

<p>CESO Regulation No. 385-1-89</p>	<p>DEPARTMENT OF THE ARMY U.S. Army Corps of Engineers Washington, DC 20324-1000</p>	<p>ER 385-1-89 15 October 2012</p>
	<p>Safety HEARING CONSERVATION PROGRAM</p>	
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CESO

Regulation  
No. 385-1-89

15 October 2012

Safety and Occupational Health  
HEARING CONSERVATION PROGRAM

1. Purpose. The purpose of this document is to prevent occupational related hearing loss among U.S. Army Corps of Engineers (USACE) personnel.
2. Applicability. This regulation applies to the entire USACE Direct Reporting Unit (DRU) including Divisions, Districts, Labs, and Centers. The USACE Safety and Health Requirements Manual, EM 385-1-1, contains the requirements for contractors concerning hearing conservation programs and the control of noise hazards.
3. Distribution. Approved for public release; distribution is unlimited. This document will be effective six months after the date of publication.
4. References. References are listed in Appendix A.
5. Definitions. Definitions are listed in Appendix B.
6. Background.

- a. Hearing Loss.

(1) Noise-induced hearing loss may be temporary or permanent. If the hearing loss is temporary, there is a return of most or all of the individual's pre-exposed hearing acuity after a period of hours away from intense sound. Over time, temporary hearing loss may lead to permanent, irreparable hearing loss. Also, there is evidence that multiple, temporary changes to the inner ear results in a predisposition to permanent hearing loss, even if the acuity recovers in the short-term.

(2) Most hearing loss is caused by excessive exposure to high frequencies and/or intensity levels of noise

(3) Research has shown that hearing loss can be enhanced and/or caused by exposure to certain chemicals, called ototoxins, listed in Appendix C. While there is a



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definite connection between the chemical exposure and hearing loss, the level of exposure to ototoxins that causes a hearing loss has not been delineated.

(4) Department of Defense (DoD) hearing conservation regulations are more stringent than the Occupational Safety and Health Administration (OSHA) standards. As part of DoD, USACE will apply the more stringent DoD standard.

b. Essential Elements of Hearing Conservation Program. The following are the essential elements in a hearing conservation program.

- (1) Noise-hazard evaluations and posting of noise-hazardous areas and equipment.
- (2) Engineering or administrative control measures to reduce noise levels.
- (3) Selection, fitting, training, care, and use of hearing protective devices.
- (4) Audiometric testing for early detection of hearing loss.

(5) Health education on the prevention of hearing loss and the use of engineering, administrative, and personal protection controls.

c. Criteria for inclusion in the Hearing Conservation Program. Personnel who are occupationally exposed to:

(1) Continuous and intermittent noise that has a time weighted average over eight hours (TWA) noise level of 85 decibels A-weighted (dBA) or greater. Computation of the TWA noise exposure incorporates a 3 dB time-intensity trade-off, which differs from the 5 dB trade-off used by the OSHA. Both USACE and OSHA integrate sounds above 80 dBA in the computation, but USACE has no upper bound on levels to include, whereas OSHA limits the integration to sounds up to 130 dBA.

(2) Impulse noise peak sound pressure levels (SPLs) of 140 decibels peak (dBP) or greater, regardless of the number of impulses involved.

(3) Exposure to ototoxins in the work area (Listed in Appendix C).

(4) Airborne ultrasonic noise, regardless of duration, in any of the one-third octave bands exceeding the corresponding value in Table 1.

d. Personnel who no longer meet the criteria above due to a job change or a change in the work environment, shall receive a job change audiogram and be removed from the Hearing Conservation Program.

e. Undocumented or Newly Identified Noise Exposure. If a work area or job task has not had a time-weighted average noise measurement, but it is difficult to speak and/or sound levels readings are over 85 dBA, workers shall have baseline audiograms, training, and be provided with hearing protection. The work area or job task shall be posted as a noise hazard area or task until a time-weighted average noise measurement documents the actual exposure and inclusion or non-inclusion in the hearing conservation program.

f. Occasional Exposure to Noise. Personnel who are required to enter noise hazardous areas or observe noise hazardous tasks, but are not exposed to an eight hour TWA over 85 dBA, shall receive annual training on the hazards of noise and the use of hearing protection and provided hearing protection. These personnel should not be considered part of the hearing conservation program and shall not receive audiometric testing.

g. Off-Duty Noise. Exposures to hazardous noise levels are not confined to the work place. Hobbies such as sport shooting, woodworking, or working around engines without the use of hearing protection, can also cause hearing loss. Training in the prevention of hearing loss should also stress protecting against off-duty noise sources.

## 7. Responsibilities.

### a. USACE Headquarters:

(1) The Chief, Safety and Occupational Health Office, shall be responsible for:

(a) Staffing, development, and review of the Hearing Conservation Program for USACE.

(b) Maintaining liaison with Army Staff and other government agencies to insure that the USACE hearing conservation program meets legal statute, DoD and Army requirements, and adequately protects workers.

(2) The Engineering and Construction Directorate shall be responsible for providing staff policy and guidance to assure that hearing conservation criteria are incorporated into specifications and designs of new and modifications of current facilities and equipment. All facilities shall be designed and all equipment procured with the objective that it produces a sound pressure level of less than 85 dBA at locations where personnel may be present during normal operation.

(3) The Operations Directorate shall be responsible for providing staff policy and guidance to assure that procured equipment produces sound pressure levels sufficiently

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low enough to result in noise exposures that do not exceed 85 dBA at all locations in which personnel may be present during normal operations. If more than one piece of equipment is purchased, the placement of that equipment should be such that the added effect of the sound pressure from each piece of equipment is less than 85 dBA at locations where personnel may be present during normal operations.

(4) The Human Resources Directorate shall coordinate any changes in the hearing conservation program with the appropriate bargaining units and shall provide guidance to supervisors on appropriate documentation required for Federal Employees Compensation Act (FECA) hearing loss claims.

b. MSC/Division Commanders. The MSC commander is responsible for program management and quality assurance of all USACE hearing conservation programs within their division.

c. Commanders at all levels shall direct that:

(1) Initially or if there is a suspected change in the noise exposure, a survey be completed of all undocumented noise sources and worker's noise exposures. All noise hazardous equipment shall be monitored and a full shift dosimeter reading will be measured for individual workers within six months of the implementation of this regulation. All newly identified noise sources shall be monitored within six months of their identification. These surveys shall be completed by an individual with specific classroom and on-the-job training related to measuring and documenting noise levels and exposures. The surveys shall be conducted in the methods described in the Appendix D.

(2) Retain an audiologist, otolaryngologist, or a licensed occupational health physician to serve as the professional Audiometric Data Reviewing Official of the audiometric monitoring component of the Hearing Conservation Program. The Audiometric Data Reviewing Officer shall review a minimum of 20% of the normal audiograms and all of the threshold shift audiograms for completeness and correctness. This includes a comparison of the baseline and subsequent audiograms; determination whether a baseline revision is indicated; determination of the work-relatedness of the threshold shifts; determination of the need for further evaluation; and a recommendation if the hearing loss is a reportable injury and should be reported on the OSHA 300 Log. A copy of the evaluation of suspected threshold shift evaluations shall be provided to the employee and retained in the official occupational health record.

(3) Write and implement a command hearing conservation program and provide with adequate resources, if documented noise sources or exposures exist within the Command. This can be a part of the over-all Safety Program.

(4) Identify and prioritize engineering controls for noise hazardous equipment and job tasks. The Risk Assessment Code system in this document should be used to prioritize the capital cost for engineering controls.

d. Each Command Safety and Occupational Health Office (SOHO) shall:

(1) Implement the USACE Hearing Conservation Program.

(2) Maintain a listing of all noise hazard areas and equipment, and copies of all noise evaluations for a minimum of 30 years.

(3) Maintain a list of all individuals who were or have been exposed to ototoxins or noise with the documented noise exposures. The name shall be retained on the list until three years past when the individual is no longer exposed to the ototoxin or noise and their last audiogram.

(4) Provide training, as required, on the hazards of noise, ototoxins, the noise exposure values, the use of engineering and administrative controls, hearing protection, and audiometric testing requirements and procedures. Annual training is required for individuals in the hearing conservation program and individuals with occasional noise exposure. Training is recommended for all employees and supervisors of those employees with the potential for noise exposure.

(5) Maintain a copy of any personal noise assessments, dosimeter readings, and audiograms specified in this document in the official employee occupational health medical record as maintained by the Command Medical Records Custodian.

(6) Require all noise hazardous equipment and areas be posted in accordance with EP 310-1-6.

(7) Provide the Audiometric Data Reviewing Officer with a current copy of ER 385-1-89, DA Pam 502, and DODI 6055.12 to familiarize himself/herself with the differences between the DoD Hearing Conservation Program requirements and the OSHA Noise Hazard regulations.

(8) Provide the Audiometric Data Reviewing Officer with copies of the audiograms required for him/her to review. An authorization for release of the records shall be obtained from the employee.

e. Supervisor. All supervisors shall:

(1) Identify for the SOHO all areas with potential noise hazards that have not previously been identified, areas with new equipment, and noise hazardous areas which have been renovated.

(2) Add both noise and ototoxin exposure hazards to the position hazard analysis and the activity hazard analysis, include the hearing protective equipment or the use of specific administrative or engineering controls required for the task or area.

(3) Post all noise hazard areas as described EP 310-1-6A.

(4) Maintain all potentially noise hazardous equipment in good working order to prevent an increase in the noise from poor maintenance, loose belts or bolts, or increased vibration.

(5) Identify to the SOHO all ototoxins used in the area.

(6) Enforce the use of personal protective equipment, engineering controls, or administrative controls required to protect against high noise or ototoxin exposure.

(7) Orient new employees to the locations, and controls of oxotoxin and noise hazards.

(8) Ensure and document all workers with the potential to enter areas of hazardous noise or who work around or with ototoxins are trained as required by this document.

(9) Schedule audiograms for all new hires that will have a potential to work in or enter a noise hazard area or do noise hazardous tasks through the Occupational Health Program Manager. Schedule annual audiograms for individuals identified as participants in the hearing conservation program. Schedule follow-up audiograms and/or otologic evaluations for any individual identified with a significant threshold shift. Schedule an audiogram for any participant in the hearing conservation program who is moving to a new position that is not part of the hearing conservation program or is leaving government service. Ensure compliance with obtaining the 30-day retest constraint following notification of a significant threshold shift.

(10) Provide employees allow workers work time to obtain their audiograms and to have time in a quiet environment before their scheduled audiograms. Employees should have 14 hours away from loud noise, on and off the job, prior to testing.

(11) Take appropriate disciplinary action for non-compliance in regards to the use of hearing protection, reporting for all required audiograms, and the use of noise controls.



f. Employee. All employees who work at operations or in areas designated as noise-hazardous or with identified ototoxins shall:

(1) Wear approved hearing and ototoxin protectors in the noise hazardous or ototoxin exposure areas.

(2) Complete scheduled audiograms and take personal hearing protection to the audiogram for evaluation of the fit.

(3) Complete the retest audiograms within the 30 day requirement.

(4) Avoid loud noises, including gunfire, generator engine, and hi-volume music noise, on and off the job, for 14 hours prior to an audiogram.

(5) Notify their supervisor of suspected noise hazards or any hearing problems.

(6) Use all engineering and administrative noise controls provided.

(7) Follow any administrative procedures or work practices established to prevent hearing loss.

## 8. Noise Evaluations.

### a. Initial Determination.

(1) Noise measurements shall be made whenever there is difficulty in communicating at distances greater than two feet; upon worker complaint of excessive noise; new equipment has been added; or whenever hazardous noise levels are suspected.

(2) Noise measurements shall be made when any new facility or new equipment is placed in service.

(3) Noise measurements shall be made when areas, that in the past were not noise hazardous, become noise hazardous based on poor maintenance or the addition of structures or new equipment.

(4) All initial continuous noise hazard determinations shall include both a series of sound level readings and full shift dosimeter sampling.

(5) All initial impulse noise determinations shall be conducted with sound level equipment and further documented by dosimeter readings obtained with a dosimeter with a fast recording or impulse noise recording level.

(6) If an ultrasound is produced and hearing protection is not already used for audible noise, the ultrasound noise shall be monitored. Measurement of the ultrasound noise will require a sound level meter which measures above the 10 kilohertz level. Workers exposed to ultrasound above the levels in Table 1 below shall be part of the hearing conservation program and the source of ultrasound noise shall be labeled a noise hazardous source.

Table 1. Exposure Guidelines for Ultrasonic Noise

One-Third Octave Band Center Frequency (kHz)	One-Third Octave Band SPL (dB re 20 micropascals (μPA))
10	80
12.5	80
16	80
20	105
25	110
31.5	115
40	115
50	115

(7) The results of the noise sampling and any controls and/or training provided shall be annotated on the position hazard analysis and the activity hazard analysis for the related positions and tasks.

b. Reevaluations.

(1) Areas identified with noise sources greater than 85 dBA, as documented by a sound level meter, shall be evaluated biennially. The evaluation should include a sound level reading to determine if there has been a significant change, a review of the employee training records, review of the condition and type of hearing protection, signage of the area, and usage of the engineering and administrative controls. Full shift sampling is not required during the biennial reevaluation unless there has been more than a 3 dBA change in the noise value.

(2) Noise measurements are required within 30 days of any change in process or equipment which may increase or decrease employees noise exposure, or may increase exposure to the extent that personal protective equipment being used may no longer provide sufficient attenuation.

c. Noise level readings shall be taken with instruments and using procedures described in Appendix D.

d. If ototoxic chemicals are present and a noise survey has not been conducted, a noise survey shall be conducted. Due to the additive effect of the ototoxin and noise, hearing protection shall be worn if the noise value is greater than 80 dBA. The presence of the ototoxic chemical shall be recorded with the noise survey and noted during the training.

e. Risk Assessment Codes (RAC). All noise hazard areas will be assigned a RAC and cost effective index to be used in prioritizing the implementation of engineering controls. The RAC will depend on many factors, such as the sound intensity and duration of exposure. The procedure for assigning risk assessment codes for noise hazards can be found in Appendix D.

f. Evaluator Qualifications. Personnel who perform noise evaluations must have 8 hours training in noise survey techniques. This training may be part of a longer Industrial Hygiene or Safety Course.

g. Documentation of Noise Surveys. All noise measurement shall be documented as discussed in Appendix D. All records shall be maintained for 30 years past the date the last person who worked in the noise hazardous area has left employment of the federal government. Sound level readings and audiogram records shall include the calibration information for the equipment. If this work is conducted with rented equipment or by contractor, the calibration record for all equipment utilized shall be part of contract deliverables.

#### 9. Posting of Noise-Hazardous Areas and Equipment.

a. All noise hazard exposure areas shall be posted as required by EP 310-1-6A with the words "caution, noise hazard hearing protection required". For fixed equipment, physically draw a contour line where the noise level drops below 85 dBA and train all employees as to the significant of this line. (Additional descriptive information such as "when equipment is in use", "within 15 feet", or similar expressions should be added to warning signs. Whole rooms or areas should be designated, or if there are only some areas within the larger space that are noise hazardous, the specific areas or equipment should be signed.)

b. Each tool or piece of equipment that produces hazardous noise levels when in use shall be marked to alert personnel.

#### 10. Engineering Control Measures.

a. When technologically and economically feasible, engineering controls shall be the primary means used to protect personnel from hazardous noise. All practical design approaches to reduce noise levels by engineering principles shall be explored. Where

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engineering controls are undertaken, the design objective shall be to reduce steady-state noise to below 85 dBA, regardless of personnel exposure time, and to reduce impulse noise levels to below 140 dBP.

b. The Risk Assessment Code system identified in Appendix D shall be used to prioritize noise control measures.

c. An evaluation shall be conducted after engineering noise controls are implemented to verify effectiveness in controlling noise levels. This applies to the design of new facilities, modifications to existing facilities and equipment, and purchase of new or replacement equipment.

d. During the biennial worksite evaluation, there shall be a discussion and reevaluation of the RAC and potential engineering controls. This discussion and reevaluation shall be documented in a noise evaluation report to the work location.

#### 11. Hearing Protective Devices.

a. The use of personal hearing protectors for limiting noise exposure is considered an interim protective measure while engineering control measures are being explored or if engineering controls have been determined not technologically, economically, or operationally feasible.

b. Hearing protective devices, such as earplugs, molded ear canal plugs, or earmuffs, will be provided to all personnel who work in hazardous noise areas. They will be worn whenever steady noise levels are 85 dBA or greater or impulse noise levels exceed 140 dBP.

c. Hearing protection shall attenuate the noise to below 85 dBA TWA. As a general rule and for increased protection double protection should be worn when noise exposures are greater than 103 dBA TWA.

d. Double protection (the combination use of earplugs with earmuffs) may not attenuate the noise low enough when noise levels are greater than 108 dBA (or greater than 165 dBP). An evaluation of the attenuation values of the hearing protection provided shall be completed and documented in writing to the SOHO who will determine if administrative controls are required. Administrative controls include alternating workers to lower the noise exposure to any one worker, or otherwise limiting individual exposure time.

e. A list of approved ear protective devices are available on the U.S. Army Public Health Institute website. These devices have been tested and found to provide

adequate protection by The Army Surgeon General when used as stated above. Before ear protective devices are procured locally, the attenuation shall be obtained from the manufacture and evaluated to determine if the protection factor is adequate to protect the employee from the noise levels and frequency at the work site.

f. The use of custom molded ear-canal insert type of hearing protection has higher attenuation values and high worker acceptability. These factors offset the higher initial cost of this type of hearing protection.

g. If there is a need to communicate in high noise areas, use of ear protection which have communication devices imbedded or attach to a communication device is authorized.

h. Technologies, such as, phones, radios, or hearing aids, shall not be used as hearing protective devices, nor used in conjunction with hearing protective devices.

i. All sized hearing protection, including ear plugs or molded hearing protection, shall be fitted to the individual during their annual audiogram by an individual trained to fit and size ear plugs/canal caps. This is not applicable to non-sized foam ear plugs.

j. Hearing protection shall be made available to all visitors to the area. All visitors shall be required to wear the hearing protection if the noise sources are operating, without regard to the amount of the time they are in the area.

## 12. Audiograms.

a. Personnel who have the potential to regularly enter areas of high noise or complete tasks that expose them to hazardous noise or ultrasound, or are exposed to ototoxins with or without noise exposure, shall receive audiograms as stated below.

(1) Before being exposed to work related noise, baseline audiograms shall be performed on any newly hired individuals or individuals changing jobs who will be enrolled in the hearing conservation program, have the potential to enter a noise hazardous area or to conduct a noise hazardous or ultrasonic operation more than eight hours a week or are exposed to an ototoxin. Existing employees, for whom baseline audiograms are not available, will be given a baseline audiogram, as soon as possible, but within no more than 30 days of the identification of the noise hazardous operation. The baseline audiogram shall be preceded by a period of at least 14 hours away from workplace noise, and employees should be instructed to avoid loud noises during off-duty hours prior to taking the audiogram.

(2) Annual audiograms shall be provided to individuals who are enrolled in the hearing conservation program and exposed to continuous or intermittent noise that has

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an 8 hour time weighted average noise level of 85 dBA or greater, are exposed to impulse noise sound pressure levels of 140 dBP, or are exposed greater than 30 days a year to an ototoxin.

(3) Prior to job changing positions an employee who received a baseline audiogram, shall receive a final audiogram if more than 60 days has elapsed since their last audiogram.

b. Personnel who perform or interpret audiometric tests must be either:

(1) The audiologist, otolaryngologists, or physician trained in audiometric testing and interpretation, diagnosis of hearing disorders, exposure assessment and determination of work related hearing loss, or,

(2) A technician who is certified by the Council of Accreditation in Occupational Hearing Conservation, and state certified, when applicable. The technician who performs audiometric tests shall be responsible to an audiologist, an otolaryngologist, or other qualified physician.

c. Audiometric Test Equipment --

(1) Audiometric test equipment must meet the specifications of and be maintained and used in accordance with ANSI S3.6-1996. Pure-tone and self-recording audiometers, if used, must also meet the requirements in Appendix E.

(2) Required functional tests and calibrations are listed in Appendix E, Para E-2.

(3) Background noise levels in audiometric test rooms must be less than those specified in Appendix E, Para E-3.

d. Evaluation of Audiograms.

(1) Each employee's annual audiogram shall be compared to the employee's baseline audiogram by a person who meets the qualifications in paragraph 12b above.

(2) There shall be no age adjustment for any of the audiograms.

(3) If an audiogram indicates a Significant Threshold Shift (STS) (either an improvement or decrease in hearing), the employee will be receive a second audiogram as soon as possible and within 30 days. The second test shall be preceded by a 14-hour period away from workplace noise. The purpose of the second audiogram is to determine if the STS is temporary or is permanent. See Flow Chart in Appendix F.

(4) If the second audiogram does not confirm the loss or gain of hearing from the first audiogram, the employee does not require any further audiograms or testing until the next periodic audiogram. If the second audiogram confirms a decrease in hearing as a STS, then the employee shall receive a third audiogram (at government expense) within 30 days of the annual audiogram. The third audiogram will include a clinical audiological evaluation or otological examination. The second and third audiogram and the audiological evaluation may be completed at the same time. The audiogram with the audiologist will be considered the third audiogram as required by DODI 6055.12. The purpose of this exam and audiogram is to determine if the STS is permanent and/or work-related, the effectiveness of the type of hearing protection being used by the employee, and if the employee should be allowed to return to work in hazardous noise. If second and third audiograms are not completed within the 30 days the threshold shift is considered permanent and the supervisor will be held accountable.

(a) A copy of the employee's most recent audiogram, baseline audiogram, available noise exposure data, any record of ototoxic exposure, and information on the type of hearing protection used by the employee will be provided to the audiologist or otolaryngologist performing the audiological evaluation.

(b) If the threshold shift is 25 dB above the audiometric zero on the 2000, 3000, and 4000 Hz scale and determined to be permanent and work-related, the injury shall be recorded as a Preliminary Accident Notification (PAN) in ENGLink which will automatically populate the OSHA 300 Log for the Command (Log of Federal Occupational Injuries and Illness). Also ENG Form 3394, Accident Investigation Report, (RCS: DAEN-SO-8(R2)) shall be created and routed for signature.

(5) A revised reference audiogram shall be established using either the second or third follow-up tests. The original and reestablished reference audiograms will be retained in the Employee Occupational Health Medical record. At the discretion of the audiologist, a revised reference audiogram shall be established if the STS is determined to be permanent hearing loss and an OSHA recordable injury.

(6) If the second audiogram indicates an employee's hearing improves, a revised baseline or reference audiogram will be established using the follow-up audiogram.

e. The employee must be informed in writing of any STS within 21 days of its determination.

f. Before the employee who has experienced a confirmed STS is allowed to return to work in hazardous noise:

(1) The employee shall be retrained in the use of hearing protection and the hazards of noise.

(2) The employee shall be refitted with appropriate hearing protection.

(3) The supervisor shall be notified, in writing that the worker has experienced a decrease in hearing. The notification shall not contain additional details without prior written authorization by the worker in accordance with the requirements for a valid authorization consistent with the Health Insurance Portability and Accountability Act (HIPAA). The affected worker shall receive a copy of the letter sent to their supervisor.

g. All audiograms will be made a part of the employee's Employee Occupational Health Medical Record as maintained by the Command's designated Medical Records Custodian. Audiograms shall be maintained as part of the medical record for 30 years past the time the employee has left federal service or is deceased.

### 13. Training.

a. Initial Orientation. Each employee who has a potential to enter a noise hazardous area or conduct a noise hazardous operation for more than 8 hours a week, shall receive an orientation on the hearing conservation program. This orientation shall include information on:

(1) The requirements of the Command hearing conservation program.

(2) The effects of noise on hearing.

(3) Specific machinery at the jobsite that produce hazardous noise or ototoxin exposures.

(4) The purposes of hearing protectors, their advantages, disadvantages, and instruction on care, use, and fitting.

(5) The purpose of audiometric testing and an explanation of the test procedure.

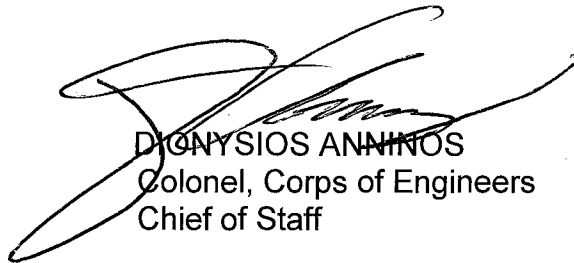
(6) The use of any engineering or administrative controls required in the area.



b. Periodic Training. Each employee in the Hearing Conservation Program shall receive annual noise hazard refresher training.

FOR THE COMMANDER:

6 Appendices  
Appendix A - Reference  
Appendix B - Definitions  
Appendix C - Ototoxins  
Appendix D - Noise Evaluations  
Appendix E - Audiometric Test Equipment  
Appendix F - Flow Chart for Audiometric Testing



DIONYSIOS ANNINOS  
Colonel, Corps of Engineers  
Chief of Staff



## APPENDIX A

### References

Department of Defense Instruction (DODI) 6055.12, 3 Dec 2010, Subject: Hearing Conservation Program.

DoD Instruction 6055.1, "DoD Safety and Occupational Health Program," 19 Aug 1998.

DoD Instruction 6055.07, "Accident Investigation, Reporting, and Record Keeping," 6 June 2011.

Code of Federal Regulations 29 CFR 1910.95, Occupational Safety and Health Standards, Occupational Noise Exposure.

Military Standard 1474D, "Department of Defense Design Criteria Standard- Noise Limits," February 12, 1997.

American National Standards Institute, ANSI Standard S1.4 through S1.4a, "American National Standards Specification for Sound Level Meters," current edition.

American National Standards Institute, ANSI Standard S1.40, "American National Standard Specifications and Verification Procedures for Sound Calibrators," current edition.

American National Standards Institute, ANSI Standard S1.25, "American National Standard Specification for Personal Noise Dosimeters," current edition.

American National Standards Institute, ANSI/ASA Standard S1.11, "Octave-Band and Fractional-Octave-Band Analog and Digital Filters," current edition.

American Conference of Governmental Industrial Hygienists, "Documentation of the Threshold Limit Values and Biological Exposures Indices," current edition.

Army Regulation (AR) 40-5, "Preventive Medicine," 25 May 2007.

Department of the Army Pamphlet (DA PAM) 40-501, "Hearing Conservation Program," 10 Dec 1998.

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U.S. Army Corps of Engineers Engineering Manual (EM) 385-1-1, "Safety and Health Requirements," Current edition.

U.S. Army Corps of Engineers Engineering Pamphlet (EP) 310-1-6A, Sign Standards Manual, VOL 1, 1 Jun, 2006.

U.S. Army Corps of Engineers Project Manager Business Process 8016G, May 2009.



## APPENDIX B

### Definitions

For the purpose of this regulation, the following terms shall mean:

**Audiogram.** A chart, graph, or table resulting from an audiometric test showing an individual's hearing threshold levels as a function of frequency. For the purpose of this document an audiogram is a record of the threshold of pure tone audibility of each ear at 500, 1000, 2000, 3000, 4000, and 6000 Hertz(Hz).

**Audiometric Data Reviewing Officer –** An audiologist, otolaryngologist, or licensed occupational health physician who reviews audiograms for completeness, consistency, and confirms the conclusion of the audiogram is compliant with OSHA and DoD regulations and good practice.

**Decibel (dB).** A unit used to express sound pressure level. The decibel level of sound is related to the logarithm of the ratio of sound pressure to a reference pressure, the reference pressure being the threshold of hearing,  $20 \mu\text{Nm}^2$ .

**A-weighted Sound Level (dBA).** A-weighted sound level is the sound pressure in decibels measured with a sound level meter using the A-weighting network and slow meter response. The A-weighted network reduces the contribution of lower frequencies, and closely approximates the human ear's response to sound.

**C-weighted Sound Level (dBC).** C-weighted sound level is the sound pressure in decibels measured with a sound level meter using the C-weighting network and slow meter response. The C-weighted network corresponds to the ear's response for the levels above 85 dB.

**dBp.** The unit used to express peak sound pressure level of impulse noise. This sound level is equal to 20 times the common logarithm of the ratio of the highest instantaneous sound pressure to a reference sound pressure of  $20 \mu\text{Pa}$ .

**Hazardous Noise.** Exposure to steady-state noise having an 8 hour TWA noise level greater than or equal to 85 dBA, or exposure to impulse and/or impulse noise levels of 140 dBp or greater, regardless of duration.

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**Hazardous Noise Area.** Any area where workers are likely to be exposed to hazardous noise levels or exposure to certain high frequency sounds (greater than 10,000 Hz) for any duration, as specified in Table 3-1, DA PAM 40-501 (1998).

**Hz.** The hertz is the unit used to measure frequency, and used to be called cycles per second or CPS. Persons with good hearing can detect sound in the 20 to 16000 Hz frequency range.

**Impulse Noise.** The pressure-time history of a single impulse includes a rise of 40 dB or more in 1 second or faster to a peak pressure, followed by a somewhat slower decay of the pressure envelope to ambient pressure, both occurring within 1 second. When the intervals between impulses are less than 500 milliseconds, the noise is considered continuous, except for short bursts of automatic weapons fire, which are considered impulse noise.

**OSHA Recordable Threshold Shift.** A threshold shift in one or both ears, with a total hearing level of 25 decibels (dB) or more above audiometric zero (averaged at 2000, 3000, and 4000 Hz) in the same ear(s). This threshold shift shall be recorded as an injury on the OSHA 300 Log. (Note in OSHA and other DoD documents this may be referred to as a Standard Threshold Shift of 25 dB.)

**Periodic Audiogram.** An annual, change of job position, pre-deployment, post-deployment or other hearing test compared to the reference audiogram to monitor changes in hearing.

**Reference Audiogram.** A baseline audiogram which is free from auditory fatigue and other transient otologic pathology provided to compare against future audiograms.

**Significant Threshold Shift (STS).** The DoD definition constitutes a change in hearing threshold relative to the initial reference audiogram of an average of 10 dB or more at 2000, 3000 and 4000 Hz, in either ear. Age correction will not be applied. Retesting is required for any significant threshold shift. A single frequency 15 dB shift at 1000, 2000, 3000, or 4000 Hz is considered an early warning flag with no requirements for follow-up testing or referrals, but with a requirement to counsel the worker and check hearing protection. This DoD definition shall be the definition used by the USACE and required by this document.

**Similar Exposure Group (SEG)** – A group of workers having the same exposure profile for noise exposure because of the similarity and frequency of the tasks they perform,

the similarity of the materials and processes with that they work, and the similarity of the way they perform the task(s). For the purpose of this document, SEGs should only be in the same physical location.

**Steady State Noise.** Steady state noise is a periodic or random variation in atmospheric pressure at audible frequencies with a duration longer than 1 second. It may be continuous (as with generators), intermittent (as with air compressor), or fluctuating with the sound level varying over a wide range (as with bulldozers).

**Time-Weighted Average (TWA) Sound Level.** A measure of the severity of the employee's workday noise exposure as measured throughout the workday. The TWA is always computed as if the TWA noise level is present for an 8-hour work shift, whether or not the workday noise lasts for 8 hours. Implicit in the TWA is a 3dB time-intensity exchange rate.





## APPENDIX C

### Ototoxins

The following is a list of the known ototoxins:

- Arsenic
- Carbon Disulfide
- Carbon Monoxide
- Cyanide
- Lead and Derivatives
- Manganese
- Mercury and Derivatives
- N-Hexane
- Stoddard Solvent
- Styrene
- Trichloroethylene
- Toluene
- Xylene



## APPENDIX D

### Noise Evaluations

D-1. Areas identified with noise sources greater than 85 dBA, as documented by a sound level meter, shall be evaluated biennially with a sound level meter. All noise level readings shall be taken without regard to the required and used personal protective equipment. The following provides the DA, DoD, and OSHA requirements for taking these samples.

a. Initial and reevaluation noise evaluations of steady state noise shall be conducted with sound level instruments.

(1) The sound level meter, used for measuring and assessing steady state noise, shall meet or exceed the requirements for a Type 2 sound level meter per American National Standards Institute (ANSI) Standard S1.4-current edition. The sound level meter shall be calibrated in the field before and after each day of use. The calibrator used shall comply with ANSI Standard S1.40 and be accurate to within plus or minus 1 decibel and shall have been subject to a complete electro-acoustical calibration annually.

(2) Sound level readings shall be taken on both the dBA and dBC scales with the meter set at slow. If measuring impulse noise the meter should be set to fast.

(3) For both initial and reevaluation surveys readings shall be taken at the approximate ear position of each of the potentially exposed employees and in concentric circles around any noise hazardous equipment to document the 85 dBA noise contour.

b. If the initial sound level readings at the ear of any of the potentially exposed individuals is over 85 dBA or during the reevaluation survey the sound level reading differed by more than 3 dBA for the equipment or potentially exposed individual, a full shift dosimeter study shall be conducted.

(1) The noise dosimeter shall integrate, at a minimum, the sound levels between 80 to 130 dBA and meet or exceed the specifications in ANSI Standard S1.25 (current edition). All dosimeters used to monitor noise in USACE locations shall be able to provide a time-intensity exchange rate of 3 dB. Over time, USACE dosimeters shall be

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replaced by dosimeters which are able to provide a time-intensity exchange rate of both 3 dB and 5 dB and have a fast and slow setting. Initial readings shall be made on the 3 dB time-intensity scale and be utilized to set the Risk Assessment Code per DoD guidance. Measurements using the 5 dB are only required if completing side by side sampling with OSHA compliance officer or requested to be evaluated for a FECA claim.

(2) Noise dosimeter readings shall be obtained on any individual with a unique noise exposure based on their job tasks. If there are individuals with similar exposures, they can be grouped into similar exposure groups (SEG) by physical location, but at a minimum three individuals or 50% of the SEG, whichever is greater, shall have full shift noise dosimeter readings.

(3) All noise dosimeter reading shall be placed in the general area of the individual's ear and shall be full shift samples, unless required for different operational noise assessments. If a determination of the noise levels for various tasks requires partial shift dosimeter sampling, the other parts of the shift shall be sampled the same day to establish a full shift sample as well as the partial shift sample.

(4) The record of all sound level readings shall include: location of the sampling with a floor drawing of the specific location; pre and post calibration record, serial number of the sound level meter, time and date of the readings, names of individuals who work in the area and how often they work in the area or do the noisy task, serial number and calibration record of the sound level meter calibrator, and name of the individual completing the survey.

(5) The record of the dosimeter reading shall include all calibration information, location, and date and time; calibrator serial number; dosimeter serial number; location of the microphone; job task or area being monitored; list of everyone in the SEG; how often the work task was completed; reading from the dosimeter and the integrated sample record.

c. If a noise source meets the definition of impulse noise, locations or tasks where the peak noise levels are at or above 140 dBP, a impulse noise survey shall be conducted to determine if the peak levels are at or above 140 dBP. The range of the peak levels found for repetitive impulses shall be determined for a representative number of repetitions.

(1) All impulse noise shall be measured with sound level meters that meet or exceed the requirements for a Type 1 sound level meter per ANSI Standard

S1.4-current addition with a peak hold circuit with a rise time not exceeding 35 microseconds; and are capable of measuring peak SPLs in excess of 140 dBP.

(2) If measuring with a sound level meter, each impulse noise task and/or equipment shall be measured for a minimum of 10 repetitions or 30 minutes, whichever is the shortest period of time.

(3) The sound level meter shall be calibrated in the field before and after each day of use to be within plus or minus 1 decibel and calibrated electro-acoustically annually. Dosimeters shall be calibrated following the manufactures recommendations. The calibration record of all noise level calibrators used shall be maintained with the survey record.

(4) The record of the impulse noise shall include, the number of the daily occurrences by exposed individual, and the range peak levels identified.

(5) Because the intensity of the impulse noise can be very dramatically based on the distance from the noise source, measurements shall be taken in the area of the ear of each potentially exposed individual.

D-2. Establishing a Risk Assessment Code (RAC) for noise hazards can be completed qualitatively using the USACE Project Management Business Process, 8016G or quantitatively using the health hazard risk assessment process in DODI 6055.1. The general guidance for these two methods is provided below, but the reader should review the referenced documents before establishing a RAC for noise. All noise risk assessments should be completed without regard to personal protective equipment.

a. The qualitative method of establishing a safety RAC is in reference p, USACE Project Management Business Process 8016G. The following is provided as guidance in using this method:

(1) Severity

(a) Catastrophic - TWA Noise values over 90 dBA continuous or 140 dBP for impulse

(b) Critical – TWA Noise values between 85 – 90 dBA continuous

(c) Marginal – TWA Noise values between 85 – 90 dBA intermittent

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(d) Negligible – TWA Noise values between 80-85 dBA continuous

(2) Probability

(a) Frequent – Continuous Exposure 40 hours/week

(b) Likely – Intermittent Exposure 30-40 hours/week

(c) Occasional – Intermittent Exposure 8-30 hours/week

(d) Rarely – Intermittent Exposure 0-8 hours/week

(3) Not considered in this level of RAC determination is the number of individuals exposed. If the number of individuals is significant (greater than 10) the Probability level should be increased by one.

b. The guidance on establishing a quantitative RAC is in reference b, DODI 6055.1, Enclosure 7. This process is a two step process and is based on noise exposure assessment, the medical effects of the exposure, the noise exposure duration, and number of exposed individuals.

(1) Determination of the Health Hazard Severity Category (HHSC):

(a) Points assessed for noise exposure would be:

- 3 pts – More than 30 days/year but less than 50 days/year - exposed over SLM > 85 dBA, but dosimeter < 85 dBA

- 5 pts – More than 50 days/year - exposed over SLM > 85 dBA, but dosimeter 85 dBA

- 6 pts – Less than 30 days/year – exposed over dosimeter > 85 dBA or exposure to ototoxin without noise exposure or exposure over 140 dBP

- 7 pts – More than 30 days/year – exposed over dosimeter > 85 dBA or over 140 dBP

- 8 pts - More than 30 days/year – exposed over dosimeter > 85dBA and exposure to an ototoxin

(b) Medical Effects Points Assessed:

- 3-4 pts – More than one employee in the area had a documented temporary reversible hearing loss, but recovered over period of quiet
- 5-6 pts – More than one employee in the area had a documented permanent hearing loss

(c) Add the points from the noise exposure code and the medical effects to obtain the points to determine the HHSC:

Total Points	HHSC
13-17	I
9-12	II
5-8	III
0-4	IV

(2) Illness Probability Category (IPC) The IPC is a function of the duration of exposure and the number of exposed personnel.

(a) Duration of Exposure Points Assessed

Type of Exposure	1-8 hours/week	>8 hours/week	Continuous
Irregular/Intermittent	1-2	4-5	
Regular/Periodic	2-3	5-7	8

(b) Number of Exposed Personnel Points Assessed

Number Exposed	Points
<5	1-2
5-9	3-4
10-49	5-6
>49	7-8

(c) Determination of the PC for noise hazards, add the number from the duration exposure points to the number of exposed personnel points to obtain an alphabetic character.



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Total Points/Illness	Probability Cause
14-16	A
10-13	B
5-9	C
< 5	D

(3) Final RAC determination for noise exposures, use the HHSC and IPC from above in the chart below

HHSC	IPC			
	A	B	C	D
I	1	1	2	3
II	1	2	3	4
III	2	3	4	5
IV	3	4	5	5

D-3. Recording and recordkeeping requirements for noise surveys. The record of all noise level surveys shall include the following: Sound Level Measuring Device model and serial number.

## APPENDIX E

### Audiometric Test Equipment

#### E-1. Pulse Tone and Self-Recording Audiometric Test Equipment.

a. In the event that pulsed-tone audiometers are used, they shall have a tone on-time of at least 200 milliseconds.

b. Self-recording audiometers shall comply with the following requirements:

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

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

(3) The slewing rate for the audiometer attenuator shall not be more than 6 dB/sec except that an initial slewing rate greater than 6dB/sec is permitted at the beginning of each new test frequency, but only until the second subject response.

(4) The audiometer shall remain at each required test frequency for 30 seconds ( $\pm 3$  seconds). The audiogram shall be clearly marked at each change of frequency and the actual frequency change of the audiometer shall not deviate from the frequency boundaries marked on the audiogram by more than  $\pm 3$  seconds.

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

#### E-2. Audiometer Calibrations.

a. Daily Inspection and Functional Test. Daily inspection shall include inspecting the ear phones for cleanliness, tension, and wiring or jack damage. The functional operation of the audiometer shall be checked before each day's use by testing a person

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and by listening to the audiometer's output to make sure that the output is free from distortion or unwanted sounds. Deviations of more than 10 dB shall require an acoustical calibration. Manipulate the attenuator to check for linear decibel output. Change frequencies to check for accurate output. Check for unwanted sounds and interferences.

b. Annual Acoustical Calibration. Audiometer calibration shall be checked acoustically, at least annually, according to the following procedures. 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 shall be sufficient to determine that the audiometer is within the tolerances permitted by American Standard Specification for Audiometers, S3-1969.

(1) Sound Pressure Output Check.

(a) Place the earphone coupler over the microphone of the sound level meter and place the earphone on the coupler.

(b) Set the audiometer's hearing threshold level (HTL) dial to 70dB.

(c) Measure the sound pressure level of the tones at each test frequency from 500 Hz through the 6000 Hz for each earphone.

(d) At each frequency the readout on the sound level meter should correspond to the levels in Table D-1 or Table D-2, as appropriate, for the type of earphone in the column entitled "sound level meter reading."

(2) Linearity Check.

(a) With the earphone in place, set the frequency to 1000 Hz and the HTL dial on the audiometer to 70dB.

(b) Measure the sound levels in the coupler at each 10-dB decrement from 70dB to 10 dB, noting the sound level meter reading at each setting.

(c) For each 10-dB decrement on the audiometer, the sound level meter should indicate a corresponding 10dB decrease.

(d) This measurement may be made electrically with a voltmeter connected to the earphone terminals.

(3) Tolerances. When any of the measured sound levels deviate from the levels in Table D-1 or Table D-2 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 greater than 10dB at any test frequency.

c. Exhaustive Calibration. An exhaustive calibration shall be performed at least every two years in accordance with sections 4.1.2; 4.1.2; 4.1.4.3; 4.4.1; 4.4.2; 4.4.3; and 4.5 of ANSI 3.6-1969. Test frequencies below 500 Hz and above 6000 Hz may be omitted from the calibration.

### E-3. Audiometer Test Room Background Noise Levels.

Rooms use for audiometric testing shall not have background sound pressure levels exceeding those in Table D-3 when measured by equipment conforming at least to the Type 2 requirements of American National Standard Specification for Sound Level Meters, S1.4-1971 (R1976), and to the Class II requirements of American National Standard Specification for Octave, Half-Octave, and Third-Octave Band Filter Sets, S1.11-1971 (R1976).

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Table E-1. Reference Threshold Levels for Telephonic - TDH-39

Frequency (HZ)	Threshold Level (dB)	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 D-2. Reference Threshold Levels for Telephonics - TDH-49 Earphones

Frequency (HZ)	Threshold Level (dB)	Meter Reading (dB)
3000.....	9.5	79.5
4000.....	10.5	80.5
6000.....	13.5	83.5

Table D-3. 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

APPENDIX F

Flow Chart for Audiometric Testing

