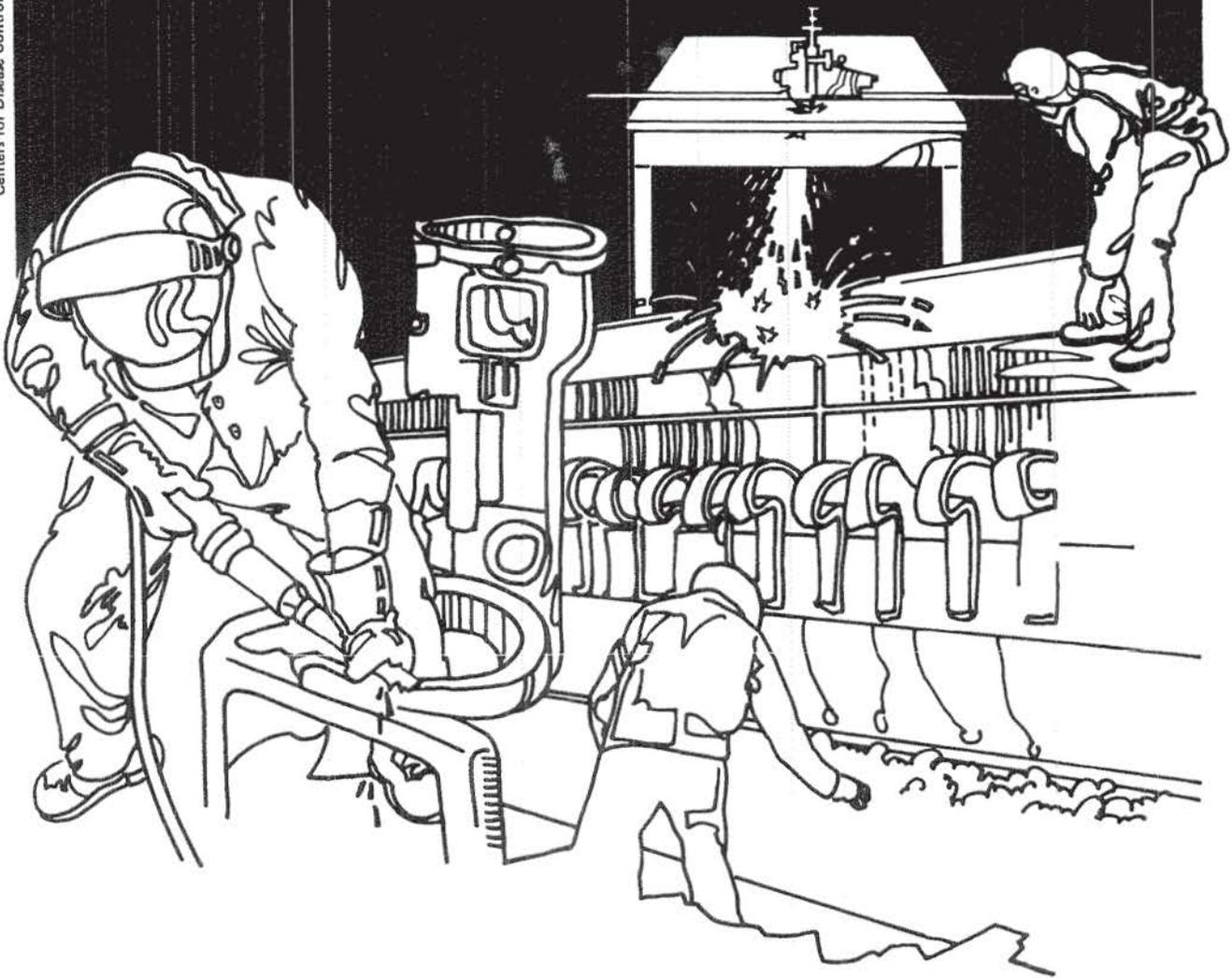


NIOSH



Health Hazard Evaluation Report

HHE 80-164-943
GOLDEN GATE BRIDGE DISTRICT
SAN FRANCISCO, CALIFORNIA

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.

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

I. SUMMARY

On June 4, 1981, the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation from a representative of the International Brotherhood of Painters and Allied Trades, Painters Local Union #4, San Francisco, California. The requestor was concerned that the painters were exposed to high levels of lead, crystalline silica, and noise during sandblasting operations on the Golden Gate Bridge.

NIOSH conducted an initial survey on June 20, 1981, in order to observe the work practices. On August 6, 1980 and August 16, 1980, follow-up medical surveys were conducted for blood lead levels and lung function tests. Since workers were required to wear supplied-air respirators with full hoods (helmets) and previous environmental data was available, an environmental survey was not conducted. Air lead levels outside the sandblasters' hoods were approximately 100 times the OSHA standard of 0.05 mg/m³. Exposures to lead and silica occurred when sandblasters removed the lenses from the hoods and replaced them with new ones. The facepiece-to-face seal is broken during this procedure. Several sandblasters work in the same area, and work continues during the lens replacements. The Golden Gate Bridge District was ordering new hoods with a double lens system which leaves the seal intact. Since the new hoods would correct any environmental exposures, the medical survey was judged to be sufficient for this health hazard evaluation.

Blood lead levels were analyzed for 28 workers. All of the levels were less than 40 ug/dl (micrograms per deciliter), the NIOSH recommended limit for occupationally exposed workers. Fifty percent of the levels were greater than 20 ug/dl, indicating that the workers are moderately exposed to lead using the current methods of control. Lung function tests and chest x-rays were performed on 30 and 29 workers respectively. No restrictive disease was found on spirometry (lung function tests), and the four cases of mild obstructive disease that were discovered were found to have normal chest x-rays. Of the 29 x-rays, there were four abnormal (separate from the lung function test cases), but none were indicative of silica-related disease.

The NIOSH medical staff reviewed an audiometric screening performed by a local hospital clinic during the time of this evaluation and the hearing protection program as administered by the Golden Gate Bridge District. A substantial amount (38%) of occupational hearing loss was reported, and recommendations were made for annual audiometric tests and complete ear examinations prior to fitting the currently used ear plugs.

Based on the medical examinations conducted by NIOSH, there was no lead or silica-related disease among the workers. Existing environmental data indicated that the current procedure of changing supplied-air hood lenses in the dust plume generated by sandblasting may expose workers to high levels of lead and crystalline silica for short time periods. Suggested medical tests and safer hoods were recommended. A significant amount of occupational hearing loss was reported, and recommendations on a hearing conservation program were made.

KEYWORDS: SIC 1721 (Bridge Painting Contractors), lead, crystalline silica, noise, hearing loss, sandblasters

II. INTRODUCTION

On June 4, 1980 the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation from an authorized union representative of the International Brotherhood of Painters and Allied Trades (Painters Local Union #4) in San Francisco, California. The requestor was concerned about the adverse effects to its members from abrasive blasting of the lead-based paint on the Golden Gate Bridge. Areas of concern for the requestor were exposures to lead, crystalline silica and noise.

NIOSH conducted an opening conference and an initial survey on June 20, 1980 to observe general operations. In the opening conference, NIOSH agreed to conduct medical evaluations for lead and silica exposures and to review existing information on noise exposures and environmental lead and silica data.

On August 6, 1980, a follow-up medical survey was conducted and blood was drawn from the Golden Gate Bridge painters for blood lead analysis. On August 16, 1980, a follow-up medical survey for lung function was conducted on the employees. A follow-up environmental survey was not conducted since the Golden Gate Bridge District had budgeted money to replace all abrasive blasting air-supplied respirator hoods during 1981. The new hoods should correct the exposures to airborne lead and silica since the facepiece-to-face seal will remain intact during the sandblasting operations.

III. BACKGROUND

The Golden Gate Bridge District is in the middle of an approximate 12-14 year project to remove the old lead-based paint from the bridge and to repaint it with paint which is virtually lead-free. The project has been in progress for about seven years and is expected to continue for 5-7 more years. Approximately, 30 employees are involved in the sandblasting and painting operation. A full shift runs about 6½ hours on the bridge. Up to five sandblasters may work on one scaffold. Exposures to lead and silica occur when a sandblaster has to change the facepiece (lens) on his hood or helmet. It requires less than a minute to change the lens but the worker is exposed to any ambient lead and silica since the other sandblasters do not stop working. Lenses can be changed every 10 minutes if they have become pitted quickly. If the facepiece-to-face seal is not broken on a supplied-air respirator with a full hood, there should be none or limited exposure to any ambient air contaminants. The Golden Gate Bridge District is aware of the lens problem and is planning to purchase new supplied-air hoods in 1981. The new hoods will have a replaceable outer lens and a permanent inner one. Therefore, as the outer lens is replaced, the facepiece-to-face seal will remain intact.

In December of 1979, a private industrial hygiene consulting firm collected air samples for lead and crystalline silica during sandblasting operations. Lead samples were collected outside the worker's hood. During a workday, lead levels outside the workers' hoods in the two samples were 5.54 mg/m³ and 8.42 milligrams per cubic meter of air for a full shift. Exposures inside the hoods were not measured but the levels would be much lower. The OSHA standard for occupational exposure to airborne lead is 0.05 mg/m³ for an 8-hour workday. One sample for crystalline silica was collected inside the

hood of one sandblaster. The calculated CAL/OSHA standard for the total dust level based on the amount of silica that was present in the sample was 2.73 mg/m³. The amount of dust in the worker's sample was 2.74 mg/m³ for a work shift. The dust level was approximately at the standard. In analyzing the data, it seemed evident that excess exposures to lead and silica could occur, but that proper work practices which included the use of the two lens hood should take care of the potential health hazard. It was felt by the NIOSH investigators that repeating the air sampling at this time, was not necessary since the existence of a potential health hazard using the current hoods was already established. Medical documentation of any adverse effects was felt to be more useful for this health hazard evaluation.

Since noise is an occupational hazard among abrasive blasters, the NIOSH medical investigator reviewed the results of the audiometric data on the painters which was completed at a private clinic during the time of the health hazard evaluation. Recommendations based on the audiometric data are included in this report.

IV. HAZARD EVALUATION DESIGN

A. Evaluation Criteria

1. Environmental samples were not collected. However, the applicable occupational exposure criteria are listed below:

<u>Substance</u>	<u>Time Weighted Average (TWA)^a</u>	<u>Ceiling Value</u>
Inorganic Lead (NIOSH)	50 ug/m ³ ^b	
Inorganic Lead (CAL-OSHA)	50 ug/m ³	
Crystalline Silica (NIOSH)	50 ug/m ³	
Crystalline Silica (CAL-OSHA)	variable ^c	

(a) TWA - NIOSH exposure recommendation is based on a work day up to 10 hours long; whereas CAL-OSHA Standard is based on an 8-hour work day.

(b) ug/m³ - micrograms of a substance per cubic meter of air

(c) total dust standard based on % silica; $\frac{30}{\%SiO_2+3}$

2. Medical

- a) Lead - venous blood samples were obtained from 28 workers in vacuum tubes containing EDTA and were sent to NIOSH's laboratory in Salt Lake City. The blood lead levels were analyzed by the Delves Cup atomic absorption technique.
- b) Lung Function Testing - lung function testing was performed on 30 workers. Age, height, and race were recorded and spirometry performed on an Ohio Medical Spirometer after calibration for drum speed and volume. Spirometry was conducted according to the regulations given in the OSHA Cotton Dust Standard (1) and adjusted for race. Percent of predicted value was calculated using the Knudson Tables for age and height.
- c) Chest X-Rays - 29 workers were sent to the U.S. Public Health Service Hospital in San Francisco for PA chest x-rays. The films were read by a NIOSH "B" reader according to the International Classification.
- d) Audiometric Testing - audiograms of workers at the Golden Gate Bridge District were reviewed for occupation hearing loss.

B. Toxicological Effects

- 1) Lead Inhalation of lead dust and fumes is the major route of lead exposure in industry. A secondary source of exposure may be from lead dust contamination on food, cigarettes, or other objects. Once absorbed lead is excreted from the body very slowly, the absorbed lead can damage the kidneys, peripheral and central nervous systems, and the blood forming organs (bone marrow). These effects may be felt as weakness, tiredness, irritability, digestive disturbances, high blood pressure, kidney damage, mental deficiency or slowed reaction times. Chronic lead exposure is associated with infertility and with fetal damage in pregnant women.

Blood lead levels below 40 ug/100 ml whole blood are considered to be normal levels which may result from daily environmental exposure. However, fetal damage in pregnant women may occur at blood lead levels as low as 30 ug/100 ml. Lead levels between 40-59 ug/100 ml in lead exposed workers indicate excessive absorption of lead and may result in some adverse health effects. Levels of 60 to 100 ug/100 ml represent unacceptable elevations which may cause serious adverse health effects. Levels over 100 ug/100 ml are considered dangerous and often require hospitalization and medical treatment.

The new OSHA standard for lead in air in most workplaces is 50 ug/M³ on an eight-hour time-weighted average for daily exposure. For this particular industry the current standard is 50 ug/M³. The new standard also dictates that in four years workers with blood lead levels greater than 50 ug/100 ml must be immediately removed from further lead exposure and in some circumstances workers with lead levels less than 50 ug/100 ml must also be removed. At present medical removal is necessary at blood lead levels of 70 ug/100 grams of whole blood or greater. Removed workers have protection for wage, benefits, and seniority until they can return to lead exposure areas.

- 2) Silica Silica in the form of crystalline silica is the major component of sand used in sandblasting. It causes silicosis, a disabling and progressive (continually developing) lung disease. Silicosis is a form of fibrosis, or scarring of the lung tissue caused by the "irritation" of silica in the lungs. The result of continual scarring of the lungs is that eventually they cannot expand as they should: this is called a "restrictive" lung disease (although it may sometimes have an obstructive component as well). Symptoms of silicosis are cough, difficulty breathing, wheezing, and repeated non-specific chest illnesses. Lung function testing shows a gradual decrease in the functional lung capacity (expansion of the lung), and chest x-rays typically show a nodular pattern of opacities. Symptoms usually progress once the disease has developed even after the worker is removed from further exposure to silica. Occasionally a short exposure to very high levels of silica may cause a rapidly developing form of silicosis (progressive massive fibrosis) which is frequently fatal within several years. The more typical form of slow-developing silicosis requires many years of exposure at moderate or relatively low levels before the onset of symptoms or x-ray findings. Gradually increasing inability to breathe may cause death from inadequate oxygenation of the blood or from heart failure. Silicosis also predisposes workers to the additional development of tuberculosis. Medical testing for exposed populations should include annual lung function testing, and chest x-rays on a periodic basis in accordance with length of exposure and age.

V. RESULTS AND DISCUSSION

Medical

- 1) Lead - all blood lead levels were less than 40 ug/dl (micrograms per deciliter). The results are contained in Table 1. Fifty percent of its blood lead levels were above 20 ug/dl indicating that the control methods for lead limit workers exposures to moderate amounts of lead.
- 2) Lung Function Testing - Four of the 30 workers who had lung function testing (spirometry) were below 75% of their predicted values for FEV₁/FVC% (forced expiratory volume in one second/forced vital capacity). All of these results (see Table 2) were indicative of mild obstruction, and none of the four workers had abnormalities on their chest x-rays; 2 of the 4 workers are smokers. Additionally, none of the four workers had less than 75% of their predicted value for FVC, an indication of restrictive disease which is more commonly related to silica exposure.
- 3) Chest X-Rays - of the 29 workers who had chest x-rays (PA) taken, four were read as abnormal (see Table 2). None of these four had abnormal spirometry findings and none of the x-ray abnormalities were related to silica exposure. One worker who had an abnormal chest film did not take a lung function test.
- 4) Audiometric Testing - workers were given full ear examinations and audiometric testing at the occupational medical clinic of a local hospital upon recommendation of the NIOSH medical staff.

The NIOSH medical staff reviewed the results of the screening. Thirty-eight percent of the workers' audiograms clearly showed noise-induced hearing loss. In addition, a significant difference in rates of hearing loss was found between workers who had been on the job less than or greater than 10 years.

VI. CONCLUSIONS

Workers at the Golden Gate Bridge District who are involved in abrasive blasting work in areas where airborne concentrations of lead and crystalline silica are well above the standards. However, workers are protected with supplied-air respirators with full helmets. Exposures to the workers occur when the lens of the helmet or hood has to be replaced and the facepiece-to-face seal broken. New helmets, which are to be purchased in the summer of 1981, will prevent the seal from being broken and keep employee exposures to a minimum. Molded ear protectors have been provided since 1973 when a noise survey was conducted by a consultant. No other hearing conservation program is in place. Medical examinations did not reveal lead or silica-related disease among the workers. However, since the potential for exposure to lead, silica, and noise still exists, recommendations for these areas of concern are contained in the Recommendation Section of this report.

VII. RECOMMENDATIONS

1. All workers potentially exposed to sandblasting/removal of paint from the bridge should have annual blood lead tests in accordance with the CAL-OSHA Lead Standard.(2)
2. All workers potentially exposed to crystalline silica in the sandblasting should have a baseline and annual spirometry, pre-employment chest x-rays, and annual chest x-rays after the first 10 years of exposure.
3. All workers potentially exposed to elevated noise levels associated with sandblasting equipment should have baseline and annual audiometry, with a complete ear examination prior to being fitted with hearing protection.
4. A complete noise survey on the sandblasting operation should be conducted in order that an appropriate noise program can be implemented.
5. Supplied air hoods with a double lens system should be purchased as soon as possible for all the sandblasters.
6. All workers exposed to lead, silica, or noise should receive annual training about the health hazards represented by those exposures and the importance of proper work practices and the use of protective equipment.

VIII. REFERENCES

- (1) OSHA: "Occupational Exposure to Cotton Dust. Final Safety and Health Standard," Federal Register, Part III, Volume 43, No. 122, pp 27350-27463, June 23, 1978.
- (2) State of California Administrative Code, Title 8, Chapter 4, Subchapter 7, Section 5216, Lead, May 31, 1980.

IX. AUTHORSHIP AND ACKNOWLEDGEMENTS

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X. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this Determination Report are currently available upon request from NIOSH, Division of Technical Services, Information Resources and Dissemination, Division of Technical Services, 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), 5285 Port Royal Road, Springfield, Virginia, 22151. Information regarding its availability through NTIS can be obtained from the NIOSH Publications Office at the Cincinnati address.

Copies of this report have been sent to:

- 1) International Brotherhood of Painters and Allied Trades, Local Union #4, San Francisco.
- 2) Golden Gate Bridge District, San Francisco.
- 3) CAL-OSHA
- 4) U.S. Department of Labor - Region IX.

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

Table 1. Blood lead levels of Workers at the Golden Gate Bridge District Collected During August 6, 1980.

<u>Individual Blood Lead Levels in ug/dl * (Workers)</u>	<u>Individual Blood Lead Levels in ug/dl (Controls)</u>
9	13
15	11
19	16
17	
18	
16	
19	
13	
15	
15	
12	
13	
18	
14	
28	
26	
25	
21	
23	
23	
20	
20	
24	
27	
21	
24	
28	
30	

*ug/dl - micrograms per deciliter of blood; deciliter is equal to 100 milliliters

Table 2. Lung Function Test and
Chest X-Ray Results

Worker #	FVC % Predicted	FEV ₁ (% Predicted)	$\frac{\text{FEV}_1\%}{\text{FVC \%}}$	CXR
1	83	74	72 a	nl
2	83	63	65 a	nl
3	81	77	76	nl
4	87	71	78	nl
5	94	81	70 a	nl
6	102	111	87	nl
7	111	79	88	nl
8	133	94	57 a	nl
9	113	112	77	nl
10	105	105	79	nl
11	102	109	87	nl
12	95	98	84	nl
13	100	113	87	nl
14	115	116	77	nl
15	108	103	76	nl
16	121	111	80	b
17	110	109	78	b
18	113	103	81	nl
19	105	104	85	nl
20	124	106	80	nl
21	129	115	79	nl
22	103	118	80	nl
23	100	114	90	nl
24	122	131	84	nl
25	101	107	84	nl
26	97	101	84	nl
27	133	121	73	nl
28	112	106	75	nl
29	130	128	79	nl
30	98	101	82	b

a = mild obstruction

b = abnormal, without evidence of silicosis

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