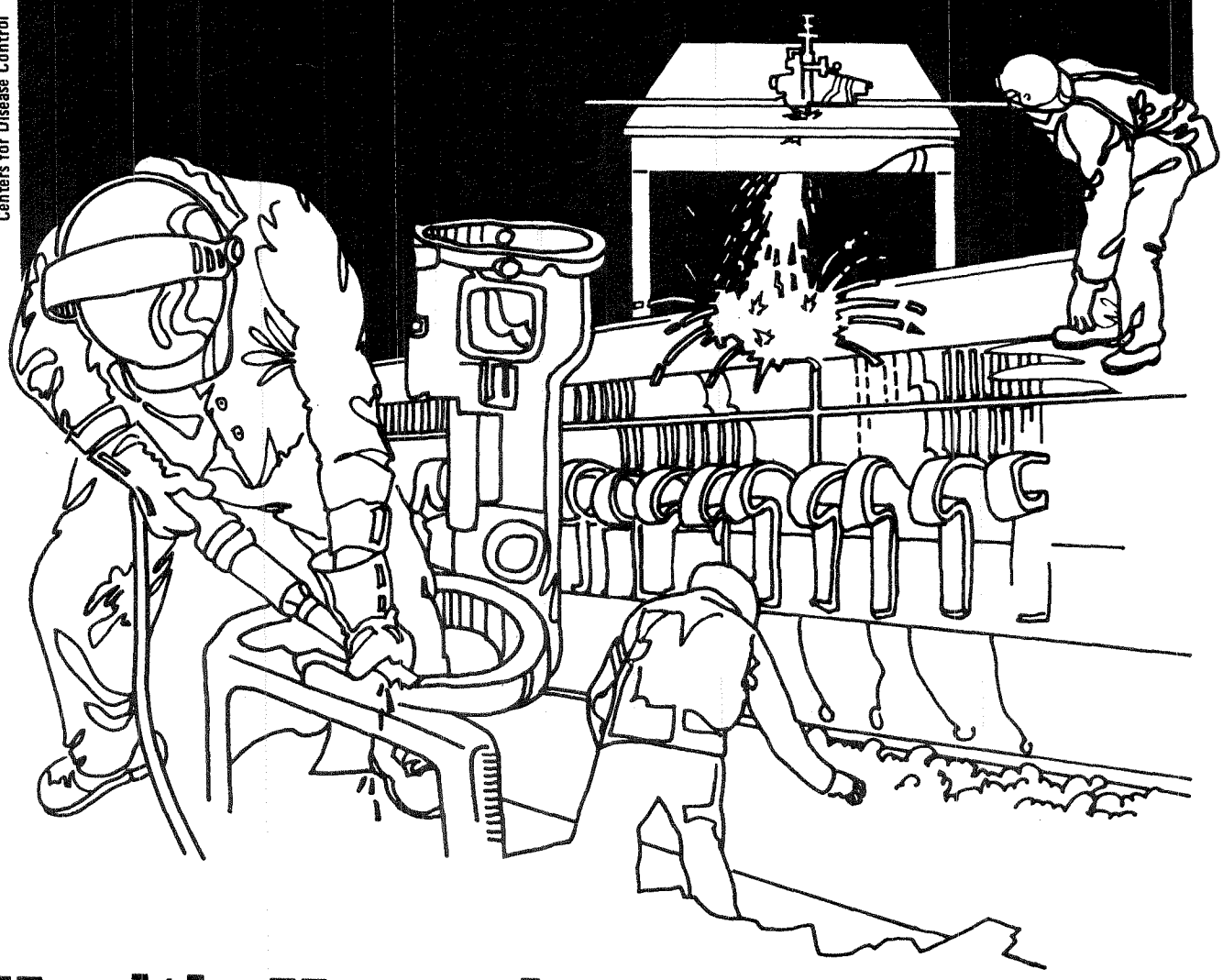
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health

NIOSH



Health Hazard Evaluation Report

HHE 80-198-824
CF&I STEEL CORPORATION
PUEBLO, 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. 699(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.

HE 80-198-824
FEBRUARY 1981
CF&I STEEL CORPORATION
PUEBLO, COLORADO

NIOSH INVESTIGATORS:
Bobby J. Gunter, Ph.D., IH
Jerome P. Flesch, IH

I. SUMMARY

In May 1980 the National Institute for Occupational Safety and Health (NIOSH) received a request from the United Steel Workers of America Local 2102, Pueblo, Colorado, to evaluate occupational exposure to noise in the wire mill nail room at CF&I Steel Corporation, Pueblo, Colorado.

The environmental investigation consisted of direct reading and 8-Hour Time-Weighted Average (TWA) noise measurements. When measuring intense noises, the A-weighting feature is used since it simulates the response to the human ear and is referred to as dBA. Measurements were made at the worker's hearing zone (close to the ear). Noise-frequency distribution (octave band analyses) and peak noise levels were also measured at 12 nail machines, an aisle way, and the scale room.

At the time of this survey noise levels exceeding the NIOSH recommended limit of 85 dBA, 8-hour TWA were found throughout the wire mill nail room. Eight-hour averages ranged from 86 for the scale operator to 105 dBA for the six nail operators which were monitored. Peak levels for the nail machines ranged from 115 to 132 dB. Excessive noise was found to be distributed over a wide frequency range from 250 to 4000 Hertz (Hz).

All workers were wearing ear plugs for hearing protection. This was rigidly enforced by management. Audiometric testing has been instituted by CF&I Steel. The first series of testing was performed just prior to our evaluation. These measurements, as well as noise level measurements, are given to the exposed workers.

On the basis of environmental data, NIOSH determined that a health hazard from excessive noise levels in the wire mill nail room did exist at CF&I Steel Corporation at the time of this survey. Plant management is developing an adequate hearing conservation program. It would be impossible to engineer the noise to an acceptable level without isolation of the workers from the nail machines. Recommendations that may assist in preventing hearing loss are included on Page 5.

KEYWORDS: SIC 3312 (Blast Furnaces, Steel Works, and Rolling Mills), noise, audiometric testing, nail manufacturing.

II. INTRODUCTION

NIOSH received a request in May 1980 from the United Steel Workers of America Local 2102, Pueblo, Colorado, to determine if there was a health hazard from high noise levels from the manufacture of nails at CF&I Steel Corporation, Pueblo, Colorado. An environmental survey was conducted on October 22, 1980. Environmental data was discussed with workers and plant management at the closing conference.

III. BACKGROUND

The wire mill nail room at CF&I Steel produces a variety of nails in sizes ranging from two inches to one foot in length. These nails are made by machines which chop large spools of wire into finished nails. CF&I Steel has engineered numerous sound control devices, such as padding underneath the nail machines and purchasing new machines. However, it would be impossible to engineer the noise to an acceptable level. The only means of worker protection other than adequate hearing protection would be administrative controls or removal from exposure.

IV. ENVIRONMENTAL METHODS AND MATERIALS

Sound pressure levels were taken with a Bruel & Kjaer (B&K) Precision Sound Level Meter equipped with an octave band analyzer. Eight-hour TWA with peak levels were made with a Metrosonics Noise Dosimeter with read-out unit and calibrator.

V. EVALUATION CRITERIA

A. Environmental

The two criteria used to assess the employee noise exposure were the NIOSH criteria for a recommended standard and the Occupational Safety and Health Administration (OSHA) Standard (29 CFR 1910.95), January 1981.

NIOSH Recommended Standard

85 dBA for an 8-hour Time-Weighted Average (TWA).

OSHA Standard

A-weighted sound level (decibel)	Reference duration (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

A-weighted sound level (decibel)	Reference duration (hour)
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
140 dB peak SPL	impact

Occupational health standards are established at levels designed to protect individuals occupationally exposed to toxic substances on an 8-hour per day, 40-hour per week basis over a normal working lifetime.

B. Toxicological

Noise, commonly defined as unwanted sound, covers the range of sound which is implicated in harmful effects. Noise can be classified into many different types, including wide-band noise, narrow-band 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.

Narrow-band noises with most of their energy confined to a narrow range of frequencies, normally produce a definite pitch sensation. For a true narrow-band noise, only a single octave band will contain a significant SPL. The noise caused by a circular saw, planer, or other power cutting tools is occasionally of the narrow-band type, but usually there is some spreading of the acoustic energy to several of the octave bands.

The impulse type of noise consists of transient pulses, occurring in repetitive or non-repetitive fashion. The operation of a rivet gun or a pneumatic hammer usually produces repetitive impulse noise. The firing of a gun is an example of non-repetitive impulse noise.

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

Results of environmental measurements show that all workers were overexposed to noise. Eight-hour averages ranged from 86 dBA to 105 dBA. Peak levels ranged from 115 to 132 dB. Results may be reviewed in Tables 1 and 2.

VII. DISCUSSION AND CONCLUSIONS

A health hazard did exist at this work place at the time of this evaluation. This conclusion is based on the excessive TWA noise levels.

Management was providing ear plugs for hearing protection. The adequacy of this hearing protection can be determined by reviewing the periodic (once a year) audiometric testing performed by the audiometric consultant. All workers were wearing hearing protection during this evaluation.

VIII. RECOMMENDATIONS

1. The hearing protection program should be continued and rigidly enforced.

2. Audiometric testing should be performed yearly. If the worker has any permanent threshold shifts, the hearing protection program should be re-evaluated.

IX. REFERENCES

1. Occupational Diseases - A Guide to Their Recognition, Revised Edition. U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, Publication No. 77-181, June 1977, pp. 510-513.

X. AUTHORSHIP AND ACKNOWLEDGMENTS

Report Prepared By:

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

Jerome P. Flesch
Assistant Chief
Hazard Evaluation and Technical Assistance Branch (HETAB)
Division of Surveillance, Hazard Evaluations, and Field Studies (DSHEFS)
NIOSH, Cincinnati, Ohio

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
NIOSH - Region VIII
Denver, Colorado

XI. DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available upon request from NIOSH, Division of Technical Service, 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. CF&I Steel Corporation.
2. United Steel Workers of America, Local 2102.
3. United Steel Workers of America.
4. U.S. Department of Labor/OSHA - Region VIII.
5. NIOSH - Region VIII.
6. Colorado Department of Health.
7. 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

Time Weighted Average (TWA) Sound Levels (dBA) in the Nail Room

CF&I Steel Corporation
Pueblo, Colorado

October 22, 1980

Job/Set	Sample Duration	TWA dBA	One-Minute Max. dBA
Nail Operator Helper/2	7 hours, 40 minutes	102	107
Nail Operator/6	7 hours, 43 minutes	101	107
Nail Operator Helper/4	7 hours, 43 minutes	105	109
Nail Operator/5	7 hours, 42 minutes	102	116
Nail Operator/1	7 hours, 50 minutes	103	109
Scale Operator	7 hours, 35 minutes	86	105
Nail Operator/12	7 hours, 28 minutes	105	110
	NIOSH RECOMMENDED STANDARD	85 dBA, 8-hour TWA	
	OSHA STANDARD	90	

TABLE 2

Direct Reading Noise Measurement Levels (dB) at Different Frequencies (Octave Band Analyses) on the Nail Making Machines

CF&I Steel Corporation
Pueblo, Colorado

October 22, 1980

	LOCATION						
Frequency	Set 5	Set 17	Set 6	Set 6	Set 1	Scale House	Set 2
A-weighted	103	106-107	112	108-109	112-113	80-81	107-108
31.5 (Hz)	85-86	86-88	88-90	86-87	86-87	80-82	86-87
63	85-86	88-89	94-96	92-94	93-94	80-82	88-89
125	90-92	92-94	96-98	93-94	100-101	80-82	94-95
250	95-96	95-96	102-104	101-103	106-107	80-82	98-99
500	98-99	98-99	105-107	102-103	107-108	80-82	102-103
1000	98-99	101-102	101-103	104-105	108-109	80-82	103-104
2000	96-97	101-102	107-108	101-102	106-107	80-82	101-102
4000	94-96	100-101	100-101	92-93	102-013	80-82	98-99
8000	94-95	99-100	94-95	84-85	95-96	80-82	90-91
16000	92-94	92-94	82-84	75-76	85-86	80-82	82-83
31500	78-80	79-80	71-72	62-64	73-74	80-82	69-7[illegible]
Linear	105-106	106-108	112-113	108-109	114-115	80-82	108-1[illegible]
Peak dB(impact)	120	119	128	124	131	82	126

	LOCATION						
Frequency	Set 12	Set 16	Aisle	Set 19	Set 4	Set 3	Set 1
A-weighted	109-110	109-110	102-103	102-103	112-113	104-105	105-106
31.5 (Hz)	86-87	85-86	84-85	82-84	85-86	85-86	92-93
63	87-88	88-89	88-89	85-86	89-90	87-88	94-95
125	93-94	96-97	92-93	92-93	95-96	91-93	96-97
250	97-98	98-99	94-95	97-98	102-103	95-96	100-101
500	104-105	103-104	97-98	98-99	105-106	99-100	102-103
1000	106-107	105-106	98-99	101-102	108-109	101-102	100-101
2000	105-106	102-104	95-96	97-98	108-109	99-100	99-100
4000	101-102	98-99	91-92	91-92	106-107	95-96	95-96
8000	96-97	95-96	83-84	87-88	96-97	90-91	87-88
16000	89-90	88-89	73-74	78-79	86-88	79-80	75-76
31500	75-76	73-74	60-61	65-66	76-77	68-69	64-65
Linear	110-111	111-112	103-104	105-106	113-114	106-107	107-108
Peak dB(impact)	126	125	115	121	132	127	124

DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
CENTERS FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
ROBERT A. TAFT LABORATORIES
4676 COLUMBIA PARKWAY, CINCINNATI, OHIO 45226

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE. $300

Third Class Mail

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF HHS
HHS 396

☆ U.S. GOVERNMENT PRINTING OFFICE: 1981-757-010/24