

TITLE: Hearing Conservation Program

INITIATOR: Susan Robb

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## 1. Program Description

1.1 The purpose of the University of California, Irvine (UCI) Hearing Conservation Program (HCP) is to prevent permanent noise induced hearing loss resulting from on-the job noise exposure. The California Occupational Safety and Health Administration (Cal/OSHA) regulation requires employers to provide employees with proper protection against the effects of noise exposure when sound levels exceed an 8-hour time weighted average (TWA) of 90 dBA (Permissible Exposure Level – PEL). The protective measures may be provided either through engineering or administrative controls. If these control measures fail to reduce the noise within the acceptable limits, personal protective equipment shall be provided and used. Additionally, whenever employee noise exposures equal or exceed an 8-hour (TWA) sound level of 85 dBA, referred to as the (Action Level – AL), the employer shall develop and administer a Hearing Conservation Program.

## 2. Scope

2.1 This HCP applies to all employees of UCI who are routinely exposed to an eight-hour time weighted average noise level of 85 dBA at or above the Cal/OSHA AL.

2.2 The departments or occupations that may be at risk to elevated noise levels are:

- Central Plant
- Grounds Keeping
- Machine Shop
- Carpentry Shop
- Key Shop
- Housing and Dining Services
- Engineering
- Student Center

2.3 UCI's Hearing Conservation Program includes:

- Noise surveys
- Audiometric Testing
- Hearing protection
- Employee education and training
- Record keeping

### 3. Definitions

**Action Level:** The level of noise exposure at which Cal/OSHA has set the current AL at 85 A-weighted decibels, or dBA, over an eight-hour period.

**Administrative Controls:** Methods that limits an employee's exposure time to noise. This includes assessing the employee to less noisy areas in the work place for a certain length of time so that the employee shall not exceed the AL.

**Audiogram Testing:** Exams that measure the sensitivity of a person's hearing threshold in decibels. The testing also establishes a baseline hearing threshold that is compared to later exams to determine if hearing loss has occurred.

**Audiometer:** An instrument of measuring the threshold or sensitivity of hearing.

**Audiologist:** A professional specializing in the study and rehabilitation of hearing, who is certified by the American Speech-Language-Hearing Association or licensed by a state board of examiners.

**A-Weighted:** The A weighting, expressed as dBA, is the scale used for most occupational noise measurements. The A weighting approximates the range of human hearing as it filters out lower frequency noises, which are not as damaging as the higher frequencies.

**Baseline Audiogram:** The audiogram against which future audiograms are compared.

**Continuous Noise:** Noise levels that vary with intervals of one second or less.

**C-Weighted:** Expressed as dBC. The C weighting filters include both high and low frequency noise and are used for impact noise and in the selection of hearing protection.

**Decibels (dB):** A measure of the sound level (loudness). The decibel scale is a logarithmic scale; as an example, a 90 dB noise is ten times louder than a 80 dB noise.

**Engineering Controls:** May include the purchase of quieter equipment using barriers, damping, isolating, muffling, installing noise absorbing materials, mechanical isolation, variations in force, pressure or driving speed or any combinations of methods to decrease noise levels.

**Frequency:** A sound's pitch measured in hertz (hz); high pitches are high frequency sounds.

**Hearing Conservation Program (HCP):** Program established when employees are exposed to noise exceeding the AL. The program shall include noise surveys, audiometric testing, hearing protectors, training and record keeping requirements.

**Hearing Protection Devices (HPD's):** Personal protective equipment that is designed to be worn in the ear canal or over the ear to reduce the sound level reaching the ear drum. Examples include ear muffs or plugs.

**Hearing Threshold Level (HTL):** The lowest threshold that the employee can hear the test tone during an audiometric test. The HTL's are recorded on the employee's audiogram.

**Hertz (Hz):** A unit of measurement of frequency, expressed as cycles per second.

**Impulse/Impact Noise:** Noise that is a sharp burst of sound, generally of less than one-half second in duration and does not repeat itself more than once per second.

**Noise:** Unwanted sound.

**Noise Dosimeter:** An instrument worn by an individual that integrates the sound level exposure over a period of time.

**Noise Reduction Rating (NRR):** The Noise Reduction Rating of hearing protection devices (HPD) indicates the theoretical amount of reduction of noise levels that can be achieved if the HPD is worn correctly. This rating is shown on the HPD packaging.

**Otolaryngologist:** A physician specializing in diagnosis and treatment of disorders of the ear, nose and throat.

**Permissible Exposure Limit (PEL):** 90 dBA TWA. Employees may be exposed to 90 dBA for an 8 hour time weighted average (TWA) exposure without experiencing serious hearing effects.

**Pitch:** Another term for sound frequency. Higher pitches are higher frequency sounds.

**Representative Exposure:** Measurements of an employee's noise dose or 8-hour time weighted average sound level that is representative of the exposures of other employees in the workplace.

**Sound:** A vibration or pressure oscillation that is detectable by the ear drum.

**Sound Level Meter:** An instrument used for the measurement of noise in sound level surveys.

**Speech Interference Levels (SILs):** The frequencies most associated with speech, which are the 500-4000 hz (frequency) range. Vowels (a, e, i, o, u) are low frequency sounds (below 2000 hz) and consonants (b, c, d, etc) are high frequency sounds. The low frequencies are the least affected by noise. If the high frequencies are affected, t's and p's or s's and f's may be easily confused.

**Standard Threshold Shift:** An average shift from the baseline measurement in either ear of 10 dB or more at 2000, 3000 and 4000 Hz. These frequencies are the most important frequencies in communication and the most sensitive to damage by industrial noise exposure.

**Time-Weighted Average Sound Level:** That sound level, which if constant over an 8-hour exposure, would result in the same noise dose as is measured.

**Threshold of Pain:** A noise level of 120 dB causes pain.

**Weighting Filters, Scales or Networks:** Sound level meters and dosimeters use a selective weighting system (filters) to eliminate certain frequencies from the measurements that are unimportant in the noise exposure.

#### 4. Responsibilities

##### 4.1 Department Heads, Managers, Supervisors, and Principal Investigators

- Notify the Environmental Health and Safety Office of noise complaints or potential noise hazards.
- Ensure that employees are provided with hearing protectors when required.
- Ensure that employees properly use and care for hearing protectors.
- Ensure that noise-hazardous equipment/areas are properly labeled or posted (greater than or equal to 85 dBA operating noise level).
- Notify the Environmental Health and Safety Office of process, materials or equipment changes that may alter noise exposures.
- Ensure that potentially overexposed employees are provided with a baseline audiometric hearing test prior to the initial work assignment and then annually thereafter.
- Enforcing the use of hearing protectors of noise reduction procedures in the designated areas / assignments.
- Ensure new employee orientation/training and annual refresher training of employees are provided to all potentially overexposed personnel.
- Post copy of occupation noise regulation; CCR Title 8, Section 5096-5100, Article 105.
- Record Keeping – Refer to 5.5 of this manual

##### 4.2 Environmental Health and Safety Office (EH&S)

- Administer the Hearing Conservation Program.

- Workplace and employee noise evaluation:
  - noise assessment to determine if administrative and engineering controls are needed, and how they will be implemented.
  - identification of areas or processes that require noise abatement and/or posting.
  - evaluation and periodic re-evaluation of employees' exposure, by job classification, to determine which job titles need to be included in the Hearing Conservation Program.
- Maintaining records of employee exposure measurements.
- Provide Hearing Conservation training in consultation with COEH.
- Assist employees in selection of proper protective devices and provide instruction on their use. (Occupational Health)
- Maintain records of employee exposure measurements. (Occupational Health)

#### 4.3 Faculty and Staff

- Wear hearing protection devices and noise reduction procedures as required (also applies to students, visitors and guests).
- Attend required training sessions on noise hazards.
- Report noise hazards and hearing protector problems to the appropriate supervisor.
- Maintain hearing protectors in sanitary condition and proper working order

#### 4.4 Center for Occupational and Environmental Health (COEH)

- Provide baseline, annual, and post-employment audiometric exams
- Performing audiogram evaluations.
- Maintaining audiometric test records.
- Recommending appropriate hearing protectors and fitting as needed.
- Communicate any identified standard threshold shifts to the employee and his or her supervisor, EH&S and Risk Management (if reportable under Title 8 CCR 14300.10).
- Provide information and training on noise hazards and hearing conservation.
- Establish any work restrictions necessary to prevent additional hearing loss.

### 5. Program Components

#### 5.1 Noise Exposure Assessments

- Representative noise monitoring with a designed sampling strategy will be performed by the EH&S Office to allow the identification of employees by representative sampling of Similarly Exposed Groups (SEGs) for inclusion in the Hearing Conservation Program and to enable the proper selection of hearing protection.
- All continuous, intermittent and impulsive sound levels from 80 to 130 dBA shall be integrated into the computation.

- Monitoring shall be repeated when any changes occur in production, process, equipment or controls which might render the hearing protectors inadequate or require additional employees to be included in the program.
- Employees exposed at or above the action level shall be notified of the results of the monitoring.
- Employees' noise exposure will be reassessed periodically as needed (i.e. following changes in processes, job responsibilities, or equipment).

## 5.2 Audiometric Testing

- Audiometric testing program will be managed by COEH.
- Performing audiometric database analysis (ADBA) procedures, as defined in ANSI Standard S12.13-1991, to assess the effectiveness of hearing conservation efforts (i.e., is hearing loss being prevented).
- Baseline audiograms shall be preceded by at least 14 hours without exposure to workplace noise. This requirement may be met by wearing hearing protectors which will reduce the employee's exposure to a sound level of 80 dBA or lower than 80 dBA.
- Baseline audiograms shall be provided for the employees whose job classification are included in the Hearing Conservation Program upon employment, and annually thereafter.
- Evaluation of Audiograms shall be done in compliance with CCR Title 8, Section 1597(d).
- Employees shall be informed in writing within 21 days when an audiogram indicates a standard threshold shift which is determined to be work related.

## 5.3 Hearing Protection

- Employees exposed to noise levels at or above an 8-hour TWA of 90 dBA shall wear hearing protectors. Employees exposed to noise levels at or above the AL of an 8-hour TWA of 85 dBA shall wear hearing protectors if they have experienced a documented standard threshold shift or have not obtained a baseline audiogram.
- Hearing protectors shall be available to all employees exposed to noise levels at or above the AL of 85 dBA, 8-hr TWA, at no cost to the employees.
- Employees shall be given the opportunity to select their hearing protectors from a variety of suitable types.
- Proper initial fitting and supervision of the correct use of hearing protectors shall be provided.
- Hearing protector attenuation shall be evaluated for the specific noise environments in which the protector will be used. The methods used for measuring attenuation shall be one of the four methods described in CCR Title 8, Section 5100, Appendix E.
- Hearing protectors must attenuate the noise level to an 8-hour TWA of 85 dBA or less.

- For employees who have experienced a standard threshold shift, the attenuation must reduce the sound level to an 8-hour TWA of 85 dBA or less.
- Re-evaluation of hearing protectors shall be done whenever a workplace noise level increase renders the hearing protector's attenuation inadequate.
- Workplaces in which the noise level exceeds 85 dBA shall have signs posted. Signs shall read " Hearing Protectors Required " .

#### 5.4 Engineering Controls

Wherever feasible, employee noise exposures shall be reduced below the AL. The following noise control measures should be implemented:

- New equipment design specifications, when feasible, should limit the noise generated by the equipment to 85 dBA or less.
- Where purchases of new equipment, or modifications or use of existing equipment will result in generation of noise levels above 85dBA, the Department must consider the implementation of engineering controls such as acoustical barriers, source enclosure, vibration isolation, or exhaust muffling in order to reduce noise levels in the work environment.
- As noise levels decrease with distance, noise-generating equipment should be placed away from the majority of employees wherever practical.

#### 5.5 Employee Education and Training

- Annual training is required for all employees exposed to noise at or above an 8-hour TWA of 85 dBA.
- The training shall cover the following information:
  - the effects of noise on hearing.
  - the purpose, advantages, disadvantages, and attenuation of various types of hearing protectors.
  - instruction of proper fitting and care of protectors.
  - the purpose and procedures of audiometric testing.
- Copies of the occupational noise regulation (CCR Title 8, Section 5096-5099, Article 105) shall be available to affected employees and their representatives. A copy of the regulation shall also be posted in the workplace.
- Any informational materials pertaining to this standard that are supplied by OSHA shall be available to the affected employees.

#### 5.6 Record Keeping

- Effective January 1, 2003, employers are required to record work-related hearing loss cases when an employee's hearing test indicates a marked decrease in overall hearing. The new rule requires recording a 10 decibel or greater shift at 2000, 3000, and 4000 hertz in one or both ears from the employee's initial

hearing test and also when they result in an overall hearing level loss of 25 decibels.

- Noise exposure measurement records shall be retained for 2 years by the EH&S Office. Audiometric test records retained by COEH for employees enrolled in the Hearing Conservation Program and shall include:
  - the name and job classification of the employee
  - the date of the audiogram
  - the examiner's name
  - the employee's most recent noise exposure assessment
  - the date of the last acoustic or exhaustive calibration of the audiometer and the measurement of the background sound pressure levels in the audiometric test rooms.
- Records of audiometric test results shall be retained for the duration of the affected employee's employment.

## 6. Reporting Requirements

6.1 Effective January 1, 2003, employers are required to record work-related hearing loss cases when an employee's hearing test indicates a marked decrease in overall hearing. The new rule requires recording a 10 decibel or greater shift at 2000, 3000, and 4000 hertz in one or both ears from the employee's initial hearing test and also when they result in an overall hearing level loss of 25 decibels.

## 7. Training Requirements and Competency Assessment

7.1 All employees should receive information regarding the Hearing Conservation Program through employee orientation, job training and instruction, specific training programs, and periodic safety committee meetings. The employee's department shall maintain training records.

7.2 Training topics include:

- Statistics on occupational hearing loss
- Basic concepts and terms relating to sound pressure level
- Anatomy of the ear
- Types of hearing loss
- Types of hearing protectors and proper usage
- Activities related to non-occupational hearing loss
- Elements of UCI's Hearing Conservation Program

7.3 Training is provided by EH&S and can be customized for work groups. Employees enrolled in the Hearing Conservation Program are required to attend annual training.

## 8. Information and External References



8.1 7.1 Cal-OSHA Regulations – Control of Noise Exposures  
[California Code of Regulations, Title 8, Section 5096-5100 Article 105](#)

8.2 Permissible Noise Exposure – Table N-1  
<http://www.dir.ca.gov/title8/5096.html>

Appendix A

**Noise Exposure Computation**

## Noise Exposure Computation

### I. Computation of Employee Noise Exposure

- A. Noise dose is computed using Table A-1 as follows: When the sound level, L, is constant over the entire work shift, the noise dose, D, in percent, is given by:  $D = 100 C/T$  where C is the total length of the work day, in hours, and T is the reference duration corresponding to the measured sound level, L, as given in Table A-1 or by the formula shown as a footnote to that table.
- B. 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:  $D = 100 (C1/T1 + C2/T2 + \dots + Cn/Tn)$ , where Cn indicates the total time of exposure at a specific noise level, and Tn indicates the reference duration for that level as given by Table A-1.
- C. The eight-hour time-weighted average sound level (TWA), in decibels, may be computed from the dose, in percent, by means of the formula:  $TWA = 16.61 \log_{10} (D/100) + 90$ . For an eight-hour workshift with the noise level constant over the entire shift, the TWA is equal to the measured sound level.
- D. A table relating dose and TWA is given in Section II.

<b>Table A-1</b>			
A-weighted sound level, L (decibel)	Reference Duration, T (hour)	A-weighted sound level, L (decibel)	Reference Duration, T (hour)
80	32.0	106	0.87
81	27.9	107	0.76
82	24.3	108	0.66
83	21.1	109	0.57
84	18.4	110	0.50
85	16.0	111	0.44
86	13.9	112	0.38
87	12.1	113	0.33
88	10.6	114	0.29
89	9.2	115	0.25
90	8.0	116	0.22
91	7.0	117	0.19
92	6.1	118	0.16
93	5.3	119	0.14
94	4.6	120	0.125
95	4.0	121	0.11
96	3.5	122	0.095
97	3.0	123	0.082
98	2.6	124	0.072
99	2.3	125	0.063
100	2.0	126	0.054
101	1.7	127	0.047
102	1.5	128	0.041
103	1.3	129	0.036
104	1.1	130	0.031
105	1.0		

In the above table, the reference duration, T, is computed by

$$T = \frac{8}{2^{(L-90)/5}}$$

where L is the measured A-weighted sound level.

II. Conversion Between "Dose" and "8-Hour Time-Weighted Average" Sound Level.

A. Noise exposure is usually measured with an audio dosimeter, which give readout in terms of "dose." Dosimeter readings can be converted to an 8-hour time-weighted average sound level (TWA).

B. In order to convert the reading of a dosimeter into TWA, use Table A-2. This table applies to dosimeters that are set to calculate dose or percent exposure according to the relationships in Table A-1. So, for example, a dose of 91 percent over an eight hour day results in a TWA of 89.3 dB, and a dose of 50 percent corresponds to a TWA of 85 dB.

C. If the dose as read on the dosimeter is less than or greater than the values found in Table A-2, the TWA may be calculated by using the formula:

D.  $TWA = 16.61 \log_{10} (D/100) + 90$  where TWA = 8-hour time-weighted average sound level and D = accumulated dose in percent exposure.

<b>Table A-2</b>					
<b>Conversion from "Percent Noise Exposure" or "Dose" to "8-Hour Time-Weighted Average Sound Level" (TWA)</b>					
Dose or Percent Noise Exposure	TWA	Dose or Percent Noise Exposure	TWA	Dose or Percent Noise Exposure	TWA
10	73.4	116	91.1	510	101.8
15	76.3	117	91.1	520	101.9
20	78.4	118	91.2	530	102.0
25	80.0	119	91.3	540	102.2
30	81.3	120	91.3	550	102.3
35	82.4	125	91.6	560	102.4
40	83.4	130	91.9	570	102.6
45	84.2	135	92.2	580	102.7
50	85.0	140	92.4	590	102.8
55	85.7	145	92.7	600	102.9
60	86.3	150	92.9	610	103.0
65	86.9	55	93.2	620	103.2
70	87.4	160	93.4	630	103.3
75	87.9	165	93.6	640	103.4
80	88.4	170	93.8	650	103.5
81	88.5	175	94.0	660	103.6
82	88.6	180	94.2	670	103.7
83	88.7	185	94.4	680	103.8
84	88.7	190	94.6	690	103.9
85	88.8	195	94.8	700	104.0

86	88.9	200	95.0	710	104.1
87	88.9	210	95.4	720	104.2
88	89.1	220	95.7	730	104.3
89	89.2	230	96.0	740	104.4
90	89.2	240	96.3	750	101.5
91	89.3	250	96.6	760	104.6
92	89.4	260	96.9	770	104.7
93	89.5	270	97.2	780	104.8
94	89.6	280	97.4	790	104.9
95	89.6	290	97.7	800	105.0
96	89.7	300	97.9	810	105.1
97	89.8	310	98.2	820	105.2
98	89.9	320	98.4	830	105.3
99	89.9	330	98.6	840	105.4
100	90.0	340	98.8	850	105.4
101	90.1	350	99.0	860	105.5
102	90.1	360	99.2	870	105.6
103	90.2	370	99.4	880	105.7
104	90.3	380	99.6	890	105.8
105	90.4	390	99.8	900	105.8
106	90.4	400	100.0	910	105.9
107	90.5	410	100.2	920	106.0
108	90.6	420	100.4	930	106.1
109	90.6	430	100.5	940	106.2
110	90.7	440	100.7	950	106.2
111	90.8	450	100.8	960	106.3
112	90.8	460	101.0	970	106.4
113	90.9	470	101.1	980	106.5
114	90.9	480	101.3	990	106.5
115	91.1	490	101.5	999	106.6
500	101.6	500	101.6		

NOTE: Authority and reference cited: Section 142.3, Labor Code.

HISTORY

1. Editorial correction of Table A-1 filed 3-22-84; effective thirtieth day thereafter (Register 84, No. 12).
2. Amendment of Table A-1 filed 8-28-84; effective thirtieth day thereafter (Register 84, No. 35).

## Appendix B

### **Methods for Estimating the Adequacy of Hearing Protector**

## Methods for Estimating the Adequacy of Hearing Protector

### Attenuation

- I. For employees who have experienced a standard threshold shift, hearing protector attenuation must be sufficient to reduce employee exposure to a TWA of 85 dB. Employers must select one of the following methods by which to estimate the adequacy of hearing protection attenuation.
- II. The most convenient method is the Noise Reduction Rating (NRR) developed by the Environmental Protection Agency (EPA). According to EPA regulation, the NRR must be shown on the hearing protector package. The NRR is then related to an individual worker's noise environment in order to assess the adequacy of the attenuation of a given hearing protector. This Appendix describes four methods of using the NRR to determine whether a particular hearing protector provides adequate protection within a given exposure environment. Selection among the four procedures is dependent upon the employer's noise measuring instruments.
- III. Instead of using the NRR, employers may evaluate the adequacy of hearing protector attenuation by using one of the three methods developed by the National Institute for Occupational Safety and Health (NIOSH), which are described in the "List of Personal Hearing Protectors and Attenuation Data," HEW Publication No. 76-120, 1975, pages 21-37. These methods are known as NIOSH methods #1, #2 and #3. The NRR described below is a simplification of NIOSH method #2. The most complex method is NIOSH method #1, which is probably the most accurate method since it uses the largest amount of spectral information from the individual employee's noise environment. As in the case of the NRR method described below, if one of the NIOSH methods is used, the selected method must be applied to an individual's noise environment to assess the adequacy of the attenuation. Employers should be careful to take a sufficient number of measurements in order to achieve a representative sample for each time segment.

NOTE: The employer must remember that calculated attenuation values reflect realistic values only to the extent that the protectors are properly fitted and worn.

- IV. When using the NRR to assess hearing protector adequacy, one of the following methods must be used:
  - A. When using a dosimeter that is capable of C-weighted measurements:
    - i. Obtain the employee's C-weighted dose for the entire workshift, and convert to TWA (see Appendix A).
    - ii. Subtract the NRR from the C-weighted TWA to obtain the estimated A-weighted TWA under the ear protector.
  - B. When using a dosimeter that is not capable of C-weighted measurements, the following method may be used:

- i. Convert the A-weighted dose to TWA (see Appendix A).
  - ii. Subtract 7 dB from the NRR.
  - iii. Subtract the remainder from the A-weighted TWA to obtain the estimated A-weighted TWA under the ear protector.
- C. When using a sound level meter set to the A-weighting network:
- i. Obtain the employee's A-weighted TWA.
  - ii. Subtract 7 dB from the NRR, and subtract the remainder from the A-weighted TWA to obtain the estimated A-weighted TWA under the ear protector.
- D. When using a sound level meter set on the C-weighting network:
- i. Obtain a representative sample of the C-weighted sound levels in the employee's environment.
  - ii. Subtract the NRR from the C-weighted average sound level to obtain the estimated A-weighted TWA under the ear protector.

NOTE: Authority and reference cited: Section 142.3, Labor Code.

#### HISTORY

1. Amendment filed 10-3-83; effective thirtieth day thereafter (Register 83, No. 41).