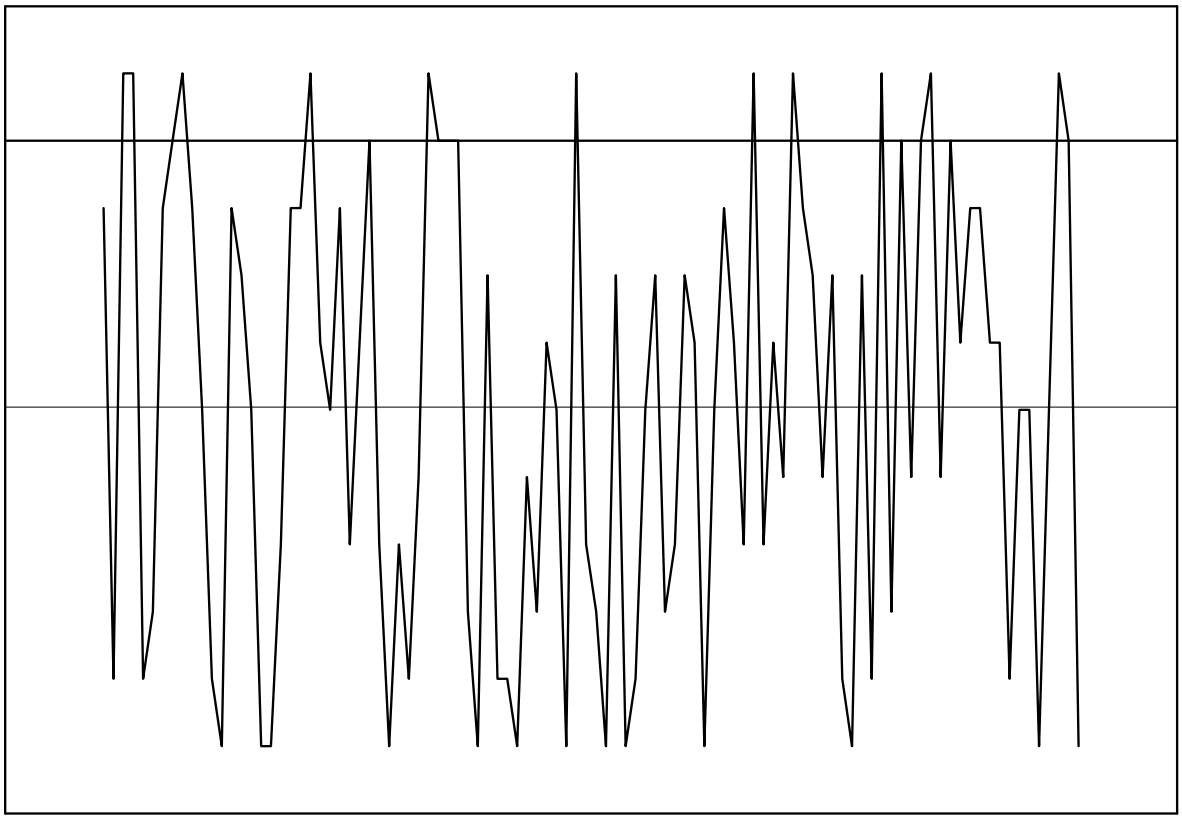

A Guide to Noise Control in Minnesota

Acoustical Properties, Measurement, Analysis and Regulation

Minnesota Pollution Control Agency

Minnesota Pollution Control Agency
520 Lafayette Road North
Saint Paul, MN 55155-4194
http://www.pca.state.mn.us
651-296-6300 or 800-657-3864 toll free
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Available in alternative formats

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Forward

The Minnesota Pollution Control Agency (MPCA) is empowered to enforce the state of Minnesota noise rules. These rules and supporting acoustical information can be viewed in the document, A Guide to Noise Control in Minnesota.

This publication is intended to provide information on the basics of sound and noise regulation.

Revised 2008

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Figures

Summary of Key Points

Minnesota's noise pollution rules are based on statistical calculations that quantify noise levels according to duration over a one-hour monitoring period. The L10 calculation is the noise level that is exceeded for 10 percent, or six minutes, of the hour, and the L50 calculation is the noise level exceeded for 50 percent, or 30 minutes, of the hour. There is not a limit on maximum noise.

The statutory limits for a residential location are L10 = 65 dBA and L50 = 60 dBA during the daytime (7:00 a.m – 10:00 p.m.) and L10 = 55 dBA and L50 = 50 dBA during the nighttime (10:00 p.m. – 7:00 a.m.) (Minn. State Noise Pollution Control Rules 7030.0040). This means that during the one-hour period of monitoring, daytime noise levels cannot exceed 65 dBA for more than 10 percent of the time, and cannot exceed 60 dBA more than 50 percent of the time.

Decibel levels of common noise sources

140 ----------	Jet Engine (at 25 meters)
130 ----------	Jet Aircraft (at 100 meters)
120 ----------	Rock Concert
110 ----------	Pneumatic Chipper
100 ----------	Jackhammer (at one meter)
90 ----------	Chainsaw, Lawn Mower (at one meter)
80 ----------	Heavy Truck Traffic
70 ----------	Business Office, Vacuum Cleaner
60 ----------	Conversational Speech, Typical TV Volume
50 ----------	Library
40 ----------	Bedroom
30 ----------	Secluded Woods
20 ----------	Whisper

Distance attenuation

When the distance is doubled from a *point* source, such as a building, the sound level decreases by *six* decibels.

Example: *50 feet = 60 decibels*
100 feet = 54 decibels
200 feet = 48 decibels

When the distance is doubled from a *line* source, like a busy roadway, the sound level decreases by *three* decibels.

Example: *50 feet = 70 decibels*
100 feet = 67 decibels
200 feet = 64 decibels

Addition and subtraction of sources

A doubling of energy, or doubling of identical sources, yields an increase of *three* decibels.

Example: 85 decibels + 85 decibels = 88 decibels

Change in decibel level and perceived change in loudness

± 1 dBA……..	Not Noticeable
± 3 dBA……..	Threshold of Perception
± 5 dBA……..	Noticeable Change
± 10 dBA……	Twice (Half) As Loud
± 20 dBA……	Four Times (One Fourth) As Loud

Monitoring guidelines

The noise source being measured should be at least 10 dBA above the background noise level.
Keep at least as far away from any large reflecting object as from the source being measured. If this is not possible, stay at least 30 feet from structures.

All measurements should be made with the microphone at lease three feet above the ground, in relatively calm weather.

Introduction

Noise is a pollutant. While its physical and emotional effects are difficult to define quantitatively, the sound level itself can be measured.

Sound is an alteration of pressure that propagates through an elastic medium such as air and produces an auditory sensation.

Noise is any undesired sound.

Waves and sound pressure level

Sound travels in a wave motion through the air to our ears. An effective tool to demonstrate wave motion is a weight hanging from a spring. Picture the following diagram as a single weight and spring combination varying as time progresses along the horizontal axis.

Weight on a spring – Example of periodic motion

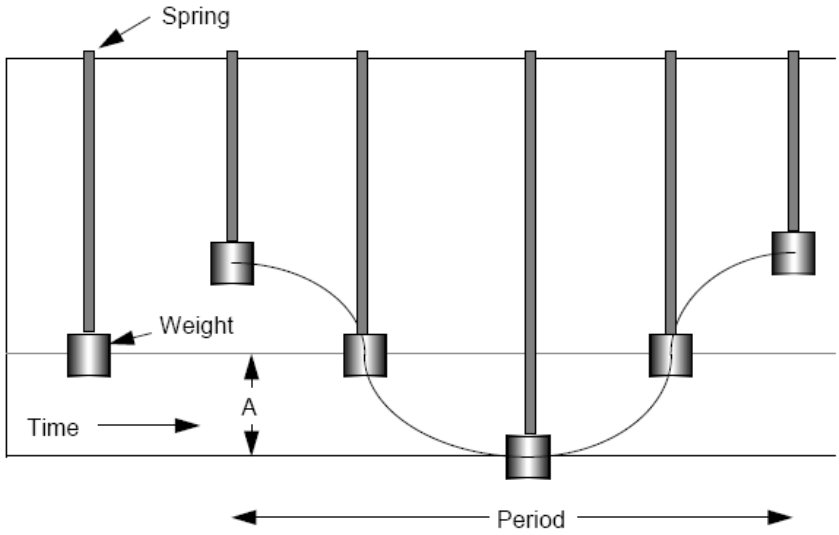


Figure 1

In Figure 1, the first position of the weight on the spring is at rest with no forces exerted upon the system. If the weight is raised above its point of rest and the progression of the weight moving down and up again is observed over a period of time, a sinusoidal wave form is produced. This example demonstrates the relationship between a linear motion, the weight bouncing on the spring, and its corresponding wave form.

The *amplitude* of the moving weight is denoted as A on the diagram and corresponds with the maximum displacement of the weight from its "at rest" position, or the peak of the wave form in the positive or negative direction. We perceive changes in amplitude as changes in loudness.

The *period* of the vibration is the amount of time taken to produce one complete cycle. The number of cycles per second defines the *frequency* of the periodic motion, denoted by the unit of *hertz*, or *Hz*. We perceive different frequencies as higher or lower pitched sounds.

Comparison of periodic motion to sound waves

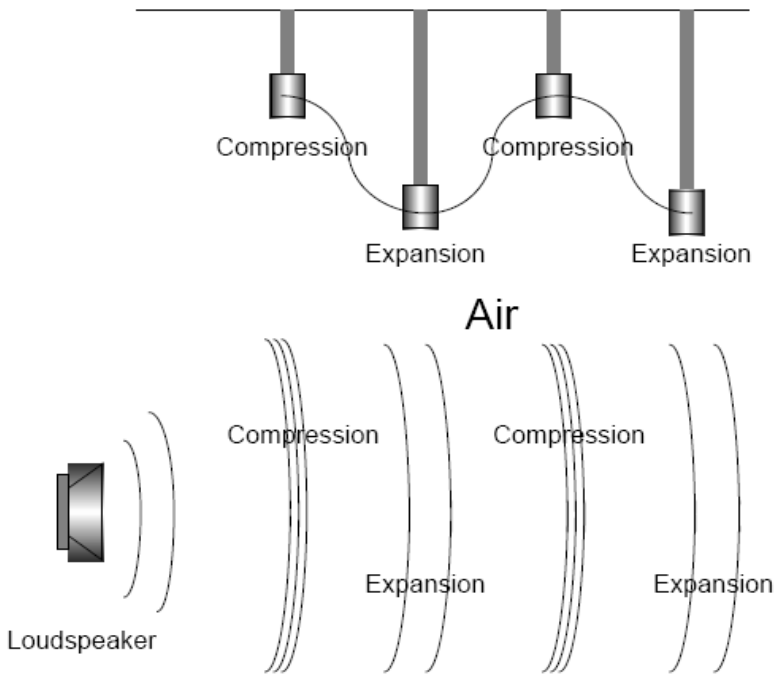


Figure 2

The graphical representation of sounds in Figure 2 is of *pure tones***,** which are sounds made up of a single frequency. A familiar example of a pure tone is the sound produced when a single key of a piano is pressed. For instance, the middle C key on a piano vibrates the associated wire at a rate of approximately 260 times per second or 260 Hertz. The vibration of the wire transfers its motion to the sound board of the piano, which then vibrates at the same frequency, causing the air adjacent to the sound board to form compression and expansion waves in the air emitting outward from the sound board. When received by the human ear, this is regarded as sound.

Most sounds are not pure tones but a mixture of tones of varying amplitude, frequency, and duration. The intensity of sound waves produce a sound pressure level, measured in a unit called the *decibel*, or *dB.* The decibel is a logarithmic measurement used to accommodate a numbering scheme that encompasses a large range of values. The logarithm is used because the human ear can detect sounds more than a million times quieter than a jet aircraft during take off.

Sound pressure level = 20 Log_{10} (Measured Sound Pressure / Reference Pressure)
Reference Pressure = 0.00002 Newton's / $(\text{meter})^2$

Decibel = The ratio between two quantities that are proportional to power. The unit of measurement for sound pressure levels, abbreviated dB.

Decibel levels of common noise sources

Many different properties affect the noise level of a specific source type. For example, three lawn mowers may have three different noise levels because of differences in each specific piece of equipment. Noise level also depends on the distance from the noise source and the attenuation of the surrounding environment.
Figure 3 provides a rough estimate of decibel levels of some common noise sources.

Decibel levels of common noise sources

Sound pressure level (dBA)	Noise source
140	Jet Engine (at 25 meters)
130	Jet Aircraft (at 100 meters)
120	Rock Concert
110	Pneumatic Chipper
100	Jackhammer (at 1 meter)
90	Chainsaw, Lawn Mower (at 1 meter)
80	Heavy Truck Traffic
70	Business Office, Vacuum Cleaner
60	Conversational Speech, Typical TV Volume
50	Library
40	Bedroom
30	Secluded Woods
20	Whisper

Figure 3

Using Decibel Measurements

Addition and subtraction of decibels is often necessary for estimating total noise levels or background noise. Because decibels are measured using a logarithmic scale, conventional linear mathematics cannot be used. The most convenient way to perform simple arithmetic functions involving logarithmic measurements is to use doubling rules. These rules provide an accurate estimate of the effect distance and multiple sources have on measured sound pressure level.

Sound propagation and sources

Sources of sound can be defined as *point* or *line* sources, based on the way sound pressure waves spread away from the source. Sound waves propagate from sources in a way similar to waves traveling away from a rock dropped in a pond. A *point* source, like a factory, emits sound that spreads out in a sphere. A *line* source, like a busy highway, emits sound that spreads out in a cylinder. Knowing the sources of sounds makes it possible to make assumptions about how the sound behaves.

Distance attenuation estimations

Over distance, sound attenuates, or is reduced in amplitude, and is perceived as the sound becoming quieter. This occurs as the sound travels outward to an increasingly larger sphere or cylinder, and the energy per unit of area decreases. These basic principles allow us to make generalized assumptions about sound.

When the distance is doubled from a *line* source, the sound level decreases three decibels.

Example: If a sound level is: 70 decibels at 50 feet it will be
67 decibels at 100 feet, and
64 decibels at 200 feet.

When the distance is doubled from a *point* source, the sound level decreases six decibels.

Example: If a sound level is: 95 decibels at 50 feet it will be
89 decibels at 100 feet, and
83 decibels at 200 feet.

Distance attenuation of noise levels from a point source

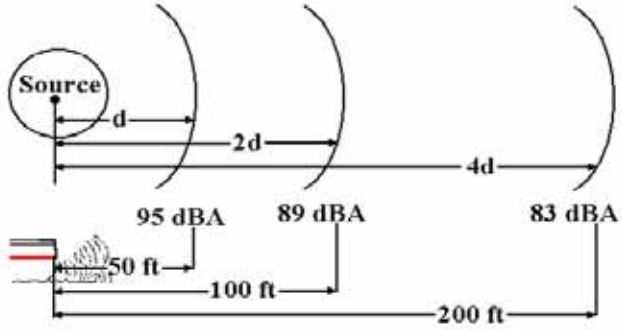


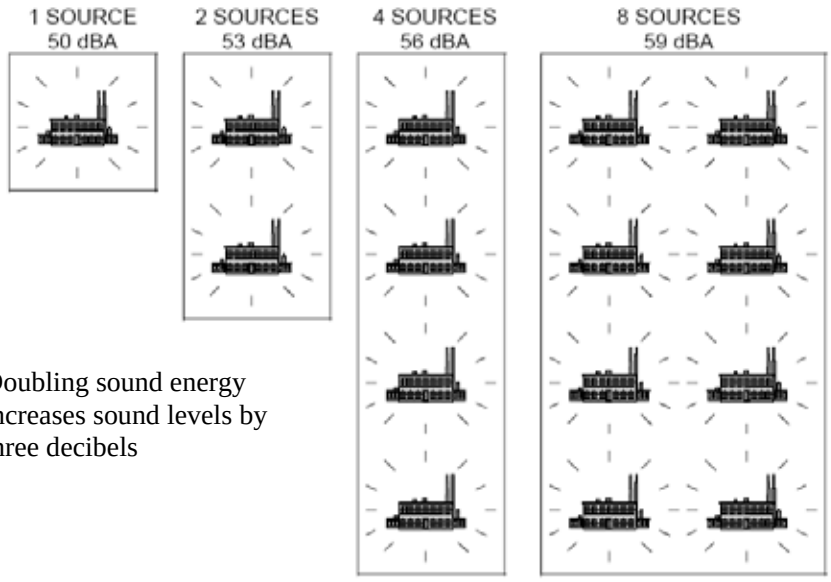
Figure 4

Addition and subtraction of decibel levels

In many situations pertaining to noise control and monitoring, it is very useful to be able to add and subtract noise levels. This can be done with principles similar to how sound attenuation over distance is estimated. It is important to note the characteristics of logarithmic addition or subtraction of decibel levels.

A doubling of sound energy yields an increase of three decibels. For example, each generator at a factory produces sound that is measured at 50 decibels, so running one generator would create sound measured at 50 dBA, turning on a second generator would increase sound by 3 dBA to 53 dBA, and doubling again to four generators would increase sound levels to 56 dBA. Figure 5 illustrates this principle.

Addition and subtraction of decibel levels



Doubling sound energy increases sound levels by three decibels

Figure 5

Background noise

Background, or ambient, noise is present in any environmental noise-monitoring situation. Background noise is considered to be all noise sources other than the noise source being monitored. This can include traffic, animals, machinery, voices, and other sounds.

Wind may be a major source of ambient noise. The MPCA's noise test procedures states that measurements should not be made when noise from wind or precipitation results in a difference between the background sound level and noise source being measured that is less than 10 dBA. In practice, this means that wind speeds must be below 11 mph, and rainy weather conditions should be avoided.

Background noise correction

Background noise could impact monitoring results. The background noise must be more than 10 decibels below the noise level of the source being monitored to have confidence in the accuracy of the measurement.

In certain instances, when a single noise source is analyzed along with other noise sources, correction factors can be used to isolate the noise source being monitored and calculate its individual noise level. This is done by measuring and recording the total noise level of all sources. Next, the noise source to be isolated is turned off and a noise level reading is taken with all the other existing noise sources in operation. Total noise level is then subtracted from the background noise level.

Background noise correction

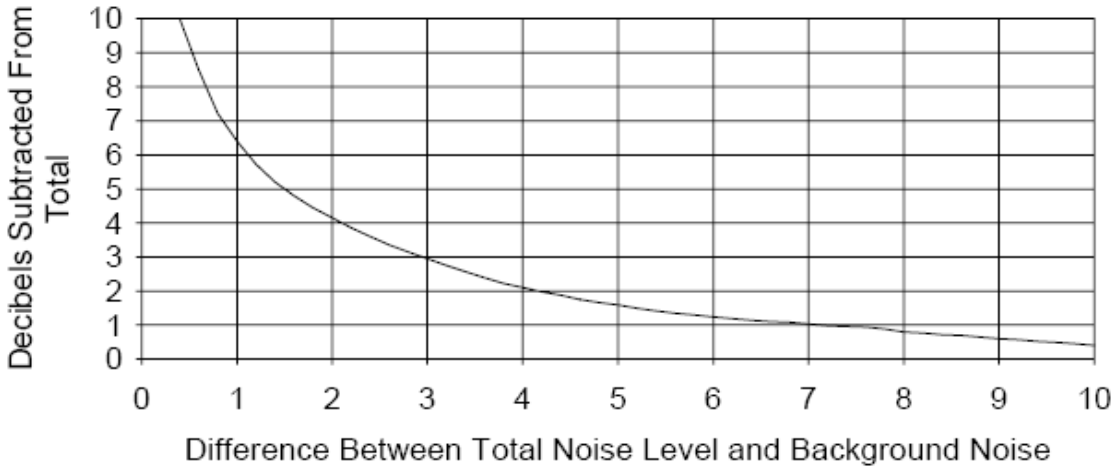


Figure 6

Figure 6 is a graph used to estimate the amount of background noise influencing a measurement, and the corresponding decibel level to be subtracted from the total measurement to determine the decibel level of the noise source being monitored.

For example, if the total noise level is 84 dBA, and then falls to 80 dBA when the source of interest is turned off, the difference of four decibels between the total noise level and background noise indicates that two decibels should be subtracted from the total. This means that an 82 dBA noise level can be attributed to the monitored source in the absence of background noise.

Human Perception of Sound

Sounds qualitative aspects that can be described with adjectives, and quantitative aspects that can be described with measurements. Sound can be perceived as pleasant or annoying, and as loudness, in terms of decibels.

Changes in loudness are described on a logarithmic scale because the human ear can hear such a wide variety of sound levels. The human ear can usually tell the difference when sound changes by 3 dBA, and a 5 dBA change is clearly noticeable. Because of the logarithmic scale, an increase of 10 dBA sounds twice as loud.

Change in decibel level and perceived change in loudness

± 1 dBA……..	Not Noticeable
± 3 dBA……..	Threshold of Perception
± 5 dBA……..	Noticeable Change
± 10 dBA……	Twice (Half) As Loud
± 20 dBA……	Four Times (One Fourth) As Loud

Figure 7

Compared to the example of addition or subtraction of sources, doubling sources yielded an increase of 3 dBA, which is a change that is just perceptible.

Weighting networks

Sound level meters used for monitoring can pick up sounds as a perfect computer, but the human ear is not so precise. The human ear cannot hear lower frequencies as well as higher frequencies.

Weighting networks are used in noise monitors to attenuate specific frequencies in the audio spectrum to attempt to duplicate the response of the human ear. The graph in Figure 8 represents the compensation of a C-weighting network, A-weighting network and the sensitivity of the ear. This illustration is useful in understanding how the ear is inefficient in the detection of lower frequencies and is very sensitive to higher frequencies.

The C-weighting network represents the actual sound pressure level that is received by the sound level meter, and does not noticeably vary in its amount of compensation throughout the audio spectrum. C-weighting is used during the calibration of sound level meters to ensure that the sound level displayed on the meter is invariant of the frequency of the calibrator.

The A-weighting network is used to duplicate the sensitivity of the human ear. At 100 Hertz, the A-weighting network filters out approximately 20 dB from the incoming signal before it is combined with the levels from the other frequency ranges to produce an A-weighted sound level.

Weighting networks

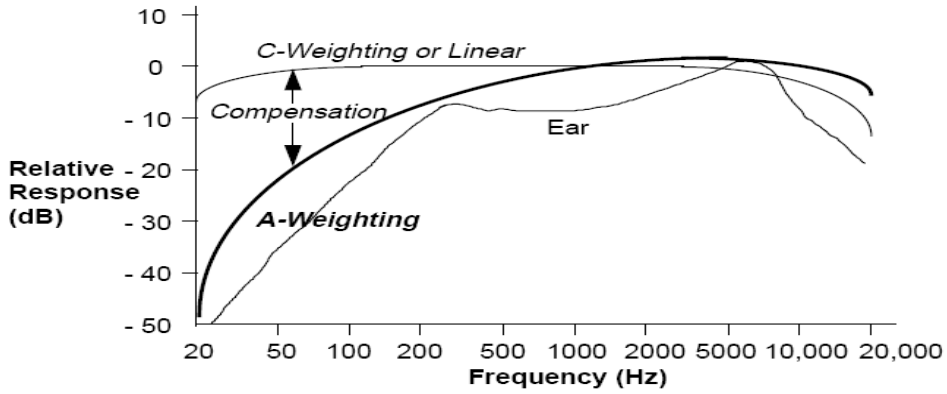


Figure 8

Measurement Procedures

This guide contains two measurement procedures. The general protocols remain the same, but your choice of procedure depends on the capabilities of your sound level meter (SLM). NTP-1 should be used if your SLM is capable of calculating monitoring results and NTP-2 should be used if your SLM only displays instantaneous readings.

Your sound level meter and microphone must comply with the specifications for ANSI S1.4-1983 Type 0, 1, 2, or S. You must also have a calibrator of a known frequency and sound level. Calibrators should be compared to a lab standard periodically.

Measurements should not be made when noise from wind or precipitation results in a difference between the background sound level and noise source being measured that is less than 10 dBA. In practice, this means that wind speeds must be below 11 mph, and rainy weather conditions should be avoided. Temperature and humidity should be within equipment specifications.

Properly choosing a monitoring location is an important consideration. Measurements should be made in an area of normal outdoor human activity, nearest to the noise source. The monitoring location may not necessarily be at the property line, such as if the property of the complainant is large and evidence of outdoor activity is limited to a backyard patio.

Another important part of site selection is the consideration of errors caused by reflecting objects. Figure 9 shows the effect on noise measurements of a reflective object such as a wall.

Errors caused by reflecting objects

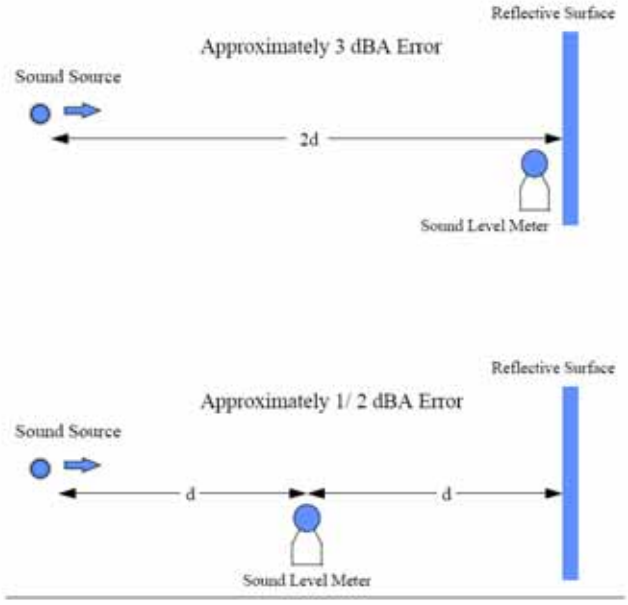


Figure 9

NTP-1 Measurement procedure for non-impulsive noise

The following test procedure has been approved by the Executive Director of the MPCA for the measurement of non-impulsive noise.

Instrumentation:

- a sound level meter and a microphone conforming to type 0, 1, 2, or S specifications under ANSI S1.4-1983
- a calibrator of known frequency and level
- a small screwdriver for sensitivity adjustment
- microphone windscreen
- noise survey form
- tripod (optional)

Meteorology:

- Measurements must not be made in sustained winds or in precipitation which results in a difference of less than 10 decibels between the background noise level and the noise source being measured
- Temperature and/or humidity conditions must be within the equipment manufacturer's specifications

Location:

- Measurements must be made at or within the applicable NAC at the point of human activity nearest the noise source.
- Measurements must be made outdoors.
- Measurements must be made at least three feet off the ground and away from natural or manmade structures which would prevent an accurate measurement (barriers, houses).

Survey Procedure:

- Monitoring must be conducted for at least a one hour time period.
- Calibration must be performed before and after the monitoring period. Adjustments should be made if necessary.
- Sound measuring devices must use the "A" weighting and FAST response characteristics.
- Background noise must be at least 10 decibels lower than the noise source being measured.
- A survey form must be completed containing date, time, location, noise source, wind speed/direction, temperature, humidity, equipment information (make, model, serial number), site sketch with the location of the noise source and measurement location (including appropriate distances), data and calibration information. A sample survey form is on the following pages.
- Follow your manufacturer instructions to obtain the L10 and L50 results.

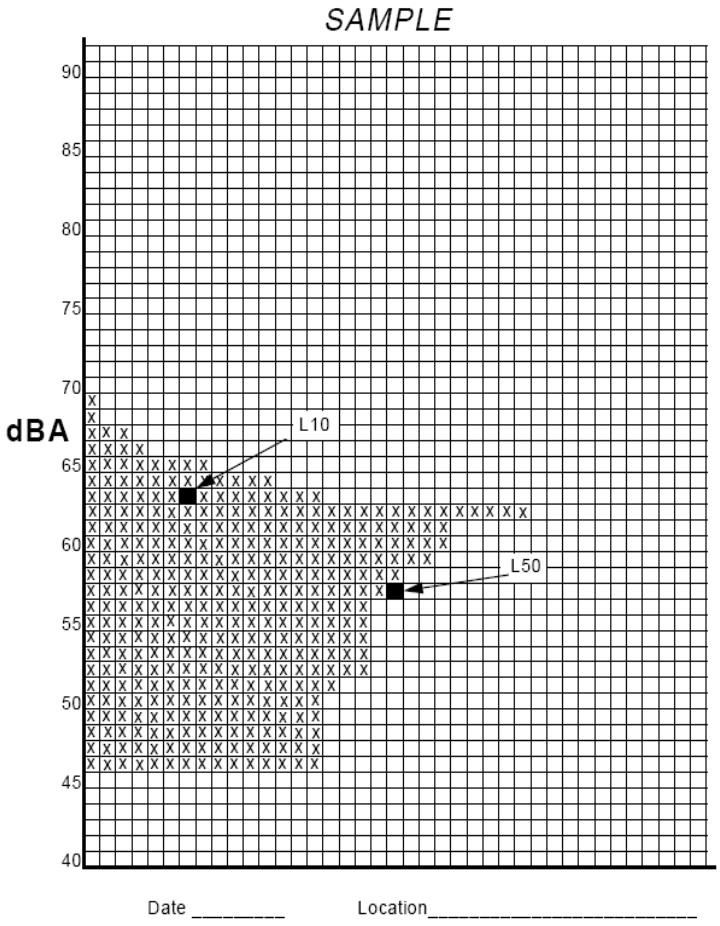
NTP-2 Manual measurement procedure for non-impulsive noise

The following test procedure has been approved by the Executive Director of the MPCA for the measurement of non-impulsive noise.

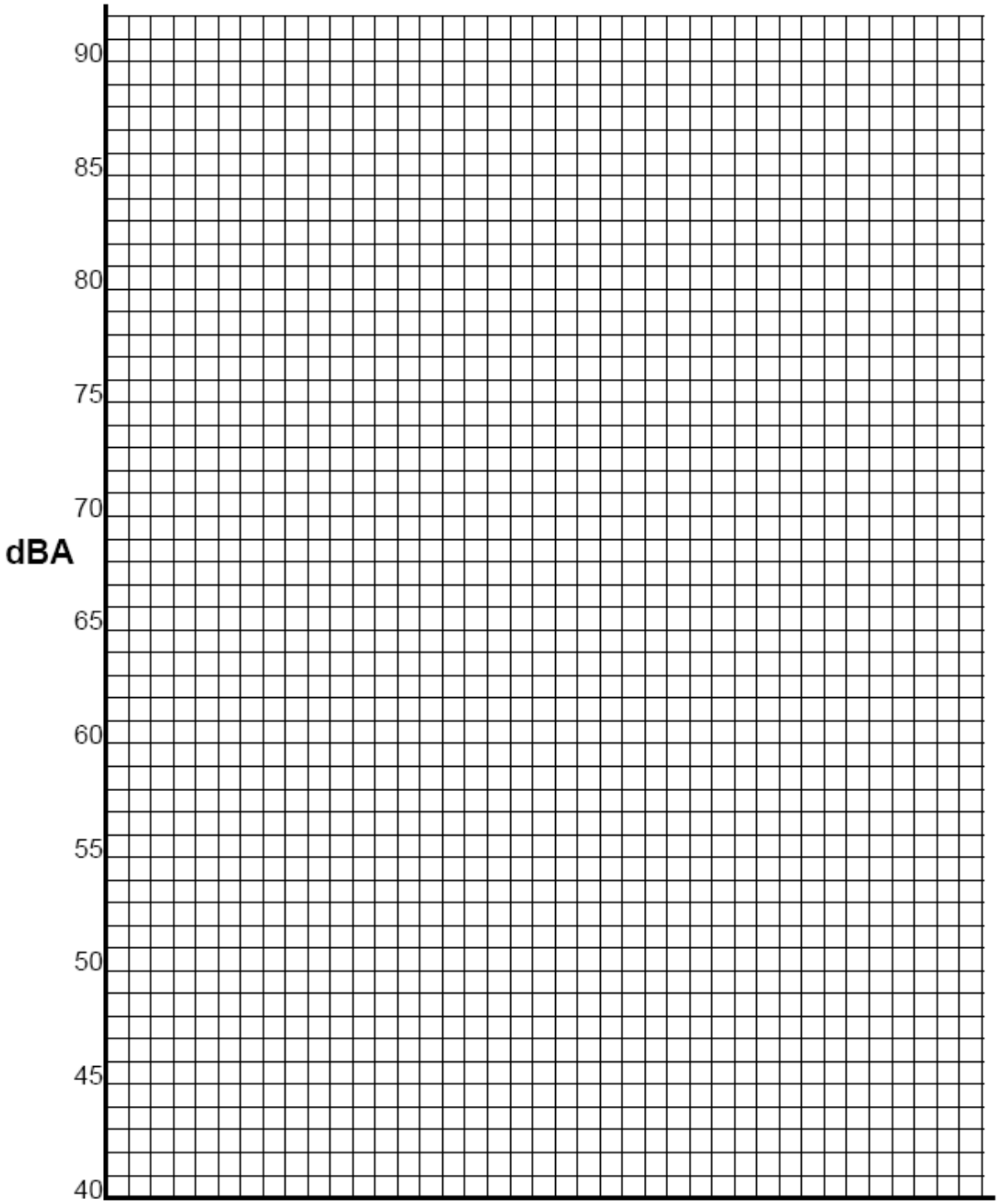
(Instrumentation, Meteorology, Location, and Survey Procedure Identical to NTP-1 Test Procedures)

Manual monitoring procedure:

- Using a hand-held sound level meter, take an instantaneous sound reading every 10 seconds and record on a sample sheet. A partner is very helpful.
- Continue taking sound readings for one hour, which will give you 360 individual readings. An example of a "sample sheet" is below.
- To determine the L10, take the 36th loudest (10 percent of 360 = 36) individual sound reading by counting from the loudest to the quietest on the "sample sheet" In the example on the next page, the L10 = 63 and is the 36th **X** from the top of the sheet.
- To determine the L50, take the 180th loudest (50 percent of 360 = 180) individual sound reading. In the example, the L50 = 57 and represents the 180th **X** from the top of the sheet.



Manual Monitoring Data Sheet



Date _____ Location_____

Noise survey

Investigator_____ Date_____

SLM Manufacturer and Model_____ Serial Number _____

Calibrator Manufacturer and Model _____

Calibrator Serial Number_____ Calibrator Frequency (Hz)_____

Initial Calibration (dBA)_____ Final Calibration (dBA) _____

Meteorological Conditions: Wind Speed_____ Direction_____ Temperature_____

Source_____

Monitor Location_____

Time Start_____ Time End_____

Results L10_____dBA L50_____dBA

Diagram *(Indicate noise source, receiver, microphone location, reflecting objects, obstructions, landmarks, and distances)*

Regulatory Agencies

Several agencies have noise regulations for different noise sources. Noise regulations are either source standards or receiver-based standards.

Department of Natural Resources (DNR) - The Minnesota DNR has source standards for snowmobiles, motorboats, personal watercraft and off-highway vehicles. For more information see: http://www.dnr.state.mn.us/index.html.

Federal Aviation Administration (FAA) - The FAA has source regulations for commercial jet engines. All commercial jet engines must meet noise emission criteria prior to being certified for flight.

Metropolitan Airport Commission (MAC) - The MAC is responsible for all noise issues related to the Minneapolis St. Paul International Airport and reliever airports. For more information see: http://www.macnoise.com/.

Minnesota Department of Transportation (Mn/DOT) – Mn/DOT is responsible for state highway noise mitigation. For more information see: http://www.dot.state.mn.us/environment/index.html.

Federal Highway Administration (FHWA) - The FHWA does not have actual noise standards, but has a 70 dBA L10guideline that is used to determine federal funding for noise abatement on highway projects.

Federal Railroad Administration (FRA) - Regulation of railroad related noise is the responsibility of the FRA. For more information see: http://www.fra.dot.gov/.

Housing and Urban Development (HUD) - HUD has noise regulations that establish acceptable noise zones for HUD housing projects.

Occupational Safety and Health Administration (OSHA) - OSHA has regulations to protect against hearing loss in the workplace. These are “dose standards” that restrict the amount of noise an employee receives over a period of time, such as eight hours.

Local Agency - A local governing agency, such as a city or county, has some responsibility for enforcing noise standards and may have an ordinance regulating noise levels.

Minnesota Pollution Control Agency (MPCA) - The MPCA has a receiver-based standard intended to limit noise levels and protect the health and welfare of the general public.

Minnesota Noise Pollution Statute and Rule

Minn. Stat. § 116.07 Powers and duties.

Subd. 2. Adoption of standards

The MPCA shall … also adopt standards describing the maximum levels of noise in terms of sound pressure level which may occur in the outdoor atmosphere, recognizing that due to variable factors no single standard of sound pressure is applicable to all areas of the state. Such standards shall give due consideration to such factors as the intensity of noises, the types of noises, the frequency with which noises recur, the time period for which noises continue, the times of day during which noises occur, and such other factors as could affect the extent to which noises may be injurious to human health or welfare, animal or plant life, or property, or could interfere unreasonably with the enjoyment of life or property.

In adopting standards, the MPCA shall give due recognition to the fact that the quantity or characteristics of noise or the duration of its presence in the outdoor atmosphere, which may cause noise pollution in one area of the state, may cause less or not cause any noise pollution in another area of the state, and it shall take into consideration in this connection such factors, including others which it may deem proper, as existing physical conditions, zoning classifications, topography, meteorological conditions and the fact that a standard which may be proper in an essentially residential area of the state, may not be proper as to a highly developed industrial area of the state. Such noise standards shall be premised upon scientific knowledge as well as effects based on technically substantiated criteria and commonly accepted practices.

No local governing unit shall set standards describing the maximum levels of sound pressure which are more stringent than those set by the MPCA.

Subd. 2a. Exemptions from standards

No standards adopted by any state agency for limiting levels of noise in terms of sound pressure which may occur in the outdoor atmosphere shall apply to:

A. segments of trunk highways constructed with federal interstate substitution money, provided that all reasonably available noise mitigation measures are employed to abate noise,
B. an existing or newly constructed segment of a highway, provided that all reasonably available noise mitigation measures, as approved by the commissioners of the Department of Transportation and MPCA, are employed to abate noise,
C. except for the cities of Minneapolis and St. Paul, an existing or newly constructed segment of a road, street, or highway under the jurisdiction of a road authority of a town, statutory or home rule charter city, or county, except for roadways for which full control of access has been acquired,
D. skeet, trap or shooting sports clubs, or
E. motor vehicle race events conducted at a facility specifically designed for that purpose that was in operation on or before July 1, 1996.

Nothing herein shall prohibit a local unit of government or a public corporation with the power to make rules for the government of its real property from regulating the location and operation of skeet, trap or shooting sports clubs, or motor vehicle race events conducted at a facility specifically designed for that purpose that was in operation on or before July 1, 1996.

Minn. Rules § 7030 Noise pollution

7030.0010 Incorporation by reference

For the purpose of chapter 7030, American National Standards Institute, Specification for Sound Level Meters, S1.4-1983 is incorporated by reference. This publication is available from the American National Standards Institute, 25 West 43rd Street 4th Floor, New York, N.Y. 10036 and can be found at: the offices of the MPCA

520 Lafayette Road North, St. Paul, Minnesota 55155; the Government Documents Section, Room 409, Wilson Library, University of Minnesota, 309 19th Avenue South, Minneapolis, Minnesota 55454; and the State of Minnesota Law Library, 25 Constitution Avenue, Saint Paul, Minnesota 55155. This document is not subject to frequent change.

The Federal Highway Administration publication, Sound Procedures for Measuring Highway Noise: Final Report, FHWA-DP-45-1R (August 1981) is incorporated by reference. This publication is available from the United States Department of Transportation, Federal Highway Administration, 1200 New Jersey Avenue S.E., Washington D.C. 20590 and can be found at: the offices of the MPCA, 520 Lafayette Road North, St. Paul, Minnesota 55155; the Government Documents Section, Room 409, Wilson Library, University of Minnesota, 309 19th Avenue South, Minneapolis, Minnesota 55454; and the State of Minnesota Law Library, 25 Constitution Avenue, Saint Paul, Minnesota 55155. This document is not subject to frequent change.

7030.0020 Definitions

Subpart 1. Application
The terms used in chapter 7030 have the meanings given them in this part.

Subp. 2. A-weighted
A-weighted means a specific weighting of the sound pressure level for the purpose of determining the human response to sound. The specific weighting characteristics and tolerances are those given in American National Standards Institute S1.4-1983, section 5.1.

Subp. 3. Daytime
Daytime means those hours from 7:00 a.m. to 10:00 p.m.

Subp. 4. dB(A)
dB(A) means a unit of sound level expressed in decibels (dB) and A-weighted.

Subp. 5. Decibel
Decibel means a unit of sound pressure level, abbreviated as dB.

Subp. 6. Impulsive noise
Impulsive noise means either a single sound pressure peak (with either a rise time less than 200 milliseconds or total duration less than 200 milliseconds) or multiple sound pressure peaks (with either rise times less than 200 milliseconds or total duration less than 200 milliseconds) spaced at least by 200 millisecond pauses.

Subp. 7. L10
L10 means the sound level, expressed in dB (A), which is exceeded 10 percent of the time for a one hour survey, as measured by test procedures approved by the commissioner.

Subp. 8. L50
L50 means the sound level, expressed in dB(A), which is exceeded 50 percent of the time for a one hour survey, as measured by test procedures approved by the commissioner.

Subp. 9. Municipality
Municipality means a county; a city; a town; a regional planning and development commission established under Minnesota Statutes, chapter 473; the metropolitan council; or other governmental subdivision of the state responsible by law for controlling or restricting land use within its jurisdiction.

Subp. 10. Nighttime
Nighttime means those hours from 10:00 p.m. to 7:00 a.m.

Subp. 11. Person

Person means any human being, any municipality or other governmental or political subdivision or other public department or agency, any public or private corporation, any partnership, firm, association, or other organization, any receiver, trustee, assignee, agency, legal entity, other than a court of law, or any legal representative of any of the foregoing, but does not include the agency.

Subp. 12. Sound pressure level
Sound pressure level, in decibels, means 20 times the logarithm to the base 10 of the ratio of the pressure to the reference pressure. The reference pressure shall be 20 micronewtons per square meter.

No person may violate the standards established in part 7030.0040, unless exempted by Minnesota Statutes, section 116.07, subdivision 2a. Any municipality having authority to regulate land use shall take all reasonable measures within its jurisdiction to prevent the establishment of land use activities listed in noise area classification (NAC) 1, 2, or 3 in any location where the standards established in part 7030.0040 will be violated immediately upon establishment of the land use.

7030.0030 Noise Control Requirement

No person may violate the standards established in part 7030.0040, unless exempted by Minnesota Statutes, section 116.07, subdivision 2a. Any municipality having authority to regulate land use shall take all reasonable measures within its jurisdiction to prevent the establishment of land use activities listed in noise area classification (NAC) 1, 2, or 3 in any location where the standards established in part 7030.0040 will be violated immediately upon establishment of the land use.

7030.0040 Noise standards

Subpart 1. Scope
These standards describe the limiting levels of sound established on the basis of present knowledge for the preservation of public health and welfare. These standards are consistent with speech, sleep, annoyance, and hearing conservation requirements for receivers within areas grouped according to land activities by the noise area classification (NAC) system established in part 7030.0050. However, these standards do not, by themselves, identify the limiting levels of impulsive noise needed for the preservation of public health and welfare. Noise standards in subpart 2 apply to all sources.

Subp. 2. Noise standards

Noise Area Classification	Daytime		Nighttime	
	L10	L50	L10	L50
1	65	60	55	50
2	70	65	70	65
3	80	75	80	75

7030.0050 Noise area classification

Subpart 1. Applicability
The noise area classification is based on the land use activity at the location of the receiver and determines the noise standards applicable to that land use activity unless an exception is applied under subpart 3.

Subp. 2. Noise area classifications
The noise area classifications and the activities included in each classification are listed below:

Noise Area Classification	Land Use Activities	
	Household Units (includes farm houses)	Transient lodging

1	Group quarters	Mobile home parks or courts
	Residential hotels	Other residential
	Cultural activities and nature exhibitions	Medical and other health services
	Correctional institutions	Educational services
	Religious activities	Motion picture production
	Entertainment assembly	Resorts and group camps
	Camping and picnicking areas (designated)	Other cultural, entertainment, and recreational activities.
2	Railroad terminals (passenger)	Bus passenger terminals (inter city)
	Railroad terminals (passenger and freight)	Bus passenger terminals (local)
	Rapid rail transit and street railway passenger terminals	Bus passenger terminals (inter city and local)
	Other motor vehicle transportation	Marine terminals (passenger)
	Airport and flying field terminals (passenger)	Marine terminals (passenger and freight)
	Airport and flying field terminals (passenger and freight)	Automobile parking
	Telegraph message centers	Transportation services and arrangements
	Wholesale trade	Retail trade -- apparel and accessories
	Retail trade -- building materials, hardware, and farm equipment	Retail trade -- automotive, marine craft, aircraft, and accessories
	Retail trade -- general merchandise	Retail trade -- furniture, home furnishings, and equipment
	Retail trade -- food	Retail trade -- eating and drinking
	Other retail trade	Finance, insurance, and real estate services
	Personal services	Repair services
	Business services	Legal services
	Other professional services	Contract construction services
	Governmental services (except correctional institutions)	Miscellaneous services (except religious activities)
	Public assembly (except entertainment assembly and race tracks)	Amusements (except fairgrounds and amusement parks)
	Recreational activities (except designated camping and picnicking areas)	Parks.
3	Food and kindred products -- manufacturing	Textile mill products -- manufacturing
	Apparel and other finished products made from fabrics, leather, and similar materials -- manufacturing	Lumber and wood products (except furniture) -- manufacturing
	Furniture and fixtures -- manufacturing	Printing, publishing, and allied industries
	Paper and allied products -- manufacturing	Chemicals and allied products -- manufacturing
	Petroleum refining and related industries	Primary metal industries
	Rubber and miscellaneous plastic products -- manufacturing	Stone, clay, and glass products -- manufacturing
	Professional, scientific, and controlling instruments; photographic and optical goods; watches and clocks -- manufacturing	Railroad, rapid transit, and street railway transportation (except passenger terminals)
	Miscellaneous manufacturing (except motion picture production)	Fabricated metal products -- manufacturing
	Motor vehicle transportation (except passenger terminals)	Aircraft transportation (except passenger terminals)
	Marine craft transportation (except passenger and freight terminals)	Communication (except telegraph message centers)
	Highway and street right-of-way	Utilities

	Race tracks	Retail trade -- eating and drinking
	Fairgrounds and amusement parks	Agricultural
	Agricultural and related activities	Fishing activities and related services
	Other transportation, communication, and utilities (except transportation services and arrangements)	Forestry activities and related services (including commercial forest land, timber production, and other related activities)
	All other activities not otherwise listed.	
4	Undeveloped and unused land area (excluding non-commercial forest development)	Non commercial forest development
	Water areas	Vacant floor area
	Under construction	Other undeveloped land and water areas.

Subp. 3. Exceptions

The noise area classification for a land use may be changed in the following ways if the applicable conditions are met.

A. The daytime standards for noise area classification one shall be applied to noise area classification one during the nighttime if the land use activity does not include overnight lodging.

B. The standards for a building in a noise area classification two shall be applied to a building in a noise area classification one if the following conditions are met:
   1) the building is constructed in such a way that the exterior to interior sound level attenuation is at least 30 dB(A);
   2) the building has year-round climate control; and
   3) the building has no areas or accommodations that are intended for outdoor activities.

C. The standards for a building in a noise area classification three shall be applied to a building in a noise area classification one if the following conditions are met:
   1) the building is constructed in such a way that the exterior to interior sound level attenuation is at least 40 dB(A);
   2) the building has year-round climate control; and
   3) the building has no areas or accommodations that are intended for outdoor activities.

D. The standards for a building in a noise area classification three shall be applied to a building in a noise area classification two if the following conditions are met:
   1) the building is constructed in such a way that the exterior to interior sound level attenuation is at least 30 dB(A);
   2) the building has year-round climate control; and
   3) the building has no areas or accommodations that are intended for outdoor activities.

7030.0060 Measurement methodology

Subpart 1. Measurement location

Measurement of sound must be made at or within the applicable NAC at the point of human activity which is nearest to the noise source. All measurements shall be made outdoors.

Subp. 2. Equipment specifications

All sound level measuring devices must meet Type O, I, II, or S specifications under American National Standards Institute S1.4-1983.

Subp. 3. Calibration

All sound level measuring devices must, at a minimum, be externally field calibrated before and after monitoring using a calibration device of known frequency and sound pressure level.

Subp. 4. Measurement procedures

The following procedures must be used to obtain representative sound level measurements:

A. Measurements must be made at least three feet off the ground or surface and away from natural or artificial structures which would prevent an accurate measurement.

B. Measurements must be made using the A-weighting and fast response characteristics of the sound measuring device as specified in American National Standards Institute S1.4-1983.

C. Measurements must not be made in sustained winds or in precipitation which results in a difference of less than 10 decibels between the background noise level and the noise source being measured.

D. Measurements must be made using a microphone which is protected from ambient conditions which would prevent an accurate measurement.

Subp. 5. Data documentation

A summary sheet for all sound level measurements shall be completed and signed by the person making the measurements. At a minimum, the summary sheet shall include:

A. date
B. time
C. location
D. noise source
E. wind speed and direction
F. temperature
G. humidity
H. make, model, and serial number of measuring equipment
I. field calibration results
J. monitored levels
K. site sketch indicating noise source, measurement location, directions, distances, and obstructions

7030.0070 Sound attenuation measurement methodology

Subpart 1. Purpose

Sound level measurements made for assessing sound attenuation as specified in part 7030.0050, subpart 3, item B, C, or D, shall be made according to the requirements of this part.

Subp. 2. Equipment

The equipment shall meet the requirements specified in part 7030.0060, subpart 2.

Subp. 3. Calibration

The equipment must meet the calibration requirements specified in part 7030.0060, subpart 3.

Subp. 4. Measurement procedure

The measurement procedure described in 25 FHWA-DP-45-1R, section 8 must be used for determination of the sound attenuation.

Subp. 5. Equivalent methods

Methods equivalent to those described in subpart 4 may be used provided they are approved by the commissioner of the MPCA. The commissioner shall approve an alternative method if the commissioner finds that the method will produce representative data and results which are as reliable as the methods specified in subpart 4.

7030.0080 Variance

If, upon written application of the responsible person, the agency finds that by reason of exceptional circumstances strict conformity with any provisions of any noise rule would cause undue hardship, would be unreasonable, impractical, or not feasible under the circumstances, the agency may permit a variance upon the conditions and within the time limitations as it may prescribe for the prevention, control, or abatement of noise pollution in harmony with the intent of the state and any applicable federal laws.

MN R. 7030.1000 Motor vehicle noise limits

7030.1000 Definition

"Motor vehicle" means any self-propelled vehicle not operated exclusively upon railroad tracks and any vehicle propelled or drawn by a self-propelled vehicle and includes vehicles known as trackless trolleys which are propelled by electric power obtained from overhead trolley wires but not operated upon rails, except snowmobiles.

7030.1010 Prohibitions

Subpart 1. Operation of vehicle

No person shall operate either a motor vehicle or combination of vehicles of a type subject to registration pursuant to Minnesota Statutes, chapter 168 at any time or under any condition of grade, load, acceleration, or deceleration in such a manner as to exceed the noise limits contained herein for the category of motor vehicle and speed limits specified, when tested with a measurement procedure approved by the commissioner.

Subp. 2. Sale of vehicle

No person shall sell or offer for sale a new motor vehicle or combination of vehicles of a type subject to registration pursuant to Minnesota Statutes, chapter 168 which when maintained according to the manufacturer's specifications would exceed the noise limits contained herein for the category of motor vehicle and speed limits specified, when tested with a measurement procedure approved by the commissioner.

Subp. 3. Modification of vehicle

No person shall modify a motor vehicle or combination of vehicles of a type subject to registration pursuant to Minnesota Statutes, chapter 168 in a manner which will amplify or increase the noise emitted by the vehicle, above the noise limits contained herein for the category of motor vehicle and speed limits specified, when tested with a measurement procedure approved by the commissioner. No person shall operate a motor vehicle so modified.

Subp. 4. Sale of parts

No person shall sell or offer for sale replacement or additional parts for a motor vehicle or combination of vehicles of a type subject to registration pursuant to Minnesota Statutes, chapter 168 which when installed in the vehicle will amplify or increase the noise emitted by the vehicle, above the noise limits contained herein for the category of motor vehicle and speed limits specified, when tested with a measurement procedure approved by the commissioner. No person shall operate a motor vehicle incorporating such parts.

7030.1020 Scope

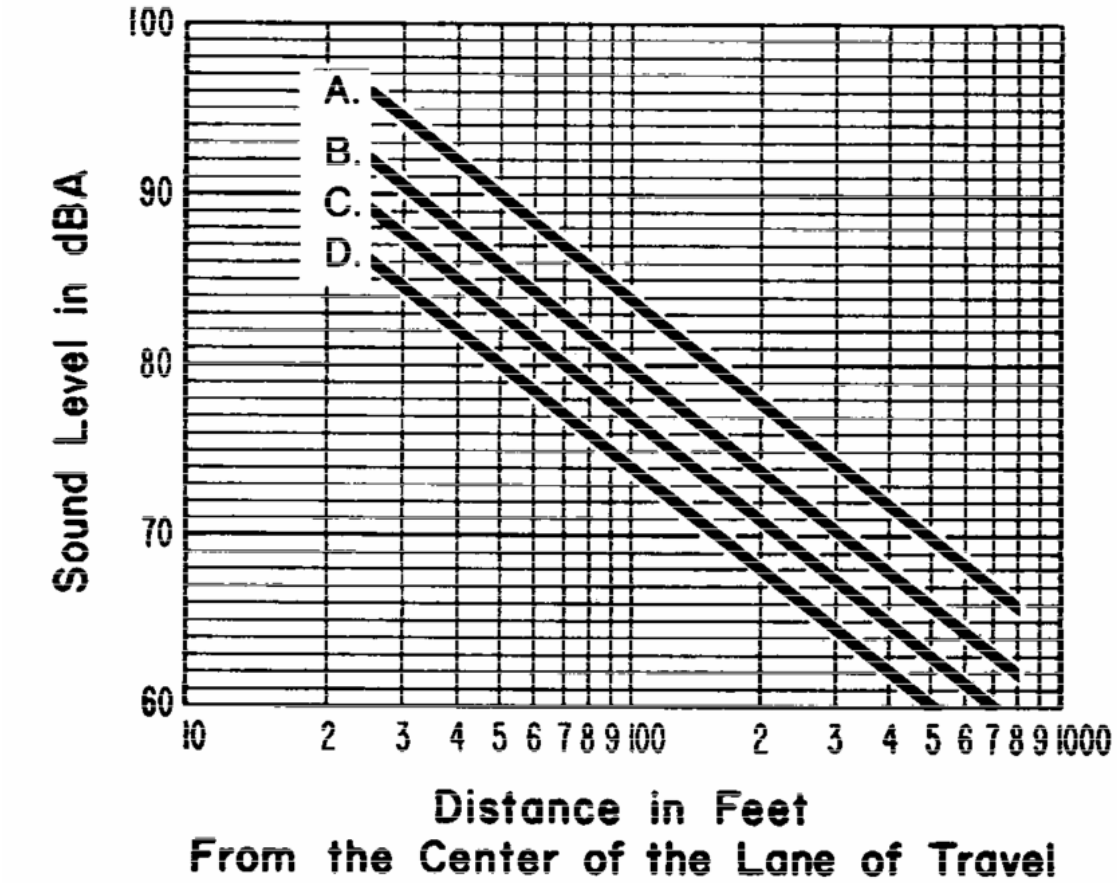
This chapter applies to the total noise from a vehicle or combination of vehicles of a type subject to registration pursuant to Minnesota Statutes, chapter 168 and shall not be construed as limiting or precluding the enforcement of any other provision of law relating to motor vehicle exhaust noise.

7030.1030 Exceptions

Vehicles under parts 7030.1050 and 7030.1060 are allowed to exceed the noise limits contained herein when performing acceleration maneuvers for safety purposes.

7030.1040 Noise limit for vehicles over 10,000 pounds

Motor vehicle noise limits for vehicles with a manufacturer's gross vehicle weight rating of more than 10,000 pounds and any combination of vehicles towed by such motor vehicle.



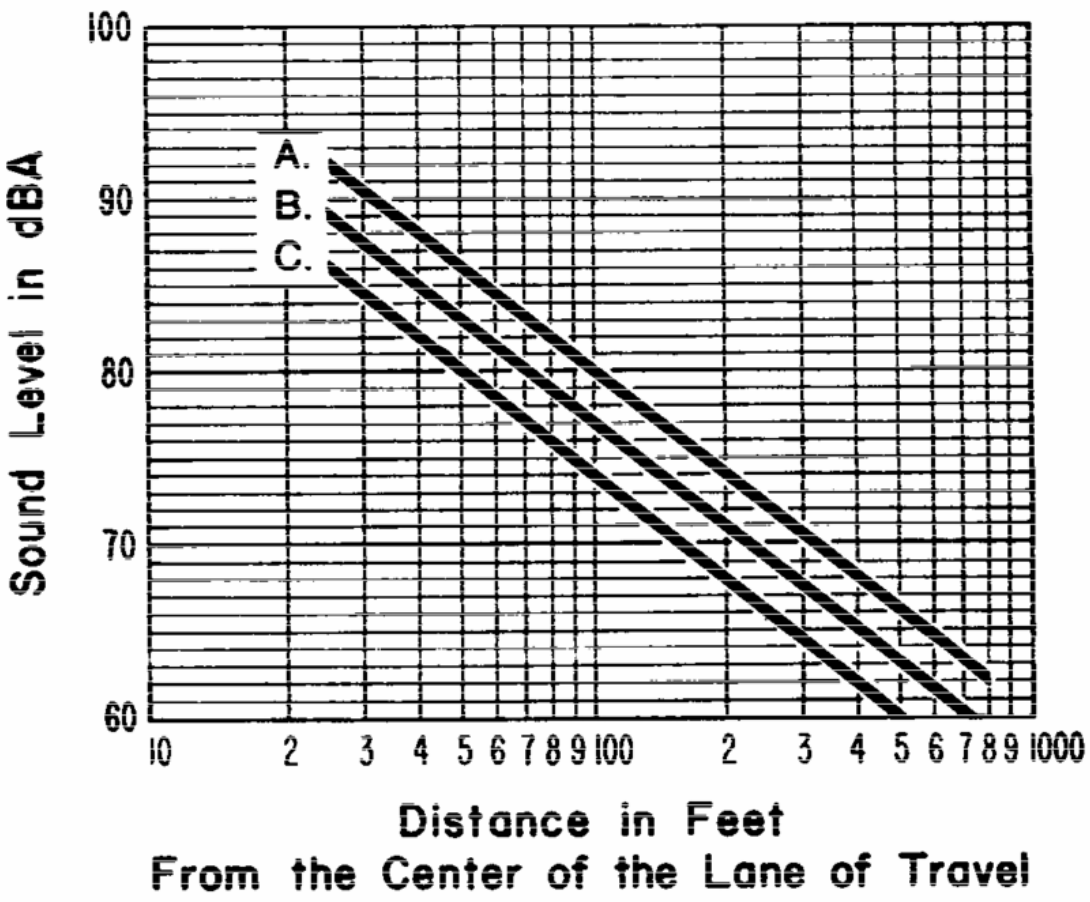
A. Speed limits greater than 35 mph.

B. Speed limits equal to or less than 35 mph and stationary run-up tests (for vehicles with governed engines). For stationary run-up tests on all-paved surfaces, add 2 dBA.

C. Speed limits equal to or less than 35 mph and stationary run-up tests (for vehicles with governed engines), for vehicles manufactured on or after January 1, 1978. For stationary run-up tests on all-paved surfaces, add 2 dBA.

D. Speed limits equal to or less than 35 mph and stationary run-up tests (for vehicles with governed engines), for vehicles manufactured on or after January 1, 1982. For stationary run-up tests on all-paved surfaces, add 2 dBA.

7030.1050 Motor vehicle noise limits for motorcycles.



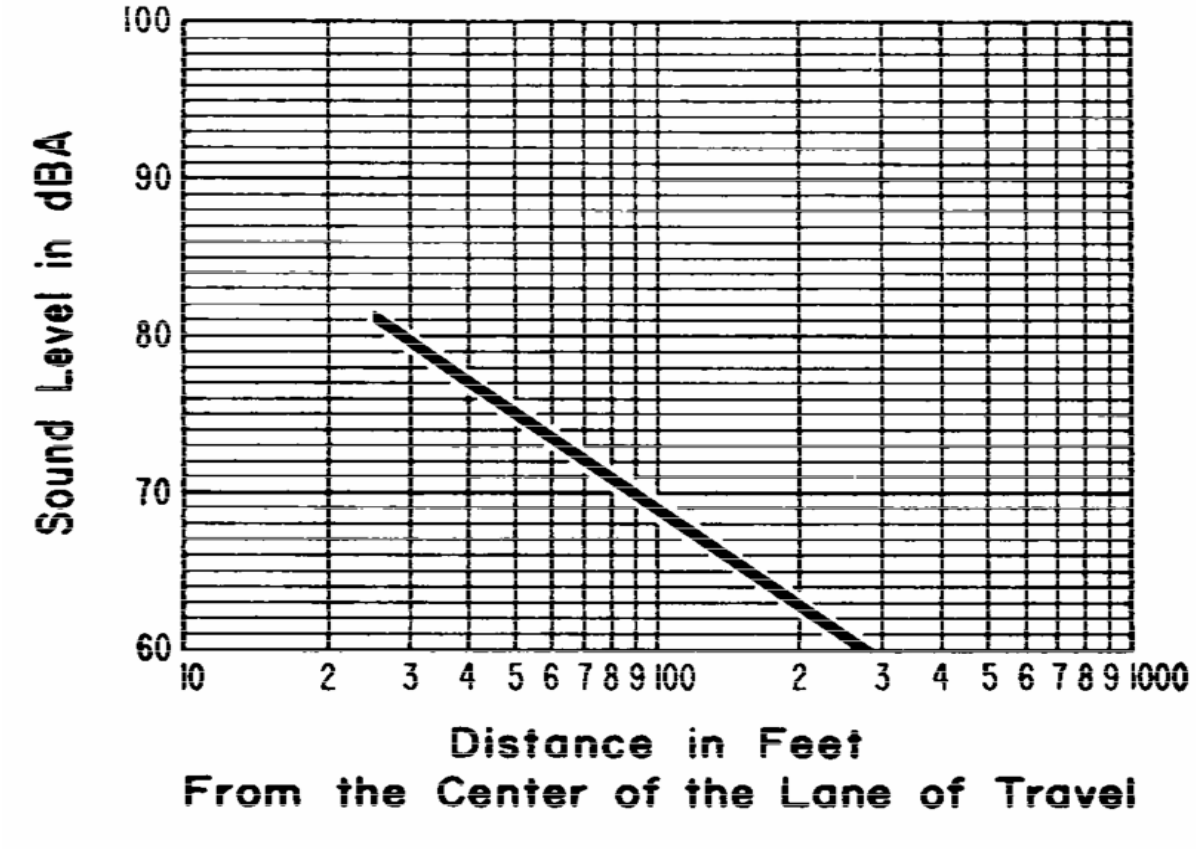
A. For vehicles manufactured before January 1, 1975.

B. Speed limits greater than 35 mph for vehicles manufactured on or after January 1, 1975.

C. Speed limits equal to or less than 35 mph for vehicles manufactured on or after January 1, 1975.

7030.1060 Noise limits for other vehicles.

Motor vehicle noise limits for any other motor vehicle not included under parts 7030.1040 and 7030.1050 and any combination of vehicles towed by such motor vehicle.



Minn. Stat. § 86B Motorboat noise limits

86B.321 Noise limits.

Subdivision 1. Operation in excess of noise limits prohibited
A person may not operate a motorboat under any condition of load, acceleration, or deceleration in a manner that exceeds the noise limits contained in subdivision 2.

Subd. 2. Noise limits

A. The noise limits for the total noise from the marine engine or motorboat may not exceed:
    1) for marine engines or motorboats manufactured before January 1, 1982, a noise level of 84 decibels on the A scale measured at a distance of 50 feet from the motorboat or equivalent noise levels at other distances as specified by the commissioner; and
    2) for marine engines or motorboats manufactured on or after January 1, 1982, a noise level of 82 decibels on the A scale measured at a distance of 50 feet from the motorboat or equivalent noise levels at other distances as specified by the commissioner.
B. The noise limits in paragraph (a) do not preclude enforcement of other laws relating to motorboat noise.

Subd. 3. Applicability
The provisions of this section do not apply to motorboats operating under a permit issued under section 86B.121 or a United States coast guard marine event permit in a regatta or race while on trial runs or while on official trials for speed records during the time and in the designated area authorized by the permit.

86B.521 Motorboat noise control

Subdivision 1. Exhaust muffling system required
A motor may not be used on a motorboat unless it is equipped with an efficient muffler, underwater exhaust, or other device that adequately muffles or suppresses the sound of the exhaust of the motor so as to prevent excessive or unusual noise. A motor may not be equipped with a cut-out.

Subd. 2. Sale of motor that exceeds noise limits prohibited
A person may not sell or offer for sale a new marine engine or motorboat that would exceed the noise limits contained in section 86B.321, subdivision 2, under a test procedure approved by the commissioner if the motor is maintained according to the manufacturer's specifications.

Subd. 3. Modification of engine to exceed noise limits prohibited

A. A person may not modify a marine engine or motorboat in a manner that will amplify or increase the noise emitted by the marine engine or motorboat above the noise limits contained in section 86B.321, subdivision 2, under a test procedure approved by the commissioner.
B. A person may not operate a motorboat with an engine modified to increase noise above the noise limits.

Subd. 4. Sale of parts that cause excessive noise

A. A person may not sell or offer for sale replacement or additional parts for a marine engine or motorboat which when installed in the marine engine or motorboat will amplify or increase the noise emitted by the marine engine or motorboat above the noise limits contained in section 86B.321, subdivision 2, under a test procedure approved by the commissioner.
B. A person may not operate a motorboat incorporating parts prohibited to be sold under paragraph (a).

Subd. 5. Applicability
The provisions of this section do not apply to motorboats operating under a permit issued under section 86B.121 or a United States Coast Guard marine event permit in a regatta, or race, while on trial runs, or while on official trials for speed records during the time and in the designated area authorized by the permit.

Minn. Stat. § 84.871 Snowmobile noise limits

84.871 Mufflers

Except as provided in this section, every snowmobile shall be equipped at all times with a muffler in good working order which blends the exhaust noise into the overall snowmobile noise and is in constant operation to prevent excessive or unusual noise. The exhaust system shall not emit or produce a sharp popping or crackling sound. This section does not apply to organized races or similar competitive events held on

A. private lands, with the permission of the owner, lessee, or custodian of the land;

B. public lands and water under the jurisdiction of the commissioner of natural resources, with the commissioner's permission; or

C. other public lands, with the consent of the public agency owning the land.

No person shall have for sale, sell, or offer for sale on any new snow-mobile any muffler that fails to comply with the specifications required by the rules of the commissioner after the effective date of the rules.

Minn. Rules § 6100.5700 Snowmobile noise limits

6100.5700 Required equipment

Subpart 5. Mufflers

Mufflers:

A. No person shall operate a snowmobile unless it is equipped with a muffler as required by law and these rules, except that snowmobiles may be operated in organized events as authorized by Minnesota Statutes, section 84.871, without such a muffler.

B. No snowmobile manufactured on or after June 30, 1970, and before February 1, 1972, for sale in Minnesota, except snowmobiles designed for competition purposes only, shall be sold, or offered for sale, unless it is equipped with a muffler that limits engine noise to not more than 86 decibels on the A scale at 50 feet.

C. No snowmobile manufactured on or after February 1, 1972, for sale in Minnesota - except snowmobiles designed for competition purposes only, shall be sold, or offered for sale, unless it is equipped with a muffler that limits engine noise to not more than 82 decibels on the A scale at 50 feet.

D. No snowmobile manufactured on or after April 1, 1975, except a snowmobile designed for competition purposes only, shall be sold, offered for sale, or operated in Minnesota unless it is so equipped and has been certified by the manufacturer to conform to a sound level limitation of not more than 78 decibels on the A scale at 50 feet as originally equipped.

E. In certifying that a new snowmobile complies with the noise limitation requirements of this rule, a manufacturer shall make such a certification based on measurements made in accordance with the SAE Recommended Practice J192 (a), as set forth in the Report of the Vehicle Sound Level Committee, as approved by the Society of Automotive Engineers September 1970 and revised November 1973.

F. No snowmobile shall be sold or offered for sale in Minnesota unless its maker has previously furnished the commissioner with a certificate of compliance certifying that all snowmobiles made by that maker meet or exceed the applicable noise level restrictions established by these rules. The certification of compliance shall be in the form of a "Snowmobile Safety Certification Committee" label conspicuously attached to the machine showing certification by the Snowmobile Safety and Certification Committee, Inc., or a label showing compliance with Snowmobile Safety Certification Committee standards accompanied by a letter containing test results of an evaluation of noise levels by a competent independent testing laboratory. Snowmobiles intended for competition purposes only shall be exempt from this part provided a separate placard identifying that such snowmobile is not so equipped is conspicuously and permanently affixed thereto.

G. Except for organized events as authorized by Minnesota Statutes, section 84.871, no snowmobile shall be modified by any person in any manner that shall amplify or otherwise increase total noise level above that emitted by the snowmobile as originally equipped, regardless of the date of manufacture.