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SILVER DEER SPECTRUM  
BOULDER, COLORADO

NIOSH INVESTIGATOR:  
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## I. SUMMARY

In January of 1986, the National Institute for Occupational Safety and Health (NIOSH) received a request from plant management at the Silver Deer Spectrum, Boulder, Colorado to evaluate exposures to lead, glues, and solvents among workers grinding, polishing, gluing and silkscreen painting of leaded glass crystal art objects.

On January 31, 1986 an environmental evaluation was conducted by a NIOSH investigator. The environmental investigation consisted of breathing zone and general room measurements of lead, xylene, benzene, and methylene chloride. Blood lead and free erythrocyte protoporphyrin (FEP) were performed by the company and this data was also reviewed and included in this report. A previous NIOSH hazard evaluation (HETA 84-384) was performed at this facility. It was referred to then as the Crystal Zoo. In this previous study five out of six lead samples had exceeded the NIOSH evaluation criteria of 0.05 mg/M<sup>3</sup>.

During this second evaluation lead was again found to be a potential health hazard although exposure levels had decreased. Three of sixteen personal breathing zone and area air samples for lead (range N.D. to 0.08 mg/M<sup>3</sup>) exceeded the evaluation criteria of 0.05 mg/M<sup>3</sup>, and 50 percent of the lead samples exceeded the action level of 0.025 mg/M<sup>3</sup>. Methylene chloride was found in 13 out of 14 air samples. Methylene chloride should be maintained at levels as low as possible due to its carcinogenic potential. Xylene and benzene were below the laboratory limit of detection in all 14 analyses.

Review of the company's biological monitoring data indicated the highest blood lead level was 33 ug/dl, none were over the allowable level of 50 ug/dl. The lowest blood lead level was 4 ug/dl and the average for the nine workers tested was 13.4 ug/dl. This is compared to 29.1 ug/dl observed on the same workers in 1984, (HETA 84-384).

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On the basis of environmental data (19% of the samples collected exceeded the OSHA standard), it was determined that a potential health hazard still existed from exposures to lead. Recommendations that can help to further reduce lead exposures are included in section VIII of this report.

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Keywords: SIC 3229 (Pressed and blown glass and glassware), lead, methylene chloride

## II. INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH) received a request in January, 1986 from the management of the Silver Deer Spectrum, Boulder, Colorado to evaluate lead and solvent exposures among workers sanding and assembling leaded glass crystal. This request was initiated after improvements in the local ventilation in both the sanding and gluing departments had been made. These corrections and improvements were based on NIOSH HETA 84-384.

Results of the environmental monitoring were discussed with management and a member of the employees in March of 1986. The delay in completing this survey was waiting for management to decide which glue they were going to use. Management hasn't decided on which glue, so information concerning the solvents used in the glues may change.

## III. BACKGROUND

This facility receives leaded crystal from a European firm; this crystal contains about 40 percent lead by weight. The crystal is cut, wet ground, and polished and then glued into various art objects. After the pieces of leaded crystal are glued together they are shipped to various distribution centers. Lead exposures occur when workers are not using wet grinding techniques and when eating and smoking without washing their hands.

## IV. EVALUATION DESIGN AND METHODS

Benzene, xylene, and methylene chloride samples were collected on organic vapor charcoal sampling tubes and vacuum pumps operated at 100 cc/minute and analyzed using NIOSH methods 1005 and 1500 with modifications.

Lead samples were collected using using 37mm AA filters and analyzed using NIOSH method 7082.

Medical monitoring was not done on this study, since NIOSH had evaluated the workers on the previous evaluation (HHE 84-384). A review of the company's biological lead monitoring information was undertaken and is summarized in this report.

## V. EVALUATION CRITERIA AND TOXICOLOGY

### A. ENVIRONMENTAL

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 ACGIH 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 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.

	<u>Environmental Exposure Limits</u> <u>8-Hour Time-Weighted Average (TWA)</u> <u>Mg/M<sup>3</sup></u>
Lead	0.05 (NIOSH) (OSHA)
Xylene	435 (NIOSH) (OSHA)
Benzene	Lowest possible level (NIOSH)
Methylene Chloride	Lowest possible level (NIOSH)

B. Medical

Blood lead levels averaging less than 15 ug/dl are considered to be normal levels which may result from daily environmental exposures. Adults not exposed to lead at work usually have a blood lead concentration less than 30 ug/dl. Fetal damage in pregnant women may occur at blood lead levels as low as 30 ug/dl. Lead levels between 40-60 ug/dl in lead-exposed workers indicate excessive absorption of lead and may result in some adverse health effects. Levels of 60-100 ug/dl represent unacceptable elevations which may cause serious health effects. Levels over 100 ug/dl are considered dangerous and often require hospitalization and medical treatment.

The Occupational Safety and Health Administration (OSHA) standard for lead is 50 ug/M<sup>3</sup> calculated as an 8-hour time-weighted average for daily exposure. The standard also dictates that workers with blood lead levels greater than 60ug/100g whole blood must be immediately removed from further lead exposure if confirmed by a followup test, and workers with average lead levels of 50 ug/100g or greater must be removed from further lead exposure until the blood lead concentration is below 40 ug/dl. Removal is also possible on medical grounds. Removed workers have protection for wage, benefits, and seniority for up to 18 months or until they can return to lead exposure areas.<sup>1</sup>

C. Toxicological

Lead<sup>1,2</sup> - Inhalation (breathing) of lead dust and fume is the major route of lead exposure in industry. A secondary source of exposure may be from ingestion (swallowing) of lead dust deposited on food, cigarettes, or other objects. Once absorbed, lead is excreted from the body very slowly. 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 fetal damage in pregnant women.

## Methylene Chloride

Methylene chloride is an irritant, it depresses the central nervous system and can elevate carboxyhemoglobin levels. The signs and symptoms of exposure include: irritation of eyes and respiratory tract, headache, dizziness, nausea and vomiting. The National Toxicology Program has reported that methylene chloride showed "clear evidence of carcinogenicity" in laboratory tests using mice. (3) Due to these findings NIOSH recommends that exposures should be maintained as low as possible.

## Xylene

Xylene vapors may cause irritation of the eyes, nose and throat. Repeated or prolonged skin contact with xylene may cause drying and defatting of the skin which may lead to dermatitis. Liquid xylene is irritating to the eyes and mucous membranes, and aspiration of a few milliliters may cause chemical pneumonitis, pulmonary edema, and hemorrhage. Repeated exposure of the eyes to high concentrations of xylene vapor may cause reversible eye damage. Acute exposure to xylene vapor may cause central nervous system depression and minor reversible effects upon liver and kidneys. At high concentrations, xylene vapor may cause dizziness, staggering, drowsiness, and unconsciousness. (4) Workers exposed to concentrations above 200 ppm complain of loss of appetite, nausea, vomiting, and abdominal pain. Brief exposure of humans to 200 ppm has caused irritation of the eyes, nose, and throat. (5)

The current OSHA standard for xylene is 100 ppm averaged over an 8-hour work shift. NIOSH has recommended that the permissible exposure limit be changed to 100 ppm averaged over a work shift of up to 10 hours per day, 40 hours per week, with an acceptable ceiling level of 200 ppm averaged over a 10-minute exposure.

## Benzene

Benzene exposures were not found in this survey. Clinical and epidemiologic data suggest a leukemogenic action of benzene in humans, the leukemia tending to be acute and myeloblastic in type, sometimes following aplastic changes in the bone marrow; benzene may also induce chronic types of leukemia. (3) Exposure to any level of benzene is considered by NIOSH to be dangerous. Bulk containers of xylene, xylene and naphthas should be periodically checked for benzene contamination.

## VI. ENVIRONMENTAL RESULTS AND DISCUSSION

Sixteen breathing zone and general room air samples were collected for lead and ranged from N.D. to 0.08 mg/M<sup>3</sup>. Three or 19 percent exceeded the evaluation criteria of 0.05 mg/M<sup>3</sup>. Eight or 50 percent of the lead samples exceeded the action level which is 0.025 mg/M<sup>3</sup> or one-half the standard, and is the level where lead monitoring is necessary. Small quantities of methylene chloride were found in 13 of 14 air samples. Levels of methylene chloride should be maintained as low as possible due to its carcinogenic potential levels of methylene chloride measured during this evaluation were relatively low. The highest level of methylene chloride was 15.7 mg/m<sup>3</sup> and the average for the 14 samples was 3.2 mg/m<sup>3</sup>.

### B. Medical

Nine (9) workers were included in the grinding room. Blood leads were done on eight of these workers by NIOSH in 1984 when performing HHE 84-384. There were no workers with lead levels above 40 ug/dl in that hazard evaluation. The company had lead levels and FEP's performed on these workers in 1985 just prior to this NIOSH evaluation. All blood leads and FEP's were well within acceptable limits. The highest blood lead was 33 ug/dl and the lowest was 4 ug/dl. The average for all 9 workers was 13.4 ug/dl. FEP's ranged from 43 to 7 with an average for all 9 workers of 19.8. The company plans to continue the biological monitoring.

## VII. CONCLUSIONS

Based on environmental levels of lead a potential health hazard existed at the time of this evaluation. No evidence of lead toxicity in the workers was found either in the blood samples or during the brief interviews.

## VIII. RECOMMENDATIONS

1. Because there is some lead exposure in the grinding room, it is important that work practices to reduce lead exposure be followed.
2. No dry grinding or polishing of the leaded glass should be permitted.
3. The down draft ventilation in the grinding stations should be maintained, cleaned, and balanced so that each work station has sufficient capture velocity. A capture velocity of 100 feet per minute should be sufficient.

## IX. REFERENCES

1. Occupational Safety and Health Administration. Occupational exposure to lead—final standard. Federal Standard. Federal Register 1978. November 14: 53007.
2. Occupational Health Guidelines for Chemical Hazards, DHHS (NIOSH) no. 81-123, January 1981.
3. NTP Technical series report no. 306; NTP Report no. 85-024; HHE Publication no. 85-168, 1976.
4. Documentation of the TLV's ACGIH, 3rd Edition, Cincinnati, Ohio; 1971.
5. Chemical Hazards in the workplace, Proctor and Hughes, 1978, pgs. 118-119.

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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. Silver Deer Spectrum
2. U.S. Department of Labor/OSHA - Region VIII
3. NIOSH - Region VIII
4. Colorado Department of Health

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 and General Room Air Concentrations  
of Lead at  
Silver Deer Spectrum  
Boulder, Colorado  
January 31, 1986

<u>Sample #</u>	<u>Job/Location</u>	<u>Sampling Time</u>	<u>Mg/M<sup>3</sup> Lead (Pb)</u>
1	Grinder	7:00a - 2:40p	0.03
2	Grinder	7:00a - 2:40p	0.08
3	Grinder	7:07a - 2:35p	0.04
4	Grinder	7:08a - 2:35p	0.04
5	Grinder	7:14a - 2:40p	0.04
6	Grinder	7:15a - 2:40p	0.03
7	Grinder	7:17a - 2:40p	0.04
8	Grinder	7:20a - 2:35p	0.06
9	Sander	7:00a - 1:30p	0.03
10	Grinder	7:10a - 2:30p	0.03
11	Grinder	7:12a - 2:35p	0.01
12	Glass Melt	7:15a - 2:30p	*
13	Glass Melt	7:20a - 2:30p	*
14	Glass Melt	7:20a - 2:30p	*
15	Glass Melt	7:20a - 2:30p	*
16	Sander	7:05a - 2:30p	<u>0.07</u>
Evaluation Criteria			0.05
Laboratory Limit of Detection mg/sample			.002

\* = Non-detectable

Table 2

Breathing Zone and General Room Air Concentrations  
of Xylene, Benzene, and Methylene Chloride at  
Silver Deer Spectrum  
Boulder, Colorado  
January 31, 1986

<u>Sample #</u>	<u>Job/Location</u>	<u>Sampling Time</u>	<u>Xylene</u>	<u>Benzene</u>	<u>MgM<sup>3</sup> MTCH</u>
1	Gluer	7:30a - 10:50a	*	*	1.38
2	Gluer	7:30a - 10:40a	*	*	0.83
3	Gluer	7:30a - 10:40a	*	*	3.04
4	Gluer	7:30a - 10:40a	*	*	1.87
5	Lead Gluer	7:35a - 10:45a	*	*	0.70
6	Area	7:35a - 2:25p	*	*	4.40
7	Gluer	11:00a - 11:45p	*	*	*
8	Gluer	9:20a - 2:30p	*	*	2.06
9	Pntr./Silk Screen	9:35a - 10:00a	*	*	15.71
10	Gluer	10:45a - 2:30p	*	*	2.00
11	Lead Gluer	10:50a - 2:30p	*	*	2.50
12	Lead Gluer	10:50a - 2:30p	*	*	2.50
13	Lead Gluer	10:55a - 12:50p	*	*	4.44
14	Lead Gluer	11:00a - 2:30p	*	*	<u>3.91</u>
Evaluation Criteria			435	10 <sup>A</sup>	*
Laboratory Limit of Detection mg/samples			0.005	0.01	0.01

\* = Non-detectable

A = Carcinogens (lowest feasible level)

MTCH = Methylene Chloride