NILECJ-GUIDE-0101.00 April 1976

NATIONAL INSTITUTE OF LAW ENFORCEMENT AND CRIMINAL JUSTICE
LAW ENFORCEMENT ASSISTANCE ADMINISTRATION
UNITED STATES DEPARTMENT OF JUSTICE

Selection Guide to HEARING PROTECTORS for use on FIRING RANGES

A USER GUIDE FROM THE NATIONAL INSTITUTE OF LAW ENFORCEMENT AND CRIMINAL JUSTICE

NATIONAL INSTITUTE OF LAW ENFORCEMENT AND CRIMINAL JUSTICE

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ACKNOWLEDGMENTS

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HEARING PROTECTORS
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FOREWORD

Following a Congressional mandate* to develop new and improved techniques, systems, and equipment to strengthen law enforcement and criminal justice, the National Institute of Law Enforcement and Criminal Justice (NILECJ) has established the Law Enforcement Standards Laboratory (LESL) at the National Bureau of Standards. LESL's function is to conduct research that will assist law enforcement and criminal justice agencies in the selection and procurement of quality equipment.

In response to priorities established by NILECJ, LESL is (1) subjecting existing equipment to laboratory testing and evaluation and (2) conducting research leading to the development of several series of documents, including national voluntary equipment standards, user guidelines, state-of-the-art surveys and other reports.

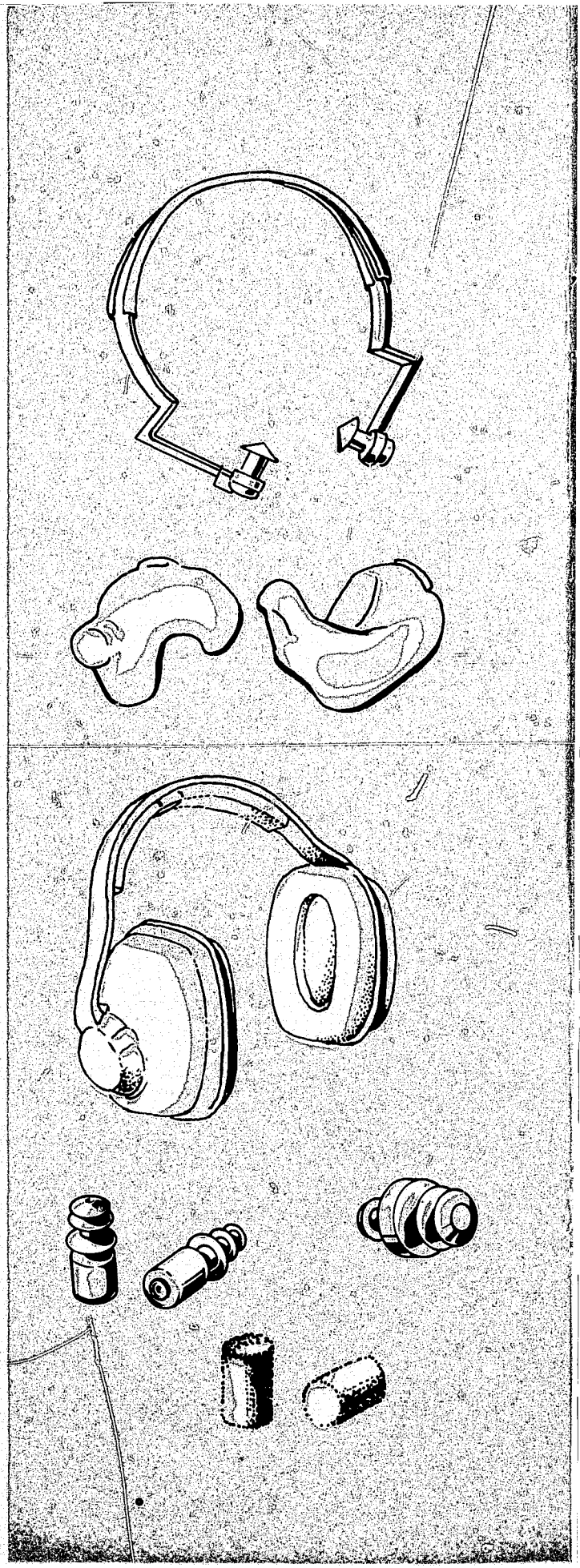
This document, NILECJ-GUIDE-0101.00, *Selection Guide to Hearing Protectors for Use on Firing Ranges*, is a law enforcement equipment guideline prepared by LESL and issued by NILECJ. Additional guides as well as other documents are being issued under the LESL program in the areas of protective equipment, communications equipment, security systems, weapons, emergency equipment, investigative aids, vehicles and clothing.

Technical comments and suggestions concerning the subject matter of this guide are invited from all interested parties. Comments should be addressed to the Program Manager for Standards, National Institute of Law Enforcement and Criminal Justice, Law Enforcement Assistance Administration, U.S. Department of Justice, Washington, D. C. 20531.

Lester D. Shubin
Program Manager for Standards
National Institute of Law Enforcement and Criminal Justice

*Section 402 (b) of the Omnibus Crime Control and Safe Streets Act of 1968, as amended.

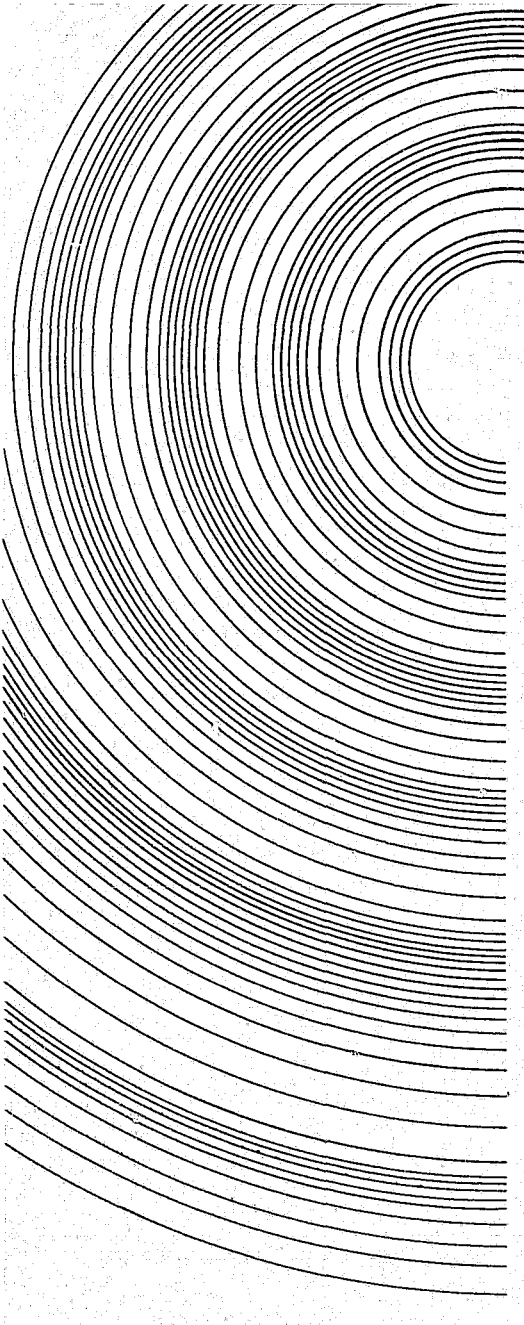
INTRODUCTION



Anyone who shoots a gun should wear hearing protectors while doing so because the gunfire noise can be deafening. Yes, gunfire noise can cause both permanent and temporary hearing damage. So often the shooter becomes aware of this fact only after it's too late. Stuffing cotton or empty cartridge cases into your ears gives practically no protection against the hazard; there is no substitute for good hearing protectors.

- What should you look for when buying hearing protectors?
- Of the many brands, types, and styles, are there some that give better protection than others?
- What kind of protection is needed?

In this guide we consider some characteristics of gunfire noise and how they affect hearing; we discuss the different types of hearing protectors currently available and attempt to provide answers to some of the questions that arise when selecting hearing protectors for use on the firing range.



SOME FACTS ABOUT GUNFIRE NOISE

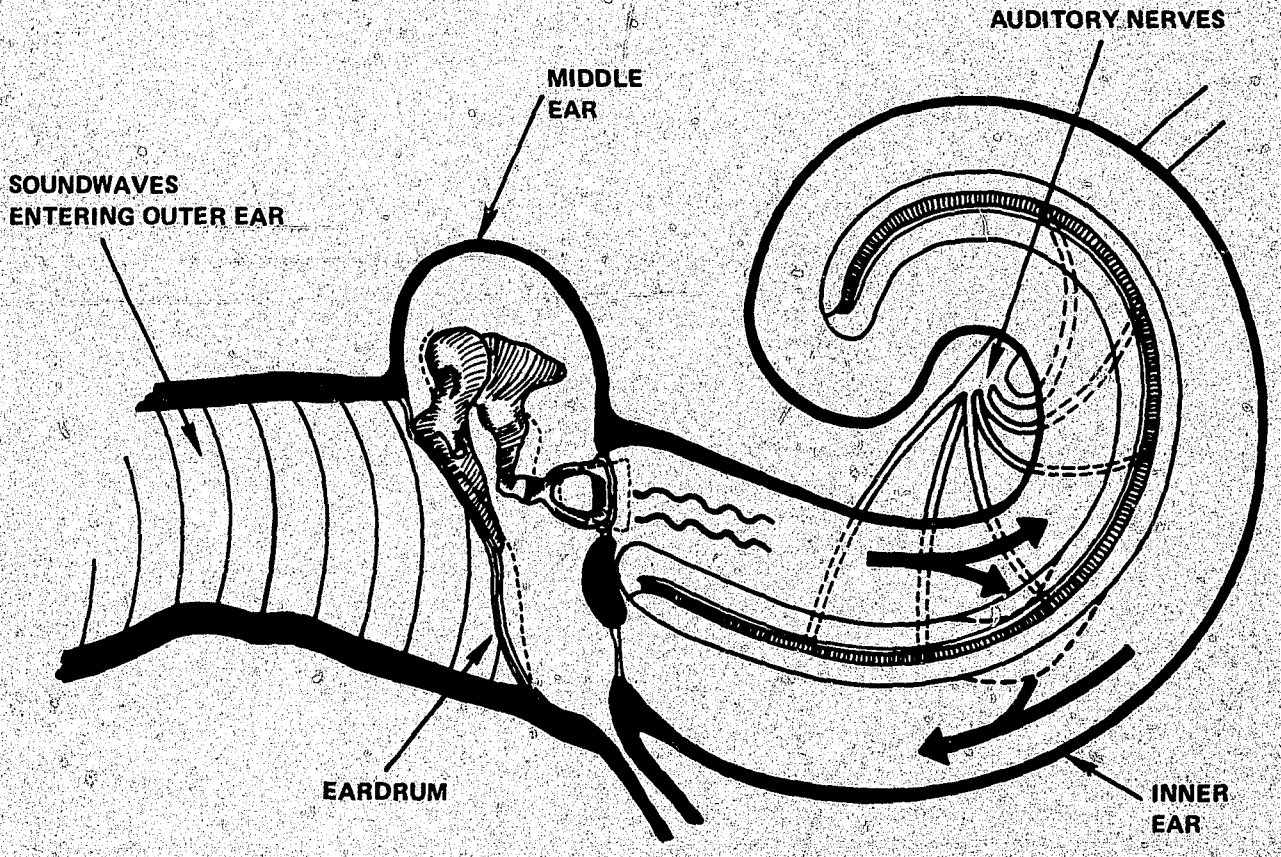
A little insight into the type of noise produced by gunfire may provide some basis for judgment in selecting a good hearing protector.

The discharge of small arms is a source of impulsive noise, and exposure to this kind of noise can cause an irreversible loss of hearing. In fact, exposure to sounds much less intense than gunfire noise may cause a gradual loss over a period of time. Since the process is rarely painful, this type of hearing loss may pass unnoticed at first. The question naturally arises: How loud must the noise be to cause damage?

Sound is heard as the result of rapid variations in the pressure of air in the outer ear. Air is compressed, resulting in higher pressure; this is followed by a period of low pressure, and then by a period of higher pressure, etc. The eardrum moves along with these changes in pressure and this moves tiny bones in the middle ear; the inner ear converts these mechanical motions into nerve impulses which are transmitted to the brain. The tone or pitch of the sound is determined by the frequency of these air pressure variations or pressure waves and is measured in hertz (Hz) or cycles per second. Impulsive noise is the result of a sudden change to high pressure followed by a less rapid return to lower pressure and contains many different frequencies.

Sound pressure is normally measured in decibels (dB). The decibel is a mathematical expression containing the ratio of a measured pressure to some reference pressure and, so defined, is actually a unit of the relative loudness of sound.

Relative loudness is measured using a scale on which the level of zero decibels (0 dB) is assigned to the lowest level of sound the human ear can detect--the so-called threshold of hearing. On this scale, a subway or a noisy street has a relative loudness of 90 dB, and the discharge of a 12 gauge shotgun will produce a relative loudness of 150 to 160 dB, depending on barrel length.


AUDITORY NERVES
MIDDLE EAR
SOUNDWAVES ENTERING OUTER EAR
EARDRUM
INNER EAR

SOME FACTS ABOUT GUNFIRE NOISE

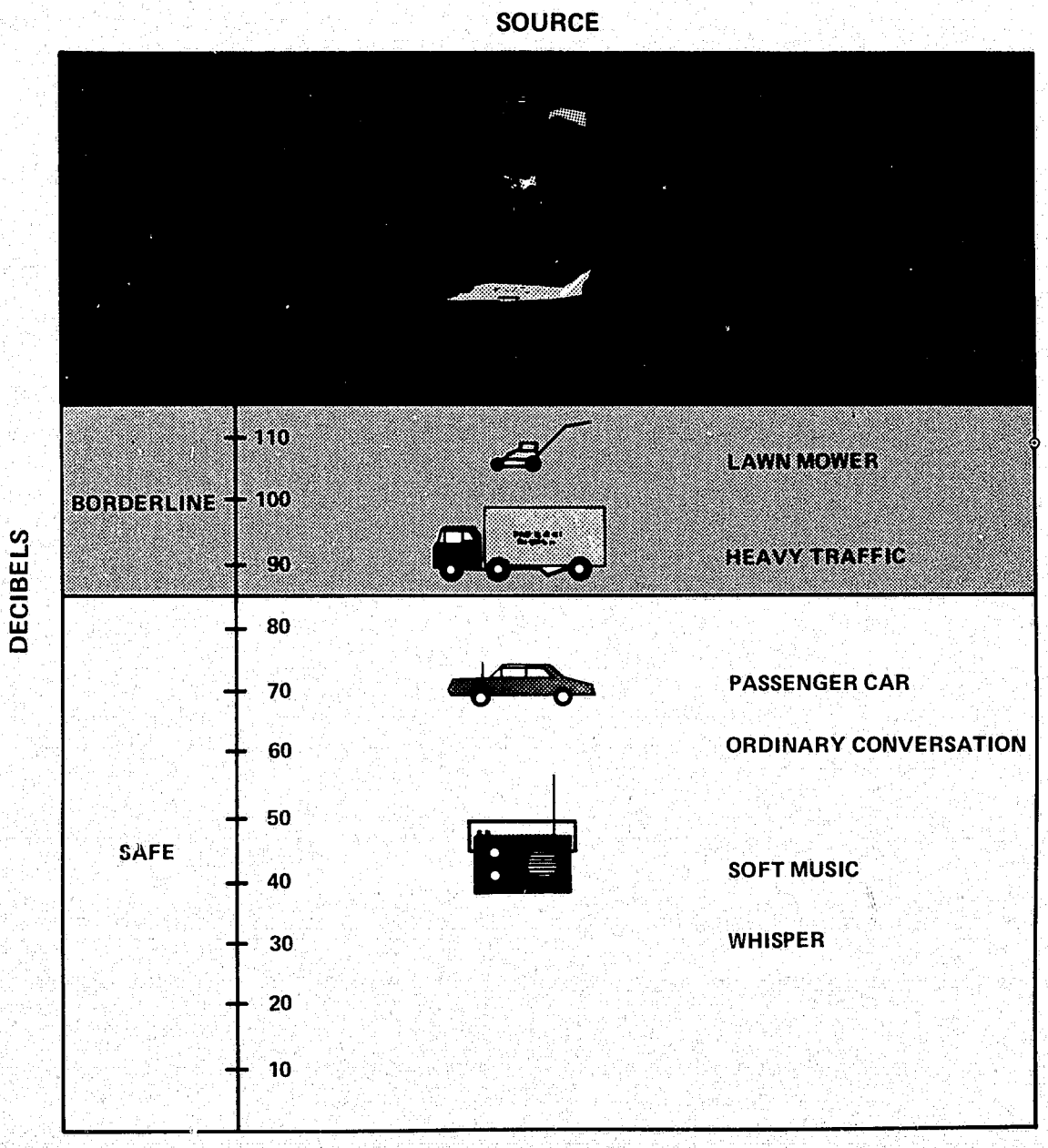
(continued)

The noise produced by gunfire is much the same as other noise in its potential to produce hearing damage. The hazard from gunfire noise depends on several characteristics of the noise, such as the relative loudness and the duration of individual pulses. It also depends on such factors as the number of noise pulses in an exposure period and the individual sensitivity of one's ears. But it is the peak sound pressure level, the loudness, that is most important and is therefore the characteristic guarded against by the use of the hearing protector.

The maximum sound pressure level that can be tolerated by the unprotected ear without danger of hearing damage differs widely among individuals. However, certain maximum levels have been proposed. The Occupational Safety and Health Act (OSHA) of 1970 has set maximum permissible noise levels and exposures in the workplace and explains the types of corrective action which must be taken if these levels are exceeded. Among other requirements, it states that no employee may be exposed to noise levels exceeding 140 dB for any period of time without adequate hearing protection. This Act covers all employees in private industry and in Federal agencies. State and local governmental agencies may comply with the Act if they choose to. It also includes employees of public agencies within some state governments. The OSHA legislation covers all noise, both continuous and impulsive.

In July 1968, the Committee on Hearing, Bioacoustics, and Biomechanics of the National Academy of Sciences–National Research Council (CHABA) proposed a Damage-Risk Criterion for gunfire noise. The criterion consists of giving the maximum safe peak pressure level, in dB, for a given duration of the noise pulse; above these levels you should wear hearing protectors. Because the overall shape and duration of the noise pulse is taken into consideration, peak pressure levels in excess of 140 dB are considered safe by CHABA when the noise pulse is of very short duration.

The latest word on maximum permissible impulsive noise levels has come from the U.S. Environmental Protection Agency (EPA). The EPA recommendations (1974) modify the CAHBA Criterion (1968) by lowering them by 12 dB.


SOURCE
DECIBELS
110
100
90
80
70
60
50
40
30
20
10
BORDERLINE
SAFE
LAWN MOWER
HEAVY TRAFFIC
PASSENGER CAR
ORDINARY CONVERSATION
SOFT MUSIC
WHISPER

SOME FACTS ABOUT GUNFIRE NOISE

(continued)

PEAK PRESSURE LEVELS OF SOME SELECTED FIREARM-CARTRIDGE COMBINATIONS*

FIREARM	BARREL LENGTH (mm)	BARREL LENGTH (inches)	CARTRIDGE†	PEAK PRESSURE LEVEL (dB)	DISTANCE FROM WEAPON'S MUZZLE (meters)	DISTANCE FROM WEAPON'S MUZZLE (feet)	CHABA (1968) RECOMMENDED MAXIMUM‡	EPA (1974) RECOMMENDED MAXIMUM‡
9 mm automatic	102	4	9 mm, 115 gr., FMJ	158	0.4	1.3	157	145
357 Magnum revolver	165	6 1/2	38 Special, 158 gr., lead	157	0.20	0.66	159	147
357 Magnum revolver	165	6 1/2	357 Magnum, 158 gr., lead	166	0.25	0.82	154	142
45 automatic	108	4 1/4	45 ACP, 230 gr., FMJ	163	0.28	0.92	154	142
41 Magnum revolver	165	6 1/2	41 Magnum, 210 gr., lead	167	0.28	0.92	154	142
44 Magnum revolver	213	8 3/8	44 Remington Magnum, 240 gr., lead	171	0.5	1.64	157	145
22 rifle	559	22	22 LRHV, 40 gr., lead	144	1.3	4.26	159	147
12 gauge shotgun	762	30	3-3/4 dr. equiv., 1-1/4 oz., lead shot	154	1.6	5.25	157	145
22 revolver	152	6	22 LRHV, 40 gr., lead	150	0.23	0.75	157	145
22 revolver	152	6	22 short blank, extra loud	142	1.2	3.94	164	152

*This table is adapted from *Noise of Police Firearms*, by P.G. Weissler, et al., J. Acoustical Soc. Am., 56, 1515 (1974).

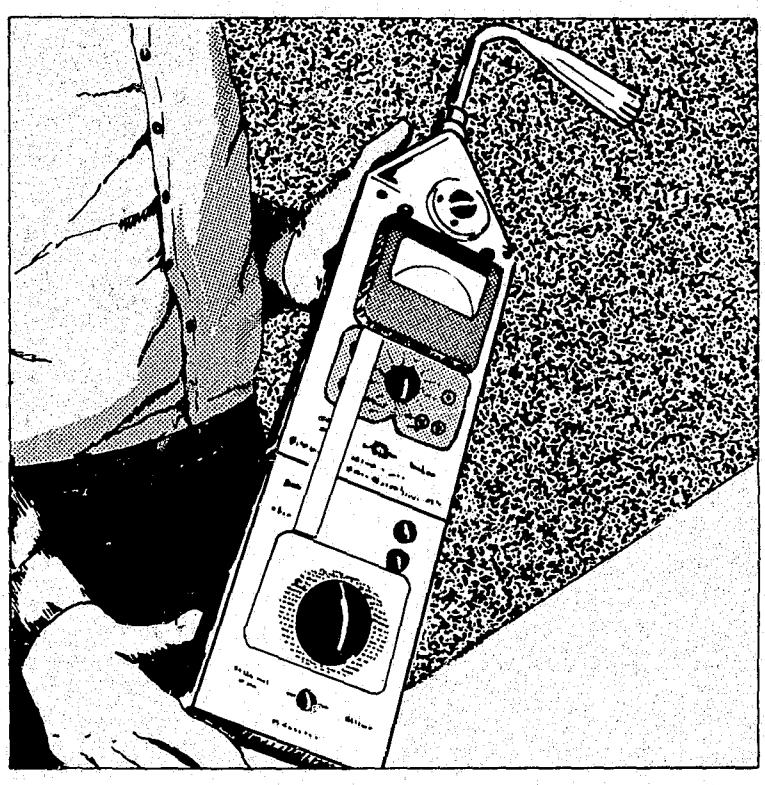
†The following abbreviations are used: FMJ - full metal jacket; LRHV - long-rifle high velocity; dr. equiv. - dram equivalents of black powder; ACP - automatic Colt pistol; gr. - grains.

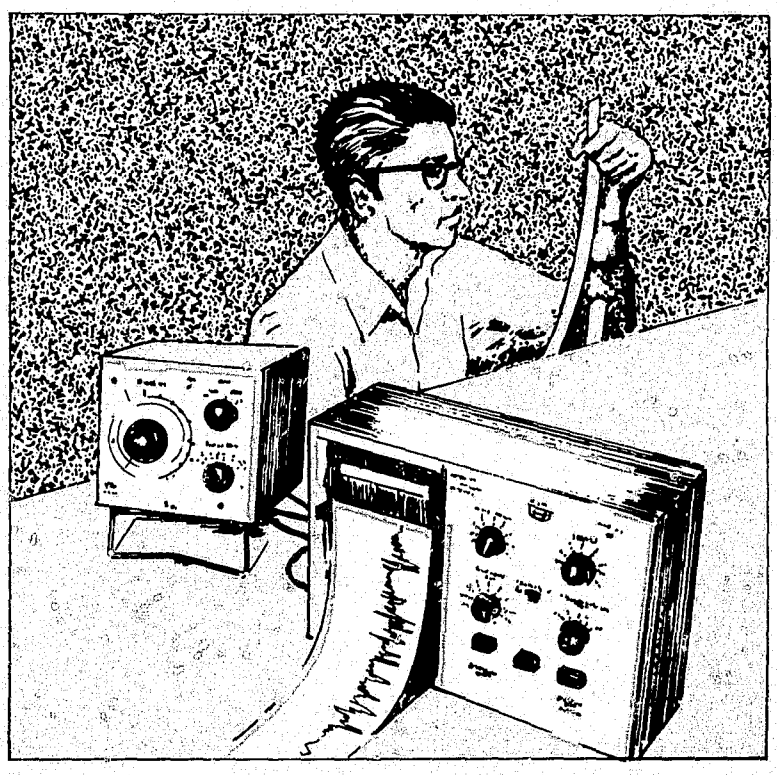
‡The last two columns refer to a daily exposure of 100 rounds.

What does all of this mean for the shooter? In an effort to answer this question, a study was recently conducted at the National Bureau of Standards in which the peak pressure levels and pulse durations of nine small arms commonly used by law enforcement personnel were measured. The results are shown in the table. Measurements were made in the laboratory and on indoor and outdoor firing ranges. It was found that the peak pressure levels close to the shooter's more vulnerable ear (the ear closer to the weapon muzzle) ranged from 142 dB to 171 dB. The quietest gun was a 22-caliber rifle with a 22-inch barrel. The noise pulse shapes and durations were such that most weapons tested exceeded the EPA recommended levels and, of course, all exceeded the 140-dB OSHA maximum. This was the case whether on the outdoor range or the indoor range and even when the indoor range was equipped with sound-absorbing shooting stalls.

The measurements of pulse shapes and durations were further analyzed for the caliber 22, 38 Special, and 357 Magnum revolvers to find out how the sound energy was distributed among the various frequencies. It was discovered that most of the energy was concentrated in the 1500- to 3000-Hz band for each of these weapons. This implies that hearing protectors for use on firing ranges should provide adequate attenuation of the noise over the same frequency region.

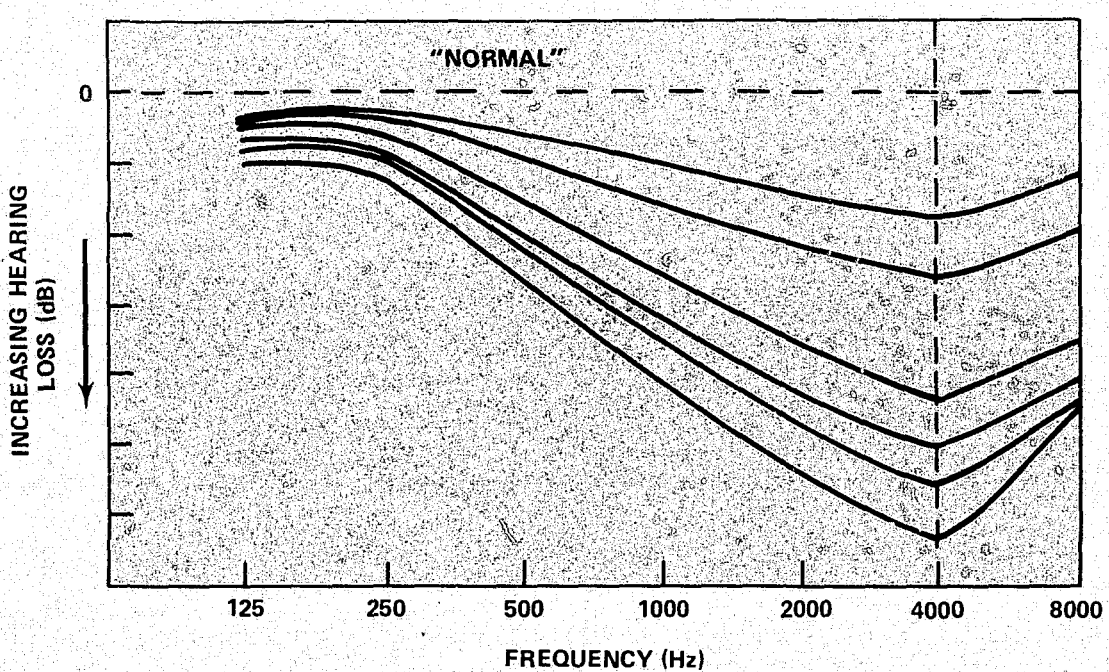
If specially trained personnel and equipment are not available to measure the loudness and duration of a particular gun-cartridge combination fired at a particular place, then it should be assumed that the peak sound pressure level is greater than 140 dB, the maximum OSHA-recommended exposure level.





THE NATURE OF GUNFIRE-INDUCED HEARING DAMAGE

TYPICAL AUDIOGRAMS OF HEARING LOSS

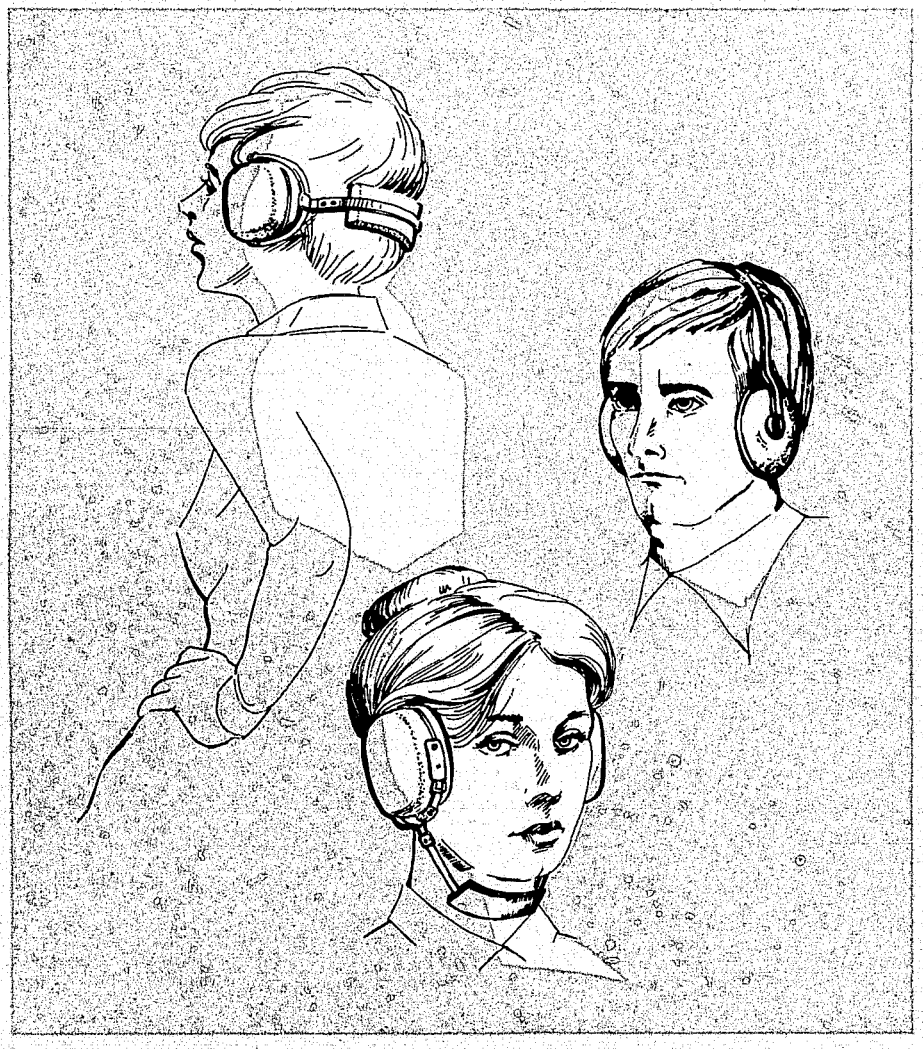


Noise-induced hearing loss may be temporary or permanent. Permanent loss is usually the result of damage to the inner ear and there is no known cure. Hearing aids cannot completely solve the problem of noise-induced hearing loss.

In general, noise causes more loss of hearing for high-pitched tones than for low-pitched tones. Most of the early damage affects hearing above the pitch range important to the understanding of speech; that is, above 2000 Hz. That's why early damage is seldom noticed by the individual. The only way to detect this early damage is through an examination by a physician or an audiologist. Regular hearing checks for people regularly exposed to a noise hazard are extremely important, since continued exposure results in more and more hearing loss. Don't wait until you have permanently lost part of your ability to hear and understand speech!

In most cases where gunfire noise is part of a person's job, its loudness cannot be reduced to a safe level by such means as "sound treatment" of the walls. And, since it is illegal to silence any gun, the shooter and anyone else exposed to gunfire noise must take personal protective measures--they should obtain hearing protectors, and wear them.

CHOOSING THE PROPER PROTECTOR



Hearing protection need not be costly, while having no protection at all can be very costly. There are over thirty brands of hearing protectors now available in the United States, and many manufacturers make several different types, in a range of prices. Ideally, one would like to test the ability of each of these devices to attenuate noise and then choose the best one. However, other practical considerations such as durability, cleanability, comfort, and price are also important. There is no one hearing protector that is "best" for everybody; yet some are obviously better choices than others. The prime consideration in choosing a hearing protector is its ability to attenuate noise to a safe level, and this ability is directly related to the construction of the protector and the fit or seal which can be obtained.

TYPES OF HEARING PROTECTION DEVICES

Of the three basic devices, earplugs, earmuffs, and helmets, the plugs and muffs are by far the most popular; the helmet may be regarded as simply a special kind of muff.

EARPLUGS

Earplugs are devices that fit into the ear. There are three kinds: pre-molded, custom-molded, and formable. The main problem with the pre-molded kind concerns their ability to fit the variety of shapes and sizes of ear canals. A "universal fit" is difficult to achieve. Some pre-molded plugs come in a range of sizes and care must be taken in choosing the proper size; some people even take a different size in each ear. Other brands rely solely on the flexibility of the plug to achieve an adequate seal.

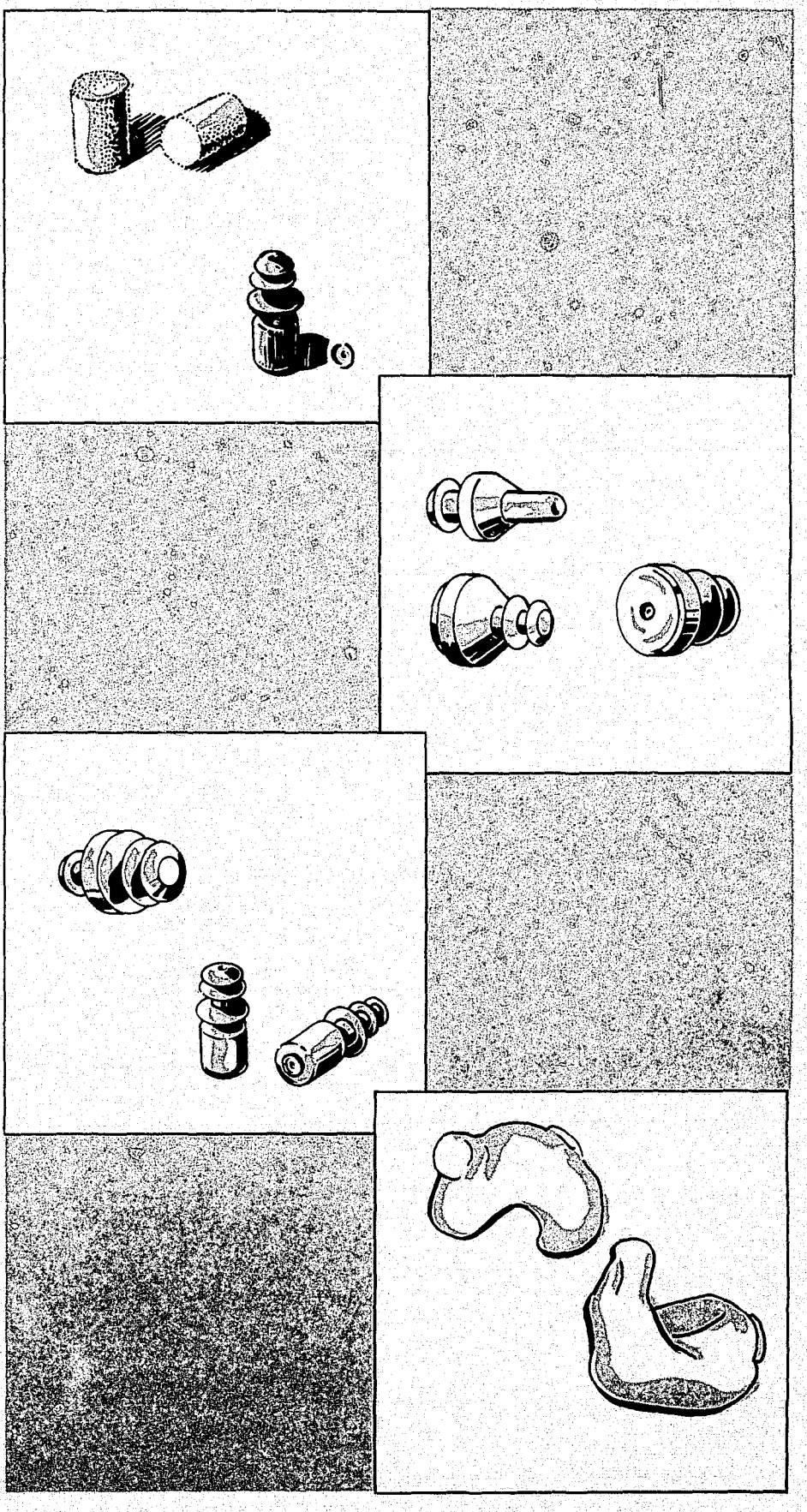
It is time-consuming and therefore more expensive to make custom-molded plugs, and if they are lost, the replacement must again be custom-molded. Formable, putty-like plugs will fit any size ear canal, but usually have to be thrown away after one or two wearings. This can be expensive.

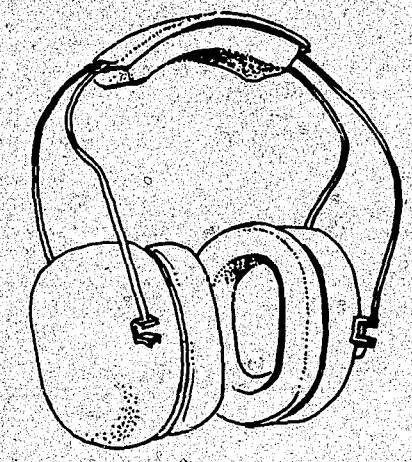
It is very important that the individual plug fits and remains seated properly, or too much noise will leak around it. In order for the earplug to work well, it must fit snugly. That can be uncomfortable. For this reason, a compromise between hearing protection and comfort may have to be made when using this type.

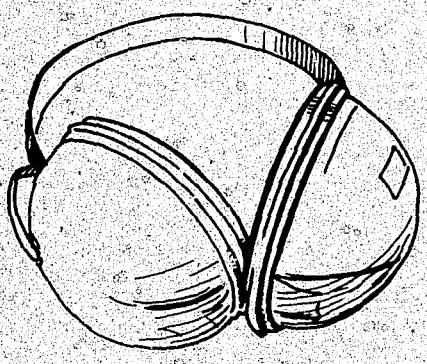
Earplugs can be unseated due to sudden motion of the head, chewing, or yawning. Aging of earplugs is another problem; they can shrink and change shape with time. The rate of aging is affected by such things as exposure to earwax, humidity, and perspiration.

Some insert devices may contain a long solid core made of aluminum or hard plastic. These should be considered unsafe because of the possibility of the device being pushed deeply into the ear canal and penetrating the eardrum.

Earplugs may not be wearable when there is an irritation or infection in the ear.







EARMUFFS

Earmuffs are usually made in one size, which fits most people satisfactorily. As with earplugs, a good seal is essential. Nearly all muff seals are made of a soft material filled with either foam, sponge, liquid, or air. Perspiration and skin oil will eventually spoil the ear seal, and it will have to be replaced. If a liquid or air-filled seal is punctured, it should also be replaced.

The spring action of the earmuff headband is very important in getting a good seal. Generally, as you increase the pressure against your head, you improve the sound attenuation of the muff. You should never bend the spring so that it "feels comfortable," since this will reduce the protection you get from the earmuff.

Earmuffs are supposed to be adjustable to most head shapes and sizes; to do this they should swivel in three directions. Some models, however, adjust in only two directions. Some people cannot get a comfortable fit from these, while still getting good protection. You should check such muffs carefully to see that they work well for you.

Earmuffs are less effective when worn with glasses. Thin wire temples on glasses frames cause less of a leak than thick plastic temples. If you must wear eyeglasses, use a piece of foam-latex or similar material to cover the temples. This will help give you a better seal and improved ear protection.

We have made a list of the pros and cons to help you select the type of hearing protectors most suitable to your needs. The list is shown on the following page.

For your convenience, we have also compiled a list of manufacturers of hearing protectors together with information on the effectiveness of the various models in attenuating sound at various frequencies. These data have been gathered from several sources, yet the test method used to obtain the sound attenuation values is the same. For most of the models listed, the attenuation values are averages of the several measurements.

You can use this table as follows: Under the given test frequency, you will find the amount by which noise of that frequency was attenuated for each of the hearing protectors listed. For example, if you were firing a caliber 357 Magnum revolver without hearing protectors you would be exposed to noise with a sound pressure level of approximately 166 dB. Wearing a muff-type hearing protector which will attenuate this 166 dB by 44 dB at 2000 Hz means that you will be exposed to no more than a 122-dB noise level at 2000 Hz when properly wearing such a muff. This type of attenuation data is also available from most manufacturers, either from their advertisements or in the information they supply with the hearing protectors they sell.

Remember, the most important consideration in choosing your hearing protector is that of being able to obtain a good seal. Hearing protectors made from the best noise-attenuating materials available will not be a good choice if some other factor, such as comfort or the need to wear eyeglasses, prevents you from obtaining an adequate seal.

THE PROS AND CONS OF PERSONAL EAR PROTECTION*

EARPLUG	EARMUFFS
To receive good protection and comfort requires a choice of styles and sizes of many ear plugs. Ear canals vary in diameter (from about 3 to 14 mm) and left and right canals may not be the same size or shape. Putty-like, disposable plugs, however, should fit all ears.	No complex fitting problems--one size fits most adults. Anyone can put them on and get a fair degree of noise reduction after a little instruction in their use. Headband tension must be adjusted individually.
Earplugs are easily carried and stored. They can just as easily be left in the "other" suit of clothes, lost from a pocket, or dropped while being placed in the ear.	Earmuffs are bulky and can't fit in a pocket.
A major advantage of earplugs is that they can be used with glasses, earrings, any hair style, and any type of hat without affecting their performance.	Earmuffs may not seat properly when glasses, hearing aids, or other personal items are worn.
Properly seated earplugs cannot be seen at a distance. In addition, supervisors must be trained to recognize the appearance of a properly seated earplug at a glance.	Earmuffs can be seen at a distance, so that a supervisor can easily tell if his men are wearing ear protection.
Earplugs can be worn only in healthy ears.	Earmuffs can be worn in spite of minor ear infections.
Earplug comfort does not depend much on the air temperature.	Earmuffs are warm and comfortable when it's cold; heat and perspiration make them uncomfortable when it's hot.
Earplugs can be cleaned easily with soap and water.	The ear cushions of muffs cannot be washed as easily as plugs. Soap, warm water, and a soft brush must be used to remove skin oil and dirt.
Earplugs are less expensive than muffs. Disposable plugs are less expensive per item, but if used frequently, they can be more expensive than earmuffs in the long run.	Earmuffs cost more than earplugs.

*The pros and cons of personal ear protection are adapted from *Industrial Noise Manual*, 2nd Edition, published by the American Industrial Association, 14125 Prevost, Detroit, Michigan 48227.

SOME QUESTIONS TO ASK YOURSELF BEFORE BUYING HEARING PROTECTORS

1. Does the protector provide an effective seal?
2. Does the protector provide adequate attenuation over the important frequency range?
3. Does the protector fit comfortably and securely?
4. Does the manufacturer adequately describe the protector's performance on the firing range?
5. Is the protector easy to maintain and clean?
6. Are parts which are subject to wear easily replaced?
7. Can it be adequately tested prior to purchase?
8. Does the manufacturer reference the current NILECJ standard?*
9. Can the protector be purchased in needed quantities?
10. Is the protector reasonably priced?

*NILECJ-STD-0102.00, Hearing Protectors for Use on Firing Ranges, U.S. Government Printing Office, Washington, D.C. 20402, Stock No. 2700-00182, Price: $0.50, or current revision.

ATTENUATION CHARACTERISTICS OF SELECTED PROTECTORS

Manufacturer	Model	Type	Attenuation (dB) at Selected Frequencies								
			125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	3000 Hz	4000 Hz	6000 Hz	8000 Hz
Adco Mold, Div. of Trend, Incorporated 1558 California Street Denver, Colorado 80202	Adco Mold Custom Earpiece	Plug	19	21	23	26	32	40	43	41	39
American Optical Co. Safety Products Div. Cambridge, Massachusetts 01550	Hear-Guard Earplug	Plug	24	21	23	29	30	35	31	29	27
	1200	Muff	11	21	31	44	43	47	41	37	33
	1220	Muff	13	21	33	42	42	42	37	35	32
	1275	Muff	7	14	25	35	38	44	38	35	28
	1600A	Muff	7	11	23	32	34	36	40	34	35
	1675A	Muff	10	16	25	34	34	36	41	34	31
	1700	Muff	12	21	29	40	40	42	41	44	33
	1701	Muff	8	19	28	40	39	42	41	34	30
Babbitt Industries, Div. of American Safety Equipment Corp. Santa Clara, California 95050	Mark 1 Earplug	Plug	18	20	30	30	34	36	35	45	41
Bilsom International Inc. 1930 Isaac Newton Square, East Reston, Virginia 22090	Bilsom Propp	Plug	10	13	17	21	33	38	39	36	34
	Type UL	Muff	12	18	28	36	44	45	44	37	28
	Type UF	Muff	9	14	28	38	40	43	47	44	42
E. D. Bullard Co. 2680 Bridgeway Sausalito, California 94965	500	Muff	14	20	31	45	42	44	39	31	30
David Clark Co., Inc. P. O. Box 155 Worchester, Massachusetts 01604	9 AN/Y	Muff	22	29	40	42	38	41	35	33	33
	10A	Muff	15	22	32	42	43	45	47	40	32
	19A	Muff	18	27	39	43	41	43	39	36	29
	E105	Muff	15	22	33	45	44	50	50	29	34
	E195	Muff	20	28	42	47	43	49	42	37	34
	E800	Muff	12	21	30	39	43	44	48	39	32
	E805	Muff	12	20	30	39	41	43	46	38	33
	115	Muff	16	23	34	44	39	42	40	35	39
	117	Muff	15	23	38	40	39	41	39	39	41

ATTENUATION CHARACTERISTICS OF SELECTED PROTECTORS (continued)

Manufacturer	Model	Type	Attenuation (dB) at Selected Frequencies								
			125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	3000 Hz	4000 Hz	6000 Hz	8000 Hz
H. E. Douglass Engineering Sales Co. P.O. Box 7209 Burbank, California 91505	Sound Sentry 500A 500B 500W	 Plug Plug Plug	 20 23 22	 18 22 19	 16 19 17	 19 26 21	 30 35 32	 33 37 36	 30 37 33	 27 34 34	 24 29 30
Environmental Acoustical Research P.O. Box 2146 Boulder, Colorado 80302	E.A.R. Sound Suppressors	Plug	26	28	28	35	36	43	44	46	45
Fibre-Metal Products Co. 5th & Tilghman Streets Chester, Pennsylvania 19016	2011 2030	Muff Muff	12 5	13 4	19 5	28 13	39 26	39 35	38 40	35 39	31 33
Flents Products Co., Inc. 103 Park Avenue New York, New York 10017	Anti-Noise Ear Stopples Quiet-Down Anti-Noise Earplug Silaflex Anti-Noise Ear Protector Impregnated Cottin Silenta Earmuff	Plug Plug Plug Plug Muff	22 9 17 24 8	22 17 18 23 13	24 21 21 24 23	27 25 26 27 35	32 30 33 39 36	40 41 42 41 43	40 43 43 42 39	40 37 36 36 36	36 35 35 33 30
French Laboratory 1948 Marconi Avenue Sacramento, California 95815	Soundown (normal length) Soundown (deep canal)	Plug Plug	21 24	23 25	26 27	31 32	35 37	42 42	39 41	39 38	34 37
Frontier Industrial Products 3521 Sunset Blvd. Los Angeles, California 90026	Anti-Noise Earplugs	Plug	18	22	22	28	29	38	36	36	37
General Electric Co. 1 River Road Schenectady, New York 12305	Pacemaker	Plug	18	16	18	20	36	40	44	40	35

ATTENUATION CHARACTERISTICS OF SELECTED PROTECTORS (continued)

Manufacturer	Model	Type	Attenuation (dB) at Selected Frequencies								
			125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	3000 Hz	4000 Hz	6000 Hz	8000 Hz
Glendale Optical Co., Inc. 130 Crossways Park Drive Woodbury, Long Island, New York 11797	Quiet-Line™ Ear Inserts	Plug	24	21	23	29	30	35	31	29	27
	GN900	Muff	14	21	31	38	43	46	44	43	42
Human Acoustics, Inc. P.O. Box 14400 Portland, Oregon 97214	Noise Breaker	Plug	3	3	5	10	26	29	25	21	17
Insta-Mold Prosthetics, Inc. 111 Walnut Street Philadelphia, Pennsylvania 15208	Insta-Mold Noiseguards	Plug	20	27	31	31	30	39	45	40	38
Mine Safety Appliances Co. 201 N. Braddock Avenue Pittsburgh, Pennsylvania 15208	Insert-type Ear Defenders	Plug	22	22	25	28	31	38	28	30	25
	Noise Foe Mk II	Muff	19	21	29	38	35	39	45	37	36
	Noise Foe Mk	Muff	11	17	28	33	37	39	47	41	37
Oto-Cure, Inc. 1600 North Michigan Saginaw, Michigan 48602	"Cep's"	Plug	14	13	17	20	29	32	39	38	39
Pacific Coast Laboratories 604 Mission Street San Francisco, California 94105	Dura-Flex Sound Mediator	Plug	25	25	26	27	24	25	28	34	29
Safeline Products Putnam, Colorado 06260	Safeline Earplug	Plug	24	21	23	29	30	35	31	29	27
	8701	Muff	14	21	32	46	41	45	40	31	30
	8702	Muff	6	13	23	34	36	41	40	36	24
	8703	Muff	8	19	28	40	39	42	41	34	30
	8713	Muff	13	21	33	42	42	42	37	35	32
	8780	Muff	7	11	23	32	34	36	40	34	36
	8781	Muff	10	16	25	34	34	36	41	34	31

ATTENUATION CHARACTERISTICS OF SELECTED PROTECTORS (continued)

Manufacturer	Model	Type	Attenuation (dB) at Selected Frequencies								
			125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	3000 Hz	4000 Hz	6000 Hz	8000 Hz
Safety Ear Protector Co. 5356 West Pico Blvd. Los Angeles, California 90019	Sepco Ear	Muff	11	13	14	19	23	29	31	39	45
Sellstrom Manufacturing Co. P.O. Box 355 Palatine, Illinois 60067	Tonedown 400	Muff	9	19	28	42	39	40	46	39	34
Sigma Engineering Products Div. Norton Co. 11320 Burbank Blvd. North Hollywood, California 91601	Comfit	Plug	28	27	29	28	37	40	42	43	43
	Auri-Seal Comfit	Plug	24	33	32	33	39	43	44	38	40
	Sonic Ear Valvs™										
	1D	Plug	2	5	4	14	30	22	30	28	21
	2D	Plug	7	5	10	20	32	27	32	20	27
	3D	Plug	9	6	8	18	33	26	35	28	28
Soundmaster Co. 1520 Broadway Oakland, California 94612	Soundmaster Noise Attenuator	Plug	19	20	23	24	34	42	44	39	42
Stayrite, Inc. Subsidiary of Hechler Bros., Inc. 22-19-37th Avenue Long Island City, New York 11101	Series A	Plug	21	25	21	23	27	32	38	43	52
	Series B	Plug	17	21	19	21	27	30	35	38	49
	Series C	Plug	18	22	15	21	27	28	25	30	47
Surgical Mechanical Research, Inc. P.O. Box 1185 Newport Beach, California 92663	SMR	Plug	29	30	33	31	33	40	44	44	42

ATTENUATION CHARACTERISTICS OF SELECTED PROTECTORS (continued)

Manufacturer	Model	Type	Attenuation (dB) at Selected Frequencies								
			125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	3000 Hz	4000 Hz	6000 Hz	8000 Hz
U.S. Safety Service Co. P.O. Box 1237 Kansas City, Missouri 64141	Saf-Ear Insert	Plug	24	21	23	29	30	35	31	29	27
	Saf-Ear Shield Series 840000	Muff	15	22	33	45	44	50	50	39	34
	Series 842000	Muff	6	13	23	37	35	36	37	33	27
	Series 844000	Muff	12	21	31	41	43	45	49	38	32
	Series 845000	Muff	15	22	33	45	44	50	50	39	34
R. Washburn Co. P.O. Box 899 Menlo Park, California 94025	RBW71	Muff	14	20	31	45	42	44	39	31	30
Welsh Manufacturing Co. 9 Magnolia Street Providence, Rhode Island 02909	Sound Off Earplug	Plug	24	21	23	29	20	35	31	29	27
	Sound Off Earmuff										
	4501	Muff	15	23	31	38	37	-	44	-	31
	4510	Muff	10	14	24	35	34	41	41	33	28
	4520	Muff	14	20	31	41	41	43	44	37	31
	4530	Muff	15	21	31	40	43	43	48	40	35
Wilson Products Division Electric Storage Battery Co. P.O. Box 622 Reading, Pennsylvania 19603	EP-100 Sound Ban Ear Protector	Plug	20	21	22	24	32	41	42	39	37
	10	Muff	22	18	20	21	34	42	43	42	43
	20	Muff	18	18	19	25	34	44	46	45	43
	Sound Barrier Earmuffs										
	150	Muff	13	16	30	40	41	33	47	43	39
	150A	Muff	15	18	27	36	40	35	44	40	38
	151	Muff	10	17	27	35	35	-	43	-	32
	151A	Muff	11	16	25	37	35	-	36	-	30
	250	Muff	8	17	26	34	35	40	40	31	25
	258	Muff	8	17	28	44	45	45	50	42	35
	258A	Muff	15	19	32	43	39	41	48	44	38
	360	Muff	19	27	37	44	41	-	46	-	42
	360A	Muff	21	24	35	46	42	-	45	-	41

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