Equip Tips

Revision No. 2
NOVEMBER 1979

U. S. DEPARTMENT OF AGRICULTURE — FOREST SERVICE EQUIPMENT DEVELOPMENT CENTER — SAN DIMAS, CALIFORNIA

PROTECT YOUR HEARING!

This revision No. 2 replaces previous issues of this publication. Be sure to discard any copies of revision No. 1 (July 1977) or the original issue (July 1974) that you might still have.

- Know why hearing protectors are as important as hardhats or safety glasses
- Know when to use a hearing protector (ear plugs and ear muffs)
- Know which ear plug or ear muff to use in each "noise hazard" situation
- Know how you can *PROTECT YOUR HEARING* ability!

Most of us know enough to protect our heads with hardhats, our eyes with safety glasses or goggles, and our feet with safety shoes—when the work situation calls for such protective gear. But what about hearing protection? If it is really noisy in a work situation (that is, as a rule of thumb, if you have to shout to be heard at 3 feet) you should be wearing ear plugs or muffs or both—or at least be doing like the employee in the sketch above! **PROTECT YOUR EARS,** for who is to say they are less important than your head, eyes, or feet?

Noise can cause deafness; it is well established that deafness caused by noise is permanent. There is no way to get back hearing that you have lost because of exposure to noise. Think back to the last time you were exposed to loud noises for an extended period of time. You probably noticed a ringing in your ears and a decline in your ability to hear things clearly, but after a while your hearing returned to normal—right? Wrong! Each exposure severe enough to cause a temporary loss in hearing also causes a slight, but permanent, loss of hearing ability. Repeated enough times, this noise-induced hearing loss can become a significant handicap.

The Forest Service has launched a multi-pronged attack on the noise hazard problem. The primary emphasis is on reducing noise at its source. The San Dimas Equipment Development Center is working on ways to quiet specialized forestry equipment (as are firms that manufacture all sorts of machines and equipment). The Center is also pursuing other aspects of a hearing conservation program—including periodic audiometric examinations for Forest Service employees exposed to dangerous noise to determine the extent of any hearing impairment. Finally, as

7971 1304

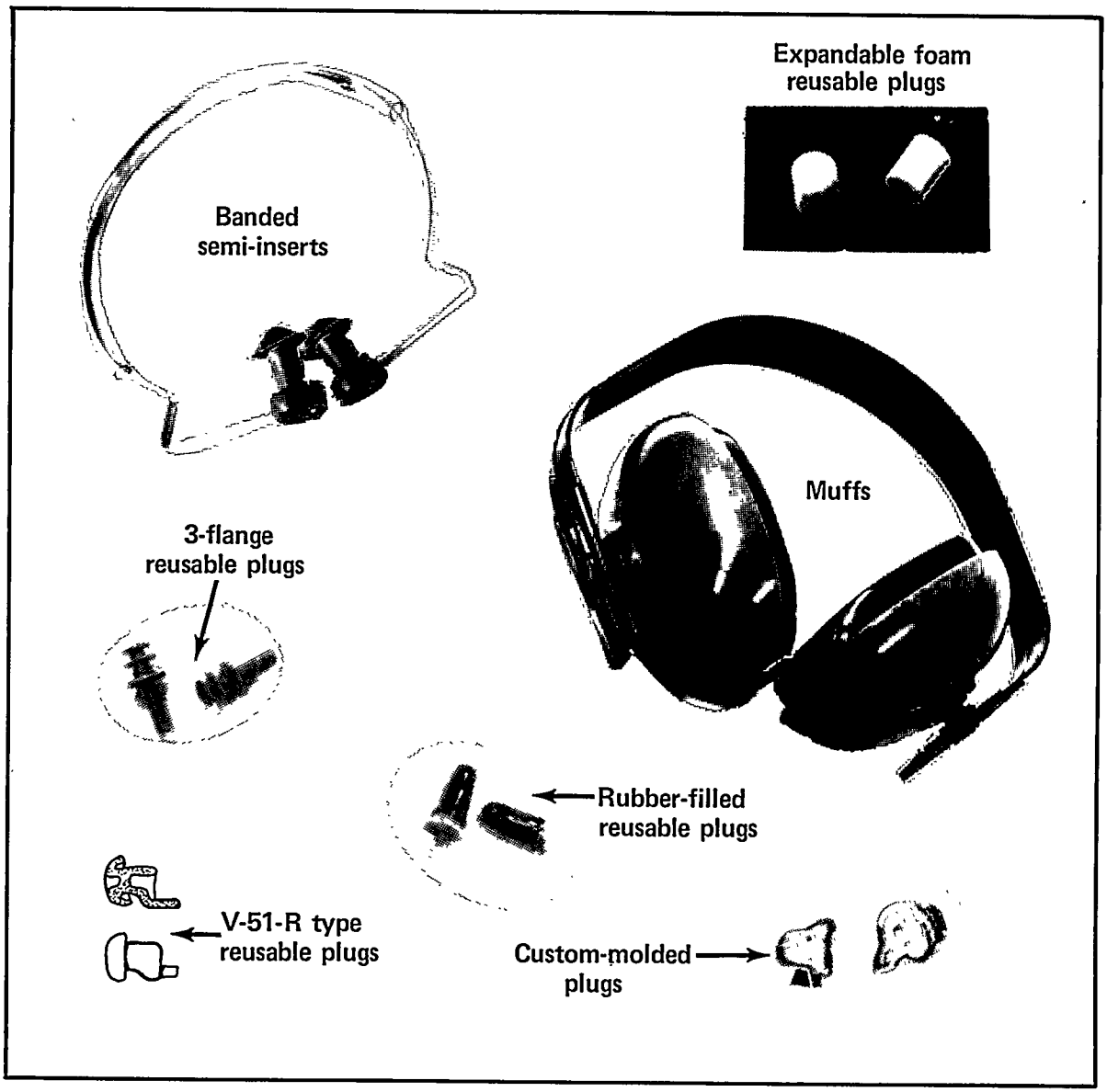

Figure 1. Representative examples of available hearing protectors.

discussed here, personal hearing protectors are being made available throughout the Forest Service. So to play it safe, always remember to have hearing protectors around and to **Stick Them In (Or On) Your Ears** whenever you are in a noisy environment.

HEARING PROTECTORS

There are many types, styles, and brands of hearing protectors available. Each has its advantages and disadvantages, and no one type is suitable for all employees or all job situations. (See figure 1.)

Disposable Plugs

These are ear plugs that are designed for only one or, at the most, just a few uses. Most disposable plugs are somewhat less effective in terms of noise reduction than the more permanent hearing protectors. Nevertheless, their low cost (they are the least expensive of all commonly available protectors) and ease of use makes them the best choice for many job situations—particularly when employees require only occasional hearing protection.

Disposables are also probably the best choice for employees with ear/throat medical problems. Before any plug is used, employees should have an otoscopic (ear) examination performed by either a medical doctor or a certified audiometric technician.

One type of disposal plug is made from acoustic fiber, a very fine glass fiber that is formed into a little trumpet and pushed gently into the ear. This particular type of disposable plug provides excellent effectiveness. Other disposable plugs are made of a specially treated waxed cotton or a putty-like substance that is molded, on the spot (clean hands are a **must**), to each individual's ear.

With disposable plugs the problem of dirt and possible infection is at a minimum, and with most types only one size has to be stocked. Some employees prefer to use plain cotton, or even cigarette filters, as hearing protectors. These are totally unsatisfactory since the hearing protection they provide is negligible.

Reusable Plugs

A very wide variety of types and styles of reusable plugs is available; their costs range from well under $1 up to $6 per pair. One standard type, designated the "V-51-R," is available from several suppliers. Other reusable plugs are flanged, as shown in figure 1, or are small plastic sacks, filled with pliable silicone or synthetic rubber, which mold themselves to each individual's ear. This latter design is very comfortable and quite effective, and is among the best for shutting out the noise of fire camp equipment when you want to sleep.

Another excellent type of reusable plug is the expandable-foam variety, standardized upon by the Aviation and Fire Management Staff. The expandable-foam plugs are rolled into thin cylinders and are then inserted into the ear where they expand to fill the entire ear cavity. These plugs **must** be held in place for a minute or so to allow them time to expand and fill the ear canal. The moldable plugs generally provide somewhat better noise reduction than most other designs of reusable plugs.

Reusable plugs have to be kept clean and sanitary. They should be washed per the manufacturers' instructions in warm soap and water or in alcohol. Regular observance of this practice will minimize the possibility of ear infection.

Banded Semi-Inserts

Banded semi-inserts come in two types. One type consists of reusable molded plugs mounted on a headband. The other is more properly called "ear canal caps." The caps do not enter the canal but rather seal the canal at its outer ends. Neither type covers the entire area around the ear. Some wearers report that banded semi-inserts are more comfortable than plugs. The amount of hearing protection provided is roughly equivalent to the better reusable plugs.

Custom-Molded Plugs

These are, as the name implies, permanently molded to an individual's ear. If properly made, they are as effective as the best of the reusable or disposable plugs. However, **fitting is difficult and they should be made only by a trained technician.** Also, shrinkage, which reduces effectiveness, can be a problem with some brands. Pure silicone plugs are reputed to have high shrinkage resistance—but this was not tested by the Forest Service at San Dimas.

Custom-molded plugs are somewhat more expensive than other plugs and, for this reason, are recommended only when their repeated use justifies the higher cost. Custom-molded plugs must be kept clean to avoid ear infection.

Muffs

Muffs are more effective than plugs—but they are more expensive and they can be cumbersome and annoying. Muffs are mounted on bands that are specifically designed for use either over the head, behind the head, or under the chin. Others are designed for universal use in any position the user selects. Over-head bands are the most comfortable of the standard muffs.

To prevent leaks, long-haired employees should brush aside hair covering their ears before the muffs are put in place. Also, eyeglasses frames cause leaks; "Stop-gap" can be ordered from the David Clark Co. to solve this problem. Further, a standard hardhat cannot be worn with muffs over the head. This can be overcome through the use of hardhat-mounted muffs. A recently introduced headband design (the Labaire), though somewhat less effective than other muffs, is reported to be very comfortable.

Table 1. Available Hearing Protectors

BRAND	TYPE	EFFECTIVENESS RANK	SUPPLIER
DISPOSABLE PLUGS			
Not applicable	Plain cotton, cigarette filters	0	DO NOT USE
Bilsom Eardown	Acoustic fiber	4	Bilsom International, Inc., 11800 Sunrise Valley Dr., Reston, VA 22091
Bilsom Propp	Acoustic fiber	4	" " " " " " " " " "
Bilsom Propoplast	Acoustic fiber	6	" " " " " " " " " "
Antinoise Ear Stopple	Waxed cotton	3	Flents Products Co., Inc., 14 Orchard St., Norwalk, CT 06850
Frontier Ear Plug	Waxed cotton	2	Frontier Industrial Products, 3521 Sunset Blvd., Los Angeles, CA 90026
REUSABLE PLUGS			
V-51-R	1-flange	5	"Many"
Charcoal Foam Plug	Expandable foam	3	Danville Hearing Aid Center, Inc., 520 Main, Danville, VA 24541
EAR	Expandable foam	10	EAR Corp., 7911 Zionsville Rd., Indianapolis, IN 46268
Silaflex	Moldable silicone	5	Flents Products Co., Inc., 14 Orchard St., Norwalk, CT 06850
Flexiplug	5-flange	2	" " " " " " " " " "
Series A	Air filled	1	Helchler Bros., Inc., 22-19 37th Ave., Long Island City, NY 11101
8773	5-flange	2	3M Co., 3M Center, St. Paul, MN 55101
Silent Partner	Filled rubber	8	Marion Health & Safety, Inc., 1515 Elmwood Rd., Rockford, IL 61101
Decidamp	Expandable foam	10	" " " " " " " " " "
Accu-fit	3-flange	3	Mine Safety Applicances Co., 400 Penn Center Blvd., Pittsburgh, PA 15235
Auri-Seal	3-flange	7	Norton Co., Safety Products Div., 2000 Plainfield Pike, Cranston, RI 02920
Comfit (w/inserter case)	3-flange	9	" " " " " " " " " "
Ear Puff	Expandable foam	10	" " " " " " " " " "
Sepco 100PE	Vented	3	Safety Ear Protector Co., 5356 W. Pico Blvd., Los Angeles, CA 90019
Ear Stopper	Filled rubber	5	Surgical Mechanical Research, Inc., P. O. Box 1185, Newport Beach, CA 92663
Sound Silencer EP100	2-flange	3	Willson Products Div., ESB Inc., P. O. Box 622, Reading, PA 19603
BANDED SEMI-INSERTS			
H.E. Douglass 7500	Over head	3	H.E. Douglass Engineering Sales, P. O. Box 636, Sun Valley, CA 91352
Silent Bandit	Universal	7	Marion Health & Safety, Inc., 1515 Elmwood Rd., Rockford, IL 61101
Tasco T-100	Universal	2	Tasco Corp., 37 Tripps Lane, E. Providence, RI 02915
Sound Ban No. 10	Universal	4	Willson Products Div., ESB Inc., P. O. Box 622, Reading, PA 19603
CUSTOM-MOLDED PLUGS			
Adcosil	–	7	Adco Hearing Conservation, Inc., 1558 California St., Denver, CO 80202
Soundown	–	7	French Laboratories, 1938 Marconi Ave., Sacramento, CA 95815
Custom Solid	–	5	Hocks Laboratories, 935 Couch St., Portland, OR 97214
Noise Guards	–	8	Insta-mold Prosthetics, Inc., P. O. Box 2146, Boulder, CO 80302
Peacekeeper	–	2	Marion Health & Safety, Inc., 1515 Elmwood Rd., Rockford, IL 61101
Soundmaster	–	4	Soundmaster Ear Protectors, 1520 Broadway Ave., Oakland, CA 94612
MUFFS			
1720	Universal	10	American Optical Co., Safety Products Div., 14 Mechanic St., Southbridge, MA 01550
1200	Over head	9	" " " " " " " " " " " "
1600A	Universal	7	" " " " " " " " " " " "
1675A	Behind head	6	" " " " " " " " " " " "
1776	Hardhat mount	8	" " " " " " " " " " " "
UL-1	Universal	8	Bilsom International Inc., 11800 Sunrise Valley Dr., Reston, VA 22091

Table 1. Continued.

BRAND	TYPE	EFFECTIVENESS RANK	SUPPLIER
UF-1	Universal	10	Bilsom International Inc., 11800 Sunrise Valley Dr., Reston, VA 22091
NF-1	Behind head	10	" " " " " " " " " "
HF-5	Hardhat mount	7	" " " " " " " " " "
Straightaway 10A, 10A-L	Over head	10	David Clark Co., 360 Franklin St., Worcester, MA 01604
Straightaway 105	Over head	10	" " " " " " " " "
Straightaway 19A	Over head	8	" " " " " " " " "
Straightaway 705, 730, 750	Hardhat mount	7	" " " " " " " " "
Straightaway 805	Behind head	7	" " " " " " " " "
Straightaway 310, 310-L	Universal	8	" " " " " " " " "
Straightaway 320, 320-L	Over head	8	" " " " " " " " "
Straightaway 27-L	Over head	10	" " " " " " " " "
Noisegard 2011	Universal	8	Fibre Metal Products, P. O. Box 248, Concordville, PA 19331
Silenta	Universal	6	Flents Products Co., Inc., 14 Orchard St., Norwalk, CT 06850
Glendale GN 900, 901	Universal	9	Glendale Optical Co., Inc., 130 Crossways Park Dr., Woodbury, NY 11797
Ear Protector	Headband 1/	2	Labaire Ear Protector Co., Midtown Mall, Front St., Worcester, MA 01608
Comfo 600	Hardhat mount	6	Mine Safety Appliances Co., 400 Penn Center Blvd., Pittsburgh, PA 15235
Comfo 500	Universal	5	" " " " " " " " " " "
Mk IV	Universal	8	" " " " " " " " " " "
Mk IV MC	Universal	9	" " " " " " " " " " "
Mk II	Over head	9	" " " " " " " " " " "
Soundoff 4520	Universal	9	Norton Co., Safety Products Div., 2000 Plainfield Pike, Cranston, RI 02920
Soundoff 4530	Universal	9	" " " " " " " " " " "
Silencio	Universal	9	Safety Direct, P. O. Box 8907, Reno, NV 89507
Tonedown 400	Universal	7	Sellstrom Manufacturing Co., P. O. Box 355, Palatine, IL 60067
Tasco T-250	Universal	10	Tasco Corp., 37 Tripps Lane, E. Providence, RI 02915
365	Universal	10	Willson Products Div., ESB Inc., P.O. Box 622, Reading, PA 19603
365A	Universal	8	" " " " " " " " " " "
368A	Over head	9	" " " " " " " " " " "

1/ Tested without the supplied inserts, which increase effectiveness.

Combinations of Muffs and Plugs

Wearing both muffs and plugs simultaneously provides the most effective hearing protection. In extreme noise situations this combination is recommended. If a muff/plug combination is selected, a high-quality porous plug (such as acoustic fiber or expandable foam) should be used and the muff used with it should have a high effectiveness score. In addition, the muff selected should cover as much of the area around the ear as possible; i.e., a big muff used in combination with a plug will be more effective than a small one.

Special Helmets

Special helmets are confined to aviation use, but not all aviation helmets are adequate hearing protectors. The later military helmets such as the SPH-4 and SPH-5 are excellent, however.

Amplitude-Sensitive Protectors

One manufacturer offers "ear valve" amplitude-sensitive protectors (Norton Co., Safety Products Div.). Since these amplitude-sensitive devices cannot be tested by the standard laboratory methods that

are used to calculate effectiveness rank, they are not included in table 1. Users report that they are effective in impulse noise situations, such as the noise from gunfire. Since the ear canal is open except when a predetermined noise level is reached, these amplitude-sensitive protectors eliminate the "stuffed-up" feeling that some wearers of standard plugs or muffs report experiencing. These protectors, according to some reports, present a very slight hazard if inserted too deeply or if a blow to the side of the user's head drives them in too deep. However, their benefit far outweighs this small potential hazard. Further, any reusable plug really is subject to this problem.

Summary

Combinations of muffs and plugs are as effective as special flight helmets, followed by the best of the muffs, then the molded plugs and reusable plugs. Most disposable plugs are somewhat less effective. There certainly is a place for all these protectors in the total Forest Service Hearing Conservation Program. If the protection needed is slight, or if protectors are only occasionally needed, then the cheap disposable plugs can be appropriate. In some situations, dust and dirt make disposable plugs or muff protectors more practical than reusable plugs, which tend to become very dirty. Foam-type reusable plugs are particularly likely to become dangerously filthy, but all hearing protectors require some periodic cleaning.

OVERVIEW OF AVAILABLE HEARING PROTECTORS

Table 1 lists many commonly available hearing protectors, along with their effectiveness rank and the name of the supplier. Only primary suppliers are listed. Many wholesalers of safety devices buy items from large manufacturers and then mark the products with their own brand names. Rebranded hearing protectors are not included in table 1. If a manufacturer offers several similar products, only the more effective are listed. **This is NOT a list of approved products!** Protectors not listed in table 1 may be appropriate for some work situations and should not necessarily be discarded if already on hand.

Effectiveness Rank

The effectiveness rank is a relative measure of the total hearing protection provided by each protector. A score of 0 indicates that a protector is in the worst 10 percent of all protectors listed. A score of 10 indicates that the protector is among the best 10 percent of the protectors listed. A score of 5 means that one half of the hearing protectors are better and one half are worse than the one with this rating. Effectiveness scores were calculated from data certified by the manufacturers and obtained by independent laboratories, and for this revision consider both the attenuation provided by the protector at each frequency and the variation in this attenuation from person to person, per NIOSH 1/ methods.

Purchasing of Protectors

Costs vary greatly from supplier to supplier and also depend on the quantity purchased, so no prices are shown. Protectors are sometimes available on Government contract–check current Federal Supply Schedule 42, part II. The National stock number for the expandable-foam plugs is given in the **Federal Fire Suppression Equipment and Supplies Catalog.**

Why So Many?

The best protection is provided by the hearing protector that the employee will wear. A great deal more than noise reduction effectiveness rank must be considered when selecting hearing protectors. Comfort is particularly important, and if an employee reports that one type of protector is uncomfortable and another is quite acceptable, the comfortable protector that will be worn is the obvious choice–even though it might have a somewhat lower effectiveness score. As yet, no standard test method has been devised to evaluate comfort–feedback from field users is the only guide.

NOISE REDUCTION– NOT SOUND ELIMINATION

Some workers will resist the use of any hearing protector. The argument most often heard is that they cannot hear their machinery, warning signals (such as a siren), or the conversation of their fellow workers or supervisor, if hearing protection is worn. This argument is invalid. One's ability to hear a wanted sound in a background of noise is related to

---

1/ **National Institute of Occupational Safety and Health.**

the ratio of the loudness of the noise to the loudness of the wanted signal (signal-to-noise ratio). The hearing protector will cut down the volume of the background noise as much as it will cut down the volume of the sound that you want to hear. Thus, there is no practical difference in signal detection in noise whether or not you are wearing protection. In fact, in certain situations, because of the nature of the hearing protection device, signal detection is actually improved by the protection device.

JOB SITUATIONS WITH NOISE HAZARDS

Table 2 is an overview of Forest Service job situations and equipment that are noise hazards. This list is not all-inclusive; there are other jobs within the Forest Service that exceed tolerable noise limits. Also there are some jobs and pieces of equipment listed that are not necessarily as loud as shown in the table. The "Level" column shows the average maximum A-weighted decibel (dBA) level at the employee's ear that the job situation presents. Because of the approximate nature of some of the measurements and the variety of situations and sources surveyed, the levels shown are rounded to the nearest 5 dBA.

The column headed "Which Protectors" indicates the type of hearing protection device that will probably be most suitable for the work situation listed. Factors other than effectiveness are considered. That is, for some jobs with an average level of, say, ø100 dBA, one type of protector is recommended and for other jobs with the same level a different type is recommended because of differing dirt conditions, use patterns, etc.

If a particular job situation is noisier than the average level given, then a more effective hearing protector should be used. Conversely, if the job situation can be shown to be quieter than the average level, less hearing protection is required. The "When" column indicates when protectors should be used. If the exposure exceeds the time shown, protectors are mandatory.

For snowmobiles, trail bikes, and all-terrain vehicles, levels are not shown; instead a permissible exposure time (PET) is given. The PET indicates the amount of time an average operator could spend per day on each of these vehicles without hearing protectors and probably not suffer any permanent hearing loss. However, because the noise of an off-road vehicle is almost always combined with a noise dose from other work situations, it is recommended that hearing protectors be worn while operating or riding in any off-road vehicle, with the possible exception of the Thiokol Sprite.

Some job situations in the Forest Service present particularly difficult challenges in hearing conservation; for instance, snow rangers who shoot down avalanches with military weapons. In this situation, the best possible hearing protection is needed—a muff of high effectiveness used in conjunction with expandable-foam ear plugs. In addition, careful monitoring of the hearing of these employees is necessary to make sure that the hearing protectors are working.

From the levels shown, it could be concluded that hearing protectors are recommended for some job situations when indeed they are not required by OSHA 2/ regulations. The purpose of a hearing conservation program is to preserve employees' hearing, not merely to comply with a set of regulations which, by the way, have been developed for work situations entirely different from those typical of the Forest Service. **The noise dose of each work situation during the day contributes to possible hearing damage.** Forest Service employees are likely to be exposed to several noise sources during their workday; therefore, the suggested protection in table 2 is justified.

Studies of hearing of operators of road and trail construction equipment, and also of aircraft and off-road vehicles, indicate that for at least these classes of equipment the OSHA criteria may be too lenient; that is, even though the criteria may be met, permanent hearing damage is likely in a significant percentage of employees. So—**STICK THEM IN (OR ON) YOUR EAR**—wear your hearing protector whenever necessary! Protect your hearing—be safe, not sorry.

2/ **Occupational Safety and Health Administration.**

Table 2. Forest Service equipment—approximate maximum noise at operator's ear and recommended protection.

JOBS	LEVEL (dBA)	WHICH PROTECTORS?						WHEN?		
		DISPOSABLE PLUGS	REUSABLE PLUGS	CUSTOM-MOLDED PLUGS	MUFFS	COMBINATION MUFF & PLUG	SPECIAL HELMET	WHENEVER ON JOB	JOB EXCEEDS ½ HOUR	JOB EXCEEDS 2 HOURS
Shop Work & Building Construction										
Metal hammering (blacksmith, body work)	110 +		x	x	x	x		x		
Pneumatic tools (drill, air wrench, etc.)	110 +		x	x	x	x		x		
Sign routing	110			x		x		x		
Abrasive cutoff saw	100			x	x			x		
Arc welding	100	x	x					x		
Grinding (bench or hand)	95 +	x			x			x		
Nail guns	95 +	x	x					x		
General machining	95	x	x							x
General woodwork & carpentry	90-100	x			x					x
Vehicles and Transportation										
Helicopters, pilot & co-pilot	105-110						x	x		
passenger—occasional	105-110	x	x		x			x		
passenger—regular	105-110			x		x	x	x		
Airtanker, pilot & co-pilot	100 +						x	x		
Light aircraft, pilot & co-pilot	95-100						x	x		
passenger—occasional	95-100	x	x		x			x		
passenger—regular (more than 2 flights/mo)	95-100			x		x	x	x		
Firefighting Equipment										
Pumpers, two-stroke engines	120 +			x	x	x		x		
four-stroke engines	115 +		x	x	x			x		
Generators	100 +		x		x			x		
Tankers, on-the-road	95 +	x	x		x			x		
pumping	100 +		x		x			x		
Timber-related Activities										
Chain saw operation	110-115	x		x	x	x		x		
Mechanized tree planter	105				x			x		
Riding in log trucks	100-105	x	x		x			x		
Nursery work, extractors, etc.	Varies	x	x	x	x			x		
Scaler, visiting sawmill	Varies		x	x	x				x	

Table 2. Continued.

JOBS	LEVEL (dBA)	WHICH PROTECTORS?						WHEN?		
		DISPOSABLE PLUGS	REUSABLE PLUGS	CUSTOM-MOLDED PLUGS	MUFFS	COMBINATION MUFF & PLUG	SPECIAL HELMET	WHENEVER ON JOB	JOB EXCEEDS ½ HOUR	JOB EXCEEDS 2 HOURS
Road and Trail Construction										
Blasting	Very high					x	x	x		
Gunite machine	Very high			x		x		x		
Pile drivers	Very high		x	x	x			x		
Chain saws	115 +			x	x	x		x		
Drills—Airtrac	115			x		x		x		
Ingersoll Rand	105			x	x			x		
Cobra	Very high			x		x		x		
Concrete cutters	110 +			x		x		x		
Compactor—Wagner WL-17	105		x		x			x		
Mobile wood chippers	105		x	x	x			x		
Shovels	105	x	x		x			x		
Trucks, 15 + tons	105	x	x		x			x		
Portable pug mills	100 +	x		x	x			x		
Redi-mix trucks	100 +	x		x	x			x		
Dozers (crawler & wheeled)—D6 or larger with cab	100			x	x			x		
without cab	105			x	x			x		
Scrapers—with cab	100	x		x	x			x		
without cab	105			x	x			x		
Crushers	100	x		x	x			x		
Endloaders (crawler & wheeled)	100	x		x	x			x		
Motorgraders with & without cab (all but John Deere)	100	x		x	x			x		
John Deere	85			none						
Power packer—LeTourneau	100		x		x			x		
Large air compressors	95 +	x	x						x	
Cranes	95	x	x							x
Electric generators	95	x	x						x	
	PET 1/									
Off-road Vehicles										
Snowmobiles	1.1	x	x	x				x		
All-terrain vehicles—Cushman Trackster	1.7		x	x				x		
Thiokol Spryte	3.2	x	x							x
Trail bikes	2.6	x	x	x				x		

1/ Permissible exposure times, hr/day

EQUIPMENT DEVELOPMENT AND TEST

The Forest Service's Equipment Development and Test (ED&T) program, conducted by two Equipment Development Centers (San Dimas, Calif., and Missoula, Mont.), provides systematic application of scientific knowledge to create new or substantially improved equipment, systems, materials, processes, techniques, and procedures that meet the objectives of advanced forest management and utilization in the United States. The ED&T effort, featuring Mechanical Engineering activities, encompasses projects in forest engineering, aviation and fire management, recreation, timber, range, wildlife, occupational safety and health, forest insect and disease, and forest residues to enable forest work to be performed more efficiently, at less cost, with minimum hazard.

As needs for field development services are identified and defined, the Centers determine if already available commercial products are suitable as is or if they require modifications necessitated by the forest environment. On the other hand, sometimes needs can only be met by the Centers taking advantage of the latest technology to create new concepts through a step-by-step product development program. These developments are typically achieved by active ED&T involvement with disciplines found throughout the Forest Service. The new equipment is field tested and demonstrated and user feedback is obtained to evaluate results. The role of the Centers is not considered complete until project output is implemented in the field.


NATIONAL FOREST SYSTEM
COOPERATIVE FORESTRY
FORESTRY RESEARCH
FOREST SERVICE
US
DEPARTMENT OF AGRICULTURE