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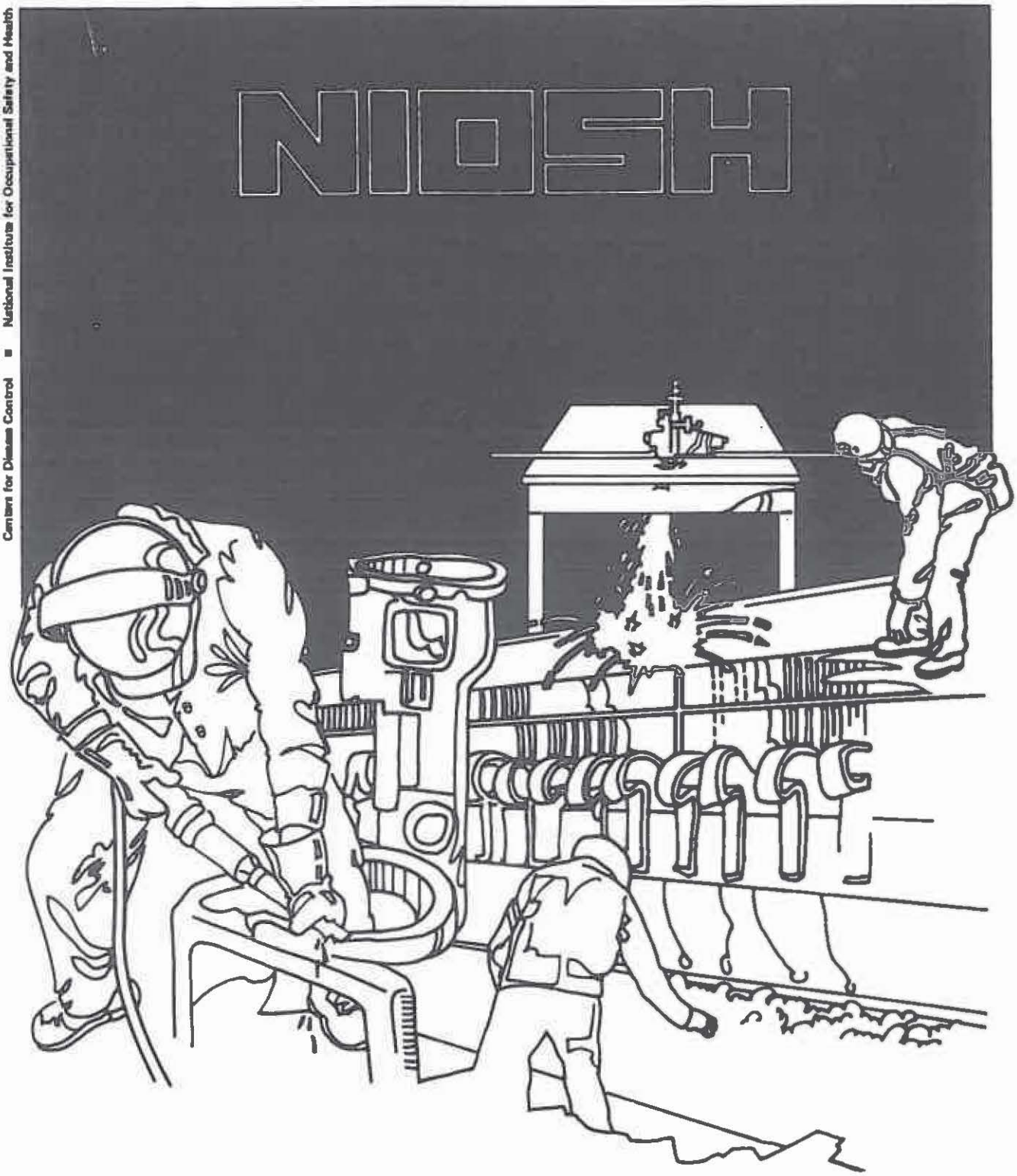

Health Hazard Evaluation Report

HETA 82-061-1152
NEOPLAN USA CORPORATION
LAMAR, 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 82-061-1152
AUGUST 1982
NEOPLAN USA CORPORATION
LAMAR, COLORADO

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I. SUMMARY

In November 1981, the National Institute for Occupational Safety and Health (NIOSH) received a request from the management of Neoplan USA Corporation, Lamar, Colorado, to evaluate the potential health hazard of exposure to zinc oxide fumes during the manufacture of bus frames.

On March 9, 1982, NIOSH investigators conducted the initial industrial hygiene survey and collected breathing zone air samples for measurement of zinc oxide, cadmium, and silver. The silver and cadmium levels were below laboratory detection limits. The zinc oxide level in one 4-hour air sample was 6.4 mg/M^3 (exceeded the evaluation criteria of 5.0 mg/M^3) and was considered to represent a health hazard.

A follow-up industrial hygiene and medical evaluation was conducted on May 11, 1982. Breathing zone air samples were again collected for zinc oxide, cadmium, and silver. All levels were well within the evaluation criteria. The observed improvement was accomplished by a modification in the assembly line which limited the welding of parts onto previously zinc painted bus frames.

Seventeen workers were privately interviewed by a NIOSH physician. All worked in the area where welding was done after primer had been applied to bus frames. Of these 17 workers, five were welders, two were silver solderers, six installed wires and pipes, three were supervisory personnel, and one was the parts person in this section of the building. Both welders and others working in the immediate vicinity (where welding is performed on zinc painted frames) reported that they were suffering ill effects from the zinc oxide fumes such as irritation of upper respiratory tract, cough, headache, nausea, chills, metallic taste in mouth, sweating, and fever.

On the basis of the environmental and medical data and personal employee interviews, NIOSH concluded that a health hazard did exist to zinc oxide at Neoplan USA Corporation at the time of this survey. This conclusion is based upon a high zinc oxide level found during the initial survey and upon medical histories. Decreased zinc oxide levels (below evaluation criteria) were found on the follow-up survey. Recommendations on ways to further eliminate worker exposure to zinc oxide fumes are included in this report.

KEYWORDS: SIC 3713 (Manufacturing/Truck and Bus Bodies), zinc oxide fumes, metal fume fever, cadmium, silver soldering.

II. INTRODUCTION

In November 1981, the National Institute for Occupational Safety and Health (NIOSH) received a request from the management of Neoplan USA Corporation, Lamar, Colorado, to evaluate the potential health hazard of exposure to zinc oxide fumes during the manufacture of bus frames. On March 9, 1982, NIOSH conducted an initial environmental survey; on May 11, 1982, a combined environmental and medical survey was performed. Plant management was notified of evaluation results in May 1982.

III. BACKGROUND

Neoplan USA Corporation is a German firm specializing in manufacturing buses in several plants in Europe and Africa. In 1981 Neoplan opened a bus plant in Lamar, Colorado.

Construction of the buses starts with a welded unitized steel body frame. The initial request mentioned possible metal fume fever from zinc oxide fumes generated while welding brackets onto the frames after they had been sprayed with a zinc primer.

Between the time of the initial industrial hygiene visit and the follow-up medical/industrial hygiene visit, the order of assembly was changed so that the need for welding of the primed frames was greatly reduced.

IV. EVALUATION DESIGN AND METHODS

A. Environmental

Three breathing zone air samples were collected on March 9, 1982, and eight breathing zone air samples on May 11, 1982, for measurement of zinc oxide on 37 mm filters using vacuum pumps operated at 1.5 liters per minute and analyzed according to NIOSH P&CAM Method No. 173.

Two breathing zone air samples for silver and cadmium were collected on March 9, 1982 and one sample on May 11, 1982, on 37 mm filters using vacuum pumps operated at 1.5 liters per minute and analyzed according to NIOSH P&CAM Method No. 173.

B. Medical

Seventeen (17) workers who worked in the area where welding was done after the primer had been applied were privately interviewed. This group represented all available workers in the area at the time of the visit. In three cases additional information was obtained from private physicians. Of the 17 workers interviewed five were welders, two primarily brazed copper tubing, six installed a variety of wires and pipes (sometimes being called on to braze or weld), three were supervisory personnel, and one ran the parts room in this section of the building.

V. EVALUATION CRITERIA

A. Environmental

Three sources of criteria used to assess the workroom concentrations of the chemicals were (1) recommended Threshold Limit Values (TLVs) and their supporting documentation as set forth by the American Conference of Governmental Industrial Hygienists (ACGIH), 1981, (2) the NIOSH criteria for a recommended standards, and (3) the Occupational Safety and Health Administration (OSHA) standards (29 CFR 1910.1000), July 1980.

	Environmental Exposure Limits 8-Hour Time-Weighted Average (TWA)
Cadmium.....	0.04 mg/M^3 (NIOSH 10-Hour TWA) 0.2 mg/M^3 (C) (NIOSH) 0.05 mg/M^3 (C) (ACGIH) 0.1 mg/M^3 (OSHA)
Silver.....	0.01 mg/M^3 (ACGIH, OSHA)
Zinc oxide fumes	5.0 mg/M^3 (NIOSH, ACGIH, OSHA)

mg/M^3 = milligrams of substance per cubic meter of air.
C = Ceiling value which should never be exceeded.

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

Cadmium is a toxic heavy metal which may enter the body either by ingestion (swallowing) or by inhalation (breathing) of cadmium metal or oxide. Once absorbed into the body, cadmium accumulates in organs throughout the body, but major depositions occur in the liver and kidneys. Acute inhalation exposure to high levels of cadmium can cause pneumonia or pulmonary edema, as well as liver and kidney damage.[1] Chronic exposure may lead to emphysema of the lungs and kidney disease, or cancer of the prostate.[2] There is also limited evidence that occupational cadmium exposure may be associated with lung cancer.

NIOSH recommends that worker exposures to cadmium dust or fume be limited to not more than 0.2 mg/M^3 during a 15-minute ceiling period or to a threshold limit value (TLV) of not more than 0.04 mg/M^3, as a time-weighted average (TWA) over a 10-hour shift. The Occupational Safety and Health Administration (OSHA) standard for cadmium dust exposure is 0.2 mg/M^3, and 0.1 mg/M^3 for cadmium fume exposure, using an 8-hour TWA.

Short term (15 minute) exposures are discussed here because of the danger of serious disease resulting from a very short but higher level exposure.

Silver exposures should be maintained below 0.01 mg/M^3. Silver and its soluble compounds may affect the body through all the normal routes of entry. Hyperpigmentation of eyes and skin may occur. Silver may cause argyria, the local or generalized impregnation of the mucous membranes, skin, and eyes with silver. Silver is poorly excreted by the kidneys.

Zinc oxide and other metal fumes are toxic by inhalation, although the precise mode of action upon the body is unknown. Excessive exposure can cause metal fume fever which usually occurs about four to six hours past exposure. Metal fume fever is characterized by the following symptoms: irritation of upper respiratory tract, cough, headache, nausea, chills, metallic taste in mouth, sweating, and fever. These symptoms of overexposure to metal fume usually disappear in one or two days once the worker is removed from exposure. Chronic effects (unless another toxic metal is involved) have not been documented.[3]

Welding fumes, besides being a possible source of metal fumes capable of causing metal fume fever, are often irritating to mucous membranes and the respiratory tract.

VI. RESULTS AND DISCUSSION

A. Environmental

On March 9, 1982, three breathing zone air samples were collected for zinc oxide fumes (Table 1). The levels for these 4-hour samples were 0.4, 0.8, and 6.4 mg/M^3. This operation is continuous; therefore, it is assumed that an 8-hour sample would have shown on overexposure.

On March 9, 1982, two breathing zone full-shift air samples were collected on silver soldering workers, and on May 11, 1982, one sample was collected. These samples were analyzed for silver and cadmium (Table 2). All samples were below laboratory detection limits of 0.003 milligrams per sample.

On May 11, 1982, eight breathing zone air samples were collected for zinc oxide (Table 3); levels ranged from 0.06 to 1.32 mg/M^3. All levels were all below the evaluation criteria of 5.0 mg/M^3. These low levels were due to better engineering controls which limited the amount of welding on the zinc painted frame.

Welding continues to be performed on zinc painted metal. As a result, workers are still experiencing symptoms that are compatible with exposure to zinc oxide fumes. Engineering should continue their efforts to eliminate the welding of plates and other parts to the previously zinc painted metal.

B. Medical

Only the two workers primarily brazing copper tubing and one of the welders failed to mention some problems with the welding fumes or other atmospheric contaminants in the buildings. The brazers primarily worked on the mezzanine level apart from the main work area. The parts room operator mentioned the fumes caused an upset stomach at first but not after one became used to them.

Of the four welders mentioning some problems, one--a smoker--gave a history strongly suggestive of chronic bronchitis since starting to work at this plant. His condition reportedly improved when off work for one and one-half weeks in a row. His smoking habit predated work at this plant. The chronic bronchitis probably is due to the combination of welding fumes and cigarette smoking.

Of the other three welders--also smokers--one had one episode of illness from the welding fumes and has since worn a respirator when working in confined areas He still occasionally gets an upset stomach and feels lightheaded. Another has evening chills, fever, and "flu"-like symptoms about weekly. Sanding can produce a zinc exposure. The wearing of an approved dust respirator should eliminate an exposure to zinc from sanding. The third welder had one episode of delayed chills, fever, and "flu"-like symptoms but it was delayed until two days after the heavy fume exposure.

All the other workers identified some problems, some when they themselves were welding, some when working in the general area next to a welder or above a welder. Five gave histories of evening chills, fever, and feeling ill into the following morning. This undoubtedly represents "metal fume fever". Frequency varied from only occasional relatively severe attacks to less marked attacks associated with an ill feeling every morning except Monday. Only one of the five definitely related the episode to his own welding activity. One worker after an extensive period of welding became sufficiently ill to require hospitalization; the only significant laboratory findings were a decreased oxygen pressure in the blood and an elevated zinc excretion. The most likely diagnosis would be a chemical pneumonitis.

Other symptoms mentioned either from welding fumes directly or from the general air were sinus problems, irritation of eyes, throat, and/or nose, nausea, a zinc taste in the mouth, headaches, and general fatigue. One worker mentioned the noise of welding as a problem.

Thus, by history, there are problems with the welding fumes, not only for the welders, but possibly even more so for those working in close proximity to the welder. Grinding and cutting on primed metal also appears to provide exposure. Approximately 50% of the welders interviewed had symptoms which could be related to metal fume fever.

Several workers also mentioned the safety hazard of the bus frames slipping off the rear dolly if the dolly hit an obstruction in the track while the frame was being pushed forward. Inspection of the frames on the two lines showed most, but not all, the frames had a stop welded either to the frame or to the dolly to prevent this.

VII. CONCLUSIONS

Based on the environmental and medical data and employee interviews, a health hazard did exist to zinc oxide fumes during this evaluation at Neoplan USA Corporation. The metal fume fever, irritation, and other symptoms are caused by workers being in close proximity to the welding plume generated when the welding arc vaporizes the zinc primer. Sanding and cutting zinc primed metal also is implicated. Respiratory protection should help. Local exhaust ventilation at the welding plume would also help eliminate the zinc fume exposure.

VIII. RECOMMENDATIONS

1. Eliminate as much as possible the welding on metal that has been painted with the zinc primer.

2. Until Recommendation 1 can be accomplished, workers should wear a respirator with Hepa ultra filters or something that is equivalent.

3. Welders should be educated on the health hazards of zinc oxide fume exposures.

4. Increased masking of areas on the bus frames where additional welding later occurs before painting them with zinc would assist in eliminating zinc fumes.

5. Local exhaust ventilation at the welding plume would also help eliminate the zinc fume exposure.

IX. REFERENCES

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3. Plunkett, E.R., Handbook of Industrial Toxicology. Chemical Publishing Company, New York (1976), pp. 441-442.

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XI. DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available upon request from NIOSH, Division of Standards 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. Neoplan USA Corporation.
2. U.S. Department of Labor/OSHA - Region VIII.
3. NIOSH - Region VIII.
4. Colorado Department of Health.
5. 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

Breathing Zone Air Concentrations of Zinc Oxide Fumes

Neoplan USA Corporation
Lamar, Colorado

March 9, 1982

Sample Number	Location/Job	Sampling Time	mg/M^3 Zinc Oxide
1	Mechanical Buildup	7:30 AM - 11:16 AM	6.4
2	Mechanical Buildup	7:34 AM - 11:20 AM	0.4
4	Mechanical Buildup	7:38 AM - 11:17 AM	0.8
EVALUATION CRITERIA			5.0
LABORATORY LIMIT OF DETECTION mg/sample			0.003

TABLE 2

Breathing Zone Air Concentrations of Cadmium and Silver

Neoplan USA Corporation
Lamar, Colorado

March 9, 1982
May 11, 1982

Sample Number	Location/Job	Sampling Time	mg/M^3 Cadmium	Silver
3	Mechanical Buildup	7:30 AM - 11:16 AM	*	*
3B	Skeleton	7:31 AM - 4:18 PM	*	*
6	Mechanical Buildup	7:30 AM - 4:10 PM	*	*
EVALUATION CRITERIA			0.04	0.01
LABORATORY LIMIT OF DETECTION mg/sample			0.003	0.003

* = below laboratory limit of detection

TABLE 3

Breathing Zone Air Concentratins of Zinc Oxide Fumes

Neoplan USA Corporation
Lamar, Colorado

May 11, 1982

Sample Number	Location/Job	Sampling Time	mg/M^3 Zinc Oxide
1	Retrofit	7:11 AM - 4:10 PM	0.19
3	Skeleton/521	7:23 AM - 4:18 PM	0.60
4	Retrofit	7:25 AM - 4:10 PM	1.26
5	All Over Factory	7:26 AM - 4:07 PM	0.10
6	Mechanical Buildup	7:30 AM - 4:10 PM	0.06
7	Mechanical Buildup	7:36 AM - 4:08 PM	1.32
9	Mechanical Buildup	7:40 AM - 8:05 AM	0.10
10	Mechanical Buildup	7:40 AM - 4:12 PM	0.36
EVALUATION CRITERIA			5.0
LABORATORY LIMIT OF DETECTION mg/sample			0.003

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