



# Hearing Loss Prevention Program

CM 598(A) Data-Driven Health and Safety for Construction

QINXUE LI

Use Table 1 to help you determine the hearing loss prevention requirements for your workplace:

<b>Criteria</b>	<b>Description</b>	<b>Requirements</b>
85 dBA TWA <sub>8</sub>	Full-day employee noise exposure dose. If you have <u>one or more</u> employees whose exposure equals or exceeds this level, you must have a hearing loss prevention program.	Hearing protection Training Audiometric testing
90 dBA TWA <sub>8</sub>	Full-day employee noise exposure dose. If you have one or more employees whose exposure equals or exceeds this level, you must reduce employee noise exposures in the workplace.	Noise controls Hearing protection Training Audiometric testing

# Exchange rate:

- NIOSH: 3 dB - For every 3 dB increase in average exposure level, allowable time is halved.

Exposure Level (dBA)	Allowable exposure time (hrs)
85 (L <sub>C</sub> )	8 (T <sub>C</sub> )
88	4
91	2
94	1
97	30 min
100	15 min
103	7 min 30 sec
106	3 min 45 sec
109	1 min 53 sec
112	0.94 min
115	28 sec

- OSHA: 5 dB - For every 5 dB increase in average exposure level, allowable time is halved.

Exposure Level (dBA)	Allowable exposure time (hrs)
90 (L <sub>C</sub> )	8 (T <sub>C</sub> )
95	4
100	2
105	1
110	0.5 (30 min)
115	0.25 (15 min)

Although some hearing damage recovery may occur during intermittent quiet periods, there is no adequate scientific basis for the use of a 5 dB ER.


(Seixas, Noah, Rick Neitzel, Lianne Sheppard, and Bryan Goldman. "Alternative Metrics for Noise Exposure among Construction Workers." *The Annals of Occupational Hygiene* 49, no. 6 (2005): 493-502.

**TABLE VI. Unprotected versus Protected<sup>A</sup> NIOSH TWA Exposures**

Trade	Number Shifts	Unprotected NIOSH TWA (TWA, dBA)			Protected NIOSH TWA (TWA <sub>prot</sub> , dBA)			Effective Protection, P <sub>eff</sub> (Unprotected—Protected) (dBA)		% Overexposures <85 dBA Due to HPDs
		Mean	SD	% >85 dBA	Mean	SD	% >85 dBA	Mean	SD	
Overall	557	87.4	5.7	64.5	84.8	7.4	51.2	2.7	6.0	20.6
Carpenters	81	89.3	4.5	84.0	86.2	6.9	65.4	3.1	6.2	22.1
Cement masons	31	87.7	5.6	61.3	85.0	7.8	51.6	2.7	5.9	15.8
Electricians	230	86.7	5.5	59.1	86.2	6.2	56.1	0.5	2.5	5.1
Insulation workers	23	81.8	3.8	26.1	81.1	4.2	21.7	0.7	3.4	16.7
Ironworkers	37	90.7	5.5	83.8	89.5	6.3	78.4	1.2	4.1	6.5
Laborers	6	87.9	5.9	50.0	84.8	5.5	33.3	3.1	7.6	33.3
Masonry workers	73	88.5	6.7	65.8	84.4	7.0	43.8	4.1	7.0	33.3
Operating engineers	33	88.1	6.0	75.8	77.3	9.0	24.2	10.9	9.2	68.0
Sheet metal workers	43	85.7	4.2	53.5	78.8	8.0	25.6	6.8	8.4	52.2

<sup>A</sup>HPD-use adjusted.

(Neitzel, Richard, and Noah Seixas. "The Effectiveness of Hearing Protection Among Construction Workers." *Journal of Occupational and Environmental Hygiene* 2, no. 4 (2005): 227-38.)



# Components of a Hearing Loss Prevention Program

➤ Monitoring:

- develop and implement a monitoring program
- notify employees the results of monitoring
- provide an opportunity to observe any noise measurements.

# Components of a Hearing Loss Prevention Program

- Audiometric testing : Provided at no cost to employees
  - must be supervised and reviewed by licensed or certified individuals:
    - an audiologist
    - an otolaryngologist
    - another qualified physician.
- And** ➤ audiograms must be conducted by
  - one of the above
- Or** ➤ a technician certified by the Council of Accreditation in Occupational Hearing Conservation (CAOHC) and responsible to a qualified reviewer
- establish a baseline audiogram for each exposed employee
- conduct audiograms annually

OSHA: A technician who operates microprocessor audiometers does not need to be certified.





# Components of a Hearing Loss Prevention Program

- Training:
  - provide training when an employee:
    - first assigned to a position involving noise exposure  $\geq 85$  dBA TWA<sub>8</sub>
    - at least annually after
  - update information and maintain a written program describing initial and refresher training.
- Hearing protection:
  - the selection must include at least two distinct types
  - must provide hearing protection at no cost to employees
  - evaluate hearing protector attenuation
- Recordkeeping:
  - Exposure measurements- retained for two years
  - Audiometric tests- retained for the duration of the employment

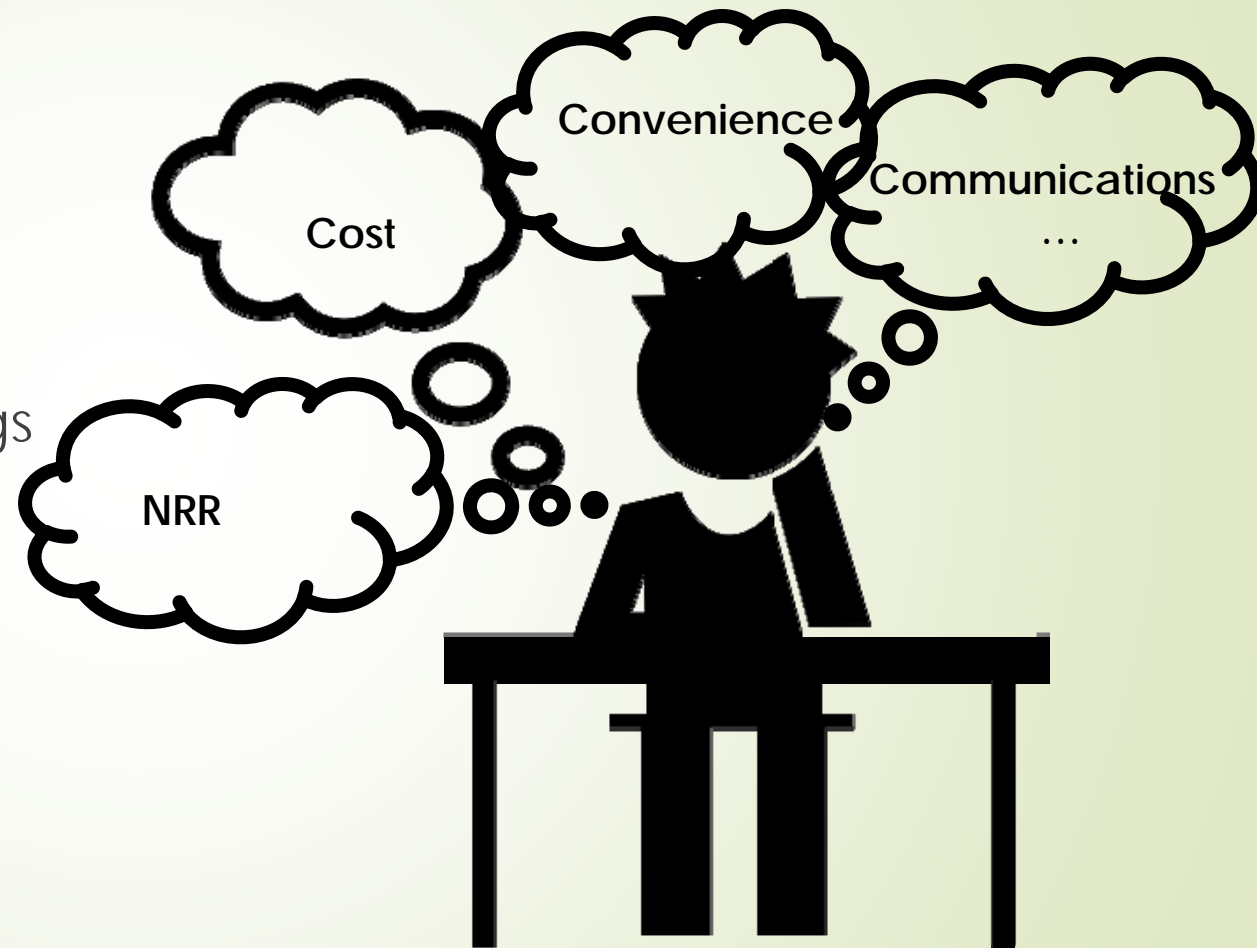
# Hearing protection devices (HPDs)

- ▶ Making sure employees use hearing protection, if you cannot feasibly control the noise. (WAC 296-817-100 Scope)
- ▶ You must make sure all hearing protection is sufficient to reduce the employee's equivalent 8-hour noise exposure to  $\leq 85$  dBA. (WAC 296-817-20015)
- ▶ However, excessive protection, where the protected exposure is below about **70 dBA** may interfere with communication and the employee's ability to hear activity or alarms around them.
- ▶ Potential range of  $dBA_{protected}$ : [70dBA,85dBA]



## Types of HPDs

- ▶ Foam earplugs
- ▶ Molded earplugs
- ▶ Earcaps
- ▶ Earmuffs
- ▶ Custom-molded earplugs



# Noise Reduction Rating(NRR)

- Required by law on all HPDs sold in the United States
- Used to determine a worker's protected A-weighted noise exposure (WAC 296-817-20015)

Type of hearing protection	A-weighted noise exposure
Single hearing protection(earplugs, earcaps or earmuffs)	$dB A_{protected} = dB A_{unprotected} - (NRR - 7)$
Dual hearing protection (earplug and earmuff worn together)	$dB A_{protected} = dB A_{unprotected} - (\max(NRR_i) - 2)$ For example, $NRR_{earplugs} = 20dB$ , $NRR_{ earmuffs} = 12dB$ , are considered to reduce employee exposures of 100 dBA TWA <sub>8</sub> to 82 dBA TWA <sub>8</sub>

# Noise Reduction Rating(NRR)

- NIOSH: considers the real-world performance of most different types of hearing protector

Type of hearing protection	A-weighted noise exposure
Earmuffs	$dBA_{protected} = dBA_{unprotected} - (0.75NRR - 7)$
Foam earplugs/custom earplugs	$dBA_{protected} = dBA_{unprotected} - (0.5NRR - 7)$
Other	$dBA_{protected} = dBA_{unprotected} - (0.3NRR - 7)$
Dual hearing protection (earplug and earmuff worn together)	$dBA_{protected} = dBA_{unprotected} - (\max(NRR_i) + 5)$

► Foam earplugs

$dBA_{unprotected}$	Min(NRR)	Max(NRR)
87.4dBA (average)	18.4	48.8
90.7dBA (Ironworkers)	25.4	55.4



3M 1100 UF NRR=29 dB

Quantity	Price per Item
1-9	\$0.53
10-24	\$0.32
25-49	\$0.21
50+	\$0.16



Laser Lite® NRR=32 dB

Quantity	Price per Item
1-9	\$0.76
10-24	\$0.46
25-49	\$0.30
50+	\$0.23



Radians Resistors™ NRR=32 dB

Quantity	Price per Item
1-9	\$1.15
10-24	\$0.69
25-49	\$0.46
50+	\$0.34

# Foam earplugs

## Advantages:

- ▶ Small
- ▶ Inexpensive
- ▶ Portable
- ▶ Generally more comfortable than others
- ▶ Worn effectively without interference from hair or glasses

## Disadvantages:

- ▶ Can be hard to fit, esp. small canals
- ▶ Can introduce dirt into canal
- ▶ Protection level can vary with:
  - ▶ canal anatomy
  - ▶ insertion method
  - ▶ wax/hair in canals



► Molded earplugs/earcaps: **Not Recommended**

$dBA_{unprotected}$	Min(NRR)	Max(NRR)
87.4dBA (average)	31.3	81.3
90.7dBA (Ironworkers)	42.3	92.3



Radians Resistors™ NRR=27 dB

Quantity	Price per Item
1	\$1.19
2-9	\$0.74
10+	\$0.59



TriSonic NRR=25dB

Quantity	Price per Item
1	\$1.00
2-9	\$0.63
10+	\$0.50



Howard Leigh NRR=21

Quantity	Price per Item
1	\$5.60
2-9	\$4.67
10-99	\$4.00
100+	\$3.73



➤ Earmuffs:

$dBA_{unprotected}$	Min(NRR)	Max(NRR)
87.4dBA (average)	12.6	32.5
90.7dBA (Ironworkers)	16.9	36.9



Radians Cap NRR=22 dB

Quantity	Price per Item
1	\$9.52
2-9	\$8.84
10-49	\$8.25
50+	\$7.74



Howard Leight NRR=27dB

Quantity	Price per Item
1	\$20.65
2-9	\$19.17
10-49	\$17.89
50+	\$16.78



# Earmuffs

## Advantages:

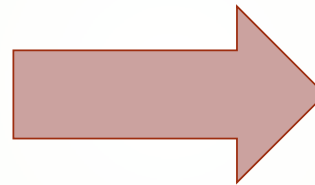
- ▶ Easy to fit properly
- ▶ Designed to fit "most" people
- ▶ Less time & effort applying and fitting
- ▶ Easily visible/monitored
- ▶ Not misplaced/lost as easily

## Disadvantages:

- ▶ Uncomfortable in hot environments
- ▶ May be cumbersome & restrict head motion
- ▶ Hair & glasses can alter protection
- ▶ More expensive

► Custom-molded ear plugs

$dBA_{unprotected}$	Min(NRR)	Max(NRR)
87.4dBA (average)	18.4	48.8
90.7dBA (Ironworkers)	25.4	55.4



**E.A.R. Inc. NRR=26**

Quantity	Price per Item
1	\$19.00
2-9	\$16.00
10-49	\$15.00
50-199	\$14.00
200+	\$11.00




# Custom-molded ear plugs

## Advantages:

- Molded to fit each individual
- Comfortable
- Worn effectively without interference from hair or glasses
- Reusable

## Disadvantages:

- Expensive
- If not properly cared for, it can insert dirt, infection etc., into ear

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- ▶ However, study shows usage rates were less than **25%** of the time while workers were exposed to noise levels greater than **85 dBA**.

(Neitzel, Richard, and Noah Seixas. "The Effectiveness of Hearing Protection Among Construction Workers." *Journal of Occupational and Environmental Hygiene* 2, no. 4 (2005): 227-38.)

- ▶ The additional use of a personal noise level indicator(NLI) was considered to increase use of HPDs among construction workers.

(Seixas, Noah S. S., Rick Neitzel, Bert Stover, Lianne Sheppard, Bill Daniell, Jane Edelson, and Hendrika Meischke. "A Multi-component Intervention to Promote Hearing Protector Use among Construction Workers." *International Journal of Audiology* 50, no. 1 (2011): S46-56.)

# Noise level indicator(NLI)



3M Noise Indicator NI-100,  
by ConfinedSpace

- Function:  
alerts users when noise levels  $\geq 85$  dB.
- Dimension:  
5.1cm (L) x 3.6cm (W) x 1.3cm (D)
- Accuracy:  
+/-3dB
- Price:  
\$40.00



# Easy-to-Implement Noise Level Awareness

## Visual “Go/No Go”

- Green LED (“Go”) flashes when noise level is below 85 dBA
- Red LED (“No Go”) flashes when noise level exceeds 85 dBA
- Easy-to-understand visual indication when hearing protection may/may not be needed

## One-button operation

- Simply clip to lapel and power-on
- Easy for workers to use and understand



Actual size

## Rechargeable battery

- Provides up to 200 hours of use between charges
- 10-hour auto-power off helps prolong battery life for extra cost savings



## Small size

- Compact, lightweight design for increased hearing protection compliance

## Other things to consider:

- ▶ Solvents, e.g. toluene , styrene
  - Direct neurotoxic mechanisms





Thank you !