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EC73-708 Noise....Sound without Value

D. E. Lane

Rollin D. Schnieder

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Noise...

SOUND WITHOUT VALUE!

Extension Service
University of Nebraska-Lincoln College of Agriculture Cooperating with the
U. S. Department of Agriculture and the College of Home Economics
E. F. Frolik, Dean J. L. Adams, Director

NOISE...SOUND WITHOUT VALUE

D. E. Lane
Extension Engineer (Power Machinery)
Rollin D. Schnieder
Extension Safety Specialist

Oh, for the peace and quiet of the country! Surely you have heard this statement. How true this was in years gone by! Now, however, the quiet clip-clop of dobbin's hooves has been replaced by the thumping of cylinders and the grinding of gears in modern tractors. Noises previously associated with cities have moved into rural areas. Some of the noises are even louder than those we have long associated with urban living.

What do the words sound and noise mean? Some people refer to sound as something pleasant. For example, a number of tones placed together might result in a beautiful symphony. However, if these notes are played too loudly or off key, they might be referred to as noise. One definition of noise is "a weed in the garden of sound."

EFFECTS OF NOISE

One of the problems associated with excessive noise is the potential damage to human hearing. Research has shown that people in agriculture are suffering hearing losses from the noise generated by powerful machinery and other equipment. Tractors, harvesters, grinders, choppers, conveyors, chain saws and power mowers are a few of the pieces of equipment contributing to the noise problem on farms and ranches.

The human ear is a marvelous device and has tremendous sensitivity. But noise levels have increased so much that many persons have lost much of this audio-sensitivity.

THE EAR

To better understand the nature of sound-induced hearing loss, take a look at the ear, (Fig. 1). Sound comes to us as pulsating waves of air pressure. These travel through the outer ear until they strike the eardrum. The vibration of the eardrum is transmitted by the bones of the middle ear to the cochlea or inner ear.

In the inner ear, vibrations are picked up by some 30,000 hairlike protrusions which in turn signal the auditory nerves to the brain. When the hairs of the cochlea have been stressed too hard for too long, they get weak and no longer respond to the sound. Rest in a quiet place can often restore the system to normal. However, after many hard days, some of the hairs refuse to straighten up and permanent hearing loss is the result.

The ability of the inner ear to recover from fatigue varies between individuals. But, ability to hear high pitched sounds is usually lost long before the understanding of speech is impaired. Young people usually can hear sound from around 20 to 20,000 Hertz (cycles per second).

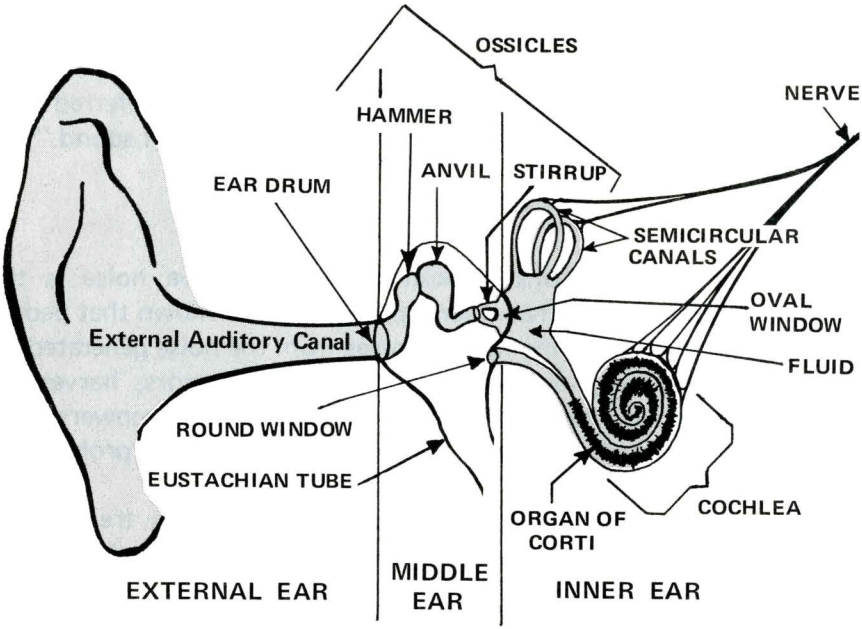

Fig. 1

The ability to hear middle and high frequency sounds usually decreases with age. The longer the noise exposure, the greater the damage to the human mechanism. Continued exposure to loud noise can lead to increasing difficulty in hearing normal conversation or even shouted warnings of danger.

PROPERTIES OF NOISE

Some properties of noise are intensity, frequency and duration. The louder the noise, the greater its intensity; high frequency noises may be more damaging to hearing than low frequency noises. Frequency is the number of variations in sound pressure per unit of time expressed in Hertz (Fig. 2).

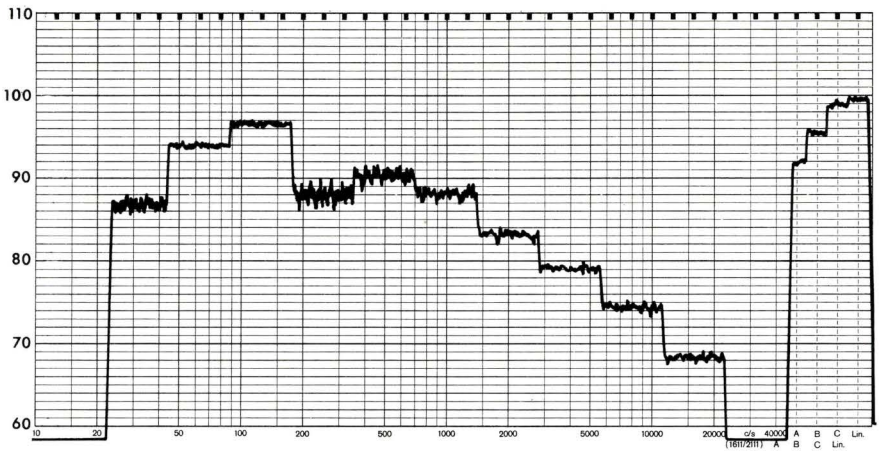

Fig. 2

Distance has an effect on sound pressure of intensity. If you are 5 feet from a noisy machine and you move back to 10 feet, the sound pressure drops to one-fourth of what it was at 5 feet.

MAN AND NOISE

Noise can affect man in several ways. It can have a psycological effect which might startle, annoy or disrupt concentration, relaxation or sleep. People working in noisy environments are more easily confused and make more errors.

Noise might also interfere with communication, thus interfering with job safety and performance.

Noise might also cause physiological effects such as loss of hearing, aural pain, fatigue, nausea, and even reduced muscular control. In extremely noisy work places, it has been possible to relate heart beat change to high noise levels.

WHY WE LOSE HEARING

While temporary hearing loss may follow short-term exposure to loud noises, normal hearing usually comes back after a rest.

Permanent hearing loss may occur as a result of aging, diseases, injury and exposure to loud noises over an extended period of time.

Sounds intense enough to cause hearing losses may not annoy a person. Actually he might even enjoy them. A farmer driving a tractor may like hearing it lug loudly through some tough spots. Some even like to remove the muffler to get the sound of more "power." In addition to these sounds, there are the sounds of snowmobiles, cycles, target shooting, sports arenas and others. On the other side, there are noises that can be annoying. Many farmers complain about the extremely high noise levels in livestock auction barns.

The now-and-then nature of the noises of these previous situations probably won't bother us too much; however, continuous doses above 90 dBA cause permanent hearing losses. The safe limit is 85 dBA.

SOUND MEASUREMENT

The decibel is a standard method of expressing sound intensity. To avoid working with unwieldy numbers in evaluating sound intensity, a logarithmic scale is used as a unit of measure.

We hear according to a logarithmic scale of intensity. Taking sound pressure levels as a means of comparing loudness, we begin by measuring the average hearing threshold of young people, i.e., the softest sound they can hear in a perfectly quiet room. This we would call one decibel.

If we add enough sound to cause a perceptible increase, we have two decibels, and so on up the scale until we reach a point where the sound actually causes discomfort or pain. Pain would be that which we might get from the sound of a jet engine or large siren. This would be about 140 decibels.

When looking at any decibel scale, remember that an increase of a few dB represents a considerable increase in sound intensity (Table 1.). This becomes important as we near the ear tolerance limits for continued noise exposure. A few dB one way or the other can make the difference between safe noise levels and those which damage hearing. You can't always rely on your ears to tell you the difference. A damaging noise level may not seem much louder than the acceptable one.

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, background music
70	Noisy office, inside auto 60 mph
80	Heavy traffic, window air-cond.
85	Inside acoustically insulated protective tractor cab in field
90	OSHA limit - hearing damage on excess exposure to noise above 90 dB
100	Noisy tractor, power mower, ATV, snowmobile, motorcycle, in subway car
120	Thunderclap, jackhammer, basketball crowd, amplified siren (100')

HOW TO CONTROL NOISE

Every noise problem breaks down into three parts: (1) source of sound, (2) path along which the sound energy travels and (3) the ear.

The control of noise at the source is an engineering problem which requires dampening of the noise by modifying or redesigning the source.

Noise reduction along the path can be accomplished in other ways: by not making the noise, by putting shields between you and the noise and by absorbing the noise with some absorbent material.

Noise control at the ear can be accomplished by the use of ear protectors, limiting exposure time or working in a sound-resistant enclosure.

HEARING PROTECTION

Sometimes we cannot control all the noise at its source. In this situation, it might be necessary to have hearing protection. Hearing protection consists primarily of the insert type earplug (Fig. 3) or the earmuff (Fig 4).

The insert type is placed in the ear canal. Materials used are rubber, soft or hard plastic, wax and special fibers such as "Swedish Wool." Rubber and plastic types are popular because they are inexpensive and easy to keep clean.

Some people prefer the earplug to be custom-fitted. It does a better job of blocking out the noise and is more comfortable. The earplug has the advantage of being cooler in hot weather.

Fig. 3

Earmuffs cover the entire ear. The main advantage of the muff is that it can be taken off and put back on quickly as needed. While they are the most reliable protection available they can cause the wearer discomfort in hot weather.

Wax and 'Swedish Wool" inserts are shaped by hand. They should be discarded after one use. Plain cotton is a poor noise suppressor and offers little protection. Neither the earplugs used by swimmers nor hi-fi earphones are suitable noise protectors.

Fortunately, no one needs to suffer hearing damage. If exposure is over 85 dBA, one should consider some type of hearing protection. Some complain that hearing protection will block out all noise. This is not true since the design of protective devices merely reduces the amount of noise reaching the ear.

Fig. 4

SOURCES OF HEARING PROTECTION

Earmuffs and earplugs are available from several sources. Equipment companies, sporting goods stores and ear doctors (otolaryngologists) usually have them available. Many student groups at land grant colleges have made them available as a public service. The mechanized Agriculture Club at the University of Nebraska provides this service. Their address is Room 101, Agricultural Engineering Building, Lincoln, Nebraska 68503.

OTHER WAYS TO CONSERVE HEARING

There are several ways to conserve hearing. One of the more important ways is to keep the exhaust system in good repair. Many replacement mufflers on the market are better than the original equipment.

When shopping for new equipment, expecially new tractors, compare the noise values from the official Nebraska Tractor Tests. The Occupational Safety and Health Act does have a section relating to noise levels (Table 2). Perhaps this will relate to other pieces of farm equipment in the future.

Keep machinery properly maintained and lubricated. Poor maintenance not only makes a machine noisier but also increases wear.

Limit the amount of exposure to noisy items such as chain saws, grinders, etc., unless you are using ear protection. Try to place noisy items such as crop drying equipment away from dwellings and livestock confinement.

Insulate or place noise barriers where you have noisy equipment. If you have a noisy cab, insulate it. Your extension agricultural engineer has information on how this should be done.

Everyone in agriculture should have a hearing test. Studies have shown that agriculturally related noises have caused hearing problems. These tests can be obtained at the University of Nebraska Speech and Hearing Clinic, Tractor Power and Safety Day, Nebraska State Fair, otolaryngologists (ear, nose and throat specialists) and other organizations sponsoring screening tests.

It is a good idea to get a test even if you think you do not have a problem since the hearing test can reveal early signs of hearing loss.

Table 2. Occupational safety and health act noise levels (as measured on standard sound level meter, A-scale, slow-response*).

Duration per day, hours	*Sound level dB*
8	90
6	92
4	95
3	97
2	100
1½	102
1	105
½	110
¼ or less	115

Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.

**Sound level meters, which measure sound pressure in decibels, have several "scales," usually A, B and C. The A-scale, commonly used for general noise measurement, corresponds to the response of the human ear which is less efficient at picking up low sounds below 500 cycles than the middle and high tones up to 8,000 cycles. The meter set on the C-scale (used in earlier Nebraska farm machinery noise studies) picks up all frequencies about equally, and the dB figure would usually be a little higher for a given machine than on the A-scale.*

In 1970, the University of Nebraska Tractor Testing Laboratory included a noise level test as part of the official Nebraska Test. The test included a bystander level test which is a requirement for tractors sold on the European market. The 100, 75, and 50% load gives the noise levels at full throttle at those loads (Fig. 5). A new test at part throttle and 50% pull was added shortly after the test started. Table 3 shows results of noise testing, Nebraska Tractor Testing Laboratory, University of Nebraska. Note the lower readings from the first test in 1970 to those in succeeding years. Much of this has resulted from refinement in cab design and improved insulation.

A great deal of credit should go to the manufacturers for the outstanding job they are doing in reducing the noise levels on tractors. A lot of advancement has been made over the last few years; more is promised in the future.

A great deal has been learned about problems relating to noise. For example, we know what noise is, the agricultural equipment producing it, and the damaging effects it causes to the hearing mechanism.

The noise level on new equipment is being reduced; however, this does not affect much of the equipment that is in use today. The task of hearing conservation is up to you. You can conserve the hearing you have by getting a hearing test and using proper ear protectors.

Fig. 5

Table 3. Nebraska tractor test summary of sound test results 1970-1971 (dBA).

Tractor name	*Test No.*	*Bystander sound level*	*Max. available power*	*75% of pull*	*50% of pull*	*50% of pull (part throttle)*
Case 970 Manual Dsl.	1034	90.0	94.0	94.5	94.5	91.0
Case 1070 Manual Dsl.	1035	89.5	95.0	94.5	95.5	------
Case 1070 P. S. Dsl.	1036	89.5	95.0	94.0	96.0	-------
Case 970 P. S. Dsl.	1037	89.5	93.0	95.0	95.5	93.5
Case 970 P. S. Gas	1038	85.5	91.5	91.5	89.5	-------
Case 970 Manual Gas	1039	86.0	92.0	92.0	90.5	-------
Oliver 1855 Dsl.	1040	86.5	93.5	95.0	94.0	-------
Oliver 1655 Dsl.	1041	88.0	98.5	99.0	97.0	-------
Oliver 1655 Gas	1042	85.0	97.0	96.0	95.5	-------
Allis-Chalmers 175 Dsl.	1043	86.0	93.0	93.0	92.0	-------
Allis-Chalmers 185 Dsl.	1044	88.5	94.5	96.0	94.5	90.5
Int'l 826 Dsl.w/cab	1045	88.0	95.0	96.0	97.0	90.0
Int'l 826 Hydro. Dsl. w/cab	1046	89.0	99.5	98.0	95.5	94.0
Int'l 1026 Hydro. Dsl. w/cab	1047	88.0	97.5	95.5	93.5	95.5
Int'l 1456 Dsl. w/cab	1048	86.4	93.0	92.0	91.5	93.0
Massey-Ferguson MF 1150 Dsl.	1049	91.4	99.0	98.5	98.5	99.0
John Deere 4320 Dsl. 2/cab	1050	88.4	92.0	92.5	92.5	90.0
Ford 3000 Gas 6-Speed	1051	81.5	100.0	99.0	96.0	93.5
Ford 3000 Dsl. 6-Speed	1052	84.8	99.5	97.5	96.0	93.5
Ford 2000 Dsl. 6-Speed	1053	86.9	100.0	98.5	96.5	94.5
Ford 2000 Gas 6-Speed	1054	81.3	98.5	96.5	93.5	-------
Oliver 1955 Dsl.	1055	87.3	95.5	95.5	95.5	91.0
Oliver 1755 Gas	1056	86.0	94.0	94.0	94.0	91.5
Oliver 1755 Dsl.	1057	92.5	97.5	96.5	96.0	92.5
Case 770 P.S. Dsl.	1058	88.4	93.5	94.0	94.0	89.5
Case 870 P.S. Gas	1059	84.4	92.5	90.5	89.0	88.0

Table 3. (Cont.)

Tractor name	*Test No.*	*Bystander sound level*	*Max. available power*	*75% of pull*	*50% of pull*	*50% of pull (part throttle)*
Case 870 Manual Gas	1060	84.4	91.5	90.0	88.5	87.0
Case 770 Manual Gas	1061	83.5	89.5	89.0	88.5	-------
Case 1170 Dsl. w/cab	1062	89.0	89.5	91.0	90.0	89.0
John Deere 7020 Dsl. w/cab	1063	87.0	97.0	96.0	96.5	92.5
John Deere 4620 P.S. Dsl. w/cab	1064	86.7	94.5	95.0	96.5	92.5
Allis-Chalmers 210 Dsl.	1065	90.5	97.0	97.5	97.5	92.5
Case 1070 P.S. Dsl. w/cab	1066	89.8	90.5	92.5	91.0	88.0
Case 1070 Man Dsl. w/cab	1067	90.0	88.5	89.0	90.5	89.0
Case 970 P.S. Dsl. w/cab	1068	89.0	91.0	91.0	90.5	90.0
Minn. Moline G1350 Dsl.	1069	86.6	99.0	98.0	97.0	92.0
Minn. Mo. A4T-1600 Dsl. w/cab	1070	94.2	87.5	87.0	86.0	85.0
Kubota L210 Dsl.	1071	80.0	96.5	95.5	95.5	------
Kubota L260 Dsl.	1072	83.0	99.0	97.5	96.0	90.0
John Deere 4620 S. R. Dsl. w/cab	1073	86.2	93.0	93.0	93.4	92.0
Deutz 8006 Dsl.	1074	84.6	98.5	98.0	96.5	93.5
Deutz 4006 Dsl.	1075	81.0	94.0	93.5	91.5	88.5
Case 870 P.S. Dsl. w/cab	1076	86.5	88.0	88.5	89.5	87.5
Case 870 Man. Dsl. w/cab	1077	87.0	88.0	88.5	89.5	89.5
Case 970 Man. Dsl. w/cab	1078	88.5	88.0	88.5	88.5	88.0
Steiger Bearcat w/cab	1079	92.5	89.5	90.5	91.5	86.0
Int. 1466 w/cab deluxe	1080	85.5	88.5	87.0	87.5	85.0
Int. 1066 w/cab deluxe	1081	86.0	85.5	86.5	87.0	85.0

Table 3. (cont.)

Tractor name	*Test No.*	*Bystander sound level*	*Max. available power*	*75% of pull*	*50% of pull*	*50% of pull (part throttle)*
Int. 966 w/cab deluxe	1082	88.5	85.5	87.0	88.0	83.5
Int. 1066 Hydro. w/cab dlx	1083	90.0	91.5	89.5	90.5	88.0
John Deere 2030 Gas	1084	84.0	94.5	94.5	94.5	88.5
John Deere 2030 Dsl.	1085	86.5	97.0	97.0	96.5	90.5
Massey Ferguson 1500 w/cab	1086	91.0	84.5	88.5	88.5	83.5
Massey Ferguson 1800 w/cab	1087	92.0	88.5	89.5	90.5	83.5
Case 770 Manual Dsl. w/cab	1088	87.0	86.5	88.5	88.5	87.5
Case 770 P.S. Dsl. w/cab	1089	85.5	86.5	88.0	87.5	85.0
Deutz D60 06 Dsl	1091	87.5	96.0	95.0	93.5	90.5
Deutz D130 06 Dsl	1092	88.0	98.0	97.0	96.0	95.5
Ford 7000 Dsl.	1093	88.5	96.5	97.0	97.5	94.0
Int'l 766 Gas w/cab	1094	84.5	85.0	86.0	84.5	85.5
Int'l 966 Hydro Dsl. w/cab	1095	92.0	89.0	90.0	87.5	86.0
Int'l 454 Gas	1096	80.0	93.0	92.0	92.0	91.0
Int'l 454 Dsl	1097	84.5	94.5	94.5	93.5	92.0
Int'l Utility 574 Gas	1098	81.5	93.5	94.5	92.0	90.0
Int'l Utility 574 Dsl.	1099	86.0	95.0	96.5	95.0	88.0
John Deere 6030 Dsl. w/cab	1100	86.0	87.0	86.5	86.5	85.0
John Deere 7530 Dsl. w/cab	1101	85.0	88.0	87.5	88.5	85.0
Case 1370 Dsl w/cab	1102	90.0	88.0	89.0	88.0	82.5
Case 1270 Dsl. w/cab	1103	89.0	88.0	88.5	88.0	85.5
Deutz D55 06 Dsl.	1104	85.5	95.5	95.5	94.5	90.5
Deutz D100 06 Dsl.	1105	89.5	100.5	99.5	100.0	94.5
Satoh S650-G Gas	1106	83.0	96.5	95.5	95.0	-------

(Table 3. (Cont.)

Tractor name	*Test No.*	*Bystander sound level*	*Max. available power*	*75% of pull*	*50% of pull*	*50% of pull (part throttle)*
Long R9500 Special Dsl.	1107	89.5	97.5	99.0	98.5	92.5
Long U445 Dsl.	1108	85.5	101.5	98.5	96.5	92.0
Long U550 Dsl.	1109	87.0	98.5	96.0	95.0	91.0
John Deere 4430 Q. R. Dsl. w/cab	1110	87.5	82.5	82.5	82.0	82.0
John Deere 4030 Q. R. Dsl. w/cab	1111	90.5	82.0	83.5	83.0	79.5
John Deere 4230 Q. R. Dsl. w/cab	1112	91.0	83.0	82.5	81.5	81.0
John Deere 4630 P.S. Dsl. w/cab	1113	88.5	82.5	83.0	83.0	82.0
Case 2470 Dsl. w/cab	1114	90.0	83.0	85.0	83.5	82.0
Int'l 354 Gas	1115	82.5	90.5	91.0	89.5	87.0
Int'l 4166 Dsl. w/cab	1116	89.5	89.5	89.0	89.0	92.0
Int'l 766 Dsl. w/cab	1117	91.0	89.0	88.5	88.5	85.5
Int'l 1468 Dsl. w/cab	1118	91.5	91.5	92.5	92.0	88.5