COMMUNITY NOISE COUNSELING PROGRAM

HANDBOOK FOR COMMUNITY NOISE COUNSELORS

A Project of

American Association of Retired Persons

National Retired Teachers Association

TABLE OF CONTENTS

PREFACE

The following handbook has been written for you, the community noise counselor. It contains both information and ideas which will help you in your efforts to improve the quality of life in your community.

This handbook is a resource document as well as a workbook. You will read about the reasons for a noise counseling program, the role of the noise counselor, and some of the techniques a noise counselor can use in reducing noise in a community. You will also find some forms in the appendix which have been designed to help you set your objectives and to assist in locating the key people in your community who can help you reach your objectives.

In addition to this handbook, special training is available. This training can play an important part in your role as a community noise counselor. However, you are not expected to become a technical expert in the properties of sound or in the intricate details of sound measurement. Your role is that of a catalyst, providing information, ideas, and direction to individuals, citizen groups, and perhaps public officials who can take action to reduce their own noise exposure as well as the exposure of others as a result of your efforts.

I. WHY A COMMUNITY NOISE COUNSELING PROGRAM

For years the residents of a neighborhood in the northwest corner of a large city lived in a quiet, almost small town community. Most of the residents had lived there for years and knew each other. It was not at all uncommon for people to gather on a neighbor's stoop on a weekend or after dinner and visit for several hours at a time.

But as the city and the outlying suburbs grew, that northwest neighborhood began to undergo a change. A new bus route was established to service the suburbs and several times an hour commuter buses would rumble through the narrow streets of the neighborhood. During the two rush hours in the morning and the two evening rush hours, as many as 25 buses an hour would drive along the neighborhood streets.

"It got to the point," said one resident "that we'd just stop talking when the buses went by. But they came so often we could hardly carry on a conversation."

Rather than let the new bus route change their lives a group of concerned citizens decided to try to do something about the noise.

They gathered one afternoon on one of the residents front stoop and counted the number of buses that passed in an hour. They then met with the consumer representative of the transit company. Within three weeks, the transit company agreed to change the bus routes for the majority of the buses. The result was a slightly longer ride for the commuters but a quieter and more pleasant community for the residents.

In communities and neighborhoods around the country, unwanted noise is a growing source of dissatisfaction and irritation. Noise from trucks, motor-

cycles, airplanes, lawnmowers, appliances, power tools, trains, and fire and rescue equipment are just a few of the sources of this increasing problem. And perhaps more annoying than the noise itself is the frustrating feeling of not being able to do anything about it.

How can one person stop the noise in a train yard just a short distance from a residential area? How can one person tone down the noise from construction equipment that starts up at 7:00 a.m. every morning? How can one person reduce the noise from jet planes in a community?

Rarely can one person accomplish any of these projects alone. But there are hundreds of cases where communities and neighborhoods have been successful in reducing or eliminating a noise problem. And while the success is the product of many individuals and groups working together, there is always one spark behind the effort--one person who has the know-how, the interest, the desire, and the patience to make his or her neighborhood a healthier and better place in which to live by reducing noise.

This handbook contains information on the effects of niose and some approaches on what can be done to reduce noise levels. It is based on the premise that one concerned individual in a community who is motivated to do something about noise can help other individuals and groups deal effectively with the noise around them. And not necessarily by making a lot of noise about noise. But rather, through the slow but rewarding process of gathering information and sharing the information with neighbors. To encourage this process, the Community Noise Counseling Program has been created.

Ideally, noise counselors can serve as the focal point in a community for all issues that concern noise. They can be advisors on noise in the home, noise in their neighborhood and their communities. They must be part researcher, part communicator, part teacher, part listener, part mediator, and above all, a problem solver.

Residents of a neighborhood may call on the noise counselor to find out how to reduce the noise from nearby construction equipment. Community groups such as the PTA may ask the noise counselor to give a presentation on noise to their members. State, county, or local governments may ask the noise counselor to testify as an informed layman at zoning or planning hearings.

If you share the concern of many of your neighbors about noise and have the desire to do something about it, the Community Noise Counseling Program is an opportunity to help your neighbor and perhaps have an important impact on your neighborhood for years to come.

The spark behind the effort--The Noise Counselor.

WHY IS NOISE A PROBLEM?

II. WHY IS NOISE A PROBLEM

To the children, the elevated trains that rumbled by their classroom window several times an hour were a pleasant diversion from reading, writing, and arithmetic. The constant rattle of metal against metal became such a regular part of the school day that the children hardly noticed the din. But over the weeks and months, the constant noise in the classroom was taking its subtle toll on the children.

In reading tests administered to children at that school, the students whose classroom faced the elevated railraod track did significantly worse on reading tests than did similar students whose classrooms were further away.

In this particular school, the classroom the children were assigned to could affect not only their learning ability and their reading ability, it could also have a very real effect on their long-term career options.

What is Noise

The most common definition for noise is "unwanted sound." But this is a highly subjective definition. To office workers, the sound from several typewriters and other office machinery may be unwanted. To the office manager, the sound means that everyone is working, that the office is functioning at top efficiency, and it is clearly the sound of music. To young people on a beach playing a portable radio, the sound of loud rock music may be sheer delight. To others around them, the "noise" from the radio may be sheer agony.

While there is bound to be some disagreement about what constitutes a noise problem, almost everyone will accept the fact that noise can be a pain in the neck as well as a pain in the ear. What is not generally known is that noise can produce serious physical and psychological stress.

No one is immune to the stress caused by noise. Though people seem to adjust to noise by ignoring it, the ear, in fact, never closes and the body still responds--sometimes with extreme tension, as to a strange sound in the night.

The annoyance people feel when faced with noise is the most common outward symptom of the stress building up inside. Indeed, because irritability is so apparent, legislators have made public annoyance the basis of many noise abatement programs. The more subtle and more serious health hazards associated with stress caused by noise traditionally have been given much less attention. Nonetheless, people who are annoyed or made irritable by noise should consider these symptoms fair warning that other things may be happening, some of which may be damaging to our health.

Of the many health hazards related to noise, hearing loss is the most clearly observable and measurable by health professionals. The other hazards are harder to pin down. For many, there may be a risk that exposure to the stress of noise increases susceptibility to disease or bodily disorders. The more susceptible individuals may experience noise as a complicating factor in heart problems and other diseases. Noise that causes annoyance and irritability in healthy persons may have serious consequences for those already ill.

Noise affects people throughout their lives. For example, there are indications of effects on the unborn child when mothers are exposed to industrial and environmental noise. During infancy and childhood, youngsters exposed to high noise levels may experience learning difficulties and generally suffer poorer health. Later in life, the elderly may have trouble falling asleep and obtaining necessary amounts of rest.

Why, then, is there not greater alarm about these dangers? Perhaps it is because people tend to dismiss annoyance as a price to pay for living in the modern world. It may also be because people still think of hearing loss as only an occupational hazard.

The effects of noise on health are often misunderstood or unrecognized. Well-documented studies to clarify the role of noise as a public health hazard must still be undertaken. What is known is that noise can have a very harmful effect on people in several ways. Some of the more salient effects are outlined in the following section. A more thorough treatment of the effects of noise on health can be found in a pamphlet entitled NOISE: A HEALTH PROBLEM, available from the United States Environmental Protection Agency, Office of Noise Abatement and Control.

Over 10 million Americans are exposed daily to noise that is permanently damaging to their hearing.

Effects of Noise on Health

Hearing Loss

Noise loud enough to cause hearing loss is virtually everywhere today. Our jobs, our entertainment and recreation, and our neighborhoods and homes are filled with potentially harmful levels of noise. It is no wonder then that over ten million Americans are estimated to be exposed daily to noise that is permanently damaging to their hearing.

When hearing loss occurs, it is in most cases gradual, becoming worse with time. The first awareness of the damage usually begins with the loss of occasional words in general conversation and with difficulty understanding telephone conversations. Unfortunately, this recognition comes too late to recover what is lost. By then, the ability to hear the high frequency sounds of, for example, a flute or piccolo or even the soft rustling of leaves will have been permanently diminished. And there is no cure for this type of hearing damage. Hearing aids do not restore noise-damaged hearing, although they can be of limited help to some people,

People with partial deafness from exposure to noise do not necessarily live in a quieter world. The many sounds still audible to them are distorted in loudness, pitch, apparent location, or clarity. Consonants of speech, especially high frequency sounds such as "s" and "ch," are often lost or indistinguishable from other sounds. Speech frequently seems garbled, sounding as if the speaker has his or her "head in a barrel." When exposed to a very loud noise, people with partial hearing loss may experience discomfort and pain. They also frequently suffer from tinnitus--irritating ringing or roaring in the head.

Heart Disease

While no one has yet shown that noise inflicts any measurable damage to the heart itself, a growing body of evidence strongly suggests a link between exposure to noise and the development and aggravation of a number of heart disease problems. The explanation? Noise causes stress and the body reacts with increased adrenalin, changes in heart rate, and elevated blood pressure.

Noise, however, is only one of several environmental causes of stress. For this reason, researchers cannot say with confidence that noise alone caused the heart and circulatory problems they have observed. What they can point to is a statistical relationship apparent in several field and laboratory studies.

Among the more serious recent findings is the preliminary conclusion that grade school children exposed to aircraft noise in school and at home had higher blood pressure rates than children in quieter areas. The exact implications for these children's health are not known, but certainly this finding is cause for serious concern.

Because the danger of stress from noise is greater for those already suffering from heart disease, physicians frequently take measures to reduce the noise exposure of their patients. For instance, a town in New Jersey moved a firehouse siren away from the home of a boy with congenital heart disease when his doctor warned that the sound of the siren could cause the boy to have a fatal spasm. Another doctor ordered a silencing device for the phone of a recuperating heart patient.

Other Reactions to Noise

In readiness for dangerous and harmful situations, our bodies make automatic and unconscious responses to sudden or loud sounds. Of course, most noise in our modern society does not signify such danger. However, our bodies still react as if these sounds were always a threat or warning.

In effect, the body shifts gears. Blood pressure rises, heart rate and

breathing speed up, muscles tense, hormones are released into the bloodstream, and perspiration appears. These changes occur even during sleep.

The idea that people get used to noise is a myth. Even when we think we have become accustomed to noise, biological changes still occur internally preparing us for physical activity if necessary.

Noise does not have to be loud to bring on these responses. Noise below the levels usually associated with hearing damage can cause regular and predictable changes in the body.

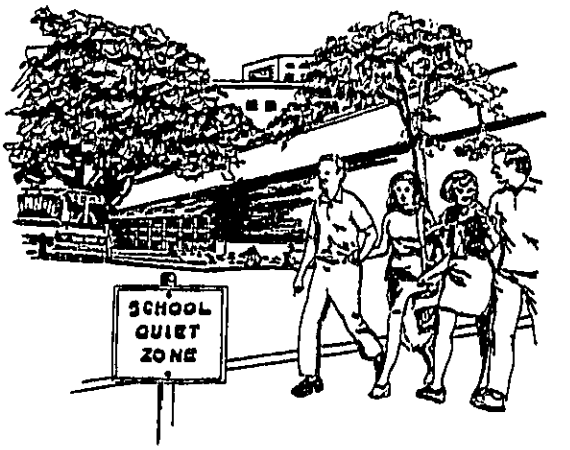
In studies dating back to the 1930's, researchers noted that workers chronically exposed to noise developed marked digestive changes which were thought to lead to ulcers. Cases of ulcers in workers in certain noisy industries have been found to be up to five times as numerous as what normally would be expected.

Similar research has identified more clearly the contribution of noise to other physical disorders. A five-year study of two manufacturing firms in the United States shows that workers in noisy plant areas showed greater numbers of diagnosed medical problems, including respiratory ailments, than did workers in quieter areas of the plants.

From a study done with animals, researchers concluded that noise may be a risk factor in lowering people's resistance to disease and infection.

To prevent aggravation of existing disease, doctors and health researchers agree that there is an absolute requirement for rest and relaxation at regular intervals to maintain adequate mental and physical health. Constant exposure to stress from noise frustrates this requirement. In doing so, it has a potentially harmful effect on our health and well-being.

There is also evidence that noise may affect the unborn child. Loud noises have been shown to stimulate the fetus directly, causing changes in heart rate. It is known that extreme stress of any kind will certainly take a toll on the fetus. While it is not known how much noise is required to produce such an



"Quiet Zones" are established around schools to reduce noise which interfere with learning.

effect, the risk of even a slight increase in birth defects is disturbing.

Noise also has an effect on children. Even in the early 1900's "quiet zones" were established around many of the nation's schools to reduce the levels of noise which were believed to interfere with children's learning and their ability to think. Today researchers are discovering that noise can affect a child's language development and reading ability. In Inglewood, California, the effects of aircraft noise on learning were so severe that several new and quieter schools had to be built. As a school official explained, the disruption of learning went beyond the time wasted waiting for noisy aircraft to pass over. Considerable time had to be spent after each flyover refocusing students' attention on what was being done before the interruption.

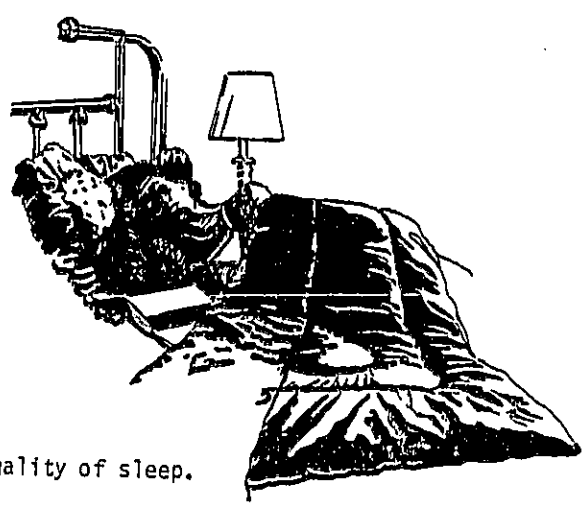
Noise has several other known and suspected effects on people. Noise can affect the quality and quantity of sleep. The elderly and sick are more sensitive to disruptive noise. And when sleep is disturbed by noise, work efficiency and health generally suffer.

Noise can also cause extreme, emotional behavior, particularly if a person is disturbed about something to begin with. In fact, antisocial behavior caused by noise may be more prevalent than is realized.

Perhaps the concern that many people share about noise as a health hazard was best summed up by Dr. William H. Stewart, former Surgeon General, in his keynote

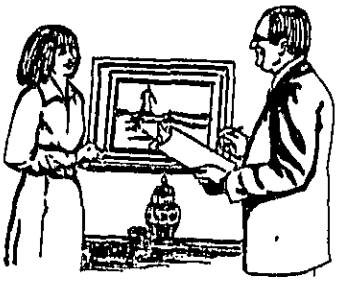
address to the 1969 Conference on Noise as a Public Health Hazard: "Must we wait until we prove every link in the chain of causation? I stand firmly with (Surgeon General) Burney's statement of 10 years ago. In protecting health, absolute proof comes late. To wait for it is to invite disaster or to prolong suffering unnecessarily. I submit that those things within man's power to control which impact upon the individual in a negative way, which infringe upon his sense of integrity, and interrupt his pursuit of fulfillment, are hazards to public health."

It is finally clear that noise is a significant hazard to public health. Truly, noise is more than just an annoyance.



Noise can affect the quality of sleep.

ROLE OF COMMUNITY
NOISE COUNSELOR



III. THE ROLE OF THE COMMUNITY NOISE COUNSELOR

Three times a week as reliable as clockwork, a massive garbage truck would slow up at an apartment complex at 5:45 a.m. to begin emptying the four refuse containers.. If the grinding sound of the truck's motor didn't wake up most of the neighborhood, the clanging of the metal containers being emptied usually did. Some people learned to sleep through the clamor. But most near-by residents woke up and lost a good night's sleep as a result.

A noise counselor became aware of the problem after presenting a short talk on noise to the local community organization.

"What can we do about it?" one of the participants asked. "We have to get our garbage collected but they make so much noise I can't get a decent night's sleep."

After listening to the problem, the noise counselor suggested an approach. The counselor made an arrangement to take sound level readings in five separate apartments in the neighborhood. Since the noise woke the people up anyway, they didn't mind working with the counselor in an attempt to solve the problem.

After taking the sound level readings, the noise counselor met with the owner of the refuse company. The counselor presented the problem and suggested a partial solution.

Rather than begin the route in residential areas, the counselor suggested the route be started in the commercial districts where few if any people could hear the noise at 5:45 a.m. By the time the trucks arrived in the residential neighborhoods, most people would be awake. The owner

agreed to rearrange the routes and within two weeks the trucks didn't arrive in the residential areas until 9:30 a.m. They still made noise but for the first time in years residents were able to get a good night's sleep.

As a noise counselor, you can contribute to the welfare of your community by engaging in five broad activities:

1. Gathering information about noise
2. Communicating this information to others
3. Conducting on-site noise surveys
4. Involving volunteers and community groups in this process
5. Helping the city as a "noise ombudsman"

Your first step will be to define the geographic area and segment of the public you intend to serve. Clearly, your neighborhood is a place to start. But where does your neighborhood end and the next person's begin? Although your specific projects will be local in nature, it may be wise to define your territory along the boundaries of the county or city government that has the primary jurisdiction in the area where you live.

Once you have identified your boundaries, you can begin work on the five broad areas mentioned above.

Gathering Information

One of your chief functions as a noise counselor will be to gather and organize as much information about noise as possible. This will involve compiling a list of names, addresses, and telephone numbers of various officials and agencies involved in noise enforcement and legislation. Many of the problems brought to you can be handled simply by referring the caller to the right official with hints on how to get results.

Develop a referral list of persons/ agencies involved in noise enforcement and legislation.

Some agencies you should include on your referral list are the local police department (you may have to make a few calls to determine the best person with whom to talk in the department); airport control tower and planning officer; health department; humane society; park police; local trucking company, contractor, business, and industry complaint departments; refuse collection agency; public works department; planning and zoning authorities; the office in charge of emergency vehicle sirens; city council members (appropriate committees, if possible); and local representatives at each level of government.

While you are collecting your information, find out what local resources are available to you. You may be able to locate films, books, and tapes that you can borrow for presentations. The local library may have audiovisual equipment to loan. Also, many of the agencies with informational films or tapes are willing to provide the necessary equipment. EPA maintains a small library of films and slide-tape presentations which you may borrow.

You should also begin to keep files on various noise problems in your community and other cities. Clip articles from newspapers and magazines and save speeches or statements of public officials.

Keep the phone numbers of the nearest Crisis Center and Suicide Prevention Hotlines handy for your reference as well. Although they probably will not be needed often, you may have an occasional caller who needs immediate help which you are not qualified to give.

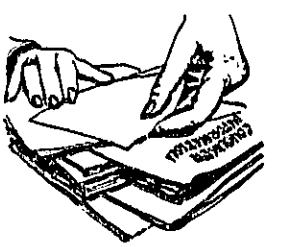
Oddly enough, you may also find it wise to keep the phone numbers of local child abuse centers, rape hotlines, etc. Often violent crimes of this type are

accompanied by much noise. Callers may not realize the origin of the noise they are complaining about, or they may simply wish to stay uninvolved. In any event, if the caller says anything to indicate that a violent crime could be in progress, the best thing to do is to contact the police, and if appropriate, the specific emergency center. By doing this, you may not only solve the noise problem, but you might avert a tragedy.

Communicating Information

As a noise counselor you may often receive letters from people you've never met with suggestions or complaints or just questions about noise. In other cases you'll receive phone calls or letters from people you know in your community. One of the most important services you can perform is to dig into your files and find the right person or the right agency for the person to talk to.

But you needn't wait until someone contacts you in order to get involved as a noise counselor. In many instances, it will be up to you to take the initiative, to find out the major noise problems in your community, to identify concerned individuals and organizations, and to develop a strategy to solve the problems.



Disseminate noise information to consumers.

Conducting On-site Noise Surveys

To help someone with a noise problem, it is often necessary to establish the extent of the problem. A sound level meter is one of the best tools you can use.

Don't let the fancy dials and knobs and buttons on the sound level meter intimidate you. It's easy to use and highly effective in quanti-

fying what may seem to some a very nebulous problem.

The sound level meter uses a microphone to transform sound pressure variations into an electrical signal which can be read on the meter's dial. Specific training in the use of the sound level meter is available.

Using the meter is a fairly simple technical process that can be learned by almost anyone. When to use the meter and how to use the findings from the meter requires good judgment and common sense.

The sound level meter might be used to determine the noise level around a construction site, an airport, or a train yard. It may be used to establish the fact that a certain traffic pattern is beyond acceptable standards. The sound level meter may be particularly helpful in establishing noise levels around the home. Home appliances and shop and garden tools are the major sources of sound around a home. EPA has grouped these appliances and tools into four categories based on the noise they produce.

Machines in the first group, which includes quieter major appliances such as refrigerators and clothes dryers, usually produce sound levels lower than 60 dB. Although the level is relatively low, such noise may be objectionable to a few people.

The second group includes clothes washer, food mixers, many dishwashers and sewing machines that produce noise from 65 to 75 dB. Exposure time tends to be brief and infrequent, but the resulting noise may disrupt the understanding of speech and may be disturbing to neighbors in multi-family dwellings.

The third group includes vacuum cleaners, noisy dishwashers, food blenders, hair dryers, electric shavers, and food grinders. They usually produce 75 to 85 db. The risk of hearing damage from them is small if the exposure is infrequent. Generally, the noise from such appliances is annoying.

Appliances in the fourth group produce the highest noise levels in the home environment--above 85 dB. They include millions of yard-care and shop

tools. Any amount of exposure to such equipment will probably interfere with activities, disrupt your neighbor's sleep, cause annoyance and stress, and may contribute to hearing loss. Both gasoline and electric walk-behind lawn mowers range from about 87 to 93 dB at the operator's ear, and even 50 feet away, range up to 72 dB; some riding mowers reach 83 dB at 50 feet.

Involving Others in the Process

Most of the success you will enjoy as a noise counselor will come as a result of working with other people. You are only one person, but if you identify other concerned people and get them involved in noise reduction activities, you can multiply the results of your efforts several times.

As you begin to work with other groups, you may find that there are a number of serious noise concerns in your community, perhaps too many to get involved in right away. One way to help you select your activity is to work with the groups that have the most enthusiasm and drive to get things done. Their priority may not always be your top priority, but together you may be able to achieve some accomplishments that will build credibility for you and for others trying to alleviate noise in your community.

Serving as Noise Ombudsman

After several months as a noise counselor, you may find that you are the most knowledgeable and experienced person in the area of noise in your community. If your particular city has no formal or structured noise program, the city administrators may turn to you for assistance in noise abatement problems.

This can happen in several ways. If the city takes the initiative, you may be asked to serve on an advisory committee for noise abatement, or you may be asked to serve as a special assistant to the mayor or city council for noise abatement.

On the other hand, it may be up to you to take the initiative in this matter.

Once you feel confident enough to serve in an official capacity, you may want to suggest to the city that you be appointed as noise ombudsman.

The dictionary defines ombudsman as "an appointed public official who investigates the activities of government agencies that may infringe on the rights of individuals". Today the word has a much broader meaning and usually refers to a person who calls the attention of public officials and private citizens to a situation that should be corrected.

Many public utilities now have ombudsmen, as do newspapers and local governments. They serve as resident critics with the blessings of the people who appointed them. It's accepted that their recommendations won't always be popular but that they will in the long run serve the public good.

In fulfilling the role of ombudsman you would serve as a focal point for both the city government and neighborhood groups. The ombudsman should not be thought of as a troublemaker, but rather as a problem solver and mediator who understands both sides of an issue and who can speak effectively for citizens' concerns.

Whether you serve as an ombudsman or a noise counselor, at some point it is inevitable that you'll be asked to tackle a problem that you can't handle. What do you do?

First of all, you are not a technical expert and you won't be expected to solve highly technical problems. When you do face a situation you can't handle, be the first to admit that this is a problem for the experts. Your contribution will be to locate the experts.

One source of information is the representative from the Acoustical Society of America (ASA) in your region (See appendix E). These representatives have agreed to serve as technical resources to noise counselors. (Even if you don't have a specific problem, give the ASA representative in your region a call to say you are serving as a noise counselor).

Local universities are another good source of technical expertise. Most schools of engineering will have at least one authority in acoustics as well as several graduate students anxious to apply their newly learned skills.

The NRTA/AARP Project Coordinator is also a source of information. A problem which you face in your area may be similar to one faced by a noise counselor in a nearby city and the Project Coordinator may be able to put you in touch with the right person.

Other resources are the community noise advisors (Appendix D), state noise officials, and various Federal officials involved in noise control.

Use a sound level meter to determine noise levels around the home, office, etc. Washers are from 65-75 dB.

IV. THE TECHNIQUES

Achieving your objectives may be a long, slow, and tedious process. As you begin to decide just how to go about getting the results you want, it may be helpful to think of various activities in terms of distinct techniques, each of which can bring you closer to your goals.

Setting Objectives

While it is important to involve others in specific projects, it is equally important for you to set your own very specific objectives as a noise counselor. This should be done after you've had the opportunity to discuss the local situation with others in your community.

A form is provided in the back of this handbook to guide you in your thinking. In defining your objectives, don't settle for vague generalities such as:

OBJECTIVE: To decrease noise in this community over the next 12 months.

Be realistic and be very specific in setting your objectives, such as:

OBJECTIVE: To identify the three major sources of noise in my immediate neighborhood and to advise the people or business responsible for the noise on ways to reduce or eliminate the problem.

or

OBJECTIVE: To get one unit of the EPA-developed school curriculum on noise adopted for use by the local school board.

The following are some other typical objectives you might set for yourself.

1. To assist 20 neighbors in identifying and dealing with noise in their homes.
2. To make one presentation a month on noise control and abatement to a community or civic group.
3. To measure the noise level at three neighborhood construction sites.

Community Organization

In order to disseminate information about the noise and to enlist other people in your efforts for noise control, you should be involved in several community groups. Look for opportunities to address groups like the PTA, the Lions, the Rotary and similar organizations.

Using a film is a good way to start your presentation. A list of films is included in Appendix G. Choose the film carefully based on your audience's interests and level of awareness about noise.

If you are not accustomed to public speaking the, the idea of giving a presentation may be a bit scarey. At first you may want to show a film and then conduct a question-and-answer session. As you gain more experience you'll probably be anxious to deliver a full fledged speech before a group. Appendix F contains an outline for a speech which you may wish to use.

One specific program involving community organizations deals with a series of courses on noise which have been developed by EPA for inclusion in school curricula. The three courses are for use by elementary schools, junior high schools, and senior high schools.

One objective for all noise counselors might be to get at least one of these modules adopted by a local school system within the first 12 months of your assignment. This isn't a job you should take on alone. The logical community organization to work with is the PTA.

Your first step may be to convince the PTA of the importance of including

this course in the curriculum. It then becomes the project of the local PTA and not the individual noise counselor. In most cases the decision on new courses will be made by the board of education. If you and the PTA can persuade the school board to adopt one or more of these courses, the course material can be ordered directly from EPA.

Another project you may wish to undertake with the PTA is getting your local school system to conduct student hearing tests. These tests would be conducted by the school nurse or audiologist. In addition to helping students and their parents identify hearing problems, the tests would begin to raise the level of awareness about hearing and noise effects throughout your community. It may be possible to conduct the hearing tests in conjunction with the school courses on noise once they are adopted by the school board. EPA has developed a series of three brochures which can be disseminated to school children at the time hearing tests are given.

Media

Radio, television, newspapers, and magazines are important factors in any community effort to affect change. The major contribution of the media is its ability to inform the community of specific health hazards that result from noise. Here are just a few of the ways you can use the media to inform your community.

News Releases

When you feel you have a news story, prepare a short (1-2 pages) news release and send it to all media in your community. Follow up with a phone call and try to persuade the editor to do a feature story on your idea.

News Conference

The news conference can be helpful when there is a story that requires a lot of background explanation. But the technique should be reserved for major announcements or stories that can't be conveyed by a simple news release. The effective news conference requires a great deal of preparation and you should have the support of several individuals and organizations before undertaking such an event.

TV Feature

Pick up the phone and call the assignment editor at one of your local TV stations if you have an important news or feature story. Remember that television has to show the story as well as tell it so try to highlight some of the visual possibilities for your station contact.

Talk Programs

Most cities have at least one radio and/or TV talk program. Try to persuade the producer to do a segment on noise in your community. You may want to be on the program yourself or you may want to arrange for others to do the program. Keep in mind that the producers of these programs have a continuing need to develop good local stories. You could be on the program two or three times in one year if you can think of new angles for the noise story (i.e., status of municipal noise control ordinance; major sources of noise in the community, health effects of noise).

Public Service Announcements

If a community group plans a meeting on noise control, send a short announcement about the meeting to all the local radio stations about two weeks before the meeting. Label your announcement "PUBLIC SERVICE ANNOUNCEMENT" and state the time, date, place, and nature of the meeting. In addition to informing the interested parties, your announcement will let the community know that people are doing something about noise. Additionally, noise public service TV Announcements are available from the EPA.

Hearings

State, county, and municipal authorities hold regular hearings on public issues. When the issue is noise, ask to be invited to give testimony and answer questions. But the issue doesn't have to be noise in order to ask for an invitation. Hearings on building codes, zoning ordinances, and even recreation facilities all can influence the noise situation. Find out what hearings are

scheduled, particularly in your county or municipal government. If these hearings relate to noise, make sure you get your concerns represented.

Many other techniques can help you control noise in your community. You may decide to write articles to go in existing community newsletters. You could start a speakers bureau by enlisting the support of a few articulate people and scheduling them to talk before community groups.

Consider these techniques and others that you come up with on your own based on your community's needs. You can't use all of them at the same time but you can increase your batting average by choosing a few techniques and concentrating on them to achieve your goals.

Some Common Noise Problems

As a noise counselor, you will quickly find out that many of the noise problems in a neighborhood come from the same type of sources. Barking dogs are one of the most common problems in a neighborhood. Loud stereos are also a source of complaints. Motorcycles and hot rod cars that blast through residential streets at all hours of the day wake up children and grown-ups alike.

You will have to learn what services are available to you in your particular city to deal with the common noise problems. The barking dog problem, for instance, may come under the jurisdiction of the police department, health department, the environmental affairs office, or the animal control office.

Determine the areas of jurisdiction in your community. Keep a list of names and telephone numbers handy so you can assist your neighbors with some of their more common noise problems. Knowing where to go about a noise problem is half the battle. Getting people to change their habits is the other half. Your role as a noise counselor will require you to spend many hours in one-to-one counseling, trying to convince your neighbors to change certain practices which produce excessive noise and disturb nearby residents.

The following is a list of some common noise problems you may encounter as a community noise counselor. There are many solutions to these problems and the list of possible solutions is provided as a place to start in trying to counsel these problems.

PROBLEM	POSSIBLE SOLUTION
1. Noisy plumbing	• reduce water pressure • install air lock
2. Noisy ventilation (forced air heating and cooling systems)	• reduce air flow velocity • install more grills • install padding around ducts where possible
3. Loud furnace blower	• align blower pully and motor • lubricate properly (should be lubricated at least once a year)
4. Noisy washing machine	• lubricate motor
5. Appliances are too noisy	• VIBRATION - isolate heavy equipment from a floor using a rubber pad or thick rug • isolate appliances from walls and cabinet enclosures; where practical and safe, surround with sound absorbing materials. • undercoat garbage disposals with damping compound (similar to auto undercoating); can also be used on outside drain of washers and dryers.
6. Noise intrusion from outside	• install storm windows and doors • caulk cracks around doors and windows
7. Barking dog	• report neighbors' dog to police or other municipal authorities • use techniques recommended by National League of Cities and Humane Society
8. Noise power tools	• use variable speed tools when possible • use isolated area of home to work in • don't use late at night or early in the morning • wear hearing protector

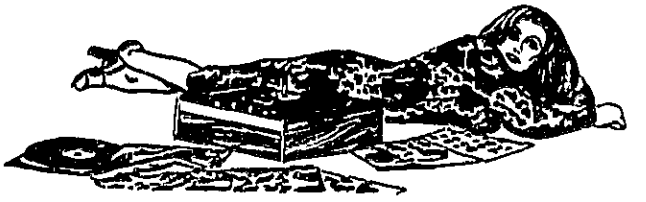
9. TV or stereo too loud	• locate equipment away from party walls • install fireproof acoustical tile behind TV or stereo • turn down volume
10. Car is too noisy	• drive sensibly • check muffler • check wheels • adjust or replace fan belt if there is a screeching noise under the hood
11. Furnace noise	• line plenum with acoustical material
12. Noise is heard through electrical outlets	• pack electrical outlet holes with fiber
13. Too much noise from neighbor's apartment	• caulk along wall and floor after removing molding • use rugs where possible • ask neighbors to be more quiet
14. Dripping faucet	• place a sponge or facecloth under the drip • tie a string or a shoelace to the faucet so the drip is channeled as a miniature stream down the string • a more permanent solution is to replace the worn washer that is causing the drip
15. Creaking doors and hinges	• install weatherstripping to tighten door seal • lubricate hinges with oil or silicone
16. Door slamming	• install door closure dampers on exterior or spring loaded self-closing doors • install a resilient gasket or weatherstripping around the door • substitute a solid-core door for a hollow-core door
17. Fans and exhausts	• remember the saying "slow and low." The slower the motor speed, the quieter the fan
18. Ventilator grill noise	• usually caused by high velocity air flowing through the grill. A streamline grill with large openings will reduce the whistling noise.

19. Window rattle

- if window panes rattle look for breaks in the putty. If the entire frame rattles, check the adjustment of springs or weatherstripping
- double-hung windows in aluminum guides can have the guide spacing adjusted for a good fit.

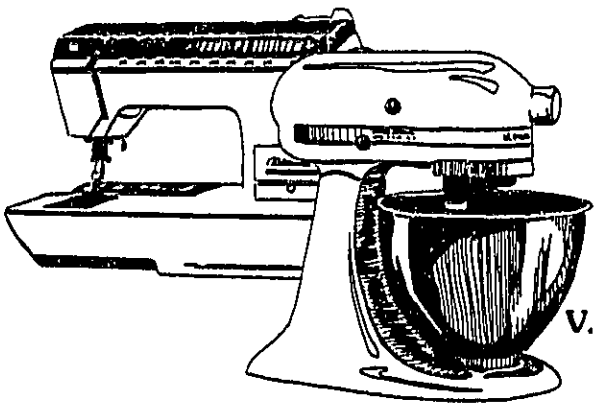
20. Air conditioner noise

- select a unit with adequate power capacity to do the job
- mount window units on resilient pads
- install perimeter gasket of soft rubber to isolate unit from wall or window structure
- locate unit away from neighbor's bedroom.



Rock music may be a delight to some--
to others, sheer agony.

BACKGROUND ON NOISE
CONTROL LEGISLATION



V. SOME BACKGROUND ON NOISE CONTROL LEGISLATION

There was never any real opposition to reducing the noise in a midwestern city. The mayor and city council wanted noise reduced. It was good politics, good business, and good plain common sense. The residents throughout the city clearly wanted to live in a quieter environment. And the business establishment felt it was losing a lot of customers due to the constant din of downtown noise.

There was no one single source of noise. A major highway carried heavy trucks and through traffic near the center of town. The city's airport was particularly close to the downtown area. Police and traffic helicopters seemed to be landing and taking off all day.

Everyone wanted to do something about the growing racket but there were so many sources of the noise it seemed like an impossible task.

A person who knew her way around Federal and State noise control programs developed a plan and presented it the city council. The plan called for the development of citizen task forces in the neighborhoods most affected by the noise. With the help of this concerned citizen, the task forces identified the Federal and/or State agency with some jurisdiction over the noise-related problem. It was a slow process, but one step at a time the city became a quieter place to live and shop. A highway was repaired so traffic could be rerouted and noise barriers were erected; helicopter landings were prohibited during

certain times of the day; downtown record stores were prohibited from blasting the latest rock music record over a three-block area.

No one action or event made this a quieter place to live. But the efforts of a concerned citizen motivated both public and private individuals to do something about the noise.

As a noise counselor, you may often be asked about the Federal government's involvement in noise control. The following information is provided for your background and to help you answer questions about the Federal Government's authority in noise control matters. Further information is available from your NRTA/AARP Project Director.

Federal noise legislation is a relatively recent development. Noise control was chiefly handled by State and local governments until the 1960's. The earliest Federal noise legislation appeared in 1968 when Congress directed the Federal Aviation Administration (FAA) to establish rules and regulations to control aircraft noise.

At the State and local level, laws tended to treat noise as a public nuisance, and enforcement was both difficult and spotty. More recently some jurisdictions, notably California, Chicago, and New York City, have established new laws and ordinances that are based on noise-generating characteristics of specific equipment and, hence, are easier to enforce.

The Clean Air Amendments of 1970 called for the establishment of an Office of Noise Abatement and Control in the U. S. Environmental Protection Agency. The legislation called for a special report to the Congress on the environmental noise problem. Public hearings on noise problems were also held. Information from the EPA report and hearings as well as extensive Congressional hearings formed the basis of the Noise Control Act of 1972. This Act represents the first major Federal attempt to eliminate excess noise at the design stage of a

wide variety of new consumer products. Here are some of the major provisions of the Act.

- EPA is directed to develop and publish information on the limits of noise required for protecting public health and welfare as well as a series of reports to identify products that are major sources of noise, and to give information on the techniques for controlling noise from such products.

- Using the criteria thus developed, the EPA Administrator is required to set noise-emission standards for products that have been identified as major sources of noise and for which standards are deemed feasible. The law requires such standards to be set for products in the categories of construction equipment, transportation equipment (except aircraft), all motors and engines, and electrical and electronic equipment. It also grants authority to set standards deemed feasible and necessary to protect public health and safety for other products.

EPA has authority to require the labeling of domestic or imported consumer products as to their noise-generating characteristics or their effectiveness in reducing noise. Manufacturers or importers of nonconforming or mislabeled products are subject to fines of up to $25,000 per day for each violation and to imprisonment for up to one year. Manufacturers must issue warrants that their regulated products comply with Federal standards at the time of sale. They are also required to maintain records and provide information, including production samples, if requested by EPA.

- The EPA Administrator also is to prescribe noise-emission standards for the operation of equipment and facilities of interstate railroads, trucks, and buses.

- All Federal agencies are directed to use the full extent of their authority to insure that purchasing and operating procedures conform to the intent of the

law. EPA may certify low-noise emission products for purchase by the Federal Government.

- EPA also provides technical assistance to State and local governments.

Section 14 of the Noise Control Act of 1972 provides EPA with the authority to conduct and finance research, to advise on training of noise control personnel and on selection and operation of noise abatement equipment, to develop improved methods of measuring and monitoring noise, to prepare model State or local noise control legislation, and to disseminate information to the public.

Other Federal Noise Control Programs

Several other Federal agencies have noise control programs of interest to the general public. As a noise counselor, you should become familiar with the programs and Federal noise officials who run these programs in your area. When appropriate, coordinate your activity with Federal noise control programs in your region. The people who are responsible for Federal programs can be an excellent resource for technical and material support. In addition, you can have an influence on their decisions by attending and testifying at public hearings of these agencies.

The following is a synopsis of prominent Federal noise control programs. Some may be more active than others in your particular area. (If you live near a military installation, for instance, you may be coordinating much of your activity with the Department of Defense.) make it your business to meet the people who are responsible for the noise programs of various other Federal agencies.

Federal Highway Administration

The FHWA noise policy addresses noise associated with highway construction and use. The focus of the policy is to elevate the consideration of noise exposure in Federal-aid highway location and design decisions by requiring

studies of expected noise levels where the highway will be located.

FHWA also provides for noise reduction on existing Federal-aid highways. This primarily involves the placement of noise barriers at particularly loud locations which present a problem to nearby residents.

Department of Defense

The DOD has a program, known as the Air Installations Compatible Use Zones Program (AICUZ), to address the problem of noise generated by its approximately 275 military airfields. The objectives of the program are the protection of the integrity of military operations at DOD bases and the protection of the safety, health and welfare of the affected public. Although priority is given to control of noise through source and operational measures, the essence of the program consists of technically assisting communities to enact land use planning and controls that will ensure that local development (of all kinds) is compatible with the noise levels generated by the airfield.

The stated priorities of the AICUZ program are: 1) to reduce the noise through source and operational controls, and 2) where these controls are inadequate, to take action to ensure land use compatibility in one or more of the following ways:

- provide guidelines and work with local governments to achieve land use controls
- acquire land or restrictive easements
- change the installation's mission
- close the installation.

Department of Housing and Urban Development

HUD requires that noise exposures and sources of noise be given adequate consideration in all HUD programs which provide financial support to urban planning. This consideration must provide assurance that new housing and other noise sensitive accommodations will not be planned for areas whose current or

projected noise exposures exceed acceptable standards. These standards are particularly important to developers whose loans are often guaranteed by HUD. If a site is too noisy, HUD will not guarantee the loan.

HUD places particular emphasis on the importance of compatible land use planning in relation to airports, other general modes of transportation, and other sources of significant noise, and supports the use of planning funds to explore ways of reducing environmental noise to acceptable exposures by use of appropriate methods.

The HUD policy is directed towards:

- Encouraging land utilization patterns for housing and other municipal needs that will separate uncontrollable noise sources from residential and other noise-sensitive areas.
- Restricting HUD support for the construction of noise-sensitive development, particularly housing on new sites which are adversely exposed to noise.

HUD's policy is not to stop the building of needed housing, but rather to encourage construction in areas that constitute good residential environments. The focus of the policy lies in HUD's power to stop or alter plans for HUD-assisted housing construction wherever noise levels are high.

Department of Labor/Occupational Safety and Health Administration

DOL is concerned with noise as an on-the-job hazard and deals with it through OSHA. OSHA programs include the development of noise exposure standards for workers; enforcement of those standards by inspections and penalties for noncompliance; training, education, and information programs to assist employers, employees, and others in complying with standards; and assistance to State programs.

Veterans Administration

The VA operates the Mortgage Loan Guarantee Program. The noise aspects of this program apply to the appraisal of residential properties near airports.

The classification scheme for property is:

- Noise should not be a factor in considering residential development (CNR Zone 1).
- May or may not be possible to develop properties which will be acceptable for GI loans (CNR Zone 2).
- Requests for appraisals of proposed residential construction will not generally be acceptable for processing (CNR Zone 3).

Federal Aviation Administration

The FAA has a program to reduce noise exposure at civil airports. The objectives of the program are to reduce the noise at the airport boundary to a prescribed level by 1980 to the extent possible and to assist communities in achieving compatible land use for the remaining areas. Although primary emphasis has been on developing source and operational controls, an active program of advising responsible officials concerning noise impacts and creating public awareness is underway. The program is implemented at individual airports through FAA's planning grant and airport development aid programs. The FAA encourages citizen participation in the process of noise compatible land use planning.

The FAA has a program to reduce noise exposure at Civil Airports.

Local Programs

In addition to these Federal programs, a growing number of local jurisdictions have enacted noise control ordinances.

Currently more than 650 municipalities have noise ordinances affecting a combined population of over 67 million people. Many communities are enacting legislation with quantitative noise emission limits which replace nonquantitative or general nuisance provisions.

There is available a Model Community Noise Control Ordinance which local communities can use to develop ordinances suited to their local needs and provisions. (See bibliography of government publications in Appendix G.)

Q's & A's FOR THE
NOISE COUNSELOR

VI. Q's & A's FOR THE COMMUNITY NOISE COUNSELOR

Q. *As a noise counselor am I expected to be an expert in the technical aspects of noise?*

A. Not at all. You should have a basic understanding of the properties of sound. In addition you should know at what level sound becomes dangerous to one's health. When technical questions about sound or noise come up, you should know where to direct people to get the answer.

Q. *How big a territory should I cover? My entire state, my county, my town or just my neighborhood?*

A. This is up to each noise counselor. Some may be more effective at the state level. Others may be more successful at the neighborhood level. Rather than try to cover too much ground, however, the counselor should identify one geographic area and concentrate efforts in that area. It is important in terms of your credibility to have a few early successes even if they don't eliminate major noise problems. Successes against noise are also important morale boosters for coworkers. This factor may affect your decision as to where to concentrate your efforts. At the very least, you should make contact with city and county noise officials in your area as well as with Federal officials. Their suggestions may help you decide what sections of your region to concentrate on.

Q. *Will I get invitations to testify at hearings and appear on television programs?*

A. Not unless you go after these invitations and you should seek them out. As you begin your role as a noise counselor, you may not be recognized as a source of information in your community. The more attention you can call to the problem of noise, the more likely something will be done about it.

Q. *Will I be waging a one-person campaign against noise?*

A. Absolutely not. You will receive support from your project officer as well as from the many other people involved in noise control. Beyond that your real function is not to wage a personal campaign as much as getting other groups and individuals involved in the process. You will quickly find that many, many others in your community are concerned about "noise pollution." They are looking for a leader, someone able to coordinate and/or direct their efforts.

Q. *Can noise counselors really make a difference?*

A. In effect, noise counselors have been making progress for years. They haven't been called noise counselors. They were concerned individuals who got together to do something about noise. As a noise counselor, you can be the catalyst that brings together various forces to create a quieter environment.

Q. *Will I receive any type of orientation or training?*

A. At the beginning of the program you will take part in a training program which will go over the basic properties of sound, the use of the sound level meter, and case studies of successful efforts to reduce noise. After your initial training, you will attend a follow-up session that will give you the opportunity to share with your colleagues the techniques and programs you have found helpful. Other training sessions will be scheduled periodically.

Q. *Can I learn how to use a sound level meter?*

A. If you can operate a television set, you can operate a sound level meter. The sound level meter is a light-weight, hand-held unit with a microphone. The dials on the meter are about as easy to read as the speedometer in a car. After you complete your training in the use of the sound level meter, you will be able to take quick and accurate readings in almost any situation. (See enclosed booklet A Primer of Noise Measurement.)

APPENDICES

APPENDICES

APPENDIX A

SOME BASIC CHARACTERISTICS OF SOUND

SOME BASIC CHARACTERISTICS OF SOUND

What is Sound?

The nature of sound is often debated with the following question: if a tree falls in the forest, and no one is near to hear it fall, is there a sound? In other words, does sound deal with a cause (a vibrating object such as the falling tree) or with an effect (the sensory experience of hearing)? The answer is that sound is both these things. It is both a physical event and a physiological sensation (1).

The sensation of sound is a result of oscillations in pressure, particle displacement, and particle velocity, in an elastic medium between the sound source and the ear. Sound is caused when an object is set into vibration by some force. This vibration causes molecular movement of the medium in which the object is situated, thereby propagating a sound wave. Sound is "heard" when a sound wave impinges on the human ear and is recognized by the brain. Further, the characteristics of the sound wave must fall within the limitations of the human ear for the sound to be heard because the human ear cannot hear all sounds. Sound frequencies (pressure variation rates) can be too high (ultrasonic) or too low (infrasonic), or the sound amplitudes may be too soft to be heard by man.

How is Sound Propagated?

Sound is transmitted from the sound source to the ear by the movement of molecules in the medium. This molecular movement is called a sound wave.

In air, sound waves are described in terms of propagated changes in pressure that alternate above and below atmospheric pressure. These pressure changes are produced when vibrating objects (sound sources) cause alternate regions of high and low pressure that propagate from the source. In the production of airborne sound waves, the vibrating sound source actually "bumps" into the adjacent air molecules forcing them to move (see Figure 1). These molecules, in turn, bump into others further away from the source, and so on. Thus, the energy from the sound source is imparted to the air molecules and thereby is transmitted through the medium. Note that sound energy and not air particles travel from the source through the medium. An analagous situation occurs when dropping a pebble into a still pond. When the pebble hits the water, it causes a wave motion to emanate from it in all directions, moving outward in concentric spheres.

There are two phases to a sound wave: compression and rarefaction. The compression phase occurs when the air molecules are forced closely together (causing an instantaneous increase in air pressure) and the rarefaction phase occurs when the air molecules are pulled apart from each other (causing an instantaneous decrease in atmospheric pressure). This complete sequence of one compression and one rarefaction is called a cycle.

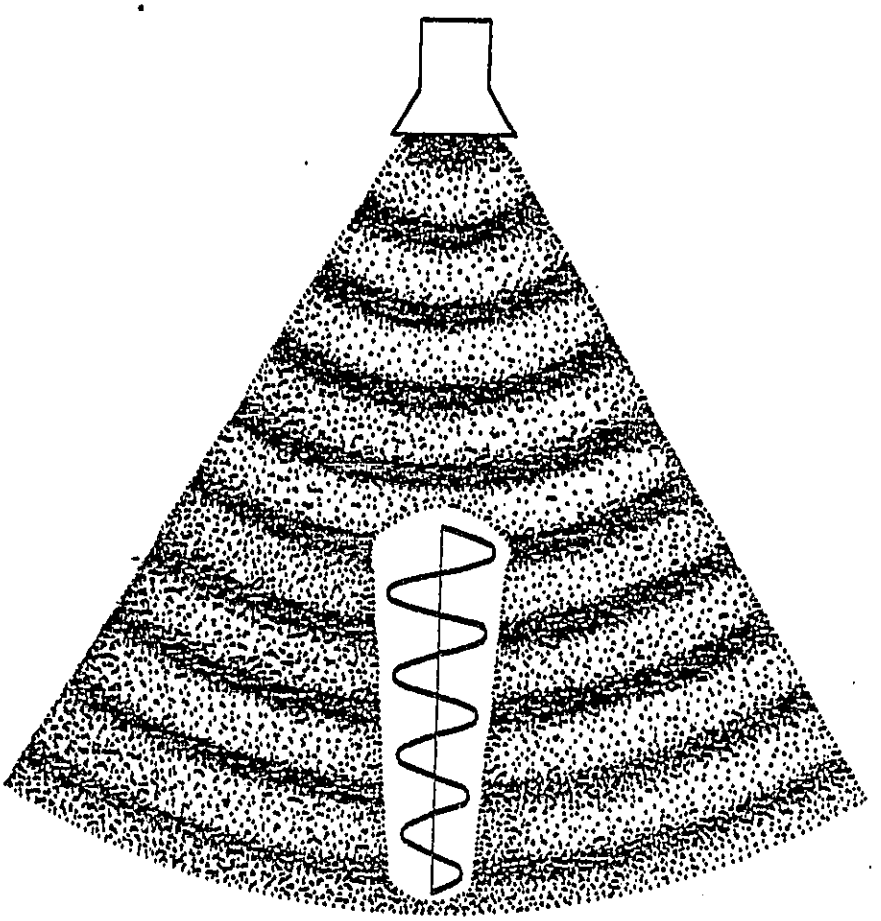


Figure 1. Propagation of a Sound Wave.

What are the Attributes of Sound?

Sound has several attributes by which it may be characterized. We have all learned to describe these attributes subjectively. That is, we refer to sounds as varying in pitch, in loudness, and in quality. However, these same attributes of sound may be measured objectively and, as such, are termed frequency, amplitude and time distribution.

Amplitude (Loudness)

The preceding section has shown that the frequency of a sound wave is dependent on the rate at which the sound source vibrates. The faster its rate of vibration, the higher the frequency of the sound generated. The amplitude of sound, however, depends on the amount of displacement of the vibrating source.

The subjective correlate of amplitude is loudness. Thus, the higher the amplitude or level of sound, the louder we perceive it, although there is not a one-to-relationship between the physical amplitude of sound and the sensation of loudness.

The ear is sensitive to a wide range of sound levels and this creates many difficulties in working with absolute sound pressure units. For instance, the human ear is sensitive to a pressure range greater than 0.00002 to 20,000 newtons per square meter. Because of the awkwardness and difficulty of working with such a broad range of absolute units, the decibel has been adopted to compress this large range and more closely follow the response of the human ear.

The decibel: The decibel (abbreviated dB) is a convenient means for describing sound pressure level: the logarithmic level of sound pressure above an arbitrarily chosen reference, 0.00002 newtons per square meter (N/m^2). This reference pressure can also be expressed as 20 micropascals (uPa). In other words, the decibel is based on a ratio comparing two sound pressures. One sound pressure is that which we wish to quantify and the other sound pressure is termed a reference. The reference represents approximately the minimum audible threshold of the normal ear. The decibel, then is based on a ratio expressing how much greater a sound pressure is than the least sound pressure we can hear, and it is expressed as a level above the specified reference pressure.

The formula for determining the sound pressure level is:

$$L_p = 20 \text{ Log}_{10} \frac{P_1}{P_0}$$

where P_1 is the sound pressure at the measurement location and P_0 is the reference pressure of 20uPa. Figure 2 relates decibel values to sounds commonly heard in our environment.

As sound increases beyond normal exposure levels, it will first cause discomfort, then tickle, and finally, pain (in the region from 110 through 130 dB sound pressure level). Permanent and irreversible damage to hearing may result from extended exposures to sound levels well below those that cause tickle and pain sensations.

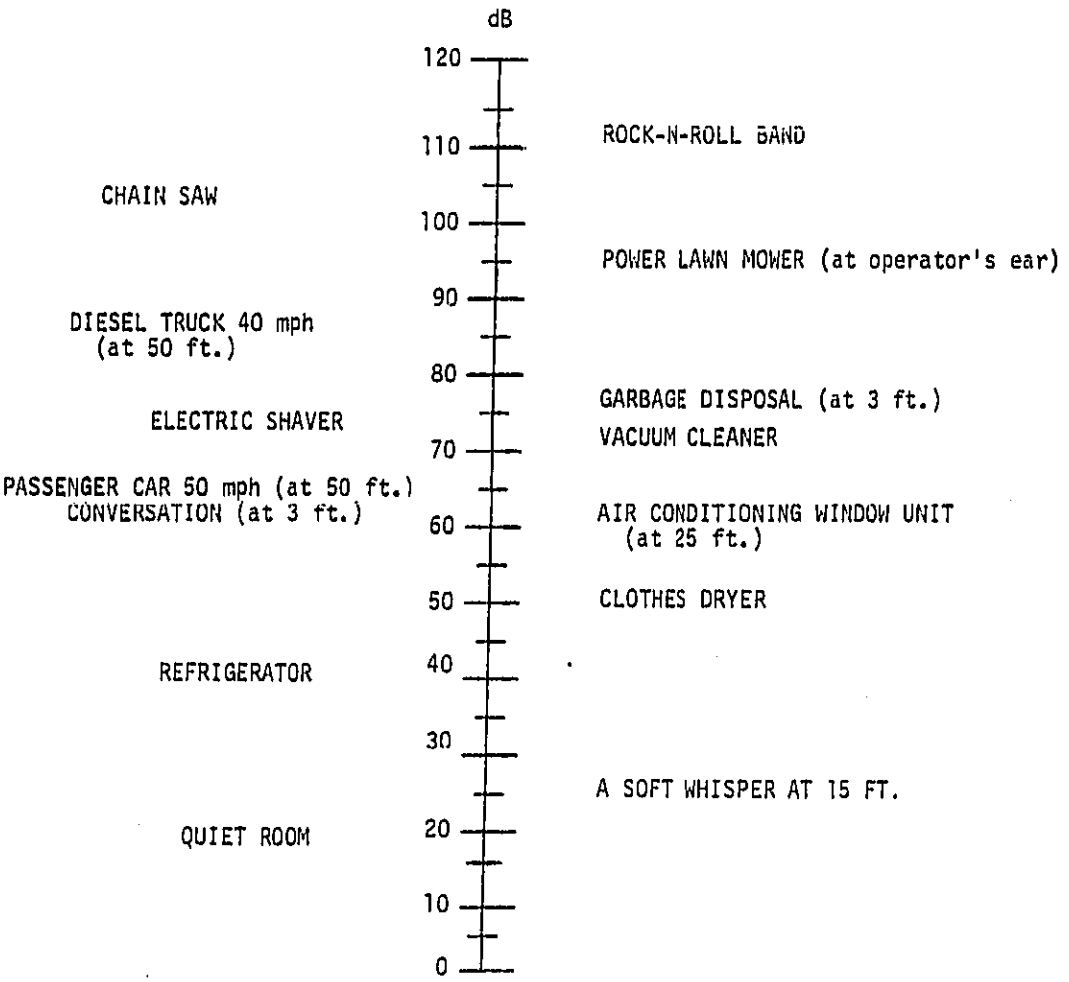


Figure 2. Noise Levels of Some Common Sources.

Frequency

Frequency is defined as the number of complete pressure variations, or cycles, per second of a sound wave. As discussed earlier, one cycle is equal to one complete compression and rarefaction variation of a sound wave.

The unit for expressing frequency is cycles per second, abbreviated c.p.s., c/s, cps, or Hertz, abbreviated Hz. The latter term is now in more general use. Thus, if a sound source vibrates 500 times per second, it produces a sound with a frequency of 500 cps or 500 HZ. The terms kilohertz (kHz) is also frequently used and means 1000 cycles per second or 1000 Hz. Thus, a 4000 Hz tone may be expressed as 4kHz.

Frequency is directly related to the subjective sensation of pitch. The term pitch indicates that the human ear is involved in the evaluation of the sound. The lower the frequency of a sound, the lower we perceive its pitch. Therefore, a sound with a frequency of 250 Hz will sound much lower in pitch than a sound with a frequency of 2000 Hz.

Sound can consist of a single frequency (called a pure tone) or a combination of many frequencies (called a complex tone). Very few sound sources can produce pure tones, although a flute almost produces one. Most sounds in our environment are complex sounds--that is, they are actually a combination of many separate pure tones which exist simultaneously and vary in level. The manner in which these separate tones are combined is the spectrum of a sound.

Because the frequency range is so broad, it is frequently divided into numerous bands. Division into octave bands, for example, is convenient when measuring sound. An octave band is a frequency bandwidth that has an upper band-edge frequency equal to twice its lower band-edge frequency. The most frequently used octave bands in sound measurement are geometrically centered at 31.5, 63, 125, 250, 500, 1000, 2000, 4000, and 8000 Hz. For example, all frequencies from 1414 Hz through 2828 Hz and is centered at 2000 Hz. It comprise one octave band centered at 1000 Hz. The next octave band includes all frequencies from 1414 Hz through 2828 Hz and is centered at 2000 Hz. It should be noted that as the octave band increases in center frequency, the width of the band increases also. For example, the 1000 Hz octave band has a width of 707 Hz, while the 2000 Hz octave band has a width of 1414 Hz.

The human ear operates within certain frequency limitations. A healthy young person can hear normal sound levels over a range of frequencies from about 20 to 20,000 Hz. However, sounds with different frequencies are not all perceived with equal loudness. The ear is most sensitive to sounds between 1000 and 4000 Hz. Generally, the ear's sensitivity falls off as frequencies increase above 4000 Hz and as they decrease below 1000 Hz.

Sounds outside the audible frequency range are sometimes termed ultrasonic or infrasonic. Ultrasonic sounds have frequencies above the normal upper limits of the audible frequency range--they are too high to be heard by most human ears. Examples of ultrasonic sounds are those which are produced by a dog whistle, ultrasonic cleaners, or welding devices. Infrasonic sounds, on the other hand, are those whose frequencies are below the normal lower limits of the audible frequency range--they are too low to be heard by most human ears. Infrasonic sounds are normally created by very large sound sources such as ventilating systems or wind tunnels.

Although ultrasonic and infrasonic sounds are not audible to many people, they can be heard or "felt" by a significant number of sensitive persons, and the stress of these exposures may be harmful to some.

Time Distribution

The time distribution of sound may be classified broadly under three noise temporal patterns:

1) Steady-state
2) Time-varying/fluctuating
3) Impulsive

Both steady-state and time-varying categories can be divided into continuous or intermittent patterns. That is, there can be intermittent fluctuating noises.

APPENDIX B

GLOSSARY

GLOSSARY

Selected acoustical terms are defined here which are commonly encountered in the study of community noise. Common symbols or abbreviations are given in parentheses.

A-Weighted Sound Level - A sound level determined using the A-weighting function. A-weighted sound levels can either be measured using a sound level meter with an A-weighted network, or can be calculated from unweighted sound levels given for frequency bands.

A-Weighting - A frequency weighting which selectively discriminates against high and low frequencies to approximate the auditory sensitivity of human hearing at moderate sound levels. Sound level meters normally contain an A-weighting network which can be used to filter the received sound. (See A-weighted sound level.)

Audiogram - An audiogram is a record of hearing threshold levels as a function of frequency. The threshold levels are referenced to statistically normal hearing threshold levels.

Audiometer - An audiometer is an instrument for measuring hearing sensitivity.

Background Ambient Sound Level - The background ambient sound level is the level of the all-encompassing unidentifiable noise which remains after sounds from all specifically identifiable sources have been eliminated. It is usually perceived as a rushing sound of many indistinguishable sources.

Day-Night Sound Level (L_{dn}) - This composite noise metric is recommended by the U.S. Environmental Protection Agency for specification of community noise from all sources. It is a calculated level, similar to an equivalent sound level over 24 hours, except that the sound levels occurring during the nighttime period, which extends from 10 p.m. to 7 a.m., are increased by a 10 dB weighting penalty before computing the 24-hour average.

Day Sound Level (L_d) - The equivalent sound level over the 15-hour time period from 7 a.m. to 10 p.m. (0700 up to 2200 hours).

Decibel (dB) - The unit used for measuring sound levels. (See level.)

Equivalent Sound Level (L_{eq}) - Equivalent sound level is a measure which describes the sound level of a time period of fluctuating environmental noise with a single number. It is the constant sound level which would contain the same amount of acoustical energy as the actual (fluctuating) level for the given period.

Frequency - The number of sound pressure fluctuations per second of a particular sound expressed in Hertz (cycles per second). Frequency is the property of sound that is perceived as pitch.

Hertz (Hz) - The preferred unit of frequency, equivalent to "cycles per second."

Hourly Equivalent Sound Level ($L_{eq\ (1)}$) - Equivalent sound level, in decibels, over a one-hour time period.

Infrasonic - Sounds of an infrasonic frequency are below the audible frequency range.

Level - In acoustics, the level scale is used for describing the amplitude of acoustical quantities. For a level value to be meaningful, the reference quantity must be specified. The level value is assigned the unit decibels.

Loudness - The loudness of sound is an observer's impression of its amplitude, which includes the response characteristics of the ear.

Maximum Sound Level - The greatest sound level during a designated time interval or event.

Metric - A measure of environmental sound. Some metrics are complex and account for characteristics such as sound duration, sound level, frequency content, time of occurrence, or single events. Statistical noise levels, equivalent noise levels, L_{dn}, etc., are all noise metrics.

Night Sound Level (L_n) - The equivalent sound level, in decibels, over the split nine-hour period from midnight up to 7 a.m. and from 10 p.m. to midnight (0000 up to 0700 and 2200 up to 2400 hours).

Noise - The terms "noise" and "sound" are often used interchangeably but, generally, sound is descriptive of useful communication of pleasant sounds, such as music; wheras, noise is used to describe dissonance or unwanted sound.

Noise Level - An informal term usually used loosely as a synonym for the A-weighted sound level.

Sound Level - Strictly defined, sound level is the quantity in decibels measured by a sound level meter satisfying requirements of American National Standard Specification for Sound Level Meters.

Sound Level Meter (SLM) - An electroacoustical instrument for measuring sound pressure level. The American National Standard Specification for Sound Level Meters, S1.4 - 1971, establishes performance criteria for three categories of meters of increasing degrees of precision that are used in community noise measurement. All of these meters normally include fast and slow meter movement and A-weighting features.

Sound Pressure - The sound pressure at a point is the total instantaneous pressure at that point in the presence of sound minus the static pressure at that point.

Sound Pressure Level - The instantaneous sound pressure level in decibels. In practice, this quantity is measured in decibels directly with a sound level meter, usually applying the A-weighting network of the meter. (See sound level.)

Ultrasonic - The frequency of ultrasonic sound is higher than that of audible sound.

White Noise - Acoustical or electrical noise in which the intensity is the same at all frequencies within a given band.

APPENDIX C

OBJECTIVES
NOISE CONTACTS

OBJECTIVES

In any endeavor it is helpful to have a clear set of objectives in front of you. They can be a guide in choosing one activity over another and they can serve as instruments in measuring your progress.

After you have served as a noise counselor for about 30 days, spend a few hours to determine your objectives. Be realistic and don't hesitate to revise them if the situation changes. Be as specific as possible.

1. During the next 3 months, I will achieve the following three specific objectives:

Objectives	Date by which this will be achieved
1.	
2.	
3.	

2. Within the first 6 months, I will achieve the following three specific objectives:

Objectives	Date by which this will be achieved
1.	
2.	
3.	

3. After one year as a noise counselor, I will achieve the following three specific objectives:

Objectives	Date by which this will be achieved
1.	
2.	
3.	

4. However long it takes me, I will achieve the following specific objectives while serving as a noise counselor:

Objectives	Date by which this will be achieved
1. _____	_____
_____	_____
2. _____	_____
_____	_____
3. _____	_____
_____	_____

KEY NOISE CONTACTS AT STATE LEVEL

EXAMPLE

1. Name Mr. Rodson L. Riggs
   Title Director
   Agency Iowa Energy Policy Council
   Address 707 East Locust, Des Moines, IA
   Telephone (515) 281-4420

2. Name _____
   Title _____
   Agency _____
   Address _____
   Telephone _____

3. Name _____
   Title _____
   Agency _____
   Address _____
   Telephone _____

4. Name _____
   Title _____
   Agency _____
   Address _____
   Telephone _____

5. Name _____
   Title _____
   Agency _____
   Address _____
   Telephone _____

KEY NOISE CONTACTS AT COUNTY/MUNICIPAL LEVEL

EXAMPLE

1. Name Eric Mendelsohn
   Title Technical Operations Chief/Noise Control
   Agency Montgomery County Environmental Protection Department
   Address 6110 Executive Boulevard, Rockville, MD
   Telephone 468-4138

2. Name _____
   Title _____
   Agency _____
   Address _____
   Telephone _____

3. Name _____
   Title _____
   Agency _____
   Address _____
   Telephone _____

4. Name _____
   Title _____
   Agency _____
   Address _____
   Telephone _____

5. Name _____
   Title _____
   Agency _____
   Address _____
   Telephone _____

KEY NOISE CONTACTS AT CIVIC, VOLUNTARY, OR CHURCH ORGANIZATIONS

EXAMPLE

1. Name Mary Louise Jambouski
   Title President, Local Chapter
   Agency League of Women Voters
   Address 2317 Hudson Parkway, Bergenfield, NJ
   Telephone (212) 857-0400

2. Name _____
   Title _____
   Agency _____
   Address _____
   Telephone _____

3. Name _____
   Title _____
   Agency _____
   Address _____
   Telephone _____

4. Name _____
   Title _____
   Agency _____
   Address _____
   Telephone _____

5. Name _____
   Title _____
   Agency _____
   Address _____
   Telephone _____

KEY NOISE CONTACTS AT MEDIA

1. Name _____

   Title _____

   Agency _____

   Address _____

   Telephone _____

2. Name _____

   Title _____

   Agency _____

   Address _____

   Telephone _____

3. Name _____

   Title _____

   Agency _____

   Address _____

   Telephone _____

4. Name _____

   Title _____

   Agency _____

   Address _____

   Telephone _____

5. Name _____

   Title _____

   Agency _____

   Address _____

   Telephone _____

APPENDIX D

REGIONAL NOISE PERSONNEL

REGION I

Connecticut
Massachusetts
Maine
New Hampshire
Rhode Island
Vermont

EPA Noise Representative:
Mr. Al Hicks
JFK Federal Building, Rm 2113
Boston, MA 02203
617/223-5708
8/223-5708 FTS

Community Noise Advisor
Paul R. Willis
Conservation Director
Town Hall
333 Washington Street
Brookline, Massachusetts 02146
617/232-9000

Occupational Safety and Health Administration:
U. S. Department of Labor

Gilbert Saulter
Department of Labor, OSHA
JFK Federal Building
Government Center, Rm 1804
Boston, MA 02203
617/223-6712

REGION II

New Jersey
New York
Puerto Rico
Virgin Island

EPA Noise Representative:
Mr. Tom O'Hare
26 Federal Plaza
New York, NY 10007
212/264-2109
8/264-2110 FTS

Community Noise Advisor
Richard Christie
Rockaway Township Health Dept.
19 Mount Hope Road
Rockaway Township, NJ 07866
201/627-7200

Occupational Safety and Health Administration:
Alfred Barden
Department of Labor, OSHA
1515 Broadway/1 Astor Plaza, No. 3445
New York, NY 10036
212/399-5941

REGION III

Delaware
District of Columbia
Maryland
Pennsylvania
Virginia
West Virginia

EPA Noise Representative:
Mr. Patrick Anderson
Curtis Building
6th and Walnut Streets
Philadelphia, PA 19106
215/597-9118
8/597-9118 FTS

Community Noise Advisor
Donna Dickman
Metropolitan Council of Governments
Department of Health and
Environmental Protection
Sixth Floor
1225 Connecticut Avenue, N.W.
Washington, D.C. 20036
202/233-6800

Occupational Safety & Health Administration:
U.S. Department of Labor

David H. Rhone
Department of Labor, OSHA
Gateway Building, Suite 15220
3535 Market Street
Philadelphia, PA 19104
215/596-1201

REGION IV

Alabama
Florida
Georgia
Kentucky
Mississippi
North Carolina
South Carolina
Tennessee

EPA Noise Representative:
Dr. Kent Williams
345 Courtland Street, N.E.
Atlanta, GA 30308
404/881-4861
8/257-4861 FTS

Community Noise Advisor
Jesse Borthwick, Administrator
Noise Control Section
Department of Environmental Regulation
2562 Executive Center Circle
Tallahassee, Florida 32301
904/487-2095

Employment and Training Administration:
U.S. Department of Labor

James Payne
Employment and Training Administration
1371 Peachtree Street, N.E. Rm 405
Atlanta, GA 30309
404/881-4411

REGION V

Illinois
Indiana
Michigan
Minnesota
Ohio
Wisconsin

EPA Noise Representative:
Mr. Host Witschonke
230 South Dearborn Street
Chicago, IL 60604
312/353-2205
8/353-2205 FTS

Community Noise Advisor
Ronald M. Buege
West Allis Health Department
7220 West National Department
West Allis, Wisconsin 53214
414/476-3770

Occupational Safety & Health Administration:
U.S. Department of Labor
Edward E. Estkowski
Department of Labor, OSHA
230 South Dearborn Street
32nd Floor, Rm 3263
Chicago, IL 60604
312/353-4716

Community Noise Advisor
Sam Hearring
Evansville Environmental
Protection Agency
Administration Bldg, Rm 207
Civic Center Complex
Evansville, IN 47708
812/426-5595

REGION VI

Arkansas
Louisiana
New Mexico
Oklahoma
Texas

EPA Noise Representative:

Mr. Mike Mendias
First International Building
1201 Elm Street
Dallas, Texas 75270
(214) 749-3837
(8) 749-3837 (FTS)

Occupational Safety and Health Admin.
(U.S. Department of Labor)
Robert Tice
Department of Labor, OSHA
555 Griffin Square Bldg, Room 602
Dallas, Texas 75202
(214) 749-2477

REGION VII

Iowa
Kansas
Missouri
Nebraska

EPA Noise Representative:
Mr. Vincent Smith
1735 Baltimore Street
Kansas City, MO 64108
816/374-3307
8/758-3307 FTS

Community Noise Advisor
Richard McElvain
Noise Pollution Specialist
Lincoln-Lancaster County
Health Department
2200 St. Mary's Avenue
Lincoln, NE 68502
402/474-1541

Occupational Safety & Health Administration:
U.S. Department of Labor

Vernon A. Strahm
Department of Labor, OSHA
Room 3000, 911 Walnut Street
Kansas City, MO 64106
816/373-5861

REGION VIII

Colorado
Montana
North Dakota
South Dakota
Utah
Wyoming

EPA Noise Representative:
Mr. Robert Simmons
Lincoln Tower, Suite 900
1860 Lincoln Street
Denver, CO 80295
303/837-2221
8/327-2221 FTS

Community Noise Advisor
James V. Adams
Environmental Protection Officer
City of Boulder
5050 Pearl Street
Boulder, Colorado 80301
303/441-3239

Occupational Safety & Health Administration

Curtis Foster
Department of Labor, OSHA
Federal Building, Rm 15010
1961 Stout Street
Denver, CO 80202
303/837-3883

REGION IX

Arizona
California
Hawaii
Nevada

EPA Noise Representative:
Dr. Richard Procunier
215 Fremont Street
San Francisco, CA 94105
415/456-4606
8/556-4606 FTS

Community Noise Advisor
James Dukes
Noise Abatement and Control Administration
City Operation Bldg
1222 First Avenue
San Diego, CA 92101
714/236-6088

Occupational Safety & Health Administration:
U.S. Department of Labor

Gabriel Gillotti
Department of Labor, OSHA
9470 Federal Bldg
450 Golden Gate Avenue, Box 36017
San Francisco, CA 94102
415/556-0586

REGION X

Alaska
Idaho
Oregon
Washington

EPA Noise Representative:
Mrs. Deborah Yamamoto
1200 Sixth Avenue
Seattle, WA 98101
206/442-1253
8/399-1253 FTS

Community Noise Advisor
Paul Herman
Bureau of Neighborhood Environment
2040 Southeast Powell Building
Portland, Oregon
503/248-4465

Occupational Safety & Health Administration:
U.S. Department of Labor

James W. Lake
Department of Labor, OSHA
Federal Office Bldg, Rm 6048
909 First Avenue
Seattle, WA 98174
206/442-5930

APPENDIX E

ACOUSTICAL SOCIETY OF AMERICA

Members of the Acoustical Society of America (ASA) have offered to serve as technical resources to noise counselors. The following is a list of ASA regional coordinators. Feel free to call on the ASA coordinator closest to you any time you have a technical question on sound, sound measurement, or noise.

John C. Burgess
Department of Mechanical Engineering
University of Hawaii
2540 Dole Street
Honolulu, Hawaii 96822

James D. Chalupnik
Department of Mechanical Engineering
FU-10
University of Washington
Seattle, Washington 98195
Tel: 206/543-5397

D. Elizabeth Cuadra
Robertson, Monagle, Eastaugh
and Bradley
510 The Financial Plaza
P.O. Box 679
Anchorage, Alaska 99510

Robert C. Chanaud
Engineering Dynamics, Inc.
6651 South Wellington Court
Littleton, Colorado 80121
Tel: 303/795-5226

Robert B. Chaney, Jr.
University of Montana
Department of Communication Sciences
and Disorders
Missoula, Montana 59801
Tel: 406/243-4131

John G. Clark
Institute for Acoustical Research
615 Southwest Second Avenue
Miami, Florida 33130
Tel: 305/856-0380

Allen L. Cudworth
Liberty Mutual Insurance
Company
175 Berkeley Street
Boston, Massachusetts 02117
Tel: 617/357-9500 ext. 3630

Stanley L. Ehrlich
Raytheon Company
Submarine Signal Division
P.O. Box 360
Portsmouth, Rhode Island 02871
Tel: 401/847-8000 ext. 2381

Hellmuth Etzold
University of Rhode Island
Kingston, Rhode Island 02881
Tel: 401/792-2517

Gerald J. Franz
Silencing Technology Associates
P.O. Box 695
Bayview, Idaho 83803

Robert S. Gales
Naval Ocean Systems Center
(Code 5121)
San Diego, California 92152
Tel: 714-225-7255

Conrad J. Hemond, Jr.
3 Cricket Lane
East Granby, Connecticut 06026

Robert L. Hershey
Booz, Allen Applied Research
4733 Bethesda Avenue
Bethesda, Maryland 20014
Tel: 301/656-2200 ext. 364

Ralph K. Hillquist
General Motors Proving Ground
Milford, Michigan 48042
Tel: 313/685-5162

Elmer L. Hixson
University of Texas
ENS 632
Austin, Texas 78712
Tel: 512/471-1294

Robert F. Lambert
University of Minnesota
Department of Electrical Engineering
Minneapolis, Minnesota 55455
Tel: 612/373-3021

Barry Leshowitz
4113 South 36th Street
Arlington, Virginia 22206

Paul L. Michael
Pennsylvania State University
110 Moore Building
University Park, Pennsylvania 16802
Tel: 814/865-5414

Douglas Muster
University of Houston
Department of Mechnical Engineering
3800 Cullen Blvd.
Houston, Texas 77004
Tel: 713/749-4456

Arthur F. Niemoeller
Central Institute for the Deaf
818 South Euclid
St. Louis, Missouri 63110
Tel: 314/652-3200 ext. 2

Charles W. Nixon
Wright-Patterson Air Force Base
Fairborn, Ohio 45433

Larry H. Royster
Department of Mechanical-Aerospace
Engineering
North Carolina State University
Raleigh, North Carolina 27607

Vincent Salmon
Industrial Noise Services, Inc.
543 Bryant Street
Palo Alto, California 94301
Tel: 415/321-7911

Louis P. Solomon
10620 Great Arbor Drive
Potomac, Maryland 20854

Allan M. Teplitzky
Consolidated Edison Company
of New York, Inc.
4 Irving Place
New York, New York 10003
Tel: 212/460-6774

Wayne M. Wright
Kalamazoo College
Physics Department
Kalamazoo, Michigan 49007
Tel: 616/383-8450

Richard J. Peppin
1711 Westwind Way
McLean, Virginia 22101

Edgar Shaw
Division of Applied Physics
National Research Council of
Canada
Ottawa, Ontario
Canada, KIA OSI

Ken Eldred
BBN, Inc.
50 Moulton Street
Cambridge, Massachusetts 02138

APPENDIX F
MODEL OUTLINE FOR SPEECH

MODEL OUTLINE FOR SPEECH

The following outline is provided as a model for developing a speech. Every talk you give should be directed specifically to the level of interest and level of commitment of your audience. Before you develop your speech you must make one key determination: What is the purpose of your speech? That purpose must fit into one of two general catagories, 1) to persuade or 2) to inform. Once you determine your key purpose, putting a speech together will make a lot more sense.

OUTLINE

PURPOSE: TO INFORM

INTRODUCTION: Should get people's attention and preview speech.

"Did you know that high blood pressure in children could be caused by excessive noise?.....

I'd like to share with you some information on the health effects of noise....."

PROBLEM: Should identify the problem and layout the causes of the problem.

"The problem is that excessive noise levels can have an adverse effect on everyone's health from an unborn baby to a senior citizen.

Let me review some of the major known and suspected adverse effects of noise on our health."

POSSIBLE SOLUTIONS: After outlining the major problems, this section should identify some of the various solutions or options available to help resolve the problem.

"The problem is a serious one but I don't want to paint too bleak a picture. There are things that we can do to reduce the health hazard of excessive noise and I'd like to mention some of them to you...."

CONCLUSION: Should review major points in the speech and end on a strong note.

"Before I conclude, let me review some key reasons why noise is a serious health hazard

A. ----------

B. ----------

C. ----------"

APPENDIX G

BIBLIOGRAPHY

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"Noise Abatement and Control," Departmental Policy, Implementation Responsibility and Standards, Circular 1390.2, August 4, 1971, U.S. Department of Housing and Urban Development, Washington, D.C.

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"Basic Users' Guide for the Integrated Noise Model, Version 1," Federal Aviation Administration, 1978, Washington, D.C.

"Policies and Procedures for Considering Environmental Impacts," Federal Aviation Administration Order 1050.1B, January 1977.

"Noise Control Plans," Federal Aviation Administration Order 1050.11, 1977.

"Airports: Land Use Compatibility Planning," Federal Aviation Administration Advisory Circular 150/5050-6, 1977.

APPENDIX H

THE EAR...AND HOW IT LETS YOU HEAR

APPENDIX H

THE EAR...AND HOW IT LETS YOU HEAR

The Middle Ear

The ear is made up of three parts--outer, middle and inner ear. The only function of the outer ear is to collect sounds. Hearing, and consequently, hearing improvement, takes place in the middle ear or the inner ear.

At the end of the auditory canal is a thin membrane called the eardrum. Just inside the eardrum is a small cavity called the middle ear--containing three small bones called the "hammer," the "anvil," and the "stirrup." Sound vibrations coming through the auditory canal vibrate the eardrum. These vibrations are then passed from one bone to another--the stirrup finally setting up vibrations in the fluid of the inner ear. These vibrations stimulate nerves which transmit sound to the brain.

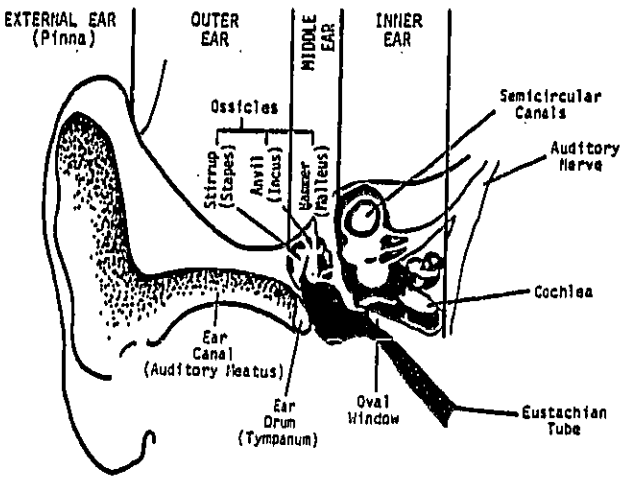
The Inner Ear

Most of what we call hearing takes place in the inner ear. When the stirrup sets up waves in the fluid of the inner ear, thousand tiny organs that look and act like piano keys go to work. Their vibrations pass to tiny hairs which lead to a nerve that goes to the brain.

Actual Hearing

Not until the brain has received the message from the stimulated nerve and has interpreted it, do we actually hear. It is the function of the brain to take the stimulation and to tell us what the sound means. Of course, all of these steps take place almost instantaneously.

Unless the part of the brain called the "auditory memory center" is out of practice due to some hearing impairment, sound becomes meaningful the moment it is heard.


EXTERNAL EAR
(Pinna)
OUTER
EAR
MIDDLE
EAR
INNER
EAR
Ossicles
Stirrup
(Stapes)
Anvil
(Incus)
Hammer
(Malleus)
Semicircular
Canals
Auditory
Nerve
Cochlea
Ear
Canal
(Auditory Meatus)
Ear
Drum
(Tympanum)
Oval
Window
Eustachian
Tube

MAIN TYPES OF HEARING LOSS...CONDUCTIVE, SENSORI-NEURAL; CENTRAL

When sound waves are not conducted adequately to the inner ear, all sounds seems to be muffled, and the person's hearing loss is called CONDUCTIVE. The cause may be an obstruction in the auditory canel--an accumulation of wax, perhaps, or a blockage caused by swelling and pus.

Occasionally, with children, doctors find a marble or a bean, and not rarely, with adults, a forgotten wad of cotton. (Only on direct orders from your doctor should you ever put cotton in the ear, and only then a large piece that cannot possibly get lost in the ear canal). Much more commonly the trouble in conductive hearing loss occurs in the middle ear, and again swelling and pus are one cause of hearing loss.

If sound waves do reach the inner ear but are not properly converted into a message that can be passed on to the brain, the loss is called SENSORI-NEURAL (sensory-neural) or neuro-sensory. Other terms are NERVE DEAFNESS and PERCEPTIVE DEAFNESS. A person with such a loss generally hears low-pitched tones better than high ones. Sounds are often distorted.

Many persons with poor hearing have MIXED loss--a combination of conductive and sensori-neural impairments.

Sometimes the trouble lies beyond the ear. The signals from the ear may not be reaching the brain because of trouble along the cochlear nerve, or the brain may not be properly interpreting them. Persons affected in such a way are said to have a CENTRAL hearing loss. They may hear speech but have difficulty understanding it.

THE PROCESS OF SPEECH

Whenever you converse with someone you receive and produce sound. In order to understand what can be involved in a communication disorder, it helps to know a little about sound itself and how it is processed.

Sound is produced whenever something starts a chain reaction of particles bumping against each other. Strike the head of a drum and you start it vibrating, moving in and out. Molecules of air surround the drum. As the drumhead bulges out, it shoves against the nearest air molecules. They in turn move out and bump their neighbors, then move back toward the drumhead. These neighbor molecules bump their neighbors in turn and so the chain of bumps continues out into space.

No individual molecule moves back and forth very far from its original position, but the bumping action itself shoots out from the drumhead travelling at about 1000 feet per second. This moving disturbance is called a sound wave.

The faster the drumhead vibrates, the more frequently each air molecule gets and gives a bump, and the higher the frequency of the sound. Frequency is measured in cycles, or number of vibrations, per second (cps). A high-pitched sound has a higher frequency than a low-pitched sound. Middle C on the piano has a frequency of about 250 cps; the highest note on the piano, also a C, has a frequency of about 4000 cps. The harder you strike the drumhead, the greater the intensity of the sound produced. The greater the intensity, the louder the sound seems.

Simple sounds of a single frequency are rare. Most sounds, like speech sounds, have several different frequencies. Certain physical phenomena complicate sounds. Reflection occurs when a moving sound wave bumps against some barrier, like a wall, and is reflected in another direction. Another phenomenon, resonance, occurs as a sound is passed through a column of air. The shorter the length of the air column, the higher the pitch of the sound.

In speaking, your own air column changes shape as you produce a sound. This column is really a long tube which starts at the lungs and continues upward through the windpipe to the larynx. Above the larynx is the section called the vocal tract, containing the throat and branching into the nose and mouth.

The vocal cords, located in the larynx, act as a valve for air from the lungs used in speaking. When the vocal cords rapidly open and shut, a column of vibrating air making a humming sound results. The faster the vibrations, the higher the frequency of the resulting hum. A change in the length and shape of the vocal tract alters the humming sound coming from the vibrating cords.

The part of the tube called the mouth can change its shape more than any other section of the vocal tract. The lips change the length and shape of the tract by rounding, spreading, or closing briefly to interrupt the air flow. The teeth can reduce or stop the flow when placed close to the lips, as in the sound V, or when brought close to the tongue tip, as in TH. The tongue is the most flexible portion of the mouth and can move backward, forward, up and down. Parts like the tip and center can move independently of the rest. Changing the shape of the vocal tract to produce different sounds is called articulation and a highly skilled exercise it is.

"The word 'church' requires 20 different adjustments of the lips, tongue, larynx, and jaws," according to Dr. Spencer F. Brown, formerly of Yale University. "These adjustments must occur in correct sequence and must be made precisely. Yet the word requires less than a quarter of a second to speak, which means that the average time available for each of the 20 necessary movements is barely over one hundredth of a second."

It is easy to see why a child with poor muscle coordination has trouble making himself understood. The same is true for the child born with a leak between his nose and mouth cavaties due to a cleft palate, which is a hole in the roof of the mouth. The essential organ for mastering articulation is not the vocal tract at all, but the ear. Unless a child can detect the differences in speech sounds, he cannot learn to make them himself.