CALIFORNIA STATE UNIVERSITY, CHICO

HEARING CONSERVATION PROGRAM

PREPARED BY THE OFFICE OF
ENVIRONMENTAL HEALTH AND SAFETY

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TABLE OF CONTENTS

LIST OF TABLES

INTRODUCTION SECTION 1.0

The purpose of this manual is to establish the acceptable limits of Noise Exposure at CSU, Chico. Title 8, Group 15, Article 105, Sections 5095-5099 of the California Code of Regulations (CCR) has established acceptable limits for the amount and duration of noise that employees can be exposed to (see Attachment 9.1). CSU, Chico employees exposed to the upper limits of noise exposure during an 8-hour shift are required by law to use ear protection, unless the noise can be controlled by administrative or engineering controls. (Section 2.0 also details noise exposure limits.)

Protection against the effects of noise exposure will be provided to employees when the sound levels and duration exceed those shown in Table 1. Sound level will be measured on the A-scale of a standard sound level meter at slow response.

TABLE 1 Permissible Noise Exposure

	Permissible Duration per Workday (Not to be exceeded)	
Sound Level (dBA)	*Hours-Minutes*	*Hours*
90	8-0	8.00
92	6-4	6.06
94	4-36	4.60
96	3-29	3.48
98	2-38	2.63
100	2-0	2.00
102	1-31	1.52
104	1-9	1.15
106	0-52	0.86
108	0-40	0.66
110	0-30	0.50
112	0-23	0.38
114	0-17	0.28

EXPOSURE LIMITS FOR NOISE SECTION 2.0

2.1 Protection

Protection against the effects of noise exposure will be provided when the sound levels and duration exceed those shown in Table 1 when measured on the A-scale of a standard sound level meter at slow response. When employees are subjected to sound levels exceeding those listed in Table 1, feasible administrative or engineering controls will be utilized. If controls fail to reduce sound levels within the levels of the Table, personal protective equipment will be provided by the Environmental Health and Safety (EHS) Office or the employee's supervisor to reduce sound levels to within the levels of the Table.

The employee's department will provide employees who are exposed to an 8-hour time-weighted average of 85 decibels or greater, with hearing protection. This will be provided at no cost to the employee. EHS will also replace old or worn-out hearing protection as necessary. Employees will be given the choice of more than one type of ear protection, and the employees will be supervised by EHS in the fitting and care of the equipment.

Hearing protectors must attenuate employee exposure at least to an 8-hour time-weighted average of 90 decibels as required by CCR Section 5096 (b). For employees who have experienced a standard threshold shift, hearing protectors must attenuate employee exposures to an 8-hour time-weighted average of 85 decibels or below.

The adequacy of hearing protector attenuation will be reevaluated whenever employee noise exposures increase to the extent that the hearing protectors provided may no longer provide adequate attenuation.

2.2 Levels of Noise Exposure

When daily noise exposure is composed of two or more periods of noise exposure at different levels, their combined effects should be considered rather than the individual effect of each. If the sum of the following fractions: $C_1 / T_1 + C_2 / T_2 ... C_n / T_n$ exceeds unity, then the mixed exposure should be considered to exceed the limit value. C_n indicates the total time of exposure at a specified noise level. T_n indicates the total time of exposure permitted at that level. If the variation in noise level involves maxima at intervals of 1 second or less, the noise is to be considered continuous. Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level. Section 3.0 details noise exposure computation.

2.3 Measurement of Noise Levels

The EHS Office has the equipment necessary for measuring noise levels using a Sound Level Meter (SLM). If there is any suspicion of excess levels of noise, EHS will conduct

tests to determine if the noise levels are permissible within the California Code of Regulations (CCR). Instruments used to measure employee noise exposure will be calibrated annually to ensure measurement accuracy. Noise level monitoring will be repeated whenever a change in production, process, equipment or controls increases noise exposure. Noise level tests will be recorded on a Noise Survey Form (see Attachment 9.2).

NOISE EXPOSURE COMPUTATION SECTION 3.0

3.1 Computation of Employee Noise Exposure

Noise dose is computed using Table 2 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 workday, in hours, and T is the reference duration corresponding to the measured sound level, L, as given in Table 2 or by the formula shown as a footnote to that Table.

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 2.

The 8-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 8-hour workshift with the noise level constant over the entire shift, the TWA is equal to the measured sound level.

TABLE 2 Workshift Noise Exposure

A-weighted Sound level, L (decibel)	*Reference Duration T (hours)*
80	32
85	16
90	8
95	4
100	2
105	1
110	0.5
115	0.25
120	0.125
125	0.063
130	0.031

In the Table, the reference duration, T, is computed by $T= 8 / 2^{(L-90) / 5}$ where L is the measured A-weighted sound level.

3.2 Conversion Between "Dose" and 8-Hour TWA Sound Level

Noise exposure is usually measured with an audiometer which gives a readout in terms of "dose." Dosimeter readings can be converted to an 8-hour time-weighted average sound level (TWA). In order to convert the reading of a dosimeter into TWA, use Table 3.

This Table applies to dosimeters that are set to calculate dose or percent exposure according to the relationship in Table 2.

TABLE 3 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
30	81.3
60	86.3
90	89.2
120	91.3
150	92.9
180	94.2
210	95.4
240	96.3
270	97.2
300	97.9
330	98.6
360	99.2
390	99.8
420	100.4
450	100.8
480	101.3
510	101.8
540	102.2
570	102.6
600	102.9
630	103.3
660	103.6
690	103.9
720	104.2
750	104.5
780	104.8
810	105.1

TABLE 3 (continued)

Dose or Percent Noise Exposure	*TWA*
840	105.4
870	105.6
900	105.8
930	106.1
960	106.3
990	106.5

AUDIOMETRIC TESTING AND EVALUATION SECTION 4.0

4.1 Audiometric Testing Program

CSU, Chico provides audiometric testing at no charge, to all employees whose exposure may equal or exceed the action level. The audiometric tests are conducted through a contract with a local medical facility. All audiograms will follow the guidelines outlined in this Section.

4.1.1 Baseline Audiogram

For each employee exposed at or above the action level, CSU, Chico's contracted medical facility is required to establish a valid baseline audiogram against which subsequent audiograms can be compared.

4.1.2 Baseline Testing

Testing to establish a baseline audiogram will be preceded by at least 14 hours without exposure to workplace noise. This requirement may be met by wearing hearing protectors that will reduce the employee's exposure to a sound level of 80 dBA or below. CSU, Chico will inform employees of the need to avoid high levels of non-occupational noise exposure during the 14-hour period immediately preceding the audiometric examination.

4.2 Evaluation of Audiogram

Each employee's annual audiogram will be compared to that employee's baseline audiogram to determine if the audiogram is valid and if a standard threshold shift, as defined in Section 5097 (d) (8) of the CCR, has occurred. The contracted medical facility will review problem audiograms and will determine whether there is need for further evaluation.

4.2.1 Employee's Options

If the annual audiogram shows that an employee has suffered a standard threshold shift, the employee has the option to obtain a retest within 30 days and consider the results of the retest as the annual audiogram.

4.2.2 Employee's Rights

If a comparison of the annual audiogram to the baseline audiogram indicates a standard threshold shift as defined by CCR, Section 5097 (d) (8), the employee will be informed of this fact, in writing, within 21 days of the determination. An annual audiogram may be substituted for the baseline audiogram when, in the judgment of the contracted medical facility, this is warranted.

4.3 Audiometric Testing Requirements

Audiometric tests will be pure tone, air conduction, hearing threshold examinations, with the test frequencies including as a minimum 500, 1000, 2000, 3000, 4000, and 6000 Hz. Tests at each frequency will be taken separately for each ear.

Audiometric tests will be conducted with audiometers (including microprocessor audiometers) that meet the specifications of, and are maintained and used in accordance with, ANSI S3.6-1969.

4.4 Audiometric Measuring Instruments

In the event that pulse-tone audiometers are used, they will have tone on-time of at least 200 milliseconds. Self-recording audiometers will comply with the following requirements:

- The chart upon which the audiogram is traced will have the lines at positions corresponding to all multiples of 10 dB hearing level within the intensity range spanned by the audiometer. The lines will be equally spaced and will be separated by at least 1/4 inch. Additional increments are optional. The audiogram pen tracings will not exceed 2 dB in width.

- It will be possible to set the stylus manually at the 10 dB increment lines for calibration purposes.

- The slewing rate for the audiometer attenuator will not be more than 6 dB/sec except that an initial slewing rate greater than 6 dB/sec is permitted at the beginning of each new test frequency, but only until the second subject response. The audiometer will remain at each required test frequency for 30 seconds (+/- 3 seconds). The audiogram will be clearly marked at each change of frequency and the actual frequency change of the audiometer will not deviate from the frequency boundaries marked on the audiogram by more than 3 seconds.

- It must be possible at each test frequency to place a horizontal line segment parallel to the time axis on the audiogram, such that the audiometric tracing crosses the line segment at least six times at that test frequency. At each test frequency, the threshold will be the average of the midpoints of the tracing excursions.

4.5 Audiometric Test Rooms

Rooms used for audiometric testing will not have background sound pressure levels exceeding those in Table 4 when measured by equipment conforming at least to the Type 2 requirements of ANSI S1.4-1971 (R1976), and to the Class II requirements of ANSI S1.11-1971 (R1976).

TABLE 4 Maximum Allowable Octave-Band Sound Pressure Levels for Audiometric Test Rooms.

Octave-band center Frequency (Hz)	500	1000	2000	4000	8000
Sound Pressure Level (dB)	40	40	47	57	62

4.6 Acoustic Calibration of Audiometers

Audiometer calibration will be checked acoustically, at least annually, according to the procedures described in this Section. The equipment necessary to perform these measurements is a sound level meter, octave-band filter set and a National Bureau of Standards 9A coupler. In making these measurements, the accuracy of the calibrating equipment will be sufficient to determine that the audiometer is within the tolerances permitted by ANSI S3.6-1969.

4.6.1 Sound Pressure Output Check

Place the earphone coupler over the microphone of the sound level meter and place the earphone on the coupler. Set the audiometer's hearing threshold level (HTL) dial to 70 dB. Measure the sound pressure level of the tones at each frequency from 500 Hz through 6000 Hz for each earphone. At each frequency the readout on the sound level meter should correspond to the levels in Table 5 or Table 6, as appropriate, for the type of earphone, in the column entitled "Sound Level Meter Reading."

4.6.2 Linearity Check

With the earphone in place, set the frequency to 1000 Hz and the HTL dial on the audiometer to 70 dB. Measure the sound levels in the coupler at each 10 dB decrement from 70 dB to 10 dB, noting the sound level meter reading at each setting. For each 10-dB decrement on the audiometer, the sound level meter should indicate a corresponding 10 dB decrease. This measurement may be made electrically with a voltmeter connected to the earphone terminals.

4.6.3 Tolerances

When any of the measured sound levels deviate from the levels in Table 5 or Table 6 by 3 dB at any test frequency between 500 and 3000 Hz, 4 dB at 4000 Hz, or 5 dB at 6000 Hz, an exhaustive calibration is advised. An exhaustive calibration is required if the deviations are 15 dB or greater at any test frequency.

TABLE 5 Reference Threshold Levels for Telephonics THD-39 Earphones

Frequency (Hz)	*Reference Threshold Level for THD-39 Hz Earphones, dB*	*Sound Level Meter Reading dB*
500	11.5	81.5
1000	7	77
2000	9	79
3000	10	80
4000	9.5	79.5
6000	15.5	85.5

TABLE 6 Reference Threshold Levels for Telephonics THD-49 Earphones

Frequency (Hz)	*Reference Threshold Level for THD-39 Hz Earphones, dB*	*Sound Level Meter Reading dB*
500	13.5	83.5
1000	7.5	77.5
2000	11	81.0
3000	9.5	79.5
4000	10.5	80.5
6000	13.5	83.5

4.7 Determination and Application of Age Corrections to Audiograms

4.7.1 Presbycusis (Hearing Loss Due to Aging)

As permitted by Section 5097 (d)(9), increases in an employee's hearing thresholds, as evidenced by an audiogram taken subsequent to a baseline audiogram, may be adjusted by lowering them for presbycusis (hearing loss due to aging). The applicable correction values at various ages and sound frequencies are included in Table 7. If the contracted medical facility chooses to adjust an employee's audiogram pursuant to Section 5097 (d)(9), they must follow the procedures described below.

4.7.2 Age Correction Values

Obtain from Table 7 the age correction values at each audiometric test frequency of interest the hearing losses at 2000, 3000, and 4000 Hz are relevant to the determination of whether a standard threshold shift, as defined by Section 5097 (d)(8), may exist for the employee by doing the following:

- Finding the age at which the most recent audiogram was taken and recording the corresponding are correction values; and

- Finding the age at which the baseline audiogram was taken and recording the corresponding age correction values.

Subtract the values found in (a) (2) from those found in (a) (1). The remainders from these subtractions represent the values, in decibels, which may be attributed to aging and are the values by which the most recent audiogram may be adjusted at the respective audiometric test frequencies.

Subtract the value found in (b) from the hearing threshold values of the most recent audiogram. When the adjustment of an audiogram for hearing loss due to aging is performed for the purpose of determining whether a standard threshold shift has occurred, the above-described calculations may be restricted to the 2000, 3000, and 4000 Hz frequencies. If the average of the hearing threshold values at 2000, 3000, and 4000 Hz found in step (c), above, is equal to or greater than 10, then the employee has exhibited a standard threshold shift, and the employer must comply with various provisions of Section 5097 (d) as well as certain other requirements such as Sections 5089 (a) (2) (B) 2 and (b) (3).

TABLE 7 Age Correction Values in Decibels for Males (M) and Females (F)

	Audiometric Test Frequencies (Hz)									
Age	*1000*		*2000*		*3000*		*4000*		*6000*	
	M	*F*	*M*	*F*	*M*	*F*	*M*	*F*	*M*	*F*
20 or Younger	5	7	3	4	4	3	5	3	8	6
22	5	7	3	4	4	4	5	4	8	6
24	5	7	3	5	5	4	6	4	9	7
26	5	8	4	5	5	5	7	4	10	8
28	6	8	4	5	6	5	8	5	11	8
30	6	8	4	6	6	5	9	5	12	9
32	6	9	5	6	7	6	10	6	14	10
34	6	9	5	6	8	6	11	6	15	10
36	7	9	5	7	9	7	12	7	16	11
38	7	10	6	7	9	7	13	7	17	12
40	7	10	6	7	10	8	14	8	19	13
42	8	10	7	8	11	9	16	9	20	13
44	8	11	7	8	12	9	17	9	22	14
46	8	11	8	9	13	10	19	10	24	15
48	9	12	8	9	14	11	20	11	25	16
50	9	12	9	10	16	11	22	12	27	17
52	9	12	10	10	17	12	24	13	29	18
54	10	13	10	11	18	13	26	14	31	19
56	10	13	11	11	20	14	28	15	34	20
58	10	14	12	12	22	15	31	16	36	21
60 or older	11	14	13	12	23	16	33	17	38	22

TRAINING PROGRAM SECTION 5.0

After an evaluation of workplace noise levels determines affected employees, a training program will be initiated and repeated annually for each employee included in the hearing conservation program. Information provided in the training program will be updated to be consistent with changes in protective equipment and work processes. Some of the information made available through the training seminar includes:

- The effects of noise on hearing.
- The purpose and advantages of hearing protection, attenuation of various types, and instructions on selecting, fitting, use, and care.
- The purpose of audiometric testing, and an explanation of the test procedures.

Upon request, the EHS Office will provide employees with any informational materials related to the EHS hearing conservation program.

RECORDKEEPING SECTION 6.0

The EHS Office maintains accurate records of all employee exposure measurements required by CCR Section 5097(b). The information regarding audiograms includes the following:

- Name and classification of the employee.
- Date of the audiogram.
- The examiner's name.
- Date of the last acoustic or exhaustive calibration of the audiometer.
- The employee's most recent noise exposure assessment.

The EHS Office will retain the noise exposure records for 2 years. Audiometric test records will be retained for the duration of the affected employee's employment.

All records on file will be provided upon request to the employee, former employee, representatives designated by the employee, and any authorized representative of the Chief of the Division of CAL/OSHA.

METHODS FOR ESTIMATING THE ADEQUACY OF HEARING PROTECTOR ATTENUATION SECTION 7.0

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. One of the methods in this Section must be used to estimate the adequacy of hearing protection attenuation.

7.1 The Noise Reduction Rating

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.

7.2 National Institute for Occupational Safety and Health

Instead of using the NRR, the EHS Office may evaluate the adequacy of hearing protector attenuation by using one of the three methods developed by the National Institute for Occupational Safety (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 from each time segment. Also, calculated attenuation values reflect realistic values only to the extent that the protectors are properly fitted and worn.

7.3 Methods to be Used When Using the Noise Reduction Rating

When using a dosimeter that is capable of C-weighted measurements:

- Obtain the employee's C-weighted dose for the entire workshift and convert to TWA.
- Subtract the NRR from the C-weighted TWA to obtain the estimated A-weighted TWA under the ear protector.

When using a dosimeter that is not capable of C-weighted measurements, the following methods may be used:

- Convert the A-weighted dose to TWA.
- Subtract 7 dB from the NRR.
- Subtract the remainder from the A-weighted TWA to obtain the estimated A-weighted TWA under the ear protector.

When using a sound level meter set to the A-weighting network:

- Obtain the employee's A-weighted TWA.
- 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.

When using a sound level meter set on the C-weighting network:

- Obtain a representative sample of the C-weighted sound levels in the employee's environment.
- Subtract the NRR from the C-weighted average sound level to obtain the estimated A-weighted TWA under the ear protector.

GLOSSARY SECTION 8.0

Action Level
An 8-hour time-weighted average of 85 decibels measured on the A-scale, slow response, or equivalently a dose of fifty percent.

Audiogram
A chart, graph or table resulting from an audiometric test showing an individual's hearing threshold levels as a function of frequency.

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

Attenuation
To reduce in intensity. To weaken or lessen.

Baseline Audiogram
The audiogram against which future audiograms are compared.

Criterion Sound Level
A sound level of 90 decibels.

Decibel (dB)
Unit of measurement of sound level.

dBA (Decibels-A-Weighted)
A unit of measurement of sound level corrected to the A-weighted scale, as defined in ANSI S1.4-1971 (R1976), using a reference level of 20 micropascals (0.00002 Newton per square meter).

Hertz (Hz)
Unit of measurement of frequency numerically equal to cycles per second.

Medical Pathology
A disorder or disease. For purposes of this regulation, a condition or disease affecting the ear, which should be treated by a physician specialist.

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

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

Sound Level
Ten times the common logarithm of the ratio of the standard reference pressure of 20 micropascals. Unit: decibels (dB). For use with this regulation, SLOW time response, in accordance with ANSI S1.4-1971 (R1976), is required.

Sound Level Meter
An instrument for the measurement of sound level.

ATTACHMENTS SECTION 9.0

ATTACHMENT 9.1

CALIFORNIA CODE OF REGULATIONS, TITLE 8, SECTION 5095-5099

ATTACHMENT 9.2

OFFICE OF ENVIRONMENTAL MANAGEMENT, HEALTH AND SAFETY

Noise Survey Form

LOCATION: _____ DATE: _____
NUMBER OF PERSONNEL EXPOSED: _____
WEARING EAR PROTECTION YES__ NO__
OPERATOR: _____ SIGNATURE: _____

DIAGRAM:
(Show measuring location)

NOTES: _____
_____

dB(A) MAX LEVEL	EXPOSURE TIME	TOTAL DURATION	PERMISSIBLE	D/P
OVER 115			NONE	
115			1/4	
110			1/2	
105			1	
102			1 1/2	
100			2	
97			3	
95			4	
90			8	
BELOW 90			ANY	