Noise Computation Examples

Use with Chapter 296-817 WAC, Hearing Loss Prevention (Noise)

This helpful tool gives you examples of noise computations that should assist you with your own computations. Also found in this helpful tool are examples of employer actions based on the specific noise computation results. You'll need to do your own noise computations and determine the specific actions needed based on the noise exposures in your workplace.

EXAMPLE 1

Assume an employee is exposed to 92 dBA for eight hours. Compute the employee's noise exposure, the time-weighted average and what action, if any, would be required of the employer.

Exposure:

The exposure time is 8 hours. The reference duration for 92 dBA is 6 hours.

$$D = 100 \times \left(\frac{C_1}{T_1}\right) = 100 \times \left(\frac{8}{6}\right) = 133\%$$

Time-weighted Average (TWA):

In **Table HT-2**, find the values for 130% and 135%. The difference in the time-weighted average values (92.2 - 91.6) equals 0.6. Since 133% is 3/5 of the way between 130 and 135, 133% equals 3/5 (0.6) + 91.6 = 92 dBA.

Employer Action:

Since the employee's exposure is above the 90 dBA TWA_8, the employer would be required to institute a full hearing loss prevention program, including:

- Controlling noise as feasible,
- Providing hearing protection and training for employees,

  AND
- Instituting an audiometric testing program.

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EXAMPLE 2

Assume a continuous noise exposure for an employee of 90 dBA and a work shift of 8 a.m. to 4: 30 p.m. with a 15-minute morning and afternoon break and a 30-minute lunch. Both breaks and lunch are in an area with less than 70 dBA exposure. (Although this exposure could be integrated into the employee's total noise exposure, it is not significant and will not be considered in these calculations.) Calculate the worker's exposure, TWA, and the employer's responsibility.

Exposure:

Actual exposure (subtracting the lunch time and work breaks from the employee's work shift) indicates a 90 dBA exposure for 7-½ hours. D = 100 (C_1/T_1) = 100 (7.5/8) = 94 (94%)

$$D = 100 \times \left(\frac{C_1}{T_1}\right) = 100 \times \left(\frac{7.5}{8}\right) = 94\%$$

Time-weighted Average (TWA):

From **Table HT-2** a noise exposure of 94% converts to an equivalent 8-hour time-weighted average of 89.6 dBA.

Employer Action:

Since the employee's time-weighted average is between 85 and 90 dBA TWA_8, a hearing loss prevention program must be developed and maintained for the employee including hearing protection, training and audiometric testing. Engineering and/or administrative controls are not required, but may be beneficial, since the hearing loss prevention program would no longer be required if the employee's exposure were reduced below 85 dBA TWA_8.

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EXAMPLE 3

Assume a technician works in a noise enclosure booth with a noise exposure of less than 70 dBA. The technician makes rounds to read gauges and instruments that are located in an area with a noise level of 105 dBA. The technician makes four trips a day, and each trip lasts 30 minutes. Calculate the employee's noise exposure, TWA and employer's responsibility.

Exposure:

With four trips a day and 30 minutes per trip, the employee is basically exposed to two hours of noise at 105 dBA with the remaining time spent inside the booth. From **Table HT-1** of the rule the reference duration for exposure at 105 dBA is 1 hour.

$$D = 100 \times \left(\frac{C_1}{T_1}\right) = 100 \times \left(\frac{2}{1}\right) = 200\%$$

Time-weighted Average:

The employee's TWA from **Table HT- 2** is 95 dBA.

Employer Action:

Since the employee's exposure is above the 90 dBA TWA_8, the employer would be required to institute a full hearing loss prevention program, including controlling noise as feasible, providing hearing protection and training for employees, and instituting an audiometric testing program.

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EXAMPLE 4

Assume a timber trimsaw operator with a background noise level inside the operator's booth of 85 Dba, cuts one timber every 10 seconds with a noise exposure during the cut of 105 Dba for three seconds. The employee works from 6 a.m. to 4:30 p.m. and has a 15-minute break in the morning and the afternoon and a 30-minute lunch break, all of which are below 70 Dba. Calculate the employee's noise exposure and TWA.

Exposure:

First sound level - 105 dBA

The employee is exposed to this sound level for three seconds out of every ten or 30% of the time. Thus the time of exposure (C_1) at this level is 0.3×9.5 or 2.85 hours. From **Table HT- 1**, the reference duration (T_1) is one hour.

Second sound level - 85 dBA

The employee is exposed to this sound level for seven seconds out of every ten or 70% of the time. Thus the time of exposure (C_2) at this level is 0.7×9.5 or 6.65 hours. From **Table HT-1**, the reference duration (T_2) is sixteen hours.

$$D = 100 \times \left(\frac{C_1}{T_1} + \frac{C_2}{T_2} \right) = 100 \times \left(\frac{2.85}{1} + \frac{6.65}{16} \right) = 327\%$$

Time-weighted Average (TWA):

From the conversion table we find a noise dose of 327% lies between 320 and 330 with values of 98.4 dBA and 98.6 dBA respectively.

320% = 98.4 dBA

330% = 98.6 dBA

327% = (7/10)*(0.2) + 98.4 = 98.5

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EXAMPLE 5

Assume a security guard works an eight-hour shift and makes eight rounds a night. In making a round of the facility the guard will spend 20 minutes in Building A, 30 minutes in Building B and 10 minutes in the yard. In Building A the noise levels are less than 70 dBA. Noise level in the yard is 85 dBA. In Building B there is a cyclic machine operation where the noise levels are:

- 100 dBA for 3 seconds (30%)
- 95 dBA for 3 seconds (30%), and
- 90 dBA for 4 seconds (40%)

Calculating the employee's noise exposure and time-weighted average (TWA):

Since the employee's noise exposure in Building A is less than 70 dBA, this exposure is not significant and will not enter into the computation (the theoretical dose would be less than 2%). In Building B we find three noise exposures, 100, 95, and 90 dBA respectively. The yard also has an exposure (85 dBA), which will enter into the total computation.

Calculating the partial exposures at each noise level we find:

At 100 dBA

$$30\% \times \frac{30 \text{ minutes}}{\text{round}} \times \frac{8 \text{ rounds}}{\text{shift}} \times \frac{\text{hour}}{60 \text{ minutes}} = \frac{1.2 \text{ hours}}{\text{shift}}$$

At 95 dBA

$$30\% \times \frac{30 \text{ minutes}}{\text{round}} \times \frac{8 \text{ rounds}}{\text{shift}} \times \frac{\text{hour}}{60 \text{ minutes}} = \frac{1.2 \text{ hours}}{\text{shift}}$$

At 90 dBA

$$40\% \times \frac{30 \text{ minutes}}{\text{round}} \times \frac{8 \text{ rounds}}{\text{shift}} \times \frac{\text{hour}}{60 \text{ minutes}} = \frac{1.6 \text{ hours}}{\text{shift}}$$

The yard at 85 dBA

$$\frac{10 \text{ minutes}}{\text{round}} \times \frac{8 \text{ rounds}}{\text{shift}} \times \frac{\text{hour}}{60 \text{ minutes}} = \frac{1.33 \text{ hours}}{\text{shift}}$$

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EXAMPLE 5 (continued)

The employee's total noise exposure can be calculated from the noise exposure formula using the following values.

Location	Sound Level	Time of Exposure	Reference Duration
Building B	100 dBA	C_1 = 1.2 hours	T_1 = 2 hours
Building B	95 dBA	C_2 = 1.2 hours	T_2 = 4 hours
Building B	90 dBA	C_3 = 1.6 hours	T_3 = 8 hours
Yard	85 dBA	C_4 = 1.33 hours	T_4 = 16 hours

The employee's total noise exposure (D) is computed as follows:

$$D = 100 \times \left(\frac{C_1}{T_1} + \frac{C_2}{T_2} + \ldots + \frac{C_n}{T_n} \right) = 100 \times \left(\frac{1.2}{2} + \frac{1.2}{4} + \frac{1.6}{8} + \frac{1.33}{16} \right) = 118\%$$

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Table HT-1

Reference Durations, in Hours, for given Noise Levels

Noise Level, L	Reference Duration, T
80	32.0
81	27.9
82	24.3
83	21.1
84	18.4
85	16.0
86	13.9
87	12.1
88	10.6
89	9.2
90	8.0
91	7.0
92	6.1
93	5.3
94	4.6
95	4.0
96	3.5
97	3.0
98	2.6
99	2.3
100	2.0
101	1.7
102	1.5
103	1.3
104	1.1
105	1.0

Noise Level, L	Reference Duration, T
106	0.87
107	0.76
108	0.66
109	0.57
110	0.50
111	0.44
112	0.38
113	0.33
114	0.29
115	0.25
116	0.22
117	0.19
118	0.16
119	0.14
120	0.13
121	0.11
122	0.095
123	0.082
124	0.072
125	0.063
126	0.054
127	0.047
128	0.041
129	0.036
130	0.031
131	0.027

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Table HT-2

Dose to Equivalent TWA_8 for Given Dose

Dose	TWA_8
10	<=70
20	78.4
30	81.3
40	83.4
50	85.0
60	86.3
70	87.4
80	88.4
90	89.2
100	90.0
110	90.7
120	91.3
130	91.9
140	92.4
150	92.9
160	93.4
170	93.8
180	94.2
190	94.6
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
320	98.4
330	98.6
340	98.8

Dose	TWA_8
350	99.0
360	99.2
370	99.4
380	99.6
390	99.8
400	100.0
410	100.2
420	100.4
430	100.5
440	100.7
450	100.8
460	101.0
470	101.2
480	101.3
490	101.5
500	101.6
510	101.8
520	101.9
530	102.0
540	102.2
550	102.3
560	102.4
570	102.6
580	102.7
590	102.8
600	102.9
610	103.0
620	103.2
630	103.3
640	103.4
650	103.5
660	103.6
670	103.7
680	103.8

Dose	TWA_8
670	103.7
680	103.8
690	103.9
700	104.0
710	104.1
720	104.2
730	104.3
740	104.4
750	104.5
760	104.6
770	104.7
780	104.8
790	104.9
800	105.0
810	105.1
820	105.2
830	105.3
840	105.4
850	105.4
860	105.5
870	105.6
880	105.7
890	105.8
900	105.8
910	105.9
920	106.0
930	106.1
940	106.2
950	106.2
960	106.3
970	106.4
980	106.5
990	106.5
1000	106.6

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SUMMARY

As you can see, the more variable the noise sources or exposure times, the more involved the computations become. Noise dosimeters overcome this problem by electronically accumulating and integrating the noise signals into the employee's noise dose. Having one person observe several noise dosimeters can save additional time. However, a simultaneous survey using a sound level meter must be conducted to support the dosimeter results.

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