

Wellesley College **Hearing Conservation Program**

I. PURPOSE

Exposure to excessive noise in the workplace can cause permanent hearing loss. Although Wellesley College attempts to control noise exposures on campus, certain operations and workstations may expose faculty, staff, or students to significant noise levels. The Hearing Conservation Program has been established to help ensure that members of the campus community do not suffer health effects from exposure to excessive noise while at work.

II. REGULATIONS AND OTHER APPLICABLE STANDARDS

OSHA 29 CFR 1910.95, "Occupational noise exposure" and relevant appendices

OSHA 29 CFR 1904.5, "Determination of work-relatedness".

OSHA 29 CFR 1904.10, "Recording Criteria for Cases Involving Occupational Hearing Loss". ANSI S1.11-1971 "Specification for Octave, Half-Octave, and Third-Octave Band Filter Sets"

ANSI S1.25-1978 "Specification for Personal Noise Dosimeters"

ANSI S1.4-1971 "Specification for Sound Level Meters"

ANSI S3.6-1969 "Specifications for Audiometers"

III. SCOPE

The provisions of the Hearing Conservation Program apply to all personnel at the Wellesley College campus.

APPLICABILITY

This program shall apply to all operations either stationary or mobile where employees are expected to be exposed to noise levels of 85 dBA or above for 8 hours as a time-weighted average.

IV. DEFINITIONS

A. Action Level

An 8-hour time-weighted average (TWA) of 85 decibels measured on the A-weighted scale, slow response, or equivalently a dose of 50%. This is the level of sound exposure at which employee participation in the Wellesley College Hearing Conservation Program is mandatory.

B. A-Weighted Sound Level (dBA)

The weighting of sound levels that represents the function of the human ear.

C. Audiometric Testing Program

The portion of the Hearing Conservation Program that consists of measuring an employee's hearing threshold to establish a baseline and for subsequent comparisons.

D. Decibel (dB)

Unit of measurement of sound level.

E. Dose

A ratio of noise exposure relative to the noise criterion level of 90 decibels, expressed as a percentage. Ninety decibels represents a dose of 100% over an 8-hour work shift. Eighty-five decibels represents a dose of 50% over an 8-hour work shift. The dose is based on the OSHA 5 dB exchange rate. The dose may be determined from the equation given in Table 1 for non-continuous noise or estimated from Table 2 based on the TWA.

F. Hearing Conservation Program (HEACP)

A written program that establishes procedures to ensure the protection of employees from high noise areas or operations in compliance with the OSHA Occupational Noise Regulation 29 CFR 1910.95.

G. Hearing Protection Attenuation

The estimated reduction in the noise level at the eardrum as a result of the use of hearing protection. Estimated using the formula: Attenuated TWA, dBA = TWA - (Noise Reduction Rating, NRR, - 7) for A - scale weighted sound levels. Attenuated TWA, dBC = TWA - NRR for C-scale weighted sound levels.

H. Noise-Induced Hearing Loss, NIHL

The OSHA recordable occupationally related hearing loss, as defined by 29 CFR 1904.10 and 29 CFR 1904.5, and includes a Standard Threshold Shift (STS) of 10 dB, with age correction, averaged over the 2K, 3K, and 4K frequencies from baseline in either ear and a 25 dB shift from audiometric zero, in the same ear as the 10 dB STS at the same frequencies.

I. Noise Reduction Rating (NRR)

The theoretical maximum amount of noise reduction that can be achieved using a hearing protection device. This is a manufacturers' calculated value and must be displayed with the hearing protection device.

J. Monitoring

The sampling of noise levels using a sound level meter, octave band analyzer, or personal noise dosimeter.

K. Permissible Noise Exposure

The maximum daily noise exposure which may be experienced by employees not using hearing protectors from a continuous 8-hour exposure to a sound level of 90 dBA or equivalent dose of 100%.

L. Standard Threshold Shift (STS)

A change in hearing threshold, relative to the most recent audiogram for that employee, of an average of 10 decibels (dB) or more at 2000, 3000, and 4000 hertz in one or both ears and substantiated within 30 days with a follow-up audiogram.

M. Time Weighted Average (TWA)

The [equivalent] noise level, in dB, based on an 8-hour exposure time frame. If the noise is not constant over an 8-hour exposure, then a calculated 8-hour TWA must be made using the equation in Table 1. The TWA may also be estimated from the dose or percent noise exposure, based on noise exposure continuous over 8-hours, as given in Table 2.

V. RESPONSIBILITIES

A. Environmental Health and Safety Shall:

1. Develop the written Hearing Conservation Program and revise the program, as necessary.
2. Identify and establish a written agreement with an audiometric testing clinic for occupationally exposed employees. The written agreement is established with *Industrial Hearing Testing*.
3. Conduct monitoring to identify areas or operations requiring inclusion in a hearing conservation program.
4. Assist in noise control measures (i.e. hearing protection, noise control).
5. Identify approved hearing protection for use by Wellesley College employees requiring protection.
6. Oversee calibration and servicing of monitoring equipment (sound level meters, noise dosimeters, and other such equipment as necessary to protect the health of the employees).

B. Industrial Hearing Testing Shall:

1. Conduct hearing testing for employees potentially exposed to noise levels at or above the OSHA Action Level of 85 dBA as an 8-hour TWA in accordance with 29 CFR 1910.95 including:
 - a. Conduct audiograms.
 - b. Provide training on the effects of noise.
 - c. Provide training in the use, care, and limitations of hearing protection devices.
2. Provide EHS with written results for employees that have experienced a standard threshold shift of 10 dB or more following loss correction for age, regardless of a 25 dB shift from audiometric zero.
3. Retain audiometric testing results for the duration of an employee's employment. Audiometric testing record forms are included in this program as Appendix J.
4. Provide EHS with written audiometric testing results for employees upon termination of employment from Wellesley College
5. Maintain written calibration of audiometers and daily operational pre-testing checks.

C. Departments, Supervisors, Directors, Managers Shall:

1. Identify potentially hazardous noise locations and operations and contact EHS for evaluations.
2. Ensure that employees required to participate in the hearing conservation program complete their annual audiometric testing.
3. Implement disciplinary steps for employees who fail to comply with the requirements of the program, including but not limited to failure to attend audiometric testing with the specified service provider and failure to wear required hearing protection devices.

D. Employee Shall:

1. Assist the supervisor in identifying potentially hazardous noise locations or operations to which they may be exposed.

2. Complete audiometric testing or exposure assessments as instructed.
3. Use hearing protection as required and in accordance with the training received.

VI. GENERAL REQUIREMENTS

A. Monitoring

When information indicates that an employee's exposure may equal or exceed the action level of 85 dBA for an 8-hour TWA assessment, monitoring shall be conducted by EHS. Affected employees shall be notified of the results of the monitoring where levels at or above the action level are identified. Monitoring activities may consist of:

1. Sound level measurements for locations where the noise level is stationary and expected to be continuous or
2. Personal noise dosimetry for work operations that are highly mobile or random in noise level.
3. Re-monitoring, if a change in equipment, process or controls increases the noise level to the extent that:
 - a. Additional employees may be exposed at or above the action level or;
 - b. The attenuation provided by the hearing protectors used by the employee(s) does not reduce the noise exposure level to 90 dBA for an 8 hour TWA or 85 dBA as 8 hour TWA for employees that have experienced a standard threshold shift.
 - c. Follow-up monitoring if an STS has occurred.
4. The opportunity for affected employees to observe the noise measurements during collection.

B. Audiometric Testing Program

All employees exposed to noise at or above the Action Level are required to participate in the program. This program consists of:

1. A baseline test to be completed within 6 months of the employee's first exposure above the action level. This test must be preceded by at least 14 hours without exposure to workplace noise at or above 85 dBA or hearing protection devices must be used prior to testing.
2. Annual testing thereafter provided that exposure at or above the action level is expected.
3. Training of affected employees regarding the hazards of noise exposure, and where necessary the fitting of employees with appropriate hearing protection devices and training about their use, care, and limitations.
4. A follow-up audiogram may be provided within 30 days if a standard threshold shift has been identified. The employee shall be informed in writing within 21 days of the determination.
5. Audiometric testing reviewed by an audiologist. The audiologist will determine if further evaluation or retraining is needed.
6. Maintenance of audiometric testing equipment in accordance with the requirements of the OSHA Occupational Noise Standard (29 CFR 1910.95 and its appendices).

C. Noise Control

Where noise levels for non-mobile sources are measured to be over 90 dBA or above the

Permissible Noise Exposure as listed in Table 1 and employees are required to work in such areas the following measures shall be taken:

1. Engineering controls will be reviewed for feasibility in noise reduction. Until they are implemented or if adequate controls are not feasible then.
2. Hearing protection devices shall be worn by employees whose exposure is at or above 90 dBA as an 8-hour TWA. Hearing protection devices will be made available to exposed employees at no cost. Hearing protection attenuation shall reduce the exposure below 90 dBA as an 8-hour TWA using the NRR of the rated device.
3. For employees exposed to noise levels at or above 85 dBA, but below 90 dBA as an 8 hour TWA the use of hearing protection devices shall be strongly encouraged.

D. Record-keeping

The audiometric testing clinic shall maintain audiometric exams for each tested employee for the duration of that employee’s participation in the program. Upon leaving employment from the University or discontinuance in the Hearing Conservation program, all records will be transferred to EHS. EHS shall maintain all noise monitoring data.

TABLES

TABLE 1: 8- HOUR TWA SOUND LEVELS & ALLOWABLE EXPOSURE TIMES			
Sound Level (dBA) (loudness)	Allowable Exposure Duration (Hours)	For brevity, only dBA values that are multiples of 5 are shown. Shaded areas represent OSHA defined exchange rate. The complete table G-16A at 29 CFR 1910.95 App A will be used. Allowable exposure duration is time in hours at a dBA level, which constitutes an exposure equivalent in energy and sound dose to 90 dBA for 8 hours.	
80	32	Calculations/Definitions: Allowable exposure time may be calculated using the following equation for sound levels not specified in this table: $T = 8/2^{(L-90)/5}$ Where T = Allowable Exposure Duration and L = measured A-weighted sound level. Example: measured sound level = 75 dBA $T = 8/2^{(75-90)/5} = 64 \text{ hours Allowable Exposure Duration}$	
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		
Sound levels below 80 dBA are not included in exposure calculations. A dose of 50% or more, or an 8h-TWA of 85 dBA or higher, triggers the Action Level requirements and mandates an employee's participation in the Wellesley College Hearing Conservation Program.			

TABLE 2: PERCENT NOISE EXPOSURE (DOSE) AND EQUIVALENT 8-HOUR TWA

Dose (%)	8-Hour TWA	
10	73.4	<p>For brevity, a shorten selection of dose values is shown. The complete list is given in table A-1 of 29 CFR 1910.95, Appendix A.</p> <p>The dose may be calculated using the following formula: $\text{Dose} = 100 \times \left\{ \frac{C_{\text{Level1}}}{T_{\text{Level1}}} + \frac{C_{\text{Level2}}}{T_{\text{Level2}}} + \frac{C_{\text{Level n}}}{T_{\text{Level n}}} \right\}$ Where C = time of exposure at any noise level and T = allowable exposure time, in hours given by Table 1.</p> <p>Example: 100 dBA for 1 hour, 95 dBA for half hour, and 80 dBA for 4h</p> $\text{Dose} = 100 \times \left\{ \frac{1}{2} + \frac{0.5}{4} + \frac{4}{32} \right\} = 100 \times (0.5 + 0.125 + 0.125) = 75\%$ <p>For a dose greater than or less than the values printed in the chart use the following equation to calculate the TWA: $8\text{h-TWA} = 16.61 \log_{10} (D/100) + 90$ Where D = accumulated dose in percent exposure.</p> <p>Example: Dose = 75%</p> $8\text{h-TWA} = 16.61 \log_{10} (.75) + 90 = 16.61(-.1249) + 90 = -2.07 + 90 = 87.93 \text{ dBA}$
20	78.4	
30	81.3	
40	83.4	
50	85.0	
60	86.3	
70	87.9	
80	88.4	
90	89.2	
100	90.0	
120	91.3	
140	92.4	
160	93.6	
180	94.2	
200	95.0	
240	96.3	
280	97.9	
300	97.9	
400	100.0	
500	101.6	

APPENDICES

APPENDIX A: NOISE DOSIMETRY DATA SHEET

Name: _____		Date: _____	
Job Title: _____			
Dosimeter Manufacturer: _____		Model & Serial #: 	
Location Description: _____			
Threshold: _____	80 dBA	Criterion Level: _____	90 dBA
		Exchange Rate: _____	5 dBA
Microphone Location: _____			
Monitoring Conducted:	<input type="checkbox"/> Personal	<input type="checkbox"/> Area	
Are Hearing Protectors Used?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
If yes, what percent of the workday?			

Exposure Description

Calibration Check

Date	Initial Reading	Time	Final Reading	Time

Calibrator QC-10 @ 1000 Hz @ 114 dB, Serial # -

Dosimetry Data

Date	115 dBA Exceeded	Start Time	Stop Time	Display Reading %	L eq(t)

APPENDIX C: NOISE COMPARISON CHART

Noise Source	Decibel Level (dBA)	Comments
Jet take-off (at 25 meters)	150	Eardrum rupture
Aircraft carrier deck	140	
Military jet aircraft take-off from aircraft carrier with afterburner at 50 ft (130 dB).	130	
Thunderclap; chain saw; Oxygen torch (121 dB).	120	32 times as loud as 70 dB; Painfully loud
Steel mill; Auto horn at 1 meter; turbo-fan aircraft at takeoff power at 200 ft (118 dB); riveting machine (110 dB); live rock music (108 - 114 dB)	110	16 times as loud as 70 dB; average human pain threshold
Jet take-off (at 305 meters); use of outboard motor; power lawn mower; motorcycle; farm tractor; jackhammer; garbage truck; Boeing 707 or DC-8 aircraft at one nautical mile (6080 ft) before landing (106 dB); jet flyover at 1000 feet (103 dB); Bell J-2A helicopter at 100 ft (100 dB).	100	8 times as loud as 70 dB; serious damage possible in 8 hour exposure
Boeing 737 or DC-9 aircraft at one nautical mile (6080 ft) before landing (97 dB); power mower (96 dB); motorcycle at 25 ft (90 dB); newspaper press (97 dB).	90	4 times as loud as 70 dB; likely damage in 8 hour exposure
Garbage disposal; dishwasher; average factory; freight train (at 15 meters); Car wash at 20 ft (89 dB); propeller plane flyover at 1000 ft (88 dB); diesel truck 40 mph at 50 ft (84 dB); diesel train at 45 mph at 100 ft (83 dB); food blender (88 dB); milling machine (85 dB); garbage disposal (80 dB)	80	2 times as loud as 70 dB; possible damage
Passenger car at 65 mph at 25 ft (77 dB); freeway at 50 ft from pavement edge 10 a.m. (76 dB); living room music (76 dB); radio, TV-audio or vacuum cleaner (70 dB)	70	Arbitrary base of comparison; Upper 70s annoyingly loud to some people.
Conversation in restaurant or office; background music; air conditioning unit at 100 ft	60	Half as loud as 70 dB; fairly quiet
Quiet suburb; conversation at home; large electrical transformers at 100 ft.	50	One-fourth as loud as 70 dB
Library; bird calls (44 dB); lowest limit of urban ambient sound	40	One-eighth as loud as 70 dB
Quiet rural area	30	One-sixteenth as loud as 70 dB; very quiet
Whisper; rustling leaves	20	
Breathing	10	Barely audible

SOURCES: Temple University Department of Civil/Environmental Engineering (www.temple.edu/departments/CETP/enviro10.html), and *Federal Agency Review of Selected Airport Noise Analysis Issues*, Federal Interagency Committee on Noise (August 1992). Source of the information is attributed to *Outdoor Noise and the Metropolitan Environment*, M.C. Branch et al., Department of City Planning, City of Los Angeles, 1970.

APPENDIX D: HEARING CONSERVATION PROGRAM EVALUATION CHECKLIST

Training and Education

Failures or deficiencies in hearing conservation programs (hearing loss prevention programs) can often be traced to inadequacies in the training and education of noise-exposed employees and those who conduct elements of the program.

	1. Has training been conducted at least once a year?
	2. Was the training provided by a qualified instructor?
	3. Was the success of each training program evaluated?
	4. Is the content revised periodically?
	5. Are managers and supervisors directly involved?
	6. Are posters, regulations, handouts, and employee newsletters used as supplements?
	7. Are personal counseling sessions conducted for employees having problems with hearing protection devices or showing hearing threshold shifts?

Supervisor Involvement

Data indicate that employees who refuse to wear hearing protectors or who fail to show up for hearing tests frequently work for supervisors who are not totally committed to the hearing loss prevention programs.

	1. Have supervisors been provided with the knowledge required to supervise the use and care of hearing protectors by subordinates?
	2. Do supervisors wear hearing protectors in appropriate areas?
	3. Have supervisors been counseled when employees resist wearing protectors or fail to show up for hearing tests?
	4. Are disciplinary actions enforced when employees repeatedly refuse to wear hearing protectors?

Noise Measurement

For noise measurements to be useful, they need to be related to noise exposure risks or the prioritization of noise control efforts, rather than merely filed away. In addition, the results need to be communicated to the appropriate personnel, especially when follow-up actions are required.

	1. Were the essential/critical noise studies performed?
	2. Was the purpose of each noise study clearly stated? Have noise-exposed employees been notified of their exposures and apprised of auditory risks?
	3. Are the results routinely transmitted to supervisors and other key individuals?
	4. Are results entered into health/medical records of noise exposed employees?
	5. Are results entered into shop folders?
	6. If noise maps exist, are they used by the proper staff?
	7. Are noise measurement results considered when contemplating procurement of new equipment? Modifying the facility? Relocating employees?
	8. Have there been changes in areas, equipment, or processes that have altered noise exposure? Have follow-up noise measurements been conducted?
	9. Are appropriate steps taken to include (or exclude) employees in the hearing loss prevention programs whose exposures have changed significantly?

Engineering and Administrative Controls

Controlling noise by engineering and administrative methods is often the most effective means of reducing or eliminating the hazard. In some cases, engineering controls will remove requirements for other components of the program, such as audiometric testing and the use of hearing protectors.

	1. Have noise control needs been prioritized?
	2. Has the cost-effectiveness of various options been addressed?
	3. Are employees and supervisors appraised of plans for noise control measures? Are they consulted on various approaches?
	4. Will in-house resources or outside consultants perform the work?
	5. Have employees and supervisors been counseled on the operation and maintenance of noise control devices?
	6. Are noise control projects monitored to ensure timely completion?
	7. Has the full potential for administrative controls been evaluated? Are noisy processes conducted during shifts with fewer employees? Do employees have sound-treated lunch or break areas?

Monitoring Audiometry and Record Keeping

The skills of audiometric technicians, the status of the audiometer, and the quality of audiometric test records are crucial to hearing loss prevention program success. Useful information may be ascertained from the audiometric records as well as from those who actually administer the tests.

	1. Has the audiometric technician been adequately trained, certified, and recertified as necessary?
	2. Do on-the-job observations of the technicians indicate that they perform a thorough and valid audiometric test, instruct and consult the employee effectively, and keep appropriate records?
	3. Are records complete?
	4. Are follow-up actions documented?
	5. Are hearing threshold levels reasonably consistent from test to test? If not, are the reasons for inconsistencies investigated promptly?
	6. Are the annual test results compared to baseline to identify the presence of an OSHA standard threshold shift?
	7. Is the annual incidence of standard threshold shift greater than a few percent? If so, are problem areas pinpointed and remedial steps taken?
	8. Are audiometric trends (deteriorations) being identified, both in individuals and in groups of employees? (NIOSH recommends no more than 5% of workers showing 15 dB Significant Threshold Shift, same ear, same frequency.)
	9. Do records show that appropriate audiometer calibration procedures have been followed?
	10. Is there documentation showing that the background sound levels in the audiometer room were low enough to permit valid testing?
	11. Are the results of audiometric tests being communicated to supervisors and managers as well as to employees?
	12. Has corrective action been taken if the rate of no-shows for audiometric test appointments is more than about 5%?
	13. Are employees incurring STS notified in writing within at least 21 days? (NIOSH recommends immediate notification if retest shows 15 dB Significant Threshold Shift, same ear, and same frequency.)

Referrals

Referrals to outside sources for consultation or treatment are sometimes in order, but they can be an expensive element of the hearing loss prevention program, and should not be undertaken unnecessarily.

	1. Are referral procedures clearly specified?
	2. Have letters of agreement between the company and consulting physicians or audiologists been executed?
	3. Have mechanisms been established to ensure that employees needing evaluation or treatment actually receive the service (i.e., transportation, scheduling, reminders)?
	4. Are records properly transmitted to the physician or audiologist, and back to the company?
	5. If medical treatment is recommended, does the employee understand the condition requiring treatment, the recommendation, and methods of obtaining such treatment?
	6. Are employees being referred unnecessarily?

Hearing Protection Devices

When noise control measures are infeasible, or until such time as they are installed, hearing protection devices are the only way to prevent hazardous levels of noise from damaging the inner ear. Making sure that these devices are worn effectively requires continuous attention on the part of supervisors and program implementers as well as noise-exposed employees.

	1. Have hearing protectors been made available to all employees whose daily average noise exposures are 85 dBA or above? (NIOSH recommends requiring HPD use if noises equal or exceed 85 dBA regardless of exposure time.)
	2. Are employees given the opportunity to select from a variety of appropriate protectors?
	3. Are employees fitted carefully with special attention to comfort?
	4. Are employees thoroughly trained, not only initially but at least once a year?
	5. Are the protectors checked regularly for wear or defects, and replaced immediately if necessary?
	6. If employees use disposable hearing protectors, are replacements readily available?
	7. Do employees understand the appropriate hygiene requirements?
	8. Have any employees developed ear infections or irritations associated with the use of hearing protectors? Are there any employees who are unable to wear these devices because of medical conditions? Have these conditions been treated promptly and successfully?
	9. Have alternative types of hearing protectors been considered when problems with current devices are experienced?
	10. Do employees who incur noise-induced hearing loss receive intensive counseling?
	11. Are those who fit and supervise the wearing of hearing protectors competent to deal with the many problems that can occur?
	12. Do workers complain that protectors interfere with their ability to do their jobs? Do they interfere with spoken instructions or warning signals? Are these complaints followed promptly with counseling, noise control, or other measures?
	13. Are employees encouraged to take their hearing protectors home if they engage in noisy non-occupational activities?
	14. Are new types of or potentially more effective protectors considered as they become available?
	15. Is the effectiveness of the hearing protector program evaluated regularly?
	16. Have at-the-ear protection levels been evaluated to ensure that either over or under protection has been adequately balanced according to the anticipated ambient noise levels?
	17. Is each hearing protector user required to demonstrate that he or she understands how to use and care for the protector? The results documented?

Administrative

Keeping organized and current on administrative matters will help the program run smoothly.

	1. Have there been any changes in federal or state regulations? Have hearing loss prevention program's policies been modified to reflect these changes?
	2. Are copies of company policies and guidelines regarding the hearing loss prevention program available in the offices that support the various program elements? Are those who implement the program elements aware of these policies? Do they comply?
	3. Are necessary materials and supplies being ordered with a minimum of delay?
	4. Are procurement officers overriding the hearing loss prevention program implementer's requests for specific hearing protectors or other hearing loss prevention equipment? If so, have corrective steps been taken?
	5. Is the performance of key personnel evaluated periodically? If such performance is found to be less than acceptable, are steps taken to correct the situation?
	6. Safety: Has the failure to hear warning shouts or alarms been tied to any accidents or injuries? If so, have remedial steps been taken?

APPENDIX E: OSHA STANDARDS AND APPENDICES HEARING LOSS RELATED

[OSHA Occupational Noise Exposure Standard and Appendices 29 CFR 1910.95](#)

[OSHA Recording Criteria for Cases Involving Occupation Hearing Loss 29 CFR 1904.10](#)