U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 77-50-419

THE GLASS DETAIL
CINCINNATI, OHIO 45202

September 1977

I. TOXICITY DETERMINATION

A health hazard evaluation was conducted in the workshop of the Glass Detail on April 14, 1977. The purpose of the evaluation was to determine whether exposures to emissions from solders and fluxes were posing a health hazard to the employees. The medical evaluation consisted of an interview; physical examination; blood analyses for CBC, BUN, creatinine, FEP, and lead; and urine lead and creatinine determinations. The environmental evaluation consisted of air sampling for potential solder and flux emissions, observation of work practices, and noting of other details relevant to hazardous exposures. On the basis of the medical and environmental evaluations, it is concluded that exposures to emissions from the solders and fluxes did not pose a health hazard to the employees at the time of the survey.

II. DISTRIBUTION AND AVAILABILITY OF REPORT

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Copies have been sent to:

1. The Glass Detail, Cincinnati, Ohio
2. U.S. Department of Labor, Region V
3. NIOSH, Region V

III. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by 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.

NIOSH received a request for a health hazard evaluation from the owner of the Glass Detail because of alleged symptomatology thought to be related to the production of stained glass windows. Upper respiratory irritation, tiredness, easy fatigability, and headache were among the most frequently noted symptoms. Because the involved individuals work with lead and soldering fluxes, a study was undertaken to determine if the symptomatology could be related to a toxic exposure to any of the involved materials.

IV. HEALTH HAZARD EVALUATION

A. Facility and Process Description

The workshop for the Glass Detail occupies one room (about 250 square feet) of a four room apartment (about 960 square feet). The workshop is an exterior room facing the south and has two side-by-side windows. The apartment is heated with a single, gas fired, vented, space heater during the colder seasons. There is no provision for air-conditioning during the summer months.

The Glass Detail employs two individuals (the owner and his partner) and has been in the present location for about 14 months. The products of the firm are various stained glass configurations (decorative pieces, windows, lamp shades, etc.). The process consists of: (1) hand cutting the glass, (2) trimming the glass pieces with an adhesive backed copper foil, (3) soldering the pieces of glass together with a 60 percent tin, 40 percent lead solder, and (4) cleaning the finished pieces with commercially available glass cleaners. The length of the workday can vary, depending on such factors as the mood of the owner, the season of the year, etc. The time spent soldering perhaps averages two hours per day although it could be much greater. The potential hazards of the above process are those of emissions from the solder and the soldering flux.

B. Study Design and Analytical Methods

1. Medical

The two employees were evaluated using several methods. A history and physical examination were performed on each individual concentrating on the symptomatology and physical signs of lead or other heavy metal intoxication. In addition, a battery of biological testing was performed consisting of the following tests: (1) blood urea nitrogen (BUN); (2) serum creatinine; (3) free erythrocyte protoporphyrin (FEP); (4) blood lead; (5) serum zinc; (6) complete blood count (CBC); (7) urine creatinine; (8) urine volume; (9) urine lead; (10) urine tin; (11) urine zinc.

The blood lead, serum zinc, and urine lead, tin, and zinc analyses were performed by the Utah Biomedical Test Laboratory at Salt Lake City. The blood FEP, CBC, BUN, serum creatinine, and urine creatinine were performed at Medical Diagnostic Services - Ohio Valley, a GSA contract lab.

2. Environmental

Air samples, both personal and fixed location, were taken in order to indicate exposures to, and general ambient levels of, lead and tin. These samples were collected using 37 mm membrane filters (closed face cassettes) and personal sampling pumps operating at air flows of 2.0 liters per minute (lpm). The samples were analyzed by conventional aqueous atomic absorption spectroscopy.

Fixed location air samples to indicate the presence of total chlorides and hydrochloric acid were collected by using 37 mm diameter membrane filters in series with midget impingers (absorbent-sodium acetate). These sampling trains were operated at 2.0 lpm using personal air sampling pumps. The filters were leached with 0.5 M sodium acetate and the resulting solution analyzed by chloride ion specific electrode. The impinger solutions were made up to a volume of 25 ml with 0.5 M sodium acetate and analyzed by chloride ion specific electrode.

Colorimetric indicator tubes were used to sample for ammonia, hydrochloric acid, formaldehyde, methyl alcohol, ethyl alcohol, and chlorine at the soldering operations.

C. Evaluation Criteria

1. Physiological Effects

Prolonged absorption of lead or its inorganic compounds from inhalation of fume or dust, as well as from oral ingestion can result in severe gastrointestinal disturbances and anemia. With serious intoxication, neuromuscular dysfunction may occur, and severe exposure may result in encephalopathy. Presenting symptoms are often weakness, weight loss, lassitude, insomnia, and hypertension. Usually associated with this is a disturbance of the gastrointestinal tract, which includes constipation, anorexia, and abdominal pain described as colicky. The physical findings, although occurring late, usually consist of facial pallor, malnutrition, abdominal tenderness, and pallor of the eye grounds. The anemia associated with lead poisoning is of the hypochromic, microcytic type with basophilic stippling of the red cells. A lead line may appear on gingival tissues, and in severe cases of poisoning, paralysis of the extensor muscles of the wrist, and less often of the ankles, can occur. Encephalopathy while common in children is unusual in adults.[1]

Nephropathy can also result from prolonged exposure to lead or its inorganic compounds. These may be a progressive and irreversible loss of kidney function, with progressive azotemia, and occasionally hyperuricemia with or without gout. Lead is teratogenic in mammalian animals so it is advised that exposure of women, in the child bearing age, to lead be carefully monitored.

Health information related to lead suggests that blood lead levels in individual workers should be kept at values less than 60 micrograms of lead per deciliter of whole blood (ug/dl). It should be noted that persons with anemia or sickle cell trait may be at increased risk from exposure to lead. NIOSH considers blood lead levels of 0 to 40 ug/dl to be in the normal range; levels of 40 to 60 ug/dl to be in the increased absorption range; and levels above 60 ug/dl to be undesirable.

Hydrogen chloride at room temperature is a gas, or in aqueous solution is hydrochloric or muriatic acid. Both the acid and high concentrations of the gas are highly irritating to eyes, skin and mucosa. Because of its irritant nature, hydrochloric acid is seldom inhaled in concentrations sufficient to cause injury.

2. Environmental Standards

The primary sources of environmental evaluation criteria considered for this study were: (1) NIOSH criteria documents,[2,3] (2) the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV's),[4] and (3) the U.S. Department of Labor Federal Occupational Health Standards.[5] The criteria judged most appropriate for this study are as follows:

SUBSTANCE	SHORT TERM EXPOSURE LIMITS (15 min.)	8-HOUR TIME WEIGHTED AVERAGE
Lead	0.45 mg/M3[b]	0.10 mg/M3[c]
Tin Oxide	20.0 mg/M3[b]	10.0 mg/M3[b]
Hydrochloric Acid	7.0 mg/M3[b]	7.0 mg/M3[b]
Ammonia	27.0 mg/M3[b]	18.0 mg/M3[b]
Formaldehyde	3.0 mg/M3[b]	3.0 mg/M3[b]
Methyl Alcohol	325 mg/M3[b]	260 mg/M3[b]
Ethyl Alcohol	1900 mg/M3[b]	1900 mg/M3[b]
Chlorine	0.5 ppm[a]	0.5 ppm[a]

a) NIOSH Criteria
b) ACGIH Threshold Limit Value
c) OSHA Proposed Standard[6]

D. Results - Discussion

The questionnaires revealed no significant past occupational or other exposures for either of the involved individuals except to the substances encountered in the stained glass fabrication business. At the time of the study, one of the two individuals was asymptomatic, the other complained of stiffness in joints, especially in the hands, of approximately one year duration and eye irritation occurring on a regular basis for approximately six months. Neither individual had any significant past medical problems and neither was being treated with medications. Both individuals were smokers, both smoked on the job, and both stated they washed their hands before eating but not necessarily before smoking. They reported that they generally did not shower after work. No other history of lead exposure could be elicited from other hobbies or activities. Both individuals gave histories of tiredness, dizziness, irritability, headache, tremors, joint pains and some gastrointestinal disturbances. These were in the past and only the symptomatology stated was present on the day of the study. Physical examination revealed both individuals to have normal physical examinations.

Results of the blood and urine examinations can be seen in Table I. All of the laboratory parameters, with the exception of the total red blood cell (RBC) count on worker number two were within the acceptable range. This particular RBC was somewhat elevated but also was reported to be a deteriorated specimen. It is unlikely that any abnormalities, even if they are real with regard to this specimen, are occupationally related.

The results of the air sampling (Tables II, III, IV) indicate low levels of contamination in the workshop. Only hydrochloric acid was detectable at levels which were a fraction of the appropriate environmental criteria. It is judged that the environmental contamination present in the workshop at the time of the survey would not cause occupational injury.

E. Conclusions

There is significant evidence from the history, physical, and biological testing, that no significant abnormalities are present in either of the two workers. The symptomatology reported to the medical investigator appears to be due to causes other than occupational, with perhaps the exception of eye and mucous membrane irritation from hydrochloric acid gas or mist generated during the soldering procedure.

F. Recommendations

1. In order to insure no worker contamination in the future, good work practices should be learned and adhered to during the performance of this particular job. It is suggested that the individuals involved wash their hands thoroughly before smoking or eating, and that a change of clothes and shower be taken at the end of the work day.

2. If desired, the worktable could be positioned in front of the workshop windows. Placing the available large comfort ventilation fan in the window so that it exhausted out, would achieve a certain degree of control, perhaps enough control so that the described symptomatology would be alleviated.

V. REFERENCES

1. Carl Zenz, Editor. Occupational Medicine - Principles and Practical Applications (Chicago: Year Book Publishers, Inc.) 1975.

2. Criteria for a Recommended Standard...Occupational Exposure to Inorganic Lead. U.S. Department of Health, Education, and Welfare, PHS, NIOSH, 1972. Pub. No. HSM 73-11010.

3. Criteria for a Recommended Standard...Occupational Exposure to Chlorine. U.S. Department of Health, Education, and Welfare, PHS, NIOSH, 1976. Pub. No. (NIOSH) 76-170.

4. Threshold Limits Values for Chemical Substances in Workroom Air by ACGIH for 1976. American Conference of Governmental Industrial Hygienists, P.O. Box 1937, Cincinnati, Ohio 45201.

5. U.S. Department of Labor. Occupational Safety and Health Administration. OSHA Safety and Health Standards (29 CFR 1910) OSHA 2206 (Revised January 1976) p. 99.

6. Statement of Edward J. Baier, Deputy Director, NIOSH, before the U.S. Department of Labor, Occupational Safety and Health Administration, Public Hearing on Occupational Lead Standard, March, 1977.

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TABLE I

BIOLOGICAL TEST RESULTS

The Glass Detail
Cincinnati, Ohio
April 14, 1977

Test and "normal range"	Specimen 1	Specimen 2
BUN (5-26 mg/dl)	12	18
Creatinine (0.5-1.3 mg/dl serum)	0.7	0.8
Free Erythrocyte Protoporphyrin (374-662 ug FEP/liter RBC)	381	916
Blood Lead (0-40 ug/dl)	18	29
Serum Zinc (50-120 ug/dl)	135	95
Creatinine, Urine (mg/dl)	39.0	213.4
Urine Volume (ml)	465	137
Hemoglobin (g/dl)	13.1	13.5
Hematocrit (%)	40.7	41.5
RBC (4.2 - 6.1 X 10^6/ul)	4.29	6.11
WBC* (4.8 - 10.8 X 10^3/ul)	11.6	6.1
Urine Lead (<100 ug/liter)**	45	46
Urine Tin (<110 ug/liter)**	<50	83
Urine Zinc (300-500 ug/liter)**	250	1000

*White blood count

**Corrected to a specific gravity of 1.024

TABLE II

RESULTS OF AIR SAMPLING FOR LEAD

The Glass Detail
Cincinnati, Ohio
April 14, 1977

TIME	SAMPLE DESCRIPTION	LEAD (mg/M^3)*	TIN (mg/M^3)*
1015-1230 1310-1350 1415-1555	Personal sample - leading glass	N.D.	N.D.
1024-1115 1120-1322 1400-1420	Personal sample - trimming glass with copper foil	N.D.	N.D.
1020-1255 1305-1600	Fixed location sample - work bench	N.D.	N.D.
1023-1600	Fixed location sample - bedroom	N.D.	N.D.
1021-1555	Fixed location sample - living room	N.D.	N.D.
Environmental Criteria		0.10	10.0

*Notes:
1. Milligrams of lead per cubic meter of air.
2. Limit of detection for lead was 6.0 micrograms per sample.
3. Limit of detection for tin was 40.0 micrograms per sample.
4. N.D. = none detected.

TABLE III

RESULTS OF AIR SAMPLING FOR TOTAL
CHLORIDES AND HYDROCHLORIC ACID

The Glass Detail
Cincinnati, Ohio
April 14, 1977

TIME	SAMPLE LOCATION	CHLORIDES (mg/M^3)*	HCl (mg/M^3)*
1038-1232	Approx. 12" from soldering	0.5	N.D.*
1043-1232	Approx. 12" from soldering	N.D.	N.D.
1305-1350 1415-1428 1430-1515	Approx. 12" from soldering	N.D.	N.D.
1306-1351 1416-1429 1431-1516	Approx. 12" from soldering	N.D.	N.D.
Environmental Criteria		-	7.0

*Notes:
1. Milligrams of chlorides or HCl per cubic meter of air
2. N.D. = none detected
3. The limit of detection for total chlorides was 65 micrograms per sample.
4. The limit of detection for hydrochloric acid was 40 micrograms per sample.

TABLE IV

RESULTS OF INDICATOR TUBE AIR SAMPLING

The Glass Detail
Cincinnati, Ohio
April 14, 1977

TIME	SUBSTANCE	CONCENTRATION (ppm)*
1120	Ammonia	N.D.
1125	Ammonia	N.D.
1145	Hydrochloric acid	0.5
1155	Hydrochloric acid	2.0
1210	Formaldehyde	N.D.
1227	Methyl alcohol, ethyl alcohol	N.D.
1320	Chlorine	0
1445	Hydrochloric acid	1.0

Notes:
1. The environmental criteria for hydrochloric acid is 5 ppm.
2. All samples were taken approximately 6" from the point of soldering.
3. ppm = parts per million parts of air by volume.