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Agricultural Noise Can Be Harmful Protect Your Hearing
Michigan State University Extension Service
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Protect Your Hearing

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Protect Your Hearing

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MODERN AGRICULTURE'S RELIANCE on machinery and mechanization has increased the noise on the farm. Studies show Michigan farmers have experienced noise-induced hearing losses resulting in serious impairment in their abilities to understand speech by age 58 to 65.¹ This publication describes these hazards, their effects and suggests ways to avoid them.

DETERMINING NOISE LEVELS

The intensity of sound, or noise, is measured in units called *decibels* (dB) and is monitored by a sound level meter (Fig. 1). Normal speech is 50 to 60 dB and a whisper is about 20 dB. The inside noise level of most automobiles is 70 to 80 dB at 60 mph. A thunderclap, jackhammer, basketball crowd or siren at 100 ft may reach 120 dB. As distance from noise source doubles,

loudness decreases to one fourth the previous level. Table 1 lists some common sounds and their corresponding decibel levels.

Table 1—Decibel levels of common sounds at typical distance from source.

0	Acute threshold of hearing
15	Average threshold of hearing
20	Whisper
30	Leaves rustling, very soft music
40	Average residence
60	Normal speech
70	Noisy office or work area
80	Window air conditioner, heavy traffic
85	Inside acoustically insulated protective tractor cab in field
90	OSHA limit - hearing damage on excess exposure to noise above 90 dB for eight hours per day
100	Noisy tractor, power mower
120	Jackhammer, thunderclap, amplified rock music, gun blast

¹Noise-induced Hearing Losses of Michigan Farmers. Unpublished Technical Report, Joseph B. Bozung, MSU Agricultural Engineering Dept.

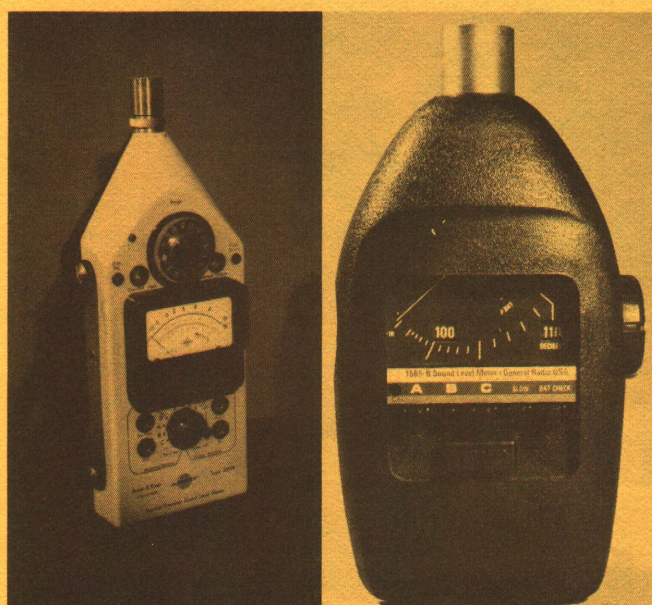


Fig. 1. Sound level meters.

Table 2 gives the maximum safe daily exposure to various noise levels. Longer exposure may cause hearing damage.

Table 2—Maximum hours of daily work at various noise levels*

Sound level (dBA)±	Maximum hr/day
97.5 - 100	2
95.5 - 97.0	3
94.0 - 95.0	4
92.5 - 93.5	5
91.5 - 92.0	6
90.5 - 91.0	7
89.0 - 90.0	8-9
87.5 - 88.5	10-11
86.5 - 87.0	12-13
85.5 - 86.0	14-15
85 or less	16 or more

*Based on 1969 Walsh-Healey Act & 1974 Proposed Noise Standard.

±The decibel value in this table is referenced to the A scale. The A scale approximates the sensitivity of the ear, being less sensitive in the lower pitch range than higher frequencies. Sound level meters use four weighting scales, A, B, C and D, for various sound evaluations.

Decibels are not additive; that is, two tractors operating side by side, each at 90 dB, do not produce 180 dB. The level would rise 3 dB to 93 dB--twice as intense as 90 dB (Fig. 2).

Frequency or pitch is the number of sound pressure waves heard per second. The frequency of the human voice ranges from 200 to 4,000 cycles per second or Hertz (Hz). Hearing loss resulting from loud noise makes it difficult to understand speech in this frequency range, especially in the high portion of the range.

Noise duration is also important as hearing loss is less likely with short duration noises. This can be determined by referring to Table 2.

NOISE EFFECTS ON THE EAR

Noise-induced hearing loss is usually gradual, but is permanent. Therefore, prevention of hearing loss is essential. A ringing noise in the ears or rushing water sound after working on a noisy job is a warning. Or you may notice a dulling of ability to hear for some time after the noise ceases. If noise is not excessive and/or of short duration, ear function may return to normal after loudness is reduced. However, exposure to continued noise levels above 85 or 90 dBA may damage hair cells in the inner ear.

Failure of the damaged ear to hear sound around 4,000 Hz is the first indication of loss. Next, frequencies between 500 and 3,000 Hz in the human voice range cannot be heard well. Generally, sounds with a narrow frequency range (constant pitch) are more damaging than those spread out through a wide range of frequencies (varying pitch). Sounds in the higher frequencies (turbo-charger) are more damaging than those at the lower frequencies (gear noise).

Interrupted noise is less damaging than continuous

noise because the ear tends to recover after a short rest. However, it takes an hour for hearing to return to normal for an individual operating a chain saw producing 115 dB for only 4 min.

AGRICULTURAL NOISE PROBLEMS

Many different sources of excessive noise exist on the farm. These include some tractors, combines, pickers, elevators, dryers, shellers, grinders, mixers, chain saws, snow blowers, conveyors, power mowers and hammermills.

University of Nebraska Tractor Tests show that tractors equipped with acoustically engineered protective cabs hold noise to acceptable levels.

Noise level measurements of agricultural tractors were begun in 1971. Tables 3 and 4 provide some guidelines to the maximum hours of operation without hearing protection of various tractor models. Ear protection is recommended when using tractors manufactured before 1970 unless you know the noise level is safe. The maximum hours of operation without excessive risk of hearing loss were established using guidelines of Michigan's Occupational Safety and Health Administration's (Mi/OSHA) noise standard for general industry (1976).

The noise levels indicated in the previous tables were measured under conditions similar to plowing with the tractor operating at 75% of maximum available horsepower. Attached equipment did not contribute to the noise level. If equipment is used that can clearly be heard over the tractor noise, then the noise level will be greater than the tractor alone. Noise levels for tractors with cabs were measured with all windows and doors closed. Opening a door or window for ventilation will increase noise level in the cab.

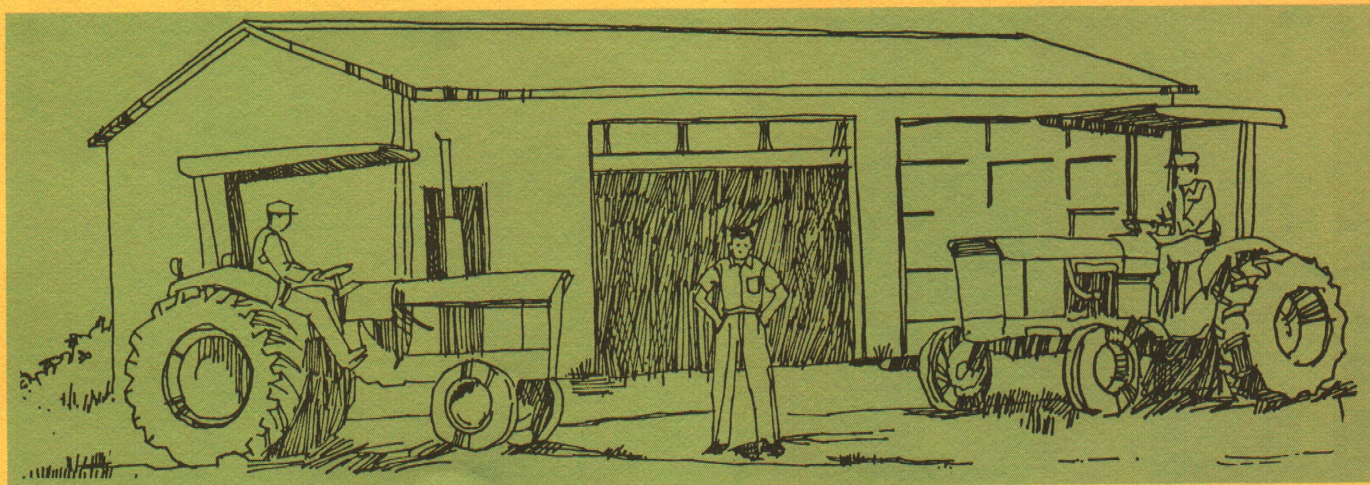


Fig. 2. When sound is doubled, measurement increase is 3 dB. For example: 90 dB. + 90 dB. = 93 dB.

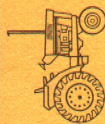


Table 3—Tractors WITHOUT cabs (*); maximum hours of operation without hearing protection.

Max. hours of operation without hearing protection**	Any equipment with this noise level (dBA)	Allis Chalmers	Deutz	Ford	International	John Deere	Kubota	White Oliver	David Brown	Massey Ferguson	Other
8+	89-90		2600 Gas 6 sp		L 285 DSL						Yanmar YM 240 - DSL (JAPAN)
7	90.5-91.0	175 Gas	2600 Gas 8 sp	354 Gas						MF 230 Gas	
6	91.5-92		3600 Gas 6 sp	454 Gas							
5	92.5-93.5	175 DSL	D40 06 DSL D45 06 DSL	3600 DSL 1600 DSL	666 Gas						
4	94-95		D60 06 DSL	2600 DSL 6 sp	454 DSL 574 Gas 885 DSL 464 Gas 666 DSL	2030 Gas 2840 DSL		1755 Gas 1855 DSL	1412 DSL (Hyd Shift) 885 Gas 885 DSL	MF 235 Gas MF 255 Gas MF 230 DSL	
3	95.5-97	185 DSL 5040 DSL	D55 06 DSL D130 06 DSL (1972)	5600 DSL 8 sp 2000 Gas 7000 DSL 6600 DSL 8 sp	574 DSL Hydro 70 DSL	2040 DSL 830 DSL 2030 DSL 2630 DSL	L 210 DSL	1955 DSL 1655 Gas (Synco-mesh) 1755 DSL Field Boss 2-60 DSL	1410 DSL 990 DSL 995 DSL	MF 255 DSL MF 265 DSL MF 245 Gas MF 245 DSL MF 255 DSL	Satoh S650 Gas Long U550
2	97.5-100	210 DSL 5050 DSL	D80 06 DSL D62 06 DSL D68 06 DSL D100 06 DSL	4100 DSL 8 sp 3000 DSL 2000 DSL 3000 Gas	464 DSL Hydro 70 Gas 674 Gas 674 DSL	2240 DSL 1530 DSL	L 260 DSL	1655 DSL 2155 DSL Field Boss 2-70 DSL Field Boss 2-50 DSL	1212 DSL 1210 DSL	MF 275 DSL MF 235 DSL MF 285 DSL STD. MP	Long 900 DSL - 16 sp Long U445 DSL Long R 9500 DSL S.A.M.E. - Buffalo - 4WD DSL

*Tractors tested as of January 1978. Sound level to operator at 75% power.
**Use hearing protection if continuous operation exceeds this time.

Example: John Deere 2840 DSL--without cab
First-Select Table 3.
Second-Locate John Deere column and Model 2840 DSL. (Note only tractors tested since 1971 are listed.)
Third-Read the two far left columns. Sound level at operator's ear at 75% power=94 to 95 dB and can be safely operated 4 hr without hearing protection.

Use Tables 3 and 4 to find the maximum hours of safe tractor operation. First, select the table that corresponds to tractors *with* or *without* cabs. Second, find your tractor make and model. Third, move to the left column and read the sound level that this tractor produces at 75% horsepower and the maximum hours of continuous operation that are permitted unless hearing protection is used.



Table 4—Tractors WITH cabs (supplied by manufacturer) (*); maximum hours of operation without hearing protection.

Max hours of operation without hearing protection**	Any equipment with this noise level (dBA)	Allis Chalmers	J.I. Case	Ford	International	John Deere	Massey Ferguson	Other
16+	85 or less	7060 PS DSL 7040 PS DSL 7000 PS DSL 7080 DSL 7060 DSL 7050 DSL 7045 DSL 7040 DSL 7030 DSL 7020 DSL 7580 DSL 8550 DSL	1270 DSL 12 sp (1974) 2670 DSL 12 sp 1370 DSL (1973) 870 DSL (1973) 2470 DSL 1570 DSL 12 sp 2670 DSL 12 sp 2870 DSL 12 sp	2600 DSL 3600 DSL 3600 Gas 4600 DSL 5600 DSL 6600 DSL 7600 DSL 8600 DSL 9600 DSL 9700 DSL 8700 DSL 7700 DSL 6700 DSL	4568 DSL 886 DSL 16 sp Hydro 186 DSL 986 DSL 16 sp 1086 DSL 16 sp 1586 DSL 12 sp 4386 DSL 10 sp	8630 DSL 8430 DSL 4230 DSL 4430 DSL 4030 DSL 4630 DSL 4040 DSL 4240 DSL 4440 DSL 4640 DSL 4840 DSL	1105 DSL 1085 DSL 1135 DSL 1155 DSL MF 2805 DSL	White Field Boss 4-180 DSL White 4-150 DSL Belarus 250 DSL Steiger Cougar II DSL White Field Boss 2-85 Steiger Bearcat III DSL Steiger Cougar III DSL Steiger Panther III DSL
14-15	85-85		M-B 4/94 DSL (Unimog 406)		766 Gas 4366 Turbo DSL		1505 DSL	Steiger Tiger II DSL Steiger Wildcat III DSL
12-13	86.5-87				966 DSL (1971) 1066 Turbo DSL (1971) 1466 Turbo DSL (1971)	6030 DSL	1805 DSL	Steiger Bearcat II DSL 10 sp Belarus MTZ 80 DSL Minn-Moline G 1355 DSL (1973) Minn-Moline A 4T-1600 DSL
10-11	87.5-88.5		970 DSL 8 sp 770 DSL 1270 DSL 12 sp (1972)		1566 Turbo DSL 766 DSL 1066 Turbo DSL (1973)	7520 DSL	1500 DSL	Belarus T-25A DSL White Field Boss 2-105 DSL
8-9	89-90		1070 DSL 8 sp 1090 DSL 8 sp 1370 DSL (1972) 870 DSL (1971)		1568 DSL 966 DSL (1973) 1066 DSL (Hydro) 4166 DSL 966 DSL (Hydro)		1800 DSL	White Field Boss 2-150 DSL Deutz D 130-06 (1973) Oliver 2255 DSL
7	90.5-91		970 DSL 12 sp 1170 DSL 8 sp 1175 DSL 8 sp					Steiger Bearcat DSL
6	91.5-92				100 DSL (Hydro)			Leyland 2100 DSL
5	92.5-93.5		1070 DSL 12 sp 1090 DSL 12 sp		1468 DSL 1466 Turbo DSL (1973)	4620 DSL		
3	95.5-97.0					7020 DSL		S.A.M.E. Panter 4 WD DSL
2	97.5-100							Leyland 255 DSL Leyland 245 DSL

*Tractors tested as of January 1978—sound level to operator at 75% power.

**Use hearing protection if continuous operation exceeds this time.

Example:International 1566 Turbo DSL - with cab

First-Select Table 4 (tractors with cabs).

Second-Locate the International column and Model 1566 Turbo DSL.

Third-Read the two far left columns. Sound level at operator's ear at 75% power =87.5 to 88.5dB and can be safely operated 10 to 11 hr without hearing protection.

Table 5—Farm equipment noise levels.

Type	dB
2-row corn picker	110
Large self-propelled combine	105
Snow blower	97
Hammermill (at 10 feet)	101
Elevator (electrically driven)	94.5
Fan drying system (20 feet)	99

Typical examples of decibel level at the operator's ear from other selected machines are shown in Table 5.

Sound levels of selected chain saws are listed in Tables 6 and 7.

Table 6—Electric-powered chain saws.

Brand and model	Noise (dBA)
STIHL E10 (Stihl Inc., Virginia Beach, VA) 9 lb	95
SEARS CAT. NO. 3460 (Sears, Roebuck) 10 lb	98
MASSEY FERGUSON 120E (Massey Ferguson, Inc., Racine, WI) 9 lb	99
SKILSAW 1601 (Skil Corp., Chicago, IL) 10 lb	95
WEN 1200 (Wen Products, Inc., 7 lb	100
WEN 2000 (Wen Products, Inc.) 7 lb	99
VILLAGE BLACKSMITH 9112T2 (McGraw-Edison Co., Columbia, MO) 10-1/2 lb	102
REMINGTON LIMB N'TRIM 12 (Desa Industries, AMCA International Corp., Park Forest, IL) 7 lb	95
WARDS CAT. NO. 30035 (Montgomery Ward) 7 lb	95
REMINGTON LIMB N'TRIM 10 (Desa Industries, AMCA International Corp.) 7 lb	96
SEARS CAT. NO. 3455 (Sears, Roebuck) 9 lb	98
SEARS 3444 (Sears, Roebuck) 8-1/2 lb	98
WARDS CAT. NO. 30031 (Montgomery Ward) 7 lb	99
POULAN 1000-1 (Beaird-Poulan Div., Emerson Electric Co., Shreveport, LA) 8 lb	96

Table 7—Gasoline-powered chain saws.

Brand and model	Noise (dBA)
STIHL 015AVE Electronic (Stihl Inc.) 11 lb	105
ECHO CS302 (Echo Chain Saw Div., Kioritz Corp. of America, Northbrook, IL) 11 lb	109
JOHN DEERE 30 (Deere & Co., Moline, IL) 11 lb	109
HOMELITE XL2 (Homelite Div., Textron Inc., Charlotte, NC) 9 lb	110
ECHO CS315 (Echo Chain Saw Div., Kioritz Corp. of America) 10-1/2 lb	106
HOMELITE XL (Homelite Div., Textron Inc.) 9 lb	110
SEARS CAT NO. 35205 (Sears, Roebuck) 9 lb	110
SEARS CAT. NO. 35091 (Sears, Roebuck) 9-1/2 lb	112
REMINGTON MIGHTY MITE WEEKENDER (Desa Industries, AMCA International Corp.) 8 lb	110
POULAN MICRO XXV DELUXE (Beaird-Poulan Div., Emerson Electric Co.) 9 lb	112
SKILSHOP 1712 (Skil Corp.) 9 lb	111
STIHL 015L (Stihl Inc.) 10 lb	107
MC CULLOCH MINI MAC 30 (McCulloch Corp., Los Angeles) 9 lb	109
WARDS CAT. NO. 24052 (Montgomery Ward) 9 lb	108
ALLIS-CHALMERS 65 (Allis-Chalmers Corp., Milwaukee, WI) 9 lb	114
MASSEY FERGUSON MF190 (Massey Ferguson, Inc.) 9-1/2 lb	120

Data in Tables 6 and 7 from *Consumer Reports*, October 1977. Copyright by Consumers Union of the United States, Inc., Mount Vernon, New York 10550

CONTROLLING NOISE

To solve a noise problem, reduce noise a) at the source; b) on the path to the ear; or c) at the ear (Fig. 3).

Noise control at the source is an engineering problem requiring equipment modification or

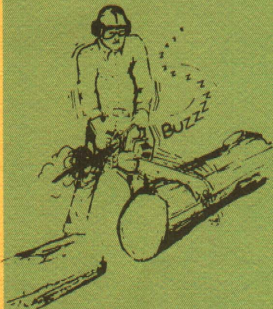
1. AT THE **SOURCE** WITH

- A Quieter Machine
- Design Changes
- Slower Speed
- Rubber Mounts
- Etc.



2. ON **PATH** TO THE EAR BY USING

- Enclosures
- Walls
- Absorbers
- Distance



3. AT THE **EAR** WITH

- Plugs
- Muffs

Fig. 3. Three methods to reduce noise.

redesign. Noise along the path can be reduced by 1) enclosing the source; 2) increasing distance between source and ear; 3) placing sound barriers between source and ear; and 4) absorbing sound. Use hearing protectors, or limit the hours of exposure to reduce noise. Hearing protection is usually an effective and inexpensive way of controlling unwanted noise.

PREVENTING HEARING LOSS

Fig. 4 is based on Michigan's Occupational Safety and Health Administration's noise standard for general industry (1976). Use ear protectors when daily hours of operation fall in the shaded portion of the graph. Good ear protection does not cut out all sound, but reduces the amount reaching the ear.

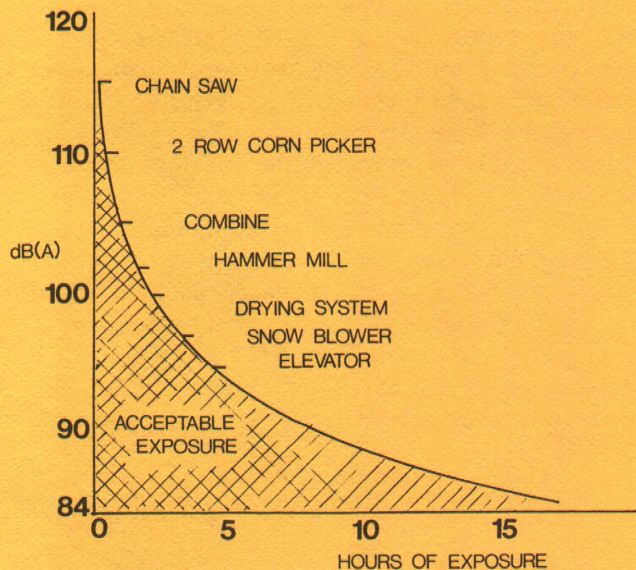


Fig. 4. Acceptable noise exposure.

HEARING PROTECTORS

Plugs and muffs are two common types of hearing protection. Ear plugs are made of rubber, plastic or expandable foam. Molded rubber or plastic ear plugs are available in different sizes and must be fitted to be

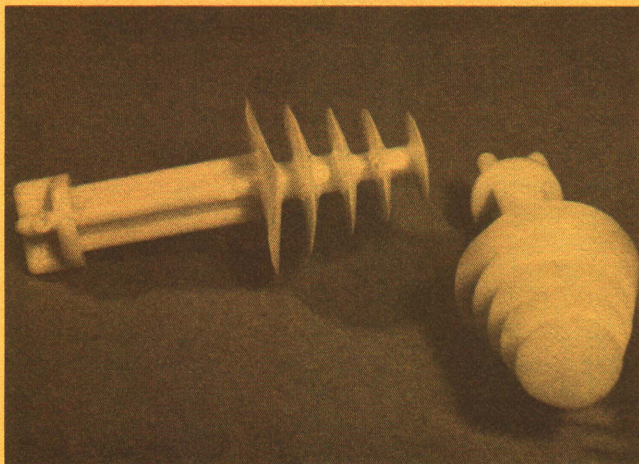


Fig. 5. Two kinds of hearing protection ear plugs.

effective and comfortable (Fig. 5). They cost about \$1 per pair and are washable. The expandable foam plugs are rolled, then inserted into the ear and into thin cylinders allowed to expand to fill the ear cavity. Foam plugs are comfortable and often more effective than molded types. They cost about 25 cents a pair.

Acoustical ear muffs are padded cups which cover the entire ear, held together by an adjustable head-band (Fig. 6). They are removed and put on quickly and easily, and ideal for intermittent or short duration noise. Many people find ear muffs more comfortable than plugs for long periods of wear, though they are bulkier and may be warm during hot weather. Prices for ear muffs begin around \$7 or \$8 per pair. (The price of the muff is not an indication of the amount of hearing protection they will provide.)

Hearing protection muffs and plugs can be purchased from farm supply stores, welding equipment

suppliers, stores such as Sears and Montgomery Ward, and sporting goods stores. Also, local hearing aid dealers can fabricate comfortable and reusable molded ear plugs.

SUMMARY

Hearing loss due to high noise levels on the farm occurs gradually, but is permanent. People are usually not aware of loss until it progresses to the point where understanding conversation is a problem. Nothing can be done to reverse its effects by that time. So, prevent hearing loss. If you do not have hearing protection, get some type and use it when working on noisy farm jobs.

If you suspect you have hearing loss, have an audiologist or otologist (ear specialist) evaluate your hearing without delay.



Fig. 6. Acoustical ear muffs.