

How Do We Protect Our Ears?

Work Sheet

Below are problems you will solve during class. Do not attempt to answer now.

1. Use Worksheet 1. Working with the person next to you, answer what is the difference in energy for each of the following pairs of dBs?

80 – 90: energy difference _____ 80 – 83: energy difference _____

75 – 105: energy difference _____ 70 – 90: energy difference _____

For the Adventurous! 85 – 100: energy difference _____

2. Use Worksheet 2. Working in your group, fill in “dB difference” and “Times Louder” for each tool on the worksheet. Be ready for your group to report the differences when asked.

3. Use Worksheet 2. Working on your own, fill in “Damage Risk” as results are presented for each tool on the screen “Can I Get Hearing Damage from My Work?” Be ready to give damage risk answer if asked.

4. Use the Worksheet Selecting Quieter Mowers and the formula on Worksheet 1 to answer the following questions about selection of quieter equipment.

What is the dB level for the Snapper Gas self-propelled mower? _____

What is the dB level for the Ariens Gas self-propelled mower? _____

What is the times louder one machine is than the other? _____

What is the difference in damage risk? (*Instructor provides*) _____

5. Working with your group, and using NIOSH dBA Exposure Calculator and Workplace Noise With/Without PPE work sheet, give at least two solutions to the following problem. Choose a group member to report results.

It is an ambitious work day. You start with 2 hours using a chain saw, followed by 4 hours using a sit-down mower. To top it off, you’ve got 2 more hours with a weed wacker.

Answer the following questions:

What percent of the daily permissible exposure level have you achieved? _____

What is the approximate 8-hour dBA level for that exposure? _____

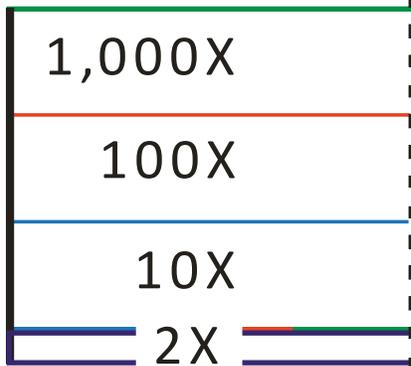
Using the materials now in your possession, provide at least two ways you could reduce the exposure equal to or less than 100% of the daily exposure. Can you get down to 50% with one of your solutions?

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Worksheet #1

Measure dBs

Cut or tear along the dotted line.
Align marks with dBs on scale
to estimate dB increases
2 to 1,000 times greater.



For The Adventurous!

Use the formula below to figure size difference of any two dBs

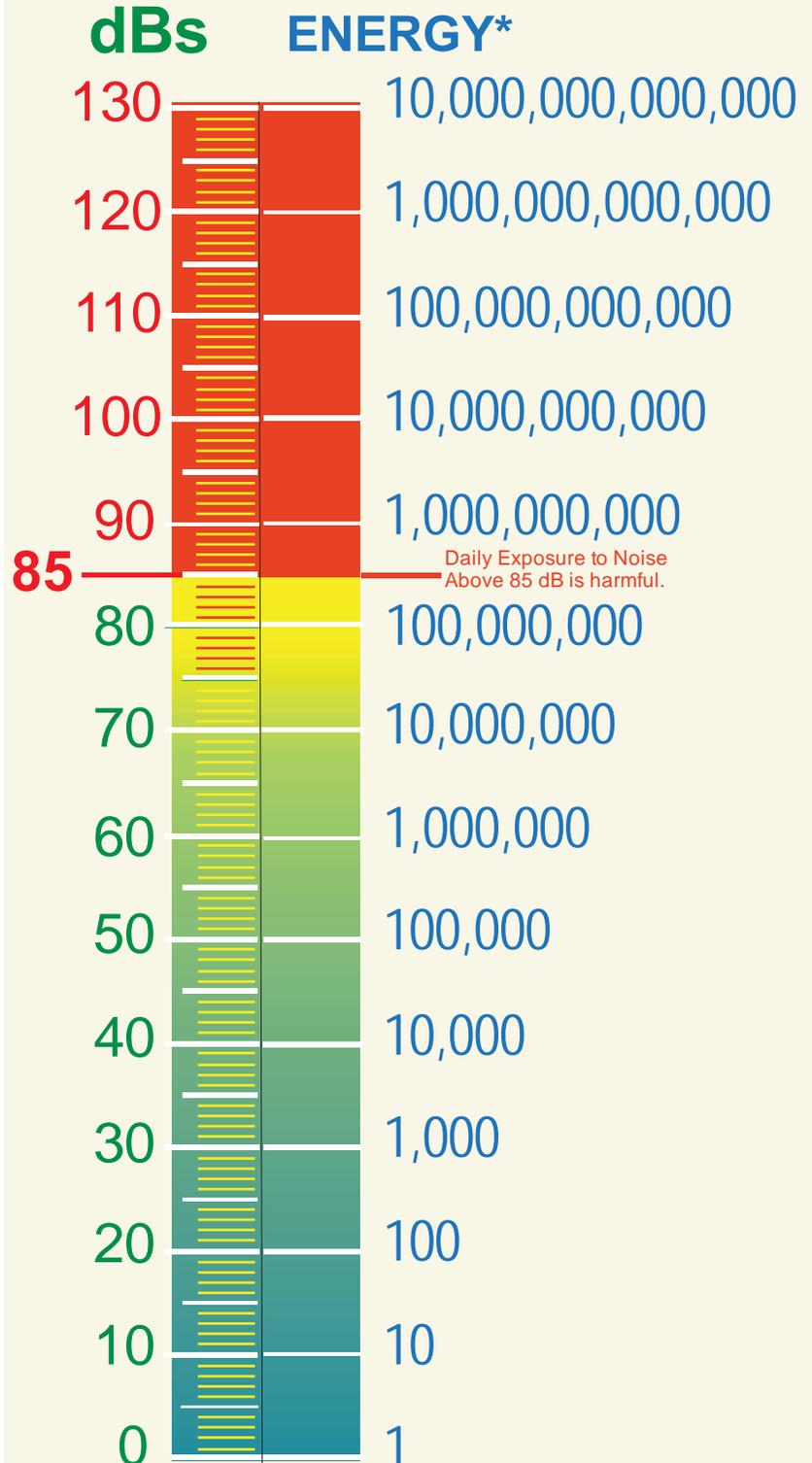
1. Subtract smaller dB from larger dB
2. Divide answer by 3
3. Use the result as the exponent of 2

For example, how much more energy is 96dB than is 81 dB?

1. $96 - 81 = 15$
2. $15/3 = 5$
3. $2^5 = 2 \times 2 \times 2 \times 2 \times 2 = 32$

96 dB has 32 times more energy than 81 dB.

NOISE ENERGY



*Relationship sound Energy in dBs and in Watts/Meter² from 10⁻¹² to 10¹³

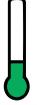
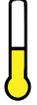
Equipment	Equipment dB	Preferred* dB	dB Difference	How Much Louder	Damage Risk
	105 dB	80 dB			
	112 dB	80 dB			
	102 dB	80 dB			
	101 dB	80 dB			
	88 dB	80 dB			
	89 dB	80 dB			
	94 dB	80 dB			
	91 dB	80 dB			
	100 dB	80 dB			
	90 dB	80 dB			

*NIOSH recommends keeping exposures at or below 80 dB. NIOSH has determined that daily exposures above 85 dB may be harmful to health. OSHA uses 85 dB as the "action level" at which an employer must establish a Hearing Protection Plan. FOF

How Do We Protect Our Ears?

Selecting Quieter Mowers.

The table below provides brand, model, published price, and noise levels of mowers. For noise levels for the operator above 85 dBA (color code red), hearing protection must be offered and worn. Between 80 and 85 dBA, hearing protection is advisable if your exposure is unusually long, or if you engage in other loud activities throughout the day. For noise under 82 dBA, hearing protection is not required but may be used.

	 Hearing Protection is not required but may be used.		 Hearing Protection Recommended.		 Hearing Protection must be offered and worn.		
	Brand	Type	Model	Price	Noise @ Operator	Noise @ 25 feet	# of 60 dBA Electric Mowers to which noise is equivalent
	McLane*	Reel Mower17"	Front Throw	\$200	63	54	0.25
	Brill/Sun Lawn	Reel Mower	Luxus 38	\$200	68	55	0.31
	Brill/Sun Lawn*	Cordless Elec Reel	380 ASM	\$350	68	56	0.40
	Silent Reel	Reel Mower		\$249	74	58	0.63
	Neuton*	Electric-Cordless	EM 4.1	\$400	77	59	0.79
	American	Reel Mower		\$130	76	60	1.00
	Yard Machines	Electric-Corded	13 inch	\$200	79	60	1.00
	Black & Decker*	Electric-Cordless	CMM 1000	\$464	79	62	1.59
	Electric Ox	Electric Riding		\$7,500	82	63	2.00
	Black & Decker*	Electric-Corded	MM875	\$244	80	64	2.52
	Ariens*	Gas-Self Prop	911097	\$470	82	72	17.00
	Honda*	Gas-Self Prop	HRX217HXA	\$700	84	74	27.00
	Bolens*	Electric-corded	18A-V17-765	\$190	85	74	27.00
	Toro*	Gas-Self Prop	PP Recycler 20031	\$420	85	74	28.00
	Murray*	Gas-Push	225112X92A	\$155	84	75	30.00
	Craftsman*	Gas-Self	37910	\$280	84	75	30.00
	Murray*	Gas-Self Prop	226111X92A	\$215	85	75	34.00
	Craftsman*	Gas-Push	38746	\$200	86	75	32.00
	Toro*	Gas-Push	20008	\$350	86	75	34.00
	Craftsman*	Gas-Self Prop	37778	\$330	86	75	34.00
	Craftsman*	Gas-Self Prop	37855	\$330	86	75	35.00
	Craftsman*	Gas-Self Prop	37784	\$400	85	76	37.00
	Yard-Man*	Gas-Self Prop	12A978Q	\$400	85	76	38.00
	Yard-Man*	Gas-Self Prop	12A445E755	\$260	87	76	38.00
	Lawn-Boy*	Gas-Self Prop	Gold Series 10655	\$400	87	76	38.00
	MTD*	Gas-Push Pro	11A588Q	\$200	88	76	38.00
	Craftsman*	Gas-Push	38855	\$229	89	74	34.00
	Bolens*	Gas-Push	11A-584E765	\$170	89	76	41.00
	Yard-Man*	Gas-Self Prop	DLX 12A567A	\$300	88	77	49.00
	Craftsman*	Gas-Self Prop	37894	\$280	88	77	50.00
	Troy-Bilt*	Gas-Self Prop	TuffCut 230	\$400	89	77	50.00
	Yard-Man*	Gas-Push	11A435D775	\$190	89	77	50.00
	Bolens*	Gas-Push	11A084C163	\$170	88	77	53.00
	Husqvarna*	Gas-Self Prop	55R21HV	\$480	86	78	57.00
	Snapper*	Gas-Self Prop	RP215517HC	\$660	91	63	80.00
	Snapper*	Gas-Push	MR216517B	\$410	90	80	102.00
	Husqvarna*	Gas-Self Prop	5521CHV	\$350	91	82	150.00

Data sources: Noise Pollution Clearinghouse and Consumer Reports

*Evaluated by Consumer Reports in the June 2004 issue

Chain Saw Noise Levels

Fuel	Brand	Model	HP	Cost	Rank how well saw cut	25 foot with load Lmax (dBA)	25 foot no load Lmax (dBA)	Operator with load Leq (dBA)	Operator with load Lmax (dBA)	Operator no load Leq (dBA)	Operator no load Lmax (dBA)
Electric	Makita	Battery		\$198	15	61	61	79	81	79	80
Electric	Neuton	Battery		\$100	14	66	67	83	84	82	83
Electric	Husquavarna	316		\$229	2	71	71	90	92	92	94
Electric	Makita	UC4000		\$199	1	75	77	92	95	93	95
Electric	McCulloch		1.5	\$40	13	77	79	94	98	95	96
Electric	Remington		3	\$85	10	78	80	98	99	97	100
Electric	Remington		1.5	\$55	11	79	81	96	99	93	95
Electric	Troybuilt		3.5	\$90	5	80	82	95	98	94	97
Electric	Poulan		2	\$50	6	81	86	100	102	96	99
Electric	Craftsman		2.5	\$50	9	81	86	101	102	97	97
Electric	Poulan		3.5	\$80	4	81	87	97	100	98	101
Electric	Remington	Pole	1.25	\$110	12	81	87	98	101	97	99
Electric	Craftsman	Saw	3.5	\$80	8	83	86	97	99	98	101
Electric	Poulan		4	\$100	3	83	87	98	101	98	102
Electric	Poulan	Pro	3	\$60	7	84	86	99	101	97	100
Gas	Husquavarna					86	88	102		106	
Gas	Pouland	261				85	92	107	109	109	112
Gas	Jonserud	2775				91	98	111	114	115	117
Gas	Jonserud	Turbo 2171				NA	97	110	114	112	116



dBA Exposure Calculator

% of 100% exposures, based on NIOSH 3dBA doubling

85 dBA NIOSH level for PPE use corresponds to OSHA 85 dBA action Level

in landcare industries OHSA requires exposure control, which may include PPE, at 85 dBA for an 8-hour TWA

Protection not required but may be used.

Protection is recommended.

Protection must be offered and worn.

DBA	Hours																
	.25	.50	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
80	.5	1.0	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.0	24.0	26.0	28.0	30.0
81	.7	1.3	2.5	5.0	7.6	10.1	12.6	15.1	17.6	20.2	22.7	25.2	27.7	30.2	32.8	35.3	37.8
82	.8	1.6	3.2	6.3	9.5	12.7	15.9	19.0	22.2	25.4	28.6	31.7	34.9	38.1	41.3	44.4	47.6
83	1.0	2.0	4.0	8.0	12.0	16.0	20.0	24.0	28.0	32.0	36.0	40.0	44.0	48.0	52.0	56.0	60.0
84	1.3	2.5	5.0	10.1	15.1	20.2	25.2	30.2	35.3	40.3	45.4	50.4	55.4	60.5	65.5	70.6	75.6
85	1.6	3.2	6.3	12.7	19.0	25.4	31.7	38.1	44.4	50.8	57.1	63.5	69.8	76.2	82.5	88.9	95.2
86	2.0	4.0	8.0	16.0	24.0	32.0	40.0	48.0	56.0	64.0	72.0	80.0	88.0	96.0	104.0	112.0	120.0
87	2.5	5.0	10.1	20.2	30.2	40.3	50.4	60.5	70.6	80.6	90.7	100.8	110.9	121.0	131.0	141.1	151.2
88	3.2	6.4	12.7	25.4	38.1	50.8	63.5	76.2	88.9	101.6	114.3	127.0	139.7	152.4	165.1	177.8	190.5
89	4.0	8.0	16.0	32.0	48.0	64.0	80.0	96.0	112.0	128.0	144.0	160.0	176.0	192.0	208.0	224.0	240.0
90	5.4	10.8	20.2	40.3	60.5	80.6	100.8	121.0	141.1	161.3	181.4	201.6	221.7	241.9	262.1	282.2	302.4
91	6.4	12.7	25.4	50.8	76.2	101.6	127.0	152.4	177.8	203.2	228.6	254.0	279.4	304.8	330.2	355.6	381.0
92	8.0	16.0	32.0	64.0	96.0	128.0	160.0	192.0	224.0	256.0	288.0	320.0	352.0	384.0	416.0	448.0	480.0
93	10.5	20.1	40.3	80.6	121.0	161.3	201.6	241.9	282.2	322.5	362.9	403.2	443.5	483.8	524.1	564.4	604.8
94	12.7	25.4	50.8	101.6	152.4	203.2	254.0	304.8	355.6	406.4	457.2	508.0	558.8	609.6	660.4	711.2	762.0
95	16.0	32.0	64.0	128.0	192.0	256.0	320.0	384.0	448.0	512.0	576.0	640.0	704.0	768.0	832.0	896.0	960.0
96	20.1	40.3	80.6	161.3	241.9	322.5	403.2	483.8	564.4	645.1	725.7	806.3	887.0	967.6	1048.3	1128.9	1209.5
97	25.4	50.8	101.6	203.2	304.8	406.4	508.0	609.6	711.2	812.7	914.3	1015.9	1117.5	1219.1	1320.7	1422.3	1523.9
98	32.0	64.0	128.0	256.0	384.0	512.0	640.0	768.0	896.0	1024.0	1152.0	1280.0	1408.0	1536.0	1664.0	1792.0	1920.0
99	40.3	80.6	161.3	322.5	483.8	645.1	806.3	967.6	1128.9	1290.2	1451.4	1612.7	1774.0	1935.2	2096.5	2257.8	2419.0
100	50.8	101.6	203.2	406.4	609.6	812.7	1015.9	1219.1	1422.3	1625.5	1828.7	2031.9	2235.1	2438.2	2641.4	2844.6	3047.8
101	64.0	128.0	256.0	512.0	768.0	1024.0	1280.0	1536.0	1792.0	2048.0	2304.0	2560.0	2816.0	3072.0	3328.0	3584.0	3840.0
102	80.6	161.3	322.5	645.1	967.6	1290.2	1612.7	1935.2	2257.8	2580.3	2902.9	3225.4	3547.9	3870.5	4193.0	4515.6	4838.1
103	101.6	203.2	406.4	812.7	1219.1	1625.5	2031.9	2438.2	2844.6	3251.0	3657.4	4063.7	4470.1	4876.5	5282.9	5689.2	6095.6
104	128.0	256.0	512.0	1024.0	1536.0	2048.0	2560.0	3072.0	3584.0	4096.0	4608.0	5120.0	5632.0	6144.0	6656.0	7168.0	7680.0
105	161.3	322.5	645.1	1290.2	1935.2	2580.3	3225.4	3870.5	4515.6	5160.6	5805.7	6450.8	7095.9	7741.0	8386.0	9031.1	9676.2
106	203.2	406.0	812.7	1625.5	2438.2	3251.0	4063.7	4876.5	5689.2	6502.0	7314.7	8127.5	8940.2	9753.0	10565.7	11378.5	12191.2
107	256.0	512.0	1024.0	2048.0	3072.0	4096.0	5120.0	6144.0	7168.0	8192.0	9216.0	10240.0	11264.0	12288.0	13312.0	14336.0	15360.0
108	322.5	645.1	1290.2	2580.3	3870.5	5160.6	6450.8	7741.0	9031.1	10321.3	11611.4	12901.6	14191.8	15481.9	16772.1	18062.2	19352.4
109	406.4	812.8	1625.5	3251.0	4876.5	6502.0	8127.5	9753.0	11378.5	13004.0	14629.5	16255.0	17880.5	19506.0	21131.5	22757.0	24382.5
110	512.0	1024.0	2048.0	4096.0	6144.0	8192.0	10240.0	12288.0	14336.0	16384.0	18432.0	20480.0	22528.0	24576.0	26624.0	28672.0	30720.0
111	645.1	1290.1	2580.3	5160.6	7741.0	10321.3	12901.6	15481.9	18062.2	20642.5	23222.9	25803.2	28383.5	30963.8	33544.1	36124.5	38704.8
112	812.7	1625.5	3251.0	6502.0	9753.0	13004.0	16255.0	19506.0	22757.0	26008.0	29259.0	32510.0	35761.0	39012.0	42263.0	45514.0	48765.0
113	1024.0	2048.0	4096.0	8192.0	12288.0	16384.0	20480.0	24576.0	28672.0	32768.0	36864.0	40960.0	45056.0	49152.0	53248.0	57344.0	61440.0
114	1290.2	2580.3	5160.6	10321.3	15481.9	20642.5	25803.2	30963.8	36124.5	41285.1	46445.7	51606.4	56767.0	61927.6	67088.3	72248.9	77409.5
115	1625.4	3251.0	6502.0	13004.0	19506.0	26008.0	32510.0	39012.0	45514.0	52016.0	58518.0	65019.9	71521.9	78023.9	84525.9	91027.9	97529.9

Workplace Noise With and Without PPE

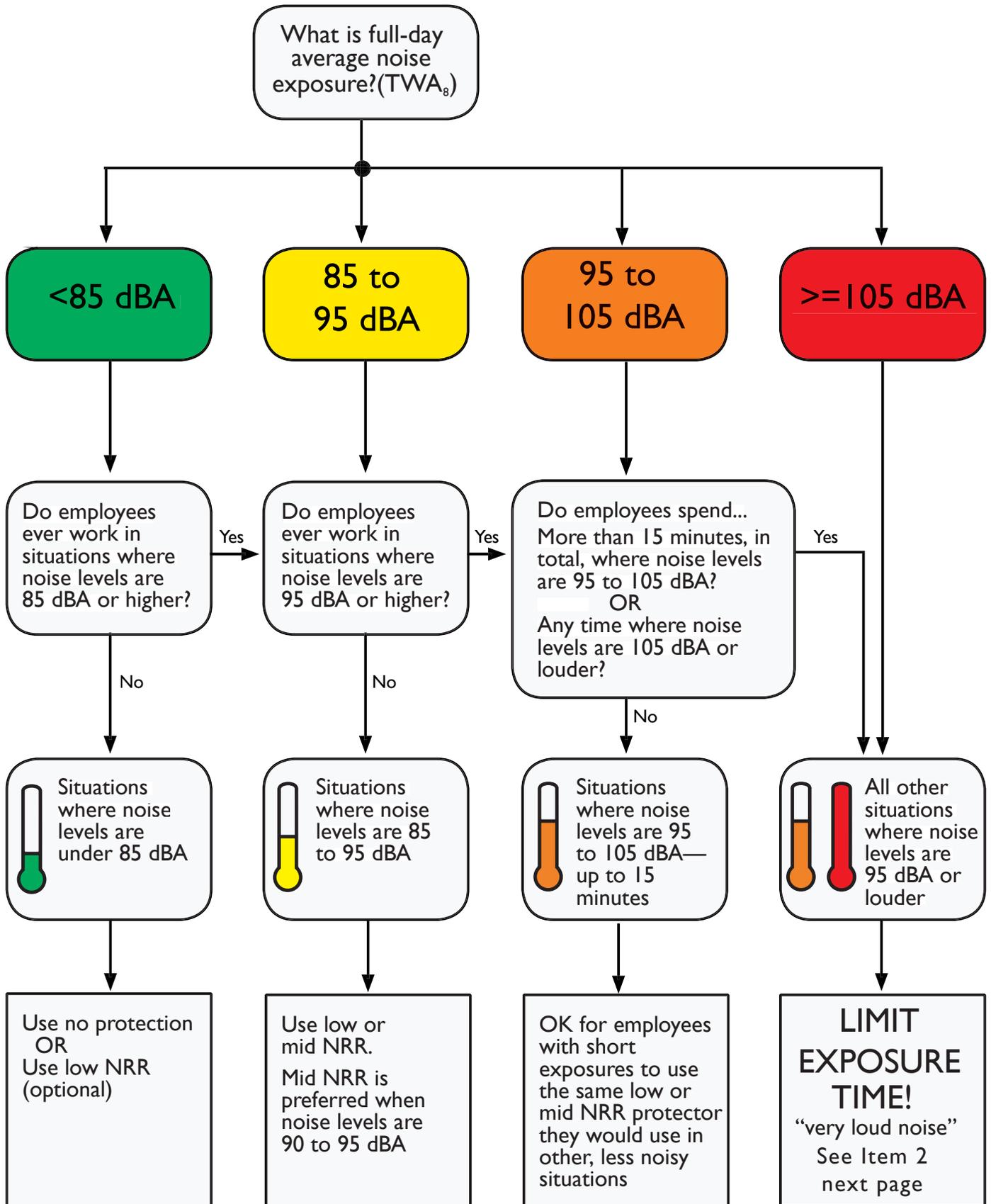
Your daily exposure to occupational noise helps determine your risk of hearing loss. Generally, the higher the decibels, the greater the risk. OSHA's noise standard for landcare is 85 dB (decibels) over an 8-hour work-day. 80 dB is the standard recommended by the National Institute for Occupational Safety and Health (NIOSH). At OSHA's level, 25 in every 100 workers will experience hearing loss over a working lifetime. At the NIOSH level of 80 dB in 8 hours, only 3 or 4 of every 100 workers will experience hearing loss over a working lifetime.

The table displays dBs for common equipment of the land care industry with various types of hearing protection. Find equipment you use and see how hearing protection reduces the dBs.

Tools/Equipment	No Protection	Formable Plugs	Foam Plugs	Muffs	Muffs+ Plugs
Air Compressor	92 dB	84 dB	79 dB	73 dB	67 dB
Background Noise	83 dB	75 dB	70 dB	64 dB	58 dB
Grinder 4 ¼"	93 dB	85 dB	80 dB	74 dB	68 dB
Hammer Drill ¼" bit	94 dB	86 dB	81 dB	75 dB	69 dB
Bob Cat S850 (operator)	88 dB	80 dB	75 dB	69 dB	63 dB
Bob Cat S850 (outside)	104 dB	96 dB	91 dB	85 dB	79 dB
Chain Saw (battery)	92 dB	84 dB	79 dB	73 dB	67 dB
Chain Saw (gas)	112 dB	104 dB	99 dB	93 dB	87 dB
Demo Saw 14" (gas)	113 dB	105 dB	100 dB	94 dB	88 dB
Hedge Trimmer (gas)	88 dB	80 dB	75 dB	69 dB	63 dB
Leaf Blower Hand Held	102 dB	94 dB	89 dB	83 dB	77 dB
Leaf Blower Backpack	104 dB	96 dB	91 dB	85 dB	79 dB
Leaf Vacuum w Tractor	104 dB	96 dB	91 dB	85 dB	79 dB
Mower Ride On (electric)	82 dB	74 dB	69 dB	63 dB	57 dB
Mower Ride On (gas)	94 dB	86 dB	81 dB	75 dB	69 dB
Mower Stand On (gas)	94 dB	86 dB	81 dB	75 dB	69 dB
Mower Walk Behind (gas)	88 dB	80 dB	75 dB	69 dB	63 dB
Mulcher (gas)	91 dB	83 dB	78 dB	73 dB	67 dB
Oxyacetylene Cutting	81 dB	73 dB	68 dB	62 dB	56 dB
Weed Whacker	100 dB	92 dB	87 dB	81 dB	75 dB
Wood Chipper	105 dB	97 dB	92 dB	86 dB	80 dB

The values in Column 2 are based on noise measurements from a variety of manufacturer and researcher sources. The values for each type of hearing protection are based on Noise Reduction Rating formulas developed by the National Institute for Occupational Safety and Health (NIOSH). Neither of these measurements may accurately reflect your noise exposures or protection factors. These depend on workplace monitoring of workers and the effectiveness of your employer's hearing protection program.

Step-by-step guidelines for selecting appropriate hearing protection



1. Guidelines for choosing hearing protection

Noise level (dBA)	Signal words	Hearing protection	Comments
115 or higher	Level A Danger	Use double protection or maybe high NRR ^{1,2}	High NRR can be OK for short exposures (less than 15 minutes) ³
105 to 115	Level B Danger	Use high NRR or maybe double protection	Mid NRR can be OK for short exposures (less than 15 minutes) ³
95 to 105	Level C Warning	Use high NRR	Low or mid NRR can be OK for short exposures (less than 15 minutes) ³
85 to 95	Level D Caution	Do not over-protect Use low or mid NRR	Mid NRR is better than low, if noise levels are usually 90 to 95 dBA
Under 85	Level E Notice	Hearing protection is optional	Low NRR is adequate for optional use

2. Guidelines for choosing hearing protection for **very loud noise!**

If the total amount of time spent in very loud noise during one day is...

	1 hour or longer	15 minutes to 1 hour	No more than 15 minutes
Level A 115 dBA or higher	Use double protection ¹	Use double protection	Use high NRR protection
Level B 105 to 115 dBA	Use double protection	Use high NRR Consider double protection	Mid NRR can be OK ³
Level C 95 to 105 dBA	Use high NRR Consider double protection ²	Mid NRR can be OK ³	Low NRR can be OK ³

1 Double protection = ear muffs plus ear plugs, together 2 Noise Reduction Rating (NRR): Low NRR < 17 dB; Mid NRR 17-24 dB; High NRR 24+ dB

3 It is OK to use the lower level of protection shown in the figure if...

- a The total amount of time and the typical noise levels are not both in the upper end of the range shown on previous page
- b Exposure occurs as brief exposures spread out over the work shift and not continuously or within a short period of time
- c The situation does not involve a lot of impact noise
- d The employee will not be exposed to noise for a large part of the rest of the shift.

How To Wear Soft Foam Earplugs

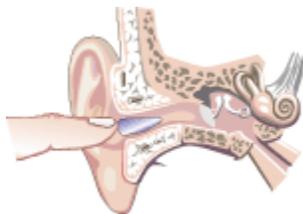
To get the best protection from your soft foam earplugs, remember to roll , pull , and hold when putting them in. Use clean hands to keep from getting dirt and germs into your ears!



- 1. Roll** the earplug up into a small, thin "snake" with your fingers. You can use one or both hands.



- 2. Pull** the top of your ear up and back with your opposite hand to straighten out your ear canal. The rolled-up earplug should slide right in.



- 3. Hold** the earplug in with your finger. Count to 20 or 30 out loud while waiting for the plug to expand and fill the ear canal. Your voice will sound muffled when the plug has made a good seal.

Check the fit when you're all done. Most of the foam body of the earplug should be within the ear canal. Try cupping your hands tightly over your ears. If sounds are much more muffled with your hands in place, the earplug may not be sealing properly. Take the earplug out and try again.