

OCCUPATIONAL SAFETY AND HEALTH STANDARDS

SUBPART G — OCCUPATIONAL HEALTH AND ENVIRONMENTAL CONTROL

(Code of Federal Regulations, Title 29, Chapter XVII, Part 1910, 36 FR 10466, May 29, 1971; amended at 36 FR 15104, August 13, 1971; 36 FR 23208, December 7, 1971; 37 FR 332, January 11, 1972; 37 FR 6576, March 31, 1972; 37 FR 11320, June 7, 1972; 37 FR 22139, October 18, 1972; 37 FR 24749, November 21, 1972; 38 FR 10929, May 3, 1973; 38 FR 20074, July 27, 1973; 39 FR 3755, January 29, 1974; 39 FR 12343, April 5, 1974; 39 FR 19468, June 3, 1974; republished at 39 FR 23502, June 27, 1974; amended at 39 FR 35896, October 4, 1974; 39 FR 41848, December 3, 1974; 40 FR 13211, March 25, 1975; 40 FR 18426, April 28, 1975; 40 FR 23072, May 28, 1975; 40 FR 24522, June 9, 1975; standards revoked at 43 FR 49726, October 24, 1978; Standards Revocation Notice corrected at 43 FR 41759, November 7, 1978; amended by 46 FR 4161, January 16, 1981; 46 FR 42632, August 21, 1981)

Subpart G—Occupational Health and Environmental Control

[Editor's note: The Occupational Safety and Health Administration August 21, 1981 (46 FR 42632) stayed the following paragraphs of the noise exposure standard (§1910.95) pending administrative review:

Provisions Stayed

Paragraph (d).
Paragraph (e), except for part of (e)(1).
Paragraph (f).
Paragraph (g), except for part of (g)(2)(ii)(b).
Paragraph (h).
Paragraph (i), except for part of (i)(1).
Part of paragraph (j)(5)(i).
Paragraph (j)(5)(ii)(a).
Paragraph (j)(5)(ii)(b).
Part of paragraph (j)(7)(i).
Part of paragraph (j)(7)(ii).
Part of paragraph (j)(7)(iii).
Paragraph (j)(7)(iv).
Part of paragraph (j)(8).
Paragraph (j)(8)(iii) and (iv).
Part of paragraph (j)(8)(iv) (a) and (b).
Paragraph (j)(8)(iv)(a).
Paragraph (j)(9).
Paragraph (j)(10).
Part of paragraph (1)(2)(i).
Paragraph (n)(3) (i), (iii), (iv) and (v).
Paragraph (p).
Part of paragraph (q)(1)(i).
Paragraph (q)(1)(ii).
Part of paragraph (q)(2)(ii)(c).
Paragraph (q)(2)(ii)(d).
Paragraph (q)(2)(ii)(e).
Paragraph (q)(3)(ii).
Paragraph (q)(4).
Part of paragraph (q)(5)(ii).
Part of paragraph (q)(5) (iii) and (iv).
Part of paragraph (r)(2).
Part of paragraph (s)(2).
Paragraph (s)(4).
Paragraph (s)(5).

Appendix B is stayed in its entirety.
Part of appendix D, including Table D-1.
Appendix F.
Part of Appendix G.

The remaining provisions of the standard became effective August 22, 1981.]

1910.93-1910.93q (These sections have been recodified in Subpart Z of this part, beginning at 1910.1000).

§ 1910.94 Ventilation.

(a) *Abrasive blasting*—(1) *Definitions applicable to this paragraph.*—(i) *Abrasive.* A solid substance used in an abrasive blasting operation.

(ii) *Abrasive-blasting respirator.* A continuous flow air-line respirator constructed so that it will cover the wearer's head, neck, and shoulders to protect him from rebounding abrasive.

(iii) *Blast cleaning barrel.* A complete enclosure which rotates on an axis, or which has an internal moving tread to tumble the parts, in order to expose various surfaces of the parts to the action of an automatic blast spray.

(iv) *Blast cleaning room.* A complete enclosure in which blasting operations are performed and where the operator works inside of the room to operate the blasting nozzle and direct the flow of the abrasive material.

(v) *Blasting cabinet.* An enclosure where the operator stands outside and operates the blasting nozzle through an opening or openings in the enclosure.

(vi) *Clean air.* Air of such purity that it will not cause harm or discomfort to an individual if it is inhaled for extended periods of time.

(vii) *Dust collector.* A device or combination of devices for separating dust from the air handled by an exhaust ventilation system.

(viii) *Exhaust ventilation system.* A system for removing contaminated air from a space, comprising two or more of the following elements (a) enclosure or hood, (b) duct work, (c) dust collecting equipment, (d) exhaust, and (e) discharge stack.

(ix) *Particulate-filter respirator.* An air purifying respirator, commonly referred to as a dust or a fume respirator, which removes most of the dust or fume from the air passing through the device.

(x) *Respirable dust.* Airborne dust in sizes capable of passing through the upper respiratory system to reach the lower lung passages.

(xi) *Rotary blast cleaning table.* An enclosure where the pieces to be cleaned are positioned on a rotating table and are passed automatically through a series of blast sprays.

(xii) *Abrasive blasting.* The forcible application of an abrasive to a surface by pneumatic pressure, hydraulic pressure, or centrifugal force.

(2) *Dust hazards from abrasive blasting.* (i) Abrasives and the surface coatings on the materials blasted are shattered and pulverized during blasting operations and the dust formed will contain particles of respirable size. The composition and toxicity of the dust from these sources shall be considered in making an evaluation of the potential health hazards.

(ii) The concentration of respirable dust or fume in the breathing zone of the abrasive-blasting operator or any other worker shall be kept below the levels specified in §1910.1000.

(iii) Organic abrasives which are combustible shall be used only in automatic systems. Where flammable or explosive dust mixtures may be present, the construction of the equipment, including the exhaust system and all electric wiring, shall conform to the requirements

[Sec. 1910.94(a)(2)(iii)]

of American National Standard Installation of Blower and Exhaust Systems for Dust, Stock, and Vapor Removal or Conveying, Z33.1-1961 (NFPA 91-1961), and the National Electrical Code, NFPA 70-1971; ANSI C1-1971 (Rev. of C1-1968). The blast nozzle shall be bonded and grounded to prevent the build up of static charges. Where flammable or explosive dust mixtures may be present, the abrasive blasting enclosure, the ducts, and the dust collector shall be constructed with loose panels or explosion venting areas, located on sides away from any occupied area, to provide for pressure relief in case of explosion, following the principles set forth in the National Fire Protection Association Explosion Venting Guide, NFPA 68-1954.

[1910.94(a)(2)(iii) amended at 39 FR 19468, June 3, 1974]

(3) **Blast-cleaning enclosures.** (i) Blast-cleaning enclosures shall be exhaust ventilated in such a way that a continuous inward flow of air will be maintained at all openings in the enclosure during the blasting operation.

(a) All air inlets and access openings shall be baffled or so arranged that by the combination of inward air flow and baffling the escape of abrasive or dust particles into an adjacent work area will be minimized and visible spurts of dust will not be observed.

(b) The rate of exhaust shall be sufficient to provide prompt clearance of the dust-laden air within the enclosure after the cessation of blasting.

(c) Before the enclosure is opened, the blast shall be turned off and the exhaust system shall be run for a sufficient period of time to remove the dusty air within the enclosure.

(d) Safety glass protected by screening shall be used in observation windows, where hard deep-cutting abrasives are used.

(e) Silt abrasive-resistant baffles shall be installed in multiple sets at all small access openings where dust might escape, and shall be inspected regularly and replaced when needed.

(f) Doors shall be flanged and tight when closed.

(2) Doors on blast-cleaning rooms shall be operable from both inside and outside, except that where there is a small operator access door, the large work access door may be closed or opened from the outside only.

(4) **Exhaust ventilation systems.** (i) The construction, installation, inspection, and maintenance of exhaust systems shall conform to the principles and requirements set forth in American National Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, Z9.2-1960, and ANSI Z33.1-1961.

(a) When dust leaks are noted, repairs shall be made as soon as possible.

(b) The static pressure drop at the exhaust ducts leading from the equipment shall be checked when the installation is completed and periodically thereafter to assure continued satisfactory operation. Whenever an appreciable change in the pressure drop indicates a partial blockage, the system shall be cleaned and returned to normal operating condition.

(ii) In installations where the abrasive is recirculated, the exhaust ventilation system for the blasting enclosure shall not be relied upon for the removal of fines from the spent abrasive instead of an abrasive separator. An abrasive separator shall be provided for the purpose.

(iii) The air exhausted from blast-cleaning equipment shall be discharged through dust collecting equipment. Dust collectors shall be set up so that the accumulated dust can be emptied and removed without contaminating other working areas.

(5) **Personal protective equipment.** (i) Only respiratory protective equipment approved by the Bureau of Mines, U.S. Department of the Interior (see 30 CFR Part 11) shall be used for protection of personnel against dusts produced during abrasive-blasting operations.

(ii) Abrasive-blasting respirators shall be worn by all abrasive-blasting operators:

(a) When working inside of blast-cleaning rooms, or

(b) When using silica sand in manual blasting operations where the nozzle and blast are not physically separated from the operator in an exhaust ventilated enclosure, or

(c) Where concentrations of toxic dust dispersed by the abrasive blasting may exceed the limits set in Sec. 1910.1000 and the nozzle and blast are not physically separated from the operator in an exhaust-ventilated enclosure.

[Sec. 1910.94(a)(5)(ii)(c) amended at 40 FR 23072, May 28, 1975]

(iii) Particulate filter respirators, commonly referred to as dust-filter respirators, properly fitted, may be used for short, intermittent, or occasional dust exposures such as cleanup, dumping of dust collectors, or unloading shipments of sand at a receiving point, when it is not feasible to control the dust by enclosure, exhaust ventilation, or other means. Respirators used shall be approved (see 30 CFR Part 11) for protection against the specific type of dust encountered.

(a) Dust-filter respirators may be used to protect the operator of outside abrasive-blasting operations where nonsilica abrasives are used on materials having low toxicities.

(b) Dust-filter respirators shall not be used for continuous protection where silica sand is used as the blasting abrasive, or toxic materials are blasted.

(iv) A respiratory protection program as defined and described in §1910.134(a) and (b), shall be established wherever it is necessary to use respiratory protective equipment.

(v) Operators shall be equipped with heavy canvas or leather gloves and aprons or equivalent protection to protect them from the impact of abrasives. Safety shoes shall be worn to protect against foot injury where heavy pieces of work are handled.

(a) Safety shoes shall conform to the requirements of American National Standard for Men's Safety-Toe Footwear, Z41.1-1967.

(b) Equipment for protection of the eyes and face shall be supplied to the op-

G-16, feasible administrative or engineering controls shall be utilized. If such controls fail to reduce sound levels within the levels of Table G-16, personal protective equipment shall be provided and used to reduce sound levels within the levels of the table.

(2) If the variations in noise level involve maxima at intervals of 1 second or less, it is to be considered continuous.

(3) (Deleted)
[Section 1910.95(b)(3) deleted by 46 FR 4161, January 16, 1981]

TABLE G-16—PERMISSIBLE NOISE EXPOSURES

Duration per day, hours	Sound level dBA slow response
8	90
6	92
4	95
3	97
2	100
1½	102
1	105
½	110
¼ or less	115

When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. If the sum of the following fractions: $C_1/T_1 + C_2/T_2 + \dots + C_n/T_n$ 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, and T_n indicates the total time of exposure permitted at that level.

Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.

[1910.95 Table G16 amended at 39 FR 19468, June 3, 1974]

[Section 1910.95(c)—(s) and Appendix A—I added by 46 FR 4161, January 16, 1981]

(c) Hearing conservation program. The employer shall administer a continuing, effective hearing conservation program, as described in paragraphs (c) through (e) of this section whenever employee noise exposures equal or exceed an 8-hour time-weighted average sound level (TWA) of 85 decibels measured on the A scale slow response or, equivalently, a dose of fifty percent. For purposes of the hearing conservation program, employee noise exposures shall be computed in accordance with Appendix A and Table G-16a, and without regard to any attenuation provided by the use of personal protective equipment.
[Section 1910.95(c) amended by 46 FR 42632, August 21, 1981]

Initial determination. (1) Each employer shall determine if any employee's exposure may equal or exceed an 8-hour time-weighted average of 85 decibels (dB) measured on the A scale. This determination shall be based on all information, observations, or calculations which indicate that employee noise exposures may be at or above that level, including the following:

- (i) Any employee exposure measurements which have been taken;
- (ii) Any employee complaints which may be attributable to noise exposure;

(iii) Any difficulties in understanding normal conversation in the workplace when the speaker and the listener face each other at a distance of two feet.

(2) This determination shall be repeated at least once a year, and whenever there is a significant change in production processes, equipment, controls, or personnel which may result in a change in noise exposure.

(1) When any information in the initial determination conducted pursuant to paragraph (d) of this section indicates that any employee's exposure may equal or exceed an 8-hour time-weighted average of 85 decibels, the employer shall within 60 days obtain individual or representative exposure measurements for all employees who may be exposed at or above that level.

When a group of employees is engaged in a similar kind of work and has approximately the same noise exposure, the employer may, in lieu of measuring the exposure of each employee, measure only one member of the group. In these cases, the employer shall select for monitoring the employee who is reasonably believed to have the greatest exposure and shall attribute the selected employee's exposure measurement to all employees in the group.

Monitoring of employee noise exposures.

(1) Every two years unless an initial determination conducted pursuant to paragraph (d)(2) of this section or actual exposure measurements indicate that employees are not exposed to a time-weighted average of 85 decibels or greater; and

(ii) Within sixty days of a change in production processes, equipment, controls, or personnel which may render the attenuation provided by hearing protection in use inadequate to meet the requirements of paragraph (u) of this section.

Notification. (1) Within 21 days of monitoring, the employer shall notify each employee exposed to a time-weighted average of 85 decibels of the results of the monitoring.

(2) Each employee shall be notified of that employee's measured exposure or the representative exposure that is attributed to that employee.

(3) New employees shall be notified of their measured exposure or the exposure attributed to them within sixty days of their first exposure at or above a time-weighted average of 85 decibels.

(g) **Method of measurement.** (1) All employee exposure measurements required by paragraph (e) of this section shall be obtained by the use of noise dosimeters which comply with the

provisions of paragraph (g)(1)(i) of this section or sound level meters which comply with the provisions of paragraph (g)(1)(ii) of this section.

(i) **Dosimeters.** Dosimeters shall meet the Class 2, 30/30-4 requirements of the American National Standard Specification for Personal Noise Dosimeters, S1.4-1971, with an operating range of at least 80 dB to 120 dB. Dosimeters shall meet the requirements of paragraph 7.5 of the specification for a test signal at a frequency of 1000 Hz and a sound level of 90 dB, having a crest factor of 30 dB.

(ii) **Sound level meters.** Sound level meters shall meet the Type II requirements of the American National Standard Specification for Sound Level Meters, S1.4-1971 (R1976).

(2) Exposure measurements shall accurately reflect employee exposures and shall be conducted in the following manner:

(i) **Dosimeters.** The microphones of the dosimeters shall be placed on the employee's shoulder or head.

(ii) **Sound level meters.** (a) Sound level meters shall be set to the A scale, slow response.

(b) All continuous, intermittent and impulsive sound levels from 80 dB to 130 dB shall be integrated into the computation of time-weighted average.

The employer shall use an appropriate sampling strategy to ensure that accurate results are obtained. The employer may use the sampling procedures given in Appendix B: *Temporal Sampling Procedures for Use with a Sound Level Meter*, which are provided as guidelines for compliance with this provision.

(d) The microphone of a sound level meter shall be positioned not less than two inches nor more than two feet from the worker's ear.

Calibration of monitoring equipment. Dosimeters and sound level meters used to monitor employee noise exposure shall be calibrated as follows:

(1) Before and after each day's measurements, an acoustical calibrator shall be used to verify the accuracy of the measuring equipment.

(2) Whenever acoustical calibration and manual adjustments of the measuring equipment cannot verify the accuracy of the measuring instrument, laboratory calibration shall be performed to ensure conformance with the requirements of ANSI S1.25-1976 or S1.4-1971, as appropriate.

(i) **Observation of monitoring.** (1) The employer shall provide affected employees or their representatives with an opportunity to observe any measurements of employee noise exposure which are conducted pursuant to paragraph (e) of this section.

(2) Without interfering with the

[Sec. 1910.95(i)(2)]

monitoring procedures, the observer shall be entitled to:

- (i) Receive an explanation of the measurement procedures;
- (ii) Observe all steps related to the noise exposure measurements performed at the place of exposure; and
- (iii) Record the results obtained.

(j) **Audiometric testing program.** (1) The employer shall establish and maintain an audiometric testing program as provided in this paragraph by making audiometric testing available to all employees whose exposures equal or exceed an 8-hour time-weighted average of 85 decibels.

(2) The program shall be provided at no cost to employees.

(3) Audiometric tests shall be performed by a licensed or certified audiologist, otolaryngologist, or other qualified physician, or by a technician who is certified by the Council of Accreditation in Occupational Hearing Conservation, or who has satisfactorily demonstrated competence in administering audiometric examinations, obtaining valid audiograms, and properly using, maintaining and calibrating audiometers. A technician who performs audiometric tests must be responsible to an audiologist, otolaryngologist or qualified physician.

[Section 1910.95(j)(3) amended by 46 FR 42632, August 21, 1981]

(4) All audiograms obtained pursuant to this section shall meet the requirements of Appendix C: **Audiometric Measuring Instruments.**

(i) **Baseline audiogram.** (1) Within 30 days of an employee's first exposure to noise at or above a time-weighted average of 85 decibels, the employer shall establish for each employee so exposed a valid baseline audiogram against which subsequent audiograms are to be compared.

(ii) **Testing to establish a baseline audiogram** shall be preceded by at least 14 hours without exposure to workplace noise.

(iii) Hearing protectors shall not be used as a substitute for the requirement that baseline audiograms be preceded by 14 hours without exposure to workplace noise.

(iv) The employer shall notify employees of the need to avoid high levels of non-occupational noise exposure during this 14-hour period.

(b) **Annual audiogram.** (i) At least annually after obtaining the baseline audiogram, the employer shall obtain a new audiogram for each employee exposed at or above a time-weighted average of 85 decibels.

(ii) Annual audiometric testing may be conducted at any time during the workshift.

(2) **Evaluation of audiogram.** (i) Each

employee's annual audiogram shall be compared to that employee's baseline audiogram to determine if the audiogram is valid and if a significant threshold shift, as defined in paragraph (j)(10) of this section, has occurred.

(ii) An audiologist, otolaryngologist, or qualified physician shall review the audiograms to determine whether any significant threshold shift is work related or whether there is need for further evaluation. The employer shall provide to the person performing this evaluation the following information:

[Section 1910.95(j)(7)(ii) amended by 46 FR 42632, August 21, 1981]

(a) A copy of the requirements for hearing conservation as set forth in paragraphs (c) through (r) of this section;

(b) The baseline audiogram and most recent audiogram of the employee to be evaluated;

(c) Measurements of background sound pressure levels in the audiometric test room as required in Appendix D: **Audiometric Test Rooms.**

(d) Records of audiometer calibrations required by paragraph (k)(5) of this section.

(iii) An audiologist, otolaryngologist, or qualified physician shall review the audiograms to determine whether any significant threshold shift is work related or whether there is need for further evaluation.

[Section 1910.95(j)(7)(iii) amended by 46 FR 42632, August 21, 1981]

(iv) If a comparison of the audiograms reveals a significant threshold shift as defined in paragraph (j)(10) of this section, a retest to obtain a new audiogram shall be performed within 30 days to determine if the shift is permanent.

(a) Retesting shall be preceded by at least 14 hours without exposure to workplace noise.

(b) Hearing protectors shall not be used as a substitute for the requirement that retesting be preceded by at least 14 hours without exposure to workplace noise.

(c) Retesting is not required if the annual audiogram was obtained after 14 hours without exposure to workplace noise. In the case the significant threshold shift revealed by the annual audiogram shall be considered permanent.

(d) If retesting also reveals a significant threshold shift as defined in paragraph (j)(10) of this section, the significant threshold shift shall be considered permanent.

(v) **Retesting procedures.** If a comparison of the annual audiogram to the baseline audiogram indicates a significant threshold shift as defined in paragraph (j)(10) of this section, the employer shall ensure that the following steps are taken:

(i) Employees not using hearing protectors shall be fitted with hearing protectors, trained in their use and care, and required to use them.

(ii) Employees already using hearing protectors shall be refitted and retrained in the use of hearing protectors and provided with hearing protectors offering greater attenuation if necessary.

(iii) If retesting or an employee reveals that the significant threshold shift is not permanent, the use of hearing protectors by that employee may be discontinued, unless the employee is required to wear hearing protectors pursuant to paragraph (b)(1) of this section.

(iv) If a significant threshold shift has been determined to be permanent on the basis of a retest audiogram or an annual audiogram conducted after 14 hours without exposure to workplace noise, the employer shall:

(a) Notify the employee in writing, within 30 days of the determination, of the existence of a permanent significant threshold shift;

(b) Refer the employee for a clinical audiological evaluation or an otological examination, as appropriate, if additional testing is necessary to determine the cause of the permanent significant threshold shift, or if the employer suspects that a medical pathology of the ear (as defined in Appendix I) is caused or aggravated by the wearing of hearing protectors;

(c) Notify the employee of the need for an otological examination if a medical pathology of the ear which is unrelated to the use of hearing protectors is suspected; and

(d) Document the existence of the permanent significant threshold shift on the OSHA Form 200 when the audiologist, otolaryngologist or qualified physician who reviews the audiogram determines that the shift is work related.

(v) **Baseline.** An annual or retest audiogram shall be substituted for the baseline audiogram under the following circumstances:

(i) Where the annual or retest audiogram reveals a permanent significant threshold shift as defined in paragraph (j)(10) of this section; or

(ii) Where the annual or retest audiogram reveals improved hearing thresholds with respect to the baseline at two or more test frequencies.

(10) **Significant threshold shift.** As used in this section, a significant threshold shift is:

(i) A change in hearing threshold relative to the baseline audiogram of 20 dB or greater at any test frequency other than 500 Hz in either ear, if no previous audiograms have thresholds that exceed 25 dB with reference to audiometric test as specified by American National Standard Z39-1966; or

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~~number of measurements where sound level measurements are used.~~

~~(f) Description of the noise measurement equipment used and the date of its last laboratory calibration.~~

~~(2) Audiometric tests. (i) The employer shall retain all employee audiograms obtained pursuant to paragraph (j) of this section;~~

~~(ii) This record shall include:~~

~~(a) Name and job classification of the employee;~~

~~(b) Date of the audiogram;~~

~~(c) The examiner's name and qualifications;~~

~~(d) Manufacturer and model of the audiometer;~~

~~(e) Date of the last acoustic or exhaustive calibration of the audiometer;~~

~~(f) Employee's most recent noise exposure assessment;~~

~~(g) Statement of whether the sound pressure levels in the test room in which the audiogram was taken meet the levels specified in Table D-1 or Table D-2 of Appendix D: Audiometric Test Rooms.~~

~~(3) Audiometric test rooms. (i) The employer shall maintain accurate records of the measurements of the background sound pressure levels in audiometric test rooms.~~

~~(ii) This record shall include:~~

~~(a) Background sound pressure level measurements at each of the following octave bands: 500, 1000, 2000, 4000, and 8000 Hz; and~~

~~(b) Date of measurement.~~

~~(4) Calibration of audiometers. (i) The employer shall maintain accurate records of all acoustical and exhaustive calibrations of audiometers required to be made pursuant to paragraph (k) of this section;~~

~~(ii) This record shall include:~~

~~(a) Type of calibration;~~

~~(b) Date performed; and~~

~~(c) Numerical results of the acoustical calibration.~~

~~(5) Retention. The employer shall retain records required in this paragraph (q) for at least the following periods:~~

~~(i) Noise exposure measurement records shall be retained for 2 years.~~

~~(ii) Audiometric test records shall be retained for the duration of the affected employee's employment plus 5 years.~~

~~(iii) Records of background sound pressure levels in audiometric test rooms shall be retained for a period of 5 years.~~

~~(iv) Records of audiometer calibrations shall be retained for a period of 5 years.~~

~~(6) Access to records. All records required by this section shall be provided upon request to employees, former employees, representatives designated by the individual employee~~

and the Assistant Secretary. The provisions of 29 CFR 1910.20(a)-(e) and (g)-(i) apply to access to records under this section.

(7) *Transfer of records.* If the employer ceases to do business, the employer shall transfer to the successor employer all records required to be maintained by this section, and the successor employer shall retain them for the remainder of the period prescribed in paragraph (q)(5) of this section.

(r) *Appendices.* (1) Appendices A, C, D, E, G, and I to this section are incorporated as part of this section and the contents of these Appendices are mandatory.

~~(2) Appendix H to this section is informational and is not intended to create any additional obligations not otherwise imposed or to detract from any existing obligations.~~

~~[Section 1910.95(r)(2) amended by 46 FR 42632, August 21, 1981]~~

~~(s) Effective dates. (1) Paragraphs (c)-(r) of this section shall become effective August 22, 1981 unless otherwise noted below.~~

~~[Section 1910.95(s)(1) amended by 46 FR 42632, August 21, 1981]~~

~~(2) Initial determinations and subsequent monitoring conducted pursuant to paragraphs (d) and (e) of this section shall be completed by February 22, 1982.~~

~~[Section 1910.95(r)(2) amended by 46 FR 42632, August 21, 1981]~~

~~(3) Baseline audiograms required by paragraph (j) of this section shall be completed by August 22, 1982.~~

~~[Section 1910.95(s)(3) amended by 46 FR 42632, August 21, 1981]~~

~~(4) In lieu of Table D-1 of Appendix B, background sound pressure levels in audiometric test rooms may conform to Table D-2 of Appendix D until April 15, 1983. After April 15, 1983, background sound pressure levels in audiometric test rooms shall comply with Table D-1 of Appendix D.~~

~~(5) Dosimeters used for employee exposure monitoring conducted pursuant to paragraph (e) of this section shall meet the requirements of paragraph (g)(1)(i) of this section by April 15, 1983.~~

Appendix A: Noise Exposure Computation

This Appendix is Mandatory

I. Computation of Employee Noise Exposure

(1) Noise dose is computed using Table G-16a as follows:

(i) When the sound level, L, is constant over the entire work shift, the noise dose, D, in percent, is given by: $D = 100 C/T$ where C is the total length of the work day, in hours, and T is the reference duration corresponding to the measured sound level, L, as given in Table G-16a or by the formula shown as a footnote to that table.

(ii) 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: $D = 100 (C_1/T_1 + C_2/T_2 + \dots + C_n/T_n)$, 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 G-16a.

[Appendix A, I.(1)(ii) corrected by 46 FR 42632, August 21, 1981]

(2) The eight-hour time-weighted average sound level (TWA), in decibels, may be computed from the dose, in percent, by means of the formula: $TWA = 16.61 \log_{10} (D/100) + 90$. For an eight-hour workshift with the noise level constant over the entire shift, the TWA is equal to the measured sound level.

(3) A table relating dose and TWA is given in Section II.

Table G-16a

A-weighted sound level, L (decibel)	Reference duration, T (hour)
80	32
81	27.9
82	24.3
83	21.1
84	18.4
85	16
86	13.9
87	12.1
88	10.6
89	9.2
90	8
91	7.0
92	6.2
93	5.3
94	4.6
95	4
96	3.5
97	3.0
98	2.6
99	2.3
100	2
101	1.7
102	1.5
103	1.4
104	1.3
105	1
106	0.87
107	0.76
108	0.66
109	0.57
110	0.5
111	0.44
112	0.38
113	0.33
114	0.29
115	0.25
116	0.22
117	0.19
118	0.16
119	0.14
120	0.125
121	0.11
122	0.095
123	0.082
124	0.072
125	0.063
126	0.054
127	0.047
128	0.041
129	0.036
130	0.031

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

$$T = \frac{3}{2(L-90)/5}$$

where L is the measured A-weighted sound level.

[Appendix A]

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A	B	C	D
SOUND LEVEL dB	COUNT	RELATIVE WEIGHTING	RELATIVE TOTAL WEIGHTING
130 or above		256.00	
129		222.86	
128		194.01	
127		168.91	
126		147.03	
125		128.00	
124		111.43	
123		97.01	
122		84.43	
121		73.52	
120		64.00	
119		55.72	
118		48.50	
117		42.22	
116		36.76	
115		32.00	
114		27.86	
113		24.25	
112		21.11	
111		18.38	
110		16.00	
109		13.93	
108		12.13	
107	1	10.56	10.56
106	4	9.19	36.76
105	3	8.00	24.00
104	3	6.96	20.88
103	3	6.06	18.18
102	3	5.28	15.84
101	3	4.59	13.77
100	2	4.00	8.00
99	2	3.48	6.96
98	1	3.03	3.03
97		2.64	
96		2.30	
95		2.00	
94		1.74	
93		1.52	
92		1.32	
91		1.15	
90		1.00	
89		0.87	
88		0.76	
87		0.66	
86		0.57	
85		0.50	
84		0.44	
83		0.38	
82		0.33	
81		0.29	
80		0.25	
below 80		0.00	0.00
Sum B =	25	Sum D =	157.98
Sum D		Average Sound Level =	103 ⁺ dB
Sum B	6.32		

Figure 8-10. Sample worksheet for computing average sound level.

Appendix C: Audiometric Measuring Instruments

This Appendix is Mandatory

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

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

(A) The chart upon which the audiogram is traced shall have lines at positions corresponding to all multiples of 10 dB 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 2 dB in width.

(B) It shall be possible to set the stylus manually at the 10-dB increment lines for calibration purposes.

(C) The slewing rate for the audiometer attenuator shall 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.

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

(E) 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 shall be the average of the midpoints of the tracing excursions.

Appendix D: Audiometric Test Rooms

This Appendix is Mandatory

After April 15, 1983, rooms used for audiometric testing shall not have background sound pressure levels exceeding those in Table D-1 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). Table D-2 may be used until April 15, 1983.

Table D-1.—Maximum Allowable Octave-Band Sound Pressure Levels for Audiometric Test Rooms

4/15/83

Octave-band center frequency (Hz)	500	1000	2000	4000	6000
Sound pressure level (dB)	27	30	35	42	41

Table D-2.—Maximum Allowable Octave-Band Sound Pressure Levels for Audiometric Test Rooms (May be used in lieu of Table D-1 until Apr. 15, 1983)

Octave-band center frequency (Hz)	500	1000	2000	4000	6000
Sound pressure level (dB)	40	40	47	57	62

Appendix E: Acoustic Calibration of Audiometers

This Appendix is Mandatory

Audiometer calibration shall be checked acoustically, at least annually, according to the procedures described in this Appendix. 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 National Standard Specification for Audiometers, S3.6-1969.

(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 70 dB.

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

D. At each frequency the readout on the sound level meter should correspond to the levels in Table E-1 or Table E-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 70 dB.

B. 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.

C. For each 10-dB decrement on the audiometer the sound level meter should indicate a corresponding 10 dB 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 E-1 or Table E-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 10 dB at any test frequency.

Table E-1.—Reference Threshold Levels for Telephonics—TDH-39 Earphones

Frequency, Hz	Reference threshold level for TDH-39 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 E-2.—Reference Threshold Levels for Telephonics—TDH-49 Earphones

Frequency, Hz	Reference threshold level for TDH-49 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

[Appendix E, Table E-2 corrected by 46 FR 42632, August 21, 1981]

Appendix F: Calculations and Application of Age Corrections to Audiograms

This Appendix is Non-Mandatory

In determining whether a significant threshold shift has occurred, allowance may be made for the contribution of aging to the change in hearing level by adjusting the most recent audiogram. If the employer chooses to adjust the audiogram, the employer shall follow the procedure described below. This procedure and the age correction tables were developed by the National Institute for Occupational Safety and Health in the criteria document entitled "Criteria for a Recommended Standard . . . Occupational Exposure to Noise," (HSM-11001).

For each audiometric test frequency;

(i) Determine from Table F-1 or F-2 the age correction values for the employee by:

(A) finding the age at which the most recent audiogram was taken and recording the corresponding values of age corrections at 1000 Hz through 6000 Hz;

(B) finding the age at which the baseline audiogram was taken and recording the corresponding values of

age corrections at 1000 Hz through 6000 Hz.

(ii) Subtract the values found in step (i)(A) from the value found in step (i)(B).

(iii) The differences calculated in step (ii) represented that portion of the change in hearing that may be due to aging.

Example: Employee is a 32-year-old male. The audiometric history for his right ear is shown in decibels below.

Employee's age	Audiometric test frequency (Hz)				
	1000	2000	3000	4000	6000
26.....	10	5	5	10	5
*27.....	0	0	0	5	5
28.....	0	0	0	10	5
29.....	5	0	5	15	5
30.....	0	5	10	20	10
31.....	5	10	20	15	15
*32.....	5	10	10	25	20

The audiogram at age 27 is considered the baseline since it shows the best hearing threshold levels. Asterisks have been used to identify the baseline and most recent audiogram. A threshold shift of 20 dB exists at 4000 Hz between the audiograms taken at ages 27 and 32. (The threshold shift is computed by subtracting the hearing threshold at age 27, which was 5, from the hearing threshold at age 32, which is 25). A retest audiogram has confirmed this shift. The contribution of aging to this change in hearing may be estimated in the following manner:

Go to Table F-1 and find the age correction values (in dB) for 4000 Hz at age 27 and age 32.

	Frequency (Hz)				
	1000	2000	3000	4000	6000
Age 32.....	6		7	10	14
Age 27.....	5		6	7	11
Difference.....	1	1	1	3	3

The difference represents the amount of hearing loss that may be attributed to aging in the time period between the baseline audiogram and the most recent audiogram. In this example, the difference at 4000 Hz is 3 dB. This value is subtracted from the hearing level at 4000 Hz, which in the most recent audiogram is 25, yielding 22 after adjustment. Then the hearing threshold in the baseline audiogram at 4000 Hz (5) is subtracted from the adjusted annual audiogram hearing threshold at 4000 Hz (22). Thus the age-corrected threshold shift would be 17 dB (as opposed to a threshold shift of 20 dB without age correction).

Table F-1.—Age Correction Values in Decibels for Males

Years	Audiometric Test Frequencies (Hz)				
	1000	2000	3000	4000	6000
20 or younger.....	5	3	4	5	8
21.....	5	3	4	5	8
22.....	5	3	4	5	8
23.....	5	3	4	5	8
24.....	5	3	5	6	9
25.....	5	3	5	7	10
26.....	5	4	5	7	10
27.....	5	4	6	7	11
28.....	6	4	6	8	11
29.....	6	4	6	8	12
30.....	6	4	6	9	12
31.....	6	4	7	9	13
32.....	6	5	7	10	14
33.....	6	5	7	10	14
34.....	6	5	8	11	15
35.....	7	5	8	11	15
36.....	7	5	9	12	16
37.....	7	6	9	12	17
38.....	7	6	9	13	17
39.....	7	6	10	14	18
40.....	7	6	10	14	19
41.....	7	6	10	14	20
42.....	8	7	11	16	20
43.....	8	7	12	16	21
44.....	8	7	12	17	22
45.....	8	7	13	18	23
46.....	8	8	13	19	24
47.....	8	8	14	19	24
48.....	9	8	14	20	25
49.....	9	9	15	21	26
50.....	9	9	16	22	27
51.....	9	9	16	23	28
52.....	9	10	17	24	29
53.....	9	10	18	25	30
54.....	10	10	18	26	31
55.....	10	11	19	27	32
56.....	10	11	20	28	34
57.....	10	11	21	29	35
58.....	10	12	22	31	36
59.....	11	12	22	32	37
60 or older.....	11	13	23	33	38

Table F-2.—Age Correction Values in Decibels for Females

Years	Audiometric test frequencies (Hz)				
	1000	2000	3000	4000	6000
20 or younger.....	7	4	3	3	6
21.....	7	4	4	3	6
22.....	7	4	4	4	6
23.....	7	5	4	4	7
24.....	7	5	4	4	7
25.....	8	5	4	4	7
26.....	8	5	5	4	8
27.....	8	5	5	5	8
28.....	8	5	5	5	8
29.....	8	6	5	5	9
30.....	8	6	5	5	9
31.....	8	6	6	5	9
32.....	9	6	6	6	10
33.....	9	6	6	6	10
34.....	9	6	6	6	10
35.....	9	6	7	7	11
36.....	9	7	7	7	11
37.....	9	7	7	7	12
38.....	10	7	7	7	12
39.....	10	7	8	8	12
40.....	10	7	8	8	13
41.....	10	8	8	8	13
42.....	11	8	9	9	13
43.....	11	8	9	9	14
44.....	11	8	9	9	14
45.....	11	9	10	10	15
46.....	11	9	10	10	15
47.....	11	9	10	11	16
48.....	12	9	11	11	16
49.....	12	9	11	11	16
50.....	12	10	11	12	17
51.....	12	10	12	12	17
52.....	12	10	12	13	18
53.....	12	10	13	13	18
54.....	13	11	13	14	19
55.....	13	11	14	14	19
56.....	13	11	14	15	20
57.....	13	11	15	15	20
58.....	14	12	15	16	21

Table F-2.—Age Correction Values in Decibels for Females—Continued

Years	Audiometric test frequencies (Hz)				
	1000	2000	3000	4000	6000
59.....	14	12	16	16	21
60 or older.....	14	12	16	17	22

Appendix G. Methods for Estimating the Adequacy of Hearing Protector Attenuation

This Appendix is Mandatory

For employees who have experienced a significant threshold shift, hearing protector attenuation must be sufficient to reduce employee exposure to a TWA of 85 dB. Employers must select one of the following methods by which to estimate the adequacy of hearing protector attenuation.

The most convenient method is the Noise Reduction Rating (NRR) developed by the Environmental Protection Agency (EPA). According to EPA regulation, the NRR must be shown on the hearing protector package. The NRR is then related to an individual worker's noise environment in order to assess the adequacy of the attenuation of a given hearing protector. This Appendix describes four methods of using the NRR to determine whether a particular hearing protector provides adequate protection within a given exposure environment. Selection among the four procedures is dependent upon the employer's noise measuring instruments.

Instead of using the NRR, employers may evaluate the adequacy of hearing protector attenuation by using one of the three methods developed by the National Institute for Occupational Safety and Health (NIOSH), which are described in the "List of Personal Hearing Protectors and Attenuation Data," HEW Publication No. 76-120, 1975, pages 21-37. These methods are known as NIOSH methods #1, #2 and #3. The NRR described below is a simplification of NIOSH method #2. The most complex method is NIOSH method #1, which is probably the most accurate method since it uses the largest amount of spectral information from the individual employee's noise environment. As in the case of the NRR method described below, if one of the NIOSH methods is used, the selected method must be applied to an individual's noise environment to assess the adequacy of the attenuation. Employers should be careful to take a sufficient number of measurements in order to achieve a representative sample for each time segment.

[Appendix G]

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

When using the NRR to assess hearing protector adequacy, one of the following methods must be used:

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

(A) Obtain the employee's C-weighted dose for the entire workshift, and convert to TWA (see Appendix A, II).

(B) Subtract the NRR from the C-weighted TWA to obtain the estimated A-weighted TWA under the ear protector.

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

(A) Convert the A-weighted dose to TWA (see Appendix A).

(B) Subtract 7 dB from the NRR.

(C) Subtract the remainder from the A-weighted TWA to obtain the estimated A-weighted TWA under the ear protector.

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

(A) Obtain the employee's A-weighted TWA in accordance with a procedure such as the one recommended in Appendix B.

(B) 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.

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

(A) Obtain a representative sample of the C-weighted sound levels in the employee's environment for each identified time segment.¹

(B) If there is more than one identified time segment, compute the 8-hour time-weighted average of the C-weighted sound levels using Figure B-5 and Table G-16a or an equivalent method.

(C) Subtract the NRR from the C-weighted average sound level to obtain the estimated A-weighted TWA under the ear protector.

Appendix H: Availability of Referenced Documents

Paragraphs (c) through (s) of 29 CFR 1910.95 and the accompanying appendices contain provisions which incorporate publications by reference. Generally, the publications provide criteria for instruments to be used in monitoring and audiometric testing.

These criteria are intended to be mandatory when so indicated in the applicable paragraphs of Section 1910.95 and appendices.

It should be noted that OSHA does not require that employers purchase a copy of the referenced publications. Employers, however, may desire to

obtain a copy of the referenced publications for their own information.

The designation of the paragraph of the standard in which the referenced publications appear, the titles of the publications, and the availability of the publications are as follows:

Paragraph designation	Referenced publication	Available from—
§ 1910.95(g)(1)(i)	"Specification for Personal Noise Dosimeters," ANSI S1.25-1978, (ASA 25-1978).	Back Numbers Department, Dept. STD, American Institute of Physics 333 E. 45th St., New York, NY 10017; American National Standards Institute, Inc., 1430 Broadway, New York, N.Y. 10018.
§ 1910.95(g)(1)(ii)	"Specification for Sound Level Meters," S1.4-1971 (R 1976).	American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.
§ 1910.95(k)(2), appendix E	"Specifications for Audiometers," S3.6-1969	American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.
Appendix D	"Specification for Octave, Half-Octave and Third-Octave Band Filter Sets," S1.11-1971 (R1976).	Back Numbers Department, Dept. STD, American Institute of Physics 333 E. 45th St., New York, NY 10017; American National Standards Institute, Inc., 1430 Broadway, New York, N.Y. 10018.
Appendix G	"List of Personal Hearing Protectors and Attenuation Data," HEW Pub. No. 76-120, 1975.	Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

[Appendix H, table corrected by 46 FR 42632, August 21, 1981]

The referenced publications (or a microfiche of the publications) are available for review at many universities and public libraries throughout the country. These publications may also be examined at the OSHA Technical Data Center, Room N2439, United States Department of Labor, 200 Constitution Avenue N.W., Washington, D.C. 20210, (202) 523-9700 or at any OSHA Regional Office (see telephone directories under United States Government—Labor Department).

Appendix I: Definitions

These definitions apply to the following terms as used in paragraphs (c) through (r) of 29 CFR 1910.95.

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 habilitation of hearing, who is certified by the American Speech, Hearing, and Language Association or licensed by a state board of examiners.

Baseline audiogram—The audiogram against which future audiograms are compared.

Crest factor—Absolute value of the ratio of the peak value and the root-mean-square value measured over a specified time interval where both values are measured in reference to the arithmetic mean value of the wave.

Criterion sound level—A sound level of 90 decibels.

Decibel (dB)—Unit of measurement of sound level.

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.

Noise dose—The ratio, expressed as a percentage, of (1) the time integral, over a stated time or event, of the 0.6 power of the measured SLOW exponential time-averaged, squared A-weighted sound pressure and (2) the product of the criterion duration (8 hours) and the 0.6 power of the squared sound pressure corresponding to the criterion sound level (90 dB).

Noise dosimeter—An instrument that integrates a function of sound pressure over a period of time in such a manner that it directly indicates a noise dose.

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 employers deems to be representative of the exposures of other employees in the workplace.

Sound level—Ten times the common logarithm of the ratio of the square of the measured A-weighted sound pressure to the square 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.

Time-weighted average sound level—That sound level, which if constant over an 8-hour exposure, would result in the same noise dose as is measured.

¹ Time segments should be identified according to a procedure such as the one recommended in Appendix B, but the same number of measurements may not be necessary to achieve a representative sample.