Noise Levels and Employee Noise Exposure: *What do the numbers mean?*

OSHA regulation, **29CFR 1910.95 Occupational Noise Exposure** and the **Hearing Conservation Amendment** state that *the employer shall administer a continuing effective hearing conservation program whenever employee noise exposures equal or exceed an 8-hour time weighted average sound level (TWA) of 85 decibels measured on the A scale or equivalently, a dose of fifty percent*. Additionally, the regulation requires that the "*Employee's most recent noise exposure assessment"* be included on the audiometric record.

In order to understand Dose and TWA, first review Table G-16A below:

A-weighted sound level, L (decibel)	Reference duration, T (hour)
80	32
81	27.9
82	24.3
83	21.1
84	18.4
85	16
86	13.9
87	12.1
88	10.6
89	9.2
90	8
91	7.0
92	6.1
93	5.3
94	4.6
95	4
96	3.5
97	3.0
98	2.6
99	2.3
100	2
101	1.7
102	1.5
103	1.3
104	1.1
105	1
106	0.87
107	0.76
108	0.66
109	0.57
110	0.5
111	0.44
112	0.38
113	0.33
114	0.29
115	0.25

In the above table, locate 90 decibels. The reference duration (the amount of time allowed at that level) is 8 hours. 90 dB for 8 hours is known as the Permissible Exposure Level or benchmark of the regulation. Locate 95 decibels – time permitted = 4 hours. Locate 100

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decibels – time permitted = 2 hours. Note this relationship; each time the level is increased by 5 decibels, the time allowed is halved. This relationship is referred to as the 5 decibel exchange or 5 decibel doubling rate. What one infers from this table is that 100 decibels for 2 hours is **equivalent** to 90 decibels for 8 hours.

When the workshift noise exposure is composed of two or more periods of noise at different levels, the total noise dose over the work day is given by: D = 100 (C(1)/T(1) + C(2)/T(2) + ... + C(n)/T(n)), where C(n) indicates the total time of exposure at a specific noise level, and T(n) indicates the reference duration for that level as given by Table G-16a. As an Example for all of us who are math challenged, let us assume the following exposures for a worker during an 8 hour day:

87 dBA for 3 hours
92 dBA for 3 hours
95 dBA for 2 hours

Substituting into the above formula obtaining the permitted time (rounded) from table G16 A :
D = 100 x 3/12 + 3/6 + 2/4
D = 100 x 3/12 + 6/12 + 6/12
D = 100 x 15/12
D = 100 x 1.25
D = 125 %
The sample worker's multiple exposures would produce a noise dose of 125 %.The above calculation is basically how the noise dosimeter operates. Now, from Table A-1, locate 125 % in the Dose or percent noise exposure column. 125 % = 91.6 dBA TWA. Therefore, our sample workers multiple noise exposures are **equivalent** to 91.6 dBA averaged over an 8 hour day.

TABLE A-1 - CONVERSION FROM "PERCENT NOISE EXPOSURE" OR "DOSE" TO "8-HOUR TIME-WEIGHTED AVERAGE SOUND LEVEL" (TWA)

Dose or percent noise exposure	TWA
10	73.4
15	76.3
20	78.4
25	80.0
30	81.3
35	82.4
40	83.4
45	84.2
50	85.0
55	85.7
60	86.3
65	86.9
70	87.4
75	87.9
80	88.4
81	88.5
82	88.6

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83	88.7
84	88.7
85	88.8
86	88.9
87	89.0
88	89.1
89	89.2
90	89.2
91	89.3
92	89.4
93	89.5
94	89.6
95	89.6
96	89.7
97	89.8
98	89.9
99	89.9
100	90.0
101	90.1
102	90.1
103	90.2
104	90.3
105	90.4
106	90.4
107	90.5
108	90.6
109	90.6
110	90.7
111	90.8
112	90.8
113	90.9
114	90.9
115	91.1
116	91.1
117	91.1
118	91.2
119	91.3
120	91.3
125	91.6
130	91.9
135	92.2
140	92.4
145	92.7
150	92.9
155	93.2
160	93.4
165	93.6
170	93.8
175	94.0
180	94.2
185	94.4
190	94.6
195	94.8
200	95.0
210	95.4
220	95.7
230	96.0
240	96.3
250	96.6
260	96.9
270	97.2
280	97.4
290	97.7
300	97.9
310	98.2

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320	98.4
330	98.6
340	98.8
350	99.0
360	99.2
370	99.4
380	99.6
390	99.8
400	100.0

Now that we have calculated noise dose and converted to a numerical TWA exposure, let us take a look at the data generated from the personal noise dosimeter. Modern dosimeters can perform a variety of functions, most of them simultaneously. Although dosimeters from different manufactures report similar findings, the terminology for these findings can be somewhat different.

The Sample Noise Dosimetry Table is a composite of readings that may be generated from a noise dosimeter.

START TIME-05:54H:M END TIME---13:54H:M RUN TIME----7:49:27

EXCHANGE RATE---5dB --90dB THRESHOLD --80dB THRESHOLD
CRITERION------90dB LAVG---------87.1dB LAVG---------89.9dB
RANGE----------50dB TWA----------87.0dB TWA----------89.8dB
TIME CONSTANT -SLOW DOSE----------65.6% DOSE----------96.8%
WEIGHTING---------A 8hr DOSE------67.1% 8hr DOSE------99.0%

Run Time = 7 hrs 49 min. total time of sample
Exchange Rate = 5 dB the OSHA mandated “exchange” or “doubling” rate (See G16a)
Criterion = 90 dB OSHA mandated benchmark i.e. 90 dB for 8 hours=100%(See G16a)

90 dB Threshold: Readings under this heading are generally used to assess OSHA compliance with engineering noise controls. This mode does not integrate or give value to those levels less than 90 dB.

80 dB Threshold: Readings under this heading are used to assess compliance with the OSHA hearing conservation amendment. Levels from 80 db to 130 db are integrated into the averages. This reading should be used to report employee noise exposure for compliance with hearing conservation regulations.

NOTE: The dosimeter uses the same Criterion level and Exchange Rate for both the 80dB and 90dB thresholds.
Lavg :The average noise exposure for the time the instrument ran.

TWA : Measured in decibels. It is the accumulated noise dose integrated over 8 hours.

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DOSE :The only difference between TWA and Dose is that TWA is expressed in decibels and Dose is expressed as a percent.

Note that in the above example the Lavg is slightly greater than the TWA. This is due to the RUN TIME. This sample was 7 hours and 49 min. in duration. If the sample time was 8 hours, Lavg and TWA would be the same. Therefore, it is best to use the Lavg reading as a predictor when the sample is less than 8 hours. If the sample is longer than 8 hours, then the TWA would be greater than Lavg and TWA should be used to report the workers noise exposure.

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