeting the requirements of Publication NPC-102 - Instrumentation.

(8) Equivalent Sound Level

The "equivalent sound level" sometimes denoted L_{eq}, is the value of the constant sound level which would result in exposure to the same total A-weighted energy as would the specified time-varying sound, if the constant sound level persisted over an equal time interval. It is measured in dBA.

The mathematical definition of equivalent sound level (L_{eq}) for an interval defined as occupying the period between two points in time t_1 and t_2 is:

$$L_{eq} = 10 \log_{10} \frac{1}{t_2 - t_1} \int_{t_1}^{t_2} \frac{p^2(t)}{p_r^2} \, dt$$

where p(t) is the time varying A-weighted sound pressure and p_r is the reference pressure of 20 μPa.

(9) Fast Response

"Fast response" is a dynamic characteristic setting of a sound level meter meeting the applicable specifications of Publication NPC-102 - Instrumentation.

(10) Frequency

The "frequency" of a periodic quantity is the number of times that the quantity repeats itself in a unit interval of time. The unit of measurement is hertz (Hz) which is the same as cycles per second.

(11) General Purpose Sound Level Meter

A "General Purpose Sound Level Meter" is a sound level meter which meets the specifications of Publication NPC-102 - Instrumentation, for General Purpose Sound Level Meters.

(12) Impulse Response

"Impulse response" is a dynamic characteristic setting of a sound level meter meeting the specifications of Publication NPC-102 - Instrumentation, for Impulse Sound Level Meters.

(13) Impulsive Sound

An "impulsive sound" is a single pressure pulse or a single burst of pressure pulses, as defined by IEC 179A, First supplement to IEC 179, Sections 3.1 and 3.2.

(14) Impulse Sound Level

The "impulse sound level" is the sound level of an impulsive sound as measured with an Impulse Sound Level Meter set to impulse response. It is measured in A-weighted decibels, denoted dBAI.

(15) Impulse Sound Level Meter

An "Impulse Sound Level Meter" is a sound level meter which meets the specifications of Publication NPC-102 - Instrumentation, for Impulse Sound Level Meters.

(16) Integrating Sound Level Meter

An "Integrating Sound Level Meter" is a sound level meter which is capable of being used to derive the equivalent sound level (L_{eq}) and which meets the specifications of Publication NPC-102 - Instrumentation, for Type B Integrating Sound Level Meters.

(17) Logarithmic Mean Impulse Sound Level

The "Logarithmic Mean Impulse Sound Level", sometimes denoted L_{LM}, of N impulsive sounds, is ten times the logarithm to the base 10 of the arithmetic mean of ten to the power of one tenth the impulse sound level of each impulsive sound.

Algebraically, it can be written as:

$$L_{LM} = 10 \log_{10} \left[\frac{1}{N} \left(10^{dBAI_1/10} + 10^{dBAI_2/10} \ldots + 10^{dBAI_N/10} \right) \right]$$

where, $dBAI_1$, $dBAI_2$, ...$dBAI_N$, are the N impulse sound levels.

(18) Overpressure

The "overpressure" at a point due to an acoustic disturbance is the instantaneous difference at that point between the peak pressure during the disturbance and the ambient atmospheric pressure. The unit of measurement is the pascal. One pascal, abbreviated Pa, is the same as one newton per square metre, abbreviated N/m^2.

(19) Overpressure Level

The "overpressure level" is twenty times the logarithm to the base 10 of the ratio of the peak pressure to the reference pressure of 20 μPa.

(20) Peak Particle Velocity

The "peak particle velocity" is the maximum instantaneous velocity experienced by the particles of a medium when set into transient vibratory motion. This can be derived as the magnitude of the vector sum of three orthogonal components and is measured in cm/s.

(21) Peak Pressure Level Detector

A "Peak Pressure Level Detector" is a device capable of measuring peak pressure or pressure level perturbations in air and which meets the specifications of Publication NPC-102 - Instrumentation, for Peak Pressure Level Detectors.

(22) Percentile Sound Level

The "x percentile sound level", designated L_x, is the sound level exceeded x percent of a specified time period. It is measured in dBA.

(23) Quasi-Steady Impulsive Sound

"Quasi-Steady Impulsive Sound" is a sequence of impulsive sounds emitted from the same source, having a time interval of less than 0.5 s between successive impulsive sounds.

(24) Slow Response

"Slow response" is a dynamic characteristic setting of a sound level meter meeting the applicable specifications of Publication NPC-102 - Instrumentation.

(25) Sound

"Sound" is an oscillation in pressure, stress, particle displacement or particle velocity, in a medium with internal forces (e.g. elastic, viscous), or the superposition of such propagated oscillations, which may cause an auditory sensation.

(26) Sound Level

"Sound level" is the A-weighted sound pressure level.

(27) Sound Level Meter

A "sound level meter" is an instrument which is sensitive to and calibrated for the measurement of sound.

(28) Sound Pressure

The "sound pressure" is the instantaneous difference between the actual pressure and the average or barometric pressure at a given location. The unit of measurement is the micropascal (μPa) which is the same as a micronewton per square metre ($\mu N/m^2$).

(29) Sound Pressure Level

The "sound pressure level" is twenty times the logarithm to the base 10 of the ratio of the effective pressure (p) of a sound to the reference pressure (p_r) of 20 μPa. Thus the sound pressure level in dB = $20 \log_{10} \frac{p}{p_r}$.

(30) Tonality

A "tone" or a "tonal sound" is any sound which can be distinctly identified through the sensation of pitch.

(31) Vibration

"Vibration" is a temporal and spatial oscillation of displacement, velocity or acceleration in a solid medium.

(32) Vibration Velocity Detector

A "Vibration Velocity Detector" is a device which is capable of measuring vibration velocity and which meets the specifications of Publication NPC-102 - Instrumentation, for Vibration Velocity Detectors.

Publication NPC-102

Instrumentation

1. Scope

This Publication sets out minimum specifications for equipment used for the measurement of sound and vibration. For most of the specifications the International Electrotechnical Commission (IEC) recommended standards 123 (First edition 1961), 179 (Second edition 1973) and 179A (First supplement to IEC 179, published 1973) have been adopted. In some cases, these standards are amended or augmented for greater precision.

TABLE 102-1

NPC-102 Section	Type of Instrument	Application
3	General Purpose Sound Level Meter	Non-impulsive sounds
4	Impulse Sound Level Meter	Impulsive sounds
5	Peak Pressure Level Detector	Peak pressure perturbations
6	Type B Integrating Sound Level Meter	Varying sounds of low crest factor
7	Type A Integrating Sound Level Meter	Varying sounds of high crest factor
8	Vibration Velocity Detector	Peak vibration velocity in solids
9	Acoustic Calibrator	Calibration of sound level meters

2. Technical Definitions

The technical terms used in this Publication are defined in the specifications themselves or in Publication NPC-101 - Technical Definitions.

3. General Purpose Sound Level Meter

(1) Purpose

A General Purpose Sound Level Meter is a sound level meter which is intended to be used for the measurement of non-impulsive sounds, without significant A-weighted acoustic energy above 2000 Hz.

(2) Specifications

A sound level meter which meets the following specifications is a General Purpose Sound Level Meter:

(a) the sound level meter, including a microphone equipped with a windscreen shall meet the specifications of IEC 123, except that, in addition to meeting the specifications of subclause 5.2 thereof, the microphone of the sound level meter shall also meet the specifications of subclause 5.2 amended by the substitution therein of an angle of incidence of $\pm 30^{o}$ instead of $\pm 90^{o}$, as it therein appears, and by the substitution of Table 102-2 hereof instead of Table 1, as it therein appears;

(b) the sound level meter shall incorporate A-weighting, which is specified in IEC 123 as optional;

(c) the sound level meter shall have a minimum usable range of sensitivity of from 40 dBA to 100 dBA and it shall read to an accuracy of ±1.0 dB over that range;

(d) a windscreen shall be installed on the microphone and shall not affect by more than 1 dB the tolerance prescribed in clauses (a) and (c);

(e) the sound level meter, including a microphone equipped with a windscreen, shall, when operated in the presence of wind, indicate a wind-induced sound level not in excess of the relevant value listed in Table 102-3.

4. Impulse Sound Level Meter

(1) Purpose

An Impulse Sound Level Meter is a sound level meter which is intended to be used for the measurement of any sounds, including sounds for which a General Purpose Sound Level Meter may be used.

(2) Specifications

A sound level meter which meets the following specifications is an Impulse Sound Level Meter:

(a) the sound level meter, including a microphone equipped with a windscreen, shall meet the specifications of a General Purpose Sound Level Meter;

(b) the sound level meter, including a microphone equipped with a windscreen, shall meet the specifications of IEC 179 and IEC 179A, supplement to IEC 179, including the optional characteristics mentioned in subclause 4.5 of IEC 179A;

(c) the sound level meter shall incorporate A-weighting as specified in IEC 179.

5. Peak Pressure Level Detector

(1) Purpose

A Peak Pressure Level Detector is a sound level meter which is intended to be used for the measurement of peak pressure perturbations in air. The value indicated by this device is not an average of the pressure level perturbations.

(2) Specifications

A sound level meter which meets the following specifications is a Peak Pressure Level Detector (the features of this device are incorporated in an Impulse Sound Level Meter as specified in section 4 above):

(a) the microphone of the sound level meter, when equipped with a windscreen, shall perform within a tolerance of ±1 dB throughout the frequency range of from 5 Hz to 31.5 Hz in the circumstances and conditions for use set out in Table 1 of IEC 179;

(b) the sound level meter without the microphone shall be capable of providing linear response as specified in subclause 4.5 of IEC 179, within a tolerance of ±1 dB throughout the frequency range of from 5 Hz to 15 kHz;

(c) the sound level meter shall incorporate the optional characteristics specified in subclause 4.5 of IEC 179A;

(d) the sound level meter shall meet the specifications set out in IEC 179 clause 3, subclauses 4.1, 4.2, 4.4, 4.5, 4.7, 4.8, clause 5, subclauses 6.2, 6.3, 6.4, 6.5, 6.8, 6.9, 7.1 through 7.9, 7.11, 8.1, 8.2, 8.3, 8.6 through 8.9, and the appropriate specifications of clause 10.

6. Type B Integrating Sound Level Meter

(1) Purpose

(a) An Integrating Sound Level Meter is a sound level meter which is intended to be used for the measurement of sound over a period of time, such that the equivalent sound level (L_{eq}) of the sound may be obtained.

(b) The Type B Integrating Sound Level Meter is specified with sufficient dynamic range and measurement precision to measure equivalent sound levels of general sounds that exceed limitations set out in this by-law.

(c) Either a Type A or Type B Integrating Sound Level Meter may be used for most such applications, but a Type A Integrating Sound Level Meter must be used when the sound under study

is Quasi-Steady Impulsive Sound (see NPC-103 - Procedures, sections 3 and 4) or when the operational dynamic range greatly exceeds 40 dB.

(2) General Description

The tolerances specified for the microphone, weighting and amplifier of a Type B Integrating Sound Level Meter are the same as those specified for a General Purpose Sound Level Meter in section 3 of this Publication. The computational portions of the instrument must operate within a net accuracy of ±1 dB for time periods of 20 minutes to one hour over a dynamic range of at least 40 dB with test signals having a crest factor (as defined in IEC 179A) up to 3. An operator-activated switch is included to inhibit the integration function alone and, if the system includes an elapsed-time clock, to inhibit both the integration and time summation functions.

(3) Specifications

A sound level meter which meets the following specifications is a Type B Integrating Sound Level Meter:

(a) the instrument will generally be a combination of microphone, amplifier, A-weighting network, computation circuit to obtain the integral of the mean square A-weighted pressure, display and a means of inhibiting the integration, but may vary from the above provided that it performs the same functions within the tolerances set out below;

(b) the instrument may include computational circuitry to calculate and display the equivalent sound level directly;

(c) the microphone of the instrument shall meet the specifications of clause 5 of IEC 123, except that, in addition to meeting the specifications of subclause 5.2 thereof, the microphone shall also meet the specifications of subclause 5.2 amended by the substitution therein of an angle of incidence of ± 30^{0} instead of ± 90^{0}, as it therein appears, and by the substitution of Table 102-2 hereof instead of Table 1, as it therein appears;

(d) a windscreen shall be installed on the microphone during operation and shall not affect by more than 1 dB the tolerance prescribed in clause (c);

(e) the sound level meter, including a microphone equipped with a windscreen, shall, when operated in the presence of wind, indicate a wind-induced sound level not in excess of the relevant value listed in Table 102-3.

(f) the A-weighting network shall meet the specifications of Table II and Figure I of IEC 123;

(g) the amplifier shall meet the specifications of subclauses 7.2, 7.3 and 7.11 of IEC 123;

(h) for each sensitivity setting of the instrument the amplifier shall have a power handling capacity at least 10 dB greater than the maximum sound level specified for that sensitivity setting;

(i) if the computation circuit is of the sampling (digital) type, when operating in conjunction with the microphone, windscreen, A-weighting network and amplifier, it shall generate a signal proportional to the mean square A-weighted pressure with a 1 ±0.25 s exponential averaging time constant;

(j) the computation circuit shall integrate the mean square A-weighted pressure and shall be capable of doing so on each sensitivity setting for a minimum of 6 minutes at the maximum sound level specified for that sensitivity setting;

(k) if the computation circuit is not capable of meeting the specification of clause (j) with the reference therein to "6 minutes" changed to "60 minutes", then the device shall be provided with a means to indicate to the operator when the integration capability has been exceeded;

(l) if the computational circuit is of the sampling (digital) type, sampling shall take place at least twice per second;

(m) the computation circuit shall operate over the usable dynamic range of the instrument with a linearity of ±1 dB for any sound with a ratio of peak pressure to root mean square pressure up to 3 (crest factor up to 3);

(n) an operator-activated switch shall be provided to inhibit integration or, if the instrument has an internal elapsed time clock, to inhibit both integration and accumulation of time;

(o) the combination of windscreen, microphone, A-weighting network, amplifier and computation circuit shall have a usable dynamic range extending at least from 50 dBA to 90 dBA and the manufacturer shall specify the usable dynamic range;

(p) the instrument may be provided with more than one sensitivity setting and the manufacturer shall specify the minimum and maximum input sound level for each sensitivity setting;

(q) if the maximum sound level specified for any sensitivity setting is less than 100 dBA, the system shall include a means of indicating to the operator that the maximum input sound level for that sensitivity setting has been exceeded and such indication shall be maintained until cancelled by the operator;

(r) the display shall indicate either,

(i) an output proportional to the integrated mean square A-weighted pressure, or

(ii) the integrated mean square A-weighted pressure divided by the duration of the period of time for which the equivalent sound level is to be determined, or

(iii) the equivalent sound level for the period of time for which the equivalent sound level is to be determined;

(s) it shall be possible to read from the display or to calculate from the reading of the display, the equivalent sound level to a resolution of ±1 dB over the usable dynamic range of the instrument for integration times from 20 minutes to 60 minutes;

(t) if the indication of the display is as described in subclause (ii) or (iii) of clause (r), the instrument shall include an elapsed-time clock;

(u) the complete instrument shall follow the recommendations and meet the specifications of subclauses 7.4, 7.5, 7.6, 7.7, 7.8 and 7.9 of IEC 123; and

(v) the instrument shall include a means of determining whether the battery of the instrument if any, has sufficient life to permit proper operation for a period of at least one hour.

7. Type A Integrating Sound Level Meter

(1) Purpose

(a) An Integrating Sound Level Meter is a sound level meter which is intended to be used for the measurement of sound over a period of time, such that the equivalent sound level (L_{eq}) of the sound may be obtained.

(b) The Type B Integrating Sound Level Meter is specified with sufficient dynamic range and measurement precision to measure equivalent sound levels of general sounds that exceed limitations set out in this by-law.

(c) Either a Type A or a Type B Integrating Sound Level Meter may be used for most such applications, but a Type A Integrating Sound Level Meter must be used when the sound under study is Quasi-Steady Impulsive Sound (see NPC-103 - Procedures, Sections 3 and 4) or when the operational dynamic range greatly exceeds 40 dB.

(2) General Description

The tolerances specified for the microphone, weighting and amplifier of a Type A Integrating Sound Level Meter are the same as those specified for a General Purpose Sound Level Meter in section 3 of this Publication. The computational portions of the instrument must operate within a net accuracy of ±1 dB for time periods of 20 minutes to one hour over a dynamic range of at least 80 dB with test signals having a crest factor (as defined in IEC 179A) up to 5. An operator activated switch is included to inhibit both the integration and time summation functions.

(3) Specifications

A sound level meter which meets the following specifications is a Type A Integrating Sound Level Meter:

(a) the sound level meter shall meet the specifications of a Type B Integrating Sound Level Meter;

(b) the instrument shall be provided with an internal elapsed-time clock;

(c) for each sensitivity setting of the instrument, the amplifer shall have a power handling capacity at least 14 dB greater than the maximum sound level specified for that sensitivity setting;

(d) the computation circuit shall operate over the usable dynamic range of the instrument with a linearity of ±1 dB for any sound with a ratio of peak pressure to root mean square pressure up to 5 (Crest Factor up to 5); and

(e) the combination of windscreen, microphone, A-weighting network, amplifier and computation circuit shall have a usable dynamic range extending at least from 40 dBA to 120 dBA.

8. Vibration Velocity Detector

(1) Purpose

A Vibration Velocity Detector is a device intended to be used for the measurement of the peak particle velocity of a solid surface.

(2) Specifications

A device which meets the following specifications is a Vibration Velocity Detector:

(a) the device shall include either a transducer which responds to the total vibration vector or three transducers which have their axes of maximum sensitivity mutually orthogonal ±1°;

(b) where three transducers are used to measure three mutually orthogonal components of vibration, the response of any one of the transducers to vibration in the plane normal to its axis of maximum sensitivity shall be less than 10% of its response to the same vibration along its axis of maximum sensitivity;

(c) the output of the device shall be proportional to the velocity of the surface on which the transducer is, or the transducers are, mounted and the output of the device shall be in such form that the device indicates, or can be used to calculate, the peak particle velocity in the frequency range of from 5 Hz to 500 Hz over a range of peak particle velocity of from 0.25 cm/s to 10 cm/s with a tolerance of ±10%; and

(d) it shall be possible to field-calibrate the device with an accuracy of ±5% using either a reference electrical signal in series with the equivalent transducer impedance or a reference vibration source.

9. Acoustic Calibrator

(1) Purpose

An Acoustic Calibrator is an electro-mechanical or mechanical device which produces sound of a known frequency and which, when coupled to a sound level meter, produces a predictable response in the sound level meter if the sound level meter is operating properly at the calibration frequency.

(2) Specifications

A device, capable of producing sound, which meets the following specifications is an Acoustic Calibrator:

(a) the device shall be capable of being physically attached to a sound level meter in such a way that the device and the sound level meter are "acoustically coupled", that is, sound from the device is transmitted through the air by way of a chamber formed by the attachment of the device to the microphone of the sound level meter;

(b) the device shall produce sound of a stated frequency, within a frequency tolerance of ±5%;

(c) the manufacturer of the device shall provide with the device, any data required in order to determine the sound level reading which should be indicated on the sound level meter when calibrated for those microphone and sound level meter types with which the manufacturer recommends the device be used. Where additional accessories must be used to provide this sound level reading, the manufacturer shall state that they must be used;

(d) the maximum tolerance in the sound pressure level generated by the device when coupled to the microphone shall apply over an atmospheric pressure range of 87 kPa to 107 kPa, and shall be ±0.5 dB over the temperature range of from $0^{o}C$ to $40^{o}C$ and ±1.0 dB over the temperature range of from $-10^{o}C$ to $50^{o}C$;

(e) if the device is battery powered, means for checking the battery condition shall be included with the device;

(f) the following data shall be provided with the device by the manufacturer,

(i) the nominal sound pressure level produced,

(ii) the nominal frequency at which the device operates,

(iii) the ranges of temperature and atmospheric pressure over which the device is intended to operate, and the applicable overall sound pressure level tolerance for these ranges.

TABLE 102-2

Permissible Tolerances on Microphone Sensitivity
Over an Angle of ± 30°

Frequency Hz	Permissible Tolerances dB	
	A*	B**
31.5 - 500	±1	±1
1000	±1	±1
2000	±2	+ 1 - 2
4000	±4	+ 1 - 4
8000	±10	+ 1 - 10

* COLUMN A: The microphone is mounted on the sound level meter.

** COLUMN B: The microphone is physically separated from the sound level meter but electrically connected thereto.

TABLE 102-3

Maximum Wind Induced Sound Level Indication Using A-weighting and Slow Response (where available)

Wind Speed	dBA
15 km/h	41
20 km/h	48
25 km/h	53

Publication NPC-103

Procedures

1. Scope

This Publication comprises the various measurement procedures to be used in connection with other Publications which provide limits or standards for sound or vibration. Several of the procedures adopted are those of nationally or internationally recognized agencies. Table 103-1 lists the measurement procedures which are included in this Publication.

TABLE 103-1

NPC-103 Section	Type of Measurement	Procedure
3	Steady or impulsive sound	Ministry
4	Varying sound	Ministry
5	Sound and vibration from blasting	Ministry
6	Powered mobile construction equipment	SAE J88a
7	Pneumatic equipment	MEMAC
8	Small engines	SAE J1046
9	Trucks with governed diesel engines	CSA Z107.22-M

2. Technical Definitions

The technical terms used in a procedure shall have the meaning given either in that procedure or in Publication NPC-101 - Technical Definitions.

3. Procedure for Measurement of Steady or Impulsive Sound

(1) (a) Classification

For the purposes of this procedure sounds can conveniently be placed in four mutually exclusive categories as follows:

(i) impulsive sounds, other than Quasi-Steady Impulsive Sounds, such as, but not limited to, the sound from gunshots, certain explosive pest control devices and certain industrial metal working operations (e.g. forging, hammering, punching, stamping, cutting, forming and moulding);

(ii) Quasi-Steady Impulsive Sounds, such as, but not limited to, the sound from pavement breakers, riveting guns, ineffectively muffled internal combustion engines or ineffectively muffled air compressors;

(iii) buzzing sounds, such as, but not limited to, the sounds from positive displacement blowers, chain saws, small combustion engines and concrete finishers;

(iv) all other sounds.

(b) Application

This procedure applies to measurements at a point of reception of:

(i) sound of a type mentioned in category (i) or (ii) of clause (a); and

(ii) sound of a type mentioned in categories (iii) or (iv) of clause (a), which is always higher than the permissible level or which, when the sound is present, does not vary in level over a range of more than 6 dB during the period of observation.

(2) Instrumentation

(a) Sound Level Meter

(i) An Impulse Sound Level Meter shall be used for the measurement of sound in category (i), (ii) or (iii) of clause 3(1) (a).

(ii) A General Purpose Sound Level Meter shall be used for the measurement of sound in category (iv) of clause 3(1) (a).

NOTE: An Integrating Sound Level Meter may be used for the measurement of sound in category (iv) of clause 3(1) (a), but the procedure set out in section 4 - Procedure for Measurement of Varying Sound must be used.

(b) Calibrator

An Acoustic Calibrator shall be used.

(c) Windscreen

A windscreen shall be used in all outdoor measurements.

(3) Measurement Location

For sound transmitted solely through air, the measurement location shall be one or more of the following points of reception:

(a) a location out-of-doors where a person may be exposed to the sound; or

(b) the plane of an exterior door or window of a room in which a person may be exposed to the sound, where the door or window is open.

(4) Use of Instrumentation

(a) Battery Check

If the sound level meter is battery powered the condition of the battery shall be checked after the meter has been allowed to warm up and stabilize. The battery condition shall be rechecked at least once per hour during a series of measurements and at the conclusion of such measurements. The meter shall not be used unless the battery condition is confirmed to be within the range recommended by the manufacturer for proper operation.

(b) Calibration

The sound level meter shall be calibrated after the meter has been allowed to warm up and stabilize, at least once per hour during a series of measurements and at the conclusion of such measurements.

(c) Sound Level Meter Settings

Measurements shall be taken using the following response settings:

(i) Impulse Response (dBAI)

The impulse response and A-weighting shall be used for impulsive sound in category (i) of clause 3 (1)(a). An 'impulse hold' facility may be used if available on the meter.

(ii) Slow Response (dBA)

The slow response and A-weighting shall be used for sound in categories (ii), (iii) or (iv) of clause 3 (1)(a).

(d) Instrument Configuration

(i) Reflective Surfaces

The microphone shall be located not less than 1 m above the ground, not less than 1 m from any sound reflective surface except for the purposes of clause 3(3)(b) and not less than arm's length from the body of the person operating the meter. Not more than one person, other than the operator of the meter, shall be within 7 m of the microphone and that person shall be behind the operator of the meter.

For the case of clause 3(3)(b) the microphone shall be in the middle of the aperture located not less than 15 cm from the window frame or door frame.

(ii) Microphone Orientation

The microphone shall be oriented such that the sound to be measured is incident at an angle recommended by the microphone manufacturer for flattest frequency response in a free field.

(e) Measurement - Slow Response

(i) Readings Taken

For sound in categories (ii), (iii) or (iv) of clause 3 (1)(a), a minimum of three observations with a minimum observation time of 15 s each shall be made. The observed average reading for each of the observations shall be noted as well as the minimum and the maximum of the range of sound levels during each observation period. If the difference between any two observed average readings is greater than 3 dB, a minimum of six observations shall be made. For the purpose of adjustments for intermittency the duration of the sound in any one hour shall be noted.

(ii) Readings Reported

The arithmetic mean of the observed average readings shall be reported, rounded to the nearest decibel. Adjustments for intermittence and quality of sound shall be made in accordance with Publication NPC-104 - Sound Level Adjustments, and the result shall be reported. The result is the one hour equivalent sound level (L_{eq}) of the sound under study for any one hour period during which the readings were taken pursuant to subclause (i).

(iii) Wide Variation of Sound Levels

If, in making observations pursuant to subclause (i), there is a difference of more than 6 dB between the lowest and highest values of the observed ranges of sound levels, this procedure shall not be used unless the lower limit of each such range is above the maximum permissible level. Instead, the procedure set out in Section 4 - Procedure for Measurement of Varying Sound at a point of reception, shall be used.

(f) Measurement - Impulse Response - Frequent Impulses

(i) Readings Taken

For sound in category (i) of clause 3 (1) (a) not less than 20 impulses shall be measured within a continuous period of 20 minutes and each measurement taken shall be reported.

(ii) Extension of Time

Where a minimum of 20 impulses cannot be measured within a continuous period of 20 minutes pursuant to subclause (i) the time period may be extended to 2 hours if an impulse occurred in each of the four consecutive periods of five minutes each during the initial 20 minute measurement period.

(iii) Level Reported

The Logarithmic Mean Impulse Sound Level (L_{LM}) of the 20 or more measurements shall be calculated and reported to the nearest decibel. This Logarithmic Mean Impulse Sound Level is a valid and effective sound level for any one hour period during which readings were taken pursuant to subclauses (i) and (ii).

(g) Measurement - Impulse Response - Single Event

Readings Taken and Reported

For impulsive sounds in category (i) of clause 3(1)(a), that occur as single, seemingly independent events not normally measurable using the procedure set out in clause (f) for frequent impulses, each impulse shall be independently measured and each impulse sound level reported to the nearest decibel.

(h) Variation in Calibration

Measurements shall not be reported if the sound level meter calibration has changed more than 0.5 dB from the previous calibration.

(i) Weather Conditions

(i) Wind

Measurements shall not be taken unless the wind-induced sound level is more than 10 dB below the measured levels. Reference should be made to Publication NPC-102 - Instrumentation, particularly Table 102-3.

(ii) Humidity

Measurements shall not be taken if the relative humidity is above the maximum for which the meter specification is guaranteed by the manufacturer (normally 90%).

(iii) Precipitation

Measurements shall not be taken during precipitation.

(iv) Temperature

Measurements shall not be taken when the air temperature is outside the range for which the specification of the instrument is guaranteed by the manufacturer. (Normally, only the lower temperature limit is significant.)

(5) Documentation

The following represents the minimum information which shall be contained in a report of an investigation where the above procedure was used. (Adapted from CSA Z107.2-1973 Methods for the Measurement of Sound Pressure Levels.)

(a) Acoustic Environment

(i) Location and description of sound sources.

(ii) Dimensioned sketch including photographs, if possible, of the location of the sound source and the point of reception, showing all buildings, trees, structures and any other sound reflective surfaces.

(iii) Physical and topographical description of the ground surface.

(iv) Meteorological conditions prevailing at the time of the investigation including approximate local wind speed in km/h, wind direction, air temperature in ^{o}C, approximate relative humidity and extent of cloud cover.

(b) Instrumentation

All the equipment used for making sound level measurements shall be listed, including:

(i) type, model and serial number of sound level meter;

(ii) type, model and serial number of microphone;

(iii) type, model and serial number of Acoustic Calibrator;

(iv) extension cables and additional amplifier, if used.

(c) Acoustical Data

The measurement details shall be described, including:

(i) the location of the microphone, using a sketch if necessary;

(ii) measurements or readings obtained, preferably listed in tabular form, referencing location on a sketch or map, time periods involved, and relevant data required for making calculations;

(iii) adjustments made for quality of sound or intermittence;

(iv) details of any calculations;

(v) comparison with applicable sound level limits, standards or guidelines.

4. Procedure for Measurement of Varying Sound

(1) (a) Classification

For the purposes of this procedure sounds can conveniently be placed in four mutually exclusive categories as follows:

(i) impulsive sounds, other than Quasi-Steady Impulsive Sounds, such as, but not limited to, the sound from gunshots, certain explosive pest control devices and certain industrial metal working operations (e.g. forging, hammering, punching, stamping, cutting, forming and moulding);

(ii) Quasi-Steady Impulsive Sounds, such as, but not limited to, the sound from pavement breakers, riveting guns, ineffectively muffled internal combustion engines or ineffectively muffled air compressors;

(iii) buzzing sounds, such as, but not limited to the sound from positive displacement blowers, chain saws, small combustion engines and concrete finishers;

(iv) all other sounds.

(b) Application

This procedure applies to measurements at a point of reception of continuous or intermittent sound mentioned in category (ii), (iii) or (iv) of clause (a).

(2) Instrumentation

(a) Integrating Sound Level Meter

An Integrating Sound Level Meter shall be used which is appropriate for the sound to be measured:

(i) Either a Type A or Type B Integrating Sound Level Meter may be used for the measurement of sound in category (iv) of clause 4(1)(a);

(ii) A Type A Integrating Sound Level Meter shall be used for the measurement of sound in categories (ii) or (iii) of clause 4(1)(a).

(b) Calibrator

An Acoustic Calibrator shall be used.

(c) Windscreen

A windscreen shall be used in all outdoor measurements.

(3) Measurement Location

(a) Air-Borne Sound

For sound transmitted solely through air, the measurement location shall be one or more of the following points of reception:

(i) a location out-of-doors where a person may be exposed to the sound; or

(ii) the plane of an exterior door or window of a room in which a person may be exposed to the sound, where the door or window is open.

(4) Use of Instrumentation

(a) Battery Check

If the Integrating Sound Level Meter uses a battery, the condition of the battery shall be checked before each measurement, and measurement shall not commence unless the battery has sufficient life remaining to permit proper operation for a period of at least one hour.

(b) Calibration

The Integrating Sound Level Meter shall be calibrated before and after each measurement period.

(c) Instrument Configuration

(i) Reflective Surfaces

The microphone shall be located not less than 1 m above the ground, not less than 1 m from any sound reflective surface except for the purposes of subclause 4(3)(a)(ii) and not less than arm's length from the body of the person operating the meter. Not more than one person, other than the operator of the meter, shall be within 7 m of the microphone and that person shall be behind the operator of the meter. For the case of subclause 4(3)(a)(ii) the microphone shall be in the middle of the aperture located not less than 15 cm from the window frame or door frame.

(ii) Microphone Orientation

The microphone shall be oriented such that the sound to be measured is incident at an angle recommended by the microphone manufacturer for flattest frequency response in a free field.

(d) Extraneous Sources

When measuring the sound from a source, integration shall from time to time be inhibited by the operator immediately when the received sound is dominated by sound from a source other than the source under study and it shall remain inhibited while such a condition persists and for at least 10 seconds thereafter. While integration is inhibited the elapsed time used to calculate the equivalent sound level shall not be allowed to accumulate.

(e) Timing

If the Integrating Sound Level Meter is not provided with an internal elapsed-time clock, the operator shall accumulate the elapsed time during the measurement period by means of a stop-watch or other time measuring device.

(f) Readings

(i) Stationary Source

When measuring the sound from a stationary source, measurements to be used in calculating results shall be taken during a continuous period not in excess of one hour and, for purposes of calculation and reporting of

results, the accumulated elapsed time of measurement as obtained in accordance with clause (d) is deemed to be one hour if the accumulated time is 20 minutes or more. Measurements containing information from an accumulated time period of less than 20 minutes are insufficient for purposes of calculating the equivalent sound level (L_{eq}) of a stationary source.

(ii) Road Traffic Noise Sources

When measuring the sound from road traffic the accumulated elapsed time obtained in accordance with clause (d) shall not be less than twenty minutes and the actual accumulated elapsed time of measurement shall be used for purposes of calculation.

(g) Adjustments

Adjustments for quality of sound shall be made in accordance with Publication NPC-104 - Sound Level Adjustments and the result reported. No adjustment shall be made for intermittence.

(h) Variation in Calibration

A measurement shall not be reported if the Integrating Sound Level Meter calibration after the measurement period is more than 0.5 dB different from that before the measurement commenced.

(i) Weather Conditions

(i) Wind

Measurements shall not be made unless the wind-induced sound level is more than 10 dB below the measured levels. Reference should be made to Publication NPC-102-Instrumentation and particularly Table 102-3.

(ii) Humidity

Measurements shall not be taken if the relative humidity is above the maximum for which the meter specification is guaranteed by the manufacturer (normally 90%).

(iii) Precipitation

Measurements shall not be taken during precipitation.

(iv) Temperature

Measurements shall not be taken when the air temperature is outside the range for which the specification of the instrument is guaranteed by the manufacturer. (Normally, only the lower temperature limit is significant.)

(j) Readings Reported

(i) For sound from a stationary source, the value to be reported based on measurements made during the accumulated elapsed time of 20 minutes or more and the time period for calculation which is one hour is, after adjustment in accordance with clause (g), the one hour equivalent sound level (L_{eq}) of the sound under study for any one hour period during which measurements were taken pursuant to subclause 4(4)(f)(i).

(ii) For sound from road traffic, the value to be reported based on measurements made during the accumulated elapsed time of 20 minutes or more and the time period for calculation which is the actual accumulated elapsed time, is the one hour equivalent sound level (L_{eq}) of the sound under study for any one hour period during which measurements were taken pursuant to subclause 4(4)(f)(ii).

(iii) The one hour equivalent sound level (L_{eq}) shall be reported to the nearest decibel.

(5) Documentation

The following represents the minimum information which shall be contained in a report of an investigation where the above procedure was used. (Adapted from CSA Z107.2-1973 Methods for the Measurement of Sound Pressure Levels.)

(a) Acoustic Environment

(i) Location and description of sound sources.

(ii) A list of the types of extraneous noise sources which caused integration to be inhibited during measurement.

(iii) Dimensioned sketch including photographs, if possible, of the location of the sound source and the point of reception, showing all buildings, trees, structures and any other sound reflective surfaces.

(iv) Physical and topographical description of the ground surface.

(v) Meteorological conditions prevailing at the time of the investigation including approximate local wind speed in km/h, wind direction, air temperature in ^{o}C, approximate relative humidity and extent of cloud cover.

(b) Instrumentation

All the equipment used for making sound level measurements shall be listed, including:

(i) type, model and serial number of Integrating Sound Level Meter;

(ii) type, model and serial number of microphone;

(iii) type, model and serial number of Acoustic Calibrator;

(iv) extension cables and additional amplifier, if used.

(c) Acoustical Data

The measurement details shall be described, including:

(i) the location of the microphone, using a sketch if necessary;

(ii) the continuous time period of observation;

(iii) the accumulated elapsed time of measurement following the procedure of clauses 4(4)(d) and (e);

(iv) the Integrating Sound Level Meter reading or output and any other relevant data required for calculations;

(v) adjustments made for quality of sound;

(vi) details of all calculations;

(vii) the equivalent sound levels obtained, preferably listed in tabular form, referencing location on a sketch or map;

(viii) comparision with applicable sound level limits, standards or guidelines.

5. Procedure for Measurement of Sound and Vibration Due to Blasting Operations

(1) Application

This procedure applies to the measurement of sound (concussion) and vibration due to blasting operations.

(2) Sound

(a) Instrumentation

(i) Measuring Device

A Peak Pressure Level Detector shall be used.

(ii) Calibrator

An Acoustic Calibrator shall be used.

(iii) Windscreen

A windscreen shall be used in all outdoor measurements.

(b) Measurement Location

The measurement location shall be at a point of reception out-of-doors within 7 m of a building.

(c) Use of Instrumentation

(i) Battery Check

If the measuring device is battery powered, the condition of the battery shall be checked after the device has been allowed to warm up and stabilize and after each measurement has been made. The device shall not be used unless the battery condition is confirmed to be within the range recommended by the manufacturer for proper operation.

(ii) Calibration

The measuring device shall be calibrated after it has been allowed to warm up and stabilize and after each measurement has been made.

(iii) Meter Setting

The measuring device shall be set to read the peak pressure level using linear response and a 'hold' facility, if available.

(d) Instrument Configuration

(i) Reflective Surfaces

The microphone shall be located not less than 1 m above the ground, not less than 1 m from any sound reflective surface and not less than arm's length from the body of the person operating the device. Not more than one person, other than the operator of the meter, shall be within 7 m of the microphone and that person shall be behind the operator of the meter.

(ii) Microphone Orientation

The microphone shall be oriented such that the concussion wave to be measured is incident at an angle recommended by the microphone manufacturer for flattest frequency response in a free field.

(e) Readings

(i) Peak Pressure Level

The value of peak pressure level reported shall be given to the nearest decibel.

(ii) Variation in Calibration

A measurement shall not be reported if the meter calibration after the measurement is more than 0.5 dB different from that before the measurement.

(iii) Battery Deterioration

A measurement shall not be reported if the battery condition after the measurement is not within the range recommended by the manufacturer for proper operation.

(f) Weather Conditions

(i) Wind

Measurements shall not be reported unless the wind-induced sound pressure level is more than 10 dB below the measured peak pressure level. Reference should be made to Publication NPC-102 - Instrumentation.

(ii) Humidity

Measurements shall not be taken if the relative humidity is above the maximum for which the meter specification is guaranteed by the manufacturer (normally 90%).

(iii) Precipitation

Measurements shall not be taken during precipitation.

(iv) Temperature

Measurements shall not be taken when the air temperature is outside the range for which the meter specification is guaranteed by the manufacturer. (Normally only the lower temperature limit is significant.)

(3) Vibration

(a) Instrumentation

(i) Measuring Device

A Vibration Velocity Detector shall be used.

(ii) Calibrator

An electrical reference signal of known voltage and frequency shall be used in the field for calibration of the Vibration Velocity Detector excluding the transducer. A reference vibration source shall be used for laboratory calibration of the complete Vibration Velocity Detector.

(b) Measurement Location

Vibration measurements shall be made at a point of reception inside a building below grade or less than 1 m above grade, preferably on a basement floor close to an outside corner.

(c) Use of Instrumentation

(i) Battery Check

If the measuring device is battery powered, the condition of the battery shall be checked after the device has been allowed to warm up and stabilize and after each measurement has been made. The device shall not be used unless the battery condition is confirmed to be within the range recommended by the manufacturer for proper operation.

(ii) Calibration

Field calibration shall be carried out before and after each measurement. Laboratory calibration of the complete Vibration Velocity Detector as used in the field, including the transducer, shall be carried out not less than once per calendar year and the results certified.

(d) Instrument Configuration

(i) Mounting

The transducer shall be affixed to a part of the structure so as to prevent movement of the transducer relative to the structure. The preferred structural element is the basement floor as indicated in clause (b).

(ii) Transducer Orientation

If three vector components of vibration velocity are recorded individually, it is preferable to orient the transducers such that the three axes of measurement are (a) vertical, (b) radial (along a horizontal line joining the location of the blast to the location of measurement) and, (c) transverse (along a horizontal line at right angles to the line joining the location of the blast to the location of measurement).

(e) Readings

(i) Peak Particle Velocity

The peak particle velocity in cm/s shall be reported.

(ii) Variation in Calibration

A measurement shall not be reported if calibration after the measurement is more than 5% different from that before the measurement.

(iii) Battery Deterioration

A measurement shall not be reported if the battery condition after the measurement is not within the range recommended by the manufacturer for proper operation.

(4) Documentation

The following represents the minimum information which shall be contained in a report of an investigation where the above procedure was used.

(a) Description of Area

(i) Location and description of the blasting operation.

(ii) Dimensioned sketch including photographs, if possible, of the location of the blasting operation, the nearest premises and the measurement location.

(iii) Description of the measurement location.

(iv) Physical and topographical description of the ground surface.

(v) Meteorological conditions at the time of the investigation, including approximate wind speed in km/h, wind direction, air temperature in degrees Celsius, approximate relative humidity, degree of cloud cover and whether or not a condition of thermal inversion prevailed.

(b) Instrumentation

All the equipment used for making sound and vibration measurements shall be listed, including:

(i) type, model and serial number of Peak Pressure Level Detector;

(ii) type, model and serial number of microphone;

(iii) type, model and serial number of Acoustic Calibrator;

(iv) windscreen;

(v) extension cables and additional amplifiers, if used;

(vi) type, model and serial number of Vibration Velocity Detector;

(vii) type, model and serial number of transducers.

(viii) type, model and serial number of vibration calibrator.

(c) Sound and Vibration Data

The measurement details shall be described, including:

(i) the location where measurements were taken, the time period involved and the orientation of instrumentation using a sketch, if necessary;

(ii) details of all calculations;

(iii) the peak pressure level in dB and/or peak particle velocity in cm/s;

(iv) comparison with applicable peak pressure limits and/or peak particle velocity limits.

6. Exterior Sound Level Measurement Procedure For Powered Mobile Construction Equipment - SAE J88a

SAE J88a Recommended Practice is adopted by the Ministry with the following change:

Where ANSI Type 1 sound level meter specification is referred to, reference shall be made instead to Publication IEC-179 (1973) for Precision sound level meters. (General Purpose Sound Level Meter)

7. MEMAC Test Code For the Measurement of Sound From Pneumatic Equipment

The MEMAC Test Code For The Measurement Of Sound From Pneumatic Equipment is adopted by the Ministry with the following additional requirement:

For measurement of percussive machines the sound level meter used shall meet the specifications of IEC Publications 179 and 179A (1973). (Impulse Sound Level Meter)

8. Exterior Sound Level Measurement Procedure For Small Engine Powered Equipment - SAE J 1046

SAE J 1046 - Recommended Practice, is adopted by the Ministry with the following changes:

(1) Where ANSI Type 1 sound level meter specification is referred to, reference shall be made instead to IEC Publications 179 and 179A (1973). (Impulse Sound Level Meter)

(2) Replace clause 3.1.1 with the following:
The minimum dimensions of the measurement zone are defined as a path of travel 1.2 m wide by 14 m long plus an adjacent area having the base along the edge of the path of travel and the apex 7 m from the midpoint of the base.

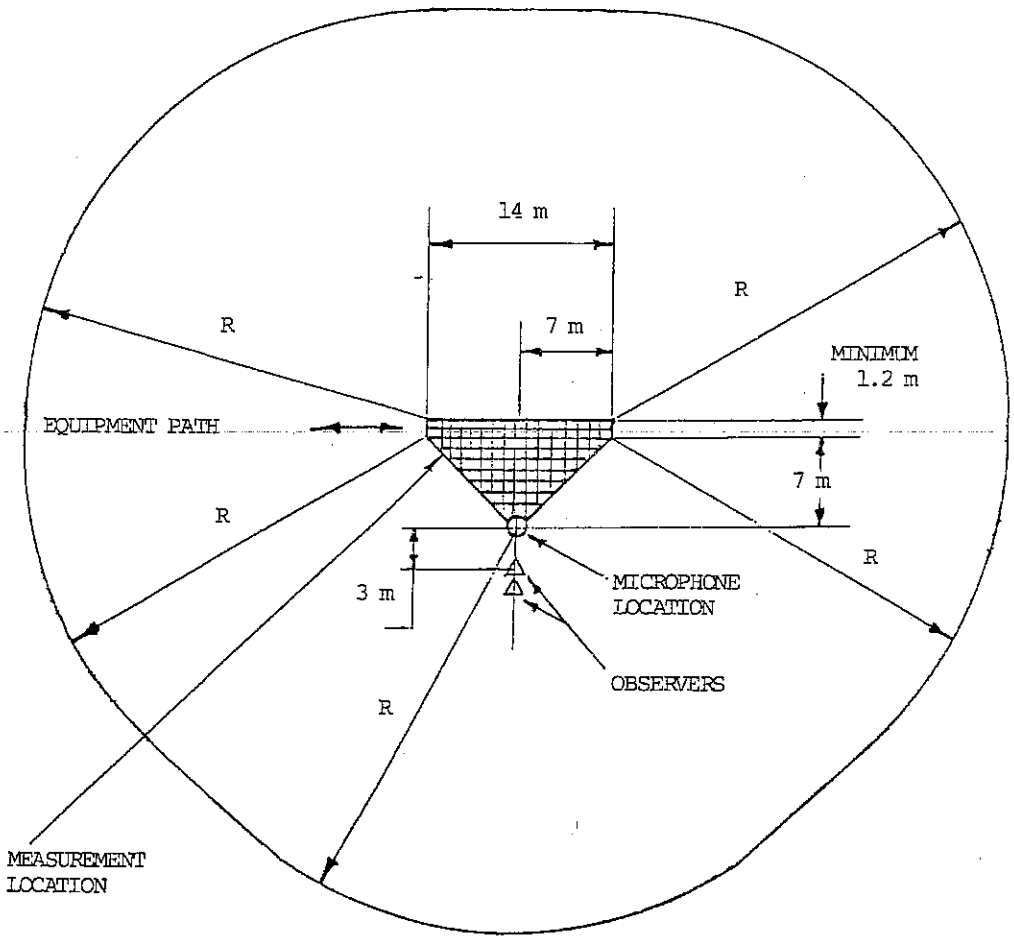
(3) Replace Fig. 1 with Fig. 103-1, hereof.

(4) In section 3.3 Measurements, all references to 25 ft. shall be changed to 7 m.

9. Procedure for Measurement of the Maximum Exterior Sound Level of Stationary Trucks with Governed Diesel Engines-CSA Z107.22-M1977

(1) CSA Z107.22-M1977 standard is adopted by the Ministry with the following change:

A General Purpose Sound Level Meter shall be used.



REF. US EPA 550/9-74-011

R = 30 m MINIMUM RADIUS

TEST SITE CONFIGURATION FOR EXTERIOR SOUND LEVEL MEASUREMENT

PROCEDURE FOR SMALL ENGINE POWERED EQUIPMENT - SAE J 1046

FIG. 103-1

Publication NPC-104

Sound Level Adjustments

1. Scope

This Publication refers to the adjustment of a sound level obtained following the procedures set out in either section 3 or 4 of NPC-103 - Procedures.

2. Technical Definitions

The technical terms used in this Publication are defined in Publication NPC-101 - Technical Definitions.

3. Intermittence

If a sound is intermittent, the following adjustment shall be subtracted from the observed value:

$$\text{Adjustment} = 10 \log_{10} \frac{1}{x}$$

where x is the fraction of an hour for which the sound persists.

Such sound level adjustments are approximated in Table 104-1.

4. Adjustment for Special Quality of Sound

(1) Tonality

If a sound has a pronounced audible tonal quality such as a whine, screech, buzz, or hum then the observed value shall be increased by 5.

(2) Cyclic Variations

If a sound has an audible cyclic variation in sound level such as beating or other amplitude modulation then the observed value shall be increased by 5.

(3) Quasi-Steady Impulsive Sound

If a sound is Quasi-Steady Impulsive Sound then the observed value shall be increased by 10.

(4) One Adjustment Only

An adjustment may be made under one only of subsections (1), (2) and (3), providing that, if subsection (3) applies, it shall be used in preference to subsection (1) or subsection (2).

TABLE 104-1

Adjustment for Intermittence

Duration of Sound In One Hour (Minutes)	Adjustment
40 - 60	0
20 - 39	3
10 - 19	6
5 - 9	9
3 - 4	12
1 - 2	15
less than 1	20

SOUND LEVEL LIMITS FOR STATIONARY SOURCES IN CLASS 1 & 2 AREAS (URBAN)

PUBLICATION NPC-205

OCTOBER 1995

Ontario

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of the
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MINISTRY OF THE ENVIRONMENT

Sound Level Limits for Stationary Sources in Class 1 & 2 Areas (Urban) Publication NPC-205

October 1995

This Publication establishes sound level limits for stationary sources such as industrial and commercial establishments or ancillary transportation facilities, affecting points of reception in Class 1 and 2 Areas (Urban). It replaces Publication NPC-105 "Stationary Sources" of the "Model Municipal Noise Control By-Law, Final Report, August 1978".

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1. SCOPE

This Publication establishes sound level limits for stationary sources such as industrial and commercial establishments or ancillary transportation facilities, affecting points of reception in Class 1 and 2 Areas (Urban). The limits apply to noise complaint investigations carried out in order to determine potential violation of Section 14 of the Environmental Protection Act. The limits also apply to the assessment of planned stationary sources of sound in compliance with Section 9 of the Environmental Protection Act, and under the provisions of the Aggregate Resources Act and the Environmental Assessment Act.

This Publication does not address sound and vibration produced by blasting; blasting in quarries and surface mines is considered in Reference [7].

The Publication includes an Annex, which provides additional details, definitions and rationale for the sound level limits.

2. REFERENCES

Reference is made to the following publications:

[1] NPC-101 - Technical Definitions

[2] NPC-102 - Instrumentation

[3] NPC-103 - Procedures

[4] NPC-104 - Sound Level Adjustments

[6] NPC-206 - Sound Levels due to Road Traffic

[7] NPC-119 - Blasting

[8] NPC-216 - Residential Air Conditioning Devices

[9] NPC-232 - Sound Level Limits for Stationary Sources in Class 3 Areas (Rural)

[10] NPC-233 - Information to be Submitted for Approval of Stationary Sources of Sound

[12] ORNAMENT, Ontario Road Noise Analysis Method for Environment and Transportation, Technical Document, Ontario Ministry of the Environment, ISBN 0-7729-6376, 1989

References [1] to [4] and [7] can be found in the
Model Municipal Noise Control By-Law, Ontario Ministry of the Environment, Final Report, August 1978.

3. TECHNICAL DEFINITIONS

"Ambient sound level"
means Background sound level.

"Background sound level"
is the sound level that is present in the environment, produced by noise sources other than the source under impact assessment. Highly intrusive short duration noise caused by a source such as an aircraft fly-over or a train pass-by is excluded from the determination of the background sound level.

"Class 1 Area"
means an area with an acoustical environment typical of a major population centre, where the background noise is dominated by the urban hum.

"Class 2 Area"
means an area with an acoustical environment that has qualities representative of both Class 1 and Class 3 Areas, and in which a low ambient sound level, normally occurring only between 23:00 and 07:00 hours in Class 1 Areas, will typically be realized as early as 19:00 hours.

Other characteristics which may indicate the presence of a Class 2 Area include:

- absence of urban hum between 19:00 and 23:00 hours;
- evening background sound level defined by natural environment and infrequent human activity; and
- no clearly audible sound from stationary sources other than from those under impact assessment.

"Class 3 Area"
means a rural area with an acoustical environment that is dominated by natural sounds having little or no road traffic, such as the following:

- a small community with less than 1000 population;
- agricultural area;
- a rural recreational area such as a cottage or a resort area; or
- a wilderness area.

Other technical terms are defined in Reference [1] and in the Annex to Publication NPC-205.

4. ESTABLISHMENT OF LIMITS - OBJECTIVE

The sound level limit at a point of reception must be established based on the principle of "predictable worst case" noise impact. In general, the limit is given by the background sound level at the point of reception. The sound level limit must represent the minimum background sound level that occurs or is likely to occur during the operation of the stationary source under impact assessment.

5. BACKGROUND SOUND LEVELS

The time interval between the background sound level measurement and the measurement of the sound level produced by the stationary source under impact assessment should be minimized as much as possible. Preferably, the two measurements should be carried out within one hour of each other.

6. SOUND LEVELS DUE TO STATIONARY SOURCES

(1) Complaint Investigation of Stationary Sources
The One Hour Equivalent Sound Level (L_{eq}) and/or the Logarithmic Mean Impulse Sound Level (L_{LM}) produced by the stationary sources shall be obtained by measurement performed in accordance with Section 7.

(2) Approval of Stationary Sources
The One Hour Equivalent Sound Level (L_{eq}) and/or the Logarithmic Mean Impulse Sound Level (L_{LM}) produced by the stationary sources shall be obtained by measurement or prediction. The estimation of the L_{eq} and/or L_{LM} of the stationary source under impact assessment shall reflect the principle of "predictable worst case" noise impact. The "predictable worst case" noise impact occurs during the hour when the difference between the predicted sound level produced by the stationary source and the background sound level of the natural environment is at a maximum.

7. PROCEDURES

All sound level measurements and calculations shall be made in accordance with References [3], [6]and [12].

Sound from existing adjacent stationary sources may be included in the determination of the background One Hour Equivalent Sound Level (L_{eq}) if such stationary sources of sound are not under consideration for noise abatement by the Municipality or the Ministry of Environment and Energy.

8. SOUND LEVEL LIMITS - GENERAL

(1) For impulsive sound, other than Quasi-Steady Impulsive Sound, from a stationary source, the sound level limit expressed in terms of the Logarithmic Mean Impulse Sound Level (L_{LM}) is the background One Hour Equivalent Sound Level (L_{eq}) typically caused by road traffic as obtained pursuant to Section 6 for that point of reception.

(2) For sound from a stationary source, including Quasi-Steady Impulsive Sound but not including other impulsive sound, the sound level limit expressed in terms of the One Hour Equivalent Sound Level (L_{eq}) is the background One Hour Equivalent Sound Level (L_{eq}) typically caused by road traffic as obtained pursuant to Section 6 for that point of reception.

9. SOUND LEVEL LIMITS - SPECIFIC IMPULSIVE SOUNDS

(1) For impulsive sound, other than Quasi-Steady Impulsive Sound, from a stationary source which is an industrial metal working operation (including but not limited to forging, hammering, punching, stamping, cutting, forming and moulding), the sound level limit at a point of reception expressed in terms of the Logarithmic Mean Impulse Sound Level (L_{LM}) is 60 dBAI, if the stationary source were operating before January 1, 1980, and otherwise is 50 dBAI.

(2) For impulsive sound, other than Quasi-Steady Impulsive Sound, from a stationary source which is the discharge of firearms on the premises of a licensed gun club, the sound level limit at a point of reception expressed in terms of the Logarithmic Mean Impulse Sound Level (L_{LM}) is:

- 70 dBAI if the gun club were operating before January 1, 1980; or
- 50 dBAI if the gun club began to operate after January 1, 1980; or
- the L_{LM} prior to expansion, alteration or conversion.

(3) For impulsive sound, other than Quasi-Steady Impulsive Sound, from a stationary source which is not a blasting operation in a surface mine or quarry, characterized by impulses which are so infrequent that they cannot normally be measured using the procedure for frequent impulses of Reference [3] the sound level limit at a point of reception expressed in terms of the impulse sound level is 100 dBAI.

10. SOUND LEVEL LIMITS - PEST CONTROL DEVICES

(1) For impulsive sound, other than Quasi-Steady Impulsive Sound, from a pest control device employed solely to protect growing crops, the sound level limit at a point of reception expressed in terms of the Logarithmic Mean Impulse Sound Level (L_{LM}) is 70 dBAI.

(2) For sound, including Quasi-Steady Impulsive Sound but not including other impulsive sound, from a pest control device employed solely to protect growing crops, the sound level limit at a point of reception expressed in terms of the One Hour Equivalent Sound Level (L_{eq}) is 60 dBA.

11. PROHIBITION - PEST CONTROL DEVICES

The operation of a pest control device employed solely to protect growing crops outdoors during the hours of darkness, sunset to sunrise, is prohibited.

12. PRE-EMPTION

The least restrictive sound level limit of Sections 8, 9 and 10 applies.

13. EXCLUSION

No restrictions apply to a stationary source resulting in a One Hour Equivalent Sound Level (L_{eq}) or a Logarithmic Mean Impulse Sound Level (L_{LM}) lower than the minimum values for that time period specified in Table 205-1.

TABLE 205-1

Minimum Values of One Hour L_{eq} or L_{LM} by Time of Day

	One Hour L_{eq} (dBA) or L_{LM} (dBAI)	
Time of Day	Class 1 Area	Class 2 Area
0700 - 1900	50	50
1900 - 2300	47	45
2300 - 0700	45	45

May 21, 1999

Annex to Publication NPC-205
Sound Level Limits for Stationary Sources in Class 1 & 2 Areas (Urban)

October 1995

A.1. GENERAL

In general, noises are annoying because they are heard over and above the level of the so-called "background" or surrounding environmental noise climate at a particular location. The standard for environmental noise acceptability of stationary sources is therefore expressed as the difference between noise from the source and the background noise.

The background noise is essentially made up of the road traffic noise which creates an "urban hum". It may also include contributions from existing industry or commercial activity adjacent to the stationary source under investigation. Contributions of these secondary noise sources are considered to be a part of urban hum and may be included in the measurements or calculation of the background sound levels, provided that they are not under consideration for noise abatement by the Municipality or the Ministry of Environment and Energy.

The sound level limits specified in Section 8 of Publication NPC-205 represent the general limitation on noise produced by stationary sources. Some noises, however, are annoying no matter where or in what kind of environment they exist. High level impulsive noises represent a special category and, consequently, are restricted by an absolute limitation. Sections 9 and 10 of this Publication provide criteria of acceptability for specific impulsive noise sources.

A.2. APPLICATION

The limits presented in Publication NPC-205 are designed for the control of noise from sources located in industrial, commercial or residential areas. The limits apply to points of reception located in Class 1 and Class 2 Areas.

Sound level limits contained in Publication NPC-205 do not apply to the excluded noise sources listed in Section A.3.(2) and neither do they apply to any equipment, apparatus or device used in agriculture for food crop seeding, chemical spraying or harvesting. In addition, several specific noise sources have been addressed in separate Publications. Limits for residential air conditioners are contained in Publication NPC-216 - Residential Air Conditioning Devices, Reference [8] and the limits for blasting operations in quarries and surface mines are contained in Publication NPC-119 - Blasting, Reference [7].

A.3. STATIONARY SOURCES

The objective of the definition of a stationary source of sound is to address sources such as industrial and commercial establishments or ancillary transportation facilities. In order to further clarify the scope of the definition, the following list identifies examples of installations, equipment, activities or facilities that are included and those that are excluded as stationary sources.

(1) Included Sources

Individual stationary sources such as:

- Heating, ventilating and air conditioning (HVAC) equipment;
- Rotating machinery;
- Impacting mechanical sources;
- Generators;
- Burners;
- Grain dryers.

Facilities, usually comprising many sources of sound. In this case, the stationary source is understood to encompass all the activities taking place within the property boundary of the facility. The following are examples of such facilities:

- Industrial facilities;
- Commercial facilities;
- Ancillary transportation facilities;
- Aggregate extraction facilities;
- Warehousing facilities;
- Maintenance and repair facilities;
- Snow disposal sites;
- Routine loading and unloading facilities (supermarkets, assembly plants, etc.).

Other sources such as:

- Car washes;
- Race tracks;
- Firearm Ranges.

(2) **Excluded Sources**

Secific sources or facilities:

- Construction activities;
- Transportation corridors, i.e. roadways and railways;
- Residential air conditioning devices including air conditioners and heat pumps;
- Gas stations;
- Auditory warning devices required or authorized by law or in accordance with good safety practices;
- Occasional movement of vehicles on the property such as infrequent delivery of goods to convenience stores, fast food restaurants, etc.

Other noise sources, normally addressed in a qualitative manner in municipal noise by-laws:

- The operation of auditory signalling devices, including but not limited to the ringing of bells or gongs and the blowing of horns or sirens or whistles, or the production, reproduction or amplification of any similar sounds by electronic means;
- Noise produced by animals kept as domestic pets such as dogs barking;
- Tools and devices used by occupants for domestic purposes such as domestic power tools, radios and televisions, etc., or activities associated with domestic situations such as domestic quarrels, noisy parties, etc;
- Noise resulting from gathering of people at facilities such as restaurants and parks.

Activities related to essential service and maintenance of public facilities such as but not limited to roadways, parks and sewers, including snow removal, road cleaning, road repair and maintenance, lawn mowing and maintenance, sewage removal, garbage collection, etc.

A.4. PREDICTABLE WORST CASE IMPACT

The assessment of noise impact requires the determination of the "predictable worst case" impact. The "predictable worst case" impact assessment should establish the largest noise excess produced by the source over the applicable limit. The assessment should reflect a planned and predictable mode of operation of the stationary source.

It is important to emphasize that the "predictable worst case" impact does not necessarily mean that the sound level of the source is highest; it means that the excess over the limit is largest. For example, the excess over the applicable limit at night may be larger even if the day-time sound level produced by the source is higher.

A.5. DEFINITIONS

In the interpretation of Publication NPC-205, the following definitions are of particular relevance:

- Ancillary Transportation Facilities
  "Ancillary transportation facilities" mean subsidiary locations where operations and activities associated with the housing of transportation equipment (or personnel) take place. Examples of ancillary transportation facilities include, but are not limited to, substations, vehicle storage and maintenance facilities, fans, fan and vent shafts, mechanical equipment plants, emergency services buildings, etc;

- Construction
  "Construction" includes erection, alteration, repair, dismantling, demolition, structural maintenance, painting, moving, land clearing, earth moving, grading, excavating, the laying of pipe and conduit whether above or below ground level, street and highway building, concreting, equipment installation and alteration and the structural installation of construction components and materials in any form or for any purpose, and includes any work in connection therewith; "construction" excludes activities associated with the operation at waste and snow disposal sites;

- Construction Equipment
  "Construction equipment" means any equipment or device designed and intended for use in construction, or material handling including but not limited to, air compressors, pile drivers, pneumatic or hydraulic tools, bulldozers, tractors, excavators, trenchers, cranes, derricks, loaders, scrapers, pavers, generators, off-highway haulers or trucks, ditchers, compactors and rollers, pumps, concrete mixers, graders, or other material handling equipment;

- Conveyance
  "Conveyance" includes a vehicle and any other device employed to transport a person or persons or goods from place to place but does not include any such device or vehicle if operated only within the premises of a person;

- Highway
  "Highway" includes a common and public highway, street, avenue, parkway, driveway, square, place, bridge, viaduct or trestle designed and intended for, or used by, the general public for the passage of vehicles;

- Motor Vehicle
  "Motor vehicle" includes an automobile, motorcycle, and any other vehicle propelled or driven otherwise than by muscular power, but does not include the cars of diesel, electric or steam railways, or other motor vehicles running only upon rails, or a motorized snow vehicle, traction engine, farm tractor, self-propelled implement of husbandry or road-building machine within the meaning of the Highway Traffic Act;

- Motorized Conveyance
  "Motorized conveyance" means a conveyance propelled or driven otherwise than by muscular, gravitational or wind power;

- Noise
  "Noise" means unwanted sound;

- Point of Reception
  "Point of reception" means any point on the premises of a person where sound or vibration originating from other than those premises is received.

For the purpose of approval of new sources, including verifying compliance with Section 9 of the Environmental Protection Act, the point of reception may be located on any of the following existing or zoned for future use premises: permanent or seasonal residences, hotels/motels, nursing/retirement homes, rental residences, hospitals, camp grounds, and noise sensitive buildings such as schools and places of worship.

For equipment/facilities proposed on premises such as nursing/retirement homes, rental residences, hospitals, and schools, the point of reception may be located on the same premises;

- Stationary Source
"Stationary source" means a source of sound which does not normally move from place to place and includes the premises of a person as one stationary source, unless the dominant source of sound on those premises is construction or a conveyance;

- Urban Hum
means aggregate sound of many unidentifiable, mostly road traffic related noise sources.

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SOUND LEVELS DUE TO ROAD TRAFFIC

PUBLICATION NPC-206

OCTOBER 1995

Ontario

Ministry of
Environment
and Energy

Ontario

MINISTRY OF THE ENVIRONMENT

Sound Levels due to Road Traffic
Publication NPC-206

October 1995

This Publication describes the methods to determine the equivalent sound level produced by road traffic. It replaces Publication NPC-106 "Sound Levels of Road Traffic" of the "Model Municipal Noise Control By-Law, Final Report, August 1978".

1. SCOPE

This Publication describes the methods to determine the One Hour Equivalent Sound Level (L_{eq}) of sound caused by road traffic. The road traffic sound level is used to define sound level limits for the purposes of complaint investigation or approval of stationary sources of sound.

The methods apply at a point of reception in any community where the background sound level is dominated by the sound of road traffic, referred to as "urban hum". Highly intrusive short duration noise caused by a source such as an aircraft fly-over or a train pass-by is excluded from the determination of this background sound level.

2. REFERENCES

Reference is made to the following publications:

[1] NPC-101 - Technical Definitions

[2] NPC-102 - Instrumentation

[3] NPC-103 - Procedures

[5] NPC-205 - Sound Level Limits for Stationary Sources in Class 1 & 2 Areas (Urban)

[11] ORNAMENT, Ontario Road Noise Analysis Method for Environment and Transportation, Technical Document, Ontario Ministry of the Environment, ISBN 0-7729-6376, 1989

References [1] to [3] can be found in the
Model Municipal Noise Control By-Law, Ontario Ministry of the Environment, Final Report, August 1978.

3. TECHNICAL DEFINITIONS

"Ambient sound level"
means Background sound level;

"Background sound level"
is the sound level that is present in the environment, produced by noise sources other than the source under impact assessment. Highly intrusive short duration noise caused by a source such as an aircraft fly-over or a train pass-by is excluded from the determination of the background sound level;

Other technical terms are defined in Reference [1].

4. SOUND LEVELS DUE TO ROAD TRAFFIC

Depending on the application, the One Hour Equivalent Sound Level (L_{eq}) of road traffic shall be obtained either by measurement or by calculation. The following procedures shall be used for complaint investigation and for the approval of stationary sources:

(1) **Complaint Investigation of Stationary Sources**

The One Hour Equivalent Sound Level (L_{eq}) of road traffic may be measured or calculated. Measurements of the One Hour Equivalent Sound Level (L_{eq}) of road traffic shall be carried out using instrumentation described in Reference [2], following procedures for the measurement of varying sound described in Reference [3].

The results of the road traffic L_{eq} measurements must not be affected by the sound due to other noise sources; the measurements should be performed when the stationary source under impact assessment is not operating. The time interval between the road traffic L_{eq} measurements and the measurement of the sound level produced by the stationary source under impact assessment should be minimized as much as possible. Preferably, the two measurements should be carried out within one hour of each other.

The calculation of the One Hour Equivalent Sound Level (L_{eq}) of road traffic shall be based on the traffic flows observed on the contributing road(s), from which traffic noise is audible at the point of reception, within one hour of the period when the sound from the stationary source is measured. The calculation procedure is described in Reference [11].

(2) **Approval of Stationary Sources**

Measurements of the One Hour Equivalent Sound Level (L_{eq}) of road traffic shall be carried out following procedures for the measurement of varying sound described in Reference [3].

Results of the measurement of the One Hour Equivalent Sound Level (L_{eq}) of road traffic shall reflect the principle of "predictable worst case" noise impact. The "predictable worst case" noise impact occurs during the hour when the difference between the sound level produced by the stationary source under impact assessment and the sound level due to road traffic is largest.

The One Hour Equivalent Sound Level (L_{eq}) of road traffic may be calculated on the basis of traffic flows observed on the contributing road(s), from which traffic noise is audible at the point of reception. The results of calculation of the One Hour Equivalent Sound Level (L_{eq}) of road traffic shall reflect the principle of "predictable worst case" noise impact. The calculation procedure is described in Reference [11].

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Publication NPC-115

Construction Equipment

1. Scope

This Publication sets sound emission standards for various items of new construction equipment according to the date of manufacture of the equipment.

2. Technical Definitions

The technical terms used in this Publication are defined in Publication NPC-101 - Technical Definitions.

3. Sound Emission Standards

Tables 115-1 to 115-4 inclusive list Residential Area sound emission standards and Quiet Zone sound emission standards for specific items of new construction equipment measured in accordance with the procedures indicated.

TABLE 115-1

Quiet Zone and Residential Area Sound Emission Standards for Excavation Equipment, Dozers, Loaders, Backhoes or Other Equipment Capable of Being Used for Similar Application

Maximum Sound Level as determined using Publication NPC-103 - Procedures, section 6 dBA		
Date of Manufacture	Power Rating Less than 75 kW	Power Rating 75 kW and larger
January 1, 1979 to December 31, 1980	85	88
January 1, 1981 and after	83	85

TABLE 115-2

Sound Emission Standards for Pneumatic Pavement Breakers

Standard	Date of Manufacture	Maximum Sound Level as measured using Publication NPC-103 - Procedures, section 7 dBA
Quiet Zone Sound Emission Standard	Jan. 1, 1979 and after	85
Residential Area Sound Emission Standard	Jan. 1, 1979 – to Dec. 31 1980	90
	Jan. 1, 1981 and after	85

TABLE 115-3

Sound Emission Standards for Portable Air Compressors

Standard	Date of Manufacture	Maximum Sound Level as measured using Publication NPC-103 - Procedures, section 7 dBA
Quiet Zone Sound Emission Standard	Jan. 1, 1979 to Dec. 31, 1980	76
	Jan. 1, 1981 and after	70
Residential Area Sound Emission Standard	Jan. 1, 1979 and after	76

TABLE 115-4

Sound Emission Standard for Tracked Drills

Standard	Date of Manufacture	Maximum Sound Level as measured using Publication NPC-103 - Procedures, section 6. dBA
Quiet Zone and Residential Area Sound Emission Standard	Jan. 1, 1981 and after	100

Publication NPC-117

Domestic Outdoor Power Tools

1. Scope

This Publication sets sound emission standards for various domestic outdoor power tools.

2. Technical Definitions

The technical terms used in this Publication are defined in Publication NPC-101 - Technical Definitions.

3. Sound Emission Standards

Table 117-1 lists sound emission standards for walk-behind powered lawn mowers measured according to the procedure indicated in the Table.

TABLE 117-1

Sound Emission Standards for Walk-Behind Powered Lawn Mowers

Date of Manufacture	Maximum Sound Level as Measured using Publication NPC-103 - Procedures section 8 dBA
Jan. 1, 1979 to Dec. 31, 1980	73
Jan. 1, 1981 and after	69

Publication NPC-119

Blasting

1. Scope

This Publication refers to limits on sound (concussion) and vibration due to blasting operations.

2. Technical Definitions

The technical terms used in this Publication are defined in Publication NPC-101 - Technical Definitions.

3. Measurement Procedures

All measurements of peak pressure level and vibration velocity shall be made in accordance with the "Procedure for Measurement of Sound and Vibration due to Blasting Operations" set out in Publication NPC-103 - Procedures, section 5.

4. Concussion - Cautionary Limit

Subject to section 5 the peak pressure level limit for concussion resulting from blasting operations in a mine or quarry is 120 dB.

5. Concussion - Peak Pressure Level Limit

If the person in charge of a blasting operation carries out routine monitoring of the peak pressure level, the peak pressure level limit for concussion resulting from blasting operations in a mine or quarry is 128 dB.

6. Vibration - Cautionary Limit

Subject to section 7, the peak particle velocity limit for vibration resulting from blasting operations in a mine or quarry is 1.00 cm/s.

7. Vibration - Peak Particle Velocity Limit

If the person in charge of a blasting operation carries out routine monitoring of the vibration the peak particle velocity limit for vibration resulting from blasting operations in a mine or quarry is 1.25 cm/s.