

INDUSTRIAL NOISE SERIES
**PART X: OSHA – NOISE
EXPOSURE IN THE
WORKPLACE**

Elden F. Ray
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TABLE OF CONTENTS

OSHA	2
MSHA	5

INDUSTRIAL NOISE SERIES

PART X: OSHA – NOISE EXPOSURE IN THE WORKPLACE

OSHA

In the United States and most parts of the world, government agencies have produced regulations that limit employee exposure to high sound levels. In the U.S., that principal agency is OSHA, Office of Safety and Health Administration.

The near-field sound level limit is frequently invoked by citing OSHA as the authority for limiting the near-field sound level to either L_A 85 or 90 decibels (dB). In the context of specifying a sound level, it is irrelevant to OSHA; it is concerned with occupational noise exposure, that is, the cumulative noise exposure that employees are exposed to as they perform their duties. OSHA does not impose a limiting sound level except for impulsive noise, where it is stated impulsive noise *should* not exceed 140 dB peak sound level. The sound level can be any level provided the employee does not exceed the allowable noise exposure limit; a function of the sound level and exposure time, not just the sound level.

The U.S. code of federal regulations (CFR), Title 29, Part 1910, Section 95¹ regulates employee exposure to noise based on sound level and exposure time and states that an employer shall administer a continuing, effective hearing conservation program whenever employee noise exposures equal or exceed an 8-hour time-weighted average (TWA) sound level of 85 decibels or equivalently, a dose (D) of fifty percent. This threshold as defined in the CFR is referred to as the *action level*. The employer must provide hearing protection equipment to employees at no cost when the 8-hour TWA equals or exceeds 85 dB or a dose of 50%.

The *action level* does not mean that the sound level must not exceed 85 dB but that a hearing conservation - protection program is to be implemented as specified in the code. Again, this is based on the TWA not the actual sound level; thus, near field levels can easily be well in excess of 85 dB without penalty. As an example, a person can be exposed to L_A 110 decibels for 14 minutes and 59 seconds without any hearing protection provided his/her TWA is less than or equal to 85 decibels (remainder of the day would have to be in a very quiet area, less than 75 dB). Some states may have additional regulations and limits that may need to be reviewed to ensure not overlooking any other regulations.

The following table lists selected exposure levels that initiate the *action level* when employee exposure limits must be monitored. At this threshold the employer must provide hearing protectors to its employees at no cost. These levels are without hearing protection.

Table I - OSHA TWA “Action Level” Thresholds

Sound Level, L_A (dB)	80	85	90	92	95	97	100	102	105	110	115
Exposure Time, T (hrs.)	16	8	4	3	2	1.5	1	.75	0.5	0.25	0.125

Note that OSHA uses a 5 dB increase in sound level per halving of the exposure time. In Europe and other parts of the world it is a 3 dB increase per halving of exposure time.

¹ General Industry Standards, U.S. code of federal regulations (CFR), Title 29 Part 1910 Section 95, Occupational Noise Exposure

INDUSTRIAL NOISE SERIES

PART X: OSHA – NOISE EXPOSURE IN THE WORKPLACE

There is an upper limit of noise exposure too. The following table lists selected sound levels and the corresponding maximum allowable employee exposure time, D=100% and/or TWA=90 dB. Note that the exposure time is twice that listed in Table I.

Table II - Selected OSHA Maximum Noise Exposure Limits

Sound Level, L _A (dB)	80	85	90	92	95	97	100	102	105	110	115
Exposure Time, T (hrs.)	32	16	8	6	4	3	2	1.5	1	0.5	0.25

Employees cannot be exposed to cumulative sound levels above D=100% and/or a TWA > 90 dB; otherwise, additional engineering controls or noise mitigation actions are required to reduce the employees' exposure; typically, this just means a higher level of hearing protection.

The maximum allowable exposure time (T), based on a particular (measured) sound level (L_A), may be calculated by:

$$T = 8 / (2^{(L-90)/5}) \text{ hours} \quad (4)$$

Equation (4) is the basis for the levels listed in Table II. The *action level* is when the exposure time is one-half the calculated allowable time.

When employees are exposed to variable levels of noise for variable time periods then the total noise dose is calculated by,

$$D = 100 \sum_{i=1}^n \left(\frac{C_i}{T_i} \right) \quad (5)$$

where n is the number of separate noise exposure events, C_i is the actual exposure time (hours) to a sound level interval and T_i is the maximum allowable exposure time per Equation (4). This is frequently confusing, so an example calculation follows.

When the dose (D) computation equals or exceeds 50% then an effective hearing conservation program is to be implemented; or, if the dose is greater than 100% (TWA > 90 dB) then actions must be taken to reduce employee exposure times and/or the source of sound levels. However, this is a cumbersome method and it may be more prudent to have employees wear inexpensive noise dosimeters to obtain a better record of their noise exposure. This may have a very good probability of not exceeding the TWA 85 dB *action level*, thus exempting the employer from administering a hearing conservation program.

INDUSTRIAL NOISE SERIES

PART X: OSHA – NOISE EXPOSURE IN THE WORKPLACE

Example Calculation of Noise Exposure

As an example, an employee will spend his day exposed to the following sound levels:

5.0 hours at 80 dB	1.0 hour at 95 dB
1.5 hours at 92 dB	0.5 hours at 98 dB

The allowable exposure times for the 80, 92 and 95 dB cases are listed in the above table and the allowable exposure time for 98 dB is calculated to be, $T = 8/2^{(98-90)/5} = 2.64$ hours.

The dose computation is as follows,

$$D = 100 \times (5/32 + 1.5/6 + 1/4 + 0.5/2.64) = 84.3 \% \quad (6)$$

The numerator is the exposure time and the denominator is the maximum allowable exposure time (hours). For example, at 80 dB the maximum allowable exposure time is 32 hours and the actual exposure time is 5 hours, thus the ratio 5/32. It is clear that the dose (D) is well above the 50% threshold but does not exceed 100%. The equivalent eight-hour time weighted average (TWA) sound level exposure is then computed using:

$$TWA = 16.61 \log (D/100) + 90 \text{ dB} \quad (7)$$

For $D = 84.3\%$, the $TWA = 88.8$ dB and of course is above the *action level*; therefore, a hearing conservation program is required to be implemented. Had the calculations shown $D > 100\%$ or $TWA > 90$ dB, then program action by the employer to reduce exposure time or reduce the noise level of the equipment would be required. Typically, just hearing protection is provided.

It is important to point out that all these calculations are based on measured in situ sound levels and exposure times. The tables and exposure limits are based on having no hearing protection in place.

Additional detailed information may be obtained from the particular Federal or applicable state OSHA codes for more comprehensive tables and information regarding hearing protection programs.

INDUSTRIAL NOISE SERIES

PART X: OSHA – NOISE EXPOSURE IN THE WORKPLACE

MSHA

Mining and off-shore drilling operations are covered separately by the Mine Safety and Health Administration under U.S. code of federal regulations (CFR), Title 30, Part 62, (Noise Rule). This law exempts sound levels below 90 dB from determining the noise exposure a person is subjected to. Thus, a person could spend all day exposed to 89 dB and have zero exposure. Within industry, mine workers are the largest population group to suffer hearing loss. The second largest group is railroad.



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solutions@universalaet.com
www.universalaet.com