U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
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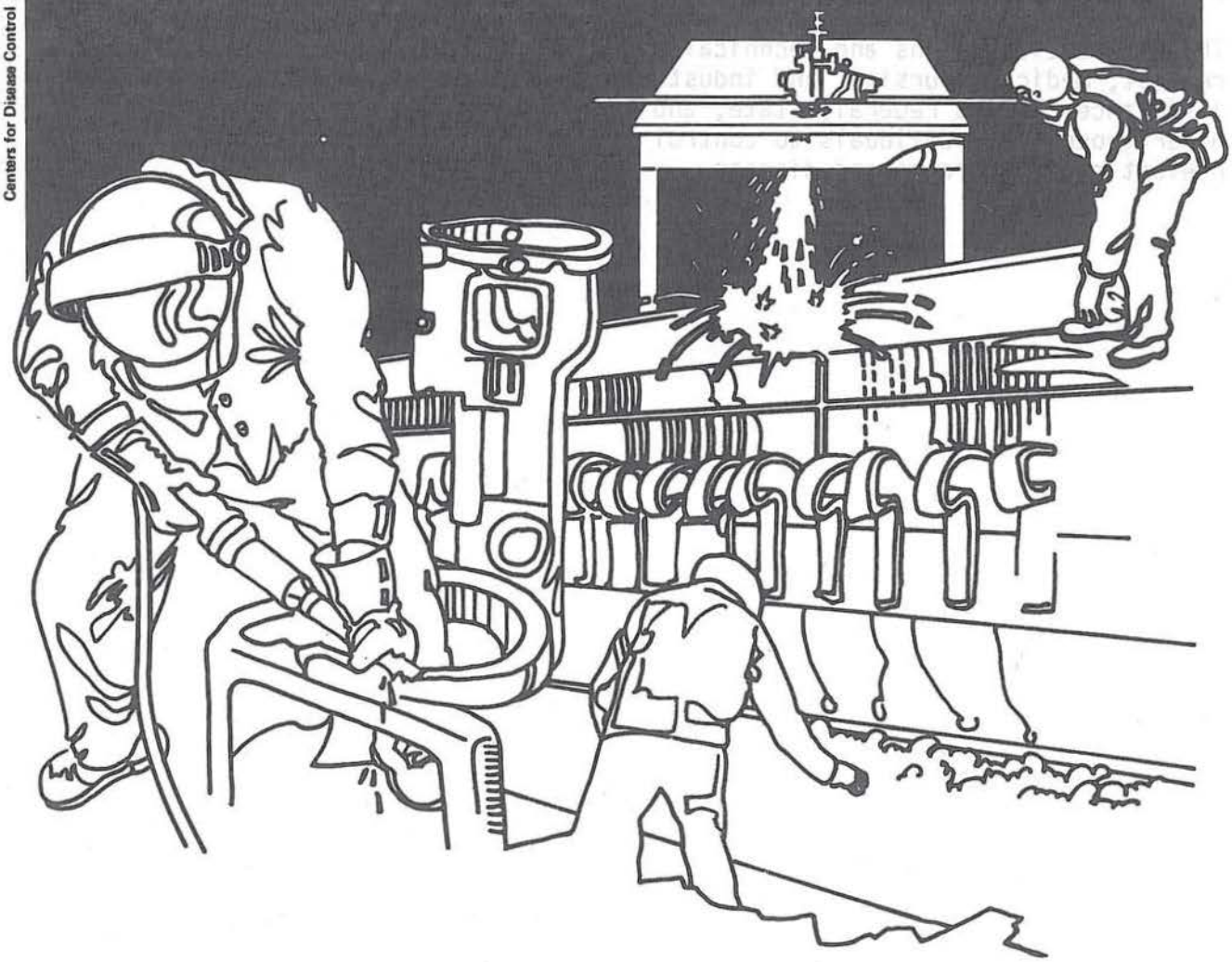
NIOSH



Health Hazard Evaluation Report

HETA 82-270-1238
DRIVE TRAIN INDUSTRIES, INC.
DENVER, COLORADO

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 82-270-1238
DECEMBER 1982
DRIVE TRAIN INDUSTRIES, INC.
DENVER, COLORADO

NIOSH INVESTIGATOR:
Paul Pryor, M.S., IH

I. SUMMARY

In May 1982 the National Institute for Occupational Safety and Health (NIOSH) received a request to conduct a health hazard evaluation at Drive Train Industries, Inc., Denver, Colorado. The company produces and refurbishes numerous parts and equipment for large motorized vehicles. The initial request concerned employee exposures to asbestos. During the walk through survey a representative of Drive Train, in addition to the asbestos concern, requested NIOSH to also evaluate potential exposures to sodium hydroxide, total welding fumes, nickel, manganese, copper, chromium (total), and noise found at various locations in the plant.

On August 12 and 24, 1982, NIOSH conducted industrial hygiene surveys to determine airborne concentrations of the contaminants listed above.

The maximum 8-hour time-weighted average (TWA) exposure concentration of asbestos measured in the operator's breathing zone (0.01 - 0.03 fibers > 5 um/cc) was less than two percent of the 2.0 fibers > 5 um/cc 8-hour TWA Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL). These results were also below NIOSH's asbestos criteria of 0.10 fibers > 5 um/cc. Personal samples for sodium hydroxide, total welding fumes, nickel, manganese, copper, and chromium (total) were also below their respective criteria and/or standards, i.e., 2.0 mg/M^3 (OSHA), 0.015 mg/M^3 (NIOSH), 5.0 mg/M^3 (OSHA), 0.1 mg/M^3 (OSHA), 5.0 mg/M^3 (ACGIH), 0.025 mg/M^3 respectively.

At the time of the August surveys, personal noise levels exceeding the NIOSH recommended limit of 85 dBA TWA were found in the machine shop. Peak noise levels for the various locations and jobs performed around the machine shop ranged from 80 to 101 dBA. Octave band frequency analysis of these locations showed levels ranging from 82-101 dBA with 80 percent of these readings falling within the 2000-4000 Hertz (Hz) range.

On the basis of the environmental data collected, NIOSH determined that a health hazard to asbestos, sodium hydroxide, total welding fumes, nickel, manganese, copper, and total chromium did not exist during the August 1982 surveys. NIOSH determined, however, that a potential health hazard from excessive noise levels existed to a portion of the workers evaluated in the machine shop. Based on consultation with management on the noise problem, Drive Train has begun a comprehensive hearing conservation program for the main employees exposed. Recommendations that can further assist in preventing hearing loss are included in this report.

KEYWORDS: SIC 3714 (Motor Vehicles and Motor Vehicle Equipment), brake drums, clutches, transmissions, drivelines, asbestos, noise, sodium hydroxide, nickel, manganese, copper, total welding fumes, total chromium, welding, hot dipping, driveline components.

II. INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH) received a request in May 1982 from a representative of the employees at Drive Train Industries, Inc., Denver, Colorado, to determine if there was a health hazard from asbestos during the reconditioning of truck brakes and clutches. During the initial phase of the investigation management requested NIOSH to evaluate three additional health concerns. These included contaminants from welding operations, e.g., nickel, manganese, copper, total welding fumes, and total chromium; sodium hydroxide from hot dipping operations; and noise from various operations in the machining of metals. Environmental surveys were conducted on August 12 and 24, 1982, to evaluate the potential exposures to these contaminants. The results were presented to the company with additional recommendations on September 29, 1982.

III. BACKGROUND

Drive Train Industries, Inc. remanufactures/rebuilds various truck parts including brakes, clutches, drivelines, transmissions, and other mechanical parts used in truck driveline systems. A large percentage of brakes and clutches, as well as a portion of the other products produced at Drive Train, are refurbished and/or relined with some asbestos material. In order to produce these parts, a variety of departments (shops) and operators are required.

Various departments/shops were evaluated by NIOSH which included the brake shop, driveline and clutch shop, transmission shop, tear down area, and machine shop. The normal processes for remanufacturing any part are typically similar. Basically, once the old core is received it is torn down and the parts are cleaned. The old core is machined and new parts are replaced as necessary.

The following is the specific information concerning each shop.

A. Brake Shop: The brake shop performs a variety of operations including tear down and stripping shoes from brakes, lathe operations, hot dip processes, and brake relining. There are a total of ten employees who work in this area and all were considered to be potentially exposed to asbestos.

B. Tear Down Area: The tear down area is specifically responsible for receiving parts and materials that will be dipped in hot solution. This solution is primarily water and sodium hydroxide. There are two operators who work in this area.

C. Driveline/Clutch Shop: This area is responsible for reconditioning drivelines and clutches and there are approximately 16-18 employees who work in these areas. A large percentage of the work performed here includes lathe, grinding, and welding operations. Each of the operators who work here can perform welding operations; however, NIOSH sampled those employees who routinely do welding.

D. Machine Shop: The machine shop performs a number of operations including refacing, lathe work, grinding, welding, boring and peenering. Peenering is a device which, once a weld is completed on a core, distributes or case hardens by impaction the area around the weld. This is an automatic device which is held in the operator's hand during the process and produces a high level of noise due to its pounding on the metal. Hearing protective devices were available; however, the company did not have a hearing conservation program prior to NIOSH's study.

Drive Train has been well aware of the potential for asbestos exposures to their employees for several years. Since 1977 they have had asbestos environmental monitoring and medical screening since 1981. The environmental monitoring has been performed annually by either Drive Train's insurance carrier or by a local laboratory. As environmental results dictated, Drive Train altered their process to reduce the asbestos exposures. This included increased local exhaust ventilation, housekeeping (using vacuum cleaners) and personal hygiene, i.e., eating and smoking outside the work area, education on personal hygiene, and uniforms for work only.

The medical evaluation for asbestos exposure is performed by a local medical clinic and is available to those employees working in the area where asbestos work is performed. The medical evaluation includes exposure history, physical examinations, pulmonary function tests, and chest X-rays. Drive Train also gives pre-employment physicals to those employees who would be working in areas where asbestos is handled.

Besides evaluating the local exhaust ventilation systems where asbestos is found, NIOSH also evaluated a welding room exhaust ventilation system in the Driveline/Clutch shop. This is a canopy hood type exhaust system which is approximately 96" L x 32" W and elevated approximately 45 inches above the welding table. The welding table is also approximately 96" L x 32" W and has a 24 inch high divider/partition extending down the center of the table and thus allows for welding on both sides.

IV. ENVIRONMENTAL DESIGN AND METHODS

A variety of sampling techniques were used to evaluate the suspected contaminants in the shop. Personal and area samples were taken on each of the employees and at the various locations described above. The following is a description of the techniques used:

A. Asbestos

Environmental breathing zone and general area air samples for asbestos were collected on AA filters (open faced) and counted on a phase contrast microscope (NIOSH Method P&CAM 239).

B. Sodium Hydroxide

Breathing zone and general area samples for sodium hydroxide were collected on AA filters and analyzed by atomic emission spectrophotometry (NIOSH Method No. S-381).

C. Welding Fumes

Breathing zone and general area samples for chromium (total), nickel, manganese, copper, and total welding fumes. Metal analysis was performed by atomic absorption spectroscopy (NIOSH Method P&CAM 173). Total weights were performed on an electrobalance and taking the difference in pre/post-tare weights.

D. Noise

Noise levels 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.

Noise levels and sound pressure levels were also evaluated around the work sites using a Bruel & Kjoer® (B&K) Precision Sound Level Meter equipped with an octave band analyzer.

V. EVALUATION CRITERIA AND TOXICOLOGY

A. Environmental

The three sources of criteria used to assess the workroom concentrations of asbestos were (1) the Occupational Safety and Health Administration (OSHA) standards (29 CFR 1910.1001); (2) the NIOSH criteria for a recommended standard; and (3) the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment (TLV) (1981).

Except for asbestos and noise which are discussed below, the environmental and medical (toxicological) evaluation criteria used for this investigation are presented in Table 1. Recommended environmental limits and general information concerning each substance are listed in this table, i.e., the source of the recommended limits, the present OSHA standard, and a brief description of the primary health effects known to date.

1. 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 (29 CFR 1910.95) specifies a maximum permissible noise exposure level of 90 dBA 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 below:

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*	---
	---	140 dB**

* No exposure to continuous noise above 115 dBA.

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

When workers are exposed to sound levels exceeding the OSHA standard, feasible 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 85 dB, the amendment will require noise exposure monitoring, employee education, and audiometric testing. Review of audiograms have 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.

B. Toxicological

1. Asbestos

NIOSH recommends that occupational exposure to asbestos be controlled so that workers are not exposed to a workroom air concentration for an 8-hour time-weighted average (TWA) exposure of 0.10 fibers per cubic centimeter greater than 5 microns in length and 0.5 fibers per cubic centimeter greater than 5 microns in length for a 15-minute Ceiling. The U.S. Department of Labor/Occupational Safety and Health Administration (OSHA) standard for asbestos for an 8-hour (TWA) exposure is 2 fibers per cubic centimeter greater than 5 microns in length, and a Ceiling concentration of 10 fibers per cubic centimeter greater than 5 microns in length. The American Conference of Governmental Industrial Hygienists (ACGIH) TLV is 0.20 fibers per cubic centimeter greater than 5 microns in length.

Asbestos is a generic term applied to a number of hydrated mineral silicates, including chrysotile, amosite, crocidolite, tremolite, and anthophyllite. Asbestos consists of fibers of varying size, color, and texture. The uses of asbestos are numerous and include thermal and electrical insulation, fire blankets, safety garments, filler for plastics, and roofing materials. The most toxic route of entry is inhalation.

The most widely recognized disease caused by asbestos is asbestosis, followed by cancer of the lungs and digestive tract, and mesothelioma.

Asbestosis is a lung disorder characterized by a diffuse interstitial fibrosis, including pleural changes of fibrosis and calcification. Asbestos bodies may be found in the sputum, and the worker exhibits restrictive pulmonary function. Along with the clinical changes a worker may have fine rales, finger clubbing, dyspnea, dry cough, and cyanosis.

Bronchogenic carcinoma and mesothelioma of the pleura and peritoneum are also caused by asbestos exposure. Excesses of cancer of the stomach, colon, and rectum have been found among asbestos workers.

The NIOSH recommendation and the TLV of 0.20 fibers/cubic centimeters greater than 5 microns in length were established to protect against asbestosis and reduce to an acceptably low risk the development of neoplasms.

Medical monitoring of asbestos workers should include preplacement and annual physical examinations with emphasis on the pulmonary system.

2. Noise

Noise, commonly defined as unwanted sound, covers the frequency range of sound which is implicated in harmful effects (4000-6000 Hz). Noise can be classified into many different types, including wide-band noise, narrowband noise, and impulse noise. To describe the spectrum of a noise the audible frequency range is usually divided into eight frequency bands, each one-octave wide, and sound pressure level (SPL) measurements are made in each band using a special sound level meter. A wide-band noise is one where the acoustical energy is distributed over a large range of frequencies. Examples of wide-band noise can be found in the weaving room of a textile mill and in jet aircraft operations.

Exposure to intense noise causes hearing losses which may be temporary, permanent, or a combination of the two. These impairments are reflected by elevated thresholds of audibility for discrete frequency sounds, with the increase in dB required

to hear such sounds being used as a measure of the loss. Temporary hearing losses, also called auditory fatigue, represent threshold losses which are recoverable after a period of time away from the noise. Such losses may occur after only a few minutes of exposure to intense noise. With prolonged and repeated exposures (months or years) to the same noise level, there may be only partial recovery of the threshold losses, the residual loss being indicative of a developing permanent hearing impairment.

Temporary hearing impairment has been extensively studied in relation to various conditions of noise exposure. Typical industrial noise exposures produce the largest temporary hearing losses at test frequencies of 4,000 and 6,000 Hertz (Hz).

The actual pattern of loss depends upon the spectrum of the noise itself. The greatest portion of the loss occurs within the first two hours of exposure. Recovery from such losses is greatest within one or two hours after exposure.

The amount of temporary hearing loss from a given amount of noise varies considerably from individual to individual. For example, losses at a given frequency due to noise intensities of 100 dBA may range from 0 to more than 30 dB.

Low frequency noise, below 300 Hz, must be considerably more intense than middle or high frequency noise to produce significant threshold losses.

Considerably fewer temporary hearing losses result from intermittent than from continuous noise exposure, even though the total amount of noise exposure is the same in both instances.

Physiologic reactions to a noise of sudden onset represent a typical startle pattern. There is a rise in blood pressure, an increase in sweating, an increase in heart rate, changes in breathing, and sharp contractions of the muscles over the whole body. These changes are often regarded as an emergency reaction of the body, increasing the effectiveness of any muscular exertion which may be required. However desirable in emergencies, these changes are not desirable for long periods since they could interfere with other necessary activities. Fortunately, these physiologic reactions subside with repeated presentations of the noise.

For performance on a task to remain unimpaired by noise, man must exert greater effort than would be necessary under quiet conditions. When measures of energy expenditure--for example, oxygen consumption and heart rate--are made during the early stages of work under noisy conditions they show variations which are indicative of increased effort. Measurements in later stages under continued exposure, however, show responses return to their normal level.

VI. ENVIRONMENTAL RESULTS AND DISCUSSION

Employee exposures to suspected airborne exposures from asbestos, noise, sodium hydroxide, welding fumes (i.e., chromium, nickel, copper, manganese) were evaluated. The following are the results of NIOSH's evaluation.

1. Asbestos

The results received for asbestos are listed in Table 2. A total of five personal samples were taken (range non-detectable to 0.03 fibers > 5 um/cc) and four area type samples (range non-detectable to 0.01 fibers > 5 um/cc). All of these samples were below the NIOSH 0.10 fibers > 5 um/cc criteria established for this investigation. Therefore, no employee was exposed to airborne levels of asbestos during our investigation that exceeded the standard or criteria referenced.

2. Noise

A total of five personal noise samples (two welders, miller operator, lathe operator, and a horizontal boring operator) and numerous area noise level measurements were taken during the survey period. Four of the five noise levels exceeded the NIOSH criteria of 85 dBA (refer to Table 3).

The peak area noise level measurements taken ranged from 89-101 dBA. These were found in and around the areas where the employees work. The octave band analyses indicated that the noise produced in these areas ranged from 82 to 101 Hertz in the 2000-6000 frequency range (refer to Table 4). This is the range which has the greatest physiological impairment to hearing in man.

These results indicate that a noise problem did exist to the employees working in the machine shop during NIOSH's investigation.

3. Sodium Hydroxide

A total of three samples, one personal and two area samples, were taken for sodium hydroxide. Each of the samples was well below the 2 mg/M^3 criteria used in the study (refer to Table 5).

4. Welding Fumes

A total of six area samples and two personal air samples were collected for analysis of chromium (total), nickel, manganese, copper, and total welding fumes. Except for one area sample all the other personal and area samples were well below their respective criteria and/or standards. The one area sample taken in the welding booth exceeded the NIOSH criteria for nickel (0.59 versus 0.015 mg/M^3 criteria) and ACGIH total welding fumes (6.4 versus 5.0 mg/M^3 criteria). (Refer to Table 6.) This area samples reflects only a potential for personal exposures.

However, it was determined that the canopy exhaust hood in the welding booth was ineffective in its ability to exhaust the welding fumes from either welding table. The exhaust flow rates ranged between 15-30 feet per minute at both tables which is far less than is required to remove the contaminant.

VII. CONCLUSIONS

NIOSH concluded that a health hazard did not exist to the employees evaluated for asbestos at the time of the NIOSH study. This was also true for those employees evaluated for sodium hydroxide and the welding contaminants evaluated at Drive Train.

A potential health hazard did exist, however, to a portion of those employees NIOSH evaluated for noise exposures. These exposures existed to the welders, miller, and lathe operators in the machine shop department. Unless engineering controls to reduce the noise levels detected in this work environment can be established, these employees should be evaluated for hearing loss and given personal protective devices to reduce their exposures. (Refer to next section.)

VIII. RECOMMENDATIONS

In view of the findings of NIOSH's environmental study, as well as personal communications with individuals at Drive Train Industries, Inc., the following recommendations are made to assist in providing a better work environment for the concerned employees:

A. Asbestos

The program designed by Drive Train to protect the employees from asbestos exposure should be maintained and continued in order to further reduce the overall asbestos exposures to the employees who work around this contaminant. Therefore, Drive Train should continue both its medical and environmental prevention program as described earlier.

B. Noise

1. Engineering Controls

Whenever possible, engineering controls are the preferred technique for reducing occupational health exposures. In the case of noise exposures the ideal steps would be engineering out the noise source via acoustical and/or noise dampering techniques. Another procedure would be isolation, i.e., removing the noise source from as many employees as possible and installing engineering controls as well as personal protection for the remaining employees who must perform the task in question. Finally, administrative controls could, in this case, reduce the TWA noise exposure to those employees not directly involved in the peenering operation. This would require each employee whose noise level exceeded the 85 dBA value to take their breaks in areas where the noise sources were substantially below those measured in the machine shops. These removal/rest periods should then reduce their TWA exposure levels below the 85 dBA level.

2. Hearing Protection

A hearing protection program should be developed and rigidly enforced for those employees who must be exposed to excessive levels of noise. The following are recommendations which should be included in the program:

a. Pre-employment hearing examinations should be given to perspective employees who would be performing the type of jobs evaluated in this survey.

b. Audiometric testing should be performed yearly. If the worker has any significant threshold shifts, the hearing protection program should be re-evaluated for the employee in question.

c. Noise monitoring should be performed routinely to help supplement the hearing protection program. This information will then identify for management and the employees work areas that are most hazardous. Also, those areas which are considered high noise areas should be posted accordingly.

d. To insure that full personal protection is being provided during those periods of exposure the Environmental Protection Agency's Noise Reduction Ratings (NRR) should be consulted and understood when selecting hearing protection in order to provide the most effective device. Each protective device (ear plugs or muffs) has a NRR rating which, for that particular type and model, describes what percent of noise attenuation may be obtained when using a particular device. However, these ratings can be misunderstood, i.e., suppose a muff (X) has good attenuation at all frequencies except at 4000 Hertz where it has excellent attenuation and its overall NRR rating is 23. Another muff (Y) has great attenuation at all frequencies except 4000 where its attenuation is poor and its overall NRR rating is 26. Therefore, if one only knew that the higher the NRR the better the protection, it would be misleading if the greatest intensity noise in their workplace was at 4000 Hertz and they were using muff Y rather than muff X.

e. An educational program to instruct new employees on the hazards of noise exposures should be implemented, as well as an annual review of noise hazards for all concerned employees should also be implemented if it has not been already.

C. Other

The overhead exhaust ventilation hood located in the welding booth is inefficient in adequately exhausting the welding fumes. Therefore, a slot type exhaust hood, which can be positioned directly adjacent to the work site, should be designed for both sides of the welding table. References regarding the proper hood

design were given to the company by Commercial Union Assurance Company's report which addressed this concern. A capture velocity of 100 feet per minute (fpm) should be the minimum level for each of these noods, i.e., the velocity/flow of air exhausted at or near the point of fume generation.

IX. REFERENCES

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X. AUTHORSHIP AND ACKNOWLEDGMENTS

Report Prepared By:

Paul Pryor, M.S.
Industrial Hygienist
NIOSH - Region VIII
Denver, Colorado

Evaluation Assistance:

Bobby J. Gunter, Ph.D.
Regional Industrial Hygienist
NIOSH - Region VIII
Denver, Colorado

Marilyn K. Schulenberg
Occupational Health Technician
NIOSH - Region VIII
Denver, Colorado

Originating Office:

Hazard Evaluation and Technical Assistance Branch (HETAB)
Division of Surveillance, Hazard Evaluations, and Field Studies (DSHEFS)
NIOSH - Cincinnati, Ohio

Report Typed By:

Marilyn K. Schulenberg
Occupational Health Technician
NIOSH - Region VIII
Denver, Colorado

XI. 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. Requestor.
2. Drive Train Industries, Inc.
3. U.S. Department of Labor/OSHA - Region VIII.
4. NIOSH - Region VIII.
5. Colorado Department of Health.
6. 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 employees for a period of 30 calendar days.

TABLE 1

EVALUATION CRITERIA AND TOXICOLOGY

Drive Train Industries, Inc.
Denver, Colorado

Substance	Recommended Environmental Limit[A]	Reference Source	Primary Health Effects	OSHA Standard
Total Chromium	0.5 mg/M^3	ACGIH[B]	Histologic fibrosis of lungs.	1 mg/M^3
Manganese	(C) 5 mg/M^3	ACGIH	Nervous disorder; loss of strength; metal fume fever; dry throat.	5 mg/M^3
Nickel	0.015 mg/M^3 10 hour TWA	NIOSH	Dermatological irritation; lung cancer; allergic asthma.	1 mg/M^3
Copper	1 mg/M^3	ACGIH	Irritation of mucous membrane, pharynx; nasal ulceration performation; eye irritation	1 mg/M^3
Welding Fumes	5 mg/M^3	ACGIH	ACGIH recommends evaluation of symptoms associated with each metal present in welding operation (refer to above).	----

[A] All air concentrations are expressed as time-weighted average (TWA) exposures for up to a 10 hour workday unless designated (C) for Ceiling which should not be exceeded.
[B] ACGIH = American Conference of Governmental Industrial Hygienists.
mg/M^3 = Approximate milligrams of substance per cubic meter of air.
(C) = Ceiling level which should not to be exceeded even instantaneously.

TABLE 2

Summary of Personal and Area Air Samples for Asbestos

Drive Train Industries, Inc.
Denver, Colorado

August 1982

Job/Area Description	Sampling Time (minutes)	Asbestos (fibers > 5 um/cc)*
Hot Dip Area	420	ND
Lathe Operator	420	0.02
Air Punch Area	420	0.01
Tear Down Operator	420	0.01
Reline Area	420	ND
Stripping Machine Area	420	ND
Brake Reliner	420	0.01
Lathe Man	420	ND
Labor--All Over	420	0.03

EVALUATION CRITERIA: OSHA -- 2.0 fibers > 5 um/cc
ACGIH -- 2.0 fibers > 5 um/cc
NIOSH -- 0.10 fibers > 5 um/cc

**LABORATORY LIMIT OF DETECTION: 0.03 fibers per field or 4500 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.

TABLE 3

Noise Dosimeter Levels

Drive Train Industries, Inc.
Denver, Colorado

August 1982

Job/Task Description	Sampling Time (hours)	8-Hour TWA Noise (dBA)
Personal Samples		
Welder/Grinder Operator	7	91*
Welder	7	86*
Miller Operator	7	85*
Lathe Operator	7	85*
Horizontal Boring Operator	7	82

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

* Noise Levels which exceeded NIOSH criteria or OSHA standard.

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

TABLE 4

Octave Band Sound-Pressure Levels

Drive Train Industries, Inc.
Denver, Colorado

August 1982

Job/Task Description	(dBA) Network	(dB) Octave Bank Center Frequencies (Hz) 1000	2000*	4000*	8000*	16000
Welder/Grinder Operator	101	98	94	101	103	92
Welder	95	91	88	94	96	82
Miller Operator	92	88	87	87	92	86
Lathe Operator	89	84	82	88	84	72
Horizontal Boring Operator	92	82	82	88	83	77

Hz = Frequency

* = 2000-6000 Hz is that range which has the greatest physiological impairment to hearing in man.

TABLE 5

Summary of Personal and Area Samples for Sodium Hydroxide

Drive Train Industries, Inc.
Denver, Colorado

August 1982

Job/Area Description	Sampling Time (minutes)		mg/M^3 Sodium Hydroxide
Tear Down Operator	420		0.02
Tear Down Area	420		ND
Hot Dip Tank	420		0.02
EVALUATION CRITERIA		OSHA NIOSH	2.0 mg/M^3 2.0 mg/M^3
LABORATORY LIMIT OF DETECTION			0.007 mg

mg/m^3 = milligrams of substance per cubic meter of air
ND = Non-detectable
mg = milligrams

TABLE 6

Summary of Personal and Area Air Samples for
Chromium, Nickel, Manganese, Copper, and Total Welding Fumes

Drive Train Industries, Inc.
Denver, Colorado

August 1982

Job/Area Description	Sampling Time (minutes)	mg/M^3				
		Chromium (total)	Nickel	Manganese	Copper	Welding Fumes (total)
Welder-Machine Shop	630	ND	0.006	ND	0.01	1.2
Mechanic	630	ND	ND	ND	ND	0.13
Machine Shop - Area	630	ND	0.59*	ND	0.005	6.4*
Mechanic	630	ND	ND	ND	ND	0.13
Welder-Clutch Shop	630	ND	0.006	ND	0.003	1.0
Welder-Clutch Shop	630	ND	0.005	0.003	0.005	ND
Welding Booth - Driveline	630	ND	0.006	ND	ND	1.2
Welding Booth - Driveline	630	ND	0.003	0.003	ND	2.3
EVALUATION CRITERIA	OSHA	1.0	1.0	5.0	0.1	---
	NIOSH	0.025	0.015	---	---	---
	ACGIH	---	---	---	0.2	5.0
LABORATORY LIMIT OF DETECTION mg/sample 0.001			.005	0.003	0.001	0.002

* = Exceeded the American Conference of Govermental Industrial Hygienist (ACGIH) and/or NIOSH criteria; however, this was not a personal sample.
mg/m^3 = milligrams of substance per cubic meter of air
ND = Non-detectable
mg = milligrams

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