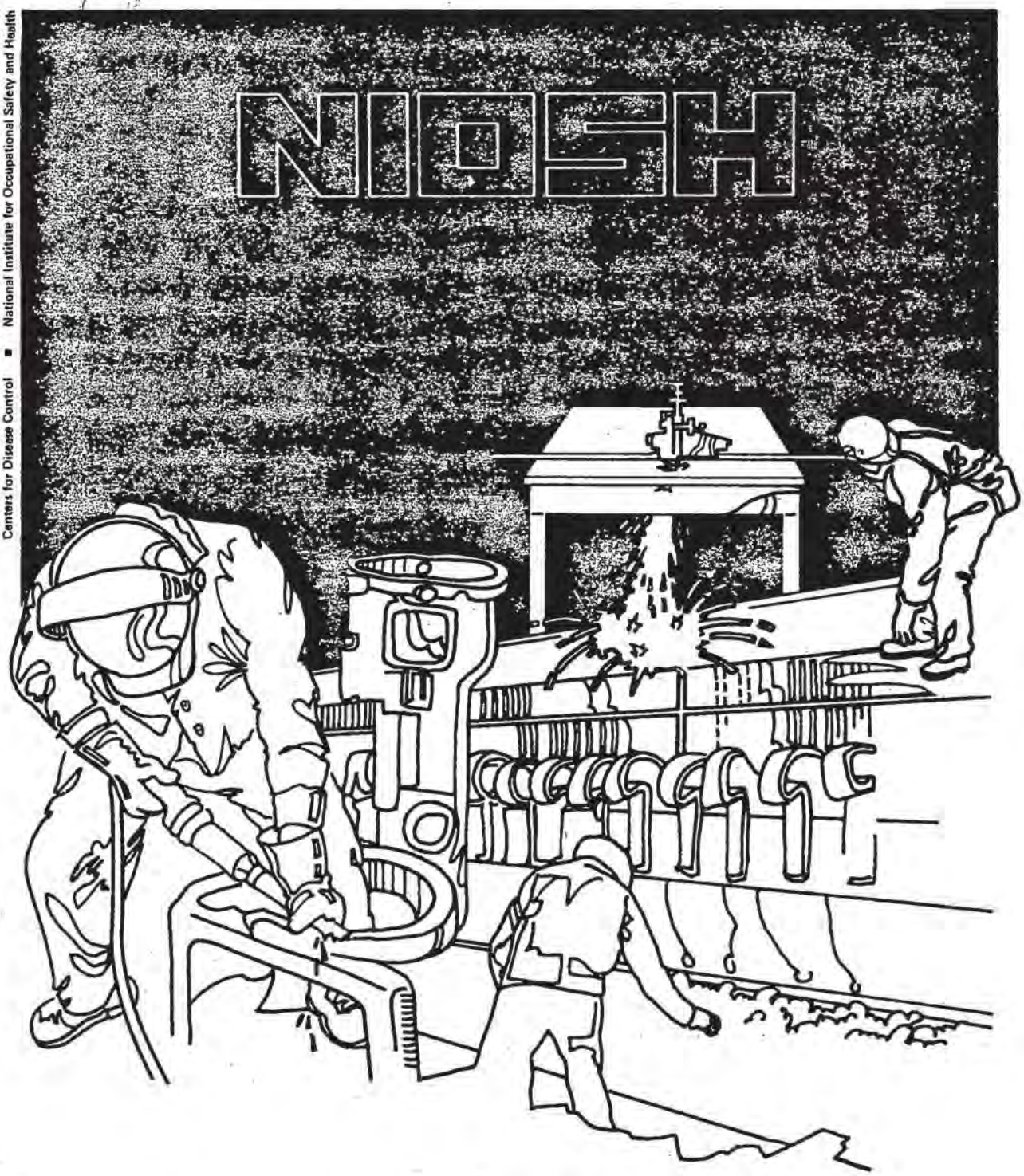
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health



Health Hazard Evaluation Report

HETA 84-028-1517
DRIVE TRAIN INDUSTRIES, INC.
ALBUQUERQUE, NEW MEXICO

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

HETA 84-028-1517
OCTOBER 1984
DRIVE TRAIN INDUSTRIES, INC.
ALBUQUERQUE, NEW MEXICO

NIOSH INVESTIGATORS:
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I. SUMMARY

In October 1983, the National Institute for Occupational Safety and Health (NIOSH) received a request to conduct a health hazard evaluation at Drive Train Industries, Inc., Albuquerque, New Mexico. The company rebuilds brakes, clutches, transmissions and differentials, primarily for trucks. The request concerned potential employee exposures to asbestos, noise and welding fumes.

On May 10, 1984, after a delay while renovations were being completed at the facility, NIOSH investigators conducted an industrial hygiene survey to determine if employee exposure hazards were present.

All air contaminants sampled for reflected personal and area concentrations below OSHA standards: asbestos (range nondetectable - 0.06 fibers/cc>5um); iron oxide (range 0.01-0.09 mg/M^3); total particulates (range 0.21-0.50mg/M^3); and sodium hydroxide (range nondetectable - 0.02mg/M^3). While the OSHA asbestos standard was not exceeded, NIOSH recommends that for a carcinogen, exposure be reduced to the lowest feasible level.

Five workers were monitored for noise exposures. Two of the workers, located in the Transmission/Rear End Department, were exposed to levels of 85 and 88 dBA. Although earmuffs were being worn on a voluntary basis, no formal hearing conservation program was in place. NIOSH recommends a maximum permissible noise exposure level of 85 dBA for 8 hours. While the OSHA standard is 90 dBA, exposures at or above a TWA of 85 dBA requires implementation of a hearing conservation program.

On the basis of the environmental data collected, NIOSH determined that a potential health hazard from excessive exposure to noise and asbestos existed at the time of this survey. All other environmental measurements did not indicate excessive exposures. Recommendations indicate the need for establishing a hearing conservation program and continued efforts to reduce asbestos exposure.

KEYWORDS: SIC 3714 (Motor Vehicles and Motor Vehicle Equipment), brake drums, clutches, transmissions, differentials, asbestos, noise, total particulate matter, sodium hydroxide, iron oxide.

II. INTRODUCTION

In October 1983, the National Institute for Occupational Safety and Health (NIOSH) received a request from Drive Train Industries, Inc., Albuquerque, New Mexico, to evaluate potential employee exposure to asbestos, noise and welding fumes. The environmental survey was delayed until May 1984 to allow for the completion of renovations being carried out at the facility.

III. BACKGROUND

Drive Train Industries, Inc., Albuquerque, New Mexico, has been at its present location for approximately four years and is involved with rebuilding brakes, clutches, transmissions and differentials, primarily for trucks. At the time of the survey, there were ten (10) employees including a supervisor working in the shop area. The locations of principal concern were the:

1. Brake Shoe Department, where two employees were responsible for the teardown, stripping and relining of brakes and resurfacing flywheels. The company has an established medical program for those employees working in the area where asbestos work is performed.

2. Transmission/Rear End Department, where three employees were involved with the teardown and rebuilding of parts. Centralized cleaning of parts was carried out in this area using compressed air, water and a sodium hydroxide solution.

3. Drive Line Department, where a machinist refurbished worn out shafts and involved lathe, grinding and welding operations.

Welding is conducted on an irregular basis and was not observed during the survey.

IV. ENVIRONMENTAL DESIGN AND METHODS

Personal and area samples were collected in the three departments and a control personal sample in the Sales area. The following is a description of the techniques used:

A. Asbestos

Two personal and two area air samples were collected for asbestos on AA filters (open faced) and counted on a phase contrast microscope according to NIOSH Method P&CAM 239.

B. Noise

Five personal noise level measurements were taken using Metrosonic noise dosimeters which register on a memory cell the dose or noise level received during the exposure period. The data can then be displayed as a read-out (hard copy) for each minute at the end of the exposure period. The read-out describes the accumulated exposure for each hour and is described as the average noise exposure for each hour evaluated.

C. Sodium Hydroxide

Three general area samples were collected on AA filters and analyzed by atomic emission spectrophotometry according to NIOSH Method P&CAM 173.

D. Total Particulate Matter

One personal and three area samples were taken on pre-weighed filters and analyzed by weight differences.

E. Iron Oxide

One personal and one area sample was taken on AA filters and analyzed for iron by NIOSH Method P&CAM 173 after digestion by NIOSH Method 7300.

V. EVALUATION CRITERIA AND TOXICOLOGY

A. Environmental Criteria

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime, without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and recommendations, 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLV's), and 3) the U.S. Department of Labor (OSHA) occupational health standards. Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding OSHA standards. Both NIOSH recommendations and ACGHI TLV's usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended standards, by contrast, are based on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is legally required to meet only those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended short-term exposure limits, or ceiling values, which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

Substance	Evaluation Criteria*	Source
Asbestos	LFL	NIOSH
	2 fibers/cc greater than 5 microns in length	OSHA
Noise	85dBA	NIOSH
	90dBA	OSHA
Total Particulate Matter	10mg/M^3	ACGIH
	15mg/M^3	OSHA
Iron Oxide (as iron)	5mg/M^3	ACGIH
	5mg/M^3	OSHA
Sodium Hydroxide	2.0mg/M^3	OSHA
	2.0mg/M^3	NIOSH

*All air concentrations are expressed as time-weighed average (TWA) exposures for up to a 10 hour workday.
mg/M^3 = milligrams of substance per cubic meter of air.
LFL = Lowest feasible level.
dBA = decibels measured on the A scale.

B. Toxicological

1. Asbestos

Chronic exposure to asbestos fibers in sufficient quantity may cause asbestosis, a lung disease involving fibrosis (scarring) of the lung and progressive respiratory impairment, and at much lower exposure levels, various forms of cancer including lung and gastrointestinal. No safe threshold for exposure has been determined for the prevention of asbestos-related cancer. Asbestos-exposed workers who smoke have a much higher increase in cancer rates than asbestos-exposed workers who do not smoke. Asbestos is primarily absorbed through the lungs, and secondarily by swallowing dusts or phlegm containing asbestos fibers.

2. Noise

Exposure to high levels of noise may cause temporary and/or permanent hearing loss. The extent of damage depends primarily upon the intensity of the noise and the duration of the exposure. There is abundant epidemiological and laboratory evidence that protracted noise exposure above 90 decibels (dBA) causes hearing loss in a portion of the exposed population.

OSHA's existing standard for occupational exposure to noise (29CFR1910.95) specifies a maximum permissible noise exposure level of 90dBA for a duration of 8 hours, with higher levels allowed for shorter durations. NIOSH, in its Criteria for a Recommended Standard, proposed a limit of 5 dB less than the OSHA standard.

Time-weighted average noise limits as a function of exposure duration are shown as follows:

Duration of Exposure (hours/day)	Sound Level, dBA NIOSH	OSHA
16	80	---
8	85	90
4	90	95
2	95	100
1	100	105
1/2	105	110
1/4	110	115*
1/8	115*	---
	---	140dB**

*No exposure to continuous noise above 115dBA.
**No exposure to impact or impulse noise above 140dB peak sound pressure level (SPL).

When workers are exposed to sound levels exceeding the OSHA standard, flexible engineering or administrative controls must be implemented to reduce levels to permissible limits. OSHA has recently issued a hearing conservation amendment to its noise standard. For workers exposed at or above a TWA of 85dB, the amendment requires noise exposure monitoring, employee education, and audiometric testing. Review of audiograms are to be made by an audiologist or otolaryngologist or a qualified physician in their absence. Employees also must be notified of monitoring results within 21 days. Employee records must be kept by the employer for up to five years after termination of employment. Finally, for those employees exposed to noise levels exceeding 90 dBA for eight hours and/or where audiometric testing results indicate a hearing loss, ear protection must be worn.

3. Total Particulate Matter

Dust particles greater than 5 microns usually are deposited in the nose, throat and upper airways. Particles trapped in this nasopharyngeal area normally elicit irritations with acute symptoms of runny noses, sore throats, chest tightness and/or coughing. In most cases, these symptoms will dissipate upon removal from the dust.

4. Iron Oxide

Iron oxide is usually a major contaminant of welding fumes, especially when welding is carried out on oxidized iron. Exposure to the iron oxide fumes will produce metal fume fever. Prolonged exposures may result in a coating of the lung interior referred to as siderosis.

5. Sodium Hydroxide

A strong alkali whose mist may cause eye or skin irritation. Severe exposures to the eyes may cause severe burns with possible blindness.

VI. ENVIRONMENTAL RESULTS AND DISCUSSION

Of the five personal noise samples (two brakemen and three gearmen), levels for two of the three gearmen equalled or exceeded the NIOSH criteria of 85 dBA (see Table 1). A potential noise problem existed at the time of the investigation in the Transmission/Rear End Department. Although hearing protection, earmuffs, were worn by the three employees working in the area, this was on a voluntary rather than required basis.

The results for the asbestos samples are listed in Table 2. All samples, both personal and area, were below existing OSHA standards (range nondetectable - 0.06 fibers/cc). However, NIOSH strongly recommends that efforts be taken to reduce overall asbestos exposure to the lowest feasible level. This is based on evidence that the lowest measurable levels of exposure may still cause asbestos-related disease.

All areas and personal samples collected for iron oxide (range 0.01-0.09mg/M^3), total particulates (range 0.21-0.50mg/M^3), and sodium hydroxide (range nondetectable - 0.02mg/M^3) were well below accepted evaluation criteria. The results for these materials are found in Tables 3-5. Eye protection was provided and worn when sodium hydroxide mist/splash conditions existed.

VII CONCLUSIONS

NIOSH concluded that a health hazard did not exist to the employees evaluated for exposure to sodium hydroxide, iron oxide or total particulates. However, a potential health hazard did exist in the Transmission/Rear End Department from employee exposure to noise and in the Brake Shoe Department from asbestos.

VIII. RECOMMENDATIONS

A hearing conservation program should be formalized for employees working in the Transmission/Rear End Department. While noise levels would not require the wearing of hearing protection in this area, their voluntary use should continue to be encouraged.

The medical program should be continued for employees potentially exposed to asbestos. Efforts should also be continued to reduce employee exposures to the lowest feasible level. Smoking should be prohibited in the asbestos area.

IX. DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available upon request from NIOSH, Division of Standard Development and Technology Transfer, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia. Information regarding its availability through NTIS can be obtained from NIOSH, Publications Office, at the Cincinnati address.

Copies of this report have been sent to:

1. Drive Train Industries, Inc., Albuquerque, New Mexico
2. U.S. Department of Labor/OSHA - Region VI
3. NIOSH - Region VI
4. State Designated Agency

For the purpose of informing affected employees, a copy of this report shall be posted in a prominent place accessible to the employee for a period of 30 calendar days.

IX. REFERENCES

1. Occupational Diseases, A Guide to Their Recognition, Revised Edition, DHEW (NIOSH) Publication No. 77-181, June 1977.

2. Handbook of Noise Measurement, seventh edition, Arnold Peterson and Ervin Gross, 1974.

3. Encyclopedia of Occupational Health and Safety, International Labor Office, McGraw-Hill Book Company, New York.

4. Criteria for a recommended standard -- occupational exposure to asbestos, DHEW (NIOSH) Publication No. 77-169, 1977.

X. AUTHORSHIP AND ACKNOWLEDGMENTS

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Table 1

Personal Noise Dosimeter Levels

Drive Train Industries, Inc.
Albuquerque, New Mexico

May 1984

Job/Task Description	Sampling Time (hours)	8-Hour TWA Noise (dBA)
Gearman 1	7	88
Gearman 2	7	85
Gearman 3	7	82
Brakeman 1	7	82
Brakeman 2	7	81

EVALUATION CRITERIA:	NIOSH 8-hour TWA 85dBA OSHA 8-hour TWA 90dBA OSHA 8-hour TWA* 85dBA

*OSHA Revised Hearing Conservation Regulation requires employer to institute a hearing protection program if TWA noise exceeds 85dBA.

Table 2

Summary of Personal and Area Air Samples for Asbestos

Drive Train Industries, Inc.
Albuquerque, New Mexico

May 1984

Job/Area Description	Sampling Time (minutes)	Asbestos (fibers/cc>5um)*
Brakeman 1	384	0.06
Brakeman 2	383	0.02
Reline Bench (east end)	409	0.02
Flywheel Grinder/Drum Lathe	409	ND
EVALUATION CRITERIA:	OSHA	2 fibers/cc>5um
	NIOSH	LFL

**LABORATORY LIMIT OF DETECTION: 0.03 fibers per field or 5000 fibers per filter.

* = fibers per cubic centimeter greater than 5 microns in length.
** = A detection limit is calculated by dividing the minimum observable fibers by the maximum number of fields specified by the method.
ND = Non-detectable and/or below laboratory limit of detection.
LFL = Lowest feasible level.

Table 3

Summary of Area Samples for Sodium Hydroxide

Drive Train Industries, Inc.
Albuquerque, New Mexico

May 1984

Area Description	Sampling Time (minutes)	mg/M^3 Sodium Hydroxide
Washer--Marc Tornado	370	ND
Rear of Washer Agitator	370	0.02
10 feet South of Washer	368	0.01
EVALUATION CRITERIA:	OSHA	$2.0mg/M^3$
	NIOSH	$2.0mg/M^3$
LABORATORY LIMIT OF DETECTION:		0.005mg

mg/M^3 = milligrams of substance per cubic meter of air.
ND = Non-detectable and/or below laboratory limit of detection.
mg = milligrams

Table 4

Summary of Personal and Area Samples for Iron Oxide

Drive Train Laboratories, Inc.
Albuquerque, New Mexico

May 1984

Job/Area Description	Sampling Time (minutes)	mg/M^3 Iron Oxide*
Machinist	375	0.01
Welding Table	401	0.09

EVALUATION CRITERIA:	ACGIH	$5mg/M^3$
LABORATORY LIMIT OF DETECTION:		0.003mg

mg/M^3 = milligrams of substance per cubic meter of air
mg = milligrams
*measured as iron

Table 5

Summary of Personal and Area Samples for Total Particulate Matter

Drive Train Industries, Inc.
Albuquerque, New Mexico

May 1984

Job/Area Description	Sampling Time (minutes)	mg/M^3 Total Dust
Reline Bench (east end)	360	0.46
Brake Shoe Table (west end)	362	0.44
Wheel-A-Brator	361	0.50
Salesman (front office)	388	0.21

EVALUATION CRITERIA:	OSHA	$15mg/M^3$
	ACGIH	$10mg/M^3$
LABORATORY LIMIT OF DETECTION		0.01mg

mg/M^3 = milligrams of substance per cubic meter of air
mg = milligrams

NOTE: Asterick Denotes stayed Material

no leakage of solvent when they are closed.

(13) Scope.

(i) This paragraph (d) applies to all operations involving the immersion of materials in liquids, or in the vapors of such liquids, for the purpose of cleaning or altering their surfaces, or adding or imparting a finish thereto, or changing the character of the materials, and their subsequent removal from the liquids or vapors, draining, and drying. Such operations include washing, electroplating, anodizing, pickling, quenching, dyeing, dipping, tanning, dressing, bleaching, degreasing, alkaline cleaning, stripping, rinsing, digesting, and other similar operations, but do not include molten materials handling operations, or surface coating operations.

(ii) "Molten materials handling operations" means all operations, other than welding, burning, and soldering operations, involving the use, melting, smelting, or pouring of metals, alloys, salts, or other similar substances in the molten state. Such operations also include heat treating baths, descaling baths, die casting stereotyping, galvanizing, tinning, and similar operations.

(iii) "Surface coating operations" means all operations involving the application of protective, decorative, adhesive, or strengthening coating or impregnation to one or more surfaces, or into the interstices of any object or material, by means of spraying, spreading, flowing, brushing, roll coating, pouring, cementing, or similar means; and any subsequent draining or drying operations, excluding open-tank operations.

1910.95—OCCUPATIONAL NOISE EXPOSURE

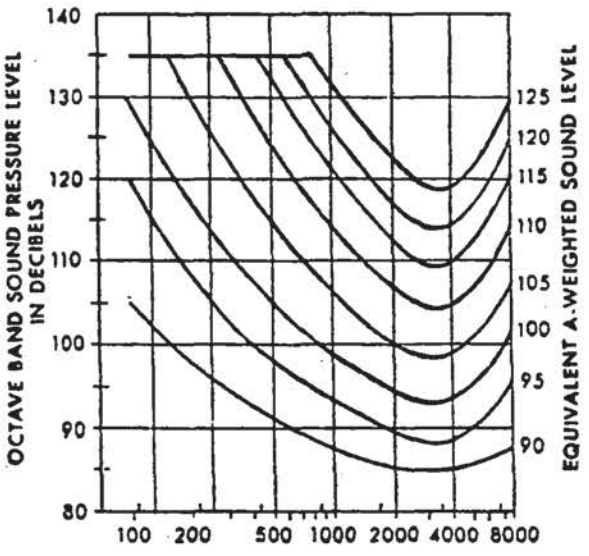
(a) Protection against the effects of noise exposure shall be provided when the sound levels exceed those shown in Table G–16 when measured on the A scale of a standard sound level meter at slow response. When noise levels are determined by octave band analysis, the equivalent A-weighted sound level may be determined as follows:

TABLE G–16—PERMISSIBLE NOISE EXPOSURES [1]

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

[1] 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: $C_1/T_1 + C_2/T_2 \ldots C_n/T_n$ 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.

Figure G-9



Equivalent sound level contours. Octave band sound pressure levels may be converted to the equivalent A-weighted sound level by plotting them on this graph and noting the A-weighted sound level corresponding to the point of highest penetration into the sound level contours. This equivalent A-weighted sound level, which may differ from the actual A-weighted sound level of the noise, is used to determine exposure limits from Table G–16.

STANDARDS AND INTERPRETATIONS

(b)

(1) When employees are subjected to sound exceeding those listed in Table 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.

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

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

(3) In all cases where the sound levels exceed the values shown herein, a continuing, effective hearing conservation program shall be administered.

(c) Hearing conservation program.

(1) The employer shall administer a continuing, effective hearing conservation program, as described in paragraphs (c) through (o) 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.

(2) For purposes of paragraphs (c) through (n) of this section, an 8-hour time-weighted average of 85 decibels or a dose of fifty percent shall also be referred to as the action level.

(d) Monitoring.

(1) When information indicates that any employee's exposure may equal or exceed an 8-hour time-weighted average of 85 decibels, the employer shall develop and implement a monitoring program.

(i) The sampling strategy shall be designed to identify employees for inclusion in the hearing conservation program and to enable the proper selection of hearing protectors.

(ii) Where circumstances such as high worker mobility, significant variations in sound level, or a significant component of impulse noise make area monitoring generally inappropriate, the employer shall use representative personal sampling to comply with the monitoring requirements of this paragraph unless the employer can show that area sampling produces equivalent results.

(2)

(i) All continuous, intermittent and impulsive sound levels from 80 decibels to 130 decibels shall be integrated into the noise measurements.

(ii) Instruments used to measure employee noise exposure shall be calibrated to ensure measurement accuracy.

(3) Monitoring shall be repeated whenever a change in production, process, equipment or controls increases noise exposures to the extent that:

(i) Additional employees may be exposed at or above the action level; or

(ii) The attenuation provided by hearing protectors being used by employees may be rendered inadequate to meet the requirements of paragraph (j) of this section.

(e) Employee notification. The employer shall notify each employee exposed at or above an 8-hour time-weighted average of 85 decibels of the results of the monitoring.

(f) Observation of monitoring. The employer shall provide affected employees or their representatives with an opportunity to observe any noise measurements conducted pursuant to this section.

(g) 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 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 checking calibration and proper functioning of the audiometers being used. A technician who operates microprocessor audiometers does not need to be certified. A technician who performs audiometric tests must be responsible to an audiologist, otolaryngologist or physician.

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

(5) Baseline audiogram.

(i) Within 6 months of an employee's first exposure at or above the action level, the employer shall establish a valid baseline audiogram against which subsequent audiograms can be compared.

(ii) Mobile test van exception. Where mobile test vans are used to meet the audiometric testing obligations, the employer shall obtain a valid baseline audiogram within 1 year of an employee's first exposure at or above the action level. Where baseline audiograms are obtained more than 6 months after the employee's first exposure at or above the action level, employees shall wear hearing protectors for any period exceeding six months after first exposure until the baseline audiogram is obtained.

(iii) Testing to establish a baseline audiogram shall be preceded by at least 14 hours without exposure to workplace noise. Hearing protectors may 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 the 14-hour period immediately preceding the audiometric examination.

(6) Annual audiogram. At least annually after obtaining the baseline audiogram, the employer shall obtain a new audiogram for each employee exposed at or above an 8-hour time-weighted average of 85 decibels.

(7) 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 standard threshold shift as defined in paragraph (g)(10) of this section has occurred. This comparison may be done by a technician.

(ii) If the annual audiogram shows that an employee has suffered a standard threshold shift, the employer may obtain a retest within 30 days and consider the results of the retest as the annual audiogram.

(iii) The audiologist, otolaryngologist, or physician shall review problem audiograms and shall determine whether there is a need for further evaluation. The employer shall provide to the person performing this evaluation the following information:

(a) A copy of the requirements for hearing conservation as set forth in paragraphs (c) through (n) 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 (h)(5) of this section.

(8) Follow-up procedures.

(i) If a comparison of the annual audiogram to the baseline audiogram indicates a standard threshold shift as defined in paragraph (g)(10) of this section has occurred, the employee shall be informed of this fact in writing, within 21 days of the determination.

(ii) Unless a physician determines that the standard threshold shift is not work related or aggravated by occupational noise exposure, the employer shall ensure that the following steps are taken when a standard threshold shift occurs:

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

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

(c) The employee shall be referred for a clinical audiological evaluation or an otological examination, as appropriate, if additional testing is necessary or if the employer suspects that a medical pathology of the ear is caused or aggravated by the wearing of hearing protectors.

(d) The employee is informed of the need for an otological examination if a medical pathology of the ear that is unrelated to the use of hearing protectors is suspected.

(iii) If subsequent audiometric testing of an employee whose exposure to noise is less than an 8-hour TWA of 90 decibels indicates that a standard threshold shift is not persistent, the employer:

(a) Shall inform the employee of the new audiometric interpretation; and

(b) May discontinue the required use of hearing protectors for that employee.

(9) Revised baseline. An annual audiogram may be substituted for the baseline audiogram when, in the judgment of the audiologist, otolaryngologist or physician who is evaluating the audiogram:

(i) The standard threshold shift revealed by the audiogram is persistent; or

(ii) The hearing threshold shown in the annual audiogram indicates significant improvement over the baseline audiogram.

(10) Standard threshold shift.

(i) As used in this section, a standard threshold shift is a change in hearing threshold relative to the baseline audiogram of an average of 10 dB or more at 2000, 3000, and 4000 Hz in either ear.

(ii) In determining whether a standard threshold shift has occurred, allowance may be made for the contribution of aging (presbycusis) to the change in hearing level by correcting the annual audiogram according to the procedure described in Appendix F: *Calculation and Application of Age Correction to Audiograms.*

(h) Audiometric test requirements.

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

(2) Audiometric tests shall be conducted with audiometers (including microprocessor audiometers) that meet the specifications of, and are maintained and used in accordance with, American National Standard Specification for Audiometers, S3.6-1969.

(3) Pulsed-tone and self-recording audiometers, if used, shall meet the requirements specified in Appendix C: *Audiometric Measuring Instruments.*

(4) Audiometric examinations shall be administered in a room meeting the requirements listed in Appendix D: *Audiometric Test Rooms.*

(5) Audiometer calibration.

(i) The functional operation of the audiometer shall be checked before each day's use by testing a person with known, stable hearing thresholds, and by listening to the audiometer's output to make sure that the output is free from distorted or unwanted sounds. Deviations of 10 decibels or greater require an acoustic calibration.

(ii) Audiometer calibration shall be checked acoustically at least annually in accordance with Appendix E: *Acoustic Calibration of Audiometers.* Test frequencies below 500 Hz and above 6000 Hz may be omitted from this check. Deviations of 15 decibels or greater require an exhaustive calibration.

(iii) An exhaustive calibration shall be performed at least every two years in accordance with sections 4.1.2; 4.1.3.; 4.1.4.3; 4.2; 4.4.1; 4.4.2; 4.4.3; and 4.5 of the American National Standard Specification for Audiometers, S3.6–1969. Test frequencies below 500 Hz and above 6000 Hz may be omitted from this calibration.

(i) Hearing protectors.

(1) Employers shall make hearing protectors available to all employees exposed to an 8-hour time-weighted average of 85 decibels or greater at no cost to the employees. Hearing protectors shall be replaced as necessary.

(2) Employers shall ensure that hearing protectors are worn:

(i) By an employee who is required by paragraph (b)(1) of this section to wear personal protective equipment; and

(ii) By any employee who is exposed to an 8-hour time-weighted average of 85 decibels or greater, and who:

(a) Has not yet had a baseline audiogram established pursuant to paragraph (g)(5)(ii); or

(b) Has experienced a standard threshold shift.

(3) Employees shall be given the opportunity to select their hearing protectors from a variety of suitable hearing protectors provided by the employer.

(4) The employer shall provide training in the use and care of all hearing protectors provided to employees.

(5) The employer shall ensure proper initial fitting and supervise the correct use of all hearing protectors.

(j) Hearing protector attenuation.

(1) The employer shall evaluate hearing protector attenuation for the specific noise environments in which the protector will be used. The employer shall use one of the evaluation methods described in Appendix B: *Methods for Estimating the Adequacy of Hearing Protection Attenuation.*

(2) Hearing protectors must attenuate employee exposure at least to an 8-hour time-weighted average of 90 decibels as required by paragraph (b) of this section.

(3) For employees who have experienced a standard threshold shift, hearing protectors must attenuate employee exposure to an 8-hour time-weighted average of 85 decibels or below.

(4) The adequacy of hearing protector attenuation shall be re-evaluated whenever employee noise exposures increase to the extent that the hearing protectors provided may no longer provide adequate attenuation. The employee shall provide more effective hearing protectors where necessary.

(k) Training program.

(1) The employer shall institute a training program for all employees who are exposed to noise at or above an 8-hour time-weighted average of 85 decibels, and shall ensure employee participation in such program.

(2) The training program shall be repeated annually for each employee included in the hearing conservation program. Information provided in the training program shall be updated to

be consistent with changes in protective equipment and work processes.

(3) The employer shall ensure that each employee is informed of the following:

(i) The effects of noise on hearing;

(ii) The purpose of hearing protectors, the advantages, disadvantages, and attenuation of various types, and instructions on selection, fitting, use, and care; and

(iii) The purpose of audiometric testing, and an explanation of the test procedures.

(l) Access to information and training materials.

(1) The employer shall make available to affected employees or their representatives copies of this standard and shall also post a copy in the workplace.

(2) The employer shall provide to affected employees any informational materials pertaining to the standard that are supplied to the employer by the Assistant Secretary.

(3) The employer shall provide, upon request, all materials related to the employer's training and education program pertaining to this standard to the Assistant Secretary and the Director.

(m) Recordkeeping.

(1) **Exposure measurements.** The employer shall maintain an accurate record of all employee exposure measurements required by paragraph (d) of this section.

(2) **Audiometric tests.**

(i) The employer shall retain all employee audiometric test records obtained pursuant to paragraph (g) 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;

(d) Date of the last acoustic or exhaustive calibration of the audiometer; and

(e) Employee's most recent noise exposure assessment.

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

(3) **Record retention.** The employer shall retain records required in this paragraph (m) for at least the following periods.

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

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

(4) **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.

(5) **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 (m)(3) of this section.

(n) Appendices.

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

(2) Appendices F and G to this section are informational and are not intended to create any additional obligations not otherwise imposed or to detract from any existing obligations.

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